REX E. KIRKSEY AGRICULTURAL SCIENCE CENTER AT TUCUMCARI

NM STATE

2020 ANNUAL REPORT

Notice to Users of This Report

This report has been prepared by Science Center staff to document the results of the various research projects from the past year and to record data for future reference. These are not formal Agricultural Experiment Station Report research results, and 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. Although staff members have made every effort to check the accuracy of the data presented, this report was not prepared as a formal release. None of the data is authorized for release or publication, without the written prior approval of the NMSU Agricultural Experiment Station.

Any reference herein to any person, organization, or activities, products, or services related to such person or organization, is solely for informational purposes and does not constitute or imply the endorsement or recommendation of NMSU or its employees or contractors. NMSU is dedicated to providing equal opportunities in areas of employment and academics without regard to age, ancestry, color, disability, gender identity, genetic information, national origin, race, religion, serious medical condition, sex, sexual orientation, spousal affiliation, or protected veteran status as outlined in federal and state anti-discrimination statutes. The College of Agricultural, Consumer and Environmental Sciences is an engine for economic and community development in New Mexico. ACES academic programs help students discover new knowledge and become leaders in environmental stewardship, food and fiber production, sustainable water use, and community health. The College's research and extension outreach arms reach every county in the state and provide research-based knowledge and programs to improve the lives of all New Mexicans and the nation in general.

Conversion Table for English and Metric (SI) Units

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

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

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

Executive Summary

In operation since 1912, the Rex E. Kirksey Agricultural Science Center at Tucumcari (REKASCT) 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.

The center, located on U.S. Highway 54 three miles northeast of Tucumcari and Interstate 40, Exit 333, 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. Most of the irrigation is applied through three center pivot irrigation systems totaling about 85 acres. One of those systems can apply either canal water or wastewater. Canal water is applied by furrow/flood irrigation to some studies. In addition to the research projects described below, approximately 20 acres are planted for use in research as needed or harvested for commercial hay production, and 24 acres are planted for annual crop commercial hay rotation with another 24 acres for grazing research. Most of the remaining irrigable lands are used for holding cattle not on a test and seven native grass pastures are used as needed for research or non-research grazing. In 2020, 24 irrigated acres were used for a grazing study and a total of 3.1 acres were in small plot research on-site. No commercial hay was harvested in 2020 due to low precipitation, irrigation system failures in all three pivots at one time or another, and labor shortages due to an open farm staff position and turnover in the administrative assistant position that consumed much of the farm manager's time.

Meeting The Needs Of New Mexico

An Advisory Committee to REKASCT comprised of local and regional farmers, ranchers, agricultural lenders, and other stakeholders provides input on research focus areas and specific projects and legislative support as needed.

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
Mr.	Cooper Glover	Mr. Cedar Rush
Ms.	Janet Griffiths	Mr. Tom Sidwell
Mr.	Devin Kanapilly	Mr. Elmer Schuster
Mr.	Justin Knight	Mr. Donald Walker
Mr.	Robert Lopez, Chairman	

Additionally contacts by other stakeholders provide information about critical research needs.

Studies conducted by REKASCT faculty and staff and published in peer-reviewed scientific literature during 2020 that resulted from specific local or regional stakeholder input include:

Darapuneni, M. K., Lauriault, L. M., Angadi, S. (2020). Irrigation strategies influenced alfalfa dry matter yield and water productivity in a semiarid subtropical environment. Irrigation and Drainage, 2020. https://doi.org/10.1002/ird.2490

Habteyes, B. G., Ward, F. A. (2020). Economics of irrigation water conservation: Dynamic optimization for consumption and investment. Journal of Environmental Management/Elsevier, 2020(110040), 10 (This was a study of the Arch Hurley Conservancy District that was partially supported by REKASCT and relied heavily on local stakeholder input for data).

Lauriault, L. M., Marsalis, M. A., Groesbeck, J. (2020). Revisiting alfalfa planting dates for the semiarid U.S. Southwest. Agronomy Journal, 112, 2006-2019. https://doi.org/10.1002/agj2.20169

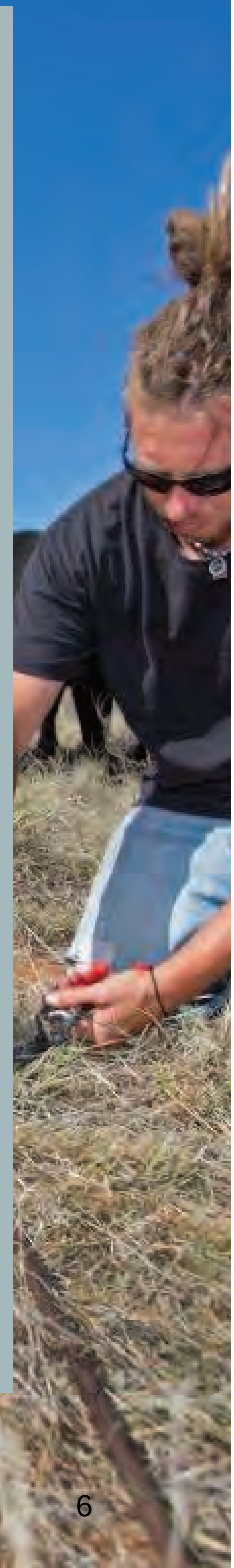
Lauriault, L. M., Shields, E. J., Testa, A. M., Porter, R. P. (2020). Persistence of select introduced entomopathogenic nematodes in the US Southwest as potential biological control for whitefringed beetle in alfalfa. Southwestern Entomologist, 45, 41-50. https://doi.10.3958/059.045.0104

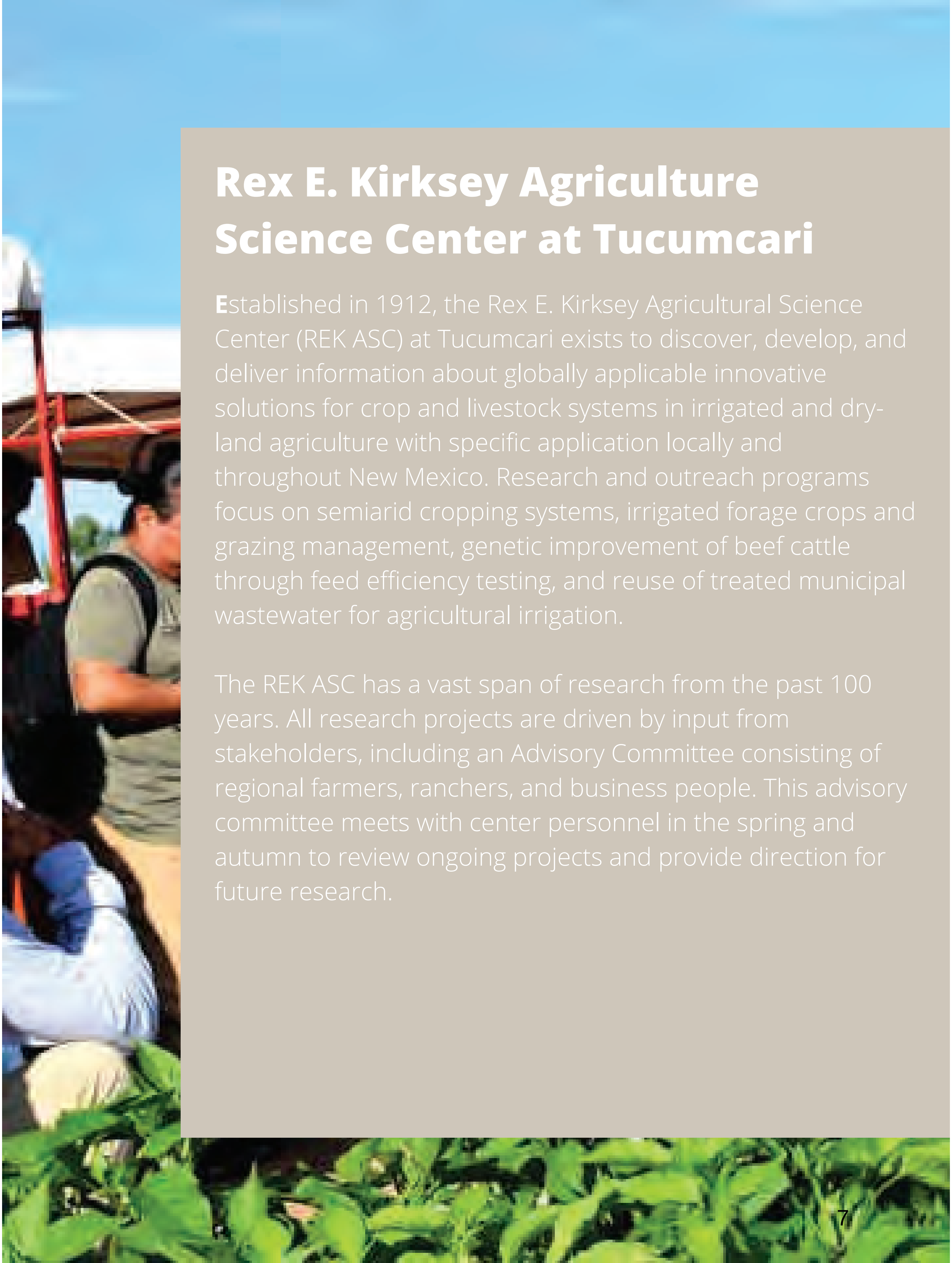
Lauriault, L. M., Waldron, B. (2020). Genotype and planting date influence Bassia prostrata in a semiarid, subtropical, dry winter region. MDPI Agronomy, 10: Special Issue - Breeding and Genetics of Forages for Semi-Arid and Arid Rangelands (251), 11. https://doi.10.3390/agronomy10020251

In addition to these publications, faculty at the REKASCT authored or coauthored nine more peer-reviewed scientific publications and three peer-reviewed Cooperative Extension Service publications along with three variety test reports.

Mission

The New Mexico State University Rex E. Kirksey Agricultural Science Center at Tucumcari (REKASCT) conducts locally driven, globally relevant research related to crop (including forages) and livestock production under irrigated and dryland conditions. These efforts focus on: **improving the quality, safety, and reliability of food and fiber products**, which enhances agricultural profitability; **stimulating economic development** using natural resources; sustaining the environment and protecting natural resources with sound practices, and **improving the quality of life for the people of New Mexico**.





Rex E. Kirksey Agriculture Science Center at Tucumcari

Established in 1912, the Rex E. Kirksey Agricultural Science Center (REK ASC) at Tucumcari exists to discover, develop, and deliver information about globally applicable innovative solutions for crop and livestock systems in irrigated and dry-land agriculture with specific application locally and throughout New Mexico. Research and outreach 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.

The REK ASC has a vast span of research from the past 100 years. All research projects are driven by input from stakeholders, including an Advisory Committee consisting of regional farmers, ranchers, and business people. This advisory committee meets with center personnel in the spring and autumn to review ongoing projects and provide direction for future research.

Agricultural Experiment Station

What Is the Agricultural Experiment Station?

