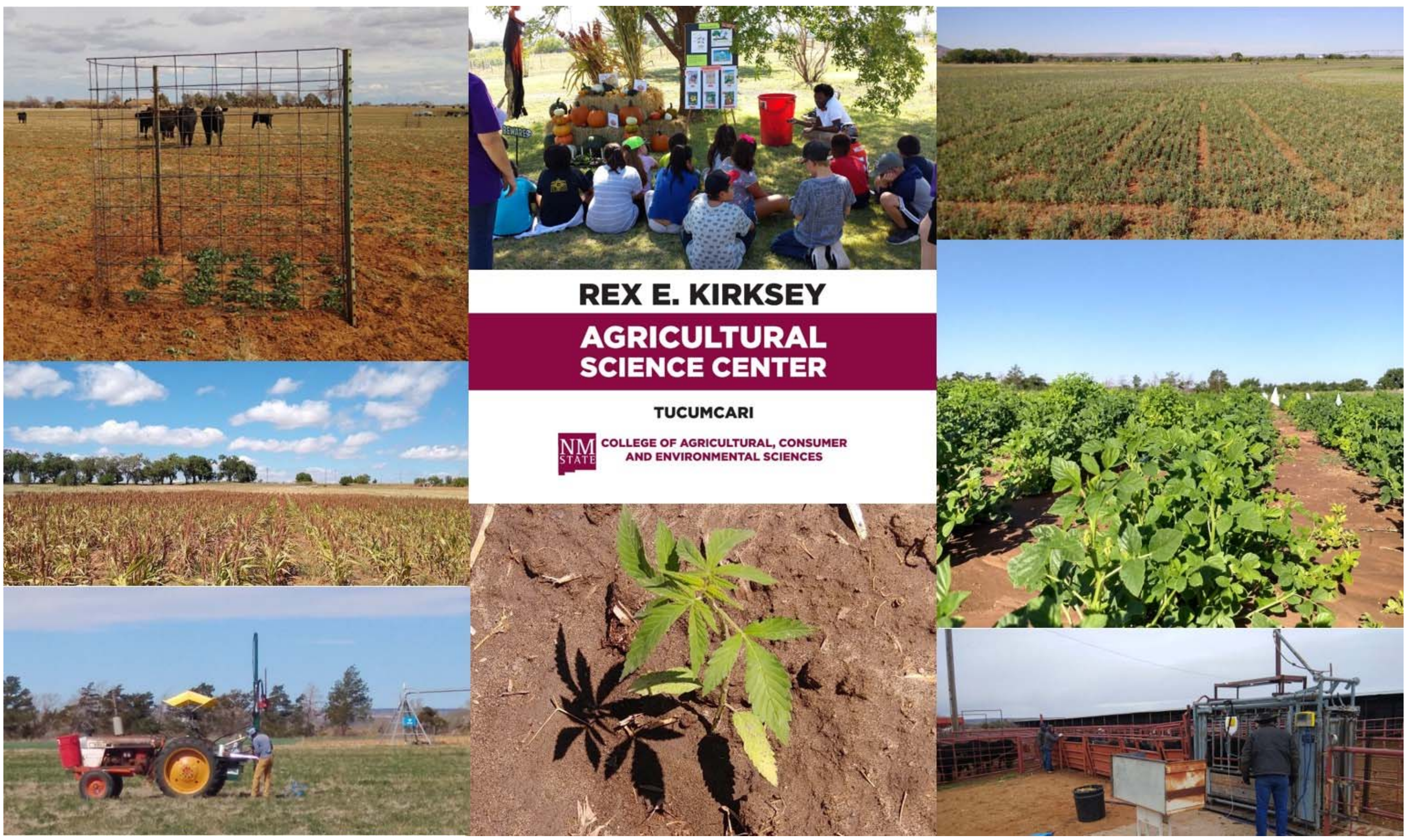
College of Agricultural, Consumer and Environmental Sciences

Rex E. Kirksey Agricultural Science Center at Tucumcari
2019 ANNUAL PROGRESS REPORT



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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 Report research results.

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

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

Natalie P. Goldberg

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

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Acknowledgements

Agricultural Science Center Advisory Committee

Mr. Phillip Box	Mr. Robert Lopez, Chairman
Mr. Will Cantrell	Mr. Franklin McCasland, Vice Chairman
Mr. Donald Carter	Ms. Marie Nava
Mr. Paul Estrada	Mr. Jim Norris
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Several individuals and companies donated products and services to the Rex Kirksey 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

Cooper Glover
Tucumcari, NM. .... Use of Rototillers

David Foote – In memory of Toni Foote
Tucumcari, NM .... Field Day Meal

Everyone's Federal Credit Union – Court Watson
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

First Title Services LLC. – Peggy Brown
Tucumcari, NM .... Field Day Meal

FNB New Mexico – Garrett Baker
Tucumcari, NM .... Field Day Meal

Kelly McFarland – CPA
Tucumcari, NM .... Field Day Meal

Shane Jennings
Tucumcari, NM .... Use of stock trailer

Lowe's Grocery Store # 94 – Veronica Encinias
Tucumcari, NM... Field Day Meal

New Mexico Hay Association – Joel Klein, President
Dexter, NM .... Unrestricted Gift ($5,000) to Support Forage Testing

Tucumcari/Quay County Chamber of Commerce – Carmen Runyan
Tucumcari, NM .... Field Day Meal

Tucumcari Federal Savings & Loan – David Hale
Tucumcari, NM... Field Day Meal

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

Tucumcari LP Gas and Oil – David Foote
Tucumcari, NM .... Field Day Meal

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

Impacts of Studies Published in 2019 and Ongoing Research Summarized in this Report

New Mexico State University's Rex E. Kirksey Agricultural Science Center at Tucumcari is boldly shaping the future by conducting innovative, locally-driven, globally-relevant research designed to discover, develop, and deliver 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) and MMSU's LEADS 2025 Strategic Plan (https://nmsu.edu/LEADS/NMSU_LEADS_Feb_2019.pdf). 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.

Published Studies

The immediately following impact statements are based on research that was conducted at Tucumcari that published in 2019 in after a peer-review, making the results accepted by the scientific community. The references are provided here and in a complete listing beginning on page 7 in the Introduction section of this report.

Strip-tillage for corn production has environmental and economic benefits in New Mexico: 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. (**Darapuneni, M. K**., O.J. Idowu, **L.M. Lauriault**, S. Dodla, K. Pavuluri, S. Ale, K. Grover, and S. Angadi. 2019. Tillage and nitrogen rate effects on corn production and residual soil characteristics. Agron. J. 111(3):1524-1532. doi:10.2134/agronj2018.09.0582).

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. (**Darapuneni, M.K.**, **L.M. Lauriault**, S. Dodla, O.J. Idowu, K. Grover, **G. Martinez**, K. Djaman, and S. Angadi. 2019. Temporal variations in plant and soil characteristics following a single strip-till manure application. Soil Tillage Res. 194, 104350:1-9. https://doi.org/10.1016/j.still.2019.104350).

Crop rotation involving alfalfa (*Medicago sativa* L.) requires effective alfalfa termination to secure maximum benefits for subsequent crops, and ineffective methods may cause counterproductive consequences to subsequent crops. When glyphosate was effective for termination, the benefits to the subsequent crops were equal to tillage. In haygrazer, when glyphosate was ineffective, forage yield was increased with tillage compared with the control at the boot growth stage. Consequently, conventional tillage was the most reliable practice that led to alfalfa termination. 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. (**Darapuneni, M.K**., **L.M. Lauriault**, and S. Angadi. 2019. Alfalfa termination strategies determine subsequent wheat and haygrazer forage yield and nutritive value. Crop Forage Turfgrass Manage. 5(1):190034. https://www.doi.org/10.2134/cftm2019.05.0034).

Alfalfa variety selection potentially returns $46 million to New Mexico's growers according to ongoing statewide alfalfa variety testing coordinated from the Rex E. Kirksey Agricultural Science Center. 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 1.11 to 1.61 tons per acre in 2019. If sold as hay, this translates to a potential difference in returns of $273 to $396 per acre due to variety. 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. (**Lauriault, L. M.**, Ray, I., Pierce, C., Djaman, K., Flynn, R. P., Marsalis, M. A., Allen, S., Martinez, G., Havlik, C., West, M. (2019). *The 2019 New Mexico Alfalfa Variety Test Report* (pp. 11). Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. https://aces.nmsu.edu/pubs/variety_trials/AVT19.pdf).

Ongoing Studies

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.

Livestock Research

The Tucumcari Bull Test and Sale continues to grow in scope and scale (p. 22). 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. 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.

Grazing field bindweed may reduce clonal regeneration and biomass (p. 24). Field bindweed is a competitive, summer-active weed that reduces productivity in irrigated pastures. Ongoing results indicate a potential reduction in bindweed biomass and the number of clones in spring and summer by grazing. 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.

Interest is increasing in grazing winter canola as an alternative dual-purpose crop in wheat rotations (p. 26). Preliminary and ongoing research results indicate that animal gains on canola in autumn were equal to those on pearl millet and greater than gains on haygrazer and that average daily gains on canola in late winter were similar to or greater than those on cereal forage; however, seasonal gains may be greater on cereal forage if it is grazed out rather than taken for grain. The influence of grazing on grain yields has not been fully evaluated at this time. 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.

Agronomic Research

Semi-arid Cropping Systems

Strip-till zone manure application in dryland increases the resource-use efficiency and on-farm profitability (p. 29). 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.

Canola is an alternative winter rotation option to winter wheat that has a potential for producing not only high valued oil grain but also excellent forage during the winter season (p. 31). Determining the optimum N-application rates will not only help the producers to maximize the canola yield and quality 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.

The United States imports $1 billion worth of guar gum or seed every year, most of which is utilized in the oil drilling industry as a fracking aid material. Growing guar domestically in the US would not only reduce the cost of production and importing drastically but also encourage other economic activities related to guar-based products (p. 32). Nitrogen and phosphorus are the two crucial nutrients of guar production. Determining the optimum N- and P-application rates will not only help the producers maximize guar yield and quality but also improve the N- and P-use efficiency and on-farm economic returns in 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.

Using nondestructive measurements similar to those for estimating brush densities may prove valuable for estimating hemp yield to assist growers plan harvest and processing costs and economic returns (p. 34). 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.

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 (p. 35). Introducing diversity into a traditional rotation will ensure better soil health. Planting efficient winter crops in the fallow provides a forage source for livestock 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 promoting broader marketing opportunities (p. 36). Based on current research, pearl millet and its intercrop with cowpea are promising options in increasing the biomass and water productivity under both irrigated and dryland 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.

Forage Crops

The application of a multi-nutrient source to potassium-deficient soils has tremendous potential for boosting alfalfa yield and nutrient value (p. 39). 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 an appropriate fertilizer source to potassium-deficient soils has tremendous potential for boosting alfalfa yield and nutrient 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.

Irrigating with treated municipal wastewater influence soil fertility for alfalfa (p. 42). 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. Although yield could not be measured in 2019, water source continued to influence soil fertility. 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.

Planting legumes with cereal forages can increase yield and nutritive value (pp. 43 and 46). A 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 land equivalency ratio (LER), a measure of the efficacy of mixing species vs. growing them separately, should be ≥1.00 for the mixture to be feasible.

Forage sorghum is well-adapted and productive in the Southern High Plains, but its performance in mixtures with candidate legumes to improve yield and nutritive value must be evaluated. Growing forage sorghum in alternate rows with cowpea, lablab, and sesbania increased crude protein over monoculture forage sorghum; however the sesbania mixture also maximized yield and LER.

Pearl millet and cowpea are well-adapted and productive, but preliminary research indicates that, while nutritive value of the mixture was slightly increased compared the monocultures, mixture LER was reduced when the species were planted in the same row. Current research indicates a potential improvement in yield leading to LER >1when pearl millet and cowpea are grown in alternating single or twin rows.

These projects address 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

With the availability of irrigation water in the Tucumcari Irrigation Project, producers are interested in alternative crops to maximize returns region (p. 48). Corn for grain is of interest; however, variety selection is a critical first step in producing high corn grain yields at the same production costs and little information is available about what hybrid performance differences in the area. This project addresses the Food and Fiber Production and Marketing Pillar for Economic and Community Development of the College of Agricultural, Consumer and Environment.

Cotton is a significant high-value crop in this region. Variety selection is a critical first step in producing high cotton yields with high quality fiber at the same production costs in any region (p. 50). 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.

Milk production is the goal of forage sorghum production in eastern New Mexico. Milk production per acre is driven by yield and nutritive value. Variety selection is a critical first step in producing high yields of forage sorghum with high nutritive value at the same production costs in any region (p. 53). This project addresses the Food and Fiber Production and Marketing Pillar for Economic and Community Development of the College of Agricultural, Consumer and Environment.

Yield for hay or grazing is the goal of sorghum-sudangrass hybrid production. Variety selection is a critical first step in producing high yields of sorghum-sudangrass hybrids with high nutritive value at the same production costs in any region (p. 55). 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.

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Introduction

The New Mexico State University Rex E. Kirksey 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 2019 included: (1) Renaming of the facility after long-time Superintendent, Rex Kirksey, by the New Mexico State University Board of Regents at the request of the center's Advisory Committee, (2) additional upgrades of the Tucumcari Beef Cattle Feed Efficiency Testing Facility by TFET, LLC, (3) an attendance of 116 at Field Day, (3) hosting a Farm Day Program for Tucumcari Elementary School's 4th and 5th grades and a pumpkin patch opportunity for county-wide elementary children and senior citizens, (4) the initiation of a process to replace the domestic water system and connect to the city water system, (5) and receipt of $150,000 from the State Legislature ($100,000 requested by Senator Pat Woods and $50,000 requested by Representative Jack Chatfield) to purchase a small plot combine and a tractor, when leveraged with other funds. Other activities 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. Impact statements for research published in 2019 and projects described in the report have preceded this introduction.

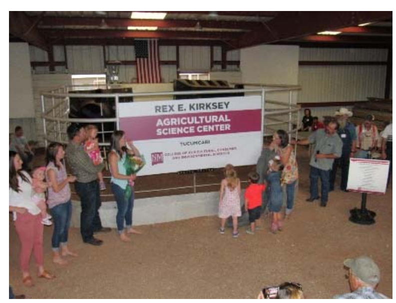
Outreach Events, Productivity, and Activities

Beef Cattle Feed Efficiency Testing

Information about the Tucumcari Feed Efficiency Tests are presented in a separate article beginning on page 22 of this report.

Field Day

The center hosted its Annual Field Day during the evening of August 8, 2019, with 116 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 Tom Sidwell, President of the New Mexico Cattle Growers Association and member of the center's Advisory Committee. After dinner the new sign showing the new name for the facility was unveiled by Rex's family (shown in the picture to the right. The sign will be installed at the entrance to the facility.



The field tour began at the Tucumcari Feed Efficiency Testing facility where the following presentations took place:

- Marcy Ward, NMSU Extension Livestock Specialist: Beef cattle feed efficiency update.
- Craig Gifford, NMSU Extension Beef Cattle Specialist: Connection between the onset of beef heifer puberty and first breeding conception success.

From there, wagons were loaded and the tour went south (literally) toward the dryland research and highway pivot areas before being cancelled due to rain. The following presentations were scheduled for that portion of the tour:

- Murali Darapuneni, NMSU Semiarid Cropping Systems Specialist: Plant and soil characteristics following a single manure application with strip-tillage.

- John Idowu, NMSU Extension Agronomist: Potential of guar for eastern New Mexico.
- Gasper Martinez, NMSU Research Assistant: Cowpea-millet mixtures for forage.

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

Other Public Programs Hosted by the Agricultural Science Center in 2019

On September 26, the center faculty hosted the Farm Day activity for Tucumcari Elementary School's 4th and 5th grades. Participants included approximately 150 students and 16 teachers and volunteers. Presentations centered on:

- The use of guar (ice cream!; Murali Darapuneni, Semiarid Cropping Systems Specialist)
- Livestock (Jason Lamb, Quay County Cooperative Extension Agent for Agriculture)
- 4-H (Joyce Runyan, Quay County Cooperative Extension Associate)
- Good bugs and bad bugs (Leonard Lauriault, Forage Crop Management Scientist)
- Plants, pumpkins, in particular (Gasper Martinez, Research Assistant)

Healthy snacks were provided through the sponsorship of local businesses listed on page iv.

The center's Research Assistant, Gasper Martinez, planned and hosted a Great Pumpkin Giveaway for area pre-K through elementary age children and senior citizens on October 19 and 26, respectively. Pumpkins were distributed to nearly 200 children from area schools and as far away as Albuquerque. The local Presbyterian Medical Services Home Visiting Program also collected pumpkins for distribution.

The center developed and produced erasable, reusable golf score cards for the Tucumcari Five-Mile Park Disk Golf Course, which the Tucumcari Quay County Chamber of Commerce distributed to state legislators during the 2019 Session. The reverse side of the card carried the center's logo and website QR code.

The center also remained open for self-guided tours of the Eastern New Mexico Outdoor Arboretum that occurred on multiple occasions in 2019.

