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REX E. KIRKSEY AGRICULTURAL SCIENCE CENTER AT TUCUMCARI

2023 ANNUAL REPORT

THE NMSU AGRICULTURAL EXPERIMENT STATION SUPPORTS RESEARCH THAT ADDRESSES REAL-WORLD PROBLEMS. RESEARCH IS AT THE CORE OF NMSU'S MISSION TO IMPROVE THE LIVES OF PEOPLE GLOBALLY.

TUCUMCAR@NMSU.EDU
TUCUMCARISC.NMSU.EDU

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These are not formal Agricultural Experiment Station research results. Readers are cautioned against drawing conclusions or making recommendations as a result of the summaries in this report. In many instances, data represents only one of several years' results that will ultimately constitute the final formal report for a project.

None of the data are authorized for release or publication without the written prior approval of the NewMexico Agricultural Experiment Station.

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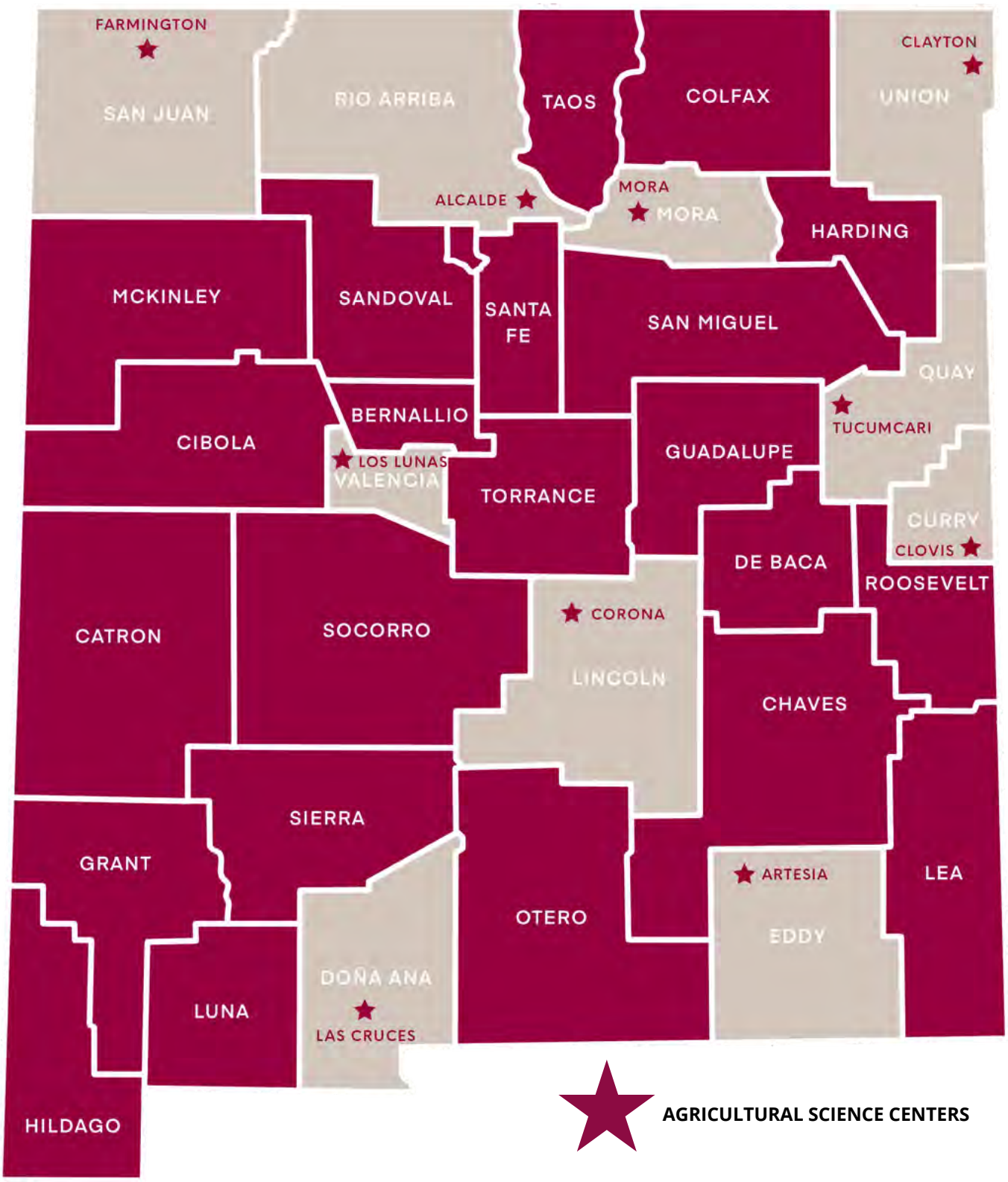
AGRICULTURAL SCIENCE CENTER LOCATIONS MAP



EXECUTIVE SUMMARY

The New Mexico State University Rex E. Kirksey Agricultural Science Center at Tucumcari (REKASCT) exists to discover, develop, and deliver and deliver information about innovative solutions for water-smart crop and livestock systems in irrigated and dryland agriculture that are of benefit to New Mexicans and also globally applicable. To that end, the vision of the Center is to lead innovative, water-smart crop and livestock research to help farmers in semiarid environments adapt to the changing climate for agriculture.