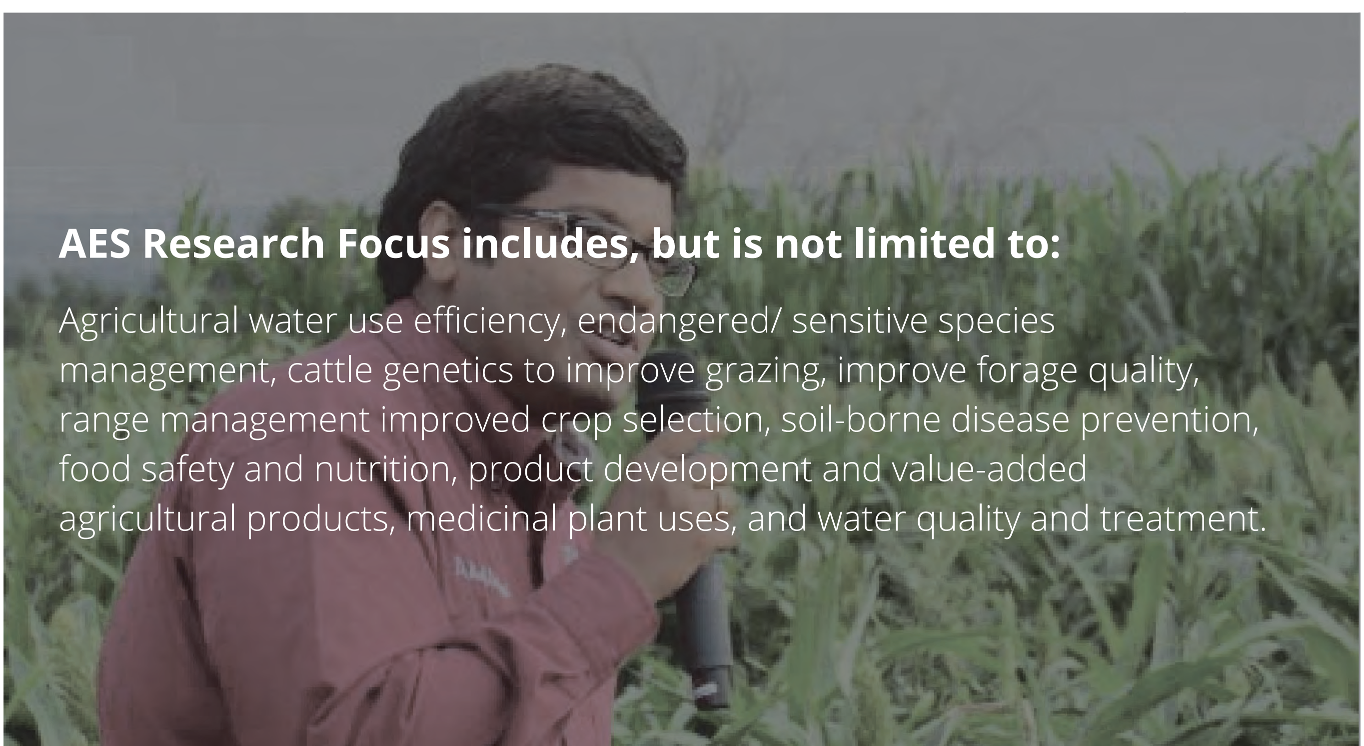
NMSU's Agricultural Experiment Station is the principal research unit of the College of Agricultural, Consumer and Environmental Sciences. All research faculty in the college have appointments in the Agricultural Experiment Station.

Mission

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

The Agricultural Experiment Station supports research designed to:

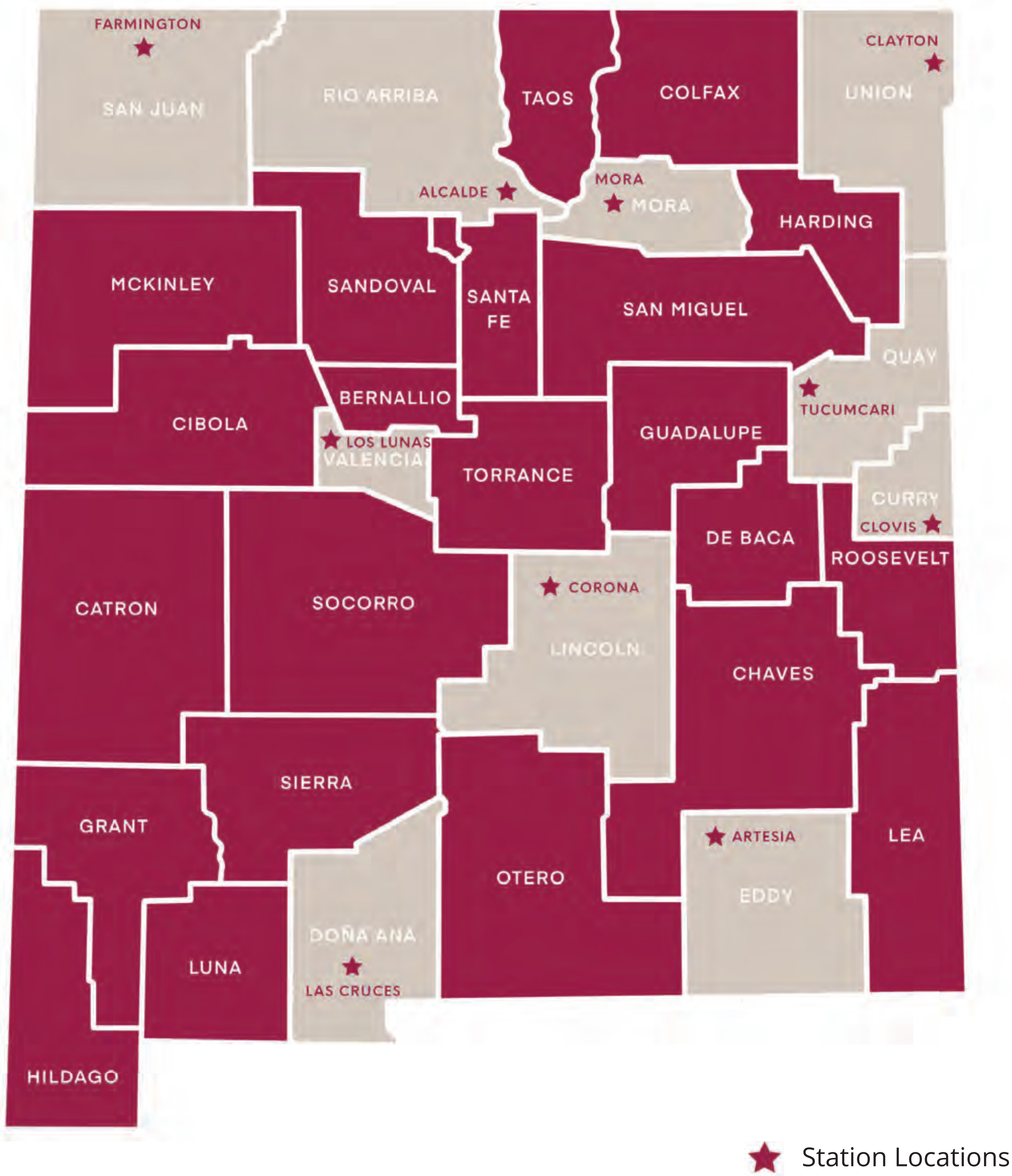
- Enhance agricultural profitability.
- Stimulate economic development using natural resources.
- Improve the quality, safety and reliability of food and fiber products.
- Sustain and protect the environment with ecologically sound practices.
- Manage and protect natural resources.
- Improve the quality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



AES Research Focus includes, but is not limited to:

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

NMSU Agricultural Experiment Station



Rex E. Kirksey Agricultural Science Center Weather Conditions

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 Rex E. Kirksey Agricultural Science Center at Tucumcari has remained in continuous operation since the establishment at its current location in January 1912. Weather observations include maximum and minimum air, soil, and water temperatures; precipitation; wind speed; and aboveground pan evaporation. Weather observations at the Rex E. Kirksey 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).

Total precipitation for 2020 was 8.95 inches, 6.75 inches less than the long-term average of 15.70 inches (Table 1). All months, except January and March, had below-average precipitation in 2020. The greatest amount of precipitation falling within 24 hours (0.63 liquid inches) was snow on October 28th.

Table 1. Monthly precipitation amounts (inches) recoded at the NMSu Rex E. Kirksey Agricultural Science Center at Tucumcari and the 1905-2020 long-term averages.

Month	2020	2019	2018	2017	2016	1905-2020
January	0.92	0.14	tr.	1.02	0.01	0.40
February	0.63	0.03	0.03	0.17	0.94	0.50
March	0.82	0.23	0.16	2.16	0.08	0.76
April	0.12	0.93	0.51	2.73	0.67	1.12
May	0.54	1.87	1.82	1.82	1.30	1.86
June	0.40	1.23	0.56	0.98	3.28	1.86
July	2.29	2.02	1.16	1.58	1.11	2.59
August	0.79	1.33	3.63	6.48	2.33	2.68
September	0.55	1.69	0.78	2.65	0.41	1.54
October	1.23	1.39	4.27	3.62	1.39	1.34
November	0.54	0.98	0.56	0.01	0.08	0.68
December	0.12	0.61	0.62	0.00	0.37	0.64
Annual total	8.95	12.45	14.10	23.22	11.97	15.70
Apr.- Oct. total	5.92	10.46	12.73	19.86	10.49	12.91

Record high and low amounts of precipitation, by month, are shown in Table 2.

Table 2. Highest and lowest monthly precipitation (inches) recorded at the NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari, 1905-2020.

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
Annual	34.96	1941	6.13	1934
Growing Season (April - October)*	31.14	1941	5.14	1934

*Until 2017, Growing Season data had been reported for April – September.
Where minimum records are shared by more than one year, only the most recent year is listed.

No precipitation records were set in 2020. 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). Total snowfall in 2020 was 12.95 inches. No snow fell in 2020 until October 26th. 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.

The mean maximum temperature for 2020 was 74ºF, the mean minimum temperature was 44ºF, and the mean annual temperature for 2020 was 59ºF, all of which were at or near the respective long-term averages (Table 3).

Table 3. Mean monthly temperatures (°F) at the NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari and the long-term averages (1905-2020).

Date	2020	2019	2018	2017	2016	1905-2020
Mean Maximum Temperature						
January	55	53	55	52	60	40
February	58	58	62	65	63	44
March	63	63	69	57	70	53
April	73	73	72	72	73	64
May	78	78	88	80	78	72
June	91	91	95	94	93	81
July	97	97	96	96	100	86
August	97	97	92	88	90	86
September	91	91	86	84	88	79
October	69	69	69	75	63	63
November	62	62	57	69	66	49
December	56	56	52	78	53	42
Annual	74	74	74	76	75	73 *
Mean Minimum Temperature						
January	28	24	22	25	29	12
February	26	26	27	34	30	17
March	32	32	36	31	35	24
April	42	42	39	44	41	37
May	49	49	56	48	49	46
June	59	59	66	61	62	55
July	67	67	66	67	68	61
August	66	66	64	62	63	57
September	63	63	57	56	58	51
October	40	40	45	45	44	39
November	29	14	29	38	35	14
December	28	28	25	24	25	25
Annual	44	43	44	45	45	43
Mean Temperature						
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

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

The lowest recorded temperature in 2020 was recorded on February 5th (10°F). The highest temperature for the year, 109°F, was recorded on July 14th, which broke the record for that date set in 1934 of 107°F. Records for daily maximum temperatures were tied or broken four times in May, twice in June, five times in July, seven times in August, twice in September, four times in October, and once in November in 2020. Record lows were set on April 15th, September 9th-11th, and October 26th.