Advisory Committee

The Advisory Committee to the Rex E. Kirksey Agricultural Science Center at Tucumcari met April 16 and December 19, 2019 at the PowWow Restaurant to provide input on research programs and continue development of their program enhancement initiative and infrastructure capital improvement plan. New Mexico District 7 Senator Pat Woods and New Mexico District 67 Representative Jack Chatfield were invited and attended these meetings when possible. Minutes of both meetings are available upon request at the center's office. Advisory Committee members are listed on page iv.

At their December 13, 2018, meeting the Advisory Committee unanimously passed a resolution to request that the NMSU Board of Regents rename the center after its longest serving superintendent, Rex E. Kirksey, who had been killed in a farming accident earlier in the year. Here is the text of that resolution:

Resolution on Renaming New Mexico State University's Agricultural Science Center at Tucumcari to Honor Rex E. Kirksey
December 13, 2018

Whereas, New Mexico State University's Agricultural Science Center at Tucumcari has been in continuous operation since 1912; and

Whereas, there are no known superintendents of record between 1912 and 1916; and

Whereas, H.G. Smith served as superintendent from 1916 to 1918; and

Whereas, C.B. Brown served from 1918 to 1920; and

Whereas, H.L Clemmer was acting superintendent from 1920 to early 1922; and

Whereas, Bob Burnham served as superintendent for at most 29 years and 2.5 months (early 1922 – March 16, 1951); and

Whereas, David Williams served as superintendent for 30 years 4.5 months (March 16, 1951 – July 31, 1980); and

Whereas, Rex E. Kirksey worked with New Mexico State University from July 1, 1980, until his retirement on until June 30, 2012, beginning his career with the University as an Extension agricultural economist program coordinator, based at the Agricultural Science Center at Tucumcari; and

Whereas, Rex became the center's superintendent in August 1981, serving in that capacity until June 30, 2012, which was approximately 30 years and 11 months – the longest tenure to date of any superintendent in the center's 106 years of continuous operation – during which time he supported turfgrass, horticultural crop, field crop and livestock research at the center, developed improved irrigation equipment infrastructure, and initiated a partnership with the City of Tucumcari and the New Mexico Water Trust Board to develop and construct infrastructure to deliver and apply treated municipal wastewater to the facility for agricultural irrigation, to name a few of his contributions to New Mexico State University, the region, and the community; and

Whereas, Rex was tragically killed on April 9, 2018, in an ATV rollover while checking cattle at his parents' farm near Tucumcari, as he had since he was a child; now, therefore, be it

Resolved, that the Advisory Committee to the Agricultural Science Center at Tucumcari, a diverse group of local and regional agricultural producers and businesspeople:

1. proposes to rename the Agricultural Science Center as the "Rex E. Kirksey Agricultural Science Center at Tucumcari," in honor of Rex's service to the University, the region, and the community,
2. urges that signage at the center's entry on US 54 and elsewhere be changed, wherever possible, to reflect the new name, and
3. urges that printed materials (e.g., stationery, future publications) be changed to reflect the new name.

Mover: Franklin McCasland, Vice Chairman
Seconder: Phillip Box
Other members present: Paul Estrada, Janet Griffiths, Justin Knight, Robert Lopez (Chairman), Marie Nava, Jim Norris, Sean Reagan, Cedar Rush, and Staci Stanbrough.

The Board of Regents approved the name change at their regular meeting on March 8, 2019. New NMSU branding documents and a new sign for the center's entrance were developed to reflect the new name.

Personnel and Facilities

Personnel

An ongoing labor shortage on the farm staff continued to limit completion of non-critical physical plant projects in 2019 as well as some research projects was exacerbated by the resignation of Herbert Anthony Williams as a Laborer effective May 30, 2019, and because Jason Box, Farm/Ranch Manager, took on many duties of the Administrative Assistant following the retirement of Patricia Cooksey on April 30, 2019. Linda Griggs worked as Administrative Assistant from June 3 to July 3, 2019, voluntarily resigning, and Lena Salas was hired into the position, effective December 9, 2019. Multiple part-time Laborer, Sr., positions were used throughout the growing season to alleviate some of the shortage.

A list of temporary employees at the center in 2019 is shown below:

Name	Job Title	Dates of Employment
Alice Johnson	Custodian	01/01/2019 – 12/31/2019
Jonathan Clark	Laborer, Sr.	01/22/2019 – 08/05/2019
Dyson Clark	Laborer, Sr.	06/24/2019 – 08/06/2019
Kyle Hamilton	Laborer, Sr.	07/16/2019 – 08/05/2019
Dustin Hight	Laborer	08/02/2019 – 10/02/2019

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, Jane Breen-Pierce, Owen Burney, Shad Cox, Efren Delgado, Koffi Djaman, David DuBois, Glenn Duff, Robert Flynn, Rajan Ghimere, Craig Gifford, Befekadu Goraw, Lois Grant, Kulbhushan Grover, Steve Guldan, Robert Hagevoort, Wendy Hamilton, Charles Havlik, Omar Holguin, John Idowu, Del Jimenez, Jason Lamb, Bernd Leinauer, Kevin Lombard, Steve Loring, Mark Marsalis, Abdel Mesbah, Chris Pierce, Tom Place, Gino Picchioni, Rich Pratt, Naveen Puppala, Ian Ray, Chadelle Robinson, Joyce Runyan, Soum Sanogo, Aaron Scott, Eric Scholljegerdes, Brian Schutte, Manoj Shukla, 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:
Biology: Scott Ferrenburg
Chemical and Materials Engineering Department: Catherine Brewer, Reza Foudazi, and Umakanta Jena
Economics, Applied Statistics & International Business Department: Robert Steiner and Dawn VanLeeuwen

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
City of Tucumcari: Britt Lusk, City Commission, and Calvin Henson
Paul Estrada, Estrada Farms, Tucumcari
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
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 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
Cedar Rush, Rush Farms, McAlister
Tom Sidwell, J-X Ranch, Tucumcari
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

USA:
Cornell University: Elson Shields and Antonio Testa
Cotton Incorporated: Gaylon Morgan
Desert Research Institute: Xuelian Bai, Erick Bandala, Richard Jasoni, Erica Marti, Kristin VanderMolen

National Science Foundation
Louisiana State University,: Ronald DeLaune, Lewis Gaston, Magdi Selim, and Jim Wang (Baton Rouge); Patrick Colyer, Syam Dodla.and Changyoon Jeong (Bossier City); and Howard Viator (St. Gabriel)
Oklahoma State University: Alex Rocateli
Oregon State University: David Hannaway
South Dakota State University, Brookings: David Clay
Southern California Coastal Water Research Project: Alvina Mehinto
Syngenta Crop Protection, Bloomington, MN: Yujin Wen
Texas A&M University: Jim Bordovsky (Plainview) and Girisha Ganjegunte (College Station)
Texas AgriLife Research and Extension: Srinivasulu Ale (Vernon) and Pat Porter (Lubbock)
Texas Tech University: Krishna Bhandari and Chuck West
University of California – Davis: Dan Putnam
University of Kentucky: Ben Goff
University of Nebraska, Scottsbluff: Gary Hergert, Jeff Bradshaw, and Robert Harveson
University of South Carolina: April HiscoxUniversity of Wisconsin – Madison: Victor Cabrera and Francisco Contreras-Govea
University of Wyoming: Jonathan Brant
USDA: N.A. Cole and Prasanna Gowda (ARS, Bushland, TX) and Blair Waldron (ARS, Logan, UT)
USDA - NIFA
West Texas A&M University, Canyon: Brock Blaser and Marty Rhodes

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

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: 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 to the ceiling level from the living room fireplace, which was accomplished in 2019. Storm water diversion had been installed in 2018. A crack on each side of the mid-house load-bearing wall was designated for annual measurement on January 1 of each year, for which the superintendent was trained (for the west side, on the living room south wall, and for the east side, on the north wall of the foyer). During 2019, neither crack had any change during 2019.

The chimney in the center of the residence was also removed to the ceiling level, leading to a replacement of the gas water heater with an electric unit. Another upgrade made to the residence was replacement of water lines leading from the feeder line to the water heater and hot and cold lines within the room in the basement immediately south of the stairs that feed the restroom, laundry room

Wind damage occurred on March 13 and April 10 to roofs on the office, lab, and conference buildings, as well as the shop and residence. During inspection of those roofs it was determined that leaks in the trailer house were due to cracks in that roof. The total damage assessment was less than the deductible for an insurance claim. Approval was given to use funding from the Agricultural Experiment Station's building renewal and repair fund to remove the residence chimneys, replace the water heater, and repair the roofs of all buildings affected, including replacing the entire roof of the residence due to ongoing leaks and removal of chimneys.

In the 2019 Legislative Session, Capital Outlay funding was provided to NMSU to make necessary repairs or upgrades to the off-campus research facilities. The first priority for the Rex E. Kirksey Agricultural Science Center was to replace domestic water lines and connect the system to the City of Tucumcari water system at the pipeline that passes by the center along US 54 and to install a new lawn irrigation system on the grounds. Planning and design for that upgrade began in late 2019.

Little change took place in 2019 in the Eastern New Mexico Outdoor Arboretum at the Agricultural Science Center at Tucumcari. The Texas redbud in the center lawn and the large Siberian Elm in the front lawn of the superintendent's residence perished, but no trees were removed from the grounds that had perished earlier. Eight of the Siberian elms along the driveway from the center's entrance (two on the east side and six on the west side) that had perished in previous years were removed in 2019, leaving only living trees. Replacements will be planted when the water system is upgraded.

A system failure in August at the North Farm Pivot, where winter crops were planted prevented irrigation to that area for the remainder of the year.

Irrigation Water

The annual Arch Hurley Conservancy District assessment for 2019 was $15.00 per water right acre and the delivery charge was $10/acre-foot. The center had retained a credit of $543.35 for pre-paid water from 2018. Water was first released into the canal on April 19, 2019, and turned off on October 24. While 10 in/A was initially allocated, another 3 in/A were allocated on July 9, making the total allocation 13 in/A or 185.14 acre-feet for the center, of which 86.67acre-feet was ordered and applied. The center retained a credit of $456.68 for pre-paid water from 2019.

Treated wastewater from the City of Tucumcari Wastewater Treatment Facility was available for irrigation throughout 2019; however, a system failure in August at the North Farm Pivot, where winter crops were planted prevented irrigation to that area for the remainder of the year. A total of 76.2 acre-feet were applied from January through September through the three center pivots. The total amount paid by the center to the City for that water was $13,841.98, including $9,000 for the water, under a 20-year contract for 300 acre-feet/year, and $4841.98 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 2019 due to ongoing 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 2019, staff at the Agricultural Science Center at Tucumcari recycled 238 lb plastic; 60 lb tin; 94 lb aluminum cans; 50 ink or toner cartridges; and 770 lb paper and other fiber products. Purchased paper totaled 199.2 lb for 2019. Additionally, while no oil was recycled in 2019, approximately 19.5 gal of non-fuel petroleum lubricants were purchased.

Community Service

The center provided three previously marked 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 pits were refilled. Additionally, manure samples were provided to Tucumcari Bio-Energy to evaluate methanol potential.

Students

Murali Darapuneni

Master's committee chair: Student yet to be hired- Developing water use profiles of winter and summer cover/opportune crops in the semi-arid environments of Eastern New Mexico.

Randall Montgomery (Doctoral committee member): Blue corn evaluations under salt stress conditions. ((In Progress, Estimated Completion Date: Spring, 2020).

Productivity

Peer-Reviewed Publications

Journal Articles

NMSU Research

Darapuneni, M. K., O.J. Idowu, **L.M. Lauriault**, S. Dodla, K. Pavuluri, S. Ale, K. Grover, and S. Angadi. 2019. Tillage and nitrogen rate effects on corn production and residual soil characteristics. Agron. J. 111(3):1524-1532. doi:10.2134/agronj2018.09.0582.

Darapuneni, M.K., **L.M. Lauriault**, and S. Angadi. 2019. Alfalfa termination strategies determine subsequent wheat and haygrazer forage yield and nutritive value. Crop Forage Turfgrass Manage. 5(1):190034. https://www.doi.org/10.2134/cftm2019.05.0034.

Darapuneni, M.K., **L.M. Lauriault**, S. Dodla, O.J. Idowu, K. Grover, G. Martinez, K. Djaman, and S. Angadi. 2019. Temporal variations in plant and soil characteristics following a single strip-till manure application. Soil Tillage Res. 194, 104350:1-9. https://doi.org/10.1016/j.still.2019.104350.

Djaman, K., K. Komlan, and **M.K. Darapuneni**. 2019. Preplant irrigation effectiveness and crop yield and water productivity in the southwest United States. J. Agri. Horti. Res. 2(2):1-6. doi.org/10.33140/JAHR.02.02.02.

Idowu, O.J., S.Sultana*, **M.K. Darapuneni,** L. Beck, and R. Steiner (2019). Short- term conservation tillage effects on corn silage yield and soil quality in an irrigated, arid agroecosystem.MDPI Agron. 2019, 9(8), 455: 1-17. https://doi.org/10.3390/agronomy9080455.

External Research

Acharya, B. S*., S. Dodla, S. Sepat, H. Bohara*, L. Gaston, J. Wang, and **M.K. Darapuneni.** 2019. Winter cover crops effect on soil moisture and soybean growth and yield under different tillage systems. Soil Tillage Res. 195:104430. https://doi.org/10.1016/j.still.2019.104430.

Bohara, H*., S. Dodla, J.J. Wang, **M.K. Darapuneni**, B.S. Acharya*, S. Magdi, K. Pavuluri. 2019. Influence of poultry litter and biochar on soil water dynamics and nutrient leaching from a very fine sandy loam soil. Soil Tillage Res. 189:44-51. https://doi.org/10.1016/j.still.2019.01.001.

Dattamudi, S*., J.J. Wang, S. Dodla, H.P. Viator, R. DeLaune, A. Hiscox, **M.K. Darapuneni**, C. Jeong, and P. Colyer. 2019. Greenhouse gas emissions as influenced by nitrogen fertilization and harvest residue management in sugarcane production. Agrosyst. Geosci. Environ. 2(1):190014. doi:10.2134/age2019.03.0014.

Himanshu, S.K., S. Ale, J. Bordovsky, and **M.K. Darapuneni**. 2019. Evaluation of crop growth stage-based deficit irrigation strategies for cotton production in the Southern Great Plains. Agric. Water Manage. 225:105782. https://doi.org/10.1016/j.agwat.2019.105782

Machicek, J*., B. Blaser, **M.K. Darapuneni**, B. Crookston*, and M. Rhodes. 2019. Harvesting regimes affect brown midrib sorghum and brown midrib pearl millet production and quality. Agron. 2019, 9(8), 416, 1-13. https://doi.org/10.3390/agronomy9080416.

Non-Peer-Reviewed Publications

Conference Proceedings and Abstracts

Beck, L. L., Marsalis, M. A., **Lauriault, L. M.** (2019). Evaluation of the efficacy of various herbicides for the control of broadleaf (Plantago major) and buckhorn (Plantago lanceolata) plantain in alfalfa (vol. Poster #1364). Madison, WI: CSSA Abstracts.

Begna, S., S. Angadi, R. Ghimire, A. Mesbah, B. and **M.K. Darapuneni.** 2019. Nitrogen application timing and winter canola seasonal biomass production and seed yield. ASA-CSSA-SSSA Meetings, San Antonio, TX.

Darapuneni, M. K., **L. Lauriault**, and J. Idowu. 2019. Temporal variations of plant and soil characteristics in dryland sorghum following single application of cattle manure under strip till management. SSSA Meetings, San Diego, CA.

Darapuneni, M. K., **L. Lauriault**, S. Dodla, J. Idowu, K. Grover, G. Martinez, K. Djaman, and S. Angadi. 2019. Temporal variations of plant and soil characteristics in dryland sorghum following single application of cattle manure under strip till management. ASA-CSSA-SSSA Meetings, San Antonio, TX.

Dodla, S., H. Bohara*, J. Wang, **M.K. Darapuneni,** B.S. Acharya*, M. Selim, K. Pavuluri**.** 2019. Poultry litter and biochar on soil water dynamics and nutrient leaching from a fine sandy loam soil. ASA-CSSA-SSSA Meetings, San Antonio, TX.

Flynn, R. P., Ganjegunte, G. K., **Lauriault, L. M.**, Ulery, A. L. (2019). Demonstration of bionergy crop growth in New Mexico under saltwater irrigation (vol. Poster 1173). Madison, WI: SSSA - Soil and Water Management and Conservation Abstracts.

Grover, K., A. Garcia, B. Schutte, B. Stringam, **M.K. Darapuneni,** and D. VanLeeuwen**.** 2019. Response of Guar to various irrigation regimes. ASA-CSSA-SSSA Meetings, San Antonio, TX.

Lauriault, L. M., Shields, E. J., Testa, A. M., Porter, R. P. (2019). In M.D. Rethwisch, E. Creech (Ed.), Adaptation of entomopathogenic nematodes for control of whitefringed beetle in alfalfa in northeastern New Mexico (vol. Poster). Davis, CA: Proceedings 2019 Western Alfalfa and Forage Symposium.

Lauriault, L. M., Shields, E., Testa, T., Porter, P. (2019). Establishment of entomopathogenic nematodes for control of whitefringed beetle in alfalfa in a non-digital environment in northeastern New Mexico. Madison, WI: Western Society of Crop Science Abstracts.