Several improvements to the center were made this year and more are planned. The advisory committee proposed an enhancement in research programs to include faculty, support staff, and research operations to conduct research and outreach/Extension activities related to reusing treated municipal wastewater for agricultural irrigation, rangeland soil health restoration, and low-input horticultural crops for human food. A new skid-steer loader was purchased using legislative funding and infrastructure replacement (dilapidated >100-year-old adobe buildings) and upgrades are scheduled to include replacement of the shop and laboratory, along with new housing for visitors. Additionally, a fourth center pivot irrigation system is to be installed with dual water source capability using legislative funding. The Tucumcari Feed Efficiency Test, LLC, also is planning upgrades and expansion to their facility. Additional partnering to install a solar array for renewal energy and to begin a research program in agrivoltaics was explored.

Faculty based at the center have been engaged in a wide variety of activities this past year. Leonard Lauriault received the Editors' Citation for Excellence in Manuscript Review from the American Society of Agronomy (ASA) and was named to the ASA-CSSA-SSSA Publications Review Advisory Committee. Leonard Lauriault also completed a term as a guest editor for a Special Issue of the MDPI Animals journal and his term as chair of the NMSU Plant and Environmental Sciences Departmental Promotion and Tenure Committee. Murali Darapuneni began serving as the Sigma Xi-NMSU Chapter President-Elect, an associate editor of Crop, Forage, and Turfgrass Management journal, and a member of the NMSU Faculty Senate.

Leonard Lauriault is a collaborator on a $300K USDA FAS grant to develop resilient forage programs for African nations over two years and he and Murali Darapuneni are collaborating on second-year funding for a cover cropping study sponsored by the New Mexico Healthy Soil Program. Murali Darapuneni is a collaborator on a $5 million NSF grant to test Alginate-based hydrogel with the Pratt Institute in Brooklyn, NY. This is a collaboration with John Idowu (EPS) and Sangu Angadi (PES and Clovis ASC) with an NMSU portion of $315K over three years.

RESEARCH HIGHLIGHTS

FEED EFFICIENCY TESTING

Investigator: Marcy Ward (maward@nmsu.edu)

PROJECT OVERVIEW

The Tucumcari Feed Efficiency Testing program continues to promote genetic improvement in feed efficiency for New Mexico's beef cattle herd, leading to greater returns for the state's ranchers and those retaining ownership in the feedlot. The Tucumcari Bull Test has grown both in scope and scale since Dr. Marcy Ward, New Mexico State University's Extension Livestock Specialist, took over as the test director, in 2014. The number of animals tested has increased since 2013, from 75 bulls tested annually to 160 bulls.

MEETING THE NEEDS OF NEW MEXICO

Genetic improvement in feed efficiency for New Mexico's beef cattle herd leads to greater returns to the state's ranchers and those retaining ownership in the feedlot. Improved feed and water use efficiency also helps with limited forage production during drought and greater pregnancy rates at New Mexico's ranches.

IMPACT

In 2023, seven breeds from 22 producers were represented in the annual sale through which the top 70 bulls of 160 tested sold for an average of $4,050 and 19 heifers for an average of $2,250. The top Angus bull sold at $14,000 and the top Hereford sold for $10,000. The widening audience of the Tucumcari Feed Efficiency Test and Sale has resulted in a more competitive market for the participating producers. To put the impact of this expansion in perspective, 75 bulls can pass on their genetics to approximately 1,500 offspring per year, whereas 160 tested bulls pass on their proven genetics to over 3,000 offspring per year.

STRIP-TILL ZONE MANURE APPLICATION FOR IMPROVING RESOURCE USE EFFICIENCY IN DRYLAND SORGHUM PRODUCTION

Investigators: Murali Darapuneni (dmk07@nmsu.edu), Leonard Lauriault, Abdullahi Liman, Gasper Martinez, John Idowu, and Koffi Djaman

PROJECT OVERVIEW

Utilizing manure as a plant nutrient source under dryland farming is often undermined by transportation and application costs due to the large quantities required. Applying manure only to the 8-inch strip-till (ST) zone may help producers reduce transportation and application costs. New Mexico State University's Rex E. Kirksey Agricultural Science Center Tucumcari is comparing the effectiveness of a one-time application of manure in the ST zone using dryland sorghum as the test crop. Treatments were an ST control and manure rates [5 and 10 tons/acre] in combination with application techniques [surface and 6-inch incorporation by ST].

MEETING THE NEEDS OF NEW MEXICO

Dryland crop production in New Mexico is a low-income enterprise. Minimizing input costs in dryland agriculture, especially under grain sorghum production, is a key management practice for maximizing profitability. The manure management and potential impacts on soil and crop production project focuses on cutting the manure material, transportation, and application costs up to 60% by applying to strip-till area around the plant root zone. Additionally, this practice will enhance water and nutrient use efficiency. Reducing greenhouse gas emissions and eutrophication problems through cutting the manure quantity will also have a significant positive impact on environmental quality.

IMPACT

By applying manure to only the strip-till area, manure application costs can be cut by up to 60%. Additionally, the research showed single 10 tons /acre manure application with 6-inch incorporation resulted in an increase in grain sorghum biomass yields and water use efficiency by 22% and 7%, respectively, compared to the no manure control eight years after the initial manure application. This demonstrates the long-term benefit of a one-time manure application in a strip-till zone. This research provides sustainable management solutions for water conservation and environmental stewardship in New Mexico. New Mexico's dryland producers can benefit significantly from this research by cutting the cost of production and improving water use efficiency.

Grain sorghum in one-time application of manure in strip-till zone at Tucumcari in 2023.