The highest and lowest recorded temperatures and mean temperature extremes are shown in Table 4. A new daily record extreme maximum temperature for July was set in 2020, which also tied the annual record extreme (Table 4). July 9-15, 2020, was the hottest 7-day period on record averaging 106°F, breaking the previous record of 105°F set for the 7-day periods ending on July 1, 1994, and 1990; July 2, 1994; June 29, 2980; July 4, 1957; and August 4, 1944, each with equal records set within the 7 days. The coldest 7-day period on record (22 °F/-5°F Max/Min) ended on January 5-6, 1919.

Table 4. Highest and lowest recorded (1905-2020) daily and mean monthly temperatures (°F) at the NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari.

	Daily Record Extremes				Mean Monthly Extremes			
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	109*	7/14/2020	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

* Indicates a new record.
Where records are shared by more than one year, only the most recent year is listed.

The last spring temperature of ≤32°F in 2020 was recorded on April 17th (Table 5).

Table 5. Last spring and first autumn temperatures of 32°F and 28°F and growing season lengths at the NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari, 1913-2020.

	2020	2019	2018	2017	2016	Long-term average	Record Extremes			
							Earliest	Year	Latest	Year
32°F or less										
Last in Spring	17-Apr	11-May	19-Apr	30-Apr	30-Apr	18-Apr	24-Mar	1943	31-May	1969
First in Autumn	27-Oct	11-Oct	15-Oct	10-Oct	9-Nov	23-Oct	17-Sep	1965	19-Nov	1989
Growing Season (Days)[1]	193	153	179	163	193	188	134	1969	225	2015
28°F or less (Hard Freeze)										
Last in Spring	17-Apr	12-Apr	10-Apr	26-Mar	2-Apr	4-Apr	6-Mar	1935	6-May	1917
First in Autumn	27-Oct	11-Oct	15-Oct	9-Nov	18-Nov	3-Nov	8-Oct	1970	27-Nov	1923
Killing Frost Free Days[2]	193	182	188	228	230	212	169	1917	256	2001

[1]Growing Season = Number of days between the last occurrence of 32°F in the spring and the first occurrence of 32°F in autumn.

[2]Killing frost-free days = Number of days between the last occurrence of 28°F in the spring and the first occurrence of 28°F in autumn.

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

The first temperature of ≤32°F in autumn was recorded on October 27th. Average last spring and first autumn freeze dates are April 18th and October 23rd, respectively (Table 5). The 2020 growing season was 193 days, 9 days shorter than the long-term average. The longest and shortest growing seasons on record are 225 and 134 days, respectively, which were recorded in 2015 and 1969, respectively (Table 5).

Summaries of pan evaporation and wind run at the center are shown in Table 6. Readings for October have been included for all years beginning in 2018. The totals and daily averages for all months and the April – September, and April – October seasons were above their respective long-term averages, but the season total was well below the April – September record set in 2011 (97.44 inches).

Table 6. Pan evaporation (inches) and wind run (average miles per hour) at the NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari and the long-term averages.

	Pan Evaporation (inches)				Wind Run (mph)	
	2020		Long-term (1953–2020)		2020	Long-term (1918–2020)
Month	Total	Daily Average	Monthly Average	Daily Average	Daily Average	Daily Average
April	11.04	0.37	10.74	0.36	4.6	5.6
May	15.48	0.50	12.60	0.41	4.8	5.0
June	18.72	0.62	14.02	0.47	6.1	4.7
July	15.55	0.49	13.56	0.44	4.1	3.8
August	15.26	0.50	11.65	0.38	3.8	3.4
September	10.48	0.35	9.31	0.31	3.8	3.7
October*	8.89	0.29	6.20	0.20	4.3	3.6
April - September total/average	86.53	0.47	71.88	0.39	4.5	4.4
April – October total/average*	95.42	0.45	86.31	0.40	4.5	4.3

*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.

Most months and the seasonal averages were at or near the average for wind speed (Table 6). April wind speed was well below the long-term averages, while June was well above the long-term average, but not greater than the maximum average wind speed of 7.5 mph for June recorded in 1946 and 1925. The April – September season average was still greater than the corresponding calmest season on record of 2.3 mph in 1979 and less than the windiest April - September season in 1918 (7.7 mph).

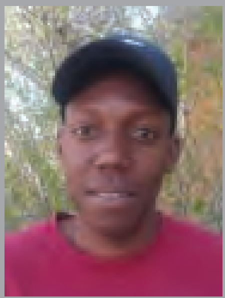
Historical daily weather data for 1905-2020 is available upon request and is scheduled to be summarized for publication in an NMSU Research Bulletin in 2021.

NMSU Rex E. Kirksey ASC Faculty and Staff

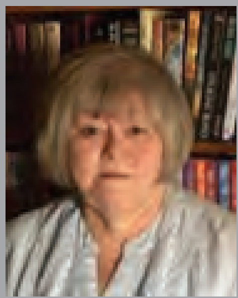
Leonard Lauriault, MS in Crop Science
College Professor
Superintendent and Forage Crop
Management Scientist

Mural Darapuneni, Ph.D.
Associate Professor
Semiarid Cropping Systems Specialist

Gasper Martinez, MS in Crop Science
Research Assistant

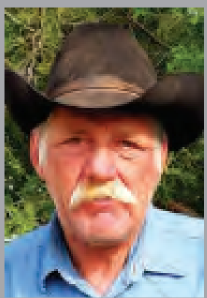


Patricia Cooksey,
retired Administrative Assistant
Part-Time



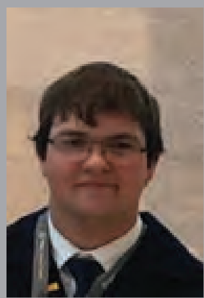
Jason Box
Farm Manager

Robert "Shane" Jennings
Lab Tech, Research



Jared Jennings
Lab Tech, Research

Dyson Clark
Laborer



Cooperators/Collaborators

Campus-based faculty

1. Agricultural Business and Agricultural Economics: Ram Acharya, Efren Delgado, Befekadu Goraw, Chadelle Robinson, Frank Ward
2. Economics, Applied Statistics & International Business: Robert Steiner, Dawn VanLeeuwen
3. Animal and Range Sciences: Eric Scholljegerdes
4. Entomology, Plant Pathology, and Weed Science: Dave Thompson, Soum Sanogo
5. Extension Animal Sciences and Natural Resources: Craig Gifford, Marcy Ward
6. Extension Plant Sciences: Leslie Beck, Richard Heerema, John Idowu, Carol Sutherland
7. Plant and Environmental Sciences: David DuBois, Lois Grant, Kulbhushan Grover, Omar Holguin, Rich Pratt, Ian Ray, Manoj Shukla, April Ulery

Off-campus research facilities

1. Alcalde: Steve Guldan, Del Jimenez, Shengrui Yao
2. Artesia: Jane Breen-Pierce, Robert Flynn
3. Clayton: Glenn Duff
4. Clovis: Sangu Angadi, Rajan Ghimire, Robert Hagevoort, Abdel Mesbah, Naveen Puppala
5. Corona: Shad Cox
6. Farmington: Samuel Allen, Koffi Djaman, Kevin Lombard
7. Los Lunas: Mark Marsalis, Amanda Skidmore, Marisa Thompson

New Mexico

1. Arch Hurley Conservancy District: Franklin McCasland
2. Phillip Box, Box Farms, Tucumcari
3. Canadian River Soil and Water Conservation District: Supervisors and Diana Cassidy
4. City of Tucumcari: Britt Lusk/Mark Martinez, City Commission, and Calvin Henson
5. Conversations about Soil Health (CAST): Marie Nava, Tucumcari
6. Tom Goncharoff, Crystal Springs Farm, Tularosa
7. Greater Tucumcari Economic Development Corporation, Patrick Vanderpool and Board of Directors
8. Mesalands Community College, Tucumcari: John Groesbeck, Manny Encinias
9. New Mexico Economic Development Department: Tim Hagaman
10. New Mexico Hay Association: Board of Directors
11. New Mexico State Legislature: Senator Pat Woods and Representative Jack Chatfield
12. New Mexico Water Trust Board
13. Quay County Cotton Boll Weevil Control District
14. Quay County Government: County Commission, Larry Moore, and Richard Primrose
15. Quay County Sun: Ron Warnock
16. Quay County TableTop Food Co-op: David White and others
17. Tucumcari Bio-Energy and Aquaponics: Bob Hockaday and David White
18. Tucumcari Feed Efficiency Test, LLC (TFET, dba Tucumcari Bull Test): Leadership and Members
19. Tucumcari Public Schools: Tonya Hodges and Veronica Hernandez
20. Tucumcari/Quay County Chamber of Commerce: Carmen Runyan

USA

1. Cornell University: Elson Shields and Antonio Testa
2. Desert Research Institute: Xuelian Bai, Erick Bandala, Richard Jasoni, Erica Marti, Kristin VanderMolen
3. National Science Foundation
4. 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)
5. Oklahoma State University: Alex Rocateli
6. South Dakota State University, Brookings: David Clay
7. Southern California Coastal Water Research Project: Alvina Mehinto
8. Syngenta Crop Protection, Bloomington, MN: Yujin Wen
9. Texas AgriLife Research and Extension: Pat Porter (Lubbock)
10. University of Kentucky: Ben Goff
11. University of Nebraska, Scottsbluff: Gary Hergert, Jeff Bradshaw, and Robert Harveson
12. University of Nevada – Reno: Juan Solomon
13. University of South Carolina: April Hiscox
14. University of Wisconsin – Madison: Victor Cabrera
15. USDA: Blair Waldron (ARS, Logan, UT)
16. West Texas A&M University, Canyon: Brock Blaser and Marty Rhodes

Brazil

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

India

1. ICRISAT, Hyderabad, Telangana
2. University of Agricultural Sciences, Raichur: M.R. Umesh

Pakistan

1. Faculty of Agricultural Sciences, Ghazi University, Dera Ghazi Khan
2. Faculty at the University of Agriculture, Faisalabad
3. Faculty at MNS University of Agriculture, Multan