Experiment Station Publications

Lauriault, L. M., Ray, I., Pierce, C., Djaman, K., Flynn, R. P., Marsalis, M. A., Allen, S., Martinez, G., Havlik, C., West, M. (2019). *The 2019 New Mexico Alfalfa Variety Test Report* (pp. 11). Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University.

Marsalis, M. A., Flynn, R. P., **Lauriault, L. M.**, Mesbah, A., Djaman, K. (2019). *New Mexico 2018 Corn and Sorghum Performance Tests*. Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University.

Other Publications Not Noted Above

Lauriault, L. M. (2019). *What I learned about irrigation last week at the Western Alfalfa and Forage Symposium*. Self-published email.

Lauriault, L. M. (2019). *What I learned this week at the Western Society of Crop Science Meeting*. Self-published email.

Presentations

Lauriault, L. M., 2019 Winter Crops School, Oklahoma State University, Stillwater, OK, Weed management in alfalfa including Roundup Ready® Technology, (December 17, 2019).

Lauriault, L. M., Quay County Private Applicators Workshop, Quay County Cooperative Extension Service, Tucumcari, NM, Weed management in alfalfa including Roundup Ready® Technology, (December 5, 2019).

Lauriault, L. M., Hay and Forage Growers Workshop, NMSU San Juan County Cooperative Extension Service, Farmington, Rotational crops for grazing, (December 4, 2019).

Lauriault, L. M., 10th Annual Forage Growers Workshop, NMSU Valencia County Cooperative Extension Service, Los Lunas, Rotational crops for grazing, (December 3, 2019).

Lauriault, L. M., Shields, E., Testa, A., Porter, R. P., Western Alfalfa and Forage Symposium, Western States Cooperative Extension Services, Reno, NV, Adaptation of entomopathogenic nematodes for control of whitefringed beetle in alfalfa in northeastern New Mexico, (November 19-21, 2019, **poster**).

Begna, S., S. Angadi, R. Ghimire, A. Mesbah, B. and **M.K. Darapuneni.** ASA-CSSA-SSSA Meetings, San Antonio, TX, Nitrogen application timing and winter canola seasonal biomass production and seed yield. (November 12, 2019).

Dodla, S., H. Bohara, J. Wang, **M.K. Darapuneni,** B.S. Acharya*, M. Selim, K. Pavuluri. ASA-CSSA-SSSA Meetings, San Antonio, TX, Poultry litter and biochar on soil water dynamics and nutrient leaching from a fine sandy loam soil. (November 11, 2019).

Grover, K., A. Garcia, B. Schutte, B. Stringam, **M.K. Darapuneni,** and D. VanLeeuwen. ASA-CSSA-SSSA Meetings, San Antonio, TX, Response of Guar to various irrigation regimes (November 11, 2019).

Beck, L. L., Marsalis, M. A., **Lauriault, L. M.**, ASA-CSSA-SSSA Meetings, San Antonio, TX, Evaluation of the efficacy of various herbicides for the control of broadleaf (Plantago major) and buckhorn (Plantago lanceolata) plantain in alfalfa, (November 11-13, 2019, **poster**).

Darapuneni, M. K., **Lauriault, L. M.**, Dodla, S. K., Idowu, O. J., Grover, K., Martinez, G. K., Djaman, K., Angadi, S., ASA-CSSA-SSSA Meetings, San Antonio, TX, Temporal variations in plant and soil characteristics following a single strip-till manure application, (November 11-13, 2019, **poster**).

Flynn, R. P., Ganjegunte, G., **Lauriault, L. M.**, Ulery, A. L., ASA-CSSA-SSSA Meetings, San Antonio, Demonstration of bioenergy crop growth in New Mexico under saltwater irrigation. (November 11-13, 2019, **poster**).

Darapuneni, M. K., Farm Day at the Rex E. Kirksey Agricultural Science Center at Tucumcari, Guar-A potential crop for New Mexico, (September 26, 2019).

Lauriault, L. M., Farm Day at the Rex E. Kirksey Agricultural Science Center at Tucumcari, Good bugs/bad bugs, (September 26, 2019).

Lauriault, L. M., 1st Annual Forage Field Day, NMSU Agricultural Science Center at Los Lunas, Los Lunas, Rotation vs. continuous grazing and fencing considerations. (September 21, 2019).

Lauriault, L. M., Guadalupe Soil and Water Conservation District Meeting, Guadalupe Soil and Water Conservation District, Santa Rosa, NM, Control options for field bindweed, (August 15, 2019).

Darapuneni, M. K., Field day, Rex E. Kirksey Agricultural Science Center at Tucumcari, Manure application in strip tillage, (August 8, 2019).

Lauriault, L. M., 2016-2019 New Mexico Pueblo Beginning Farmer/Rancher Program, New Mexico State University Cooperative Extension Service/USDA/IAIA Land Grant Programs, Albuquerque, NM, Irrigated perennial cool-season forage crops for pasture and hay in northern New Mexico, (July 16, 2019).

Lauriault, L. M., Science, Technology, and Telecommunications Committee, New Mexico State Legislature, Tucumcari, NM, Using technology in agricultural research to discover new scientific knowledge, (July 9, 2019).

Lauriault, L. M., Shields, E., Testa, T., Porter, P., Annual Meeting of the Western Society of Crop Science, Western Society of Crop Science, Pasco, WA, Establishment of entomopathogenic nematodes for control of whitefringed beetle in alfalfa in a non-digital environment in northeastern New Mexico, (June 25, 2019).

Lauriault, L. M., Employee Chemical Safety Training, Tucumcari Public Schools, Tucumcari, NM, Using cleaning products and pesticides safely, (April 12, 2019).

Lauriault, L. M., Shields, E., Testa, A., Porter, P., Southwest Hay & Forage Conference, New Mexico Hay Association, Ruidoso, NM, Establishment of entomopathogenic nematodes in Quay County alfalfa, (January 24, 2019).

Darapuneni, M. K., **L. Lauriault**, and J. Idowu. 2019. Temporal variations of plant and soil characteristics in dryland sorghum following single application of cattle manure under strip till management. SSSA Meetings, San Diego, CA, (January 9, 2019).

Grants and Contracts

Funded:

Beck, L.L., Marsalis, M.A., **Lauriault, L.M.**, Evaluation of the efficacy of herbicide tank-mixes and sequential applications for the control of plantain (Plantago spp.) in alfalfa, National Alfalfa & Forage Alliance, Award amount: $8,580.00, October 1, 2018 - August 31, 2019).

Darapuneni, M. K., Angadi, S.V., Idowu, O.J., Acharya, R.N., Developing water use profiles of winter and summer cover crops in semi-arid environments of Eastern New Mexico. AES Competitive Operations Grant-FY 2019. Award amount: $49,672. May 15, 2019 - December 31, 2020.

Darapuneni, M.K., **L.M. Lauriault**. Alfalfa response to polyhalite in New Mexico. Sirius Minerals Plc. Award amount: $34,500. November 25, 2019 - December 31, 2020.

Not Funded:

Darapuneni, M. K., J. Lamb, T. Sidwell, C. Rush, P. Box, P. Estrada. 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. Western SARE. Amount requested: $49,560.

Bhandari, K. (Texas Tech Univ.), **L.M. Lauriault**, M. Marsalis, **M.K. Darapuneni**. Interseeding alfalfa in a perennial winter grass. Alfalfa Seed and Alfalfa Forage Systems Grant (USDA-NIFA). Amount requested $299,978.

Duff, G.C., **L.M. Lauriault**, M. Marsalis, **M.K. Darapuneni**. Evaluation of summer-dormant tall fescue for growing cattle in New Mexico. AES Competitive Operations Grant-FY 2019. Amount requested $50,000.

Lauriault, L. M., Hagevoort, G. R., Marsalis, M. A., Robinson, C., Flynn, R. P., Putnam, D. H. (UC – Davis), Promoting Cost Effective, Complete Nutrition Forage in China from US Ingredients, US Department of Agriculture/Foreign Agricultural Services, Amount requested: $64,997. **International activity invited by Dr. Manoj Shukla.**

Hannaway, D.J. (Oregon State Univ.), **Lauriault, L. M.**, et al., Increasing the use of alfalfa in integrated farming systems in the PNW with grazing demonstrations, and expanded modeling and mapping tools, Sponsoring Organization: Oregon State University, Amount requested: $39,995.

Pending:

Bandala, E., **Lauriault, L. M.**, Acharya, R., et al., Using engineered biosorbents to Remove Endocrine Active Contaminants in Treated Wastewater for Agricultural Reuse, USDA/NIFA/ Agriculture and Food Research Initiative, Amount requested: $141,027, January 1, 2020 - December 31, 2025. **This project is a collaboration with the Desert Research Institute, Las Vegas, NV, on which I was approached and invited Dr. Ram Acharya to participate.**

Other External Funding

Idowu, O.J., Angadi, S., **Darapuneni, M.** Sub-contract amount: $6,000. Nitrogen and phosphorus management in Guar. Sustainable Bio-economy for Arid Regions Grant. USDA-NIFA, June 2019 to June 2020.

Lauriault, L. M., Ray, I.M., Marsalis, M.A. $6,450.00, Fee-based state-wide alfalfa variety testing. Multiple seed companies, April 2019 to December 2023.

Lauriault, L. M., $8,400.00, Fee-based corn and sorghum performance evaluations. Multiple seed companies, April to December 2019.

Lauriault, L. M., $750.00, Fee-based cotton performance evaluations. Multiple seed companies, April to December 2019.

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

Plant and Environmental Sciences Department Undergraduate Student Recruitment & Retention Committee

Plant and Environmental Sciences Department Academic Department Program Review Committee

Plant and Environmental Sciences Department Strategic Planning Committee.

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

Associate Editor, Agronomy Journal, Madison, WI, USA. Made decision on 6 manuscripts.

Associate Editor, Crop, Forage, and Turfgrass Journal, Madison, WI, USA. Made decision on 4 manuscripts.

Reviewed 3 manuscripts for Agronomy Journal in addition to being Associate Editor.

Adjunct faculty, West Texas A&M University, Canyon, TX.

Leonard Lauriault

Department of Agronomy Faculty of Agricultural Sciences, Ghazi University, Provided letter of reference for final tenure review of Dr. Muhammad Ibrahim, Dera Ghazi Khan, Pakistan, (January 3, 2019).

Department of Plant and Soil Sciences, Oklahoma State University, Provided letter of reference for continued immigration status for Dr. Alexandre Rocateli, Stillwater, OK, USA,I (February 19, 2019).

AES Competitive Graduate Assistantship Grant Review Panel, reviewed 5 proposals. (April 2, 2019).

Conducted employee chemical safety training for Tucumcari Public School janitorial staff (April 12, 2019).

Assisted another faculty member in gathering information for their project, My Key Accomplishments on this Committee: Provided Scott Ferrenburg, NMSU Assistant Professor - Biology, with contact information regarding alfalfa insects and connected him with an entomologist at Texas Tech University who I had recently learned had worked with the specific insects of interest. (April 16, 2019).

Testified to New Mexico Legislative Science, Technology and Telecommunications Committee, Tucumcari, NM, USA (July 6, 2019 - July 7, 2019).

Judged Agricultural Products, Quay County Fair, Tucumcari, NM, USA (August 14, 2019).

Set up booth display about the activities of the Agricultural Science Center at the center's Bull Sale (March 6, 2019) and Field Day (August 8, 2019) and the Quay County Fair (Tucumcari, August 14-17, 2019).

New Mexico State University Cooperative Extension Service, Provided letter of reference for tenure review of Quay County Cooperative Extension Service Agent for Agriculture and County Program Director, Jason Lamb, (October 31, 2019).

Faculty Grievance Review Board, Committee Member, provide eligible faculty members with a fair and expeditious process by which they may seek redress for grievable issues and may seek resolution of disagreements/disputes arising in the workplace.

Responded to over 63 miscellaneous questions from New Mexico stakeholders, including NMSU NRCS, and FSA personnel, as well as residents and extension personnel in other states.

Coordinated NMSU's statewide alfalfa variety testing program.

Managed the Eastern New Mexico Outdoor Arboretum at the Rex E. Kirksey Agricultural Science Center.

Assisted Tucumcari Feed Efficiency Test, LLC, as needed.

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.

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

Eastern New Mexico Hemp Production Co-op Development Steering Committee.

Member of Certified Crop Advisor Board of New Mexico.

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

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

Gasper Martinez

Planned and hosted Great Pumpkin Giveaway 400 pumpkins distributed, an outreach event for K-5 aged children and senior citizens (October 19 and 26).

Professional Development Activities and Other Meetings Attended Not Previously Mentioned

Jason Box

Continuing Education, Tucumcari ASC Field Day. Tucumcari, NM (August 8, 2019).

Continuing Education, Forklift Training. Tucumcari, NM (July 18, 2019).

Continuing Education, WPS Training. Tucumcari, NM (April 12, 2019).

Continuing Education, Clovis ASC Spring Field Day. Clovis, NM (April 11, 2019).

Continuing Education, Auxin Herbicide Training. Amarillo, TX (March 8, 2019).

Continuing Education, Equipment for Mechanical Cultivation. Webinar (March 5, 2019).

Continuing Education, No-Till Texas Soil Symposium. Amarillo, TX (February 12-13, 2019).

Murali Darapuneni

Conference Attendance, ASA, CSSA, and CCS meetings, San Antonio, Texas, USA, (November 10 to 13, 2019).

Leonard Lauriault

Continuing Education, 10th Annual Forage Growers Workshop, NMSU Valencia County Cooperative Extension Service, Los Lunas (December 3, 2019).

Continuing Education, 2019 Western Alfalfa and Forage Symposium, Western States Cooperative Extension Services, Reno, NV (November 19-21, 2019).

Seminar/Workshop, "Ready Set Safe: Prepare to respond to complex emergencies", NMSU Police/College of ACES, Las Cruces, NM, USA (October 11, 2019).

Continuing Education, Field Day, NMSU Agricultural Science Center at Clovis, NM (August 9, 2019).

Legislative Committee Meeting, "NM Science, Technology and Telecommunications Committee", NM State Legislature, Tucumcari, NM, USA (July 6, 2019 - July 7, 2019).

Continuing Education, Annual Meeting of the Western Society of Crop Science, Western Society of Crop Science, Pasco, WA (June 25, 2019).

Continuing Education, Southwest Hay & Forage Conference, New Mexico Hay Association, Ruidoso, NM (January 24-25, 2019).

Gasper Martinez

Continuing Education, Spring Field Day, NMSU Agricultural Science Center at Clovis, NM (April 11, 2019)

Continuing Education, Quay County Private Applicators Workshop (December 5, 2019)

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

NMSU Annual Compliance Trainings.
NMSU Assurance of Actual Training, IACUC.
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.
Worker Protection Standard, Pesticide Handler.
Forklift Certification

Murali Darapuneni

NMSU Annual Compliance Trainings.
HAZMAT, CPN Neutron Gauge.
Nuclear Gauge Safety Certification CPN.
Neutron Gauge Operation, New Mexico State University.

Leonard Lauriault
NMSU Annual Compliance Trainings
NMSU Assurance of Actual Training, IACUC.
Certified Forage and Grassland Professional, American Forage and Grassland Council.
Certified Hay Sampler, National Forage Testing Association.
Worker Protection Standard - Train-the-Trainer for Workers, Iowa State University Extension and Outreach.
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.

Gasper Martinez
NMSU Annual Compliance Trainings
NMSU Assurance of Actual Training, IACUC.
Worker Protection Standard, Pesticide Handler.
Neutron Gauge Operation, New Mexico State University (July 18, 2018 – Present).
Public Pesticide Applicator's License.
Forklift Operator Safety Training

Lena Salas
NMSU Onboarding Compliance Trainings.
NMSU Annual Compliance Trainings.

Farm Staff
NMSU Annual Compliance Trainings.
NMSU Assurance of Actual Training, IACUC.
Worker Protection Standard, Pesticide Handler.
Forklift Certification.

Honors and awards:
Jason Box: NMSU 10-Year Service Award
Jared Jennings: NMSU 10-year Service Award

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 are reported for October.

Total precipitation for 2019 was 12.44 inches, 3.62 inches less than the long-term average of 16.06 inches (Table 1). The record high total annual precipitation of 34.96 inches was set in 1941 and the record low annual precipitation of 6.13 inches was set in 1934 (Table 2).

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

Month	2019	2018	2017	2016	2015	Long-term Average (1905-2019)
January	0.14	tr.	1.02	0.01	1.44	0.40
February	0.03	0.03	0.17	0.94	0.89	0.47
March	0.22	0.16	2.16	0.08	0.38	0.75
April	0.93	0.51	2.73	0.67	1.93	1.14
May	1.87	1.82	1.82	1.30	4.02	1.90
June	1.23	0.56	0.98	3.28	2.07	1.89
July	2.02	1.16	1.58	1.11	7.56	2.63
August	1.33	3.63	6.48	2.33	2.03	2.74
September	1.69	0.78	2.65	0.41	1.31	1.58
October	1.39	4.27	3.62	1.39	0.81	1.32
November	0.98	0.56	0.01	0.08	1.23	0.64
December	0.61	0.62	0.00	0.37	2.85	0.60
Total	12.44	14.10	23.22	11.97	26.52	16.06

Table 2. Highest and lowest monthly precipitation (inches) recorded at the NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari, 1905-2019.