EVALUATION OF ALTERNATE CROPPING SYSTEMS IN A SEMI-ARID ENVIRONMENT OF EASTERN NEW MEXICO

Investigators: Murali Darapuneni (dmk07@nmsu.edu), Leonard Lauriault, and Abdullahi Liman

PROJECT OVERVIEW

Water for agriculture is becoming increasingly limited in New Mexico and other semi-arid regions globally. Identifying water-use efficient cropping systems in limited irrigation/dryland environments is crucial to increasing productivity and agricultural sustainability. A study at New Mexico State University's Rex E. Kirksey Agricultural Science Center Tucumcari is evaluating the water use productivity of 9 alternate cropping systems that include winter and summer grasses and legumes under limited irrigated conditions in a crop rotation. No seasonal data were collected in 2023 due to late planting and weed problems. The study will be planted again in late spring 2024.

MEETING THE NEEDS OF NEW MEXICO

Successful identification of novel alternate cropping systems in semi-arid New Mexico to replace water-inefficient partial fallow or crops will not only help the local farming community to achieve higher resource use efficiency (especially water) and productivity but also promote cropping diversity throughout New Mexico, along with broader marketing opportunities. The introduction of resource-use-efficient crop selection will result in broader diversity in the existing cropping systems. Increasing the diversity in the cropping systems will not only reduce the seasonal risk of crop failures due to water scarcity but also increase farm-level income security and improve soil health.

IMPACT

Identification of resource-efficient alternate cropping systems to replace partial fallow in the current semi-arid cropping systems will have a potential production impact on more than 200,000 acres, accounting for approximately 27% of the total agricultural production area in New Mexico and the impact can be much more substantial when applied to similar environments globally. Alternate cropping to achieve higher resource use efficiency (especially water and nutrients) and productivity will not only generate higher farm-level income for producers but also promote broader marketing and economic opportunities in New Mexico, as well as improve soil health.

EVALUATION OF EDIBLE DRY BEANS AND GUAR FOR YIELD AND WATER USE EFFICIENCY CHARACTERISTICS

Investigators: Murali Darapuneni (dmk07@nmsu.edu), Leonard Lauriault, Abdullahi Liman, John Idowu, Koffi Djaman, Gasper Martinez, and Erik Lehnhoff

PROJECT OVERVIEW

Water scarcity and nutrient supply are major problems of New Mexico's arid and semi-arid agriculture. Addressing these two problems with resource-efficient crop selection is one of the potential tools available for producers to use. Therefore, an experiment since 2021 at New Mexico State University's Rex E. Kirksey Agricultural Science Center at Tucumcari is testing the yield potential, water use efficiency, and nitrogen dynamics of five edible dry bean cultivars and guar under limited irrigation.

MEETING THE NEEDS OF NEW MEXICO

Growing dry beans in New Mexico will not only serve the local agricultural crop and livestock needs but also help in the enhancement of New Mexico's agriculture-based economy. Addressing the water issue of rainfed/limited irrigation semiarid agriculture in New Mexico through innovative cropping systems and crop selection solutions is critical to achieving maximum productivity and sustainability in these environments. Both dry bean and guar are dual-purpose potential crops for New Mexico with high protein and nutritional value. As legume crops, beans enrich the soil with nitrogen and other nutrients if residue is incorporated into the soil after the grain harvest.

IMPACT

It is anticipated that identifying water-use efficient edible dry bean and guar crops will increase the per acre productivity in approximately 380,000 acres by rotating with traditional winter wheat/other semi-arid crops in New Mexico. The yield results showed significantly greater seed and biomass yields in pinto beans and black beans than in other crops tested. Guar showed consistent drought tolerance and resistance to wilting in the field compared to other edible dry bean varieties, which was demonstrated by relatively high water use efficiency for both seed and biomass production. The introduction of resource-use efficient crop options will not only result in broader diversity in the existing cropping systems but also increase farm level income security through efficient use of available water resources.

COLLABORATING AGRICULTURAL SCIENCE CENTERS:

Farmington Agricultural Science Center and Leyendecker Plant Science Center

Dry bean species tested in Tucumcari during 2021-2023

BIOCHAR AS A SOIL AMENDMENT MATERIAL USED IN FORAGE SORGHUM PRODUCTION

Investigators: Murali Darapuneni (dmk07@nmsu.edu), Abdullahi Liman, Sanguino Angadi, John Idowu, and Leonard Lauriault

PROJECT OVERVIEW

Biochar is a carbon-rich pyrolysis product obtained from burning biological materials such as plant biomass and animal waste. Biochar is generally used as an organic soil amendment material for crop production to enhance soil chemistry and water retention, improve plant growth and nutrition, and reduce greenhouse gas emissions. A three-year field experiment was initiated in 2023 at New Mexico State University's Rex E. Kirksey Agricultural Science Center at Tucumcari to evaluate the effects of various combinations of biochar and manure on soil chemical characteristics, water use, and crop growth and quality of forage sorghum.

MEETING THE NEEDS OF NEW MEXICO

New Mexico crop producers can use biochar as a multi-purpose soil amendment material to enhance water retention, soil physiochemical characteristics, and crop yield and quality. Climate change is an important issue that can also be addressed with the soil application of biochar which can help significantly reduce carbon emissions to the atmosphere. Salt problems in arid and semi-arid soils of New Mexico can be effectively mitigated with the application of biochar which can also lead to increased vegetative growth and yield and water use efficiency of the crops.

IMPACT

First-year research results showed no significant impact on plant growth, biomass yields, or biomass water use efficiency. However, the study will be continued in subsequent years either to confirm the 2023 results or to investigate the new findings further. Biochar's effects on soil characteristics are yet to be analyzed. If biochar application is proven effective in mitigating the salt-affected soils, this practice will improve the agricultural productivity of over 128,000 acres in New Mexico.

COLLABORATING AGRICULTURAL SCIENCE CENTERS:

Clovis Agricultural Science Center

Biochar experiment conducted at Tucumcari during 2023.