Punjab

1. The Islamia University of Bahawalpur

United Kingdom

1. Anglo American Crops, Scarborough: Brad Farber

Ag Science Center at Tucumcari

Fiscal Year: **2020**

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

Department	Acct Type	Account Index Desc	Revenue YTD	Expense Budget	Expense YTD	jet Balance Available	Fund Balance Dr/(Cr)
Ag Science Ctr at Tucumcari	ALFALFA RESPONSE TO POLYHALITE NM	ALFALFA RESPONSE TO POLYHALITE YR2		$34,500.00	$394.56	$34,105.44	
Ag Science Ctr at Tucumcari	HATCH FEDERAL APPROPRIATIONS FY 20	INNOVATIVE CROPPING SYSTEM & MGNT S		$58,040.00	$41,597.56	$16,442.44	
		Total Restricted Funds		**$92,540.00**	**$41,992.12**	**$50,547.88**	
Ag Science Ctr at Tucumcari	RESTR MAIN CURR USE GIFTS	09661252S09061252FIELD DAY TUCUMCAR	$425.00	$0.00	$1,732.46	($1,732.46)	($17.54)
Ag Science Ctr at Tucumcari	RESTR MAIN CURR USE GIFTS	FORAGE GRASS-ASC TUCUMCARI GIFT	$0.00	$0.00	$32.95	($32.95)	($3,772.53)
		Total Gift Funds	**$425.00**	**$0.00**	**$1,765.41**	**($1,765.41)**	**($3,790.07)**
							* See note
Ag Science Ctr at Tucumcari	APPLIED CHARGES	ASC TUCUMCARI TRACTOR/VEHICLES	$0.00	($2,000.00)	$7,444.00	($9,444.00)	($45,617.61)
Ag Science Ctr at Tucumcari	APPLIED CHARGES	IRRIGATION SERVICES-ASC TUCUMCARI	$0.00	($5,000.00)	($2,905.32)	($2,094.68)	($4,381.96)
Ag Science Ctr at Tucumcari	SALES & SERVICE	TUCUMCARI BULL TEST	$2,755.53	$0.00	$8,252.89	($8,252.89)	($32,186.18)
Ag Science Ctr at Tucumcari	SALES & SERVICE	TUCUMCARI ASC SALES	$16,767.56	$3,000.00	$14.62	$2,985.38	($51,484.94)
Ag Science Ctr at Tucumcari	SALES & SERVICE	TUCUMCARI PASTURES	$0.00	$500.00	$0.00	$500.00	$0.00
		Total Sales and Service Funds	**$19,523.09**	**($3,500.00)**	**$12,806.19**	**($16,306.19)**	**($133,670.69)**
							* See note
Ag Science Ctr at Tucumcari	STATE APPROPRIATIONS	ASC-TUCUMCARI SALARY		$260,849.54	$202,755.28	$58,094.26	
Ag Science Ctr at Tucumcari	STATE APPROPRIATIONS	TUCUMARI TEMP SALARY SAVINGS		$22,695.00	$0.00	$22,695.00	
Ag Science Ctr at Tucumcari	STATE APPROPRIATIONS	DISCOVERING FORAGE MGMNT SOLUTIONS		$83,754.00	$70,869.40	$12,884.60	
Ag Science Ctr at Tucumcari	STATE APPROPRIATIONS	INNOVATIVE CROPPING SYSTEMS		$58,039.96	$58,039.68	$0.28	
Ag Science Ctr at Tucumcari	STATE APPROPRIATIONS	TUCUMCARI ADMIN		$70,392.00	$69,446.49	$945.51	
Ag Science Ctr at Tucumcari	STATE APPROPRIATIONS	DRYLAND CROPPING AGRONOMY		$15,000.00	$13,263.23	$1,736.77	
Ag Science Ctr at Tucumcari	STATE APPROPRIATIONS	DISCOVERING FORAGE MGMNT SOLUTIONS		$12,490.00	$12,483.48	$6.52	
		Total State Appropirated Funds		**$523,220.50**	**$426,857.56**	**$96,362.94**	

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

Table 2. Listing of major purchases paid for during FY 2019-2020, NMSU Rex E. Kirksey Agricultural Science Center at Tucumcari.

Description	Index	Amount	Total Cost
Treated wastewater, electric, maintenance, City of Tucumcari	120592	$10,000.00	
	121851	$3,247.50	$13,247.50
Cab filter for the CNH 140 Tractor, Wood Equipment	121851	$1,702.27	$1,702.27
Almaco Small Plot Combine, Gary W. Clem, Inc.	130689	$100,000.00	
	124340	$22,695.00	
	120186	$12,000.00	
	120435	$12,965.89	$147,660.89
John Deere 5100 M Utility Tractor, Western Equipment	130683	$50,000.00	
	107346	$5,400.00	
	121584	$10,551.35	$65,951.35
Soil and plant sample analysis, Ward Laboratories	121851	$139.00	
	125881	$4849.00	
	124581	$2530.00	
	129155	$9034.00	$16,551.00
Total			$232,562.01

Image 1. New Almaco Combine

Image 2. John Deere Tractor

AES RESEARCH

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

Forestry

Agronomy

Dairy

Weather and Climate

Horticulture

Task Force Reports

Livestock and Range

Water

Economics

GENETIC IMPROVEMENT IN THE NEW MEXICO COW HERD

Investigators: Marcy Ward

SITUATION

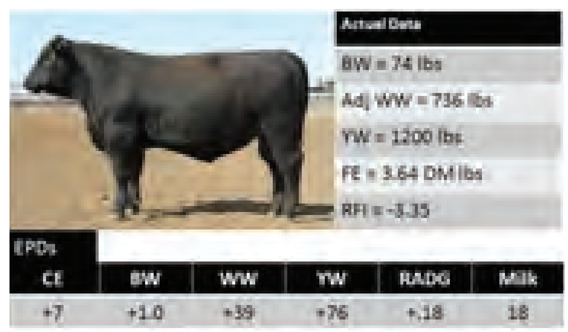
The New Mexico beef industry contributes 900 million dollars to the gross state product annually. Drought is a significant risk to this economically important industry. Optimizing genetics and animal efficacy can help minimize losses due to drought.

EXTENSION RESPONSE

Two approaches have been taken to achieve genetic improvement of the New Mexico cow herd. The NMSU Tucumcari Bull Test allows purebred cattle producers to evaluate the efficiency of their cattle through extensive data collection. Educational programming provides producers more information to improve their genetic selection decisions.

IMPACTS

- The Tucumcari Bull test has doubled its capacity in efficiency testing bulls since 2015.
- Since 2015, the average value of bulls sold through the Tucumcari bull test has increased by $500.00 per animal; improving the profitability of New Mexico cattle producers.
- Data collected from the Tucumcari has results in producers improving the efficiency of their cattle by 40% since its inception in 1961.
- Producers that have attended education seminars that cover genetic selection have improved their knowledge base in this area by 25%.



EFFECTS OF CATTLACTIVE© SUPPLEMENTATION ON PERFORMANCE OF WEANED HEIFERS

Investigators: M. A. Ward1 and K. Taylor2

1New Mexico State University Department of Extension Animal Science and Natural Resources, Las Cruces, NM 88003
2Department of Animal and Range Sciences, Las Cruces, NM 88003

POTENTIAL IMPACT(S)

How quickly naïve cattle start on feed is a critical component for long-term health in the feed yard. Supplementation programs can help overcome changes in diet associated with entering a feed yard after weaning for pastured cattle.

METHODS

Two studies were conducted to evaluate the effects of CattlActive© on newly received heifers to a feedlot. Protocols for both studies were the same, with pens switched between studies. In study one, 33 single-sourced/implanted heifers were randomly allotted to either control (CON; no supplement) or treatment (TRT; CattlActive© supplement). In study 2, 60 sale barn-sourced heifers were again randomly allotted to either CON or TRT. Upon arrival, heifers were weighed, affixed with electronic identification tags, and placed in pens containing a Growsafe® intake system. Cattle were fed a total mixed ration containing 60% roughage and 40% concentrate twice daily. The CON group had the addition of wheat bran and the TRT had the addition of CattlActive© dry supplement at a rate of 7.5g per head per day. Cattle were fed for 30 days. All cattle were evaluated for health twice daily. Animals demonstrating signs of sickness were treated appropriately and returned to their home pens. Cattle were weighed at the initiation and conclusion of the 30-day trials so average daily gain (ADG) and feed conversion (FE) could be calculated.

Data were analyzed by analysis of variance in SAS; where P values < 0.05 are considered significant.

RESULTS

In study one, the weight discrepancies noted between CON and TRT were due to animals that were removed from the study due to health or injury. Their data was omitted completely from the analysis. Consequently, one of the larger animals from CON and a lighter animal from TRT were the ones that fell out of the data set. In terms of performance, there were no differences in ADG and FE between CON and TRT (Table 1.). Dry matter intake (DMI) tended to be higher in TRT. This may be because heifers on the CattlActive© supplement had an increased rate of intake per day (P<0.005). In study 2, there was a much more uniform weight distribution between treatments. Two animals from CON and one from TRT were omitted from the study. As in study one, there were no differences in ADG, DMI, and FE. In this study, however, CON tended to have an increased rate on feed than TRT. This differs from responses observed in study 1 (Table 2).

Variable	CON	TRT	SE	P value
Number of heifers	15	16	-	-
In Wt (lbs)	560	585	-	-
Out Wt (lbs)	674	712		
ADG (lbs)	2.87	3.17	.19	.27
DMI (lbs)	14.73	16.31	.64	.086
FE(lbs)	5.42	5.34	.33	.86
Rate on Feed(lbs/d)[a]	4.16[b]	4.97[c]	.19	.005

[a] Rate of feed indicates the average amount of feed (lbs) animals increased their daily intake for the duration of the 30-day trial.
[b,c]Differences between treatments at a significance value (0.05 < P)

Table 1. Study 1 performance of weaned heifers on a grower ratio.

Variable	CON	TRT	SE	P value
Number of heifers	28	29	-	-
In Wt (lbs)	549	550	-	-
Out Wt (lbs)	644	659		
ADG (lbs)	2.65	2.72	.16	.74
DMI (lbs)	15.58	14.65	.53	.23
FE(lbs)	6.05	5.92	.32	.78
Rate on Feed(lbs/d)[a]	5.86	5.23	.24	.062

Table 2. Study 2 performance parameters of weaned heifers on a grower ratio.

SUMMARY

Though there were no differences in performance parameters between CON and TRT in both studies, it can be noted that the cattle treated with the CattlActive© product increased their feed intake at a significantly greater rate than those that only received the wheat bran in the first trial. Because differences tended to reverse for rate on feed in the second study, it warrants further investigation. How quickly naïve cattle start on feed is a critical component for long-term health in the feed yard, and with further study, CattlActive© may aid in improving intake the first two to three weeks an animal is on feed.

GRAZING EFFECTS ON FIELD BINDWEED INFESTATION IN GRASS PASTURES

Investigators: L.M. Lauriault1, M.K. Darapuneni1, P. Box2, G.K. Martinez1, J. Box1, L. Salas1, J. Jennings1, and S. Jennings1

1New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401
2Owner, 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. Before 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, 2018, and 2019 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 has not been replanted since 2017. In 2020, irrigation was applied by flood/furrow (6.0 inches) to the north pasture and by sprinkler (11.4 inches) to the south pasture to supplement the total annual 8.9 inches of precipitation. The pastures were rotationally grazed from April 30 to October 31, 2020, by 36 cow-calf pairs and two bulls. Aboveground plant material within a 3.33 sq. ft. quadrat was hand-clipped to ground level in and near each exclosure in May, July, August, September, and November. 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 2020 were analyzed using SAS Proc Mixed to compare sampling location (grazed or ungrazed) and 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. Sampling locations and sampling periods were significantly different ($P < 0.05$) or trended toward significance ($0.05 < P < 0.10$) for the number of bindweed clones and g DM/sq m of bindweed and other weeds (Table 1).

