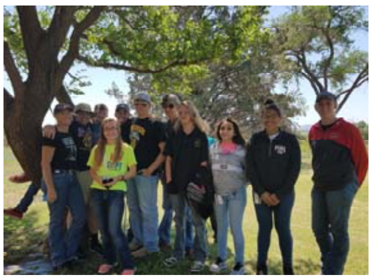
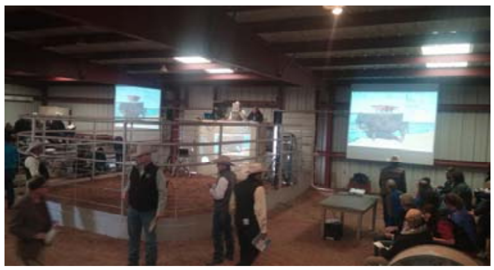
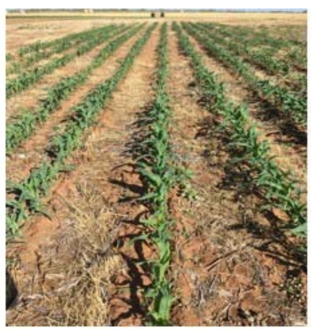
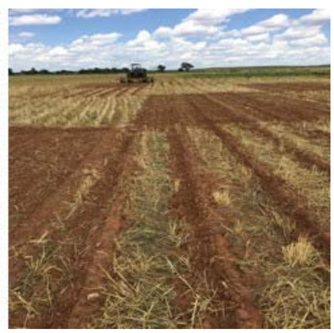
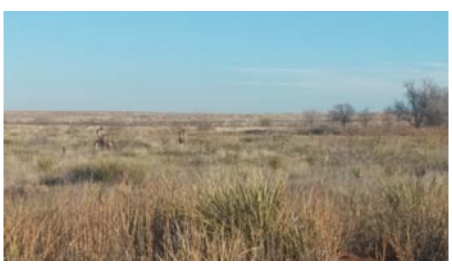
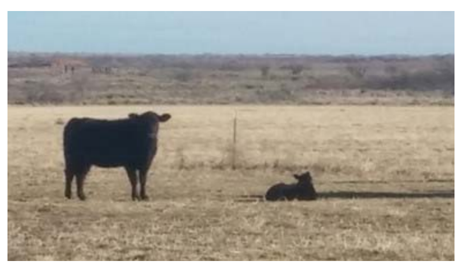
2017

ANNUAL PROGRESS REPORT

Agricultural Science Center at Tucumcari
6502 Quay Road AM.5
Tucumcari, NM 88401

NM STATE

NOTICE TO USERS OF THIS REPORT

This report has been prepared to aid Science Center staff in analyzing results of the various research projects from the past year and to record data for future reference. These are not formal Agricultural Experiment Station Report research results.

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

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

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

2017

ANNUAL PROGRESS REPORT

New Mexico State University
Agricultural Science Center at Tucumcari
6502 Quay Road AM.5
Tucumcari, NM 88401-9661

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Jared Jennings
Senior Laborer

Anthony Williams
Laborer

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<u>Miscellaneous</u>

Acknowledgements

Several individuals and companies donated products and services to the Agricultural Science Center at Tucumcari during 2017. Appreciation is expressed to the following persons and organizations for their contributions.

Agricultural Science Center Advisory Committee

Mr. Phillip Box
Mr. Donald Carter
Mr. Paul Estrada
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Arch Hurley Conservancy District – Franklin McCasland
Tucumcari, NM .... Field Day Meal

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

Phillip Box
Tucumcari, NM .... Use of round baler

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

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

Curtis & Curtis Seed & Supply, Blake Curtis
Clovis, NM............. 10 lbs. KS585 grain sorghum seed, 10 lbs. NK300 grain sorghum seed,
.... 5 lbs. monida oats seed

Dickinson Implement - Dwight Haller
Tucumcari, NM .... Field Day Meal

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

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

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

First Title Service LLC – Rex & Cyndie Kirksey
Tucumcari, NM .... Field Day Meal

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

Green Cover Seed – Keith Berns
Bladen, NE .... 10 lbs. each Frosty & Balady Berseem Clover Seed

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

Kansas State University / Kauffman /Seed – Dr. Michael Stamm
Manhattan, KS .... 200 lbs. Griffin Canola Seed

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

Michigan State University – James Kelly
East Lansing, MI .... 3lbs Eldorado Pinto Bean Seed

New Mexico State University – Lois Grant
Las Cruces, NM .... 3 lbs. each (Dry beans): Mystery, Select Black, Espresso, San Juan Co., Rio Bavispe, NM Bolitas

North Dakota State University – Hans Kandel
Fargo, ND.............. 3 lbs. each (pinto bean seed): ND Palomino, ND 307, Lariat, Stampede

Park Seed – Patricia Blinn
Greenwood, SC.. 1 lb. Bodacious Sweet Corn Seed

Tucumcari/Quay County Chamber of Commerce – Gail Sanders
Tucumcari, NM .... Field Day Meal

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

Tucumcari LP Gas and Oil – Tommy Ortiz
Tucumcari, NM .... Field Day Meal

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

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

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

Introduction

The New Mexico State University Agricultural Science Center at Tucumcari is located on U.S. Highway 54 three miles northeast of Tucumcari and Interstate 40, Exit 333. The center consists of 464 acres, with 170.9 acres having Arch Hurley Conservancy District water rights. In operation since 1912, the center is New Mexico State University's oldest continuously operating off-campus research facility. Home of the annual Tucumcari Bull Test (also known as Tucumcari Feed Efficiency Test, LLC, TFET), which helps producers improve their beef herds, the center's mission also includes developing forage and grazing systems for irrigated lands in the western USA and the evaluation of crops for local adaptation and semi-arid irrigated and dryland cropping systems. Historical research at the center evaluated trees for windbreak and farmstead plantings, which led to the establishment of over 50 species of trees and shrubs on the center grounds, making it an oasis of trees in a sea of native grassland.

Significant events at the Agricultural Science Center in 2017 included: (1) An upgrade of the Tucumcari Beef Cattle Feed Efficiency Testing Facility by TFET, LLC; (2), (3) an attendance of 124 at Field Day, (4) hosting nearly 250 students, teachers, and volunteers at a Kids, Kows, and More event, and (5) purchase of a telehandling forklift and a hay pickup truck using NM Capital Outlay funds. These and other activities hosted or participated in by the staff at the Agricultural Science Center at Tucumcari along with the ongoing projects are described in this publication, which is available online at http://tucumcarisc.nmsu.edu/projects--results.html.

Outreach Events, Productivity, and Activities

Beef Cattle Feed Efficiency Testing

Information about the Tucumcari Feed Efficiency Tests are presented in a separate article beginning on page 21 of this report.

Pre-Field Day Program

The center hosted a special program during the afternoon of August 8, 2017, prior to the Annual Field Day with 18 in attendance. The program, held in the Conference Building, included a presentation by Jerry Hawkes, NMSU Extension Agricultural Economist, about developing crop cost and return estimates for the Tucumcari Irrigation Project and a presentation by Sal Lopez and Lee Gallegos of the New Mexico Workers' Compensation Administration regarding changes in the workers' comp law for farmers and ranchers.

Field Day

The center hosted its Annual Field Day during the evening of August 8, 2017, with 124 in attendance. The program, held in the Bull Test Sale Barn, included dinner, sponsored by local businesses and catered by the Tumbleweeds 4-H Club as a fundraiser, preceded by a presentation by New Mexico Farm and Livestock Bureau President, Craig Ogden.

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

- Eben Oosthuysen, NMSU Animal and Range Sciences Graduate Student: Grazing research update.
- Leonard Lauriault, NMSU Forge Crop Management Scientist: Relay intercropping cover crops into corn or sorghum for fall forage.
- Murali Darapuneni, NMSU Semiarid Cropping Systems Specialist: Strip-tillage: Scope and opportunity.

Murali Darapuneni discusses the scope and opportunity for using strip-tillage, while in the background Leonard Lauriault checks the weather radar for threatening rain. The final three presentations were made at the Bull Test Sale Barn due to the threat.

- Randall Montgomery, NMSU Plant and Environmental Sciences Graduate Student: Blue corn for silage.
- Leslie Beck, NMSU Extension Weed Specialist: Resisting weed resistance.
- Sifat Sultana, NMSU Plant and Environmental Sciences Graduate Student: Tillage management systems for corn and cotton.

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

Other Public Programs Hosted by the Agricultural Science Center in 2017

On April 7, the center hosted a 4-H tagging day.

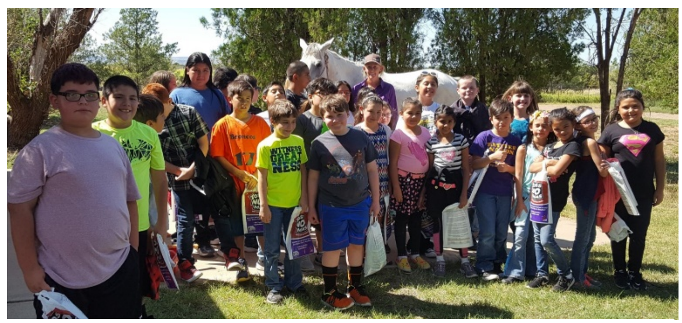
An Earth Day community service project was held on April 20, 2017, for members of Tucumcari High School Senior Class. The future of this program is questionable due to a change in school staff and state-mandated testing schedules.

On June 15, the center hosted a visit by Melody Martinez, NMSU Cooperative Extension Service Intern, escorted by Robert Flynn, NMSU Extension Soils Specialist.

On August 28, 2017, the center hosted a field laboratory lecture for the Mesalands Community College Range Science Class (see the article on Feed Efficiency Testing on page 21 for other interaction with classes from Mesalands Community College).

On September 21, the center hosted a Farm Day activity for Tucumcari Elementary Schools 4th and 5th grades and provided a healthy snack sponsored by local businesses. Participants included 150 students, 10 teachers and volunteers, and 6 presenters. The event was highlighted in the NMSU Chancellor's Corner Weekly Activity Report (https://president.nmsu.edu/activity-report-september-23-september-29/). Presentation topics included:

- 4-H Projects (Joyce Runyan, NMSU Quay County Cooperative Extension Service)
- Horse demonstration (Staci Stanbrough, Mesalands Community College Agriculture Instructor)
- Weeds (Ashley Cunningham)
- Soil organic matter (Murali Darapuneni)
- Good bugs, bad bugs (Leonard Lauriault)
- Tas no Mas and Recycling (Sharayah Sisneros and Alyssa Reveles, City of Tucumcari)



Tucumcari Elementary 4th & 5th Graders at Staci Stanbrough's horse demonstration.

The center also remained open for tours of the Eastern New Mexico Outdoor Arboretum. Details about the arboretum are given elsewhere in this report.

Quay County Cotton Boll Weevil Control District

The Agricultural Science Center at Tucumcari continued to assist the Quay County Cotton Boll Weevil Control District (QCCBWCD) with its activities in 2017. In addition to cotton grown at the Agricultural Science Center, 642 acres were grown in the county. Jason Lamb, Quay County Cooperative Extension Service Agent for Agriculture, scouted for boll weevil and pink bollworm using traps with no captures. Activities by QCCBWCD were mostly limited to maintaining an active organization so as to maintain a record of boll weevil activity in the area, in preparation for future cotton production in the area.

Advisory Committee

The Advisory Committee to the Agricultural Science Center at Tucumcari met April 28 and December 12, 2017, at the PowWow Restaurant. Minutes of both meetings are available upon request at the center's office.

At the April meeting, Rolando A. Flores, Dean of the College of Agricultural, Consumer and Environmental Sciences, provided an update on NMSU and the recent legislative session. He also gave his vision for the college. Near the conclusion of the meeting Dean Flores met in closed session with the

Advisory Committee. Leonard Lauriault informed the committee that the center's groundwater discharge permit renewal is currently in review. Otherwise, the 2016 research update was provided through the Annual Report. Finally, Leonard reported that Dean Flores had just been awarded the Distinguished Alumni Award from the Kansas State University Department of Grains and Industries and Tom Sidwell, an Advisory Committee member, was to receive the Leyendecker Agriculturalist of Distinction Award from the college (shown receiving the award on the cover of this report). Dr. Jerry Hawkes, NMSU Extension Agricultural Economist, made a presentation about developing cost and return estimates for the Tucumcari Irrigation Project and requested information from the committee members to help with developing those estimates.

At the December meeting, Dr. Steve Loring, Associate Director of the Agricultural Experiment Station gave an NMSU update and discussed the plans for the General Obligation Bonds in 2018 and 2020.. He also reported that the Legislative Finance Committee office staff would be visiting some of the Agricultural Science Centers (not Tucumcari). Leonard presented an updated Infrastructure Capital Improvement Plan and asked the committee if they wanted to make any changes to the program enhancement initiative. He also distributed an impact flyer that he had developed for the center. The committee then provided some input regarding future research activities.

Personnel and Facilities

Personnel

Ashley Cunningham, Agricultural Research Assistant at the center, resigned effective December 15, 2017. Approval was given to fill the open position early in 2018. An ongoing labor shortage on the farm staff continued to limit completion of non-critical physical plant projects in 2017.

A list of temporary employees at the center in 2017 is shown below:

Name	Job Title	Dates of Employment
Alice Johnson	Custodian	01/01/2017 – 12/31/2017

Internal and External Connections

Several College of Agricultural, Consumer and Environmental Sciences personnel from other locations worked cooperatively with staff at the Tucumcari center in 2016. These individuals included: Sangu Angadi, Leslie Beck, Sultan Begna, Jane Breen-Pierce, Owen Burney, Kenneth C. Carroll, Shad Cox, Tom Dominguez, David DuBois, Glenn Duff, Robert Flynn, Rajan Ghimere, Befekadu Goraw, Kulbhushan Grover, Steve Guldan, Robert Hagevoort, Charles Havlik, Omar Holguin, Mike Hubbert, John Idowu, Jason Lamb, Bernd Leinauer, Kevin Lombard, Clint Loest, Steve Loring, Mark Marsalis, Abdel Mesbah, John Mexal, Mick O'Neill, Curtis Owen, Chris Pierce, Tom Place, Gino Picchioni, Rich Pratt, Naveen Puppala, Ian Ray, Joyce Runyan, Aaron Scott, Eric Scholljegerdes, Brian Schutte, Manoj Shukla, Gerald Sims, Carol Sutherland, Dave Thompson, April Ulery, Frank Ward, Marcy Ward, Margaret West, Pei Xu, Shengrui Yao, and Jinfa Zhang.

Individuals from outside the NMSU College of Agricultural, Consumer and Environmental Sciences, who worked cooperatively with center staff in 2017 were:

New Mexico:
Canadian River Soil and Water Conservation District: Supervisors and Sandi Morgan
Canadian River Riparian Restoration Project: Jack Chatfield
City of Tucumcari: Jared Langenegger, City Commission, and Calvin Henson
Greater Tucumcari Economic Development Corporation, Patrick Vanderpool and Board of Directors
Mesalands Community College: Staci Stanbrough and students of Animal and Plant Science Classes
Northeast New Mexico Regional Water Planning Committee
Ute Lake Watershed Alliance: Jack Chatfield and Mark Murphy
New Mexico Department of Agriculture: Secretary Jeff Witte
New Mexico Department of Cultural Affairs: Eric Blinman
New Mexico Economic Development Department: Tim Hagaman
New Mexico Hay Association: Board of Directors
New Mexico Transportation Department
Quay County Government: County Commission, Larry Moore, and Richard Primrose

Quay County Sun: Thomas Garcia and Steve Hanson
Tucumcari Feed Efficiency Test, LLC dba Tucumcari Bull Test: Leadership and Members
Tucumcari Public Schools: Andrea Rinestine, Tonya Hodges, and Doris Houlihan
USDA: Kenneth Alcon (NRCS, Las Vegas, NM) and Relissa Nials (NRCS, Tucumcari, NM)

USA:
Texas AgriLife Research and Extension: Jourdan Bell (Amarillo), G. Ray Smith (Overton), and Calvin Trostle (Lubbock)
Texas Boll Weevil Eradication Foundation: Lyn Vandiver
University of Kentucky: Ben Goff
University of Nebraska, Scottsbluff: Gary Hergert and Cody Creech
University of Wisconsin – Madison: Francisco Contreras-Govea
University of Wyoming: Jonathan Brant
USDA: N.A. Cole and Prasanna Gowda (ARS, Bushland, TX), Aaron Miller (APHIS, Abilene, TX), and Blair Waldron (ARS, Logan, UT)
West Texas A&M University, Canyon: Bob Stewart and Brock Blaser
Valent USA Corporation: Chris Meador

India:
University of Agricultural Sciences, Raichur: M.R. Umesh
Tamil Nadu Agriculture University, Kumulur, Tiruchirappalli: K. Annadurai

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

Pakistan:
Faculty at the University of Agriculture, Faisalabad

Buildings, Grounds, and Facilities

The Eastern New Mexico Outdoor Arboretum at the Agricultural Science Center at Tucumcari continued to deteriorate in 2017 due to multiple factors. The chinquapin oak died in 2017, possibly due to winter kill as indicated by separated bark and the Fremont cottonwood, which died back almost annually, finally perished completely. One of the honeysuckles and the original smoketree perished because their bark mostly stripped off by grasshoppers in 2016. Other shrubs may also have been too severely impacted by the grasshoppers to have survived the 2017-2018 winter. The Apache plume was damaged by fire when the lawn in front of the office was burned, but had largely recovered by the end of the growing season. The Chinese pistache and red mulberry, which had perished in 2015, were removed for firewood with smaller limbs chipped for mulch. Another Chinese pistache had been planted south of the shop a couple of years ago in anticipation of the demise of the original specimen.

For the Earth Day community service project on April 20, 2017, a select group of Tucumcari High School seniors cleaned out the flower beds in and tree rows around the office and picked up trash along the center's US 54 road frontage.

A fire occurred near the southeast corner of the center property on March 31, 2017, when a dead tree fell against the power line. The fire was controlled shortly after ignition and damage was limited to a small area due to rapid response by the volunteer fire department.

Other alterations and improvements to the grounds and facilities were limited to planting the weather yard with a native grass blend.

In the first week of October, problems occurred with the application systems of both irrigation water sources. The pumps at the City of Tucumcari Wastewater Treatment Plant were struck by lightning making that system non-functional for the remainder of the year and the electric line to the West Pivot failed for some unknown reason. Repairs to both systems are anticipated in early 2018.

Irrigation Water

The annual Arch Hurley Conservancy District assessment for 2017 was $14.00 per water right acre. The center had retained a credit of $803.35 for pre-paid water from 2016. The total allocation for 2017 was 10 in/A or 142.42 acre-feet for the center, 13 acre-feet of which was delivered at $10/acre-foot. Water was first released into the canal on April 21, 2017, and finally turned off on October 31 after three periods without delivery for conservation purposes. While the water was initially allocated at 4 in/A, another 2 in/A were allocated on June 12, July 11, and September 12. The center retained a credit of $673.35 for pre-paid water from 2017.

Delivery of treated wastewater from the City of Tucumcari Wastewater Treatment Facility for irrigation was continuous in 2017 until the first week of October. A total of 41.8 acre-feet were applied from January through September through the three center pivots. The total amount paid by the center to the City for that water was $13,053, including $9,000 for the water, under a 20-year contract for 300 acre-feet/year, and $4,053 in electricity for pumping and labor to read the meters. Net returns from commercial hay production in 2017 that was possible due to the availability of this water and internal charges to research projects were sufficient to cover the cost of this water. Wastewater delivery system upgrades to allow for greater storage capacity at the treatment plant using funds provided by the Agricultural Experiment Station in 2016 were not completed in 2017. Every six months a semi-annual report is submitted to NMED showing monthly water use, meter inspection, and amount of nitrogen applied to the water use area. That report is available from the center upon request. Because the current permit was to expire in April 2017, an application for renewal that was submitted six months prior was approved by NMED in June 2017.

Sustainability and Environmental Stewardship

Continuing with sustainability through recycling in 2017, staff at the Agricultural Science Center at Tucumcari recycled 200.6 lb plastic; 49.8 lb glass; 77 lb aluminum cans; 54 ink or toner cartridges; and 1039.1 lb paper and other fiber products. Purchased paper totaled 199.2 lb for 2016. Additionally, 29.4 gal of non-fuel petroleum lubricants were purchased in 2017 while none was recycled.

Community Service

From November 13 until the end of the year, the center provided pasture for rodeo stock owned by Mesalands Community College.

Students

Murali Darapuneni

Bilgi Sarihan (Master's committee co-chair):

Randall Montgomery (Doctoral committee member): Blue corn evaluations under salt stress conditions. (January 1, 2016 - December 31, 2017).

Gasper Martinez Jr. (Master's committee co-chair): Cotton genotypes for salt stress environment (January 1, 2016 - December 31, 2017).

Sifat Sultana (Master's committee co-chair): Tillage effects on corn and cotton. (January 1, 2017 through December 31, 2018).

Brad Crookston, Josh Machicek (Master's committee member as adjunct faculty at West Texas A&M University in collaboration with Brock Blaser): Pearl millet response to irrigation, row spacing, and tillage in the Texas High Plains (January 1, 2016 - December 31, 2018).

Leonard Lauriault

Befekadu Goraw (Doctoral candidate: assisted with NM WRRI Student Water Research Grant in collaboration with Frank Ward): Economic performance of water conservation and storage capacity development to adapt to climate in the American Southwest – The Arch Hurley Conservancy District (April 2016 – December 2017).

Productivity

Peer-Reviewed Publications

Journal Articles

Darapuneni, M. K., Angadi, S., Begna, S., **Lauriault, L. M.**, Umesh, M.R., Kirksey, R. E., Marsalis, M. A. (2017). Grain sorghum water use efficiency and yield are impacted by tillage management systems, stubble height, and crop rotation on water use efficiency and yield characteristics of grain sorghum. *Crop, Forage, and Turf Grass Management*. https://dl.sciencesocieties.org/publications/cftm/pdfs/3/1/cftm2016.09.0062.

Darapuneni, M. K., Morgan, G. D., McKay, B. L., Dodia, S. K., **Lauriault, L. M.** (2017). Selecting cool-season forage grasses for their yield, seasonal yield distribution, and nutritive value in the Blacklands and Rolling Plains ecoregions of Texas. *Crop, Forage, & Turfgrass Management*. https://dl.sciencesocieties.org/publications/cftm/pdfs/3/1/cftm2017.04.0031.