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.
Until 2017, Growing Season data were reported for April - September.

Near average precipitation was recorded in May, October, and December, while September and November 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 (1.28 inches) was measured on September 20th. Record high and low amounts of precipitation, by month, are shown in Table 2. No precipitation records were set in 2019.

The mean maximum temperature for 2019 was 74ºF, the mean minimum temperature was 44ºF, and the mean annual temperature for 2019 was 59ºF, all of which were at or near the respective long-term averages (Table 3).

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

Date	2019	2018	2017	2016	2015	Long-term average (1905-2019)
	……….………Mean Maximum Temperature (°F)…………………..					
January	53	55	52	53	49	53
February	58	62	65	63	57	57
March	63	69	57	70	65	65
April	73	72	72	73	75	73
May	78	88	80	81	75	81
June	91	95	94	93	91	92
July	97	96	96	100	94	97
August	97	92	88	91	92	92
September	91	86	84	88	91	88
October	63	69	75	83	73	73
November	62	57	69	66	63	63
December	56	52	57	53	55	53
Annual	74	74	75	71	71	74 *
	……….………Mean Minimum Temperature (°F)…………………..					
January	25	22	25	24	24	24
February	26	27	34	30	26	27
March	32	35	31	35	35	33
April	42	39	44	41	42	42
May	49	56	48	51	49	51
June	59	66	61	62	62	62
July	67	66	67	68	66	67
August	66	64	62	63	64	64
September	63	57	56	58	62	59
October	40	45	45	49	49	46
November	31	29	38	38	33	34
December	28	25	24	25	28	25
Annual	44	44	45	45	43	45
	……….....…………..Mean Temperature (°F)……………………..					
January	39	38	39	38	36	38
February	42	44	50	47	42	42
March	48	52	44	53	50	49
April	58	56	58	57	58	58
May	68	72	64	66	62	66
June	75	81	78	78	76	77
July	82	81	82	84	80	79
August	82	78	75	77	78	77
September	77	72	70	73	76	71
October	54	57	60	66	61	59
November	46	44	54	52	48	47
December	42	38	41	39	49	39
Annual	59	59	60	60	57	59

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

The lowest recorded temperature in 2019 of was recorded on February 8th (6ºF). The highest temperature for the year, 107ºF, was recorded on July 21st, which tied the record for that date set in 2011. New records for daily maximum temperatures were set on July 20th (106ºF, previous record was 105 ºF, set in 1951), August 17th (103ºF, previous record was 102 ºF, set in 1951), August 26th (99ºF, most recently set in 2000), and August 30th (101ºF, previous record was 100ºF, most recently set in 1943). Record lows were set on October 25th and 31st (24ºF and 14ºF, respectively, breaking records set in 1997 and 1994, 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 2019 (Table 4).

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

	Daily Record Extremes (1913-2019)				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 2019 was recorded on May 11th (Table 5). The first temperature of ≤32ºF in autumn was recorded on October 11th. Average last spring and first autumn freeze dates are April 4th and October 14th, respectively. The 2019 growing season was 153 days, 41 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 Rex E. Kirksey Agricultural Science Center at Tucumcari.

						Long-term average	Record Extremes			
	2019	2018	2017	2016	2015	(1913-2019)	Earliest	Year	Latest	Year
32°F or less										
Last in Spring	11-May	19-Apr	30-Apr	30-Apr	26-Mar	4-Apr	24-Mar	1943	15-May	1945
First in Autumn	11-Oct	15-Oct	10-Oct	9-Nov	6-Nov	14-Oct	17-Sep	1965	19-Nov	1989
Growing Season (Days)	153	179	163	193	225	194	136	1945	225	2015
28°F or less (Hard Freeze)										
Last in Spring	12-Apr	10-Apr	26-Mar	2-Apr	6-Mar	26-Mar	6-Mar	2015*	6-May	1917
First in Autumn	11-Oct	15-Oct	9-Nov	18-Nov	12-Nov	25-Oct	8-Oct	1970	27-Nov	2001**
Number of Hard Freeze-Free Days	182	188	228	230	251	213	169	1917	256	2001

*Also in 1935

**Also in 1965 & 1923

Total snowfall in 2019 was 3.80 inches. The last snowfall in spring 2019 was recorded on March 5th and the first snowfall in autumn fell on October 25th. 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. June, August, and September monthly totals and daily averages, and April - September season total evaporation were above their respective long-term averages and the season total was well below the record set in 2011 (97.44 inches). Most months were at or near the average for wind speed. April wind speed and the April – September season average were below the long-term averages, while September was well above the long-term average. The April – September season average was still greater than the corresponding calmest season on record of 2.3 mph in 1979 and the windiest April - September season was in 1918 (7.7 mph).

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

	Pan Evaporation				Wind Run	
	2019		Long-term (1953 – 2019)		2019	Long-term (1918 – 2019)
Month	**Total**	**Daily Average**	**Monthly Average**	**Daily Average**	**Daily Average**	**Daily Average**
	……………………….inches……………………..				mph	mph
April	10.01	0.33	10.74	0.36	4.3	5.4
May	11.84	0.38	12.56	0.41	4.5	4.8
June	14.20	0.47	13.95	0.46	4.4	4.5
July	13.46	0.43	13.53	0.44	3.8	3.7
August	12.58	0.41	11.60	0.37	3.6	3.3
September	11.65	0.39	9.29	0.31	4.6	3.6
October*	3.96	0.13	4.86	0.16	4.0	3.7
April - September total/average	73.74	0.40	71.66	0.39	3.7	4.2
April – October total/average*	77.70	0.36	81.76	0.45	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 data since 2018.

Operational Revenues and Expenditures

The Agricultural Science Center at Tucumcari received $97,882.00 in operational funds in FY 2018-2019. (Table1).

The center billed itself $16,063.00 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 $4,200.00, the corn & sorghum variety tests generated $6,850.00 and the cotton variety test generated $801.48 in FY 2018-2019.

The center's operational expenditures in fiscal year 2018-2019 totaled $143,975.00 (Table 1). Irrigation Services was the largest expenditure ($26,250.00). Farm/Ranch Services was the second largest expense totaled $13,542.00, including tractor hours and vehicle use. 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). The third largest expenditure was Domestic Travel ($12,635.00).

Expenditures for Other Supplies (which includes non-office supplies, irrigation supplies, and pest control supplies, etc.) was $9,267.00 in FY 2018-2019. The total for Fee/Seed/Fertilizer and other farming inputs purchased was $3,046.00.

Major purchases during the 2018-2019 Fiscal Year are listed in Table 2.

Table 1. NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari, Approximate Expenditures by Index and Account Codes FY 2018-2019.

	Admin	Forage	Semi-Arid	Station	Tucumcari	Tractor &	Renewal &	Field	Forage	Salary	Bull	Irrigation	Grand
	Plan	Mgmt.	Cropping	Sales	Pastures	Vehicle	Replacemen	Day	Foundation	Savings	Test		Total
Item	121851	125881	124581	120435	123736	101507	107346	902395	903124	124340	120176	120592	
REVENUE													
Beginning Balance	70,392	12,490	15,000	20723	111	50272	2306	1381	3005		47063	3337	226,080
Legislative Appropriations													0
Sales/Fees Generated				15,806				136			10,110		26,052
Private Gifts								2,050	950				3,000
Cattle Gain													0
Irrigation Services												14,185	14,185
Vehicle/Tractor Usage						17,750							17,750
TOTAL REVENUES	70,392	12,490	15,000	36,529	111	68,022	2,306	3,567	3,955	0	57,173	17,522	287,067
EXPENDITURES													
PERSONNEL													
Temporary/Term Salary	4,623										2,050		6,674
Temporary Fringes	940										417		1,357
Overtime													0
Regular Finges	132												132
TRAVEL													0
Domestic Travel	2,367	2,486	7,683	99									12,635
Non Employee Travel Domestic													0
SUPPLIES													0
Auto/Tractor Supplies	460					4,349						91	4,900
Fuels & Lubricants	821		275	399		3,836					52		5,383
Office Supplies	1,419	350	134										1,903
Other Supplies	6310	221	1,271		97	853					3	514	9,267
Lab Supplies				259									259
Cleaning/Janitorial Supplies	245												245
Medical/Safety Supplies	170												170
Feed/Seed/Fertilizer/Pesticides	1,850	450	92	695							(42)		3,046
Taxable Moving Expense	446												446
Dues/Fees/Taxes	3,371	561	145								(15.49)	1	4,062
Business Meals/Food Items	771		468					72					1,310
Books	10												10
Publications/Films/Periodicals	182												182
Taxable Allowance	360												360
Furn/Office Equip<=$5000	5,689					2,600							8,289
Small Tools	1,463					61							1,523
Bldg. Repair & Maint Parts	59					**2,039**							2,097
Equip. Repair/Maintenance Parts	2,071					2,012						4,213	8,296
Computer/Electronic Supplies	66	319											385
TOTAL SUPPLIES & MATERIALS	33,824	4,387	10,067	1,453	97	15,749	0	72	0	0	-3	4,819	70,464

Table 1 (continued). NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari, Approximate Expenditures by Index and Account Codes, FY 2018-2019.

Item	Admin Plan 121851	Forage Mgmt. 125881	Semi-Arid Cropping 124581	Station Sales 120435	Tucumcari Pastures 123736	Tractor/ Vehicle 101507	Renewal & Replacemen 107346	Field Day 902395	Forage Foundation 903124	Salary Savings 124340	Bull Test 120176	Irrigation 120592	Grand Total
SERVICES													
General Services													
Medical/Vet Services													0
Postage	446					8						8	462
Telephone	1,279												1,279
Cellular Expense	360												360
Internet	1,419												1,419
Printing/Reproduction			411										411
Repair/Maint. Bldg	344												344
Repair/Maint. Electric													0
Repair/Maint.Equipment	780												780
Utilities - Electric	6,480											1,373	7,853
Utilities - Gas	1,353												1,353
Trash Hauling	602												602
Seminar/Training	275	450											725
Vehicle Insurance						1,486							1,486
Advertising	88										1		89
Sales Tax	(4)												-4
Prof/Contract Services	189							1,625	136				1,951
Rental	302												302
Lab Analysis	61	4,569	262										4,892
Promotion- P.R	130												130
Irrigation Services	14,352	1,021	877									10,000	26,250
hours)	7,185	2,308	3,348								701		13,542
Freight	92	164	76			28			13				374
Support Tax													0
Non Building Repair/Maint.	780					5,023							5,803
TOTAL SERVICES	36,514	8,512	4,974	0	0	6,546	0	1,625	149	0	702	11,381	70,404
Furn/Equipment >= $5000													0
TOTAL EXPENSES	70,338	12,900	15,041	1,453	97	22,295	0	1,697	149	0	699	16,200	140,868
ENDING BALANCE	54	-410	-41	35,076	14	45,727	2,306	1,870	3,806	0	56,474	1,322	146,199

Table 2. Listing of major purchases paid for during FY 2018-2019, NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari.

Index	Description		Cost
101507	Repairs to JD 5400 (Labor)- Western Equipment		$4,550.72
101507	Tires for Dump Truck, Ray 's Truck Service		$2,464.45
101507	Upgrade to Weigh System on Haldrup, Rusty's Weigh Scales & Service Inc		$4,266.88
120592	Parts for 2 Nelson Valves (Repair & Maintenance, Ag Services		$3,648.00
120592	Motor for Injector Pump, Inject-o-meter		$565.07
120592	Treated wastewater, electric, maintenance partial payment, City of Tucumcari	$10,000.00	
121851		$3,247.50	$13,247.50
121851	John Deere ZTrak Mower, Western Equipment		$4,456.84
121851	Replacement PTO shaft for Agric Rototiller, South West Distributing		$802.13
121851	Manual Pump/Sealant, Gemplers		$542.97
121851	Replacement PTO shaft for Agric Rototiller, South West Distributing		$802.13
	Total		$35,346.69

Tucumcari Beef Cattle Feed Efficiency Testing at the Rex E. Kirksey Agricultural Science Center

Investigator(s):

M. Ward[1], S. Jennings[2], J. Box[2], J. Jennings[2], L.J. Salas[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, Rex E. Kirksey Agricultural Science Center at Tucumcari, NM 88401

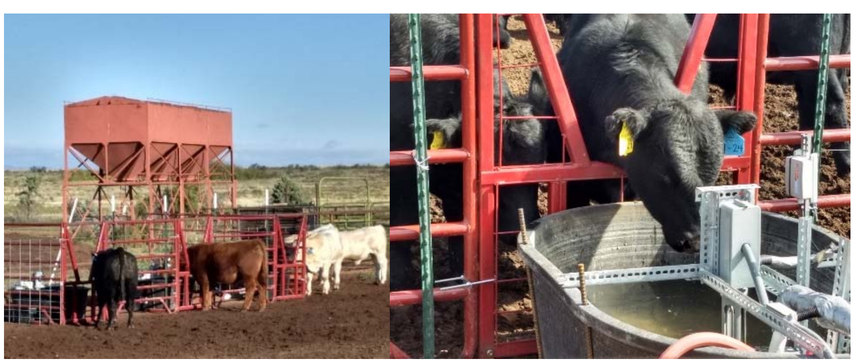
Impacts:

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 2019, 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 2019 sale was somewhat impacted by a large amount of bulls hitting the market within the two week window before the sale. 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. Online sales continued in 2019, with three bulls sold to producers in Colorado and Texas. 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. The 2019 sale catalog was also posted on the American Angus Association website. There were over 3000 visits to the catalog page when published.

In the spring of 2019, Dr. Ward along with several of the TFET members submitted and were awarded a $50,000 Western Sustainable Agriculture Research and Education grant. The grant project will measure water intake in purebred beef cattle. This technology will be a novel addition to the bull test and the service they have to offer.



Water Intake Stanchions in Large Growsafe Pen

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.

2019 Outcomes:

The TFET group awarded Delany Hope the 2019 Mesalands College scholarship. She was fairly new to cattle and did a great job developing impressive skills that very were beneficial to us on our work days. Wyatt Bishop continues to excel as on-site test manager. To assist Wyatt, TFET hired another student part time. Mateo Olivas is the latest addition to the TFET crew. He is a student at Mesalands College. These young people are gaining hands on experience in the beef industry all while helping the TFET program.

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.

TUCUMCARI BULL TEST EST. 1961

Grazing Effects on Field Bindweed Infestation in Grass Pastures

Investigators:

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

[1]New Mexico State University, Rex E. Kirksey 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. Ongoing results indicate a potential reduction in bindweed biomass and the number of clones in spring and summer by grazing.

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 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. Prior to grazing, three 16 ft x 16 ft exclosures uniformly distributed were installed in each pasture. Other details of management and results are presented in the 2017 and 2018 Annual Reports of the Rex E. Kirksey Agricultural Science Center at Tucumcari, which are downloadable from: https://tucumcarisc.nmsu.edu/projects--results.html.

Cereal forage was not replanted in 2018 or 2019. In 2019, irrigation was applied when possible to supplement total annual 12.5 inches of precipitation. The pastures were rotationally grazed from January 1 until December 13, 2019, by a combination of bulls, cows and calves, and heifers with bulls. aboveground plant material within a 3.33 sq.ft. quadrat was hand-clipped to ground level in and near each exclosure in July and September. Sampling locations outside the exclosures were selected to represent the standing forage within the exclosure (the same drill rows), 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.

Bindweed and forage data collected in 2019 were analyzed using SAS Proc Mixed to compare sampling location, sampling period, and their interaction.

Results:

Sampling location and sampling period data and results of statistical analysis are presented in Table 1. There were no significant interactions between sampling location and sampling period. Although there was large variation between the grazed and ungrazed locations, as in previous years for most variables, only g DM/sq m for other weed was significantly different between the locations (Table 1). For sampling period, bindweed clones and g DM/sq m differed because July values were greater than September values. Differences in results between 2019 and previous years may be due to differences in sampling times related to the seasonal availability of labor. Sampling will take place in May, July, and September 2020 to determine if grazing has a sustained effect on spring and summer growth of field bindweed. It is expected that a no-till cover crop will be planted in one replicate during spring/summer 2020 as part of an NRCS program to install sprinkler irrigation, which may offer opportunities for additional data collection.

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 2019. Data are the lsmeans of two pastures and three subsamples within each pasture.

Treatment effect	**Bindweed clones**	**Bindweed**	**Other weed**	**Cereal**	**Other grass**
	# /sq. m	- - - - - - - - - - - - - - g DM / sq. m	- - - - - - - -	- - - - - - - -	- - - - - - - -
		Sampling location (SL)			
Ungrazed	64.62	36.50	169.07	37.12	100.35
Grazed	44.70	6.48	106.63	9.66	55.03
SEM	7.73	7.58	35.78	7.04	29.38
		Sampling period (SP)			
July	78.36	27.57	148.86	34.06	93.42
September	30.97	15.40	126.83	12.73	61.96
SEM	7.73	7.58	35.78	7.04	29.38
		P-value of F			
SL	0.1426	0.1747	0.0418	0.1147	0.3367
SP	0.0123	0.0222	0.3139	0.0658	0.4911
SL x SP	0.5285	0.3334	0.1932	0.8484	0.7235

Rotational grazing by beef cattle took place from January 1 to December 13, 2019.