While no cereals have been planted since 2017, some volunteering continued to occur, although to a lesser extent than in 2019. Because no cereals have been planted in recent years, data collection will be postponed until after cereals are planted in the future.

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 2020. 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	60.31	18.56	71.13	4.66	62.73
Grazed	48.28	11.87	40.09	0.70	44.62
SEM	6.42	3.23	8.82	3.00	13.14
Sampling period (SP)					
May	68.75 AB	19.96 AB	31.74 B	2.65	48.59
Jul	74.84 A	25.23 A	46.02 B	9.76	64.55
Aug	45.49 BC	15.37 ABC	101.78 A	1.86	46.41
Sep	47.92 BC	10.12 BC	60.32 B	0.00	66.68
Nov	34.45 C	5.40 C	38.20 B	0.00	42.16
SEM	10.79	5.29	14.44	4.91	21.50
		P-value of F			
SL	0.0920	0.0643	0.0054	0.2144	0.1969
SP	0.0174	0.0230	0.0033	0.2811	0.7107
SL x SP	0.5988	0.7201	0.2693	0.6002	0.4637

Sampling period means within a column followed by the same letter(s) are not significantly different at a P-value of F ≤ 0.05.

NITROGEN AND PHOSPHORUS MANAGEMENT IN GUAR PRODUCTION

Investigators: M. Darapuneni1, O.J. Idowu2, S. Angadi3, G. Martinez1, L.M. Lauriault1, P. Cooksey1, J. Box1, Jennings1, and S. Jennings1
1New Mexico State University, Agricultural Science Center at Tucumcari, NM 88003
2New Mexico State University, Las Cruces, NM 88401
3New Mexico State University, Agricultural Science Center at Clovis, NM 88101

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 east 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 24, 2020, using a row planter with a metering cone and set to 30-in row spacing. Before planting, 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 P_2O_5 (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. Metolachlor and Treflan were sprayed on June 25 in between rows at the rate of 1.3 pt/A and 2.5 pt/A, respectively, to control weeds. In addition to 4 in precipitation received during the growing season, the experiment was irrigated with 11.5 in of treated municipal wastewater. For the final harvest on November 2, 2020, 3 ft of the center two rows of each plot were hand-harvested to assess the grain yield characteristics and plant chemical composition. Sub-samples of grain were transported to Las Cruces for tissue nutrient analysis.

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

RESULTS

As evident in the results (Table 1), the application of current N and P rates in guar was not advantageous over the unfertilized control. Although statistically not significant, 25-25 treatment combinations yielded greater seed yield 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. Soil data collection up to a least 18 in. depth of the effective root zone would have been more helpful in assessing the comprehensive effects of inter-horizon nutrient dynamics on guar yield. Due to the COVID pandemic, the post-harvest soil data were not collected during the 2020 growing season. Tissue nutrient analysis is in progress.

Table 1: Guar seed yield with N and P applications at Tucumcari, NM in 2020

N-P Combinations	Seed Yield (lb/ac)
0-0	1318 a
0-25	1093 a
0-50	1048 a
25-0	1030 a
25-25	1669 a
25-50	1315 a
50-0	992 a
50-25	1277 a
50-50	1217 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: L.M. Lauriault1 and G.K. Martinez1

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

POTENTIAL IMPACT(S)

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



METHOD(S)

In 2019, a licensed industrial hemp seed grower in Quay County (Permit #AHPL-165-2019) offered his 2-acre field for a research project. The 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 the reproductive, leaf, and stem component weights. After harvesting, all plants were between two layers of black plastic sheeting to promote drying. In early 2020, after the plants dried, leaves and reproductive components were separated from the stems. The leaf/reproductive and stem components for each plant were weighed and the leaf/reproductive component held for further separation, which did not take place during 2020 due to COVID-19 restrictions and the likelihood that the seed would not be sold in 2020.

Plant measurement component weight 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

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 all variables except between crown diameter and basal stem diameter, stem weight, or leaf/reproductive weight. The strongest relationships are between basal stem diameter and both stem and leaf/reproductive component weights. When and if leaf and seed yield component data are available, they will be added to the correlation analysis.

Table 1. Simple statistics of hemp plant measurements and component weights in Quay County, NM, in 2019 and 2020.

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
Stem weight, oz.	5	12.83	8.77	3.98	23.71
Leaf/reproductive weight, oz.	5	7.83	7.78	1.67	20.56

N and Std Dev signify the number of plants evaluated and the standard deviation of the sample means.
The range is the least and greatest measurement.

Table 2. Pearson Correlation Coefficients (r, n = 5) among hemp plant measurements and component weights in Quay County, NM, in 2019 and 2020.

		Variable			
Variable		Plant height	Crown diameter	Stem diameter	Stem weight
		ft.	ft.	in.	oz.
Crown diameter, ft.	Correlation coeffient	0.93			
	Prob > |r|	0.0226			
Stem diameter, ft.	Correlation coeffient	0.89	0.80		
	Prob > |r|	0.0405	0.1064		
Stem weight, oz.	Correlation coeffient	0.89	0.74	0.94	
	Prob > |r|	0.0430	0.1565	0.0155	
Leaf/reproductive weight, oz.	Correlation coeffient	0.90	0.77	0.98	0.91
	Prob > |r|	0.0363	0.1318	0.0043	0.0327

ALFALFA RESPONSE TO VARIOUS FERTILIZER APPLICATIONS IN LOW POTASSIUM SOILS

Investigators: M. Darapuneni1, L.M. Lauriault1, G. Martinez, J. Box1, P. Cooksey1, J. Jennings1, and S. Jennings1

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

POTENTIAL IMPACT(S)

Alfalfa (*Medicago sativa* L.) is among the top cash crops of New Mexico. In Alfalfa, potassium (K) alone constitutes about 2.5% of tissue weight. The application of 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 maximizing forage yield and quality. It has been reported that alfalfa requires high amounts of K to sustain yield and to maintain stand persistence. The Minimum K concentration in plant tissue for the 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 P2O5, 60 lb of K2O, 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.

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

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 the 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.

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, in 2020 to evaluate the effect of various K and S fertilizers on alfalfa yield and quality. The soil initial 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 P2O5, 143 lbs of K2O, and 71 lbs of S. The experimental treatments were randomized in 4 blocks.

Before 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 the 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.

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. The size of the experimental unit was 12 ft wide 15 ft long for an area of 180 ft2. Prowl (2 qts/A) was sprayed to control weed populations in the early spring. The fertilizer treatments were imposed on March 4, 2020, when the alfalfa was at the 3-5 leaf stage. All fertilizers were solid formulations and applied simultaneously by hand broadcasting method.

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

During the 2020 season, harvests (cuttings) of alfalfa were performed on April 28, May 29, June 30, July 30, September 2, and November 12. At each harvest, a sample from the 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 the PROC MIXED procedure (SAS Institute, 2013). If significant at a 5% significance level, a mean separation test was conducted using Tukey's multiple range test.

RESULTS

Table 3: Alfalfa yield (lb/A) response to various fertilizer applications

Fertilizer	Alfalfa seasonal yield
NP	19503 ab
NP + MOP	19420 ab
NP + SOP	20447 ab
NP + KNO3	19497 ab
NP + MOP + AS	20502 ab
NP + SOP + AS	21360 a
NP + KNO3 + AS	20664 a
NP + MOP + Gypsum	19717ab
NP + SOP + Gypsum	18987 ab
NP + KNO3 + Gypsum	18493 b

A combination of NP + SOP + AS fertilizers increased the alfalfa yield, although statistically not significant from other fertilizer treatments used in the study (Table 3). In general, AS proved to be better in increasing alfalfa yield compared to Gypsum. This may be since SO4-2 ions form complexes with Ca that inhibit the overall release of S for plant uptake.

For the most part, the alfalfa nutritive value and mineral composition the quality was unaffected by the type of fertilizer treatment used in the study (data not shown). The NP + KNO3 + AS treatment had greater ADF and NDF values, although not significantly different from many other K and S fertilizers.

ALFALFA VARIETY TESTING IN THE TUCUMCARI IRRIGATION PROJECT

Investigators: L.M. Lauriault1, G.K. Martinez1, P.L. Cooksey1, J. Box1, J. Jennings1, and S. Jennings1

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

POTENTIAL IMPACT(S)

Variety selection is key to a highly productive alfalfa stand. Differences between the highest- and lowest-yielding varieties in irrigated alfalfa tests statewide ranged from 0.42 to 2.91 tons per acre in 2020. If sold as hay, this translates to a potential difference in returns of $97 to $672 per acre due to variety, or an increase of at least $15 million for the industry. This project addresses the Food and Fiber Production and Marketing Pillar for Economic and Community Development of the College of Agricultural, Consumer and Environment Sciences.

METHOD(S)

A standard alfalfa variety test with 15 entries was planted September 14, 2018, in the field fronting US 54. The test area (Redona fine sandy loam) was conventionally tilled and formed into a flat seedbed for sprinkler irrigation with treated municipal wastewater. Plots (5 ft x 20 ft of which the center 5 ft x 15 ft were harvested for yield) were sown using a disk drill fitted with a seed-metering cone at 20 lb inoculated seed/acre in a Randomized Complete Block design with 4 replications set up for nearest neighbor analysis. Except for from July 12 to August 10, 2020, when there was an irrigation system failure, irrigations with treated municipal wastewater were applied from November 2019 through October 2020 for a total of 22.3 inches to supplement 9.9 inches of precipitation during that period. No fertilizer or pesticides were applied in 2020. Because of the irrigation system problems and the inability to get repair parts promptly due to COVID-19, the test was harvested by hand, twice in 2020, compared to six harvests typically taken at the center.

RESULTS

Yield data from the 2018 test collected in 2020 were subjected to detrending by nearest neighbor analysis and statistical procedures for tests of significance and means separation and are presented in Table 1 with varieties arranged by descending total yield for 2020.

Reports giving results from statewide testing in 2020 and previous years are available at the New Mexico State University College of Agricultural, Consumer and Environmental Sciences' Publications and Videos Variety Test Reports webpage (http://Aes.nmsu.edu/pubs/variety_trials/welcome.html#alfalfa) as well as from the Agricultural Science Center at Tucumcari and county Cooperative Extension Service offices.

Table 1. Dry matter yields (tons/acre) of alfalfa varieties sown September 14, 2018, at NMSU's Rex E. Kirksey Agricultural Science Center at Tucumcari and sprinkler-irrigated with treated municipal wastewater†.