Hergert, G.W., **Darapuneni, M. K.** et al. (2017). Agronomic potential of using precipitated calcium carbonate on early plant growth and soil quality in the Intermountain West – greenhouse studies. *Journal of Sugar Beet Research, 54*:1, 35-49. www.bsdf-assbt.org/wp-content/uploads/2017/12/ASSBT-Journal-Jan-June-2017-Hergert.pdf

Cooperative Extension Service Publications

Beck, L. L., Marsalis, M. A., **Lauriault, L. M.** (2017). *Guide A-325 (revised), Managing Weeds in Alfalfa*. Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. http://aces.nmsu.edu/pubs/_a/A325/welcome.html

Idowu, J., Angadi, S., **Darapuneni, M. K.**, Ghimire, R. (2017). *Guide A-152, Reducing Tillage in Arid and Semi-arid Cropping Systems: An Overview*. Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. http://aces.nmsu.edu/pubs/_a/A152/welcome.html

Non-Peer-Reviewed Publications

Agricultural Experiment Station Publications

Marsalis, M. A., Flynn, R. P., **Lauriault, L. M.**, Mesbah, A., O'Neill, M. K. (2017). *New Mexico 2016 Corn and Sorghum Performance Tests*. Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. http://aces.nmsu.edu/pubs/variety_trials/16CornSorghumRpt.pdf

Popular Press and Other Publications

Garcia, K., **Darapuneni, M. K.** (2017). NMSU professor sets his sights on determining best dryland cropping system New Mexico State University Press Release. Las Cruces, NM: New Mexico State University Communications and Marketing. https://newscenter.nmsu.edu/Articles/view/12555/nmsu-professor-sets-his-sights-on-determining-best-dryland-cropping-system.

Garcia, T., **Lauriault, L. M.** (2017). Director: Field day successful. *Quay County Sun* (ed., pp. 1A, 3A). Tucumcari, NM: Quay County Sun.

Garcia, T., **Lauriault, L. M.** (2017). Annual Ag Field Day kicks off Tuesday. *Quay County Sun* (ed., pp. 1A, 2A). Tucumcari, NM: Quay County Sun.

Garcia, T., **Lauriault, L. M.** (2017). Science center closure possible. *Quay County Sun* (ed., pp. 1A, 2A). Tucumcari, NM: Quay County Sun.

Lauriault, L. M. (2017). *Some of what I learned at the Western Alfalfa and Forage Symposium*. Self-published email.

Lauriault, L. M. (2017). *Some of what I learned at the Western Society of Crop Science Meeting this week*. Self-published email.

Presentations at Public Conferences or Meetings

Lauriault, L. M., 8th Annual Forage Growers Workshop, NMSU Valencia County Cooperative Extension Service, Los Lunas, "Grazing management: Maximizing permanent pasture longevity and stocking rates" (December 5, 2017).

Darapuneni, M. K, Guest Lecture, Mesalands Community College, Tucumcari, "Soil water and importance" (November 30, 2017).

Lauriault, L. M., Quay County Private Applicators' Workshop, Quay County Cooperative Extension Service, Tucumcari, "Preventive management for alfalfa pest control" (November 21, 2017).

Darapuneni, M. K., **Lauriault, L. M.**, Tri-Society Meeting, ASA, CSSA, SSSA, Tampa, FL, "Water use and yield potential of winter and summer alternate/cover crops" (October 25, 2017).

Darapuneni, M. K., Tri-Society Meeting, ASA, CSSA, SSSA, Tampa, FL, "Evaluation of nitrogen stabilizers on nitrogen use efficiency of poultry litter" (October 23, 2017).

Darapuneni, M. K., **Lauriault, L. M.**, Tri-Society Meeting, ASA, CSSA, SSSA, Tampa, FL, "Manure application in strip tillage: Effects on grain sorghum yield, water use efficiency, and nutrient uptake under dryland cropping systems" (October 23, 2017).

Cunningham, A. E., Farm Day, NMSU Agricultural Science Center, Tucumcari, "Weeds" (September 21, 2017).

Darapuneni, M. K., Farm Day, NMSU Agricultural Science Center, Tucumcari, "Soil organic matter" (September 21, 2017).

Lauriault, L. M., Farm Day, NMSU Agricultural Science Center, Tucumcari, "Good bugs/bad bugs" (September 21, 2017).

Lauriault, L. M. Guest Lecture, New Mexico State University, Animal and Range Sciences Department ANRS 429 – Stocker/Feedlot Management, "Introduced forages for stocker operations" (September 14, 2017).

Darapuneni, M. K., Field Day, NMSU ASC-Tucumcari, "Strip tillage- scope and opportunity" (August 8, 2017).

Lauriault, L. M., Field Day, NMSU Agricultural Science Center, Tucumcari, "Relay intercropping cover crops into corn or sorghum for fall forage" (August 8, 2017).

Montgomery, R., **Darapuneni, M. K.**, Pratt, R., Field Day, NMSU Agricultural Science Center, Tucumcari, "Blue corn for silage" (August 8, 2017).

Oosthuysen, E., Scholljegerdes, E. J., Loest, C. A., **Lauriault, L. M.**, Field Day, NMSU Agricultural Science Center, Tucumcari, "Grazing research update" (August 8, 2017).

Sultana, S., **Darapuneni, M. K.**, .Idowu, O. J., Beck, L., Field Day, NMSU Agricultural Science Center, Tucumcari, "Tillage management systems for corn and cotton" (August 8, 2017).

Lauriault, L. M., Marsalis, M. A., New Mexico Farm & Livestock Bureau Summer Conference, New Mexico Farm & Livestock Bureau, Santa Ana Pueblo, Bernalillo, NM, "From research to real profits: An example from alfalfa planting dates" (July 20, 2017).

Marsalis, M. A., **Lauriault, L. M.**, New Mexico Farm & Livestock Bureau Summer Conference, New Mexico Farm & Livestock Bureau, Santa Ana Pueblo, Bernalillo, NM, "From research to real profits: An overview of NMSU value-added forage research" (July 20, 2017).

Lauriault, L. M., Guldan, S. J., Annual Meeting of the Western Society of Crop Science, Western Society of Crop Science, Parma, ID, "Relay intercropping with cover crops improves fall forage potential of sweet corn stover" (June 7, 2017).

Marsalis, M. A., **Lauriault, L. M.**, Annual Meeting of the Western Society of Crop Science, Western Society of Crop Science, Parma, ID, "Planting date effects on yield of alfalfa in New Mexico" (June 6, 2017).

Lauriault, L. M., Quay County Weed Management Workshop, Quay County Cooperative Extension Service, Tucumcari, "Current concerns about Roundup Ready alfalfa" (April 5, 2017).

Lauriault, L. M., Employee Chemical Safety Training, Tucumcari Municipal Schools, Tucumcari, "Using cleaning products and pesticides safely" (February 16, 2017).

Idowu, O. J., **Darapuneni, M. K.**, Omer, M., Beltwide Cotton Conference, National Cotton Council, Phoenix, AZ, "Reduced tillage for cotton in irrigated desert southwest" (January 4, 2017).

Grants and Contracts

Funded:

Darapuneni, M. K. (Principal), **Lauriault, L. M.** (Co-Principal), Sponsored Research, "Alfalfa response to Polyhalite in New Mexico", Sponsoring Organization: Sirius Minerals Plc, Sponsoring Organization Is: Other, Research Credit: $27,600.00, PI Total Award: $34,500.00, Current Status: Funded (Internal paper work pending). (November 25, 2017 - October 31, 2019).

Marsalis, M. A. (Co-Principal), **Lauriault, L. M.** (Co-Principal), Beck, L. L. (Principal), Sponsored Research, "Evaluation of the Efficacy of Various Herbicides for Control of Broadleaf (*Plantago major*) and Buckhorn (*Plantago lanceolata*) Plantain in Alfalfa", Sponsoring Organization: National Alfalfa & Forage Alliance, Sponsoring Organization Is: Other, Lauriault Research Credit: $500.00, PI Total Award: $10,000.00, Current Status: Funded. (October 1, 2017 - May 31, 2018).

Not Funded: None

Pending: None

Other Proposals

Funded:

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

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

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

Lauriault, L. M. "Fee-based corn and sorghum variety testing, 2017," Multiple seed companies, $2995.00, Description: Entry fees for corn and sorghum varieties, Status: Funded, Effective Start Date: April 1, 2017, Effective End Date: December 31, 2017.

Lauriault, L. M. "Fee-based cotton variety testing, 2017," Multiple seed companies, $900.00, Description: Entry fees for cotton varieties, Status: Funded, Effective Start Date: April 1, 2017, Effective End Date: December 31, 2017.

Lauriault, L. M. "Donations for Field Day and other outreach activities, 2017," Local and regional businesses, $1575.00, Description: Funds solicited to support outreach and educational programs, Status: Funded, Effective Start Date: January 1, 2017, Effective End Date: December 31, 2017.

Lauriault, L. M. "Fee-based alfalfa variety testing, 2016," Multiple seed companies, $4850.00, Description: Entry fees for alfalfa varieties planted in one year and compared for the next three years at various NMSU locations across the state, Status: Funded, Effective Start Date: April 1, 2016, Effective End Date: December 31, 2019.

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

Yao, S. (Principal), **Lauriault, L. M.**, et al., "Jujube cultivar evaluation, selection and promotion in New Mexico," USDA Specialty Crop Block Grant (through NMDA), $60,000.00, Description: This project focuses on jujube cultivar selection, evaluation and marketing in New Mexico., Status: Funded, Effective Start Date: October 1, 2015, Effective End Date: September 30, 2017.

Lauriault, L. M. "Fee-based alfalfa variety testing, 2014," Multiple seed companies, $5,250.00, Description: Entry fees for alfalfa varieties planted in one year and compared for the next three years at various NMSU locations across the state, Status: Funded, Effective Start Date: April 1, 2014, Effective End Date: December 31, 2017.

Not funded:

Darapuneni, M. K. "IMPACT Mini Grant," New, $40,000.00, Description: Developing water use profiles of winter and summer rotation/cover/opportune crops in semi-arid environments, Status: Applied but Not Awarded, Effective Start Date: October 2017, Effective End Date: October 2018.

Yao, S. (Principal), **Lauriault, L. M.**, et al., "Jujube cultivar improvement in the Southwestern United States," Western SARE, $200,000.00, Description: This was a pre-proposal for the Western SARE Research and Extension grant. We were not selected for the full proposal, Status: Applied but Not Awarded, Effective Start Date: October 2017, Effective End Date: September 2020.

Other Activities

Jason Box

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

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

Murali Darapuneni

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

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

Associate Editor, American Society of Agronomy, Editor, Madison, WI, USA, Made decisions (Reject/Accept) on 6 manuscripts during 2016 (August 2016 - August 2018).

Reviewed 16 manuscripts for four scientific journals.

Leonard Lauriault

Conducted employee chemical safety training for Tucumcari Public School janitorial staff (February 16, 2016).

Judged Agricultural Products, Quay County Fair, Tucumcari, NM, USA (August 16, 2016).

Coordinated NMSU's statewide alfalfa variety testing program.

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

New Mexico Beef Cattle Performance Association/Tucumcari Feed Efficiency Test, LLC. Assisted with test weigh days and sale.

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

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

Set up booth display about the activities of the Agricultural Science Center at the Quay County Fair (Tucumcari, August 16-19, 2017), as well as at the center's Bull Sale (March 11, 2017) and Field Day (August 8, 2017).

Lead Field Trip, Mesalands Community College Range Science Class, Tucumcari, NM. (August 28, 2017).

New Mexico State Forestry/Groundwork Studio/City of Tucumcari, Assisted with city tree inventory, Tucumcari, NM, USA (October 2, 2017).

Quay County Food Shed Co-op Exploration, Tucumcari, NM. (December 8, 2017).

Reviewed 2 manuscripts for scientific journals.

Program Reviewer, United States Citizenship and Immigration Services, Reviewed CV and provided an independent letter of recommendation regarding continued residence in the USA for an Assistant Professor and Extension Agronomist, TAMU (April 19, 2017).

Reviewer, USDA Small Business Innovation Research Program - Phase II (March 28, 2017).

Member of Certified Crop Advisor Board of New Mexico

Member of Northeastern New Mexico Regional Water Plan Steering Committee.

Member of Ute Reservoir Watershed Alliance.

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

Member of Plant and Environmental Sciences Department, Extension Animal Sciences and Natural Resources Department (College Rank Spring and Fall Review), and College of Agricultural, Consumer and Environmental Sciences Promotion and Tenure Committees.

Professional Development Activities and Other Meetings Attended Not Previously Mentioned

Jason Box

Continuing Education, "Summer Crops Field Day". Bushland, TX (August 10, 2016).

Continuing Education, "Clovis ASC Field Day". Clovis, NM (August 9, 2017).

Continuing Education, “Tucumcari ASC Field Day”. Tucumcari, NM (August 8, 2017).
Continuing Education, “Goat Producers Symposium”. Tucumcari, NM (July 8, 2017).
Continuing Education, “Quay County Weed Workshop”. Tucumcari, NM (April 4, 2017).
Continuing Education, “Preventive Plant Meeting”. Tucumcari, NM (February 28, 2017).
Continuing Education, “Groundwater Level Monitoring”. House, NM (February 17, 2017).
Continuing Education, “High Plains Irrigation Conf”. Amarillo, TX (February 15, 2017).
Continuing Education, “Llano Estacado Cotton Conf”, Muleshoe, TX (January 30, 2017).

Murali Darapuneni

Conference Attendance, "New Mexico Sustainable Agriculture Conference", WSARE, Albuquerque, NM, USA (December 13, 2017).

Conference Attendance, "ASA, CSSA, and SSSA meetings", Tri Societies, Tampa, Florida, USA (October 22, 2017 - October 25, 2017).

Seminar/Workshop, "Field day at Los Lunas", ASC-Los Lunas, Los Lunas, New Mexico, USA (August 15, 2017).

Seminar/Workshop, "Annual Field Day-Clovis", Agricultural Science Center-Clovis, Clovis, NM, USA (August 9, 2017).

Leonard Lauriault

Conference Attendance, "New Mexico Innovative Farming Conference", Central Curry and other Soil and Water Conservation Districts, Clovis, NM, USA (December 7, 2017).

Conference Attendance, "Forage Growers Workshop", NMSU Valencia County Cooperative Extension Service, Los Lunas, NM, USA (December 5, 2017).

Conference Attendance, "Western Alfalfa and Forage Symposium", Western States Cooperative Extension Services, Reno, Nevada, USA (November 28, 2017 - November 30, 2017).

Continuing Education, "Western Ag Media & Extension Program", Alforex Seeds, Madison, WI, USA Description: Can now address questions from alfalfa growers about the new products. (November 28, 2017).

Continuing Education, "Meeting and Trigg Ranch Tour", Ute Reservoir Watershed Alliance, Mosquero, NM, USA Description: Learned about and discussed see best management practices in place at the ranch to improve watershed health. How was this activity applied in a meaningful way? Increased knowledge about ranch best management practices to improve watershed health. (August 17, 2017).

Continuing Education, "Field Day", NMSU Agricultural Science Center at Clovis, Clovis, NM, USA (August 9, 2017).

Conference Attendance, "Goat Producers Symposium", Eastern New Mexico Goat Producers/Quay County Cooperative Extension Service, Tucumcari, New Mexico, USA (July 8, 2017).

Conference Attendance, "Annual Meeting", Western Society of Crop Science, Parma, ID, USA (June 6, 2017 - June 8, 2017).

Conference Attendance, “Climate Outlook Forum”, National Drought Mitigation Center, Clovis, NM, USA (April 26, 2017).

Conference Attendance, "Southwest Hay and Forage Conference", New Mexico Hay Association, Ruidoso, NM, USA (January 12, 2017 - January 13, 2017).

Memberships

Murali Darapuneni

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

Leonard Lauriault

Western Society of Crop Science, Scope: International
Crop Science Society of America, Scope: International.
American Society of Agronomy, Scope: International.
New Mexico Hay Association, Ex-officio Director, Scope: State.

American Forage and Grassland Council, Scope: National.
Sigma-Xi Scientific Society, Scope: International.

Certifications:

Jason Box
New Mexico Beef Quality Assurance Trained Producer, New Mexico Livestock Board.
First Detector Certification, National Plant Diagnostic Network.
Public Pesticide Applicator’s License.
Private Pesticide Applicator’s License for Rodent Control.
NMSU Assurance of Actual Training, IACUC.
Agricultural Science Center Hazard Communication Standard.
Worker Protection Standard, Pesticide Handler (through May 1, 2020).
Forklift Certification

Murali Darapuneni
HAZMAT, CPN Neutron Gauge. (August, 2014 - Present).
Nuclear Gauge Safety Certification CPN. (August 26, 2014 - Present).
Neutron Gauge Operation, New Mexico State University. (January 1, 2016 - December 31, 2016).
Agricultural Science Center Hazard Communication Standard.
Worker Protection Standard, Pesticide Handler (through May 1, 2020).

Leonard Lauriault
Certified Hay Sampler, National Forage Testing Association (December 1, 2017 - Present).
Worker Protection Standard - Train-the-Trainer for Workers, Iowa State University Extension and Outreach. (February 16, 2017 - Present).
Certified Forage and Grassland Professional, American Forage and Grassland Council (through December 31, 2019).
Public Pesticide Applicator’s License (categories 1a&b, 3a&b, and 10), New Mexico Department of Agriculture.
Private Pesticide Applicator’s License for Rodent Control (PRRO), New Mexico Department of Agriculture.
NMSU Assurance of Actual Training, IACUC.
Agricultural Science Center Hazard Communication Standard.
Worker Protection Standard, Pesticide Handler (through May 1, 2020).

Farm Staff:
NMSU Assurance of Actual Training, IACUC.
Agricultural Science Center Hazard Communication Standard.
Worker Protection Standard, Pesticide Handler (through May 1, 2020).
ational Plant Diagnostic Network.
Public Pesticide Applicator’s License.
Private Pesticide Applicator’s License for Rodent Control.
NMSU Assurance of Actual Training, IACUC.
Agricultural Science Center Hazard Communication Standard.
Worker Protection Standard, Pesticide Handler (through May 1, 2020).
Forklift Certification

Murali Darapuneni
HAZMAT, CPN Neutron Gauge. (August, 2014 - Present).
Nuclear Gauge Safety Certification CPN. (August 26, 2014 - Present).
Neutron Gauge Operation, New Mexico State University. (January 1, 2016 - December 31, 2016).
Agricultural Science Center Hazard Communication Standard.
Worker Protection Standard, Pesticide Handler (through May 1, 2020).

Leonard Lauriault
Certified Hay Sampler, National Forage Testing Association (December 1, 2017 - Present).
Worker Protection Standard - Train-the-Trainer for Workers, Iowa State University Extension and Outreach. (February 16, 2017 - Present).

Certified Forage and Grassland Professional, American Forage and Grassland Council (through December 31, 2019).
Public Pesticide Applicator's License (categories 1a&b, 3a&b, and 10), New Mexico Department of Agriculture.
Private Pesticide Applicator's License for Rodent Control (PRRO), New Mexico Department of Agriculture.
NMSU Assurance of Actual Training, IACUC.
Agricultural Science Center Hazard Communication Standard.
Worker Protection Standard, Pesticide Handler (through May 1, 2020).

Farm Staff:
NMSU Assurance of Actual Training, IACUC.
Agricultural Science Center Hazard Communication Standard.
Worker Protection Standard, Pesticide Handler (through May 1, 2020).
Forklift Certification

Annual Weather Summary

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

Total precipitation for 2017 was 23.22 inches, 6.43 inches more than the long-term average of 16.79 inches, and more than double that reported in 2013, 2014, and 2016 and slightly lower than 2015 (Table 1). This was still far below the record of 34.96 inches set in 1941 (Table 2).

Table 1. Summary of monthly precipitation amounts (inches) recorded at the NMSU Agricultural Science Center at Tucumcari, 1905-2017.

Month	2017	2016	2015	2014	2013	Average
January	1.02	0.01	1.44	0.01	0.40	0.39
February	0.17	0.94	0.89	0.03	0.88	0.51
March	2.16	0.08	0.38	0.22	0.00	0.77
April	2.73	0.67	1.93	0.21	0.01	1.17
May	1.82	1.30	4.02	2.42	0.82	1.99
June	0.98	3.28	2.07	4.00	1.13	2.02
July	1.58	1.11	7.56	2.54	1.23	2.80
August	6.48	2.33	2.03	0.82	0.92	2.84
September	2.65	0.41	1.31	2.73	4.28	1.64
October	3.62	1.39	0.81	0.19	0.26	1.34
November	0.01	0.08	1.23	0.37	0.43	0.67
December	0.00	0.37	2.85	0.38	0.11	0.64
Total	23.22	11.97	26.52	13.92	10.47	16.79

Above average precipitation was recorded in January, March, April, August, September, and October, although, only 0.04 inches fell between October 6th and the end of the year. The greatest amount of precipitation falling within a 24-hour period (2.07 inches) was measured on October 4th. Record high and low amounts of precipitation, by month, are shown in Table 2. No precipitation records were set in 2017.

Table 2. Highest and lowest monthly precipitation amounts recorded at the Agricultural Science Center at Tucumcari 1905-2017.

Month	Maximum (inches)	Year	Minimum (inches)	Year
January	11.68	1999	0.00	2012
February	12.40	1912	0.00	2006
March	13.69	1919	0.00	2013
April	14.89	1997	0.00	1996
May	18.72	1921	0.00	1927
June	16.39	1919	0.00	1947
July	11.28	1950	0.24	1987
August	18.38	1933	0.12	1951
September	17.23	1941	0.00	1948
October	17.51	1923	0.00	2016
November	14.00	1905	0.00	2012
December	14.27	1959	0.00	2017
April - September Growing Season	25.70	1919	4.65	1934
Annual	34.96	1941	6.13	1934

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

The mean maximum temperature for 2017 was 74ºF, the mean minimum temperature was 45ºF, and the mean annual temperature for 2017 was 60ºF, all of which were 1ºF above the respective long-term averages (Table 3).