Influence of Grazing by Beef Yearlings on Canola Forage and Grain Yield

Investigators:

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Potential Impact(s): Interest is increasing in grazing winter canola as an alternative dual-purpose crop in wheat rotations. Preliminary and ongoing research results indicate that animal gains on canola in autumn were equal to those on pearl millet and greater than gains on haygrazer and that average daily gains on canola in late winter were similar to or greater than those on cereal forage; however, seasonal gains may be greater on cereal forage if it is grazed out rather than taken for grain.

Methods:

Winter canola and cereal rye pastures (4 acres each) were arranged in a randomized complete block design with two replicates in the West Pivot. Because wastewater irrigation delivery system was off during the last half of August 2018, land preparation was delayed and seed drilling on 7-in spacing took place from September 26-28, 2018, for canola and from October 4-5, 2018, for rye. Seeding rates were 35 and 10 lb coated seed/A for rye and canola, respectively. The pastures received 9.6 in of irrigation with treated municipal wastewater from September 2018 through June 2019 to supplement 10.7 in of precipitation and 12 lb N/A on December 5, 2018, and 22 lb N/A on January 31, 2019, both through the sprinkler.

Prior to grazing, three 4 ft x 4 ft exclosures were uniformly distributed in each pasture. Additional exclosures were installed near the original exclosures in the canola pastures on February 5. Immediately prior to the initiation of grazing and approximately every 28 days thereafter until cattle were removed, standing forage was sampled near each exclosure grouping to represent the standing forage in that area, but to avoid trampling adjacent to the exclosures. A 0.5 yd^2 area was hand-clipped to ground level at each location and canola plants were counted as they were being clipped. The harvested material from each location was dried in a forced-air oven at 140°F for 48 hours to determine dry matter (DM) yield. Forage samples were held for prospective nutritive value analysis.

Weaned calves [662 ± 48 lb body weight] were received from the Clayton Livestock Research Center on January 4, 2019, and held on native grass pastures until the initiation of treatment grazing, which took place on January 8, 2019. On that date, six steers were allocated to each pasture based on a nearly uniform BW and standard deviation among pastures. Immediately prior to initiation of grazing and every 28 days thereafter until the steers were removed, they were penned for 16 h and weighed. Minerals (ADM Fall and Winter Beef Mineral) were supplied *ad libitum* in each pasture and hay was continually available in the canola pastures.

The March and April measurement dates were scheduled to coincide with impending removal of the canola and cereal rye cattle, respectively. Time between weigh dates and weight differences were used to calculate average daily gains (ADG, lb/hd/d) for measurement periods and for animal gain during the seasonal grazing period. Forage within the cereal rye exclosures and nearby were sampled on April 9 to estimate seasonlong forage yields and post-grazing dry matter.

To evaluate the influence of grazing cessation date on canola grain production, the canola was left to grow after the cattle were removed until sampling for biomass and grain components within each exclosure and outside of the exclosure grouping in each canola pasture took place on July 3, 2019. For that sampling, whole canola plants were clipped to ground level and bagged carefully to minimize seed shattering. Plants were counted as they were clipped. After collection, samples were held until threshing by a small plot combine, which had not taken place at the time of this report.

For 2019-20, it was decided that only the influence of grazing cessation date on canola grain yields would be evaluated. On September 9-10, 2019, canola was planted in an 8-acre area of the West Pivot as described above where canola had been planted in 2018. Irrigations totaling 1.0 in were applied in September to supplement 4.7 in precipitation from September through December. As for the 2018-19 study, it was anticipated that yearling cattle would be received and turned out to pasture in early January 2020. Six replicates of exclosures will be installed every two weeks beginning with the initiation of grazing.

Forage and cattle data from the 2018-2019 study were averaged by pasture and analyzed using SAS Proc MIXED to compare measurement date, pasture type, and the date x pasture interaction, requiring an alpha level of $P \leq 0.05$. Replicate and pasture were considered random. Only date was tested for canola plant counts. Only forage species was tested for animal gain data. When the effect of date or the date x forage species interaction was significant ($P \leq 0.05$), lsmeans were separated by least significant difference. Means and standard deviations were calculated for canola post-grazing plant counts collected on July 3 from the exclosures and continually-grazed areas and for cereal rye seasonlong forage yield.

Results:

Canola plant counts were not influenced by grazing (Table 1).

Table 1. Forage and animal data for beef yearlings grazing canola or cereal rye during late winter 2018-19 at the Rex E. Kirksey Agricultural Science Center at Tucumcari.

Date	Canola Plants	Forage	Animal Weight	Average Daily Gain 8-Jan to 5-Feb	Average Daily Gain 5-Feb to 14-Mar	Seasonal Animal Weight Gain[1]
				- - - - - - - - - - - lb/hd/d - - - - - - - - - - -		
	#/sq ft	lb/A	lb/hd			lb/hd
8-Jan	14	420	662	-----	-----	-----
5-Feb	14	373	636	-----	-----	-----
14-Mar	10	401	652	-----	-----	-----
Forage						
Canola	-----	262	654	-0.95	0.76	28
Rye	-----	535	647	-0.91	0.11	36
			P-values			
Date	0.1692	0.9218	0.2475	-----	-----	-----
Forage	-----	0.0278	0.6722	0.9579	0.0049	0.0117
Forage*Date	-----	0.4960	0.6216	-----	-----	-----

[1]Data represents February 5 to March 14 for canola and February 5 to April 9 for cereal rye.

Plant counts remained fairly unchanged by grain harvest-time with 6.7 ± 3.3, 8.6 ± 2.0, and 6.9 ± 1.5 plants/sq ft in exclosures installed pre-grazing to represent ungrazed canola and to represent canola grazed from January 8 until February 5 and nearby to reflect influences of grazing until cattle were removed in March. Consequently, post-grazing canola stands with a mid-March removal date remained within those recommended for maximum grain yields (5-8 plants/sq ft). Grazed forage above ground level differed by pasture species, but there were no significant date or date x forage species effects. The cereal rye had seasonlong forage yields of 2622 ± 254 lb/A and post-grazing forage yield of 505 ± 125 lb/A, much of which was stems.

Cattle in both forage species treatments lost weight (negative ADG) in the first month and gained weight thereafter (Table 1). The initial weight loss is attributed to a change in environment and diet and is consistent to previous studies comparing canola and cereal forages at this location. From February to March, average daily gains of cattle grazing canola were greater for cattle grazing canola than for cattle grazing cereal rye (Table 1); however, because the rye cattle remained in the pastures for 26 days after the canola forage was depleted and those cattle were removed, seasonal gain was 8 lb/animal greater for cattle grazing cereal rye from February 5 to April 9 than for cattle grazing canola from February 5 to March 15. If a cereal, such as wheat, had been grown for grain and grazed, cattle would have been removed at about the same time as they had been when grazing canola in this study.

These results are for a single year and must be validated by additional studies.

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

Investigators

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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 single 10 tons /A manure application with 6-inch incorporation, grain sorghum biomass and grain yields were still greater by 28% and 64%, respectively, compared to no manure control.

Method(s):

Three separate but identical studies were established in 2015, 2017, and 2018 by applying manure in strip-tillage area 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 all three years 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 and either left at the surface or incorporated to a 6- to 8-in depth by a second pass of the strip-till machine. Manure application rates were calculated on %w/w basis and applications were made manually. 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 each year, 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 have been reported in the 2015, 2016, 2017, and 2018 Annual Progress Reports of the Agricultural Science Center at Tucumcari (https://tucumcarisc.nmsu.edu/projects--results.html).

Grain sorghum was planted on May 14, 2019, in all three manure application areas at 43,344 seeds/A 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. The trial was managed under dryland conditions, with no lifesaving irrigation. Total precipitation received during the tested period from planting to harvesting was about 7.9 in. Roundup (2%v/v), Detonate (8 fl oz/A), Atrazine (4 pt/A), and Metolachlor (1.33 pt/A) herbicides were sprayed before planting to control broad leaf and grass weeds. All plots were fertilized on June 19, 2019, with 11-52-0 (MAP) at the rate of 30 lb N and 61 lb P/A.

At two-week intervals from immediate post-planting (May 16, 2019) to immediate post-harvest, soil moisture samples were collected to a 30-in depth from two locations each from within a strip-tilled row of each plot without affecting plants using a Giddings Hydraulic Soil Sampling Machine. Upon collection, samples were divided into 6-in increments. Incremental samples from same soil depth within a plot were combined and 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 17, 2019, 10 ft of the center two rows of each plot were hand harvested to assess stalk biomass and grain yield characteristics and plant chemical composition. Sub-samples of biomass and grain were collected and sent to Ward Laboratories, Kearney, NE, for tissue nutrient analysis.

Data were analyzed using SAS software (SAS Institute Inc., Cary, NC, 2013). An alpha level of 10% was required to show a significant difference. When a difference among treatments was found, means were separated by least significant difference.

Results:

Both biomass and grain yields of grain sorghum were significantly (P<0.1) influenced by manure treatments (Table 1). Most manure treatments, except 5T+S, showed significantly greater biomass and grain yields than the control with no manure application. Although statistically not significant, manure incorporation at a 6-in depth in both 5T and 10T rates tended to improve the biomass and grain yields over the corresponding surface applications. The higher manure rate (10T) in combination with incorporation appeared to have numerically greater biomass and grain yields. The most benefit of manure application in maximizing the yields (biomass and grains) was observed in the third year after application (2017 manure application year).

Table 1: Effect of strip-tillage manure applied in 2015, 2017, and 2018 on grain sorghum yield at the NMSU Rex E. Kirksey Tucumcari, NM, in 2019.

Manure Treatment	**Biomass (lb/A)**	**Grain (lb/A)**
	2015 Manure Application Year	
Control	8363 b	16 c
5T+ S	8886 ab	36 bc
5T+ I	9583 a	48 ab
10T+ S	9409 a	45 ab
10T + I	9592 a	63 a
P-value	0.0462	0.0537
CV (%)	27.3	32.4
	2017 Manure Application Year	
Control	10454 d	106 c
5T+ S	10629 cd	169 bc
5T+ I	13416 bc	239 ab
10T+ S	13939 ba	202 ab
10T + I	14462 a	291 a
P-value	0.0375	0.0378
CV (%)	24.3	27.8
	2018 Manure Application Year	
Control	8139 b	60 b
5T+ S	8538 b	69 b
5T+ I	9585 ab	88 a
10T+ S	9932 a	82 ab
10T + I	10803 a	93 a
P-value	0.0493	0.0678
CV (%)	22.3	33.1

At the time of reporting, the plant sample analysis is still in progress with Ward Laboratories.

Nitrogen Management in Canola Production

Investigators:

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Potential Impact(s):

Canola is an alternative winter rotation option to winter wheat that has a potential for producing not only high valued oil grain but also excellent forage during the winter season. Determining the optimum N-application rates will not only help the producers to maximize the canola yield and quality but also improve the N-use efficiency and on-farm economical returns in the semi-arid New Mexico.

Methods:

A study was established during the fall of 2018 under the center pivot irrigation system at 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 the NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari in 2018-19.

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 of 10 x 30 ft plots. 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 for the experiment are mentioned in the Table 2. The N-source used in the study was 28-0-0-5 and applications were made via a boom sprayer. Intermittent plant samples and final soil samples were collected to estimate the yield, quality, and N-use efficiency.

Table 2. Treatments structure for fall planted canola study at the NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari in 2018 and 2019.

Treatment	Rate	% Application	Date Applied
T1	120lb/A	100% Fall	10/30/2018
T2	120lb/A	50% Fall+ 50% Spring	10/30/2018, 03/04/2019
T3	120lb/A	25% Fall+ 50% Spring+25% Flowering	10/30/2018, 03/05/2019, 04/16/2019
T4	120lb/A	100% Spring	03/04/2019

Soil and plant sample processing are pending at the time of reporting this article.

Nitrogen and Phosphorus Management in Guar Production

Investigators:

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Potential Impact(s):

The United States imports $1 billion worth of guar gum or seed every year, most of which is utilized in the oil drilling industry as a fracking aid material. Growing guar domestically in the US would not only reduce the cost of production and importing drastically but also encourage other economic activities related to guar-based products. Nitrogen and phosphorus are the two crucial nutrients of guar production. Determining the optimum N- and P-application rates will not only help the producers maximize guar yield and quality but also improve the N- and P-use efficiency and on-farm economic returns in semi-arid New Mexico.

Methods:

A study was established under the center pivot irrigation system located along US 54 on the west side of the center's driveway where the soil was Canez sandy loam.Guar variety "Kinman" was planted at the rate of 20 lb/ac on June 13, 2019, using a row planter with a metering cone and set to 30-in row spacing. Before planting and after harvesting, soil samples were collected to a depth of 12 inches. The experiment was planted in a randomized block design with four replications of 10 x 20 ft plots. A total of 9 treatment combinations consist of 3 rates of N (0, 25, 50 lb/ac) and 3 rates of P2O5 (0, 25, and 50 lb/ac) were applied in a band 6 inches away from the seed row at the same time of planting. Urea (46-0-0) and Triple Super Phosphate (0-45-0) were used as N and P sources. Metoolachlor and RoundUp PowerMax were sprayed in between rows at the rate of 1.3 pt/A and 1.5%, respectively, to control weeds. In addition to 7.7 in precipitation received during the growing season, the experiment was irrigated with 11.5 in of treated municipal wastewater. Micronutrients (Foli Gro 531) were sprayed on September 5, 2019, to correct Fe, Mn, S, and Zn deficiencies. Plant measurements (plant populations, plant height, number of leaves, number of nodes, and flowering time) and biomass samples were collected on a monthly basis for yield and quality estimation. For the final harvest on November 9, 2019, 5 ft of the center two rows of each plot were hand-harvested to assess the biomass and grain yield characteristics and plant chemical composition. Sub-samples of biomass and grain were transported to Las Cruces for tissue nutrient analysis.

Seed and biomass yield data were analyzed using PROC GLM procedure (SAS Institute, 2013). If significant at 5% significance level, a mean separation test was conducted using Tukey's multiple range test.

Results:

As evident in the results (Table 1), application of current N and P rates in guar was not advantageous over the unfertilized control. Although statistically not significant, 0-25 and 25-50 treatment combinations yielded greater seed and biomass yields numerically than the other N-P combinations. The non-responsive nature of treatments may be due to spatial variability that exists in the original soil nutrient status or variation due to weed populations in the experiment or a combination of both. In the current study, the soil samples were collected to a depth of 6 in only. More soil data collection up to the depth of the effective root zone would be helpful in assessing the comprehensive effects of inter-horizon nutrient dynamics on guar yield. Soil and plant analysis are pending at the time of reporting this article.

Table 1: Guar seed and biomass yields as a result of N and P applications at the NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari in 2019.

N-P Combinations	Seed Yield (lb/ac)	Biomass Yield (lb/ac)
0-0	827 a	2800 a
0-25	929 a	3245 a
0-50	805 a	2977 a
25-0	832 a	2120 a
25-25	787 a	2700 a
25-50	951 a	3188 a
50-0	607 a	2427 a
50-25	589 a	1993 a
50-50	768 a	2708 a

0, 25, 50 treatments are control, 25 lb/ac, and 50 lb/ac, respectively, of either fertilizer ingredient.

Estimation of Hemp Yield Components in the Tucumcari Irrigation Project Using Nondestructive Plant Measurements

Investigators:

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Potential Impact(s):

Little is known about how to estimate hemp stem, leaf, and seed yield components. Using nondestructive measurements similar to those for estimating brush densities may prove valuable for estimating hemp yield to assist growers plan harvest and processing costs and economic returns.

Method(s):

A licensed industrial hemp seed grower in Quay County (Permit #AHPL-165-2019) offered his 2-acre field for a research project. Unsexed seed of cultivar 'Young Sim 10' had been hand-sown in rows 5 ft apart and 2 ft apart within rows (4,356 seeds/A) in May 2019. Sprinkler irrigation was used season long to prevent moisture stress maintain a cool canopy, supplementing 8.1 in of May through October precipitation, and 100 lb N/A had been applied. Whole plant hand-harvesting by the grower took place during October. On October 15, five intact plants were selected based on varied plant height for measurement of height, crown diameter (the spread of branches; two measurements averaged), and basal stem diameter (two measurements averaged). These plants were labeled for future separation and measurement of reproductive, leaf, and stem component weights. After harvesting, all plants were between two layers of black plastic sheeting to promote drying. When dried the plants will be separated into yield components and each component weighed.

At the time of this report, yield component weights had not been determined. Plant measurement data were analyzed using SAS PROC CORR procedures to determine which nondestructive measurements would be best correlated to yield components, if any were ($r > 0.50$; $P < 0.05$).

Results and Discussion:

Plant gender establishment was approximately 45% male and 55% female. After pollination the male plants perished. Simple statistics are presented in Table 1 and results of correlation analysis are presented in Table 2. The simple statistics indicate the diversity of plant sizes selected for the study while the correlation coefficient indicates the strength of the relationship between two variables, without proving any cause and effect and the probability of < 0.05 suggests that there is a 95% likelihood that the relationship is consistent. Consequently, Table 2 shows that there is a strong relationship between plant height and both crown and stem diameter, but that a weak relationship exists between crown and stem diameters. When yield component data are available, they will be added to the correlation analysis.

Table 1. Simple statistics of hemp plant measurements in Quay County, NM, 2019.