SOIL NUTRIENT AND MICROBIAL RESPONSE AFTER 10 YEARS OF IRRIGATION WITH TREATED MUNICIPAL WASTEWATER

Investigators: Leonard Lauriault (lmlaur@nmsu.edu), Murali Darapuneni, and Xiufen Li (PES)

PROJECT OVERVIEW

On March 7, 2023, soil samples were collected at the Rex E. Kirksey Agricultural Science Center to at least 3 ft deep and separated into 1 ft increments for nutrient analysis and microbial analysis in the upper 1 ft. Preliminary results indicate differences among cropping systems and soil type in soil micronutrient and cation exchange capacity and soil microbial activity. Although three PFAS compounds were found in the wastewater, none were found in the surface 36 inches of soil after 10 years of application.

MEETING THE NEEDS OF NEW MEXICO

New Mexico's municipalities seek uses for their treated municipal wastewater to minimize disposal costs and adverse effects on the state's water bodies and the environment. A study at New Mexico State University's Rex E. Kirksey Agricultural Science Center at Tucumcari evaluated the soil nutrient and microbial response and potential PFAS accumulation after treated municipal wastewater was used for agricultural irrigation for 10 years.

IMPACT

Long-term application of treated municipal wastewater can have positive, benign, or negative results on plant nutrient availability depending on soil type and cropping system. Perennial cropping with a legume, such as alfalfa, generally provides greater benefits when irrigated with treated wastewater than annual grass forage cropping. Municipalities can benefit by providing the water as an alternative source of agricultural irrigation as opposed to more costly disposal methods and reduce the use of potable water for agricultural irrigation. Producers can benefit from the plant nutrients available in the wastewater and save on the cost of applying nutrients, either in organic or inorganic forms.

FUNDING ACKNOWLEDGMENT:
New Mexico Department of Agriculture Healthy Soil Program

INFLUENCE OF IRRIGATED WINTER COVER CROPPING SYSTEMS ON SOIL HEALTH AND PERFORMANCE OF THE COVER CROPS AND THE SUBSEQUENT TILLED FORAGE SORGHUM CROP

Investigators: Leonard Lauriault (lmlaur@nmsu.edu), Murali Darapuneni, and Xiufen Li (PES)

PROJECT OVERVIEW

Winter cereal and legume cover crops were established in September 2022 and sprinkler-irrigated with treated municipal wastewater. After cover crops were terminated in May 2023 with the remaining cover crop biomass left intact, forage sorghum was no-till planted and harvested in early November after being freeze-killed shortly after heading. Soil samples were collected immediately post-planting, after cover crop termination, and after forage sorghum harvest in November 2023 and analyzed for nutrient content by 1-ft depth increments and soil microbial activity in the surface foot. Cover crop and forage sorghum biomass were measured and evaluated for nitrogen uptake.

MEETING THE NEEDS OF NEW MEXICO

New Mexico's municipalities seek uses for their treated municipal wastewater to minimize disposal costs and adverse effects on the state's water bodies and the environment. A study at New Mexico State University's Rex E. Kirksey Agricultural Science Center at Tucumcari, NM USA, evaluated the soil nutrient and microbial and crop responses when winter cover crops and the subsequent forage sorghum crop were irrigated with treated municipal wastewater.

IMPACT

Forage sorghum following hairy vetch took up more nitrogen than forage sorghum planted after oat, rye, and triticale, and nearly so after barley and Austrian winter pea. Excessive nitrogen content in treated municipal wastewater that could otherwise be used for agricultural irrigation is a common issue for New Mexico water treatment plants. In addition to being a more environmentally friendly method to dispose of the water, its reuse through frequent irrigation applications at low rates could reduce or outright negate the amount of organic or inorganic nitrogen fertilizers required to maximize the production of double-cropped winter cereal and sorghum forage crops. The use of legumes as a cover crop increased forage sorghum biomass yield, crude protein content, and other nutritive value components.

FUNDING ACKNOWLEDGMENT:

New Mexico Department of Agriculture Healthy Soil Program

Cover crop species planted as monocultures at Tucumcari 2022. Top row, l-r: Austrian winter pea, hairy vetch, and unplanted control Bottom Row, l-r: Cereal rye, barley, triticale, oat

EVALUATION OF DOUBLE CROPPING SELECTED WINTER CEREAL COVER CROPS HARVESTED FOR FORAGE AND SUMMER SORGHUM FORAGE PRODUCTION ON FIELD BINDWEED CONTROL

Investigators: Leonard Lauriault (lmlaur@nmsu.edu) and Murali Darapuneni

PROJECT OVERVIEW

Winter cereal forage cover crops (barley, rye, oat, and triticale) were planted into a conventionally tilled seedbed in an area at the NMSU Rex E. Kirksey Agricultural Science Center heavily infested with field bindweed on September 26, 2023, and irrigated with treated municipal wastewater to promote germination and subsequent growth. Three weeks later, after uniform establishment of the cereals, emerged bindweed clones (plants connected by rhizomes) were counted in each plot. Statistical analysis revealed no differences among treatments in initial bindweed clone counts, which averaged 8.6 plants per square yard.

MEETING THE NEEDS OF NEW MEXICO

Using no-tillage and competitive cropping strategies could potentially reclaim New Mexico's annually cropped areas that are infested with field bindweed and return the land to its agricultural potential without the use of herbicides.