	2020 Harvests		2020
Variety Name	13-Jul	21-Oct	Total
SW7408	1.23*	0.97*	2.21**
African Common	1.30**	0.86*	2.15*
Zia	1.19*	0.92*	2.11*
SW8476	1.05*	1.01**	2.06*
Dona Ana	1.13*	0.87*	2.00*
SW8412	1.06*	0.90*	1.96*
SW8409	0.90	1.01**	1.91*
SW5210	0.99	0.87*	1.86*
SW7473	1.08*	0.72*	1.79
SW8421S	1.08*	0.71*	1.78
NM Common	1.05*	0.69*	1.74
Hi-Gest 660	0.75	0.94*	1.69
SW1509	0.80	0.88*	1.68
HybriForce-3600	0.89	0.77*	1.66
SW1517	0.86	0.79*	1.64
Mean	1.02	0.86	1.88
LSD (0.05)	0.26	NS	0.38
CV%	17.94	22.89	14.01

†Data were detrended using nearest neighbor analysis and analyzed using analysis of variance.

No harvests were taken in 2019 due to harvesting equipment and irrigation system failures; Irrigation system failures also occurred in 2020 that were exacerbated by parts availability issues due to COVID-19.

**Highest numerical value in the column.

*Not significantly different from the highest numerical value in the column based on the 5% LSD.

NS means that there were no significant differences between the varieties within that column at the 5% level.

PERFORMANCE OF COTTON IN THE TUCUMCARI IRRIGATION PROJECT

Investigators: L.M. Lauriault1, G.K. Martinez1, R.P. Flynn2, P. Cooksey1, J. Box1, J. Jennings1, and S. Jennings1

1New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401
2New Mexico State University, Agricultural Science Center at Artesia, NM 88210

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 commercial cotton variety test was planted into a strip-tilled flat seedbed at the West Pivot (Redona fine sandy loam) on May 21, 2020, 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. Treflan (pt/A) and Brawl (1.22 pt/A) herbicides had been applied on May 19; Glyphosate (2% solution) and Clethodim (1 pt/A) herbicides were applied on May 21, and Glyphosate (2% solution) was applied on July 22. Nitrogen (96 lb/A) was applied as a liquid through a ground spray rig on June 16. Except for during July 12 to August 10, when there was an irrigation system failure, irrigations with canal water were applied May through September for a total of 20.9 inches. There was another unassociated system failure in early October that was not corrected before harvest. A total of 5.8 inches of precipitation fell during the May through October growing season. This coupled with the interruption in irrigation led to poor early flowering and a second flush of flowers too late in the season for bolls to mature. No defoliant or boll opener was used.

Harvesting took place on November 3, 2020, 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 before harvesting the plots. Also before harvest, 25 bolls were collected from each plot. 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. Seed cotton yields were not uniformly measurable. Lint 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. Yields were not measurable due to low precipitation and inadequate and non-uniform irrigation during flowering and boll formation. Lint quality was assessable based on the few bolls that did mature.

Table 1. Plant population and lint quality data[1] from the wastewater-irrigated commercial cotton performance test at NMSU's Rex E. Kirksey Agricultural Science Center at Tucumcari in 2020.

Brand/ Company	Hybrid/Variety	Plants /acre	Trash Code	Trash Area	Trash Count	Length	Unif	SFI	Str	Elg	Mic	Maturity	Rd	Yellowing	Color	Grade	Loan Value
Bayer	BX2116GLTO	45302	2.0	0.2	11.3	1.16	82.4	9.1	30.5	5.7	3.9	81.5	78.1	8.1	28.5	1.8	50.82
Bayer	BX2141GLTP	37897	3.0	0.3	17.0	1.03	77.2	12.8	29.0	5.3	4.7	83.5	77.1	7.7	33.5	1.8	51.55
DeltaPine	DP1829B3XF	17969	2.3	0.3	15.5	1.13	79.4	10.2	31.0	5.5	4.5	83.0	78.1	7.9	31.0	1.3	50.87
DeltaPine	DP1908B3XF	14810	2.3	0.2	12.7	1.10	79.9	10.7	29.4	5.1	4.1	82.3	80.8	7.1	27.7	1.3	52.28
DeltaPine	DP2020B3XF	24611	2.0	0.2	10.5	1.08	79.1	11.0	26.3	5.2	4.1	82.3	78.9	8.2	26.0	1.5	50.58
Bayer	FM1830GLT	21236	2.7	0.3	11.3	0.98	76.6	14.0	25.7	4.9	4.3	83.0	77.7	8.5	31.0	1.0	49.28
Bayer	FM2334GLT	28423	1.8	0.2	11.3	1.11	79.6	10.0	27.8	5.2	4.5	83.3	78.5	7.7	28.5	2.0	50.87
Phytogen	PHY210W3FE	38551	2.0	0.2	9.3	1.00	76.5	14.7	26.2	5.9	4.4	82.3	77.5	8.6	31.0	2.0	47.32
Phytogen	PHY320W3FE	35828	2.8	0.3	16.8	1.06	78.8	12.5	29.1	6.5	3.9	81.0	76.8	7.9	36.0	1.5	50.00
Phytogen	PX2C14W3FE	37244	2.8	0.3	15.3	1.07	80.8	11.1	30.7	6.4	3.6	80.0	78.5	7.5	33.5	1.3	50.28
Phytogen	PX2D18W3FE	43124	2.3	0.2	14.0	1.02	77.1	13.7	28.5	6.2	4.0	81.3	77.0	8.1	33.5	2.0	48.88
Phytogen	PX2E05W3FE	42798	2.8	0.3	14.0	1.03	79.2	12.2	29.4	6.8	4.6	82.5	78.0	8.6	28.5	1.8	49.77
	Trial Mean	32316	2.4	0.3	13.3	1.06	78.9	11.8	38.7	5.7	4.2	82.1	78.0	7.9	30.8	1.6	50.17
	LSD, 0.05	10065	NS	NS	NS	0.08	3.5	3.4	1.0	0.8	NS	1.9	2.0	1.0	6.6	NS	NS
	CV	21.6	28.8	39.5	37.3	5.3	3.1	20.1	8.0	9.0	15.0	1.6	1.7	6.9	14.8	42.9	4.8
	Prob>F	0.0001	0.2430	0.3426	0.4122	0.0034	0.0717	0.0545	0.0442	0.0001	0.3636	0.0281	0.0337	0.0340	0.1169	0.5774	0.7229

[1]Yields were immeasurable due to poor boll formation associated with hot, dry weather and inability to irrigate during flowering. In many cases the entire yield was collected during pre-stripping boll sampling.

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 (FULL IRRIGATION) GRAIN SORGHUM IN THE TUCUMCARI IRRIGATION PROJECT

Investigators: L.M. Lauriault1, G.K. Martinez1, J. Box1, P.L. Cooksey1, J. Jennings1, and S. Jennings1

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

METHOD(S)

To evaluate the grain yield of grain sorghum varieties under full irrigation, a test was planted into a strip-tilled flat seedbed under the West Pivot. The soil was Redona fine sandy loam that had previously been in cereal rye pasture. 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. Plots were planted May 14, 2020, using a small plot row crop planter with a seed-metering cone on each planter unit. The seeding rate was 80,000 seed/acre. Except for during July 12 to August 10, when there was an irrigation system failure, irrigations with treated municipal wastewater were applied May through September for a total of 20.7 inches. There was another unassociated system failure in early October that was not corrected before harvest. A total of 5.8 inches of precipitation fell during the May through October growing season. Atrazine (2 pt/A) and Brawl (1 pt/A) were applied on May 18 and Detonate (1/2 pt/A) was applied on June 28. Fertilizer (60 lb N/A + 11 lb S/A) was applied through a spray rig on July 1.

Grain heads from all plots of the fully-irrigated test were hand-harvested and individually bagged on September 29 and stored for threshing with an Almaco SPC40 small plot combine. Combine-run grain from each plot was weighed and an aliquot was evaluated for test weight (lb/bu) and then dried for 48 h at 221ºF and reweighed to calculate % moisture. Grain yields (lb/ac) were adjusted to 14.5% moisture.

Adjusted grain yield, harvest moisture, and test weight 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

Good stands established for both tests and a 7-ft fence surrounding the field prevented predation by deer that had happened previously in other fields; however, inadequate irrigation and precipitation during the initial heading led to the second flush of heads and reduced yields. Results of statistical analyses of data from the fully-irrigated test are presented in Table 1.

Reports giving results from statewide testing in 2020 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. Adjusted grain yield, moisture at threshing, and test weight data from the New Mexico 2020 wastewater-irrigated, single-cut forage sorghum performance test at the Rex E. Kirksey Agricultural Science Center at Tucumcari.

Brand/Company Name	Hybrid/Variety Name	Adjusted Grain Yield	Moisture at Threshing	Test Weight
		lb/a	%	lb/bu
GX18919	Dyna-Gro Seed	774	8.7	51.6
M57GB19	Dyna-Gro Seed	755	8.8	45.7
GX17912	Dyna-Gro Seed	646	8.7	37.2
M60GB88	Dyna-Gro Seed	577	9.0	42.7
ADVG2275	Advanta Seeds	565	9.1	43.3
M54GR24	Dyna-Gro Seed	446	9.0	42.1
M59GB94	Dyna-Gro Seed	441	8.9	41.6
GX20564	Dyna-Gro Seed	421	9.0	33.8
M57GC29	Dyna-Gro Seed	398	9.3	41.3
ADVG2106	Advanta Seeds	355	9.1	28.9
M62GB77	Dyna-Gro Seed	355	9.0	34.0
M59GB57	Dyna-Gro Seed	354	8.9	37.8
M69GR88	Dyna-Gro Seed	347	8.9	32.0
ADVXG116IG	Advanta Seeds	344	9.0	35.6
ADVXG397	Advanta Seeds	343	9.0	35.2
M74GB17	Dyna-Gro Seed	325	9.0	28.5
ADVXG267	Advanta Seeds	314	8.8	33.7
ADVXG9127	Advanta Seeds	309	9.2	33.3
M60GB31	Dyna-Gro Seed	274	9.2	30.1
GX19981	Dyna-Gro Seed	264	8.8	35.1
AG1301	Advanta Seeds	208	8.9	32.3
M71GR91	Dyna-Gro Seed	190	8.6	25.0
M72GB71	Dyna-Gro Seed	140	8.9	25.0
	Trial Mean	398	8.9	35.9
	LSD (P > 0.05)	292	0.5	11.5
	CV	52.0	3.9	22.7
	F Test	0.0016	0.5142	0.0012

Grain yields are adjusted to 14.5% moisture.

Grain heads were hand-harvested on September 29 and threshed on December 21, which is when the moisture was evaluated.