Table 3. Summary of mean monthly temperatures at the NMSU Agricultural Science Center at Tucumcari, 1905-2017.

Date	2017	2016	2015	2014	2013	Average 1905-2017	
…………………………Mean Maximum Temperature (°F)………………………………							
January	52	53	49	56	52	53	
February	65	63	57	56	57	57	
March	57	70	65	66	57	65	
April	72	73	75	75	71	73	
May	80	81	75	82	81	81	
June	94	93	91	91	96	91	
July	96	100	94	93	94	93	
August	88	91	92	93	95	91	
September	84	88	91	82	85	85	
October	75	83	73	79	74	75	
November	69	66	63	61	60	62	
December	57	53	55	55	51	53	
Annual	74	75	71	71	74	73	**
…………………………Mean Minimum Temperature (°F)………………………………							
January	25	24	24	22	24	24	
February	34	30	26	26	28	27	
March	31	35	35	32	31	33	
April	44	41	42	42	38	42	
May	48	51	49	51	52	51	
June	61	62	62	62	64	61	
July	67	68	66	64	66	65	
August	62	63	64	64	66	63	
September	56	58	62	58	61	56	
October	45	49	49	47	42	44	*
November	38	38	33	30	34	33	*
December	24	25	28	25	24	25	
Annual	45	45	43	44	44	44	
………………………………Mean Temperature (°F)…………………………………							
January	39	38	36	39	38	38	
February	50	47	42	42	43	42	
March	44	53	50	49	44	49	
April	58	57	58	58	54	57	
May	64	66	62	66	66	66	
June	78	78	76	76	80	76	
July	82	84	80	79	80	79	
August	75	77	78	79	80	77	*
September	70	73	76	70	73	71	*
October	60	66	61	63	58	60	**
November	54	52	48	45	47	48	**
December	41	39	49	40	38	39	
Annual	60	60	57	59	58	59	*

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

The lowest recorded temperature in 2017 of was recorded on January 7th (-4ºF). The highest temperature for the year, 107ºF, was recorded on June 18th, which was a record for that date. Other daily record high temperatures were observed on February 11th (84ºF) and 12th (83ºF), March 21st (87ºF) and 24th (85ºF), June 6th (106ºF), and December 30th (78ºF). Record lows were set on March 29th (31ºF), May 20th (36ºF), and October 10th (31ºF). Highest and lowest recorded temperatures and mean temperature extremes are shown in Table 4. The 84ºF maximum temperature recorded on February 11, 2017, was a new daily record extreme highest temperature for the month of February (Table 4).

Table 4. Highest and lowest recorded temperatures (°F) and mean temperatures (°F), by month, at the NMSU Agricultural Science Center at Tucumcari, 1905-2017.

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

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

The last spring temperature of 32ºF in 2017 was recorded on April 30th (Table 5). The first temperature of 32ºF in fall was recorded on October 10th. Average last spring and first fall freeze dates are April 4th and October 14th, respectively. The 2017 growing season was 163 days, 31 days shorter than the long-term average. The longest and shortest growing seasons on record are 225 and 136 days, respectively, which were recorded in 2015 and 1945, respectively.

Table 5. Summary of last spring and first fall temperatures of 32°F and 28°F and growing season at the NMSU Agricultural Science Center at Tucumcari 1913-2017.

	2017	2016	2015	2014	2013	1913-2017 Average	Record Extremes Earliest	Year	Latest	Year
32°F or less										
Last in Spring	30-Apr	30-Apr	26-Mar	15-Apr	24-Apr	4-Apr	24-Mar	1943	15-May	1945
First in Fall	10-Oct	9-Nov	6-Nov	11-Nov	19-Oct	14-Oct	17-Sep	1965	19-Nov	1989
Growing Season (Days)	163	193	225	210	169	194	136	1945	225	2015
28°F or less (Hard Freeze)										
Last in Spring	26-Mar	2-Apr	6-Mar	15-Apr	3-May	26-Mar	6-Mar	2015*	6-May	1917
First in Fall	9-Nov	18-Nov	12-Nov	11-Nov	6-Nov	25-Oct	8-Oct	1970	27-Nov	2001**
Number of Hard Freeze-Free Days	247	230	251	210	187	213	169	1917	256	2001

*Also in 1935

**Also in 1965 & 1923

The last snowfall in spring 2017 was recorded on April 30th. No snow fell in fall/winter 2017. Total snowfall in 2017 was 10.63 inches. The last snowfall in spring has occurred as late as May 18th in 1935 and 1980. The first snowfall in winter has been recorded as early as October 8th in 1970.

Summaries of pan evaporation and wind run at the center are shown in Table 6. Except for July and September, daily and season total evaporation were below their respective long-term averages and the season total was well below the record set in 2011 (97.44 inches). Also except for July, which was near the average for wind speed, April to August wind speeds were well below average and well below the record of 7.7 mph for April to September set in 1918, but greater than the calmest season on record of 2.3 mph in 1979.

Table 6. Summary of pan evaporation (inches) and wind run (average miles per hour) at the NMSU Agricultural Science Center at Tucumcari, 1918-2017.

	Pan Evaporation				Wind Speed	
	2017		1953 - 2017		2017	1918 - 2017
Month	Total	Daily Average	Monthly Average	Daily Average	Daily Average	Daily Average
	……………………inches……………………				mph	mph
April	9.99	0.33	10.74	0.36	4.3	5.4
May	10.94	0.35	12.53	0.40	3.5	4.8
June	11.19	0.37	13.92	0.46	3.4	4.5
July	14.07	0.45	13.52	0.44	3.6	3.7
August	9.90	0.31	11.55	0.37	2.4	3.3
September	9.40	0.31	9.25	0.31	*	3.6
Season total/average	65.49	0.35	71.50	0.39	3.44	4.22

*The anemometer malfunctioned as of August 29, 2018. Data for those days was retrieved from the New Mexico Climate Center. The anemometer was not replaced until October 2018.

Operational Revenues and Expenditures

The Agricultural Science Center at Tucumcari received $98,882.00 in operational funds in FY 2016-2017. (Table1).

The center billed itself $22,313.00 for vehicle and equipment use based on established mileage rates and hourly charges for vehicles, tractors, and other equipment.

The alfalfa variety-testing program generated $4,850.00, the corn & sorghum variety test generated $4,355.00 and the cotton variety test generated $226.00 in FY 2016-2017.

The center's operational expenditures in fiscal year 2016-2017 totaled $145,919.00 (Table 1). Irrigation Services was the largest expenditure ($25,639.00). Farm/Ranch Services was the second largest expense totaled $49,526.00, including tractor hours and vehicle use. Although Tractor/Vehicle Use and Irrigation Services are in the expenditure category of Table 1, they also are a revenue source for the Irrigation Index (120592) and the Tractor/Vehicle Index (101507). The third largest expenditure was Repair & Maintenance Equipment Service $10,860.00).

Expenditures for Other Supplies (which includes non-office supplies, irrigation supplies, and pest control supplies, etc.) was $7,188.00 in FY 2016-2017. The total for seed and chemicals purchased was $3,843.00,

Major purchase during the 2016-2017 Fiscal Year are listed in Table 2.

Table 1. NMSU Agricultural Science Center at Tucumcari, Approximate Expenditures by Index and Account Codes FY 2016-2017.

Item	Admin Plan 121851	Station Sales 120435	Forage Mgmt. 125881	Dryland Cropping 124581	Tucumcari Pastures 123736	Tractor & Vehicle 101507	Renewal & Replacement 107346	Field Day 902395	Forage Foundation 903124	Murali Start-up 124497	Bull Test 120176	Irrigation 120592	Yucca Harvesting 127129	Grand Total
REVENUE														
Beginning Balance	71,392	13,420	12,490	15,000	(49)	36,077	5,422	1,393	1,509	12,353	24,164	2,760	2,499	198,429
Sales/Fees Generated		10,386												10,386
Private Gifts								1,700						1,700
Cattle Gain					6,134									6,134
Irrigation Usage												21,794		21,794
Vehicle/Tractor Usage						22,313								22,313
TOTAL REVENUES	71,392	23,806	12,490	15,000	6,085	58,390	5,422	3,093	1,509	12,353	0	24,554	2,499	260,756
EXPENDITURES														
PERSONNEL														
Temporary/Term Salary	5,454		258											5,711
Temporary Fringes	1,011		55											1,066
Overtime	1		1											2
Regular Finges	132													132
TRAVEL														0
Domestic Travel	1,305	592	988	4,856					63				946	8,751
Foreign Travel		1,489	4,451											5,940
SUPPLIES														0
Auto/Tractor Supplies	4					1,456								1,460
Fuels & Lubricants	696	1	169	320	39	3,826			392		(30)			5,412
Office Supplies	1,556	449		17										2,022
Other Supplies	3,418	1,803		355	925	583		34			9	13	48	7,188
Lab Supplies	45													45
Cleaning/Janitorial Supplies	245													245
Medical/Safety Supplies	94	71						20						185
Feed/Seed/Fertilizer	1,353	1,252		50	1,050					138				3,843
Keys														0
Dues/Fees/Taxes	291	295	245	963		319				1		2,493	224	4,831
Business Meals/Food Items	428							1,614						2,042
Books														0
Publications/Films/Periodicals	119		**80**											199
Furn/Office Equip<=$5000	2,307			275										2,582
Small Tools	208					389								597
Bldg. Repair & Maint Parts														0
Equip. Repair/Maintenance Parts	254					1,354						326		1,934
Computer/Electronic Supplies	117			16										133
Veh. Repair/Maint. Parts														0
TOTAL SUPPLIES & MATERIALS	19,038	5,952	6,246	6,851	2,014	7,925	0	1,668	456	139	(22)	2,832	1,219	54,318

Table 1. (continued) NMSU Agricultural Science Center at Tucumcari, Approximate Expenditures by Index and Account Codes, FY 2016-2017.

Item	Admin Plan 121851	Station Sales 120435	Forage Mgmt. 125881	Dryland Cropping 124581	Tucumcari Pastures 123736	Tractor/ Vehicle 101507	Renewal & Replacement 107346	Field Day 902395	Forage Foundation 903124	Murali Start-up 124497	Bull Test 120176	Irrigation 120592	Yucca Harvesting 127129	Grand Total
SERVICES														
General Services	261													261
Medical/Vet Services		155			513									667
Postage	416	131	32	280	7	7				14		5		893
Telephone	1,279													1,279
Cellular Expense	360													360
Internet	1,685													1,685
Printing/Reproduction				131										131
Repair/Maint. Bldg	302													302
Repair/Maint. Electric														0
Repair/Maint.Equipment	2,758					5,713						2,390		10,860
Utilities - Electric	5,925											2,074		7,999
Utilities - Gas	1,083													1,083
Trash Hauling	520													520
Seminar/Training	99													99
Vehicle Insurance						529								529
Advertising														0
Sales Tax	1							27						28
Prof/Contract Services	146													146
Equip/Hardware Rental	180							280						460
Lab Analysis	187	1,008	1,880	2,149					1,053	23		51		6,351
Vehicle Usage	1,030	2	2	500	66									1,600
Irrigation Services	14,675	1,011	1,307	1,736	2,952							3,958		25,639
Farm/Ranch Services (Tractor ho	11,949	623	2,958	2,950	342						645		1,245	20,712
Freight	184	56	16	(28)		23				9				260
Computer Software			50	436										486
TOTAL SERVICES	43,040	2,985	6,244	8,156	3,879	6,273	0	307	1,053	46	645	8,478	1,245	82,352
Furn/Equipment >= $5000	9,250													9,250
TOTAL EQUIP. & CAP. OUTLAY	9,250	0	0	0	0	0	0	0	0	0	0	0	0	9,250
TOTAL EXPENSES	71,329	8,937	12,490	15,007	5,893	14,197	0	1,975	1,509	185	623	11,310	2,464	145,919
ENDING BALANCE	63	14,869	(0)	(7)	191	44,193	5,422	1,118	0	12,168	(623)	13,244	35	114,837

Table 2. Listing of major purchases paid for during FY 2016-17, NMSU Agricultural Science Center at Tucumcari.

Index	Description		Cost
101507	Repairs to the 1995 GMC pick-up		$3,661.10
101507	Repairs to the Case 990-1 tractor		$1,515.80
101507	Parts/labor to repair the Case Maxxum 140 tractor		$2,033.25
101507	Parts/labor to repair the ZeroMax on plot planter		$645.64
101507	Parts/labor to repair the pivot	$2,500.00	
120592		$938.89	$3,438.89
120592	Annual Irrigation Assessment - AHCD		$2,392.59
120592	Electric to deliver water	$2,225.30	
124340		$2,175.00	$4,400.30
124340	City of Tucumcari Treated Effluent Wastewater		$9,000.00
120592	Operation, maintenance, repair/replacement		
	including meter reading		$1,620.00
121851	Update to GPS System on Case Maxxum 140 tractor		$9,250.00
121851	480 volt Distribution Center		$2,676.86
121851	Pallet fork, pallet tine, & tine bale spear		$1,926.00
121851	Shirts& caps for promotional purposes		$853.60
121851	Replacement of highway sign		$575.00
123736	Fence posts		$675.15
	Grand Total		$44,664.18

Tucumcari Beef Cattle Feed Efficiency Testing

Investigator(s):

M. Ward[1], S. Jennings[2], J. Box[2], J. Jennings[2], A. Williams[2], P.L. Cooksey[2], L.M. Lauriault[2], and A.E. Cunningham[2]

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

Impacts

The Tucumcari Bull Test has grown both in scope and scale since Dr. Ward took over as the test director, in 2014. The number of animals tested has grown by 300% since 2013, from 75 bulls tested annually to 225 bulls and heifers tested in 2017. To put the impact of this expansion in perspective, 75 bulls can pass on their genetics to approximately 1500 offspring per year, where 225 tested animals pass on their proven genetics to over 3280 offspring per year.

In 2013, there were 8 active producers and the facility tested 75 bulls, selling only 43. By 2017, the test was measuring performance on 155 bulls, had 19 producers involved, and sold 110 bulls at the sale. The economic impact for producers has also been significant. Until 2015, Tucumcari Bull Sale averages were consistently $300-$500 lower per bull than other productions sales in the state. The 2017 Tucumcari Bull Sale average was $200 to $400 greater per animal than the other regional production sales.

The test and sale audience has widened as well. In 2013, approximately 75 producers attended the Tucumcari Bull Sale. By 2017, over 200 producers were in attendance, representing five states. The other audience to consider are the visitors to the website and sale catalog pages. The Tucumcari Bull Test is in the top 6 of bull tests listed on Google's main search page for bull efficiency tests. This exposure has generated interest from across the United States. The 2017 sale catalog was also posted on the American Angus Association website. There were over 2000 visits to the catalog page when published.

Partnerships are in the works with producers who purchase bulls at the Tucumcari Bull Sale. The intent is to follow the offspring from those bulls through the production line. This will allow Dr. Ward to follow the genetic progress of New Mexico cow herds. Additionally, heifers tested through the facility will also be followed into the production herd. The members of the Tucumcari Feed Efficiency Test are also generating a DNA library. As cattle enter the facility to be performance tested, DNA samples will be collected to monitor genetic progress.

Summary:

Many New Mexico cattle producers struggle to understand the value of genetic selection for production improvement. Many make their purchasing decisions of bulls and females based on price rather than quality. There is a large learning curve needed to be addressed to help New Mexico cattle producers remain competitive. Currently, many New Mexico calves are discounted in price. Part of the reason for this financial discount is calf quality, due to poor genetic potential.

The purebred sector of the beef industry is another area that requires attention. Also called seedstock operators, purebred cattle breeders supply the genetics to the commercial cattle producer. For cattle quality to improve, educating the seedstock producers is just as important.

Objective:

To educate commercial cattle producers in New Mexico on how they can select for genetic improvement. This education should lead to producers making more educated decisions when buying herd replacements and appreciate the value of investing in good genetics. For the seedstock operator, provide an outlet where they may gain specific information on how their cattle compare to others to help them improve the genetic potential of their herds.

2017 Outcomes:

In 2017, the core group of cattle producers involved in the Tucumcari Bull Test facility, invested an additional $32,000 to expand the efficiency testing capacity (from 128 individually tested bulls to 160). This expansion was the result of an increased demand for the data generated at the test station. As a result of this expansion, the 2017/2018 bull test and sale will go down as the biggest in test's history.

Dr. Ward was also involved in the development of a scholarship program collaboration with Mesalands College in Tucumcari, New Mexico. Funded by the producer group, two students each year will be awarded a working scholarship that will result in them gaining hands on experience in cattle health management.

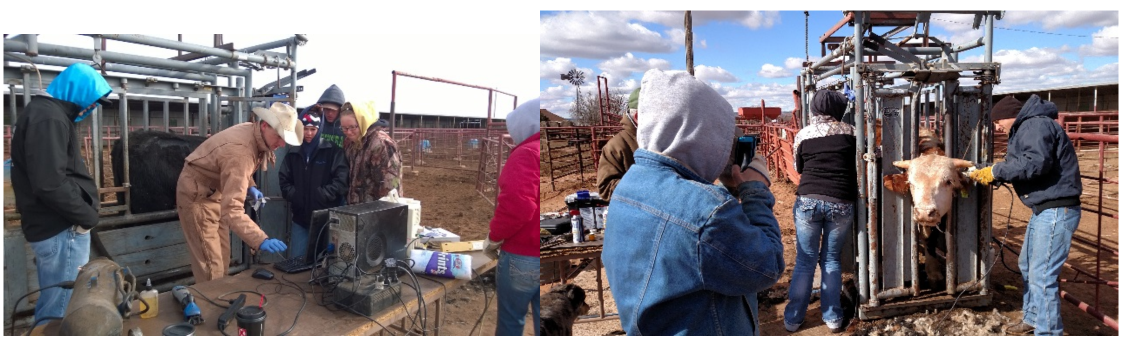
Outputs:

The ACES-NMSU Tucumcari Bull Test and Sale Website is the primary source of information dissemination of performance data, genetic information, and pedigree information. Sonja Jo Serna, ACES Media Specialist, serves as the primary administrator of the website, and the Livestock Specialist provides content. Four performance reports, pedigrees of each animal, and their genetic information are made available on the website every year. These reports and genetic information are used by both the test participants and potential buyers to help make educated decisions on how to improve the genetics within their herd. To date, Dr. Ward has generated over 300 summary and individual reports to these producers.

Dr. Ward has also provided the cooperators an informational brochure for them to hand out to their customers. This brochure describes the data generated at the station along with the financial impact efficient bulls can provide to an operation.

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

Every March, producers from around the region come to the Ag Science Center for the auction sale to buy bulls that had been performance tested. The information collected during the test is put on display and made available in handouts on sale day.



Mesalands College students helping with data collection day and sale prep.

TUCUMCARI BULL TEST EST. 1961

Evaluation of Fall/Winter Pastures for Late-Gestation to Early Lactation Beef Cows

Investigator(s):

L.M. Lauriault[1], E.J. Scholljegerdes[2], Roy Hartzog[3], P.L. Cooksey[1], J. Box[1], A. Cunningham[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

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Potential Impact(s): Interest is increasing in the use of winter canola as an alternative crop in wheat rotations in the Southern High Plains. Along with that, interest has been expressed in whether the canola can be grazed similarly to wheat with minimal effect on grain production. If grazing is feasible, canola could become an alternative dual-purpose crop for the region.

Method(s):

Winter cereal rye (CR), dormant native range (NR), frosted down pearl millet (PM), frosted down sorghum-sudangrass [haygrazer (SxS)], and winter canola (WC) pastures were compared in the winter of 2016-17 to determine the relative effect of pasture type on late-gestation or early lactation beef cows and their calves. Additionally, the effect of grazing on canola grain production was evaluated.

Pastures were arranged in a completely randomized design with two replicates. Details of pasture establishment and management and animal management are given in The 2016 Annual Report of the Agricultural Science Center at Tucumcari. In 2017, the WC received 11.5 inches of irrigation to supplement 8.1 inches of January through June precipitation while the CR received 6.8 inches of irrigation to supplement 6.1 inches of January through April precipitation as well as nitrogen applications on January 17 (13 lb N/A), February 1 (25 lb N/A), and February 21 (76 lb N/A).

Prior to grazing, three 16 ft^2 exclosures were uniformly distributed in each CR and WC pasture because continued growth was anticipated in those pastures while the PM and SxS were completely frozen down and senesced and NR was dormant. Immediately prior to the initiation of grazing and every 28 days thereafter until cattle were removed, standing forage was sampled at three uniformly distributed locations in each pasture. A 0.5 yd^2 area was hand-clipped to ground level at each location in the CR, NR, and WC pastures. The harvested material from each location was dried in a forced-air oven at 140°F for 48 hours to determine dry matter (DM) yield. A self-propelled forage plot harvester equipped with a weighing system was used to harvest PM and SxS pastures. The length of the harvested area was measured after harvesting to calculate harvest area. A subsample of harvested material from each location was collected, weighed, dried for 48 h at 140°F and reweighed to determine DM content and yield. All sampling locations were selected to represent the standing forage in that area, but to avoid trampling adjacent to the exclosures when those were present. Subsequent sampling locations in pastures without exclosures were always near the initial sampling location. Initial samples had been immediately delivered to the lab for nutritive value analysis by NIRS to determine any need for supplementation. Subsequently collected samples were held for prospective nutritive value analysis. Additional samples of WC were collected to monitor nitrate levels while it was actively growing and initially from the PM and SxS. Results of the initial nutritive value and nitrate analyses have been reported and no additional NIRS analysis has been done. The CR was allowed to continue growing and forage was harvest within and near the exclosures on April 11 using the forage plot harvester as described.

Privately owned late-gestation (>6 months) 3-year-old Angus cows, all having previously calved, were provided for this project. Four animals had been assigned to each pasture by a combination of initial body weight, estimated months pregnant, and body condition score (BCS). Grazing was initiated on December 15, 2016. Bloat blocks (Sweetlix Bloat Guard® Pressed Block) were provided in WC and CR pastures and hay was provided *ad libitum* in the WC pastures. Cows on NR were fed 24.5 lb Hi-Pro 20% Southwest Breeder cubes/hd while cows grazing PM and SxS were fed 12 lb/hd/wk and CR and WC cows received 7 lb/hd/wk, based on initial forage nutritive value. Cube supplementation was split into 3 feedings per week. Immediately prior to initiation of grazing and every 28 days thereafter until cattle were removed, cattle were penned for 16 h and weighed. Cattle were removed from the WC pastures on February 22, 2017. On March 2, 2017, cattle were removed from the CR and NR pastures and on March 7, they were removed from the PM and SxS pastures.