Variable	N	Mean	Std Dev	Range	
Plant height, ft.	5	4.82	1.93	2.30	7.32
Crown diameter, ft.	5	3.66	1.13	1.84	4.76
Stem diameter, in.	5	0.96	0.28	0.73	1.38

N and Std Dev refer to the number of plants measured and the variability among plants for that measurement, respectively.

Table 2. Pearson Correlation Coefficients (r) and probability that there is no correlation among hemp plant measurements (n = 5) in Quay County, NM, 2019.

		Variable	
Variable	Statistic	Crown diameter	Stem diameter
Plant height	r	0.93	0.89
	Prob > |r|	0.0226	0.0405
Crown diameter	r		0.80
	Prob > |r|		0.1064

The correlation coefficient (r) indicates the strength of the relationship between two variables, but no cause and effect.

The probability of < 0.05 suggests that there is a 95% likelihood that the relationship is consistent at the level of r.

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

Investigators

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

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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 livestock but also potentially generates additional income by producing seed under favorable weather conditions.

Materials and Methods:

To evaluate the production and input-use efficiency of several winter cover/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.

Table 1. Species, cultivars, and seeding rates for irrigated and dryland winter cover crops planted at the NMSU Rex E. Kirksey Agricultural Science Center atTucumcari 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 legumes were inoculated with appropriate strain of *Rhizobium*.

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 10 x 20 ft. The plots were planted using a plot drill with a metering cone and set to 8 in row spacing on October 15, 2019, 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, 2019. These samples were broken down into 1ft increments for nutrient analysis. Access tubes were installed to 5 ft deep in the holes left after soil sampling to measure water use efficiency using a CPN Hydroprobe. The study produced no measurable quantities of seed or biomass yields due to lack of irrigation from pivot system failure. Additionally, no data was collected in 2019 from a 2018 planting.

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

Investigators:

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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 promoting broader marketing opportunities. Based on current research, pearl millet and its intercrop with cowpea are promising options in increasing the biomass and water productivity under both irrigated and dryland conditions.

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 the NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari in 2019.

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 8-in row spacing on June 06, 2019. 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 6-in increments for nutrient analysis. Access tubes were installed to 5 ft deep in the plots to measure water use efficiency using a CPN Hydroprobe every two weeks.

Irrigated plots received 14 in of water to supplement 10.4 in growing season precipitation. Two 1 in. lifesaving irrigations were given to dryland plots to encourage proper germination and establishment at the beginning of the trial. The irrigation was not provided after August 1, 2019, due to center pivot system failure. Weed management was done by hand-weeding to control large weed infestations.

Both dryland and irrigation experiments were harvested on October 23, 2019. 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 1yd^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. Seed 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, all crop species failed to produce measurable amounts of seed yield (Table 2). Pearl millet and its intercrop with cowpea produced significantly greater biomass yield compared to other crops ($P<0.05$) with the same amount of supplemental irrigation (Table 2). 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 low quality feed sources cannot meet the nutritional requirements of cattle, if livestock is an integral component of the farming system.

Table 2. Yield characteristics of various cover/rotation crops under irrigated conditions at the NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari during summer, 2019.

Crop	Seed yield (lb/A)	Biomass yield (lb/A)
German Millet	-	4936 bc
Lablab	-	3561 c
Lima Bean	-	3454 c
Pearl Millet	-	10885 a
Proso Millet	-	5966 b
Pearl Millet + Cowpea	-	10517 a
CV (%)	-	31

All species also failed to produce measurable amounts of seed yield under dryland conditions (Table 3).

Table 3. Yield characteristics of various cover/rotation crops under dryland conditions at the NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari during summer, 2019.

Crop	Seed yield (lb/A)	Biomass yield (lb/A)
German Millet	-	1092 c
Lablab	-	1729 c
Pearl Millet	-	5186a
Proso Millet	-	2875 b
Pearl Millet + Cowpea	-	4129 ab
CV (%)	-	29

Despite several efforts for controlling weeds, continuous influx 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 3; $P<0.05$).Under irrigated conditions, biomass water-use efficiency (WUE) of the pearl

Table 5. Water use efficiency of various cover/rotation crops under both irrigated and dryland conditions at the NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari during summer, 2019.

Crop	Irrigated		Dryland	
	Crop Water Use (in.)*	Biomass WUE (lb ac-in-1)	Crop Water Use (in.)	Biomass WUE (lb ac-in-1)
German Millet	10.1 d	488 b	6.2 b	176 c
Lablab	13.7 ab	259 c	6.8 b	254 c
Lima Bean	12.5 c	276 c	-	-
Pearl Millet	14.7 a	740 a	8.5 a	610 a
Proso Millet	13.1 bc	455 b	6.4 b	449 b
Pearl Millet + Cowpea	15.2 a	662 a	7.9 a	522 ab
CV%	23	17	21	27

*Total crop water use for producing biomass yield millet and its intercrop with cowpea was statistically greater than all other crops tested. Millets generally showed greater biomass WUE than legumes (Table 4).

Under dryland conditions, similar to irrigated conditions, pearl millet and its intercrop showed significantly greater biomass WUE than the other tested species. Irrigated biomass WUE is generally greater than its corresponding dryland biomass WUE for all crop species. The millets belong to C4 species and are proven to be physiologically more efficient in producing more yield with less water.

Alfalfa Response to Various Fertilizer Applications in Low Potassium Soils

Investigators

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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 an appropriate fertilizer source to potassium-deficient soils has tremendous potential for boosting alfalfa yield and nutrient value.

Introduction:

Balancing Potassium (K) and Sulfur (S) nutrients in the formulation of alfalfa fertilization is crucial to maximize forage yield and quality. It has been reported that alfalfa requires high amounts of K to sustain yield and to maintain stand persistence. Minimum K concentration in plant tissue for healthy growth of alfalfa is 2.5%, which translates to a cumulative requirement of 500 lb ac^{-1} of K to produce about 10 ton ac^{-1} yield target under irrigated arid-zone environment. Similarly, optimum tissue S concentration of alfalfa was reported to be 0.22%. The K nutrition in alfalfa was proven to reduce leaf spot severity, increase nodulation, and reduce leaf drop. Sulfur was also reported to increase the nodulation in alfalfa, which indicates a synergistic association of S with K in promoting N-fixation. In general, each ton of alfalfa removes 56 lb of N, 13 lb of P_2O_5, 60 lb of K_2O, 45 lb of S, and 5 lb of Mg under New Mexico environments indicating a high level nutrient demand of alfalfa for forage production, especially K and S.

Currently, muriate of potash (MOP), sulfate of potash (SOP), and potassium nitrate (KNO3) are the common types of K fertilizers used in New Mexico. Among these K fertilizers, MOP is most popular and widely used in alfalfa. Ammonium sulfate (AS), SOP, and gypsum are the common types of S fertilizers used in alfalfa. Although there is no apparent benefit of ammonium-N from AS in alfalfa production, this product is still used to correct the S deficiency. Both K and S are supplemented by SOP, giving it an.

The objective of the experiment is to evaluate the efficacy of various K and S fertilizers on nutrient dynamics, forage yield, and quality in alfalfa under irrigated conditions in New Mexico.

Method(s):

A study was conducted in a producer field at Tularosa, NM, to evaluate the effect of various K and S fertilizers on alfalfa yield and quality. The soil K levels at this site are around 80-90 ppm. An experiment was designed with 10 fertilizer sources (treatments) that included a control (NP)(Table 1). Urea (46-0-0) and Mono Ammonium Phosphate (MAP: 11-52-0) were used as N and P sources in the experiment. Except for the NP control, the fertilizers were applied to supplement the target dosage of 160 lbs of N, 90 lbs of P_2O_5, 143 lbs of K_2O, and 71 lbs of S. The experimental treatments were randomized in 4 blocks.

Prior to planting, soil samples were collected at two incremental depths 0-30 and 30-60 to determine the initial nutrient status of soil (Table 2). Another soil sampling was conducted at the end of study to estimate the nutrient balance and possible effects of treatments on plant nutrient uptake and residual nutrient status. Simultaneously, irrigation water samples were collected and analyzed to account for variability due to water quality. Alfalfa was irrigated with a center-pivot sprinkler.

Table 1: Fertilizer treatments tested in alfalfa at Tularosa, NM, during 2019.

Trt No.	Fertilizer
1	NP
2	NP + MOP
3	NP + SOP
4	NP + KNO3
5	NP + MOP + AS
6	NP + SOP + AS
7	NP + KNO3 + AS
8	NP + MOP + Gypsum
9	NP + SOP + Gypsum
10	NP + KNO3 + Gypsum

Table 2: Initial nutrient content of the soil at the experimental site, Tularosa, NM.

Soil pH, 1:1	8.05
Excess Lime	HIGH
Organic matter, LOI%	1.97
Nitrate-N, ppm N	23.4
Olsen P, ppm P	4.3
Potassium, ppm K	84.1
Sulfate Ca-S, ppm S	351
Zinc, ppm Zn	1.76
Iron, ppm Fe	3.2
Manganese, ppm Mn	4.7
Copper, ppm Cu	0.26
Calcium, ppm Ca	19070
Magnesium, ppm Mg	477
Sodium, ppm Na	271
CEC/Sum of Cations me/100g	120.8

Alfalfa (WL 440) at the seeding rate of 40 lb ac^{-1} was broadcast-planted with a Brillion seeder on October 21, 2018, in a conventional tilled fine tilth soil. Size of experimental unit was 12 ft wide 15 ft long for an area of 180 ft^2. Prowl (rate?) was sprayed to control weed populations in the early spring (date?). The fertilizer treatments were imposed on March 5, 2019, when the alfalfa was at the 3-5 leaf stage. All fertilizers were solid formulations and applied simultaneously by hand broad casting method.

During the 2019 season, harvests (cuttings) of alfalfa were performed on July 1, August 5, September 16, and November 11. At each harvest, a sample from 12''x 40'' area was hand clipped, weighed, and stored in a container for transportation to the lab at Tucumcari, NM. After transportation, the samples were dried at 140˚F for 48 hours and reweighed for calculation of moisture percentage and dry matter yield of alfalfa.

Alfalfa samples were later delivered to the lab for NIRS analysis of nutritive value and tissue nutrient content.

Dry matter yield data were analyzed using PROC MIXED procedure (SAS Institute, 2013). If significant at 5% significance level, a mean separation test were conducted using Tukeys multiple range test.

Results:

A combination of NP + SOP + AS fertilizers increased the alfalfa yield, although statistically not significant from NP, NP + KNO3, NP + KNO3 + AS, and NP + MOP + Gypsum treatments (Table 3). Sulfur fertilizers (AS and Gypsum) in combination with SOP and KNO3 performed better than in combination with MOP. In general, AS proved to be better in increasing alfalfa yield compared to Gypsum. This may be due to the fact that $SO4^{-2}$ ions form complexes with Ca that inhibit the overall release of S for plant uptake.

Table 3: Alfalfa yield (lb/A) response to various fertilizer applications at Tularosa, NM in 2019.

Fertilizer	Alfalfa seasonal yield
NP	12881 ab
NP + MOP	11844 d
NP + SOP	12599 b
NP + KNO3	12619 ab
NP + MOP + AS	12037 cd
NP + SOP + AS	13779 a
NP + KNO3 + AS	13186 ab
NP + MOP + Gypsum	12212 ab
NP + SOP + Gypsum	12526 b
NP + KNO3 + Gypsum	12406 bc

At the time of reporting, the soil and plant sample analysis is still in progress with Ward Laboratories.

Influence of Water Source (Canal Water or Treated Municipal Wastewater) on Soil Characteristics in Alfalfa Culture

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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. Although yield could not be measured in 2019, water source continued to influence soil fertility.

Methods:

Alfalfa variety, 6829R, was planted under the West Pivot irrigation system on August 18, 2017. The variety was selected based on performance in a New Mexico Alfalfa Variety Test at this location. The test area (Redona fine sandy loam) was 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 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. Previous years' results are reported in The Annual Progress Reports of the Agricultural Science Center at Tucumcari (https://tucumcarisc.nmsu.edu/projects--results.html).

In 2019, the test received 13.5 inches of irrigation from May through August 2019 to supplement 12.0 inches of precipitation from November 2018 through October 2019. No pesticides or fertilizers were applied in 2019. Also, forage yields were not measured in 2019 due to a breakdown of the forage plot harvester at the beginning of the season. Consequently, no forage yield or nutritive value data are available for the year.

On December 12, 2019, two soil cores from each plot were collected to 12 inches and combined for PFLA and soil fertility analysis at Ward Laboratories (Kearney, NE).

Soil fertility and PLFA data 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:

Total microbial biomass and other PLFA variables that had been different between water sources in 2018 were not different in 2019. Despite there being no fertilizer applied and no forage removed in 2019, phosphorus levels continued to be different with wastewater-irrigated soil having greater soil phosphorus than canal water-irrigated soil, although at lower average levels than in 2018. Similarly, manganese, which had not been different in 2018, was reduced from 2018, but to a greater degree in the wastewater-irrigated soil. Soil chloride, which also had not been different in 2018, was increased in wastewater-irrigated soil, but not in canal water-irrigated soil.

Forage sorghum - legume mixtures

Investigators

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Impacts(s):

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 land equivalency ratio (LER), a measure of the efficacy of mixing species vs. growing them separately, should be ≥1.00 for the mixture to be feasible. Forage sorghum is well-adapted and productive in the Southern High Plains, but its performance in mixtures with candidate legumes to improve yield and nutritive value must be evaluated. Growing forage sorghum in alternate rows with cowpea, lablab, and sesbania increased crude protein over monoculture forage sorghum; however the sesbania mixture also maximized yield and LER.

The following study evaluated mixtures of forage sorghum and legumes for yield and nutritive value and 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):

Monoculture forage sorghum (FS; planted at 90,000 seeds ac^{-1}), cowpea and lablab (both sown at 98,000 seeds ac^{-1}), and sesbania (sown at 1,072,000 seeds ac^{-1}) were planted in four rows with a 15-inch row spacing. Binary mixtures of each legume with FS were planted with species in alternate rows at half the monoculture seeding rate. There were four randomized complete blocks. The soil was Canez fine sandy loam. Plots (5 ft x 20 ft) were planted on May 29, 2019, into a previously prepared conventionally-tilled seedbed. Each plot had four 15-inch rows when fully planted by making two passes with a disk drill fitted with a single cone arranged to plant two alternate rows at a time. No pesticides or fertilizers were applied. From June through September 2019, 6.3 inches of precipitation fell on the study area and 19.3 inches of treated municipal wastewater was applied by overhead irrigation.

On September 30, 2019, a 4 ft^2 area within each plot was hand-clipped to near ground level to estimate forage yield. Species in mixtures 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 and LER, where LER of mixtures = (mixture FS yield/monoculture FS yield) + (mixture legume yield/monoculture legume yield), and LER of monocultures = 1. Dried samples were ground to pass a 1-mm screen and delivered to Ward Laboratory (Kearney, NE) to estimate nutritive value by near infrared spectroscopy. Selected nutritive value components of the total DM of the mixtures were calculated as the weighted averages of the estimates for each component species.

Total forage dry matter yield, LER, and selected nutritive value components of the total forage harvested from FS and all mixtures were analyzed using the Mixed procedure of SAS to determine if differences existed among treatments. A separate analysis using the Mixed procedure of SAS compared DM yield and crude protein (CP) of monoculture legumes with the mixtures. Replicates were considered random. When differences among treatments were significant ($P \leq 0.05$), lsmeans were separated at $P \leq 0.05$ by least significant difference.

Results:

Results of statistical analysis and treatment means for the comparison of total DM yield, LER, and selected nutritive value components of FS with mixtures in 2019 are presented in Table 1. Growing cowpea or lablab with FS had no significant effect on total forage yield compared to monoculture FS, although yield of FS+Lablab was >1 ton/acre lower than monoculture FS; however, growing FS with sesbania significantly increased total forage yield over that of monoculture FS and the LER of that mixture was greater than monoculture FS and FS+Lablab. Growing FS with each of the legumes increased total forage CP compared to the monoculture but there was no influence of mixing FS with these legumes on fiber-based nutritive value in regard to neutral detergent fiber (NDF), NDF digestibility (NDFD), and in vitro true dry matter digestibility (IVTDMD) (Table 1).

Table 1. Total forage dry matter yield of monoculture forage sorghum (FS) and binary mixtures of FS with cowpea, lablab, and sesbania; land equivalency ratios; and nutritive value when irrigated with treated municipal wastewater at NMSU's Rex E. Kirksey Agricultural Science Center at Tucumcari in 2019.

Treatment	Yield, tons/acre	LER	CP, %	NDF, %	NDFD, %	IVTDMD, %
FS monoculture	8.77 B	1.00 B	3.98 B	65.2	49.0	69.1
FS+Cowpea	8.75 B	1.21 AB	6.00 A	61.0	47.1	69.2
FS+Lablab	7.68 B	1.04 B	5.78 A	59.7	47.5	69.4
FS+Sesbania	11.11 A	1.57 A	5.51 A	60.6	45.4	67.8
SEM	0.72	0.14	0.45	2.5	1.3	0.7
P-value	0.0223	0.0413	0.0087	0.3183	0.2331	0.4095

LER, CP, NDF, NDFD, IVTDMD and SEM signify land equivalency ratio, crude protein, neutral detergent fiber, NDF digestibility, in vitro true dry matter digestibility, and standard error of the mean, respectively.
Means within a column having the same letter are not significantly different at the alpha level of P = 0.05.