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 CVs (<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 X SUDANGRASS UNDER A SINGLE-CUT HAY SYSTEM IN THE TUCUMCARI IRRIGATION PROJECT

Investigators: L.M. Lauriault1, G.K. Martinez1, J. Box1, P. Cooksey1, J. Jennings, and S. Jennings1

1New Mexico State University, 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 the yield and nutritive value of forage sorghum varieties for silage, a test was planted into a strip-tilled flat seedbed under the West Pivot. The soil was Redona fine sandy loam that had previously been in cereal rye pasture. Individual plots were 20 x 5 ft with a 5-ft unplanted alley left between plots to facilitate harvesting. The test was a Randomized Complete Block design with 4 replicates. Plots were planted May 14, 2020, using a small plot drill with a seed-metering cone at a seeding rate of 25 lb/ac with a row spacing of 6 inches. The seeding rate was 25 lb/A. Except for during July 12 to August 10, when there was an irrigation system failure, irrigations with treated municipal wastewater were applied May through September for a total of 20.7 inches. There was another unassociated system failure in early October that was not corrected before harvest. A total of 5.8 inches of precipitation fell during the May through October growing season. Atrazine (2 pt/A) and Brawl (1 pt/A) were applied on May 18 and Detonate (1/2 pt/A) was applied on June 28. Fertilizer (60 lb N/A + 11 lb S/A) was applied through a spray rig on July 1.

Swathed forage, leaving 6-inch stubble, from each plot was harvested on October 22 with a Case-IH model 8750 forage harvester with a forage pick-up head. Chopped material from individual plots was collected in a garbage can and immediately weighed. Before dumping the garbage can, a sample from each plot was placed in a labeled paper bag and sealed in a plastic bag. Immediately after harvesting was complete these samples were weighed, removed from the plastic bag, dried at 150°F for 48 hours, and 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 (NEl). Milk per ton and milk per acre was 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. Differences among entries (Hybrid/Variety) existed for all variables, except fresh forage yield, TDN, and NEl.

Reports giving results from statewide testing in 2020 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 2020 wastewater-irrigated, single-cut sorghum x sudangrass performance test managed for hay 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
BrowningSeed, Inc.	Cadan99BWMR	3.8	7.5	51.8	6.9	63.9	55.3	2.4	4.3	63.2	0.650	3772	14471
Dyna-GroSeed	DannyBoyIIBMR	2.6	7.3	36.2	9.1	62.6	68.3	0.0	7.3	64.4	0.662	3648	9606
Dyna-GroSeed	Dynagrazell	3.5	7.1	49.3	7.3	65.0	55.7	2.1	3.9	62.8	0.645	3763	13057
Dyna-GroSeed	FirstGraze	3.1	5.9	52.1	7.7	63.8	55.8	2.2	4.4	63.6	0.653	3744	11521
Dyna-GroSeed	Fullgrazell	4.6	8.3	56.0	6.8	67.6	58.0	0.2	4.3	62.7	0.644	3653	16849
Dyna-GroSeed	FullgrazeIIBMR	3.3	7.4	45.7	7.8	64.4	60.0	0.7	4.4	63.9	0.657	3708	12117
BrowningSeed, Inc.	HeadlessWonderPPS	3.5	7.5	48.5	9.0	66.4	57.8	0.1	5.6	62.8	0.645	3651	12812
BrowningSeed, Inc.	MaxiPearl	4.3	8.1	53.0	9.7	70.8	54.3	0.1	6.7	60.4	0.618	3569	15294
Dyna-GroSeed	SuperSweet10	3.0	6.1	50.7	7.5	66.3	56.3	1.0	4.0	62.9	0.646	3705	11161
BrowningSeed, Inc.	SweetSiouxBMR	3.0	6.4	46.6	7.8	62.6	60.0	2.2	4.7	64.5	0.664	3713	11035
BrowningSeed, Inc.	SweetSiouxWMR	2.1	4.2	50.8	7.3	62.7	57.7	2.4	4.6	64.4	0.663	3719	7815
BrowningSeed, Inc.	ThreeLittleIndians	3.0	6.2	48.9	6.9	63.1	57.3	2.4	4.5	64.3	0.661	3718	11101
BrowningSeed, Inc.	TifLeaf3	3.2	5.8	56.0	11.6	68.0	58.5	0.0	7.2	62.7	0.644	3497	11248
	Trial Mean	3.3	6.8	49.9	8.1	65.2	58.0	1.2	5.0	63.3	0.650	3682	12220
	LSD P < 0.05	1.0	NS	8.4	1.5	3.7	5.4	1.3	1.3	NS	NS	107	3813
	CV	21.5	21.2	11.8	13.0	3.9	6.5	77.0	17.7	25.0	2.7	2.0	21.7
	F Test	0.0108	0.3265	0.0183	0.0001	0.0045	0.0124	0.0002	0.0001	0.1459	0.1457	0.0009	0.0149

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.

INITIATIVE FOR ENHANCEMENT OF RESEARCH AND OUTREACH PROGRAMS AT REKASCT

The Advisory Committee to REKASCT has identified several programmatic needs for the Tucumcari area that also apply to New Mexico, in general, including Semiarid Cropping Systems; Soil-Plant-Water Quality-Environment Relationships; Range Soil Health and Riparian Issues; and Small Landholders Horticulture. To bring about this program enhancement, phased funding is needed for new PhD - level faculty researchers with start-up funding, support staff, and operations.

Semiarid Cropping Systems

In 2013, the New Mexico State Legislature provided funds to NMSU for a Semiarid Cropping Systems Specialist at REKASCT. That position was filled in 2014 and the candidate has initiated a research program with multiple projects to address limited irrigation and dryland cropping needs and in early 2015 an Agricultural Research Assistant was hired to support that and existing programs.

The remaining program enhancement initiative, to hopefully be fully funded over the next three years, requests recurring funds for the creation of three additional Ph.D. level faculty positions at REKASCT, along with accompanying support personnel, and essential faculty start-up and operating funds.

Soil-Plant-Water Quality-Environment Relationships

Water resource planners, not only in the semiarid American Southwest but throughout the country and the world, are considering all sources that might be available for any use. Interest is increasing in the possibilities of reusing treated municipal wastewater for agricultural irrigation. According to the New Mexico State Engineer's Office, in 2010, approximately 313,287 acre-feet were used for the public water supply and groundwater discharge permits for municipality wastewater treatment facilities (WWTF) in New Mexico totaled over 100,000 acre-feet. While reuse of treated municipal wastewater will not come close to meeting the state's total water use, it could make a significant impact in reducing the amount of the public water supply that is being used for irrigation.

A $1.75 million New Mexico Water Trust Board grant and loan to the City of Tucumcari WWTF led to a 20-year contract with the City of Tucumcari for NMSU to purchase 300 acre-feet per year of wastewater and the installation of two additional center pivot irrigation systems, thereby increasing sprinkler irrigation capacity from 35 to 85 acres with two additional valves for future expansion at REKASCT to develop research programs related to the reuse of treated municipal wastewater for agricultural irrigation.

The Soil-Plant-Water Quality-Environment Relationships faculty member at REKASCT will conduct a research and outreach program related to plant stresses and soil and environmental impacts when using quality-impaired water sources for agricultural irrigation in semiarid regions, including recycled treated municipal wastewater. Other projects related to regional agricultural production will be conducted as needed, particularly, toward reduced irrigation as well as precision agriculture. **To fund this program, $237,000 of recurring funds for the faculty member, a research assistant, and operations and $50,000 of non-recurring funds for a start-up package are requested in FY2021-22.**

Rangeland Soil Health and Riparian Issues

Eighty-nine percent of the agricultural land in New Mexico is classified as rangeland, which has been the backbone of New Mexico agriculture for more than a century with annual cash receipts for grazing livestock, mostly beef cattle, and sheep, which are primarily raised on rangelands, approaching $1 billion in New Mexico before the current drought. Much of the beef cattle production occurs in the eastern half of the state where REKASCT is centrally located.

Producers and agricultural professionals (e.g., scientists, Extension, NRCS, private consultants) alike share concerns about the sustained productivity of rangelands. In many cases, extended periods of drought and continuous grazing have contributed to the alteration of rangelands, such that the productivity of large areas is suppressed, undesirable plant species have invaded and are outcompeting native vegetation for water, and soil erosion has increased. In 2019, the New Mexico Legislature also realized the need and passed the Healthy Soil Act to begin addressing the problems.

The Rangeland Soil Health and Riparian Issues faculty member will develop a research and outreach program to assist range managers with grazing systems, range and pasture improvement, invasive species control, and riparian restoration in semi-arid watersheds to resolve soil health problems. Although a significant component of activity will be on cooperator land, this faculty member will be based from REKASCT and have access to the staff and facilities at REKASCT. **To fund this program, $258,000 of recurring funds for the faculty member, 1 research assistant, a farm supervisor, and operations, and $50,000 of non-recurring funds for a start-up package are requested in FY2022-23.**

Small Landholders Horticulture

In the past decade, there has been a shift in farm sizes throughout New Mexico such that many landholders operate with less than 20 acres, especially those near urban centers, but also in rural areas such as Tucumcari. Many of these landholders are interested in producing maximum yields of food for local consumption and exportation to urban centers with minimal input. A significant number are new to agriculture and desire information about innovative production practices that apply to their situation.

The Small Landholders Horticulture faculty member at REKASCT will develop a research and outreach emphasis to assist small landholders in maximizing the productivity of horticultural crops with limited resources, particularly limited irrigation capacity and alternative fertilizer sources, as well as new crops. They also will evaluate the possibility of using treated municipal wastewater for human food production. This is a concept in which the US EPA and US FDA have become interested. **To fund this program, $245,000 of recurring funds for the faculty member, 1 research assistant, a farm laborer, and operations and $50,000 of non-recurring funds for a start-up package and $50,000 of non-recurring funds are requested in FY2023-24.**

The Advisory Committee to NMSU's Rex E. Kirksey Agricultural Science Center at Tucumcari supports appropriation of recurring funds to the Agricultural Experiment Station and Cooperative Extension Service for other activities as well.