During the study period, 22 of the 40 cows calved. Because all pastures, except one, had calves born and there was a difference in performance between birthing cows (B) and non-birthing (NB), that effect was added to the model. Four calves were still born, three of which were born to cows in the same WC pasture the other was in an NR pasture. Nitrate and iodine toxicities have both been associated with canola forage and still birth in cattle; however, both of those causes were ruled out by laboratory analysis along with sulfate toxicity and Leptospirosis.

To evaluate the impact of grazing occupation cessation time on canola grain production, additional exclosures were installed near the original exclosures in the WC pastures on January 17 and February 8, 2017. After the cattle were removed from the WC pastures, the canola was left to grow with supplemental irrigation until sampling for biomass and grain components was conducted within each exclosure and outside of the grouping on June 22. For that sampling, whole plants were clipped to ground level and bagged carefully to minimize seed shattering. Plants were counted as they were clipped. After collection, bag contents were poured into a large container and all pods that had not shattered in the bag were hand-threshed. Seed was passed through a screen to remove most inert material after which the resultant seed was weighed.

Forage and seed subsamples and cattle data were averaged by pasture and analyzed using SAS Proc MIXED to compare pasture type and, for the cattle data, the effect of birthing. The effect of time of grazing cessation (the installation of exclosures at various dates) on spring biomass and grain components was compared within the WC pastures. Pasture number was considered random. When the F-test for pasture or grazing cessation was significant ($P < 0.05$) lsmeans were separated using least significant differences (LSD's). Trends ($0.05<P<0.10$) also were indicated with 5% LSD's

Results:

Data and results of statistical analysis of forage data are presented in Table 1. Differences in DM yield were not evident until February 10, when CR and WC were lower than the NR, PM, and SxS pastures. By March 10, both had begun active growth again, but they were still different from other pastures (Table 1). Cattle had been removed from the WC pastures in February and from the CR pastures a few days before the March 10 sampling to allow regrowth for grain and hay production, respectively. Hay production by CR was significantly higher than production had been for PM the previous autumn, while SxS was intermediate (Table 1). It was anticipated that SxS and PM would have lower yield due to their late planting date (August 18, 2016) and CR, although volunteer, had been irrigated throughout the winter and received spring nitrogen applications, one of which came after cattle were removed to promote growth.

Table 1. Aboveground forage dry matter (DM) yields in pastures at Tucumcari in winter 2016-17 and hay DM yields (3-inch stubble) of warm-season annual grasses after freeze on December 15, 2016, and cereal rye at heading on April 20, 2017.

Pasture	15-Dec	17-Jan	10-Feb	10-Mar	Hay
	- - - - - - - - - - - - - - Lb DM/A - - - - - - - - - - - - - -				
Canola (WC)	2778	858	79 B	441 B	-----------
Haygrazer (SxS)	1958	1515	1418 A	1348 A	1958 AB
Pearl millet (PM)	1757	1747	1135 A	1596 A	1758 B
Native range (NR)	1664	1669	1405 A	1588 A	-----------
Cereal rye (CR)	1014	543	157 B	637 B	3891 A
P-value	0.2724	0.2746	0.0247	0.0053	0.0853

Data and results of statistical analysis of cattle data are presented in Table 2. As reported in The 2016 Annual Report of the Agricultural Science Center, no differences existed between pasture treatments for

Table 2. Cattle variables for pastures at Tucumcari in winter 2016-17.

Treatment Effect	Initial BW	Term	Initial BCS	Births	Birth wt.	Gain	ADG
Pasture	lb/cow	Months	-----	No.	lb/calf	lb/pair	lb/d/pair
Canola	1236	6.5	5.3	3.0	70.5	42.5	0.62
Haygrazer (SxS)	1214	6.9	5.2	2.5	83.5	-17.5	-0.21
Pearl millet (PM)	1202	6.5	5.2	2.0	82.5	59.0	0.76
Native range (NR)	1248	7.4	5.2	2.5	95.5	59.5	0.77
Cereal rye (CR)	1225	6.7	5.1	1.0	85.5	52.8	0.64
Birthing							
Non-birthing (NB)	1183	6.1	5.1	18.0	0.0	85.0	1.12
Birthing (B)	1267	7.5	5.3	22.0	83.5	-6.5	-0.09
			P-values				
Birthing	0.1398	0.0020	0.3535	-----	0.0012	0.0087	0.0084
TRT	0.9776	0.3970	0.9763	-----	0.3994	0.3627	0.3931
Pasture*Birthing	0.8972	0.4392	0.9808	-----	0.3994	0.9489	0.9108

BW, BCS, and ADG signify body weight, body conditions score, and average daily gain, respectively.
Term is the stage of pregnancy in months.
Calf birthweight is the average weight of calves born in the pasture and does not include zero values for cows not giving birth. The comparison of NB and B cows in regard to calf birth weight is not considered biologically important. The comparison of importance is in the likelihood of a difference in birth weight between pasture treatments, which would have been indicated by a pasture x birthing interaction.

between NB and B in the initial estimation of months of pregnancy (term) because the cows that birthed were 1.4 months later in their pregnancy than the cows that did not give birth during the study period. Calf birthweight is the average weight of calves born in the pasture and does not include zero values for cows not giving birth. Hence, the comparison of NB and B cows in regard to calf birth weight is not considered biologically important. The comparison of importance is in the likelihood of a difference in birth weight between pasture treatments, which would have been indicated by a pasture x birthing interaction, which was not observed (Table 2). Gain and average daily gain for the pair were different between cows giving birth and those not, which also is not surprising due to the presence of a growing calf within the NB cows and a nursing calf on the B cows.

Table 3 shows the effect of cessation of grazing on canola biomass and grain components. No difference existed between cessation dates for any variable, likely due to marginal plant populations. Generally, 40 plants/sq. yd. are necessary to satisfactory production and a 2000 lb/A grain yield would equate to about 187 g/sq. yd.

Using dry pregnant cows some of which calved during the study, for this project complicated the results, as did the low plant populations. Additional studies using newly weaned calves or yearlings would be more suited for this type of pasture management, similarly to the current use of winter cereal pastures. Consequently, those are planned to determine the feasibility of grazing canola as a dual-purpose crop.

Table 3. Biomass and grain components per square yard on June 22, 2017, of canola at Tucumcari after grazing was ceased on various dates during winter 2016-17.

Date	Plants	Total biomass	Vegetative biomass	Grain
	#/sq yd		g/sq yd	
17-Jan	55	363	334	29
26-Jan	28	408	344	64
8-Feb	36	366	335	31
21-Feb	31	388	341	47
Ungrazed	47	438	375	63
P-value	0.2049	0.9124	0.9775	0.4912

Evaluation of Late Summer/Autumn Pastures for Beef Steers

Investigator(s):

L.M. Lauriault[1], E.J. Scholljegerdes[2], P.L. Cooksey[1], J. Box[1], A. Cunningham[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

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

Potential Impact(s): Interest is increasing in the use of winter canola as an alternative crop in wheat rotations in the Southern High Plains. Along with that, interest has been expressed in whether the canola can be grazed similarly to wheat with minimal effect on grain production. If grazing is feasible, canola could become an alternative dual-purpose crop for the region.

Methods:

Winter canola, sorghum-sudangrass (haygrazer), and pearl millet pastures were compared in the late summer and autumn of 2017 to determine the relative effect of pasture type on performance of beef steers. Additionally, the effect of grazing on canola grain production was evaluated.

Pastures were arranged in a randomized complete block design with two replicates. Seed drilling on 7-inch spacing took place from July 12-14, 2017, at seeding rates of 9, 35, and 10 lb/A for pearl millet, haygrazer, and canola, respectively. The pastures received 4.3 inches of irrigation with treated municipal wastewater from August through early October, when the irrigation delivery system failed at the wastewater treatment plant, to supplement 14.3 inches of August through November precipitation. Only 0.01 inch of precipitation fell after irrigation was no longer possible. No fertilizers were applied.

Prior to grazing, three 16 ft^2 exclosures were uniformly distributed in each pasture. Immediately prior to the initiation of grazing and every 28 days thereafter until cattle were removed, standing forage was sampled at three uniformly distributed locations in each pasture. A 0.5 yd^2 area was hand-clipped to ground level at each location in the canola pastures. The harvested material from each location was dried in a forced-air oven at 140°F for 48 hours to determine dry matter (DM) yield. A self-propelled forage plot harvester equipped with a weighing system was used to harvest pearl millet and haygrazer pastures. The length of the harvested area was measured after harvesting to calculate harvest area. A subsample of harvested material from each location was collected, weighed, dried for 48 h at 140°F and reweighed to determine DM content and yield. All sampling locations were selected to represent the standing forage in that area, but to avoid trampling adjacent to the exclosures. Forage within the exclosure in the pearl millet and haygrazer pastures was measured with the harvester and subsampled for DM content on October 18, after the forage was completely frost-killed. Forage samples were held for prospective nutritive value analysis.

Newly weaned calves [564 ± 44 lb body weight (BW)] were purchased from the Clovis Livestock Market on September 6, 2017, branded and vaccinated with Cattlemaster and Vision 7 and treated with an Ivermectin pour-on, and held on native grass pastures until the initiation of treatment grazing, which took place on September 20, 2017. Six steers were allocated to each pasture based on a nearly uniform BW and standard deviation among pastures. Immediately prior to initiation of grazing and every 28 days thereafter until the steers were removed, they were penned for 16 h and weighed. Minerals (ADM Fall and Winter Beef Mineral) were supplied *ad libitum* in each pasture. Steers were removed from the haygrazer pastures on October 9 in anticipation of forecasted frost. Cattle were removed from the pearl millet pastures when forage was depleted to approximately the same level of residual forage as had been left on the haygrazer. They were removed from the canola pastures on December 6 when canola plants were nearly defoliated. Time between weigh dates and weight differences were used to calculate average daily gains (ADG, lb/hd/d) for measurement period and for the seasonal grazing period.

To evaluate the impact of grazing occupation cessation time on canola grain production, additional exclosures were installed near the original exclosures in the canola pastures on November 8 and 22, 2017.

Forage and cattle data were averaged by pasture and analyzed using SAS Proc MIXED to compare pasture type. Replicate was considered random. When the F-test for pasture was significant ($P < 0.05$) lsmeans were separated using least significant differences (LSD's). Trends ($0.05<P<0.10$) also were indicated with 5% LSD's

Results:

Data and results of statistical analyses are presented in Table 1. There was no difference in initial ungrazed for on September 20 despite a large difference in magnitude between the canola and grass pastures. One of the canola pastures had half the yield of the other, which was the likely cause of increase variability and the numeric difference between pasture means. Grass pastures continued to grow until frost-killed producing approximately another 700 lb DM/A by October 18 to maintain an equal amount of forage production for the season. Low yields seasonlong yields (October 18 ungrazed forage) are likely due to the late planting date (July 12-14).

Table 1. Forage dry matter (DM) and cattle variables when grazing different summer/autumn pastures at Tucumcari in 2017.

Pasture	Ungrazed forage 20-Sep	Ungrazed forage 18-Oct	Post-grazing residual forage	Average daily gain 18-Oct	Average daily gain 15-Nov	Average daily gain 6-Dec	Average daily gain Seasonal
	- - - - - - - - - - - lb DM/A	- - - - - - - - -		- - - - - - - - - - - - - - - - lb/hd/d	- - - - - - - - - - - - - - - -		
Canola	1345	--------	396	0.07 A	0.38	0.94	0.56 A
Haygrazer	2518	3275	1211	-0.72 B	--------	--------	-0.72 B
Pearl millet	2373	3206	974	0.09 A	0.08	--------	0.08 A
P-value	0.1356	0.9046	0.4598	0.0585	0.6714	--------	0.0278

LSMeans in the same column followed by the same letter are not significantly different based on the 5% LSD.

Seasonal average daily gains over 20, 56, and 77 days of grazing for haygrazer, pearl millet, and canola, respectively.

Having come from the sale barn, these calves looked good, but apparently had problems acclimating to the pastures offered, as indicated by low average daily gains, particularly, by the haygrazer steers, which actually lost weight (Table 1). By the end of the trial, the canola steers were gaining nearly 1 lb/d w hile the pearl millet steers sustained <0.1 lb/d. Previous studies have demonstrated that healthy steers grazing haygrazer or pearl millet can attain upwards of 2 lb/d ADG.

After the cattle were removed from the canola pastures, the canola was left to grow until sampling for biomass and grain components could be conducted within each exclosure and outside of the grouping in each pasture in spring 2018. For that sampling, whole canola plants will be clipped to ground level and bagged carefully to minimize seed shattering. Plants will be counted as they are clipped. After collection, bag contents will be poured into a large container and all pods that had not shattered in the bag will be hand-threshed. Seed will be passed through a screen to remove most inert material after which the resultant seed will be weighed. It is anticipated that the irrigation system will be repaired during winter and water can fertilizer can be applied to promote spring growth and grain production.

Impact of Overseeding Bindweed-Infested Grass Pastures with Winter Cereals on the Bindweed

Investigator(s):

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

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Potential Impact(s):

Field bindweed is a competitive, summer-active weed that reduces productivity in irrigated pastures. Overseeding pastures with winter cereals could reduce competition by field bindweed when it begins growth in the spring and could allow desirable species to compete during the spring/summer growing season.

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 was used to evaluate the impact of grazing winter cereals on field bindweed competition. Locally-grown combine-run triticale seed was no-till drilled into two existing field bindweed-infested, predominantly native, warm-season grass, irrigated pastures on September 15, 2017. The seeding rate was 60 lb/A. Flood irrigation (0.65 in./A) was applied from September 20-27 to supplement 6.30 inches of precipitation that fell in September and early October. In August, 6.48 inches of precipitation had fallen.

After establishment of the triticale and prior to grazing, three 16 ft x 16 ft exclosures were uniformly distributed in each pasture. Grazing was initiated on October 16 by cows and calves, which were removed on November 25, 2017, when forage became limited as part of the managed rotation. Immediately prior to initiation of grazing, standing forage was hand-clipped to ground level near each exclosure and, approximately every 28 days thereafter, standing forage was hand-clipped to ground level in and near each exclosure. Sampling locations outside the exclosures were selected to represent the standing forage within the exclosure, but far enough away to avoid trampling adjacent to the exclosures. Clipped material was bagged separately as bindweed, other weed, triticale, and other grass. Bindweed clones were counted as they were clipped. Harvested material was dried in a forced-air oven at 140°F for 48 hours to determine dry matter yield. After drying, samples were held for prospective estimation of nutritive value by NIRS analysis. At the December sampling it was determined that sampling should not be resumed until March 5, 2018, if there is sufficient growth.

Forage data were analyzed using SAS Proc GLM to compare sampling location and date and their interaction. When the F-test for sampling date or the interaction was significant ($P < 0.05$) means were separated using least significant differences.

Results:

Data and results of statistical analysis are presented in Table 1. There no significant interactions between sampling location (grazed or ungrazed areas) and sampling period. Only yield of triticale varied between grazed and ungrazed sampling locations (Table 1), which was not surprising. Bindweed clones and yield of bindweed both declined across sampling periods, which also was expected. The decline in bindweed clones after 17-Nov is due to the disappearance of the aboveground components due to grazing and dormancy (Table 1). The first hard freeze (28°F) occurred on 9-Nov (Table 5 on page 14), but soil temperatures remained >40°F and air temperatures remained above freezing afterward until 6-Dec at which time the daily lows dropped consistently to <20°F. It is likely that the clones still exist below the surface. The increase in triticale yield across sampling periods also was expected as temperatures were favorable for growth (Table 1). Nevertheless, growth was not able to keep up with utilization by cattle and lack of precipitation was going to limit growth even further.

Table 1. Bindweed clonal population and dry matter yield of bindweed, other weeds, triticale, and other grasses in bindweed-infested pastures

Treatment effect	Bindweed clones	Bindweed	Other weed	Triticale	Other grass
Sampling location (SL)	# /sq. m	- - - - - - - - - - - - - - - - - -	g / sq. m	- - - - - - - - - - - - - - - - - -	
Ungrazed	37.1	7.19	5.13	14.08	19.92
Grazed	35.5	6.91	5.74	10.38	17.21
Sampling period (SP)					
10-Oct	45.1	10.56	9.57	6.30	13.30
17-Nov	51.2	9.59	4.37	15.61	25.26
11-Dec	12.7	1.00	2.37	14.78	17.13
LSD, 0.05	16.2	3.16	NS	3.49	NS
		P-value of F			
Pasture	0.1213	0.0572	0.2639	0.0959	0.0077
SL	0.7678	0.7870	0.8383	0.0207	0.5026
SP	0.0034	0.0010	0.1970	0.0018	0.1107
SL x SP	0.9683	0.9084	0.7951	0.1545	0.6213

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

Sampling will continue in 2018 to determine if competition by the triticale impacts spring and summer growth of field bindweed as measured by a reduction in the number of clones and yield over time.

Alternative Crops in Winter Wheat-Based Cropping Systems

Investigator(s):

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

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Potential Impact(s):

Multiple cropping systems projects are aimed at developing efficient modified winter wheat and alternate cropping systems to increase crop diversity and production capacity, water use efficiency, soil quality, and sustainability in this region. In New Mexico, winter wheat is planted on approximately 380,000 acres, mostly under dryland management. If even a small yield improvement ($10/acre; equivalent to about 1.5 bushel wheat @ $6.50/bu) can be made through advanced rotation, while improving the water use efficiency and soil quality, a significant economic benefit ($3.8 million) would result.

Introduction:

Under dryland conditions of the Southern High Plains, the production capacity of traditional winter wheat cropping systems (wheat-fallow and wheat-sorghum-fallow rotations) has stagnated. The scope of crop intensification in the rotation to improve the overall productivity of dryland cropping systems is extremely limited by the availability of soil moisture in the growing season. Considering the unpredictable weather and erratic precipitation patterns, supplementing nitrogen and other inputs under rainfed conditions is often a risky and an unprofitable management decision for most of the existing winter wheat cropping systems. In addition, the peak summer fallow period of the traditional winter wheat cropping system allows considerable amount of nutrient loss from the top soil due to lack of cover. Keeping the disadvantages of the existing cropping system in view, devising a new strategy is necessary for efficient utilization of stored soil moisture and to conserve the finite resources of soil while maintaining production sustainability.

In reality, the replacement of the fallow period in wheat-fallow rotation with any alternative crop will affect the soil water content and yields of the following cash crop. At the same time, leaving fallow in the rotation will inevitably result in unproductive evaporation losses of soil moisture, making the system more vulnerable and inefficient. Introducing an alternative crop in the fallow period will have several advantages in terms of productivity per each drop of water, soil quality, and sustainability. Optimizing crop rotation benefits in traditional winter wheat systems by introducing diversity is necessary for sustainable crop production in semi-arid environments. The effects of alternative crops in the rotation sequence in terms of productivity, water availability, and nutrient use efficiency should be evaluated before making any practical recommendations to producers.

Methods:

To evaluate alternate crops in winter wheat based cropping systems, under dryland conditions, a study was established in 2014 using six winter and summer rotation crop treatments in the field along US 54 on the east side of the center's driveway. The experiment was established on a 15-year-old stand of predominantly warm-season grasses and is a randomized block design with three replications in which plots are 30x40 ft. The soil type is Canez fine sandy loam (Fine-loamy, mixed, superactive, thermic Ustic Haplargids). The crop rotation options with winter wheat are given in Table 1 along with cultivars, seeding rates, planting depths, and planting times and years. To maximize the data generation capacity, each rotation will be continually planted in three sequential segments during spring/fall season until one cycle of the rotation is complete within a given year.

Access tube installation into 2015 fall planted plots took place on October 13 and 14, 2015, and subsequent tubes have been installed in plots as needed (see details in the 2015 Annual Progress Report of the Agricultural Science Center at Tucumcari, available upon request). Beginning spring 2016, a CPN 503DR Hydroprobe was used to measure soil moisture content. Cable stops were placed every six inches from 0 to 48 inches.

Table 1. Treatment species, varieties, seeding rate, and planting season for alternative cropping systems in winter wheat at Tucumcari, NM in 2017.

Species	Scientific Name	Variety	Seeding Rate (PLS lb/A)	Planting Depth (in)	Season Planted
Winter wheat	*Triticum aestivum*	TAM111	40	1	F14, F15
		Winterhawk	40		F16
Chickpea	*Cicer arietinum*	CDC Frontier	200	1.5	S15, S16,S17
Berseem clover	*Trifolium alexandrinum*	Balady	20	0.5	F14, F15
		Frosty	20		F16
Austrian winter pea	*Pisum sativum*	UNKNOWN	80	1.5	F14, F15, F16
Pearl millet	*Pennsitum glaucum*	Wonderleaf	6	0.75	S15, S16,S17
Winter canola	*Brassica napas*	DKW45-25	5	0.5	F14, F15, F16
Tepary bean	*Phaseolus acutifolius*	Blue Speckle	25	1.5	S15, S16,S17
Grain sorghum	*Sorghum bicolor*	KS585	3.75	1	S15, S16,S17

At the beginning of the 2017 spring planting season, initial incremental soil sampling was conducted on the soil profile to a depth of 24 inches to determine the nutrient status and soil moisture content. Residual nitrogen in most plots was 15 lb/A with few exceptions and soil moisture content was about 7%, at spring planting determined by gravimetric soil moisture analysis. Spring crops in 2017 were planted on June 23. Germination tests were performed by the seed distributor to ensure seed quality for each species prior to planting. The test was planted with a John Deere row crop planter equipped with no-till coulters on a toolbar preceding the planter units with appropriate seed boxes and planting adjustments for each crop's seeding rate as established by the planter plate manufacturer. The row spacing was 15 inches.

Spring crops planted in 2017 were harvested from a 10ft by 2-row area in each planted plot on October 10, 2017, and dried down to measure biomass and grain yield. Seedheads were clipped from all stalks in the sampling area and stored in paper bags while remaining above ground biomass was clipped at ground level and put into polybags. Harvested samples were dried at 140°F for two days and overall dry weights were measured. Seedheads were thrashed by hand. Data were used to estimate yield characteristics per acre.