IMPACT

Field bindweed is a perennial weed with an extensive root system that significantly reduces crop productivity when it gains a competitive advantage. Tillage is known to reduce bindweed competition, but conversion to no-tillage practices in semiarid regions is encouraged. Using winter cereal cover crops planted in early autumn when the bindweed is dormant or growth is reduced may interfere with spring growth by bindweed limiting its competition with summer crops and allowing for forage harvest of both winter and summer crops. Sorghums are known to exhibit allelopathy against other plants and compete by shading as a taller-growing species. No-tilling sorghum-sudangrass soon after winter cereal harvest may allow the sorghum forage to gain a competitive advantage over the bindweed and continue competition by shading until harvest. This double cropping sequence could continue, potentially depleting the established bindweed and preventing new seedlings from becoming established.

Winter cereal forages for control of field bindweed. The cereals have been heavily grazed by wildlife and the bindweed is dormant (2-15-2024).

PERFORMANCE OF IRRIGATED ALFALFA VARIETIES IN NEW MEXICO

Investigators: Leonard Lauriault (lmlaur@nmsu.edu), Koffi Djaman, Robert Flynn, Mark Marsalis, Ian Ray (emeritus)

PROJECT OVERVIEW

Variety selection is a critical first step in producing high alfalfa yields with high nutritive value at the same production costs. Alfalfa varieties (15 entries planted in 2018) were grown at Tucumcari under irrigation and harvested four times for hay in 2023. Statewide testing, coordinated by the Rex E. Kirksey Agricultural Science Center at Tucumcari, was also conducted at Agricultural Experiment Station research facilities at Las Cruces, Artesia, Los Lunas, and Farmington.

MEETING THE NEEDS OF NEW MEXICO

In 2023, alfalfa hay production was estimated at 783,000 tons with estimated gross returns from alfalfa hay totaling over $238 million, which is a 28% increase from 2022 and sustains alfalfa hay's position as New Mexico's #1 cash field crop. Besides its value for hay, alfalfa also is the legume of choice in irrigated perennial pastures. Whether used as pasture or hay, the value of alfalfa to New Mexico is greatly magnified by its contribution to livestock production and receipts from the sale of meat, milk, and other products generated by New Mexico's livestock enterprises.

IMPACT

To assist New Mexico's alfalfa growers select varieties, results from statewide testing in 2023 and previous years are available at the NMSU College of Agricultural, Consumer and Environmental Sciences County Cooperative Extension Service Offices as well their Specialty Publications website (https://pubs.nmsu.edu/specialty/index.html). Based on estimates, the average price for alfalfa hay in 2023 was $304/ton. Differences between the highest- and lowest-yielding varieties at Tucumcari (0.53 tons/acre) led to a difference in gross returns of $161/acre for two cuttings of irrigated hay at Tucumcari. Yield differences in established, irrigated tests statewide ranged from 0.98 to 2.00 tons per acre in 2023. If sold as hay, this translated to a potential difference in returns of $298 to $608 per acre due to variety, which would lead to an increase of at least $43 million for New Mexico's alfalfa industry.

FUNDING ACKNOWLEDGMENT:

Alfalfa seed company entry fees

COLLABORATING AGRICULTURAL SCIENCE CENTERS:

Artesia Agricultural Science Center, Farmington Agricultural Science Center, Leyendecker Plant Science Center, and Los Lunas Agricultural Science Center

Alfalfa variety performance evaluation

EVALUATION OF IRRIGATED WINTER MALTING BARLEY VARIETIES IN EASTERN NEW MEXICO

Investigators: Leonard Lauriault (lmlaur@nmsu.edu) and Kevin Lombard

PROJECT OVERVIEW

Variety selection is a critical first step in producing high yields of winter malting barley at the same production costs. Thirty winter malting barley entries provided by the University of Minnesota as part of a nationwide evaluation program were planted at New Mexico State University's Rex E. Kirksey Agricultural Science Center in autumn 2022 and harvested for grain in June 2023. Twenty-nine entries were planted in autumn 2023 for harvest in 2024. All entries were heavily grazed by wildlife over winter 2022-23, which is happening again in 2023-34 and may influence grain production.

MEETING THE NEEDS OF NEW MEXICO

New Mexico has experienced considerable growth in its craft brewing industry in recent years with substantial economic returns. This also has resulted in a need to produce grain ingredients for the industry, including malting barley and hops. Consequently, stakeholders in the grain-producing region of eastern New Mexico are interested in the local adaptation of winter malting barley as a potential alternative crop to winter wheat.

IMPACT

Statewide, New Mexico experienced a 344% increase from 2016 to 2019 in jobs in the craft brewing industry, which had a $391 million impact on New Mexico in 2019. Grain yield differences among winter malting barley varieties at Tucumcari ranged from 53.8 to 93.4 bu/ac with a study average of 78.8 bu/ac. At the August 2023 farm price of $7.52/bu, this would return from $404 to $702/ac. Since winter cereal grazing is commonly practiced for dual-purpose production, if producers desire to include grazing, they are encouraged to follow the same recommendation as for dual-purpose wheat to remove livestock at the first hollow stem to protect grain production potential and receive the added value from livestock production.

COLLABORATING AGRICULTURAL SCIENCE CENTERS:

Farmington Agricultural Science Center

INFLUENCE OF WATER SOURCE ON RED BELL PEPPER AND ROMA TOMATO VARIETAL PERFORMANCE IS EASTERN NEW MEXICO

Investigators: Leonard Lauriault (lmlaur@nmsu.edu) and Murali Darapuneni

PROJECT OVERVIEW

Four varieties each of red bell peppers and Roma tomatoes were directly seeded at New Mexico State University's Rex E. Kirksey Agricultural Science Center at Tucumcari into a conventionally tilled seedbed with drip irrigation installed to supply either treated municipal wastewater or potable water, both supplied by the city of Tucumcari. Plots were irrigated only with potable water to promote germination; however, stand establishment was not successful with little explanation. Consequently, in 2024, greenhouse-grown transplants will be used in case soil conditions are not conducive to germination and establishment in 2023.