Comparisons of component species yield and CP are shown in Table 2. Forage sorghum yield in the FS+Sesbania treatment was greater than forage sorghum growing with cowpea or lablab, but not greater than that of the monoculture, FS, which was also not different than the forage sorghum in binary mixtures with cowpea and lablab. Crude protein content of forage sorghum growing with lablab and sesbania was greater than the CP content of forage sorghum as a monoculture (Table 2).

Table 2. Component species dry matter yield and crude protein of forage sorghum, cowpea, lablab, and sesbania when grown as monocultures and in binary mixtures irrigated with treated municipal wastewater at NMSU's Rex E. Kirksey Agricultural Science Center at Tucumcari in 2019.

	Binary mixture component species			
	Forage sorghum		Legume	
Treatment	Yield, tons/acre	CP, %	Yield, tons/acre	CP, %
FS monoculture	8.77 AB	3.98 B	--	--
Cowpea	-----	-----	3.58 A	16.60 A
FS+Cowpea	7.69 B	4.88 AB	1.07 B	13.90 B
Lablab	-----	-----	3.39 A	14.53 AB
FS+Lablab	7.02 B	5.28 A	0.66 B	11.23 C
Sesbania	-----	-----	2.11 AB	11.18 C
FS+Sesbania	10.02 A	5.30 A	1.11 B	8.40 D
SEM	0.68	0.40	0.60	1.00
P-value	0.0304	0.0795	0.0048	0.0003

CP, FS, and SEM signify crude protein, the forage sorghum in treatments, and standard error of the mean, respectively.
Means within a column having the same letter are not significantly different at the alpha level of P = 0.05.

For legume DM yield, the monoculture legumes had equal yields that were reduced when grown with forage sorghum (Table 2). The exception was sesbania, for which yields when grown with FS were not significantly lower than its monoculture. A similar reduction was observed for CP of the legumes with a reduction when grown with FS (Table 2).

Tepary bean and FS+Tepary bean also had been included in the study; however, although tepary bean established fair stands, it had matured and completely deteriorated by harvest. Consequently, no data were collected from those treatments and they were deleted from the study. Additional research is necessary to validate the results for binary mixtures of cowpea, lablab, and sesbania with FS, and perhaps tepary bean will be evaluated in binary mixtures with pearl millet, which matures more rapidly than the FS selected for this study (see the article on millet – cowpea mixtures on p 46 of this report).

Pearl Millet – Cowpea Forage Mixture Planting Arrangements

Investigators

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Impacts(s):

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 land equivalency ratio (LER), a measure of the efficacy of mixing species vs. growing them separately, should be ≥1.00 for the mixture to be feasible. Pearl millet and cowpea are well-adapted and productive in the Southern High Plains, but their performance in mixtures under irrigation has not been thoroughly evaluated. Preliminary research indicated that, while nutritive value of the mixture was slightly increased compared to monoculture pearl millet, mixture LER was reduced when the species were planted in the same row compared to the monocultures; however, current research indicates a potential improvement in yield when pearl millet and cowpea are grown in alternating single or twin rows.

Method(s):

Treatments were monoculture pearl millet (millet; sown at 25 lb ac^{-1}) and monoculture cowpea (cowpea; sown at 50 lb ac^{-1}), or millet-cowpea mixtures half the seeding rate of each species in the same row (millet-cowpea), alternate single rows (millet-cowpea1:1), twin rows alternating (millet-cowpea2:2), or four rows alternating (millet-cowpea4:4) with four randomized complete blocks. The soil was Canez fine sandy loam. Plots (5 ft x 20 ft) were planted on June 11, 2019, into a previously prepared conventionally-tilled seedbed. Each plot had eight 6-inch rows when fully planted by making two passes with a disk drill fitted with a single cone arranged to plant four rows at a time. For both monocultures, cowpea-millet, and millet-cowpea4:4, four adjacent 6-inch rows on half the toolbar were planted on each pass. Species seed for millet-cowpea were combined in the same packet. For millet-cowpea1:1, four 12-inch rows distributed across the toolbar but offset by 3 inches with, and two sets of two 6-inch rows separated by an 18-inch gap, also offset by 3 inches (millet-cowpea2:2). For millet-cowpea1:1, millet-cowpea2:2, and cowpea-millet4:4 each species was planted on a separate pass. Roundup PowerMax® (1.5% solution) was applied on June 12 to control weeds that had emerged since land preparation. No other pesticides or fertilizers were applied. From June through August 2019, 4.6 inches of precipitation fell on the study area and 13.3 inches of irrigation was applied.

On August 29, 2019, a 4 ft^2 area within each plot was hand-clipped to near ground level to estimate forage yield. Species in mixtures were bagged separately. Harvested biomass was weighed, dried for 2 days at 150°F, and reweighed to determine dry matter (DM) yield of each species and LER, where LER of mixtures = (mixture millet yield/monoculture millet yield) + (mixture cowpea yield/monoculture cowpea yield), and LER of monocultures = 1. Dried samples were ground to pass a 1-mm screen and delivered to Ward Laboratory (Kearney, NE) for nutritive value analysis by near infrared spectroscopy.

Dry matter yield of each species, total forage DM yield, LER, and selected nutritive value of the total forage harvested were analyzed using the Mixed procedure of SAS to determine if differences existed among treatments. Replicates were considered random. When differences among treatments were significant ($P \leq 0.05$), lsmeans were separated at $P \leq 0.05$ by least significant difference.

Results:

Results of statistical analysis and treatment means for 2019 are presented in Table 1. Cowpea yields generally increased as the width of the cowpea stand increased. Yield of pearl millet was not influenced by growing with cowpea in any planting arrangement, although, as pearl millet stand width increased from millet-cowpea to millet-cowpea2:2, pearl millet yields numerically increased and then declined at millet-cowpea4:4, which represented adjacent plantings of monoculture pearl millet and monoculture cowpea (Table 1). Total forage yield of the mixtures and LER were also not different, but followed similar patterns of a numerical increase from the millet-cowpea planting arrangement to the millet-cowpea2:2 arrangement, then declining at the millet-cowpea4:4 arrangement.

Table 1. Dry matter yield of monoculture pearl millet, monoculture cowpea, and their mixture, land equivalency ratios, and nutritive value of the total yield when irrigated with treated municipal wastewater at NMSU's Rex E. Kirksey Agricultural Science Center at Tucumcari in 2019.

Treatment	Cowpea	Pearl millet	Total	LER	CP	ADF	NDF	NDFD	IVTDMD
	- - Dry matter yield, Tons/acre - -				- - - - - - - - - - - - - - - % - - - - - - - - - - - - - - -				
Cowpea	2.09 A	0.00 B	2.09 B	1.00	17.3 A	31.6	33.0 B	49.3 B	86.3 A
Millet	0.00 D	7.33 A	7.33 A	1.00	7.6 C	35.9	68.5 A	58.5 A	73.1 B
Millet-cowpea	0.35 C	4.53 A	4.88 AB	0.78	8.2 BC	36.3	67.4 A	57.4 A	73.3 B
Millet-cowpea1:1	0.67 BC	6.16 A	6.83 A	1.13	8.3 BC	36.6	66.1 A	54.7 A	72.9 B
Millet-cowpea2:2	0.47 BC	7.25 A	7.72 A	1.25	9.3 BC	35.3	66.6 A	55.3 A	71.8 B
Millet-cowpea4:4	0.72 B	4.76 A	5.49 A	1.08	10.2 B	35.7	65.0 A	54.8 A	72.9 B
SEM	0.13	1.19	1.21	0.13	0.9	1.3	2.0	1.5	1.4
P-values	<.0001	0.0009	0.0009	0.2504	<.0001	0.1290	<.0001	0.0091	<.0001

Millet, cowpea, millet-cowpea, millet-cowpea, millet-cowpea, millet-cowpea, LER, CP, ADF, NDF, NDFD, IVTDMD and SEM signify monoculture pearl millet, monoculture cowpea, the species mixture planted in the same row, the species planted in alternate rows, the species planted in two adjacent rows alternating between species, the species planted in four adjacent rows alternating between species, land equivalency ratio, crude protein, acid detergent fiber, neutral detergent fiber, NDF digestibility, in vitro true dry matter digestibility, and standard error of the mean, respectively.

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

For nutritive value, acid detergent fiber (ADF) was not different among treatments; however, crude protein (CP), neutral detergent fiber (NDF), and in vitro true dry matter digestibility (IVTDMD), which is calculated from estimated nutritive value components, were all more optimum for cowpea than any treatment including pearl millet (Table 1). Otherwise, the NDF digestibility (NDFD) of pearl millet was greater than cowpea. As with, total yield and LER, numeric increases in CP were observed from millet-cowpea to millet-cowpea2:2, although it continued to millet-cowpea4:4, which was significantly greater than the pearl millet monoculture (Table 1). That being stated, there also was a numeric decline in NDF from pearl millet to millet-cowpea4:4, which could be beneficial, but a similar numeric decline in NDFD and IVTDMD, both of which could be detrimental. Nonetheless, NDFD and IVTDMD of all treatments is relatively high and the declines are not considered truly detrimental. Consequently, the improvement in CP for the millet-cowpea2:2 arrangement compared to monoculture pearl millet and in yield compared to monoculture cowpea, coupled with increased LER makes that treatment seem promising.

Additional research is necessary to validate these results.

Performance of Treated Municipal Wastewater-Irrigated Grain Corn in the Tucumcari Irrigation Project

Investigators:

L.M. Lauriault[1], G.K. Martinez[1], J. Box[1], L.J. Salas[1], J. Jennings, and S. Jennings[1]

[1]New Mexico State University, Rex E. Kirksey Agricultural Science Center at Tucumcari, NM 88401
[2]Volunteer

Potential Impact(s):

With the availability of irrigation water in the Tucumcari Irrigation Project, producers are interested in alternative crops to maximize returns. Corn for grain is of interest; however, variety selection is a critical first step in producing high corn grain yields at the same production costs and little information is available about what hybrid performance differences in the area.

Methods:

To evaluate grain yield of corn hybrids under full irrigation, a test was planted into a conventionally-tilled flat seedbed in an area designated for irrigation with treated municipal wastewater under the West Pivot. The soil type was Redona fine sandy loam and the land had been in grain sorghum production the previous year. The test was a Randomized Complete Block design with 4 replicates. Individual plots were 20 x 5 ft (two, 30-inch rows). Plots were planted May 28, 2019, using a small plot row crop planter with a seed-metering cone on each planter unit to plant 30,000 seed/A. A 5-ft unplanted alley was left between plots to facilitate harvesting. Liquid nitrogen fertilizer (100 lb N/ac) was applied on May 30, 2019, using a ground spray applicator. Herbicide applications were 3.5 oz/acre Sharpen on May 5 and 2% glyphosate on May 29 and July 9. A total of 13.5 inches of treated municipal wastewater was applied to supplement 7.7 inches of June through October precipitation.

Ears from 10 ft of each row each plot were hand-harvested and bagged on October 16 and stored. During harvesting, plants and ears in each plot were counted. Ears were mechanically threshed with a corn sheller. Grain weights were recorded and an aliquot was evaluated for test weight (lb/bu) and then dried for 36 h at 221ºF and reweighed to calculate % moisture. Grain yields (lb/ac and bu/ac as a 56 lb bu) were adjusted to 15.5% moisture.

Plant populations, adjusted grain yield, grain moisture, and test weight data were analyzed using SAS PROC GLM procedures to determine where differences between hybrids existed. Means were separated by protected least significant difference ($P < 0.05$).

Results and Discussion:

Results of statistical analyses of grain yield components are presented in Table 1. Although test weights were high, yields were low, likely due to lack of supplemental irrigation during the seed-filling stage.

Reports giving results from statewide testing in 2019 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://aces.nmsu.edu/pubs/variety_trials/welcome.html#corn) as well as from the Agricultural Science Center at Tucumcari and county Cooperative Extension Service offices.

Table 1. Yield data from the New Mexico 2019 wastewater-irrigated grain corn performance test at NMSU's Rex E. Kirksey Agricultural Science Center at Tucumcari

Brand/Company Name	Hybrid/Variety Name	CRM	Population	Grain Yield Adjusted to 15.5% Moisture	Moisture at Evaluation	Test wt.
		-----	Plants/ac	bu/ac	%	lb/bu
Dyna-GroSeed	D41SS71	101	23305	38	8.3	58.2
Dyna-GroSeed	D43VC81	103	23740	47	8.4	59.3
Dyna-GroSeed	D48VC76	108	24394	43	8.7	58.9
Dyna-GroSeed	D51VC67	110	26354	39	8.8	59.4
Dyna-GroSeed	D52VC15	112	22651	38	8.7	57.7
Dyna-GroSeed	D53TC19	113	21998	43	8.7	61.8
Dyna-GroSeed	D53VC33	113	23740	31	8.6	58.6
Dyna-GroSeed	D54SS74	114	24394	47	10.3	60.4
Dyna-GroSeed	D54VC14	114	25047	36	8.9	61.3
Dyna-GroSeed	D55VC80	115	24612	32	9.6	59.9
Dyna-GroSeed	D57VC17	117	24612	41	8.9	60.5
Dyna-GroSeed	D57VC51	117	26354	26	8.4	56.1
Dyna-GroSeed	D58VC65	118	25701	26	10.4	59.8
		Trial Mean	24377	37	9.0	59.4
		LSD P < 0.05	NS	NS	NS	3.0
		CV	9.4	32.5	11.6	3.5
		F Test	0.2619	0.2564	0.0891	0.0349

CRM signifies comparative relative maturity, which is an evaluation made by company of days to harvest compared to other hybrids from the same company. Since it is a relative measurement, it should not be viewed as an exact representation of days to harvest.

Moisture at Evaluation was measured after the corn was shelled, when it was weighed and evaluated for test weight, which was approximately 80 days after ears had been harvested. Harvested ears were stored in poly bags inside a storage shed.

LSD and CV signify the least significant difference between two means within that column required to say that they are truly different and the coefficient of variation, which indicates the amount of variability in the data. Small CV's (<20) are considered good.

NS signifies not significant at the 5% probability based on the F Test at the bottom of the column, which when multiplied by 100 is the likelihood that no difference exists between any means in the column. A <5% likelihood is required in this table to say that a difference existed between at least two means in the column. Consequently, no LSD value is published.

Performance of Cotton in the Tucumcari Irrigation Project

Investigators:

L.M. Lauriault[1], G.K. Martinez[1], R.P. Flynn[2], J. Zhang[3], L.J. Salas[1], J. Box[1], J. Jennings[1], and S. Jennings[1]

[1]New Mexico State University, Rex E. Kirksey Agricultural Science Center at Tucumcari, NM 88401
[2]New Mexico State University, Agricultural Science Center at Artesia, NM 88210
[3]New Mexico State University, Plant and Environmental Sciences Department, Las Cruces, NM 88003

Potential Impact(s):

Cotton is a significant high-value crop in this region. Variety selection is a critical first step in producing high cotton yields with high quality fiber at the same production costs.

Method(s):

A cotton variety test was planted into a conventionally-tilled flat seedbed at the West Pivot (Redona fine sandy loam) on May 28, 2019, using a 2-row plot row crop planter with a seed-metering cone on each planter unit. Rows were 30 inches apart. Plots were 20 x 5 ft with a 5-ft unplanted alley between plots to facilitate harvesting. The seeding rate was 5 seeds/ft of row (87120 seeds/A) in a Randomized Complete Block Design with 3 replicates. Varieties and lines tested were commercial cultivars and experimental lines developed at NMSU. Metolachlor (1 pt/A) had been applied on May 25; Prowl H2O (2 pt/A) was applied on May 29; Clethodim (6 fl oz/A) was applied on July 11; and Glyphosate (2%) was broadcast as a shielded application on July 22. Acephate (8 oz/A) was applied on July 11 to control thrips. Nitrogen (100 lb/A) was applied as a liquid through a ground spray rig on May 30. Irrigations using canal water were applied approximately twice weekly until the end of September. A growing season (June through October) total of 12.5 inches of irrigation was applied to supplement 9.5 inches of precipitation. No defoliant or boll opener was used.

Harvesting took place on December 19, 2019, using a John Deere model 484 cotton stripper modified to harvest two rows and to catch harvested material in a trash can. Two-row borders surrounding the test were stripped prior to harvesting the plots. Also prior to harvest, 25 bolls were collected. After stripping, plants were counted, and the total length of skips (>12 inches) in the planted row was estimated for each plot. Boll samples were shipped to NMSU's Agricultural Science at Artesia for ginning and turnout calculations after which lint samples were sent to a lab at Louisiana State University for fiber quality analysis. Individual plot weights were adjusted to lint yields based on historical seedcotton to trash ratio of ginned samples for material harvested with the same equipment. Lint yield and quality data were analyzed by SAS Proc GLM with means separated by protected 5% LSD.

Results:

Varietal means and results of statistical analyses are presented in Table 1. Few differences existed among varieties due to very low yields and great variability within the study as indicated by CVs greater than 10 for most variables.

Table 1. Lint yield and quality and economic data from the wastewater-irrigated commercial cotton performance test at NMSU's Rex E. Kirksey Agricultural Science Center at Tucumcari in 2019.