Fall crops were planted between November 30 and December 1, 2017, and average initial soil moisture content was about 5% at the time of planting. Planting procedures were consistent between spring and fall plantings. Soil moisture probe measurements continued until the first hard freeze (28°F).

The study was maintained under rainfed conditions and pest problems were managed using appropriate management tools as shown in Table 2.

Table 2. Applications made to the winter wheat cropping system study at Tucumcari, NM in 2017.

Brand Name	Rate	Crop Plot	Application Date
Roundup	2%	All plots	June 19, 2017
Brimestone	2 pt/100 gal	Legumes	June 19, 2017
Basagran	1 pt/A	Legumes	June 19, 2017
COC	2 pt/100 gal	Legumes	June 19, 2017
Roundup	1.5%	Unplanted	September 6, 2017
In Place	1:4 parts	Grass and Fallow	September 6, 2017

The yield data was analyzed using SAS

Proc GLM procedure and significance of treatment means was reported using LSD test with 5% type III error significance.

Results:

Winter crops in 2016 failed to produce measurable yields due to poor stand establishment. Biomass and grain yields of crop species planted in the spring 2017 are presented in Table 3. Biomass yields of both grain sorghum and pearl millet were statistically similar, but significantly higher than spring wheat. Grain yield of pearl millet was statistically higher than grain sorghum and winter wheat (P<0.05).

Table 3. Biomass and grain yield of crop species planted in spring of 2017 at Tucumcari, NM.

	Biomass Yield (lb ac^{-1})	Grain Yield (lb ac-1)
Grain sorghum	2617	196
Pearl millet	2743	450
Spring Wheat	398	173
LSD 0.05	545	175

Fall 2017 planted crops failed to establish due to delayed planting and lack of sufficient soil moisture.

Manure Incorporation in Strip Tillage Systems

Investigator(s):

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

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Potential Impact(s):

Manure management project at Tucumcari aimed at cutting the manure material, transportation, and application costs by 60% by applying to strip-till area around the plant root zone. Additionally, this will enhance the water and nutrient use efficiency. This practice also has a potential patent opportunity for new commercial dry manure applicator in the strip till area.

Method:

To evaluate manure rate and incorporation effects on water dynamics, nutrient availability, and yield characteristics of grain sorghum in strip tillage systems under dryland conditions, a study was established in 2017. The site was an area of Canez fine sandy loam in the field along US 54 on the east side of the center's driveway into 8 in. triticale stubble that had been previously strip-tilled using an Orthman 1tRIPr strip tillage machine set on 30-in. centers. Treatment combinations included an application of 0, 5, or 10 ton/A of manure (0T, 5T, and 10T, respectively) applied at the surface of the strip-tilled band that was either left at the surface or incorporated to a 6-8inch depth by a second pass of the strip-till machine. The experiment was a split-plot design with 4 replications with the main treatment being manure application rate and subplot as the incorporation method. Each experimental unit was a 30x10 ft. with four rows on 30-in. row spacing. Manure application rates were calculated on %w/w basis and applications were made manually on May 25, 2017. Before applying the manure, three random samples were collected from a manure pile and composited before being sent to Ward Laboratories, Kearney, NE for chemical analysis.

Table1. Chemical characteristics of the manure used in the study conducted at Tucumcari, NM during 2017.

Moisture (%)	6.45	Calcium (%)	1.89
pH	8.1	Magnesium (%)	0.48
Soluble Salts (mmhos/cm)	20.09	Sodium (%)	0.26
Total Nitrogen (%)	1.48	Sulfur (%)	0.28
Organic Nitrogen (%)	1.44	Zinc (ppm)	133
NH_4-N (%)	0.016	Iron (ppm)	4921
NO_3-N (%)	0.028	Manganese (ppm)	173
Phosphorus (P_2O_5) %	1.25	Copper (ppm)	43
Potassium (K_2O)%	1.15		

Based on the chemical analysis, the manure was a good source of N, P, and Fe with each ton of manure providing 33 lb total N, 28 lb of P_2O_5, and 9.5 lb of Fe on a dry basis. This manure also supplemented significant amounts of other macro and micro nutrients. The maximum rate of 10T manure application in the study provided 330 lb of total N, 280 lb of P_2O_5, and 9.5 lb of Fe, out of which approximately 50% of P and Fe nutrients were available for plant growth and development in the first year of manure application and remaining 50% will be available in the subsequent years through mineralization. Chemical analysis also showed that about 85-90% of total N present in the manure was organic and this form of N is mostly unavailable to plant growth. It was estimated that approximately 20% of total N present in the manure was available for plant growth in the first year and remaining in the subsequent years through mineralization.

Grain sorghum was sown at 43,344 seeds/A on June 6, 2017, with a John Deere row crop planter. Plots were given supplemental irrigation on June 22 and June 30, 2017 at 1.5 in of irrigation each time. At two-week intervals from immediate pre-planting to immediate post-harvest, soil moisture samples were collected to a 30-in. depth from two locations each from the strip-tilled row adjacent to the plants using a Giddings Hydraulic Soil Sampling Machine. Initial soil samples were collected on July 1. Upon collection, samples were divided into 6-in. increments. Incremental samples from same soil depth within a plot were stored in a paper bag and wrapped in a plastic bag then weighed. The samples were then dried at 221°F for 24 hours and reweighed to determine the gravimetric moisture content (%w/w) and total water use was calculated as the difference between applied water (precipitation + irrigation) and soil water content. Initial plant population counts were counted on June 30, 2017. Larger Russian thistle plants that grew later in the season were removed by hoeing.

On December 11, 2017, 10-ft.of the center two rows of each plot were harvested to assess stalk yield characteristics and plant chemical composition using a forage plot harvester equipped with a weighing system. Sub-samples of biomass were collected, bagged, weighed, and dried as described for soil samples to determine dry matter content and yield. Dried samples were ground to pass a 1-mm screen and sent to Ward laboratories, Kearney, NE, for tissue nutrient analysis.

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

Results:

The chemical analysis of soils at the end of the study showed a significant increase in the nitrate-N and Olsen-P contents at the top 0-12 inches soil depth in the incorporation manure application method compared to the control and corresponding surface treatments (Table 2). However, there were no significant differences in the nitrate-N and Olsen-P contents among different manure treatments at 12-24'' incremental depths. Other chemical characteristics such as pH and organic matter were not influenced by either manure rate or application method at both depths.

Table 2. Effect of manure treatments on chemical characteristics of soil at the end of study in strip-tillage at Tucumcari, NM during 2017

	Soil depth							
Manure Treatment	**0-12"**	**12-24"**	**0-12"**	**12-24"**	**0-12"**	**12-24"**	**0-12"**	**12-24"**
	pH		**No3-N (ppm)**		**Organic Matter (%)**		**Olsen-P (ppm)**	
Control	8.3	8.2	1.02	1.01	1.02	1.01	10.79d	8.01
5T+ S	8.4	8.3	1.15	1.05	1.15	1.05	12.07c	8.73
5T+ I	8.4	8.4	0.97	1.10	0.97	1.10	11.95c	8.15
10T+ S	8.5	8.3	1.03	1.07	1.03	1.07	13.70b	8.20
10T + I	8.4	8.4	1.11	1.17	1.11	1.17	16.75a	9.07
P-value	0.7804	0.5678	0.5067	0.3569	0.5067	0.3569	0.0134	0.3450

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

The trial was managed under dryland conditions, with lifesaving irrigation. Total precipitation received from planting to harvesting was 9 inches. Supplemental irrigation (3 in.) was provided due to poor soil moisture conditions after planting to ensure good germination and stand establishment in the experiment as indicated by the lack of difference in plant population (Table 3). Extremely dry conditions at the critical pollination and grain filling stages resulted in no grain production in 2017, despite the application of supplemental irrigation. Therefore, only biomass yields were reported. Biomass yield of grain sorghum was significantly affected by manure treatments (Table 3). The 10T manure rate increased yield over both the control and the 5T rate and manure incorporation at a 6-inch depth in both 5T and 10T manure rate applications significantly improved the biomass yield over their corresponding surface applications.

Table 3. Effect of manure rate and incorporation method on plant population, water use, and biomass production as a function of water use of strip tilled grain sorghum at Tucumcari, NM, during 2017.

Manure Treatment	Plant population	Biomass	Biomass N	Biomass P	Total Water Use	Water Productivity
	Plants/A	lb/A	%	%	Inches	lb ac-in^{-1}
Control	34546	2306c	1.34	0.12c	6.88	335d
5T+ S	34477	2197d	1.52	0.16bc	6.52	336d
5T+ I	36735	2358c	1.57	0.17b	6.40	368c
10T+ S	37795	2643b	1.38	0.15bc	6.41	412b
10T + I	38179	2873a	1.67	0.22a	6.26	459a
P-value	0.1074	0.0143	0.0850	0.0458	0.8671	0.0158

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

Although statistically not significant, there was a trend that showed slightly elevated levels of the tissue N in the manure incorporation treatments over surface applications (Table 3). This may be due to significant increase in the soil nitrate-N and Olsen-P in the incorporation method compared to surface application (Table 2). Tissue P elemental composition of grain sorghum was significantly impacted by both manure rate or application method in the study during 2017 (Table 3). Incorporation method, especially in 10T rate, significantly increased the biomass P content. Water dynamics and water use efficiency of manure applications are presented in the Table 3. Total plant water use was statistically not influenced by either manure rate or incorporation method. The water productivity (biomass yield/acre-inch of water use) was significantly affected by manure treatment (Table 3). Incorporation of the 5T and 10T manure rates at 6 in depth increased the water productivity by 32 lb ac-in^{-1} (368 vs 336 lb ac-in^{-1}) and 47 lb ac-in^{-1}(459 vs 412 lb ac-in^{-1}) compared to its corresponding surface application, respectively. Although statistically not significant, there was a trend that showed a relative increase in the water productivity of higher manure application compared to its corresponding lower manure application (Table 3).

Additional study with consistent results may strengthen trends observed in this single year data.

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

Investigator(s):

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Potential Impact(s):

Identification of opportune/cover crops to replace the fallow period in semi-arid cropping systems will not only help the local farming community to achieve higher resource use efficiency (especially water and nutrients) and productivity, but also promote state-level infrastructure and broader marketing opportunities. Understanding the water use dynamics of various cover crops and increasing diversity in the cropping systems will not only reduce the seasonal risk of crop failures due to water scarcity, but also increase the farm-level income security through efficient use of available water resources. The outcome of this project will potentially ensure increased productivity, sustainability, and food and forage security.

Methods:

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

Table 1. Species, cultivars, and seeding rates for irrigated and dryland spring cover/rotation crops at Tucumcari in 2017.

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

The study was established under the center pivot irrigation system at the North Farm. The soil type was Canez fine sandy loam. The experiment was planted in a randomized block design with four replications with plot dimensions of 10x20ft. The plots were planted using a plot drill with a metering cone and set to 8in row spacing on June 7, 2017. After planting, soil samples were collected and access tubes were installed into each plot using a Giddings Machine using a 48in by 2in diameter sampling tube with view slots. Soil samples collected were broken down into 6in increments for nutrient samples. Access tubes were installed to 5ft deep in the plots to measure water use efficiency using a CPN Hydroprobe every two weeks. When appropriate, weed management (Table 2) was used in addition to hand weeding plots to control large weed infestations.

Table 2. Pesticides used during the spring planted cover/rotation crop study at Tucumcari in 2017.

Chemical	Rate	Crop	Date
Basagran + InPlace	2pt/A + 8 oz/A	Legumes	7/10/2017
Detonate + NIS + InPlace	8 fl oz/A + 2pt/100gal + 1:4 parts	Grasses	7/10/2017
Basagran + InPlace	2pt/A + 8oz/A	Legumes	7/14/2017
Basagran + InPlace + CoC	2pt/A + 8oz/A + 1qt/A	Legumes	8/17/2017
Clethodim + CoC	6floz/A + 1qt/A	Legumes	8/18/2017

Irrigated plots received 7.5 in. of water to supplement 11.6 in. growing season (June to October) precipitation. Two 1 in. lifesaving irrigations were given to dryland plots to encourage proper germination and establishment at the beginning of the trial.

Both dryland and irrigation experiments were harvested on October 13, 2017. Sesbania plots were harvested using a self-propelled forage plot harvester equipped with a weighing system. A subsample of harvested material from each plot was collected and dried for 48 h at 140°F to determine dry matter content and yield. For sesbania, the plot area harvested was 5ft by a length measured after harvesting. Aboveground biomass for cowpeas and millets were harvested using 1m^2 sampling frames at three random locations within each plot. Seedheads and biomass were placed into separate bags. Seeds were cleaned using a combination of sieves and forced-air seed cleaner. Seeds and biomass samples were dried for 48 h at 140°F and weighed to determine yield. The yield data were analyzed using SAS Proc GLM and treatment means were separated using LSD test with 5% type III error significance.

Results:

Most of the crop species failed to produce measurable amounts of seed yield under dryland conditions (Table 3). In addition to the non-uniform and untimely precipitation received during summer of 2017, a large number of weeds in the dryland cropping area suppressed the crop growth and development to the most extent. Weed control options in the study were limited due to the complexity of treatment structure that includes both broadleaf and monocot species in adjacent plots. Biomass yield was significantly higher in both sole pearl millet and its combination with cowpea ($P<0.05$).

Table 3. Yield characteristics of various cover/rotation crops under dryland conditions in Tucumcari during summer, 2017

Crop	Seed yield (lb/A)	Biomass yield (lb/A)
Cowpea	38c	995c
German Millet	536a	1973b
Pearl Millet	185b	3280a
Proso Millet	167b	1407bc
Pearl Millet + Cowpea	235b	3224a
Sesbania	--	1275c
Lablab	--	891c
LSD 0.05	117	674
CV (%)	37	32

Under irrigated conditions, seed yield was significantly ($P<0.05$) higher in pearl and German millet compared to other species, with the same amount of supplemental irrigation (Table 4). Like in the dryland experiment, biomass yield was significantly higher in both sole pearl millet and its combination with cowpea ($P<0.05$). In this cover crop mix, In addition to the soil health benefits, legumes produce high-value protein-rich animal feed when the existing low quality feed sources cannot meet the nutritional requirements of cattle, if livestock is an integral component of the farming system. The water use dynamics of this project are yet to be determined.

Table 4. Yield characteristics of various cover/rotation crops under irrigated conditions in Tucumcari during summer, 2017

Crop	Seed yield (lb/A)	Biomass yield (lb/A)
Cowpea	281c	4172b
German Millet	1245a	4979b
Pearl Millet	1348a	6664a
Proso Millet	319c	2699c
Pearl Millet + Cowpea	961b	6906a
Sesbania	--	1426d
Lablab	--	1893d
LSD 0.05	212	1027
CV (%)	27	34

Tillage and Nitrogen Management in Corn

Investigator(s):

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Potential Impact(s):

Tillage and N management research in corn at Tucumcari demonstrates potential impacts on soil and environmental quality, sustainability, economics, and crop production. Based on current year's test results, strip tillage has a potential yield advantage of $5.6 million (based on 2016 harvested acreage and price) in value over conventional tillage for the grain part alone in the New Mexico. Also, cutting down the N fertilizer rate from 275 lb/A to 175 lb/A would save about $25/A on average production cost in corn.

Introduction:

In New Mexico, soil degradation is a common problem. An indicator of this problem is accelerated soil erosion by wind and water on cropland. One way to address soil degradation is by reducing tillage in agricultural soils, which will aid in rebuilding soil quality levels. Both strip-till and no-till systems have been shown to lead to soil improvement in terms of organic matter build up and moisture conservation. The benefits of strip-till and no-till systems have been demonstrated for many parts of the United States. However, the impacts of these tillage systems in the semi-arid and arid Southwest have not been well documented. To make reduced tillage systems attractive to farmers in the region, multi-locational trials testing these tillage systems are needed.

Methods:

As a part of multi-location trial, a study was planted in Tucumcari on June 6, 2017, to evaluate the impacts of tillage method and nitrogen rate (N-rate) on crop yields and soil quality in the semi-arid environment of eastern New Mexico. The study was designed in a split-plot with tillage method as a main plot and N-rate as a sub-plot. Three tillage methods tested in the study were: conventional-, no-, and strip- till. Two N-rates were 175 and 275 lb ac^{-1}. The main plot treatments were assigned in a randomized block with 4 replications with N-rate randomized within main plot. The soil type is Canez fine sandy loam (Fine-loamy, mixed, superactive, thermic Ustic Haplargids). Soil moisture content at the time of planting was about 8.8%. The study was established in 8-in. wheat stubble. Plots were prepared using an Orthman 1tRIPr strip-tillage machine or a conventional-till rototiller. The plot dimensions were 20x30 ft. Within each split plot, there was a total of four planted rows and the center two rows were harvested for analysis. Corn (Dyna-Gro 1716779) was planted using a John Deer row crop planter set on 30-in. row spacing with the appropriate settings based on manufacturer instructions. The seeding rate was 80,000 seeds/A. No-till coulters were installed on a toolbar in front of the planter units to accommodate that treatment. It was assumed that these coulters would have no impact on the conventional-till and strip-till treatments. An initial application of nitrogen fertilizer was applied on July 9 2017, at 30 lb/A on all plots and remaining N was applied on August 25, 2017, according to the N-rate treatment. Gramoxone (3 pt/A) was applied on May 12 and Starane Ultra was applied on June 24. Plant populations were counted on July 17, 2017, from three random locations per sub-plot at 1m long each and averaged for the sub-plot. The test was watered as frequently as every two weeks based on precipitation. Pest problems were managed using appropriate management tools as shown in Table 2 for all treatments.

Soil samples from two sites from within each sub-plot were collected at the beginning and conclusion of the study in 12-in increments to a depth of 24 in. using the Giddings Sampling Machine with a 1in diameter sampling tube. Samples from each increment depth within a sub-plot were composited, placed in paper bags, and wrapped in a plastic produce bag. Samples were then weighed, dried in an oven for 24 hours at 221°F and weighed again to estimate gravimetric soil moisture.

Plot harvest took place on October 25, 2017. Each plot was harvested in 10ft increments at 3 random locations within each sub-plot. From the sampling area, total above ground biomass was harvested and weighed. Ears were harvested, weighed, and shelled. All non-grain (vegetative) biomass (stalk, cob, and husk) were shredded together and weighed. Grain was weighed and the volume was measured to determine test weight. Grain and vegetative samples were dried for two days at 140°F and re-weighed before being sent for tissue N analysis by combustion with a LECO TruMac. The yield data were analyzed using SAS Proc GLM and significance of treatment means were reported using LSD test with 5% type III error significance.

Results:

Results of statistical analyses and data for the effects of tillage, N-rate, and their interactions on yield characteristics and composition of corn are presented in the Table 1. There was no interaction between the tillage and N-rate in affecting the yield characteristics.

Table 1. Effects of tillage and N-rate on yield characteristics and N composition of corn at Tucumcari, NM in 2017

Treatment	Plant Population	Grain Yield	Stover Yield	Test Wt.	Grain N	Stover N
	Plants/A	lb/A	lb/A	lb/bu	%	%
Tillage						
Conventional	76234a	6765	6836	53.3	1.42	0.97
Strip-tillage	74743ab	8650	7496	57.3	1.49	1.27
No-tillage	72675b	6203	6510	54.5	1.42	1.14
LSD $_{(0.05)}$	2347	788	745	2.7	NS	NS
N-rate (lb/A)						
175	74864	6891	6868	55.1	1.65	1.15
275	74211	7004	6955	54.9	1.59	1.16
			P-values			
Tillage	0.0345	0.0274	0.0483	0.0012	0.7896	0.6543
N-rate	0.6782	0.3496	0.8492	0.7342	0.4356	0.0956
TillageXN-rate	0.1834	0.6193	0.4078	0.9612	0.3456	0.5423

Means within a column for the tillage treatment having the same letter are not significantly different based on the 5% LSD.

Grain and silage yields and test weights were significantly affected by tillage method (Table 1). Strip tillage showed a significant advantage over both conventional tillage and no-tillage. N-application rate had no significant on yield characteristics and test weight (Table 1). Both tillage method and N-rate had no significant effect on seed and biomass nitrogen. However, although statistically not significant at 5% probability level, strip tillage had slightly elevated levels of stover N (Table 1).

Long-term benefits of conservation tillage and N management in corn are yet be assessed.

Cover Crops for Improving Sustainability of Winter Wheat - Sorghum – Fallow Cropping Systems

Investigator(s):

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Potential impact(s):

Based on the current study, replacing fallow with cover crops in a traditional winter wheat-sorghum-fallow cropping system can have significant economic advantages. For example, replacing fallow with an oat cover crop in this study can produce potential gross economic benefit worth of $220 per acre. Additionally, planting cover crops will have a significant advantage in improving long-term soil quality and sustainability.

Methods:

This study was established to compare cash crop performance following cover crop treatments to focus on both soil organic carbon and nitrogen dynamics in wheat-sorghum-fallow following cover cropping as well as measuring water content and water use efficiency. For this purpose, initial soil samples were collected during October 2016 from 0-6 in. depth, at the time of plot establishment, and composited for each set.

Table 1. Treatment information for Improving Sustainability of Winter Wheat – Sorghum – Fallow Cropping Systems under irrigated and dryland conditions at Tucumcari.