MEETING THE NEEDS OF NEW MEXICO

Red bell peppers and Roma tomatoes are commonly used in chile pepper-based processed foods in New Mexico; however, little or no local production is in place leading to high transportation costs for New Mexico True and Hatch chili products. Variety selection is a critical first step in producing high yields of any crop with high quality at the same production costs. Water sources for locally grown food also is a concern due to drought and water shortages.

IMPACT

To date, no results are available from this study; however, if red bell peppers and Roma tomatoes can be successfully grown in New Mexico the benefit to the state's small landholders and its chile processing industry could be considerable.

FUNDING ACKNOWLEDGMENT:
Paulita's New Mexico, Tucumcari

Alan Porter speaking about red bell peppers and Roma tomatoes at Field Day

BY THE NUMBERS

RESEARCH PUBLICATIONS

PEER-REVIEWED JOURNAL ARTICLES

- Creegan, E.F., Flynn, R.P., Brewer, C.E., Heerema, R., Darapuneni, M.K., Velasco-Cruz, C. (2023). Pecan biomass and dairy manure utilization: Compost treatment and soil in-situ comparisons of selected pecan crop and soil variables. *Processes, 11(2046)*, 1-14. https://doi.org/10.3390/pr11072046
- Lauriault, L.M., Darapuneni, M.K., Martinez, G K. (2023). Pearl millet – cowpea forage mixture planting arrangement influences mixture yield and nutritive value in semiarid regions. *MDPI Crops, 3(4)*, 266-275. https://doi.org/10.3390/crops3040024.
- Lauriault, L.M., Scholljegerdes, E.J., Sawyer, J.E. (2023). Stocking density effects on predominantly blue grama pasture mass and animal performance. *MDPI Grasses, 2(3)*, 142-155. https://doi.org/10.3390/grasses2030012.
- Shrestha, B., Darapuneni, M.K., Stringam, B., Lombard, K.A., Djaman, K. (2023). Irrigation and nitrogen application rates on potato *(Solanum tuberosum L.)* growth, yield, and quality: A Review. Agronomy, MDPI. https://www.mdpi.com/2073-4395/13/10/2566.
- Umesh, M.R., Angadi, S., Begna, S., Gowda, P.H., Hagevoort, G.R., Lauriault, L.M., Darapuneni, M.K. (2023). Intercropping and species interactions on physiological and light use characteristics of forage cereals-legumes combinations in semi-arid regions. *Field Crops Research, 290(108755)*, 9 pp. https://doi.org/10.1016/j.fcr.2022.108755.

CONFERENCE PROCEEDINGS, ABSTRACTS, AND EXPERIMENT STATION REPORT (NON-PEER-REVIEWED)

- Sidhu, H.S., Angadi, S., Idowu, O. J., Lauriault, L.M., Miller, F., Singh, P., Nielson. (2023). *M. Guar fertility management under pre-season vs in-season irrigation*, Madison, WI: Western Society of Crop Science, Abstract.
- Darapuneni, M.K., Idowu, O.J., Djaman, K., Lauriault, L.M., Lehnhoff, E.A., Ayman, A. (2023). Edible dry bean potential in eastern New Mexico, Madison, WI: American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, Abstract.
- Lauriault, L.M., Darapuneni, M.K., Martinez, G.K. (2023). *Crop and soil response of treated wastewater- Irrigated spring and winter cover crops.* Madison, WI: Western Society of Crop Science, Abstract.
- Lauriault, L. M., Ray, I., Pierce, C., Djaman, K., Flynn, R. P., Marsalis, M. A., Havlik, C., Martinez, G., West, M. (2023). *The 2022 New Mexico alfalfa variety test report* (pp. 12 pp.). Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. https://pubs.nmsu.edu/variety_trials/AVT23.pdf.

GRANTS AND CONTRACTS

Contracts, Grants, and Sponsored Research **Number of Proposals Submitted in 2023: Three. Number of Proposals funded in 2023: One. Funds requested in 2023: $1,150,000. Funds awarded in 2023: $300,000. Grant Expenditures in 2023: None.**

Funded (Total: $300,000)

- Kahiu, M.N., Anchang, J., Hanan, N., **Lauriault, L.M**., Marsalis, M.A., Delgado, E., Scholljegerdes, E.J. ($300,000) Sustainable forage solutions for drought resilience in African livestock systems, USDA-FSA. Effective Start Date: January 1, 2024, Effective End Date: December 31, 2025.

Sponsorships, Other Funding - Non ARGIS **Number of Proposals Submitted in 2023: Four. Number of Proposals funded in 2023: Four. Funds requested in 2023: $1,263,198 + entry fees and donations. Funds awarded in 2023: $69,761 with alfalfa entry fees divided by four. Expenditures in 2023: approximately $80,244.**

Funded:

- NMDA's Healthy Soil Program, New Mexico Department of Agriculture, $63,197.92, Description: Evaluating treated municipal wastewater for winter cover cropping and the subsequent summer forage to protect the soil, promote soil health, and protect freshwater sources II, Status: Funded, Effective Start Date: August 2023, Effective End Date: May 2024.
- NMDA's Healthy Soil Program, New Mexico Department of Agriculture, $73,414.87, Description: Mitigating excessive nitrogen in treated municipal wastewater through crop uptake by winter cereal cover crop/forages, Status: Funded, Effective Start Date: August 15, 2022, Effective End Date: May 31, 2023.
- Fee-based alfalfa variety testing, 2023, Multiple seed companies, $475.00, Description: Entry fees for alfalfa varieties planted in one year and compared for the next two to four years at various NMSU locations across the state, Status: Funded, Effective Start Date: April 1, 2023, Effective End Date: December 31, 2027.
- Fee-based alfalfa variety testing, 2022, Multiple seed companies, $1,675.00, Description: Entry fees for alfalfa varieties planted in one year and compared for the next two to four years at various NMSU locations across the state, Status: Funded, Effective Start Date: April 1, 2022, Effective End Date: December 31, 2026.
- Fee-based alfalfa variety testing, 2021, Multiple seed companies, $3,500.00, Description: Entry fees for alfalfa varieties planted in one year and compared for the next four years at various NMSU locations across the state, Status: Funded, Effective Start Date: April 1, 2021, Effective End Date: December 31, 2025.

GRANTS AND CONTRACTS

- Fee-based alfalfa variety testing, 2020," Multiple seed companies, $5,325.00, Description: Entry fees for alfalfa varieties planted in one year and compared for the next four years at various NMSU locations across the state, Status: Funded, Effective Start Date: April 1, 2020, Effective End Date: December 31, 2024.
- Fee-based alfalfa variety testing, 2019," Multiple seed companies, $6,450.00, Description: Entry fees for alfalfa varieties planted in one year and compared for the next four years at various NMSU locations across the state, Status: Funded, Effective Start Date: April 1, 2019, Effective End Date: December 31, 2023.
- Fee-based cotton variety testing, 2023," Multiple seed companies, $875.00, Description: Entry fees to evaluate local adaptation of stripper cotton varieties. In addition to the fee, the company provided all seed, Status: Funded, Effective Start Date: May 1, 2023, Effective End Date: December 31, 2023.
- Roma tomato and red bell pepper variety testing, 2023," Paulita's New Mexico, $500.00, Description: Funding to evaluate the local adaptation of Roma tomato and red bell pepper varieties. In addition to the funding, the company provided all seed, Status: Funded, Effective Start Date: May 1, 2023, Effective End Date: December 31, 2023.

OUTREACH ACTIVITIES

Tucumcari Bull Test and Sale (March 11): Despite high winds, there were at least 100 in-person attendees, and 80 watched from 10 states online. Seven breeds from 22 producers were represented in the sale through which the top 70 bulls of 160 tested sold for an average of $4,050 and 19 heifers sold for an average of $2,250. Several Angus bulls sold at over $7,000, with the top sale being $14,000. The top Hereford sold for $10,000.

The Tucumcari Feed Efficiency Testing program continues to promote genetic improvement in feed efficiency for New Mexico's beef cattle herd which leads to greater returns for the state's ranchers and those retaining ownership in the feedlot. Improved feed efficiency also helps with limited forage production during drought and greater pregnancy rates at New Mexico's ranches. To put the impact of this genetic improvement in perspective, 160 tested bulls pass on their proven genetics to over 3000 offspring per year. The widening audience of the Tucumcari Feed Efficiency Test and Sale has resulted in a more competitive market for the participating producers. For more information, contact Dr. Marcy Ward, NMSU State Extension Livestock Specialist (maward@nmsu.edu).

Field Day (August 1): With 101 in attendance, an increase from the previous year. Dr. David Dubois, State Climatologist, described the statewide weather station expansion provided by legislative support. A meal followed that was catered by the Quay County Roadrunners 4-H Club as a fundraiser for the club sponsored by local businesses. Research presentation topics included virtual fencing, biochar and manure amendments to improve soil quality, soil carbon management, edible dry beans, Roma tomatoes, and red bell peppers as potential crops for local economic development, and winter cereal cover crops and winter barley.

OUTREACH ACTIVITIES

Farm Day (September 28): An opportunity for Tucumcari's 4th & 5th grades to learn about the importance of agriculture. Those in attendance included 144 students and 24 adults, probably half of whom were parents. Presentations included: "Soil health," "4-H, with a chicken project demo," "What else, Beef!," "Good bugs, bad bugs." "Edible dry beans,", and "Native foods used by Indigenous People."

Field trip for Santa Rosa, NM FFA, and agriculture classes (November 8): A high school recruiting opportunity during which presentations were made regarding the history and ongoing crop and livestock research programs of the Rex E. Kirksey Agricultural Science Center as well as equipment for specialized research and commercial crop production. Attendees included 20 8-12 grade students, along with the FFA advisor, agriculture teacher, and bus driver.

PEOPLE

COOPERATORS AND COLLABORATORS

NMSU CAMPUS-BASED FACULTY

- Agricultural Business and Agricultural Economics, including Extension: Ram Acharya, Brian Hurd, Jay Lilywhite, Frannie Miller, Frank Ward, Luis Ramos-Coronado (graduate student)
- Animal and Range Sciences: Hatim Geli, Eric Scholljegerdes, Leah Schmitz (former student), Luis Ochoa (student)
- Center for Learning and Training Development: Vanetta Busch
- Entomology, Plant Pathology, and Weed Science: Steve Hanson, Chanz Robbins, Soum Sanogo, Dave Thompson, Erik Lehnhoff
- Extension Animal Sciences and Natural Resources: Sam Fernald, Craig Gifford, Marcy Ward
- Extension Plant Sciences: Leslie Beck, Richard Heerema, John Idowu, Bernd Leinauer, Ciro Velasco-Cruz, Phillip Lujan
- Economics, Applied Statistics & International Business: Robert Steiner, Dawn VanLeeuwen
- Family and Consumer Sciences, including Extension: Efren Delgado, Nancy Flores
- Fish, Wildlife and Conservation Ecology: Wiebke Boeing, Kelly Jones, Theresa Laverty
- ·Hotel, Restaurant, and Tourism Management: Daren Bloomquist
- Plant and Environmental Sciences: Julius Anchang, David DuBois, Kenneth C. Carroll, Rajan Ghimire, Ryan Goss, Lois Grant, Kulbhushan Grover, Yvette Guzman, Niall Hanan, Omar Holguin, Geno Picchioni, Rich Pratt, Ian Ray , Manoj Shukla, Caitriana Steele, Blair Stringam, April Ulery, Aquib Mohammed Ayman (graduate student - Tucumcari), Emily Creegan (graduate student), Abdullahi Liman (graduate student - Tucumcari), Mohammed Omer (Post-Doc)
- Special thanks to CES county and district faculty