Brand/Company	Hybrid/Variety	seed-cotton	Lint		Turnout	bollwt	Trash Code	Trash Area	Trash Count
		lb/a	lb/a	bales/a	%	g			
NMSU	Acala1517-08	170	76	0.16	44.51	3.06	3.0	0.3	14.0
Brownfie	BSD9X	454	214	0.45	45.97	3.27	3.7	0.7	25.7
Bayer	FM2498GLT	170	81	0.17	47.71	3.34	3.0	0.3	10.0
Bayer	FM2574GLT	227	82	0.17	38.38	3.32	4.3	0.8	30.7
NMSU	NM18B1592	255	117	0.24	45.75	3.89	6.0	1.7	39.0
NMSU	NM18B1603	170	78	0.16	45.71	3.01	5.0	1.0	42.0
NMSU	NM18B1617	383	174	0.36	45.07	3.04	4.5	0.9	30.0
NMSU	NM18B1618	511	222	0.46	43.88	2.61	3.5	0.7	35.0
NMSU	NM18B1637	43	23	0.05	52.98	3.02	4.0	0.8	32.0
NMSU	NM18B1641	284	132	0.27	47.18	2.99	3.7	0.7	27.7
NMSU	NM18N1613	170	80	0.17	47.24	2.99	4.0	0.7	35.0
PhytoGen	PHY210W3FE	128	70	0.15	53.72	3.31	4.0	0.6	21.0
PhytoGen	PHY250W3FE	128	66	0.14	53.12	3.27	3.5	0.5	18.5
PhytoGen	PHY333WRF	341	178	0.37	52.17	3.36	5.0	1.3	48.5
	Trial Mean	270	124	0.26	46.93	3.16	4.1	0.8	29.7
	LSD, 0.05	NS	NS	NS	NS	NS	NS	NS	NS
	CV	91.3	101.5	101.5	23.7	18.7	24.8	52.9	42.4
	Prob>F	0.8114	0.8951	0.8951	0.9831	0.9590	0.6645	0.6312	0.5445

NS signifies not significant at P < 0.0500 based on the Prob>F at the bottom of the column. Consequently, no LSD value is published.

Table 1 (cont.). Lint yield and quality and economic data from the wastewater-irrigated commercial cotton performance test at NMSU's Rex E. Kirksey Agricultural Science Center at Tucumcari in 2019.

Hybrid/Variety	Length	Unif	SFI	Str	Elg	Mic	Maturity	Rd	Yellowing	Color	Grade	Loan price
												Cents
Acala1517-08	1.11	84.6	8.3	33.3	5.6	5.0	83.0	72.1	10.5	32.0	1.0	50.35
BSD9X	1.04	80.1	11.1	26.3	3.7	4.8	83.7	75.4	8.1	34.3	2.3	50.40
FM2498GLT	1.11	82.3	10.3	26.8	3.8	4.9	84.0	77.3	8.9	31.0	3.0	52.05
FM2574GLT	1.05	80.0	12.5	26.5	3.8	5.4	85.0	76.1	7.7	34.3	1.7	47.53
NM18B1592	1.08	78.5	9.3	29.1	4.3	4.9	84.0	72.5	8.8	41.0	3.0	51.45
NM18B1603	1.04	80.0	10.8	31.9	4.7	5.0	83.5	71.7	7.8	46.0	2.0	51.00
NM18B1617	1.06	81.7	10.1	31.8	5.8	4.9	82.5	69.8	10.3	42.5	1.0	51.28
NM18B1618	1.04	81.5	10.6	30.7	4.7	4.9	83.5	73.6	8.1	36.0	3.0	50.90
NM18B1637	1.07	78.1	12.9	33.5	5.2	4.7	83.0	71.9	9.7	42.0	1.0	51.90
NM18B1641	1.08	81.9	9.2	31.2	5.2	5.1	83.7	73.6	8.8	34.3	3.5	50.25
NM18N1613	1.11	81.4	9.3	32.7	5.2	5.1	84.0	72.1	8.7	41.0	3.0	50.10
PHY210W3FE	1.01	82.3	9.4	25.5	3.9	4.9	83.5	77.0	8.1	31.0	2.5	50.83
PHY250W3FE	0.96	79.6	12.9	25.9	4.9	5.1	83.5	76.7	8.8	31.0	2.5	48.80
PHY333WRF	0.99	81.3	12.4	23.8	5.6	5.2	83.0	71.0	8.5	41.5	1.5	48.60
Trial Mean	1.04	80.9	10.8	28.7	4.7	5.0	83.6	73.9	8.6	36.6	2.2	50.12
LSD, 0.05	NS	NS	NS	5.10	NS	NS	NS	3.40	NS	NS	NS	NS
CV	4.3	2.6	15.5	8.7	15.4	6.8	1.2	1.9	9.3	15.8	13.1	4.2
Prob>F	0.2359	0.6286	0.2991	0.0459	0.1473	0.8429	0.8543	0.0047	0.2674	0.2519	0.5978	0.6593

NS signifies not significant at $P < 0.0500$ based on the Prob>F at the bottom of the column. Consequently, no LSD value is published.

Performance of Treated Municipal Wastewater-Irrigated Forage Sorghum under a Single-cut Silage System in the Tucumcari Irrigation Project

Investigators:

L.M. Lauriault[1], G.K. Martinez[1], J. Box[1], L.J. Salas[1], J. Jennings, and S. Jennings[1]

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

Potential Impact(s):

Milk production is the goal of forage sorghum production. Milk production per acre is driven by yield and nutritive value. Variety selection is a critical first step in producing high yields of forage sorghum with high nutritive value at the same production costs in any region.

Methods:

To evaluate yield and nutritive value of forage sorghum varieties for silage, a test was planted into a conventionally-tilled flat seedbed under the North Farm Pivot. The soil was Canez fine sandy loam that had previously been fallowed. Plots were planted June 5, 2019, using a small plot row crop planter with a seed-metering cone on each planter unit. The seeding rate was 80,000 seed/acre. Irrigations with treated municipal wastewater were applied in June and July for a total of 9.3 inches after which the irrigation system failed. A total of 6.3 inches of precipitation fell during the June through September growing season. No fertilizer or pesticides were applied. Individual plots were 20 x 5 ft (two 30-inch rows) with a 5-ft unplanted alley left between plots to facilitate harvesting. The test was a Randomized Complete Block design with 4 replicates.

Ten ft of a single row were hand-harvested on September 24, 2019. Hand-harvested material from individual plots was collected in a garbage can and immediately weighed after which a portion was chopped with a wood chipper and subsampled. This subsample was placed in a labeled paper bag and sealed in a plastic bag and weighed. Immediately after 140°F for 48 hours, subsamples were reweighed to determine harvest moisture and to convert fresh field weights to dry matter yield.

Dried samples were ground to pass through a 1-mm screen and submitted to Ward Lab (Kearney, NE) for estimation of forage nutritive value analysis by near infrared spectroscopy for crude protein (CP), neutral detergent fiber (NDF), 48-h neutral detergent fiber digestibility (NDFD), starch, ash, total digestible nutrients (TDN), and net energy for lactation (NE_l). Milk per ton and milk per acre were calculated.

Dry and green forage yield, harvest moisture, and nutritive value data were analyzed using SAS PROC GLM procedures to determine where differences between varieties existed. Means were separated by protected least significant difference ($P < 0.05$).

Results and Discussion:

Results of statistical analysis for yield and nutritive value data are presented in Table 1. Low dry forage yields were likely due to the lack of irrigation after July and the lack of applied fertilizer. This also likely influenced nutritive value.

Reports giving results from statewide testing in 2017 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#corn) as well as from the Agricultural Science Center at Tucumcari and county Cooperative Extension Service offices.

Table 1. Yield, nutritive value, and estimated milk production data from the New Mexico 2019 wastewater-irrigated, single-cut forage sorghum performance test at the Rex E. Kirksey Agricultural Science Center at Tucumcari.

Brand/Company Name	Hybrid/Variety Name	Dry Forage	Green Forage	Moisture at Harvest	CP	NDF	NDFD 48hr	Starch	Ash	TDN	NE_l	Milk/ Ton	Milk/ Acre
		t/a	t/a	%	%	%	%	%	%	%	Mcal/lb	lb/t	lb/a
Advanta Seeds	ADVF7232	1.8	5.7	30.9	4.5	65.9	61.0	3.9	3.5	62.6	0.643	2589	4703
Advanta Seeds	ADVXF025	1.7	4.9	34.7	4.3	66.6	60.3	6.5	3.4	63.0	0.648	2713	4693
Advanta Seeds	ADVXF033	2.3	7.3	30.4	4.3	64.9	56.8	4.6	2.9	64.5	0.663	2360	5412
Advanta Seeds	AF7201	1.9	5.6	34.3	4.9	64.1	62.5	6.1	3.0	64.7	0.666	2672	5149
Advanta Seeds	AF7401	1.7	6.3	26.5	5.7	63.1	63.0	3.9	3.8	65.4	0.674	2568	4356
Advanta Seeds	AF8301	3.1	9.6	32.4	3.8	67.1	55.3	4.7	2.1	63.0	0.647	2363	7392
Dyna-Gro Seed	F74FS72 BMR	2.3	7.5	29.9	5.6	63.3	64.3	4.4	2.6	66.1	0.681	2588	5893
Dyna-Gro Seed	F75FS13	1.6	4.7	33.2	2.8	66.8	55.8	6.7	3.2	62.2	0.638	2448	3857
Dyna-Gro Seed	Fullgraze II	2.2	6.8	30.3	4.3	65.9	56.0	5.3	1.9	64.9	0.667	2432	5194
Dyna-Gro Seed	Fullgraze II BMR	2.6	9.4	27.6	4.5	69.1	58.8	3.9	2.6	61.9	0.635	2639	6817
Dyna-Gro Seed	SuperSile20	1.8	5.6	30.5	4.0	67.1	57.0	4.3	2.8	62.8	0.644	2460	4380
Dyna-Gro Seed	SuperSile30	2.2	7.2	30.4	5.0	65.4	56.8	4.7	3.1	64.7	0.667	2461	5451
Dyna-Gro Seed	TopTon	2.3	8.4	27.8	3.5	67.3	59.3	3.5	3.4	61.7	0.633	2455	5757
Mojo Seed Enterprise	X033	1.2	3.8	31.1	4.2	67.6	57.3	4.4	2.2	63.8	0.656	2502	3017
	Trial Mean	2.0	6.6	30.7	4.4	66.0	58.8	4.8	2.9	63.7	0.654	2518	5148
	LSD P < 0.05	1.0	3.5	3.4	1.0	3.1	2.7	1.3	1.0	2.3	0.026	113	NS
	CV	35.6	36.6	7.8	15.4	3.3	3.2	19.3	25.4	2.5	2.7	3.1	34.7
	F Test	0.0804	0.0426	0.0004	0.0001	0.0137	0.0001	0.0001	0.0145	0.0043	0.0047	0.0001	0.1219

CP, NDF, NDFD, TDN, NE_l and NS signify crude protein, neutral detergent fiber, NDF digestibility, and total digestible nutrients, respectively.

LSD and CV signify the least significant difference between two means within that column required to say that they are truly different and the coefficient of variation, which indicates the amount of variability in the data. Small CV's (<20) are considered good.

NS signifies not significant at the 5% probability based on the F Test at the bottom of the column, which when multiplied by 100 is the likelihood that no difference exists between any means in the column. A <5% likelihood is required in this table to say that a difference existed between at least two means in the column. Consequently, no LSD value is published.

Performance of Treated Municipal Wastewater-Irrigated Sorghum-Sudangrass in the Tucumcari Irrigation Project

Investigators:

L.M. Lauriault[1], G.K. Martinez[1], J. Box[1], L.J. Salas[1], J. Jennings, and S. Jennings[1]

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

Potential Impact(s):

Yield for hay or grazing is the goal of sorghum-sudangrass hybrid production. Variety selection is a critical first step in producing high yields of sorghum-sudangrass hybrids with high nutritive value at the same production costs in any region.

Method(s):

To evaluate yield and nutritive value of sorghum-sudangrass varieties for hay, a test was planted into a conventionally-tilled flat seedbed under the North Farm Pivot. The soil was Canez fine sandy loam that had previously been fallowed. Plots were planted June 5, 2019, using a small plot drill with a seed-metering cone and a row spacing of 6 inches. The seeding rate was 25 lb/acre. Irrigations with treated municipal wastewater were applied in June and July for a total of 9.3 inches after which the irrigation system failed. A total of 7.7 inches of precipitation fell during the June through October growing season. No fertilizer or pesticides were applied. Individual plots were 20 x 5 ft (two 30-inch rows) with a 5-ft unplanted alley left between plots to facilitate harvesting. The test was a Randomized Complete Block design with 4 replicates.

On October 23, 2019, 25 sq ft were hand-harvested and collected in a garbage can and weighed after which a portion was immediately chopped with a wood chipper and subsampled. This subsample was placed in a labeled paper bag and sealed in a plastic bag and weighed. Immediately after 140°F for 48 hours, subsamples were reweighed to determine harvest moisture and to convert fresh field weights to dry matter yield.

Dried samples were ground to pass through a 1-mm screen and submitted to Ward Lab (Kearney, NE) for estimation of forage nutritive value analysis by near infrared spectroscopy for crude protein (CP), neutral detergent fiber (NDF), 48-h neutral detergent fiber digestibility (NDFD), starch, ash, total digestible nutrients (TDN), and net energy for lactation (NE_l). Milk per ton and milk per acre were calculated.

Dry and green forage yield, harvest moisture, and nutritive value data were analyzed using SAS PROC GLM procedures to determine where differences between varieties existed. Means were separated by protected least significant difference ($P < 0.05$).

Results and Discussion:

Results of statistical analysis for yield and nutritive value data are presented in Table 1. Low dry forage yields were likely due to the lack of irrigation after July and the lack of applied fertilizer. This also likely influenced nutritive value.

Reports giving results from statewide testing in 2019 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#corn) as well as from the Agricultural Science Center at Tucumcari and county Cooperative Extension Service offices.

Table 1. Yield, nutritive value, and estimated milk production data from the New Mexico 2019 wastewater-irrigated, single-cut forage sorghum performance test at NMSU's Rex E. Kirksey Agricultural Science Center at Tucumcari.

Brand/Company Name	Hybrid/Variety Name	Dry Forage	Green Forage	Moisture at Harvest	CP	NDF	NDFD 48hr	Starch	Ash	TDN	NE_l	Milk/ Ton	Milk/ Acre
		t/a	t/a	%	%	%	%	%	%	%	Mcal/lb	lb/t	lb/a
Browning Seed,Inc.	Cadan99 BWMR	2.9	6.5	44.1	3.0	74.5	52.0	3.8	4.1	56.2	0.571	2349	6720
Browning Seed,Inc.	CadanPPS	2.2	6.4	34.8	3.6	73.0	60.3	1.8	5.8	56.9	0.579	2741	6090
Dyna-Gro Seed	DannyBoy II BMR	2.3	6.9	33.5	3.4	69.5	63.5	2.7	4.1	59.9	0.612	2593	6003
Dyna-Gro Seed	F75FS13	2.6	7.1	36.9	2.2	67.2	57.5	5.3	3.8	59.8	0.611	2369	6204
Dyna-Gro Seed	FirstGraze	2.7	6.3	43.1	2.1	79.0	49.5	2.7	4.3	51.5	0.519	2158	5848
Dyna-Gro Seed	Fullgraze II	2.8	7.6	36.5	2.2	70.6	57.0	3.7	2.6	59.7	0.611	2395	6646
Dyna-Gro Seed	Fullgraze II BMR	2.3	7.7	30.3	2.4	71.6	62.3	2.9	3.6	58.8	0.600	2620	6099
Dyna-Gro Seed	SuperSweet10	2.6	6.5	39.7	2.1	78.8	48.3	3.0	3.9	52.4	0.529	2171	5651
Dyna-Gro Seed	TopTon	2.2	7.2	30.2	3.0	67.8	61.0	2.9	4.4	60.5	0.619	2429	5237
Browning Seed,Inc.	WondergreenSX66	2.9	6.1	47.7	3.2	79.1	46.0	3.1	4.6	52.3	0.527	1973	5752
	Trial Mean	2.6	6.8	37.7	2.7	73.1	55.7	3.2	4.1	56.8	0.578	2380	6025
	LSD P < 0.05	0.5	0.7	7.4	1.0	4.0	3.0	1.1	0.9	3.4	0.037	195	NS
	CV	13.8	6.7	13.5	25.5	3.8	3.8	24.6	14.5	4.1	4.5	5.6	14.1
	F Test	0.0384	0.0003	0.0003	0.0162	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.3996

CP, NDF, NDFD, TDN, NE_l and NS signify crude protein, neutral detergent fiber, NDF digestibility, and total digestible nutrients, respectively.

LSD and CV signify the least significant difference between two means within that column required to say that they are truly different and the coefficient of variation, which indicates the amount of variability in the data. Small CV's (<20) are considered good.

NS signifies not significant at the 5% probability based on the F Test at the bottom of the column, which when multiplied by 100 is the likelihood that no difference exists between any means in the column. A <5% likelihood is required in this table to say that a difference existed between at least two means in the column. Consequently, no LSD value is published.