Year	Cropping Event
	Set I
Fall 2016	winter wheat planting
Spring 2017	winter wheat harvest
Spring 2017 - Spring 2018	fallow period
Winter-Spring 2018	cover crop planting
Spring 2018	terminate cover crop: May
Spring 2018	grain sorghum planting
	Set II
Fall 2016	fallow period
Winter-Spring 2017	cover crop planting: mid-Feb to March
Spring 2017	terminate cover crop: May
Spring 2017	grain sorghum planting
Fall 2017	harvest grain sorghum at maturity
	Set III
Fall 2016	fallow period
Winter-Spring 2017	cover crop planting: mid-Feb to March
Spring 2017	terminate cover crop: May
Spring 2017	fallow: May - Oct.
Fall 2017	winter wheat planting

The study was established on October 6, 2016, under the North Farm center pivot irrigation system in areas defined for limited irrigation and dryland. Three 120 x 120 ft sets of the study, using 20 x 30 ft plots, were laid out in each area for staggering of treatments over time as shown in Table 1. Cover crop treatments include oats (40 lb/A, Austrian winter pea (20 lb/A), winter canola (2 lb/A), as well as two, two-species mixes (pea + oats or pea + canola, with each species sown at ½ their monoculture rate), a three species mix (pea, oat, canola, each sown at 1/3 their monoculture rate) and a six species mix [canola, pea, and oat, each sown at 1/6 their monoculture rate, and barley, hairy vetch, forage radish sown at 6.67, 2.5, and 0.67 lb/A, respectively, which is 1/6 of their monoculture seeding rate). Cover crops in set II and set III were planted on February 24, 2017, and terminated on May 22, 2017. Grain sorghum in set II was planted on June 16, 2017, and harvested on December 11, 2017. For grain sorghum, the plot area harvested was 20x5ft^2. Grain yield was estimated per acre basis by adjusting moisture content at 14%. Aboveground biomass for all cover crops were harvested using 1m^2 sampling frames at three random locations within each plot. Seeds and biomass samples were dried for 48 h at 140°F and weighed to determine yield. The yield data were analyzed using SAS Proc GLM and treatment means were separated using LSD test with 5% type III error significance

Methods:

Cover crop results in set II suggest that oat and its mix with pea had significantly greater forage yield than other cover crops and their mixes, except Pea/Oat, which was intermediate (Table 2). The magnitude of forage yield for different single cover crop species was in the order of canola < pea < oat (oil seed crop < legume < grass). Yield of the grain sorghum cash crop planted after cover crop termination was significantly impacted by previous season cover crop type and their composition ($P<0.05$). In almost all cases, except the sorghum followed by pea/canola mix, the grain yields of sorghum were either equal or higher than fallow. In general, grain sorghum followed by cover crop mixes (2-way, 3-way, and 6-way) yielded more than single species, with an exception of oat. Thus, in this study, planting cover crops in the early spring did not affect the yields of the subsequent cash crop. Moreover, in some cases, it is evident that there was a significant economic benefit from planting the cover crop. However, it is cautioned that periodical soil moisture irregularities or drought persistence at any particular growth stage during the crop season may have significant impact on the yield dynamics of cover crop and its subsequent cash crop. Any reasonable conclusions from this study require long-term data before making any practical recommendations.

Table 2. Set II results: Cover crop yield and subsequent grain sorghum yields in 2017.

	Yield	
Cover crop	**Cover Crop forage**	**Sorghum grain**
	lb/A	
Canola	1516b	3153b
Fallow	-------	3316b
Oat	2487a	4116a
Pea	1942ab	3309b
Pea/Canola	1670b	2517c
Pea/Oat	2453a	4153a
Pea/Oat/Canola	1723b	4443a
Six-way mix	1547b	4249a

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

Reduced Tillage Effects on Cotton Growth and Yield in Semi-Arid Regions of New Mexico

Investigator(s):

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Potential Impact(s):

Reduced tillage practices can be effective in minimizing the soil erosion effects of strong wind on more than 50,000 acres of cotton across the New Mexico. Adoption of conservation tillage could also control the release of greenhouse gas emissions, help the soil to retain more organic matter and carbon, and reduce energy consumption benefiting the producers economically by reducing production costs.

Methods:

To evaluate how different tillage systems affects the growth, lint yield, and lint quality of cotton in New Mexico, a study was conducted at the NMSU Agricultural Science Center in Tucumcari, to evaluate the comparative effects of conservation tillage practice (strip till and no-till) vs. conventional tillage methods (Con-till bedded; Con-till flat) methods with cotton as the test crop in three replicates of a randomized complete block design. Strip tillage involved a single pass of the strip tillage equipment (Orthman Manufacturing 1tRIPr strip tiller), creating a narrow zone of seed bed, leaving the rest of the intervening soil undisturbed. Conventional tillage involved five tillage passes (plowed, twice disked, subsoiled, harrowed) before planting the corn seeds. For the Con-till bedded treatment, after tillage into a flat seedbed, beds as for furrow irrigation were formed on 30-inch centers. In no-till, the soil is totally undisturbed, while the seeds are drilled directly into the standing stubble. Upland cotton, “Acala 1517-08,” planted on May 24, 2017, was terminated due to poor stand establishment. Replanting took place on June 19, 2017. The seeding rate was 3-4 seeds per foot (15-20 lbs per acre). For cotton, the planter settings were: a sprocket of 11 front and 14 back, using metal plate H3102B and spacer: metal V5055. Each plot consisted of four 30-inch rows. Approximately a month after planting, plant population counts were taken. Subsequent data included plant height, number of nodes, squares, total bolls, open bolls. Plants were harvested for lint yield on December 9, 2017. For yield estimation, all bolls in 10 feet of the two middle rows were harvested. Additionally, 25 matured bolls (1 or 2 bolls per plant) were collected per plot to get the yield quality. The bolls were weighed and later were ginned, separating the seed from fiber. Lint yield per acre was calculated by multiplying lint yield from the harvested area by an area factor. Weed biomass samples were collected three times (49, 124, and 170 DAP) during the crop growth season. Weed biomass/A was measured by hand-clipping all weeds within a three representative 1 ft^2 areas for each plot. Harvested material was dried at 158^o F for 48h. Soil samples were collected before planting and after harvest from five random locations per plot and mixed to prepare a composite sample. The pre and post season composite soil samples were analyzed for physical (dry aggregate size distribution and wet aggregate stability) and chemical characteristics (active permanganate oxidizable carbon).

Data were analyzed by SAS Proc GLM and when a significant difference was observed, means were separated by least significant difference using an alpha level of $P < 0.05$.

Results:

Plant population, plant height, number of nodes, and number of bolls were not different ($P<0.05$) among the tillage treatments (Table 1). Additionally, all tillage management practices had statistically similar lint yield, except beds. However, the relative effects of tillage treatments were largely impacted by intensive rains during peak reproductive stages and harvest. Moreover, delayed replanting also affected the flowering and pollination that resulted in poor lint yields.

Table 1. Tillage effects on selected plant characteristics in cotton at Tucumcari, NM in 2017.

Tillage treatment[1]	Plant population	Plant Ht	Nodes	No. Bolls	Lint yield
	plants/A	Inches	#/plant	#/plant	lb/A
Strip till	58835	20.7	9.7	1.8	102b
No-till	63888	20.7	9.1	2.2	54b
Con-till flat	55176	22.8	10.2	2.6	99b
Con-till bedded	50820	23.8	10.0	2.3	164a

[1]Strip till, No-till, and Con-till signify strip tillage, no-tillage, and conventional tillage, respectively. Con-till bedded was a conventionally tilled flat seedbed formed into beds as for furrow irrigation on 30-inch centers.

Weed biomass did not differ significantly among the tillage treatments early in the growth season, but they did vary significantly at 124 and 170 days after planting (Table 2). For the most part, no-till had consistently higher weed biomass compared to other two tillage management systems, which could prompt higher economic costs in controlling weeds.

Any reasonable conclusions from this study require long-term data before making any practical recommendations. This study will continue in 2018.

Table 2. Weed dry biomass as a function of tillage treatments in cotton at Tucumcari, NM in 2017.

	Weed dry weight (lb) per acre		
Tillage treatments[1]	49 DAP	124 DAP	170 DAP
Strip till	971	1618ab	971c
No-till	1133	1942a	2104a
Con-till flat	971	1457b	1457b
Con-till bedded	971	2104a	1133bc

[1]Strip till, No-till, and Con-till signify strip tillage, no-tillage, and conventional tillage, respectively. Con-till bedded was a conventionally tilled flat seedbed formed into beds as for furrow irrigation on 30-inch centers.
DAP signifies days after planting.

Reduced Tillage Effects on Corn in Semi-Arid Regions of New Mexico

Investigator(s):

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Potential Impact(s):

Reduced tillage practices can be effective in minimizing soil erosion effects of strong wind in arid and semi-arid regions of New Mexico. Based on current year's test results, strip tillage can provide a potential yield advantage over conventional tillage in corn for both grain and silage in New Mexico worth of $14.2 million based on 2016 acreage and price.

Methods:

To evaluate how different tillage systems affects the growth, yield and forage quality of corn silage in New Mexico, an experiment was conducted in 2017 at the NMSU Agricultural Science Center at Tucumcari to evaluate the comparative effects of conservation tillage practices (strip till and no-till) vs. conventional tillage (Con-till) methods with corn as the test crop in three replicates of a randomized complete block design. Strip tillage involved a single pass of the strip tillage equipment (Orthman Manufacturing 1tRIPr strip tiller), creating a narrow zone of seed bed, leaving the rest of the intervening soil undisturbed. Conventional tillage involved five tillage passes (plowed, twice disked, subsoiled, harrowed) before planting the corn seeds. In no till, the soil is totally undisturbed, while the seeds are drilled directly into the standing stubble. Mycogen corn variety "TMF2H918" was planted on May 24, 2017, under the West Pivot. Each plot consisted of four rows spaced 30 inches apart. The seeds were planted at a depth of about 2 inches. Plant population was measured approximately a month after seed establishment. Data was collected on weed biomass, plant height, number of leaves, number of nodes, and number of ears after ear formation three times during the growing spell. For seed and biomass yield estimation, two rows of 10ft each were harvested in each plot on November 22, 2017. For the estimation of seed yield, ears were harvested, weighed, and shelled. All non-grain (vegetative) biomass (stalk, leaves, cob, and husk) were shredded together and weighed. Grain and vegetative samples were dried in an oven at about 158^{o} F for 48h to estimate the dry seed and biomass weights. Weed biomass samples were collected two times (74 and 149 DAP) during the crop growth season. Weed biomass was measured in each treatment by using a quadrat with 3 ft x 3 ft dimensions. The quadrat was randomly placed on the ground in each plot and the weed biomass within that area was manually collected and dried at 158^{o}F for 48h to estimate of the weed biomass. Soil samples were collected before planting and after harvest. Soil was collected from five random locations per plot using a soil auger and mixed to form a composite sample for laboratory analyses.

Data were analyzed by SAS Proc GLM and when a significant difference was observed, means were separated by least significant difference using an alpha level of $P < 0.05$.

Results:

Plant population, plant height, number of nodes, and number of leaves were not different among the tillage treatments (Table 1) and most plants had only one cob.

Tillage had a significant effect on corn seed and biomass yield ($P<0.05$). The grain yield results suggest that strip tillage had comparative advantage over other tillage management systems, followed by no-tillage (Table 1). The biomass yield results followed the similar trend as in grain yield. Strip tillage, being a fusion practice, had a combination benefits of both no-till and conventional till that resulted in higher grain and biomass yields.

Table 1. Tillage effects on selected plant characteristics in corn at Tucumcari, NM in 2017.

Tillage treatment	Plant population	Plant Ht	Nodes	Leaves	Grain	Biomass
	plants/A	Inches	#/plant	#/plant	lb/A	tons/A
Strip till	59532	87.08	14.33	15.33	5471a	15.59a
No-till	60984	86.83	14.08	15.08	4645c	9.89b
Con-till	59532	88.58	13.75	14.75	5074b	7.99c

Strip till, No-till, and Con till signify strip tillage, no tillage, and conventional tillage, respectively.
Means within a column followed by the same letter are not significantly different based on the 5% LSD.

Tillage had a significant effect on corn seed and biomass yield ($P<0.05$). The grain yield results suggest that strip tillage had comparative advantage over other tillage management systems, followed by no-tillage (Table 1). The biomass yield results followed the similar trend as in grain yield. Strip tillage, being a fusion practice, had a combination benefits of both no-till and conventional till that resulted in higher grain and biomass yields.

Weed biomass differed early in the growth season, but was similar at 149 days after planting (Table 2). For the most part, no-till had consistently higher weed biomass compared to other two tillage management systems, which could prompt higher economic costs in controlling weeds.

Any reasonable conclusions from this study require long-term data before making any practical recommendations. This study will continue in 2018.

Table 2. Weed dry biomass as a function of tillage treatments in corn at Tucumcari, NM in 2017.

	Weed biomass (lb) per acre	
Tillage	**74 DAP**	**149 DAP**
Strip till	2266.4b	1618.9a
No-till	3075.8a	1780.8a
Con-till	2266.4b	1942.6a

[1]Strip till, No-till, and Con-till signify strip tillage, no-tillage, and conventional tillage, respectively.
DAP signifies days after planting.

Alfalfa Planting Date Evaluation

Investigator(s):

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Potential Impact(s):

The Advisory Committee to the Agricultural Science Center at Tucumcari requested an evaluation of the effects of earlier than recommended planting due to first delivery of water in mid- to late May and the availability of Roundup Ready® varieties as a summer weed control option during establishment. Earlier planting may allow for recovery of some of the establishment costs in the seeding year, thereby, reducing interest in those inputs. Ongoing research demonstrates a more longer-term benefit to earlier planting of semi-dormant to slightly non-dormant varieties.

Method(s):

Alfalfa variety, WL 454HQ.RR (semi-dormant fall dormancy 6), was planted on June 5 & 26, July 17, August 7 & 28, and September 18 in 2013 and 2014 in adjacent tests under the highway center pivot irrigation system, in the field fronting US 54. The test area (Redona/Canez fine sandy loam) was conventionally tilled and formed into a flat seedbed for each test. Plots were sown using a disk drill fitted with a seed-metering cone at 20 lb inoculated seed/A in a Randomized Complete Block design with 3 replications. It was assumed that slight cultivation by the disks on the planter would be sufficient to freshen the seedbed on subsequent planting dates. After the first planting, irrigations with Class 1B treated municipal wastewater were applied approximately twice weekly to the test area to supplement precipitation, including plots not yet planted. Irrigation prior to planting was considered to have a negligible effect on establishment and yield as the soil was well-drained and maintained at field capacity.

Plots for the 2013 planting were 5 ft x 30 ft of which the center 5 ft x 25 ft were harvested for yield using a self-propelled forage plot harvester equipped with a weighing system. For the 2014 planting, plots were 5 ft x 20 ft of which the center 5 ft x 15 ft were harvested using the same equipment. During each harvest, a subsample of harvested material from each plot was collected and dried to determine dry matter concentration and yield and then ground to pass a 1-mm screen for stored for nutritive value analysis by near-infrared spectroscopy. For each test, in the seeding year, the first harvest was taken as soon as possible after 80 days after planting with any subsequent harvest approximately 35 days after that, unless that interfered with a 42 day rest period between planting or previous harvest and the anticipated first hard freeze (about November 5). Harvest dates in the seedling year of each test varied by treatment, such that, the first two planting dates were harvested twice, the middle two planting dates were harvested once, and the last two planting dates fell within or past the recommended late summer/autumn planting window and were not harvested at all. Six harvests were taken each year after seeding, which, in 2017, was May 19, June 21, July 19, Aug. 15, Sep. 11, and Oct. 30 for both tests.

Prior to the last harvest of 2017, irrigations with treated municipal wastewater totaling 19.5 inches were applied to supplement 25.0 inches of pre-growing season and growing season precipitation (November 2016 through October 2017). No fertilizers were applied in 2017; however, Warhawk (2 pt/A) was applied on April 7 to control alfalfa weevil and Nolo Bait (14 lb/A) was applied on June 21 to control grasshoppers. Applications of Clethidim (6 oz/A) were made on July 12 and August 18 to control grasses.

Total annual and cumulative dry matter yields at the same stand age from both tests were subjected to SAS MIXED procedures for tests of significance to compare test (planting year) and planting date and their interaction. Means were separated using an alpha level of $P < 0.05$ when a significant difference was observe. Replicate x test was considered random.

Results:

The main effect of test and the test x planting date interaction were not significant for any yield variable (Table 1). Differences among planting dates in annual yield through the 3rd production year (2016 for the

2013 test and 2017 for the 2014 test) were consistent across years with minor changes in magnitude. These differences in annual yield led to a difference between the 5-Jun planting and the 28-Aug planting for the 4-yr total yield that was 1.57 tons/A greater than the difference in the 3-yr total yield (data not shown).

Table 1. Dry matter yield (tons/A) over years of alfalfa planted on various dates at Tucumcari NM. Data including the 2013 & 2014 tests are the means of two tests and 3 replicates; data for the 2013 test only are the means of 3 replicates.

	2013 & 2014 Tests					2013 Test only	
Date	**Seeding year**	**1st Production Year**	**2nd Production Year**	**3rd Production Year**	**4-Yr Total**	**4th Production Year**	**5-Yr Total**
5-Jun	1.90A(2)	5.98A	6.80A	5.84A	20.52A	5.95	25.94A
26-Jun	1.38B(2)	4.85B	5.77B	5.22AB	17.22B	4.53	19.82ABC
17-Jul	0.48C(1)	4.07BC	5.56B	4.75B	14.85BC	5.21	19.13BC
7-Aug	0.50C(1)	4.64B	5.84AB	5.07AB	16.04B	5.85	20.88AB
28-Aug	0.00D(0)	3.07CD	4.88B	4.27B	12.22C	5.32	17.18BC
18-Sep	0.00D(0)	2.73D	5.03B	4.48B	12.25C	4.33	14.02C
			P-value of F				
Test (T)	0.7213	0.5358	0.1112	0.5496	0.2341	-----	-----
Date (D)	0.0001	0.0001	0.0082	0.0708	0.0001	0.2345	0.0380
T x D	0.1759	0.4787	0.6831	0.2605	0.6404	-----	-----

Means within a column followed by the same letter are not significantly different at $P < 0.05$.
Values in parentheses are the number of cuttings that year.

Although the effect of planting date was not significant for the 4th production year data from the 2013 test, the numeric differences and ranking among the planting dates was consistent to previous years and the contributed to widening the yield gap over the life of the stand between the 5-Jun and Aug-28 plantings (Table 1). These same results were observed with the 3rd production year data of the 2013 test, as reported in the 2016 Annual Report of the Agricultural Science Center at Tucumcari; however, addition of 3rd production year data from the 2014 led to a trend for a difference in yield shown in Table 1. Further data collection in 2018 providing 4th production year data from the 2014 test will determine if the lack of difference in 4th production year yields of the 2013 test is a true effect.

Consequently, producers could plant on June 5 or possibly earlier instead of August 28 and harvest at least twice in the seeding year to recover a considerable amount of the establishment costs. Earlier planting also will likely have increasing yield differences over the life of the stand.

Investigator(s):

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Potential Impact(s):

Municipalities are seeking uses for treated wastewater to minimize the release of potential pollutants into surface and ground water bodies. Because the soil can be a natural filtering agent, agricultural irrigation is being considered. Wastewater treatment plants (WWTP) are producing water that is generally safe to apply to animal feed and fiber crops. Alfalfa is the most important forage crop worldwide because it is adapted to a wide range of soil and climatic factors and has been successfully established and grown New Mexico State University's Agricultural Science Center using recycled Class 1B treated municipal wastewater from the City of Tucumcari WWTP. However, yield reductions have been observed compared to previous years when only canal water from the Arch Hurley Conservancy District was available. The Agricultural Science Center has the capability to apply both treated wastewater and canal water through the same irrigation system in the same field, which has a fairly uniform soil type. Determination of the potential impact of using treated municipal wastewater for irrigating alfalfa could assist producers with deciding whether or not to use the water source to irrigate alfalfa.

Methods:

Alfalfa (cv. 6829R) was planted August 18, 2017, in the field under the West Pivot. The test area (Redona fine sandy loam) was conventionally tilled and formed into a flat seedbed for sprinkler irrigation with canal water on the southeast side and treated municipal wastewater on the southwest side. Plots (5 ft x 20 ft) were sown using a disk drill fitted with a seed-metering cone at 20 lb inoculated seed/A in a strip-plot design with 4 replications within each irrigation source area. The effective planting width was 4 ft (8, 6-inch rows). In 2017, irrigations totaling 1.5 inches were applied in August and September to supplement 12.8 inches of growing season precipitation (August through October 2017). In early October, the irrigation system failed and no further irrigation was applied in 2017, while after the first week in October, precipitation totaled 0.04 inches for the remainder of the year. No fertilizers or pesticides were applied in 2017.

Soil samples had been collected immediately pre-planting from each test area for fertility and soil microbial community by phospholipid fatty acid (PLFA) analyses. On August 29 and September 6, 2017, plant counts were taken and averaged. On October 25, 2017, all plants in 1 ft of all rows (4 ft^2) from the east end of each plot were hand-clipped to ground level weighed, dried at 140°F for 48 hours, and reweighed for calculation of dry matter percentage and dry weight prior to being delivered to the lab for NIRS analysis of nutritive value. There were 6-22 leaves on harvested plants suggesting a degree of variation over time in germination and/or emergence of the alfalfa in this study.

Plant count, seedling dry wt., and selected nutritive value and selected PLFA data were analyzed using SAS PROC MIXED procedures to determine where differences ($P < 0.05$) existed between water sources. Replicate within water source was considered random.

Results and Discussion:

Data and results of statistical analysis are presented in Table 1. While there was no difference between irrigation sources in the number of plants/m^2, dry weight/m^2 and dry matter percentage were both higher for alfalfa irrigated for establishment using canal water compared to treated wastewater. Greater dry weight may have been due to more rapid germination allowing for more mature plants at the time of sampling. This also would explain the greater acid detergent fiber (ADF), neutral detergent fiber (NDF), and NDF digestibility (NDFD) for alfalfa irrigated with canal water compared to alfalfa irrigated with wastewater (Table 1) as more mature plants will have greater fiber accumulation and a decrease in the digestibility of the fiber.

Preplant soil analysis revealed no apparent issues in regard to fertility (including toxicities) or potential salt problems. Total microbial biomass and diversity index in the soil were not different between water sources after establishment; however, there was a difference in the proportion of total microbial biomass being arbuscular mycorrhizae (Table 1). The total biomass was poor to slightly below average for canal water irrigated soil and wastewater irrigated soil, respectively, and the diversity index was average to slightly below average for the canal water irrigated soil and the wastewater irrigated soil, respectively. The lack of arbuscular mycorrhizae in the wastwater area may indicate that compounds of concern in the wastewater have an impact on these soil microbes. Lack of precipitation or irrigation from early October until sampling time also may have been a factor.

Table 1. Plant and soil phospholipid fatty acid analysis data from a new alfalfa seeding irrigated with canal water or treated municipal wastewater at Tucumcari in 2017.