NMSU OFF-CAMPUS RESEARCH FACILITIES

- Alcalde: Rob Heyduck, Del Jimenez, Shengrui Yao, Saeid Salmasi
- Artesia: Jane Breen-Pierce, Robert Flynn
- Clayton: Glenn Duff, Bianca Birkenstock (graduate student)
- Clovis: Sangu Angadi, Rajan Ghimire, Robert Hagevoort, Abdel Mesbah, Naveen Puppala, Pramod Acharya (Post-doc), Paramveer Singh (graduate student), Harjot Sidhu (graduate student)
- Corona: Shad Cox
- Farmington: Samuel Allen, Koffi Djaman, Kevin Lombard, Gasper Martinez, Margaret West, Bhimsen Shrestha (graduate student)
- Los Lunas: Mark Marsalis, Marisa Thompson, Charles Havlik

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OTHER UNIVERSITY, FEDERAL, STATE, AND INDUSTRY PARTNERS AND COLLABORATORS

- Alan Porter, Paulita's New Mexico, Tucumcari
- Arch Hurley Conservancy District: Franklin McCasland, Tucumcari
- Canadian River Soil and Water Conservation District, Tucumcari
- Cindie Kehlet, Pratt Institute, Brooklyn, NY
- City of Tucumcari
- Colorado State University: Jessica Davis, Jeffrey Davidson, Kevin Larson, Sophia Linn, Daniel Mooney
- East Foundation, San Antonio, TX, Jason Sawyer
- Greater Tucumcari Economic Development Corporation, Tucumcari
- Louisiana State University, Baton Rouge: Syam Dodla
- Marie Nava, Rancho Alma Linda
- Mesalands Community College, Tucumcari
- Mississippi State University, near Starkville: Rocky Lemus
- Natural Resources Conservation Service: Relissa Nials and Team 6, Tucumcari
- New Mexico Economic Development Department
- New Mexico Environment Department
- New Mexico Hay Association: Board of Directors
- Phillip & Kathleen Box, Box Farms, Tucumcari
- Quay County Cotton Boll Weevil Control District, Tucumcari
- Quay County Government: County Commission and manager, Tucumcari
- Quay County Sun, Tucumcari
- Quay County TableTop Food Co-op, Tucumcari
- Sam Gonzales, Los Terrenos Ranch, Farmington
- Southwest Quay Soil and Water Conservation District, Tucumcari
- Texas AgriLife Research and Extension: Jourdan Bell (Amarillo), Pat Porter and Calvin Trostle (Lubbock)
- Tim & Andrea Clark, Clark Farms, Tucumcari
- Tucumcari Bio-Energy and Aquaponics, Tucumcari
- Tucumcari Feed Efficiency Test, LLC (TFET, dba Tucumcari Bull Test
- Tucumcari Public Schools
- Tucumcari/Quay County Chamber of Commerce
- University of Arizona: Debankur Sanyal
- University of Nebraska, Scottsbluff: Gary Hergert, Jeff Bradshaw, and Robert Harveson
- USDA: Sultan Begna (ARS, Parlier, CA), Wooiklee Paye (ARS, Florence, SC), Prasanna Gowda (ARS, Stoneville, MS)
- West Texas A&M University, Canyon: Brock Blaser, Elora-Danam Ellison (student), and Marty Rhodes

INTERNATIONAL PARTNERS AND COLLABORATORS

INDIA

- University of Agricultural Sciences, Raichur: M.R. Umesh

COOPERATORS AND COLLABORATORS

INTERNATIONAL PARTNERS AND COLLABORATORS

ITALY

- Department of Agronomy, Food, Natural Resources, Animals, and Environment (DAFNAE), University of Padova, Legnaro, Italy: Stefano Macolino and Cristina Pornaro
- Padana Sementi Elette s.r.l., Padova, Italy: Guido Pignata,

PAKISTAN

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

PUNJAB

- The Islamia University of Bahawalpur

UNITED KINGDOM

- Anglo American Crops, Scarborough: Brad Farber, Rachel Fields

ADVISORY COMMITTEE

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- Mr. Tom Sidwell
- Mr. Donald Walker

GRADUATE STUDENTS

- Abdullahi Liman (PES) - MS (Agronomy)
- Aquib Ayman (PES)- MS (Agronomy)

ASC PERSONNEL

LEONARD LAURIAULT

Research Director
Forage Crop Management Scientist

MURALI DARAPUNENI

Semiarid Cropping Systems
Specialist

PATRICIA COOKSEY

Administrative Assistant,
part time

JASON BOX

Farm Ranch Manager

RAM MILLER

Farm Ranch Manager,
Assistant

GASPER MARTINEZ

Research Assistant
(until mid-May 2023)

AQUIB AYMAN

Graduate Student

ABDULLAHI LIMAN

Graduate Student