Infrastructure Capital Improvement Plan

Infrastructure Capital Improvement Plan, FY2014-15 to FY2024-25
New Mexico State University Rex E. Kirksey Agricultural Science Center at Tucumcari
Project Summary

Year/Rank	Project Title	Category*	Funding Sources	FY2014-15	FY2019-20	FY2020-21	FY2021-22	FY2022-23	FY2023-24	FY2024-25	Total
2014-01	Telehandler forklift	R/F	Purchased; Capital Outlay ($75K, Dennis Roch) + internal funding	$69,000	$0	$0	$0	$0	$0	$0	$69,000
2014-02	Hay handlng equipment	F	Purchased; Capital Outlay ($75K, Dennis Roch)	$12,000	$0	$0	$0	$0	$0	$0	$12,000
2014-03	Limb chipper	R/F	Purchased; internal funding	$10,000	$0	$0	$0	$0	$0	$0	$10,000
2014-04	Rototiller, 5-ft tractor mounted	R/F	Purchased; internal funding	$5,000	$0	$0	$0	$0	$0	$0	$5,000
		2015-2019 Legislative funding distributed elsewhere or not available									$0
2019-01	Replace residence roof	S/R/O/F	Purchased; AES Building Renewal and Replacement funding	$0	$8,912	$0	$0	$0	$0	$0	$8,912
2019-02	Plot combine	R	Purchased; SB536 ($100K, Pat Woods) + internal funding	$0	$147,661	$0	$0	$0	$0	$0	$147,661
2019-03	Tractor, 50 hp, GPS equipped	R/F	Purchased; HB548 ($50K, Jack Chatfield) + internal funding	$0	$65,951	$0	$0	$0	$0	$0	$65,951
2020-01	Domestic water system replacement	S/R/O/F	Purchased; NMSU Capital Outlay	$0	$0	$513,000	$0	$0	$0	$0	$513,000
2022-02	Fence replacement, 2 miles immediately necessary	S/R/F	Internal funds	$0	$0	$7,500	$0	$0	$0	$0	$7,500
2020-03	Large round baler	R/F	Internal funds, if available	$0	$0	$15,000	$0	$0	$0	$0	$15,000
2021-01	Planning, design, and cosntruction of shop/multipurpose building	S/R/O/F	NMSU Capital Outlay or other Legislative	$0	$0	$0	$200,000	$2,000,000	$0	$0	$2,200,000
2021-02	Truck, 1 ton	R/F		$0	$0	$0	$40,000	$0	$0	$0	$40,000
2021-03	Stock trailer	R/F		$0	$0	$0	$10,000	$0	$0	$0	$10,000
2021-04	Copy machine	F/R/O		$0	$0	$0	$10,000	$0	$0	$0	$10,000
2021-05	Self-propelled forage chopper	R/F		$0	$0	$0	$30,000	$0	$0	$0	$30,000
2021-06	Utility vehicle (Ranger/Mule), 2	R/F		$0	$0	$0	$24,000	$0	$0	$0	$24,000
2022-01	Planning, design, and cosntruction of office/lab building and greenhouse	S/R/O/F	NMSU Capital Outlay or other Legislative	$0	$0	$0	$0	$450,000	$1,500,000	$0	$1,950,000
2022-01	Skid loader with attachments	R/F		$0	$0	$0	$0	$50,000	$0	$0	$50,000
2022-02	Combine	F		$0	$0	$0	$0	$30,000	$0	$0	$30,000
2022-03	Tractor, 100 hp, GPS equipped	R/F		$0	$0	$0	$0	$75,000	$0	$0	$75,000
2022-06	Truck, 1/2 ton	R/F/O		$0	$0	$0	$0	$30,000	$0	$0	$30,000
2022-07	Utility vehicle (Ranger/Mule), 2	R/F		$0	$0	$0	$0	$24,000	$0	$0	$24,000
2022-08	Hay rake	R/F		$0	$0	$0	$0	$10,000	$0	$0	$10,000
2022-09	Plot planter/ drill	R		$0	$0	$0	$0	$35,000	$0	$0	$35,000
2023-01	Irrigation equipment/infrastructure	R/F	NMSU Capital Outlay or other Legislative	$0	$0	$0	$0	$0	$120,000	$0	$120,000
2023-02	Finish Plow	R/F		$0	$0	$0	$0	$0	$30,000	$0	$30,000
2023-02	Flat bed trailer	R/F		$0	$0	$0	$0	$0	$10,000	$0	$10,000
2023-03	Truck, 1/2 ton	R/F		$0	$0	$0	$0	$0	$40,000	$0	$40,000
2023-04	Fence upgrades	R/F		$0	$0	$0	$0	$0	$25,000	$0	$25,000
2024-01	Tractor, 50 hp, GPS equipped	R/F		$0	$0	$0	$0	$0	$0	$70,000	$70,000
2024-02	Vertical Tillage Plow	R/F		$0	$0	$0	$0	$0	$0	$30,000	$30,000
2024-03	15' Grain Drill	R/F		$0	$0	$0	$0	$0	$0	$60,000	$60,000
2024-04	Swather	R/F		$0	$0	$0	$0	$0	$0	$30,000	$30,000
2024-05	Field day wagons	S/R/O		$0	$0	$0	$0	$0	$0	$1,000	$1,000
			Amount spent	$96,000	$222,524						$5,787,024
			Legislative funding provided	$75,000	$158,912	$513,000					

*F, O, R, and S signify Facilities, Outreach, Research, and Safety, respectively. Order of letters indicates relative importance of use.

Projects not funded in a given year will be reprioritized in a future year. Other projects may be completed earlier depending on funding levels and changes in priorities.

Activities

RESEARCH

The following research projects were conducted in 2020, with approved NMSU COVID-19 Critical Research Memos.

Livestock Research (also NMSU Institutional Animal Care and Use Committee approved)

- 2019-20 and 2020-21 Tucumcari Bull Tests (Marcy Ward, Principal Investigator): Conducted from early November through early March, culminating with a sale in mid-March on NMSU property in facilities owned and operated by the Tucumcari Feed Efficiency Test, LLC (TFET). Each test included privately-owned 160 bulls evaluated for individual animal feed and water intake as a measure of genetic efficiency.
- Feed Efficiency Test sponsored by ProEarth Animal Health to evaluate CattleActive product on newly weaned calves (Marcy Ward, Principal Investigator): Conducted in two runs from August through October 2020 at the TFET facility including a total of 96 animals.
- Evaluation of water and feed intake of purebred cattle in confinement and on arid rangelands, and its implications on selection principles (Marcy Ward, Principal Investigator, with Sam Smallidge, Craig Gifford, and TFET): The water intake system housed at Tucumcari will allow for a multi-year impactful long term database to be developed. Data will be collected annually in conjunction with the Tucumcari Feed Efficiency Test.
- Canola grazing study (Leonard Lauriault, Principal Investigator, with Sangu Angadi, Murali Darapuneni, Eric Scholljegerdes, and Glenn Duff): Planted in September 2019 to evaluate the influence of grazing cessation date in spring on canola grain production. The pasture was partially sown to winter cereal forage grass and partially to canola and grazed by 50 yearling cattle from early January through mid-March. This project was initiated in 2016 at the request of stakeholders in eastern New Mexico.
- Grazing effects on field bindweed persistence (Leonard Lauriault, Principal Investigator, collaborating with Murali Darapuneni): Initiated in 2017 on private property using privately-owned cattle at the request of the Advisory Committee to evaluate long-term grazing effects on field bindweed persistence and competition with desirable pasture species.

Cropping Systems Research (Murali Darapuneni, Principal Investigator)

- Manure applications in the strip-till zone of dryland sorghum: Continuing research with three small plot studies were initially planted in 2017, 2018, and 2019 and replanted annually to evaluate soil and crop responses to two levels of manure applied only to the 8-inch strip-till zone and incorporated or not as a cost-saving measure. Low precipitation in 2020 led to crop failure.

- Opportune and cover crops: Continuing research to evaluate various cover crop species planted for summer or winter cover, with the prospect of harvesting an economic crop during the typical fallow period for traditionally-grown crops, if growth permits with and without irrigation. The winter study failed in 2019-20 due to low precipitation and irrigation system failure.
- Guar fertility: Sponsored by Sustainable Bioenergy for Arid Regions in collaboration with John Idowu to evaluate the response of guar to various fertilizer treatments.

Forage Crop Research

- Polyhalite alfalfa study: Effect of various fertilizer ingredient combinations on alfalfa production (Murali Darapuneni, Principal Investigator): Externally-funded project on private property near Tularosa.
- Warm-season annual forage grass-legume mixtures (Leonard Lauriault, Principal Investigator, collaborating with Murali Darapuneni): Ongoing studies were planted again in 2020 to evaluate mixtures of various legumes with forage sorghum and planting arrangements of forage cowpea with pearl millet and forage sorghum. Both studies failed due to low precipitation and an irrigation system failure.
- Regional tepary bean forage evaluation (Rich Pratt, Principal Investigator with Leonard Lauriault and Co-PI's in California, Nevada, Oklahoma, and Washington State): Fourteen genotypes evaluated at multiple locations for forage yield and nutritive value. The study at Tucumcari failed due to low precipitation and an irrigation system failure.

Crop Variety Performance Evaluations (Leonard Lauriault, Principal Investigator)

- A 15-entry alfalfa variety test was planted in 2018. Because of irrigation system failures and low precipitation, the study was only harvested twice in 2020.
- A grain corn performance evaluation included 16 entries that were abandoned due to irrigation system failure during pollination.
- Cotton performance testing consisting of 14 entries produced harvestable yields despite irrigation system failures.
- The forage sorghum performance evaluation included 17 entries and has been harvested despite irrigation system failures.
- A grain sorghum performance test included 23 entries and successfully produced grain despite the irrigation system failures.
- In the sorghum x sudangrass, 13 entries were harvested despite irrigation system failures.

OUTREACH AND COMMUNITY ENGAGEMENT

- Responded to over 70 stakeholder requests for information in 2020, including from surrounding states and internationally.
- In lieu of in-person Advisory Committee meetings, that group was kept updated on issues related to REKASCT by email and land mail in 2020.
- Participated in monthly meetings of the Canadian River Soil and Water Conservation District, by Zoom since the onset of COVID-19, and maintained equipment and rental reservations.
- Participated in monthly meetings of the TableTop Co-op for local food production, by Zoom since the onset of COVID-19; served on Budget Committee and as Chair of Membership and Officer Nomination Committee
- Served as ex officio director of the New Mexico Hay Association and participated in quarterly meetings as conference calls.
- Solicited support for educational programs funds from local businesses by mail, raising $600 during a year in which no onsite public programs were held.

Donors:

- Arch Hurley Conservancy District – Franklin McCasland, Tucumcari, NM
- Farm Credit Services – Will Cantrell, Tucumcari, NM
- Farmers' Electric Cooperative, Inc. – Lance Adkins, Clovis, NM
- FNB NM/AimBank – Garrett Baker, Tucumcari, NM
- Phillip and Kathleen Box, Tucumcari, NM

- **March 14:** Annual Tucumcari Bull Test and Sale
- **August 6:** Posted Virtual Field Day presentations to the Facebook page (https://www.facebook.com/tucumcarisc/); Lauriault emceed the video and presented an update on tepary bean research; Darapuneni gave an update on manure applications to the strip-tillage zone; Gasper Martinez discussed sorghum-legume mixtures for forage, and Elora Ellison (Darapuneni's co-advisee) described her graduate research on cowpea-millet forage mixtures at Tucumcari and WTAMU. Other presentations were by John Idowu (guar) and Susann Mikkelson (cooking demonstration). The keynote presentation was made by Dr. Leslie Edgar, the Associate Dean of the College and Director of the Agricultural Experiment Station, who came to NMSU in May.
- **October 24:** Great Pumpkin Giveaway canceled due to COVID-19 restrictions. Pumpkins were harvested and delivered to the elementary school.
- **October 28:** Participated by invitation in Mesalands Community College Strategic Planning Agriculture Focus Group
- **November 4:** Presented Virtual Farm Day presentations to Tucumcari Elementary School 4th and 5th Grades; included presentations by Darapuneni on plant parts and function and by Lauriault on chewing cuds, belching cows, and climate change.
- **November 17:** Presented grazing research update as part of the 2020 NMSU Beef/Livestock Research Update webinar series.

New Mexico State University
6502 Quay Rd. AM 5 Tucumcari, NM 88401
www.tucumcarisc.nmsu.edu
(575) 461-1620