Source	Plants	Dry Wt.	Dry Matter	CP	ADF	NDF	NDFD	Total Microbial Biomass	Diversity Index	Arbuscular Mycorrhizae
	#/m^2	g/m^2	%	%	%	%	% of NDF	ng/g		% of Total Biomass
Canal Water	324	12.93	26.7	23.7	21.1	28.3	49.2	775.3	1.3	1.1
Wastewater	330	7.64	26.0	24.2	18.1	23.6	59.2	1067.8	1.2	0.0
SEM	36	0.80	0.2	0.2	0.4	0.5	2.4	348.0	0.0	0.3
P-value of F	0.9151	0.0035	0.0405	0.2176	0.0011	0.0005	0.0237	0.5746	0.1096	0.0391

CP, ADF, NDF, NDFD, and ND signify crude protein, acid detergent fiber, neutral detergent fiber, NDF digestibility, and not detectable, respectively.

Rhizobia were not detected in the PLFA samples (data not shown), although, the alfalfa roots included in the soil sample were nodulated. Perhaps the lack of detectable Rhizobium was because nodules had not been shed to release nitrogen into the soil, which also would have released the Rhizobium.

In 2018, the center 5 ft x 15 ft of each plot will be harvested 6 times for yield using a self-propelled forage plot harvester equipped with a weighing system. For each harvest, a subsample of harvested material from each plot will be collected and dried to determine dry matter concentration and yield as well as for nutritive value analysis by near-infrared spectroscopy. Samples for PLFA analysis also may be collected in spring and fall.

Investigator(s):

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Potential Impact(s):

Whitefringed beetle (*Naupactus leucoloma*, WFB) larval infestations damage alfalfa root systems leading to early stand demise (Figure 1). The incidence of early stand decline is increasingly being associated with WFB infestations throughout New Mexico. A group of entomopathogenic nematodes (EPN) known to prey on relatives of WFB have been discovered by researchers at Cornell University, Ithaca, NY, who are interested in determining if the nematodes will control other insect pests. It would be in the best interest of New Mexico's alfalfa growers if these nematodes were found to be adapted to New Mexico's climatic and soil conditions and effective in controlling WFB.

Figure 1. A two-year-old stand of alfalfa destroyed because of root feeding by whitefringed beetle grubs. Note the sparse stand of alfalfa plants and abundant growth of weeds and grasses. The previous stand was also in this condition two years after planting. (Photo credit: Leonard Lauriault, August, 2008).

Methods:

In response to a request by the Advisory Committee to the Agricultural Science Center at Tucumcari, a local producer who had suffered loss from WFB was approached about the possibility of using a newly planted field to evaluate the local adaptation of EPN. Nematodes [*Steinernema carpocapsae* (Sc), which lives in the top 2 inches of soil, S. *feltiae* (Sf), which would move to 6-8 inches deep, and *Heterorhabditis bacteriophora* (Hb), which will live as deep as 12-14 inches] were released by New Mexico State University's Agricultural Science Center at Tucumcari into an area of the alfalfa field sown the previous summer. Nematodes in containers of sawdust containing parasitized wax moth larva had been received via next-day delivery from Cornell University on the morning of the application date and prepared for application by rinsing the sawdust through a 2x layer of window screen with 10 gal. water. Treatments were nematode cocktails of two species (Sf + Sc or Sf + Hb). Plots were 60 ft x 60 ft arranged in a randomized complete block design with 4 replicates. An adjacent area was designated to be 4 replicates on untreated plots. A small plot sprayer (10-ft boom) with the nozzles and screens removed was used to dribble streams 20 inches apart at a rate of approximately 1 gal/1000 sq.ft across the center 40 ft x 40 ft of each treated plot. Applications were made between and 7 and 8:30 pm on May 25, 2017, when beginning and ending air temperatures were 85 and 75°F, respectively. The first treatment applied was Sf + Hb. The sprayer was thoroughly rinsed before Sf + Sc was applied. On May 25, the afternoon high 4-inch soil temperature was 81°F and the following morning's low was 63°F. During the applications, the sprinkler was running in another part of the field and the producer expected that it would pass across the test area overnight. The corners of treated areas within each plot were marked with whisker stakes using a 60 penny nail driven to 2 inches below the surface.

The center 40 ft x 40 ft was sampled for the presence of the nematodes October 31 to November 2, 2017. A single treatment was sampled each day beginning with the untreated control followed by Sf + Hb and then Sf + Sc. Twenty 20 soil cores were collected to 6 inches from each plot on a 4 x 5 grid uniformly spaced across the plot. Each core was separated into the top 2 inches and the next 4 inches and placed in separate containers for laboratory analysis for the presence of the EPN by species (Sc in the top 2 inches and Sf and Hb in the next 4 inches) expressed as a percentage of the 20 samples within a plot having nematodes as indicated by the presence of parasitized wax moth larvae.

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

Results and Discussion:

Results of statistical analyses of the presence of EPN species and combinations are presented in Table 1. Establishment of Sf in this study was typical to what has been found in northern New York (20-30%). In other experiments, Sf had the greatest effect and the other two species help when insect pressure is high; however, Sf is often overlooked by other researchers because it is lackluster in the lab although it persists at a very high level in the field, killing a lot of insects. The presence of Hb (Table 1) was nearly typical of that in northern New York (5-20%). Since Hb is a cruising EPN, only limited signs are observed based on the density of the host population, which in the present study was expected to be low, if not non-existent. While typical establishment rate for Sc in northern New York has been about 10%, none were found in the present study (Table 1). That was attributed to the environment in which the top 2 inches of soil are characterized by high temperatures and very dry conditions. A very low percentage of samples included both Sf and Hb (Table 1). In other studies, it has taken 1-2 years for sufficient establishment and dispersion of the EPNs. Once well-dispersed, the Sf are most active in the upper 6 inches and Hb are most active below that. Once that stratification occurs, deeper sampling will be needed.

Table 1. Percentage establishment of entomopathogenic nematodes in alfalfa at Tucumcari, NM. Data are the percentage of 20 soil cores per plot collected October 31 to November 2, 2017, in which the applied nematodes were present. Data are the means of 4 replicates; untreated plots were in an adjacent area and not within the statistical randomization to minimize the likelihood of incidental contamination.

Treatment	Sf	Hb	Sc	Both	None
Untreated	0.00 b	0.00	0.00	0.00	100.00 a
Sf + Hb	22.25 a	3.75	0.00	1.25	72.75 b
Sf + Sc	22.50 a	0.00	0.00	0.00	77.50 b
P-value	0.0003	0.1664	Undetectable	0.4219	0.0001

Sf, Hb, and Sc signify entomopathogenic nematode species *Steinernema feltiae*, *Heterorhabditis bacteriophora*, and *S. carpocapsae*, respectivley.
Lsmeans within a column followed by the same letter are not significantly different at the 0.0500 p-value.

Additional samplings will be conducted again in spring and fall 2018, using the same technique as was used in 2017. It was anticipated that horses would be allowed to occupy the field over winter, which may disperse the nematodes across plots and throughout the field. At some point a laboratory evaluation will be made to determine whether any of these EPNs are predatory upon WFB.

Improving Drought and Salinity Tolerance in Maize (*Zea mays* L.) by Introgression of Southwestern Developed Open Pollinated Landraces

Investigators

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Potential Impact(s):

Little research has been conducted on the agronomic and genetic characteristics of southwestern maize. We posit that the introduction of arid-adapted "genetics" and traits into modern varieties can increase the drought and salinity tolerance, thus achieving greater water use efficiency while still meeting agricultural demands.

Introduction:

Both maize (*Zea mays* L.) grain and silage are important crops in New Mexico. In 2014, 124,000 acres of maize were planted across the state (www.nass.usda.gov). In fact, maize acreage has increased by almost 25% since 1985. Much of that increase was due to an increase in silage production to meet the demands of the dairy industry.

Maize is a thirsty, salt sensitive crop and New Mexico may not seem like an ideal place to grow such large amount of maize. Commercial maize production in New Mexico requires large amounts of irrigation. Drought stress is further compounded by soil salinity. Flynn and Ulery (2011) that about 19% of all soil samples received by NMSU's SWAT lab from 2000 to 2008 were considered saline. However, maize cultivation in New Mexico traces back at least 3500 years (da Fonseca et al, 2015) and many landrace varieties have developed over centuries in the southwest. Some of these landraces may serve as genetic donors to improve both drought and salinity tolerance in modern varieties.

Methods:

This was the second year of a multi-year study to determine the salt tolerance of southwestern open pollinated landraces. Thirteen open pollinated maize varieties along with five commercial checks were planted May 29, 2017, in a complete randomized block design with three replications. Twenty seeds were hand-planted on 3-ft row spacing for a plant density of 23,000 plants/A. The soil was Redona fine sandy loam.

Forage samples were hand-harvested by collecting 10 plants per plot on September 26, 2017. Plants were weighed and then chopped using a 5hp MTD Chipper/Shredder (Cleveland, OH). Plots with <10 plants were sampled only for nutritional quality. Two sub-samples were collected from each plot for harvest moisture and nutritional quality analysis. These samples were held in an ice-chest with ice until frozen and delivered as such for processing and nutritional quality analysis by Near-Infrared Spectroscopy (NIRS) at SDK Laboratory (Hutchinson, KS). Forage yield was adjusted to 65% moisture, which is optimum for ensiling and the industry standard for payment. Statistical analysis of variance of all traits was performed using SAS Proc GLM to test the effects of genotype.

Results:

Emergence data recorded on July 5, 2017, show an average of 17 plants per plot. Stand count data recorded on September 25, 2017, revealed an average of 9 plants per plot or a 55% survival rate. Six regionally developed accessions survived at similar rates when compared to commercial hybrids. At the same time four regionally developed accessions survived at much lower rates. 'Gaurijio Maize Azul' and 'Mexican June' yielded more than the commercial checks at 22.3 and 20.3 tons/A, respectively. While

‘Southern Maize Negro’, ‘Montgomery County Blue and White’, and ‘Mayo Batch’ yielded just above or similar to the commercial checks at 16.2, 17.0, and 18.4 tons/A, respectively. It should also be noted that ‘Rio Grande Blue’, ‘Northern Ute’, and San Felipe Pueblo Blue’ did not have enough plants remaining (10) to accurately estimate yield. While commercial checks may lack the yield found in some southwest accessions, they did prove to express superior forage quality attributes. They appeared to have lower ADF and NDF values, while expressing higher digestibility and energy traits. The only exception to this was ‘Montgomery County Blue and White’, which did express forage quality traits similar to some silage specific commercial hybrids. This may suggest that there is room for improvement of regionally developed accessions through selective breeding.

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Alfalfa Variety Testing in the Tucumcari Irrigation Project

Investigator(s):

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Potential Impact(s):

Variety selection is a critical first step in producing high yields of alfalfa at the same production costs.

Methods:

A standard alfalfa variety test with 19 entries was planted May 12, 2015, in the field fronting US 54. The test area (Canez fine sandy loam) was conventionally tilled and formed into a flat seedbed for sprinkler irrigation with treated municipal wastewater. Plots 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. Plots are 5 ft x 20 ft of which the center 5 ft x 15 ft were harvested for yield six times in 2017 after 5-ft borders were removed. The 2015 Annual Report of the Agricultural Science Center at Tucumcari (available by request at tucumcar@nmsu.edu) provides more details about establishment. In early October, the wastewater distribution system failed and only 0.03 inch of precipitation fell from then until the last harvest. Irrigations with treated municipal wastewater totaling 13.0 inches were applied to supplement 25.0 inches of pre-growing season and growing season precipitation (November 2016 through October 2017). No fertilizers were applied in 2017; however, Warhawk (2 pt/acre) was applied on April 7 to control alfalfa weevil and Nolo Bait (14 lb/acre) was applied on June 21 to control grasshoppers. Applications of Clethidim (6 oz/acre) were made on July 12 and August 18 to control grasses.

Results:

Yield data from the test collected in 2017 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. Yield differences over the two years of this study between the average of those varieties that yielded equally to the highest yielding variety (varieties in the table with an asterisk for the 2-yr average) compared to the average of those varieties yielding less than the highest yielding variety (varieties in the table without an asterisk) was that are approximately 0.7 tons/year. At the average price for alfalfa hay in New Mexico for 2016 ($170/ton) and 2017 ($177/ton), selecting a variety that yielded equal to the highest yielding variety would have returned approximately $242/acre over the two years for the same production costs.

Reports giving results from statewide testing in 2017 and previous years are available at the New Mexico State University College of Agricultural, Consumer and Environmental Sciences' Publications and Videos Variety Test Reports webpage (http://Aes.nmsu.edu/pubs/variety_trials/welcome.html#alfalfa) as well as from the Agricultural Science Center at Tucumcari and county Cooperative Extension Service offices.

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

	2016	2017 Harvests						2017	2-Yr
Variety Name	**Total**	**19-May**	**20-Jun**	**19-Jul**	**15-Aug**	**11-Sep**	**30-Oct**	**Total**	**Average**
NuMex Bill Melton	4.62**	1.93*	1.10*	0.36*	1.04*	0.97*	0.46*	5.85**	5.23**
6829R	4.38*	1.72*	1.21**	0.39*	1.06*	0.94*	0.38*	5.68*	5.03*
NM14BMHS1	4.19*	1.75*	1.02*	0.43*	0.90*	0.82	0.46*	5.36*	4.78*
NM14BMHR2	4.17*	1.84*	0.93	0.36*	1.05*	0.75	0.41*	5.33*	4.75*
NM14BMC0	3.99*	1.88*	0.94	0.27*	0.97*	0.74	0.46*	5.26*	4.62*
Mallard	3.98*	1.87*	1.00*	0.26*	1.00*	0.73	0.36	5.23	4.61*
NM14BM1008251	3.94*	1.27*	1.14*	0.44**	0.90*	0.82	0.44*	5.00	4.47
Malone	3.77	1.40*	0.96	0.40*	1.09*	0.93*	0.44*	5.22*	4.49
NM14MalHS3	3.69	1.98**	0.68	0.28*	1.09*	0.69	0.41*	5.12	4.41
African Common	3.65	1.64*	1.12*	0.37*	1.13**	0.83	0.50**	5.59*	4.62
NM14MLLS2	3.65	1.47*	0.84	0.24*	0.88*	0.72	0.35	4.50	4.07
NM Common	3.52	1.60*	0.76	0.31*	1.11*	0.98**	0.35	5.10	4.31
ICON	3.33	1.45*	0.64	0.27*	0.92*	0.79	0.45*	4.51	3.92
SW 5909	3.27	1.56*	0.78	0.24*	0.99*	0.68	0.37	4.61	3.94
SW 5213	3.27	1.63*	0.87	0.28*	1.03*	0.78	0.35	4.93	4.10
Zia	3.23	1.46*	0.93	0.31*	1.06*	0.80	0.38	4.94	4.09
Red Falcon BR	3.19	1.69*	0.65	0.29*	0.85*	0.53	0.19	4.19	3.69
SW 5113	3.10	1.39*	0.75	0.28*	0.99*	0.64	0.25	4.28	3.69
Roadrunner	3.03	1.61*	0.91	0.35*	0.82*	0.54	0.28	4.50	3.76
Mean	3.68	1.64	0.91	0.32	0.99	0.77	0.38	5.01	4.35
LSD (0.05)	0.72	NS	0.24	NS	NS	0.14	0.10	0.72	0.63
CV%	13.85	24.57	18.73	35.41	15.97	12.86	18.96	10.18	14.38

†Data were detrended using nearest neighbor analysis and analyzed using analysis of variance.
2016 Harvest dates: 24-May, 22-Jun, 9-Aug, 13-Sep, and 8-Nov.
**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.

Investigator(s):

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Potential Impact(s):

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

Methods:

To evaluate grain yield of corn hybrids under full irrigation, a test was planted into a strip-tilled flat seedbed in an area designated for irrigation with treated municipal wastewater under the West Pivot. The soil type was Redona fine sandy loam and the land had been previously fallowed. The test was a Randomized Complete Block design with 4 replicates. Individual plots were 20 x 5 ft (two, 30-inch rows), all of which was harvested. Plots were planted May 31, 2017, using a small plot row crop planter with a seed-metering cone on each planter unit to plant 29,000 seed/A. A 5-ft unplanted alley was left between plots to facilitate harvesting. Irrigations with treated municipal wastewater were applied approximately twice weekly for a May through until early October at which time the irrigation system failed and only 0.03 inch of precipitation fell between that and harvest. A total of 13.8 inches of irrigation was applied to supplement 17.1 inches of growing season precipitation. Roundup (77 oz/A) was applied on June 1 and 7.29 oz/A of Starane was applied on June 24.

Ears from each plot were hand-harvested and bagged on October 24 and stored. During harvesting, plants and ears in each plot were counted. On January 11, 2018, ears were mechanically threshed with a corn sheller. Grain weights were recorded and an aliquot was evaluated for test weight (lb/bu) and then dried for 36 h at 221ºF and reweighed to calculate % moisture. Grain yields (lb/ac and bu/ac as a 56 lb bu) were adjusted to 15.5% moisture.

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

Results and Discussion:

Results of statistical analyses of grain yield components are presented in Table 1. Generally later maturing varieties (higher CRM) had greatest yields; however, there were significant differences among varieties within groups of CRMs. Additionally, depending on the availability of water over the growing season, a shorter season (lower CRM) hybrid may be the best choice.

Reports giving results from statewide testing in 2016 and previous years are available at the New Mexico State University College of Agricultural, Consumer and Environmental Sciences' Publications and Videos Variety Test Reports webpage (http://aces.nmsu.edu/pubs/variety_trials/welcome.html#corn) as well as from the Agricultural Science Center at Tucumcari and county Cooperative Extension Service offices.

Table 1. Yield data from the New Mexico 2017 wastewater-irrigated grain corn performance test at NMSU's Agricultural Science Center at Tucumcari.

Brand/Company Name	Hybrid/Variety Name	CRM	Population	Grain Yield Adjusted to 15.5% Moisture		Moisture At Shelling	Test wt.
		-----	Plants/ac	lb/ac	bu/ac	%	lb/bu
SyngentaSeeds	G95D32-3110	95	24720	6031	108	10.1	57.3
DuPontPioneer	P9697AM	96	26681	6169	110	10.4	57.0
RobSeeCo	IC4848-3000GT	98	24103	5107	91	10.9	54.7
MycogenSeeds/DowAgroSciences	MY00J47	100	26354	5074	91	10.8	54.8
RobSeeCo	RC5112-3011A	101	24067	4397	79	10.7	55.8
RobSeeCo	IC5296-3120	102	24684	6394	114	10.9	53.0
DuPontPioneer	P0365AM	103	26027	5625	100	11.7	56.5
MycogenSeeds/DowAgroSciences	MY04Y97	104	25265	6496	116	10.6	53.9
DuPontPioneer	P0589AM	105	25156	5442	97	10.9	56.4
SyngentaSeeds	G06Z97-3102	106	26245	7135	127	11.3	56.9
DuPontPioneer	P0801AM	108	25156	5175	92	10.4	53.4
Dyna-GroSeed	D49VC39RIB	109	20909	6370	114	10.8	56.3
SyngentaSeeds	G11B63	111	25591	7428	133	12.6	55.6
Dyna-GroSeed	D52SS91	112	27552	6520	116	12.4	58.1
SyngentaSeeds	N76A-3000GT	114	24067	5503	98	11.4	51.6
Dyna-GroSeed	D55VP77RIB	115	26681	7748	138	12.1	57.6
Dyna-GroSeed	D57VP51RIB	117	27334	7120	127	12.4	56.9
Dyna-GroSeed	D58VC37RIB	118	26281	8351	149	11.6	58.0
		Trial Mean	25463	6208	111	11.2	88.5
		LSD P < 0.05	NS	2051	37	1.2	1.8
		CV	8.6	23.2	23.2	7.7	2.3
		F Test	0.1063	0.0244	0.0244	0.0009	0.0001

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

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

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

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

Performance of Cotton in the Tucumcari Irrigation Project

Investigator(s):

L.M. Lauriault[1], A.E. Cunningham[1], R.P. Flynn[2], J. Zhang[3], P.L. Cooksey[1], J. Box[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401
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Method(s):

A cotton variety test was planted into a strip-tilled flat seedbed at the West Pivot (Redona fine sandy loam) on May 30, 2017, 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 4 replicates. Varieties and lines tested were commercial cultivars and experimental lines developed at NMSU. Gramoxone (3 pt/A) had been applied on May 12; Glyphosate (2%) was broadcast on June 1 and as a shielded application on August 2. Nolo Bait (14 lb/A) was applied on June 21 to control grasshoppers. Clethodim (6 oz./A) was applied on July 12. No fertilizer was applied in 2017. Irrigations using canal water were applied approximately twice weekly until early October at which time the irrigation system failed and only 0.04 inch of precipitation fell after that. A growing season total of 15.3 inches of irrigation was applied to supplement 17.1 inches of May through December precipitation. No defoliant or boll opener was used.

Harvesting took place on December 13, 2017, using a John Deere model 484 cotton stripper modified to harvest two rows and to catch harvested material in a trash can. Two-row borders surrounding the test were stripped prior to harvesting the plots. Also prior to harvest, 25 bolls were collected. After stripping, plants were counted, and the total length of skips (>12 inches) in the planted row was estimated for each plot. Boll samples were shipped to NMSU's Agricultural Science at Artesia for ginning and turnout calculations after which lint samples were sent to a lab at Louisiana State University for fiber quality analysis. Individual plot weights were adjusted to lint yields based on historical seed cotton to trash ratio of ginned samples for material harvested with the same equipment. Lint yield and quality data were analyzed by SAS Proc GLM with means separated by protected 5% LSD.

Results:

Except for two entries (DP1646B2XF and FM2334GLT, 2287 and 4792 plants/A, respectively), establishment was generally good throughout the test but plant populations after harvest were considerably lower than in 2016, as were yields (Table 1). Differences in yield and fiber quality existed among varieties (Tables 1 and 2).

Table 1. Lint yield and quality and economic data from the wastewater-irrigated commercial cotton performance test at NMSU's Agricultural Science Center at Tucumcari in 2017.

Brand/Company	Hybrid/Variety	Population	seed-cotton	Lint		Turnout	bollwt	Trash Code	Trash Area	Trash Count
		Plants/ac	lb/a	lb/a	bales/a	%	g			
NMSU	Acala1517-08	36784	1320	527	1.10	39.97	4.88	2.5	0.3	9.0
Monsanto	DP1549B2XF	25877	320	131	0.27	41.23	3.81	2.0	0.2	4.3
Monsanto	DP1612B2XF	30676	1035	435	0.93	42.00	4.37	2.7	0.3	8.0
NMSU	NM13G1007	36528	1424	563	1.17	40.07	4.25	2.0	0.2	4.0
NMSU	NM13G3016	35323	1282	559	1.17	43.63	3.82	2.0	0.2	6.5
NMSU	NM16M1125	23750	516	203	0.43	39.43	4.85	2.5	0.3	6.5
NMSU	NM16M1192	37115	1137	478	1.00	41.93	3.90	2.5	0.3	4.5
NMSU	NM16M1203	20086	418	171	0.33	40.53	3.88	2.7	0.3	8.3
NMSU	NM16M1221	33767	972	387	0.83	40.50	4.27	2.5	0.3	7.0
NMSU	NM16M1234	27911	1227	472	1.00	39.07	4.28	3.0	0.4	12.0
Bayer	ST4946GLB21	41540	1444	637	1.33	44.40	4.66	2.3	0.2	8.0
Bayer	ST5517GLTP	36769	883	360	0.73	40.87	4.58	2.5	0.3	5.0
	Trial Mean	32430	1010	416	0.87	41.22	4.31	2.4	0.3	7.0
	LSD, 0.05	13214	646	262	0.56	2.24	0.6	NS	NS	NS
	CV	27.8	43.6	43.0	43.5	3.7	10.3	18.9	26.3	42.1
	Prob>F	0.0971	0.0520	0.0332	0.0366	0.0226	0.0287	0.6004	0.6795	0.3910

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

Table 1 (cont.). Lint yield and quality and economic data from the wastewater-irrigated commercial cotton performance test at NMSU's Agricultural Science Center at Tucumcari in 2017.

Hybrid/Variety	Length	Unif	SFI	Str	Elg	Mic	Maturity	Rd	Yellowing	Color	Grade	Gross returns	Loan price
												$/ac	Cents
Acala1517-08	1.25	86.1	6.5	35.9	5.8	4.4	82.0	80.6	8.4	21.0	1.0	367	58.40
DP1549B2XF	1.16	82.0	8.7	32.6	5.2	3.6	80.0	82.4	8.1	14.3	1.3	91	56.97
DP1612B2XF	1.24	85.7	6.6	34.4	7.9	4.2	79.7	80.0	9.9	11.0	3.0	308	57.50
NM13G1007	1.25	84.8	6.9	35.3	6.3	4.3	81.0	82.3	8.4	11.0	2.0	429	58.30
NM13G3016	1.25	84.2	7.3	34.2	4.9	4.1	81.5	83.6	7.8	11.0	2.0	277	58.25
NM16M1125	1.22	84.9	7.7	35.9	5.4	4.3	82.0	82.2	8.2	11.0	2.0	152	58.30
NM16M1192	1.22	85.0	6.5	33.6	4.2	4.6	83.0	83.7	7.4	16.0	1.5	278	58.25
NM16M1203	1.24	87.0	6.5	39.3	5.0	3.9	81.3	82.2	8.1	17.7	1.0	122	58.43
NM16M1221	1.26	86.4	6.1	38.1	4.9	4.4	82.0	81.2	8.5	16.0	1.5	195	58.40
NM16M1234	1.22	85.1	6.8	33.7	4.7	4.2	82.0	80.5	8.3	21.0	1.0	257	58.30
ST4946GLB21	1.22	85.3	6.5	37.0	6.0	4.4	81.3	81.3	8.7	11.0	2.0	487	58.30
ST5517GLTP	1.22	84.8	7.2	34.1	5.3	4.4	82.0	79.9	9.2	11.0	3.0	222	57.23
Trial Mean	1.23	85.1	7.0	35.4	5.5	4.2	81.4	81.6	8.4	14.2	1.8	263	58.02
LSD, 0.05	NS	1.4	0.8	2.0	0.7	0.4	1.4	1.8	1.1	NS	0.9	170	NS
CV	2.9	1.1	7.8	3.8	8.1	6.6	1.2	1.4	8.2	27.3	34.7	42.7	1.1
Prob>F	0.2495	0.0032	0.0049	0.0015	0.0001	0.0594	0.0517	0.0437	0.0807	0.1046	0.0261	0.0170	0.2111

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 Irrigated Forage Sorghum under a Single-cut Silage System in the Tucumcari Irrigation Project

Investigator(s):

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

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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.

Methods:

To evaluate yield and nutritive value of forage sorghum varieties for silage, a test was planted into a strip-tilled flat seedbed under the North Farm Pivot. The soil was Canez fine sandy loam and the previous crop was cereal forage. Plots were planted June 1, 2017, using a small plot row crop planter with a seed-metering cone on each planter unit. The seeding rate was 80,000 seed/A. Irrigations with treated municipal wastewater were applied approximately twice weekly for a May through early October when the wastewater delivery system failed and after which only 0.03 inch of precipitation fell. A total of 16.8 inches irrigation water was applied to supplement 23.2 inches growing season precipitation. Starane (0.4 pt/acre) and Detonate (8 oz/acre) were applied on June 4 and July 10, respectively, to control broadleaf weeds and 76 lb N/acre was applied on September 7. Individual plots were 20 x 5 ft, all of which was harvested. A 5-ft unplanted alley was left between plots to facilitate harvesting. The test was a Randomized Complete Block design with 4 replicates.

Standing forage, leaving 6-inch stubble, from each plot was harvested on October 25 with a Case-IH model 8750 forage harvester with a row crop head. Chopped material from individual plots was collected in a garbage can and immediately weighed. Prior to dumping the garbage can, a sample from that plot was placed in a labeled paper bag and sealed in a plastic bag. Immediately after 140°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 the University of Wisconsin Forage Lab for forage nutritive value analysis by wet chemistry for crude protein (CP), neutral detergent fiber (NDF), 48-h neutral detergent fiber digestibility (NDFD), starch, ash, total digestible nutrients (TDN), and net energy for lactation (NE_l). Milk per ton and milk per acre were calculated by the lab.

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. By selecting one of the varieties that had milk/acre yields equal to the highest milk/acre yielding variety compared to those varieties with milk/acre yields that were significantly lower than the higher yielding varieties, producers could increase potential milk yield by approximately 4026 lb/a on average.

Reports giving results from statewide testing in 2017 and previous years are available at the New Mexico State University College of Agricultural, Consumer and Environmental Sciences' Publications and Videos Variety Test Reports webpage (http://Aes.nmsu.edu/pubs/variety_trials/welcome.html#corn) as well as from the Agricultural Science Center at Tucumcari and county Cooperative Extension Service offices.

Table 1. Yield, nutritive value, and estimated milk production data from the New Mexico 2017 wastewater-irrigated, single-cut forage sorghum performance test - 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
705F	DynaGroSeed	2.7	7.8	66.8	6.2	61.2	64.9	6.2	5.6	58.5	0.520	2160	5928
AF7401	AltaSeeds	2.4	6.8	68.0	7.9	54.5	72.3	5.3	6.5	60.2	0.518	2202	5215
DualForageSCA	DynaGroSeed	1.0	2.9	64.3	6.8	67.0	64.3	1.4	6.1	58.3	0.520	2141	2164
F74FS23	DynaGroSeed	2.5	7.1	66.1	6.1	53.9	71.1	8.2	6.2	59.9	0.520	2197	5440
F76FS77	DynaGroSeed	2.4	6.9	70.1	8.6	57.5	70.7	4.5	6.5	61.0	0.535	2280	5446
FullgrazeBMR	DynaGroSeed	1.6	4.4	69.8	8.3	59.4	69.3	3.6	6.4	60.1	0.525	2219	3414
SP1615	Chromatin,Inc.	3.4	9.7	71.6	8.7	60.0	68.6	3.5	6.5	60.6	0.533	2272	7713
XF7103	AltaSeeds	1.1	3.2	69.1	8.5	60.2	70.9	0.7	7.2	60.2	0.520	2201	2445
XF7302	AltaSeeds	2.7	7.7	66.1	7.8	56.8	71.9	4.6	6.4	60.8	0.525	2249	6133
XF7303	AltaSeeds	1.9	5.3	66.6	8.6	57.0	68.7	4.7	6.7	59.7	0.525	2206	4064
	Trial Mean	2.2	6.2	67.9	7.8	58.7	69.3	4.3	6.4	59.5	0.524	2213	4796
	LSD P < 0.05	0.9	2.4	2.4	1.2	2.4	2.0	2.1	0.5	NS	NS	NS	1959
	CV	27.2	27.2	2.5	10.6	2.8	2.0	34.4	5.9	2.3	2.6	4.2	28.2
	F Test	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0006	0.1304	0.6626	0.5073	0.0001

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.

Jujube Cultivar Evaluation

Investigator(s):

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

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Potential Impact(s):

Low available water and late frosts are critical problems challenging fruit production in eastern New Mexico. Jujubes, also called Chinese dates, are a potential alternative crop to help small-scale farmers produce a crop every year because they are drought tolerant once established and they avoid spring frosts by blooming later. Jujubes are nutritious with 4-10 times more vitamin C than oranges.

Methods:

In an area or native grass east of the office (Quay loam soil), two reps of 36 grafted jujube cultivars were transplanted on April 11-12, 2016. Each experimental unit consisted of two trees of the cultivar planted adjacent to each other and each replicate consisted of 4 rows of 18 trees (Figure 1). The intra-row spacing was 10 ft and there was 15 ft between rows. Details of infrastructure development and planting are provided in the 2016 Annual Report of the Agricultural Science Center at Tucumcari (available by request at tucumcar@nmsu.edu).

Irrigation system controller problems led to inconsistent watering throughout the 2018 growing season; however, significantly greater than average precipitation (23.2 inches vs. the average of 16.8 inches) kept most of the trees well-watered. Grasshoppers were controlled with NoloBait (14 lb/acre) applied on June 21. Also on June 21, fertilizer at the rate of 25 lb N and 130 lb P_2O_5/acre was applied around each tree.

Specimen trees were evaluated for survival on April 13, 2017, followed by weekly observations for flower buds and then biweekly observations for fruit set.

Results:

Figure 1 shows results of survival and bloom evaluations. No specimens that perished in 2016 were replaced in 2017.

The earliest observed bloom was April 19, 2017 and all surviving plants had bloomed by May 15. Once blooming had begun, there was a continuous flush of flowers throughout the growing season. Both specimens of Honeyjar in Rep 1 set 1 or 2 fruit by August 30, as did both specimens of Mayazao in Rep 2, but there was no measurable harvestable fruit production at the end of the growing season.

Figure 1. Jujube cultivars planted at NMSU's Agricultural Science Center at Tucumcariin April 2016.

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

The left of the page is north.
Yellow highlight signifies dead plants observed 8/12/16.
Pink highlight signifies dead plants (no leaves this spring) observed 4/13/17.
Gray highlight signifies flower buds observed 4/19/17.
Green signifies plants with blooms observed 5/15/17.

Performance of Irrigated Pinto Beans in the Tucumcari Irrigation Project

Investigator(s):

L.M. Lauriault[1], A.E. Cunnigham[1], R.C. Pratt[2], L. Grant[2], P.L. Cooksey[1], J. Box[1], J. Jennings[1], S. Jennings[1], and A. Williams[1]

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Potential Impact(s):

Pinto beans are one of the most common edible dry beans consumed in the United States. The Advisory Committee to the Agricultural Science Center requested an assessment of pinto beans as a replacement crop after cotton is hailed out or as an alternative to cotton altogether.

Methods:

A pinto bean variety test was planted into a strip-tilled flat seedbed at the West Pivot (Redona fine sandy loam) on May 30, 2017, 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 83,365 seeds/A in a Randomized Complete Block Design with 4 replicates. Varieties and lines tested were commercial cultivars and experimental lines developed at NMSU. Gramoxone (3 pt/A) had been applied on May 12; Glyphosate (2%) was broadcast on June 1 and as a shielded application on August 2. Nolo Bait (14 lb/A) was applied on June 21 to control grasshoppers. Clethodim (6 oz./A) was applied on July 12. No fertilizer was applied in 2017. Irrigations using canal water were applied approximately twice weekly until the end of October for a growing season total of 13.8 inches to supplement 17.1 inches of May through December precipitation.

On December 20, 2017, plots were harvested and threshed using an Allis-Chalmers Model 66 All Crop B series harvester. Harvested material was stored in paper bags until further processing. On January 30, 2018, combine-run grain was recleaned using a Clipper Office Tester (Bluffton Agri/Industrial Corp.) equipped with a #21 top screen and a #7 bottom screen and ¾ air to remove inert material and smaller bean chips. Oversized beans were reclaimed from the scalpings. Recleaned bean weights were recorded after which the entire sample was dried for 36 h at 221ºF and reweighed to calculate % moisture at the time of evaluation and test weight (lb/bu).

Edible dry bean yield, moisture at the time of evaluation, and test weight data were analyzed using SAS PROC GLM procedures to determine where differences between hybrids existed. Means were separated by protected least significant difference ($P < 0.05$).

Results and Discussion:

Varietal means are presented by descending edible dry bean yield in Table 1 along with growth type and results of statistical analyses. Although uniform stands were established for all plots, yields were considerably lower than those measured elsewhere, possibly due to the irrigation system failure during pod-filling, although temperatures also may have been a factor in podset and development as maximum air temperatures averaged 96°F in July when blooming and podset would have occurred. Also, while all varieties are described as being indeterminate (types II or III), only two (Espresso and Rio Bavispe) were still green when on October 10th when the first hard freeze occurred.

Table 1. Performance of canal water-irrigated pinto bean varieties at NMSU's Agricultural Science Center at Tucumcari, NM, in 2017.

Brand/Company	Variety	Type	Maturity, days	Edible Dry Bean Yield, lb/a	Moisture at Evaluation, %	Test Wt., lb/bu
AmeriSeed/ProVita Inc.	PT11278	?	?	529**	8.8	52.0*
AmeriSeed/ProVita Inc.	LaPaz	IIb	99-103	493*	8.6	53.8*
NDSU	Lariat	II	100	491*	8.7	52.8*
NMSU	Espresso	III	?	432*	8.6	47.7
Native Seed/SEARCH	NM Bolitas	III	110	411	8.6	53.6*
Native Seed/SEARCH	Rio Bavispe	III	97	400	8.6	54.6*
NMSU	Mystery	II	?	381	8.5	54.8*
NDSU	ND-Palomino	IIa	102	367	8.0	55.2**
NDSU	Stampede	II	96	345	8.7	47.4
NDSU	ND-307	IIb	103	293	8.2	52.7*
MSU	Eldorado	II	98	288	8.7	54.6*
NMSU	Select Black	III	?	256	8.7	54.1*
NativeSeed/SEARCH	San Juan CO	II	?	216	8.7	53.3*
Idaho Seed Bean Co.	Max	III	80	203	9.0	52.3*
Rogers/Syngenta	Poncho	III	97	190	8.7	52.4*
Seminis	Windbreaker	III	94-98	180	8.7	54.0*
			Trial Mean	338	8.6	52.8
			LSD P < 0.05	200	NS	4.7
			CV	41.3	5.0	6.3
			F Test	0.0144	0.4073	0.0926

Moisture at evaluation was measured when samples were processed for test weight 40 days after field harvesting.

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 (F Test < 0.0500) 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.

Investigator(s):

L.M. Lauriault[1], R.C. Pratt[2], L. Grant[2], R. Montgomery[2], A.E. Cunningham[1], J. Box[1], P.L. Cooksey[1], J. Jennings[1], S. Jenings[1], and A. Williams[1]

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Potential Impact(s):

Heat and drought-tolerant tepary bean is a native legume that is related to common dry beans (e.g. pinto beans) that were cultivated by early farmers from as far south as Central America to as far north as the Four Corners area of the United States. Many bean species have value as forage crops. If tepary bean has potential as a forage crop, it could be grown as a short-season crop in water-limited situations and be used to potentially increase the yield and nutritive value of currently used warm-season cereal grass forages and possibly reduce the applied nitrogen requirement through atmospheric nitrogen fixation.

Methods:

A test with 7 entries was planted June 13, 2017, at the Agricultural Science Center under the center pivot irrigation system adjacent to US 54. The test area (Canez fine sandy loam) was conventionally tilled and formed into a flat seedbed. Plots were sown using a disk drill fitted with a seed-metering cone at 43560 uninoculated seed/A in a Randomized Complete Block design with two replications. In 2017, irrigations with treated municipal wastewater totaling 12.2 inches were applied to supplement 15.3 inches of growing season precipitation (June through October 2017). No fertilizers or pesticides were applied in 2017. On October 9, 2017, plants from a uniform area within each plot were hand-clipped to ground level weighed, dried at 140°F for 48 hours, and reweighed for calculation of dry matter (DM) percentage and DM yield prior to being delivered to the lab for NIRS analysis of nutritive value. Due to a significant presence of sand on the forage, DM yield was converted to organic matter (OM) yield using the ash content returned from the NIRS analysis.

Organic matter yield and selected nutritive value data were analyzed using SAS PROC MIXED procedures to determine where differences ($P < 0.10$) existed between entries. Replicate was considered random. When a difference was detected for any variable, entry means were separated using a protected LSD generated by the PDMIX800 procedure in SAS.

Results and Discussion:

The tepary beans in this study did not emerge uniformly as they had in 2013 and 2014 in hand-planted grain (and forage in 2014) studies in the same field and soil type using the same irrigation water source. Nonetheless sufficient area in each plot was available for data collection. Data and results of statistical analysis of selected data are presented in Table 1. Yields in this study were higher than those measured in 2014 for tepary bean forage when there was no difference among entries (844 ± 377 lb DM/ac). The difference between studies is likely due to length of growth period. In 2014, plants were clipped 40 days after planting (dap), while in 2017, they were clipped 118 dap, which would have allowed more time for genetic differences in growth and development patterns among entries to be expressed. In 2017, TARSTep32 and USU1578 outyielded all other entries.

Estimates of nutritive value in 2017 indicated lower nutritive value than for 2014, likely due to greater maturity of the harvested material in 2017. While there was no difference among entries in 2017 for crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), lignin, or fat, USU1533, Blue Speckle, and USU1528 had the highest NDF digestibility (NDFD), although the latter two entries were not different from several other entries (Table 1). Yellow Select had lower total digestible nutrients (TDN) than all other entries. The lack of difference in many of the estimates of nutritive value indicates the similarity in stage of maturity among the entries, which were all in pod formation.

Table 1. Organic matter (OM) yield and selected nutritive value of tepary been varieties at NMSU's Agricultural Science Center at Tucumcari in 2017.

Variety	Yield	CP	ADF	NDF	NDFD	TDN	Lignin	Fat
	lb OM/ac	%	%	%	% of NDF	%	%	%
TARSTep32	5616 A	16.0	27.6	34.0	51.0 BC	69.1 A	6.76	1.60
USU1528	5283 A	15.8	31.3	39.1	51.5 ABC	66.7 A	8.09	0.95
Yellow Select	2770 B	14.9	29.9	36.1	47.5 CD	56.6 B	7.38	2.05
USU1533	2630 B	16.9	27.2	35.1	56.0 A	65.2 A	7.34	1.20
Chiapas Select	2176 B	16.1	30.9	38.5	50.0 BCD	69.6 A	8.14	1.00
Blue Speckle	1716 B	17.0	25.4	33.1	55.5 AB	71.5 A	6.90	1.30
USU1530T	1638 B	15.8	37.1	44.8	45.0 D	65.6 A	8.74	1.20
P-value	0.0763	0.2956	0.1130	0.1804	0.0593	0.0599	0.3912	0.1721
SEM	845	0.6	2.2	2.7	1.7	2.4	0.54	0.23

CP, ADF, NDF, NDFD, TDN, and SEM signify crude protein, acid detergent fiber, neutral detergent fiber, NDF digestibility, total digestible nutrients, and standard error of the mean, respectively.
LSMeans within a column followed by the same letter are not different at the P < 0.10 level.

Other estimates of nutritive value were not different among entries (77.9 ± 3.7% IVTDMD, 0.6887 ± .05 Mcal/lb NE_l, 1.73 ± 0.41% Ca, and 0.24 ± 0.02% P). The calcium:phosphorus (Ca:P) ratio is of concern because it was 7.21:1, on average. Generally, because the Ca:P ratio in the body is about 2:1, the diet should closely match that, although there is a broad range of 1.5:1 to 8:1 in which no ill effects have been observed. When the ratio is >8:1, as it was for tepary bean forage in 2014, supplementation with phosphorus or a product having a 1:1 ratio is recommended to bring the total ration into a safer range. Consequently, it is likely that tepary bean forage should not be the sole component of any feed ration for any lengthy period of time.

Studies with failed satisfactory establishment or completion in 2017

Investigator(s):

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Data collection from several studies initiated in 2016/2017 (listed below) did not establish or were not completed as scheduled.

Darapuneni: Dryland/irrigated winter cover crop study planted in both years, but there was no data collection in 2017 from the 2016 planting and no emergence of the 2017 planting (lack of precipitation/irrigation system failure).

Darapuneni: Dryland winter rotation study (poor establishment due to lack of precipitation in 2017).

Darapuneni: Canola N management study in collaboration with Clovis Science Center (poor emergence due to irrigation system failure in 2017)

Lauriault: Dry matter yield and nutritive value of sorghum forage – legume mixtures under single-cut management (poor emergence in 2017).

Lauriault: Dry matter yield and nutritive value of corn and sorghum forages relay intercropped with brassicas and oat for autumn forage (poor establishment of intercrop species in 2016 and 2017).

Lauriault: Varietal performance evaluations in 2017 for irrigated grain sorghum (bird predation right before harvest), sunflowers (poor emergence), and multiple-cut sorghum x sudangrass (poor emergence).

Lauriault: Late summer/autumn grazing of winter cereal grasses and canola by beef yearlings (due to an irrigation system failure, pastures were not planted in 2017).

Lauriault: Perennial forage Kochia evaluation (little observed increase in stands to initiate additional studies).

Lauriault/Cunningham: Impact of selected OMRI certified herbicides on field bindweed and the bindweed mite (insufficient mite populations; new areas were infested in 2016 with little success; other infested areas were identified in 2017, but populations continued to be low).