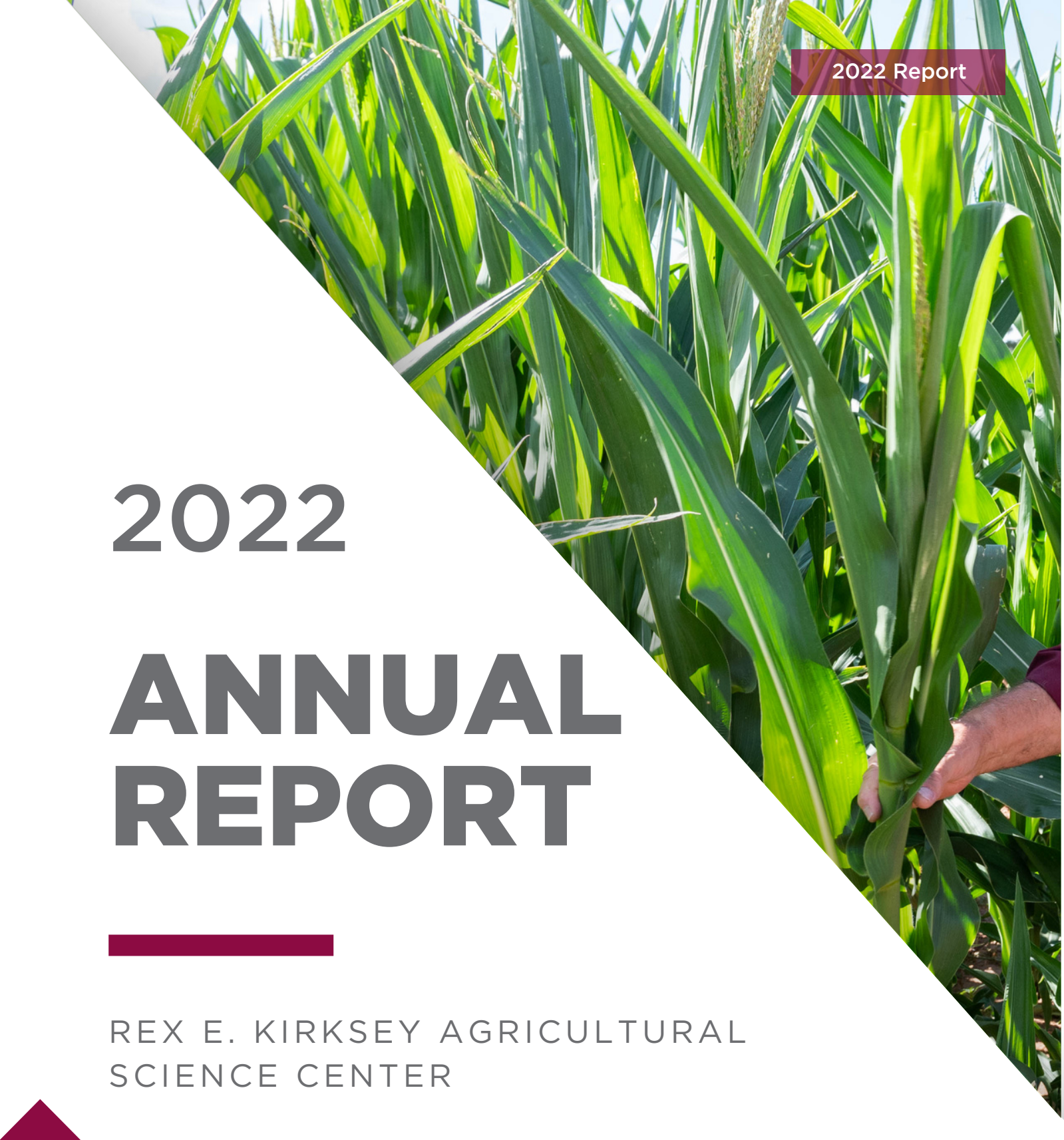

2022 Report

2022 ANNUAL REPORT

REX E. KIRKSEY AGRICULTURAL SCIENCE CENTER

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.

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Notice to Users of this Report

This report has been prepared to aid Science Center staff in analyzing the results of various research projects from the past year and to record data for future reference. These are not formal Agricultural Experiment Station Report research results. The reader is cautioned against drawing conclusions or making recommendations as a result of the data in this report. In many instances, data represents only one of several years' results that will ultimately constitute the final formal report. Although staff members have made every effort to check the accuracy of the data presented, this report was not prepared as a formal release.

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

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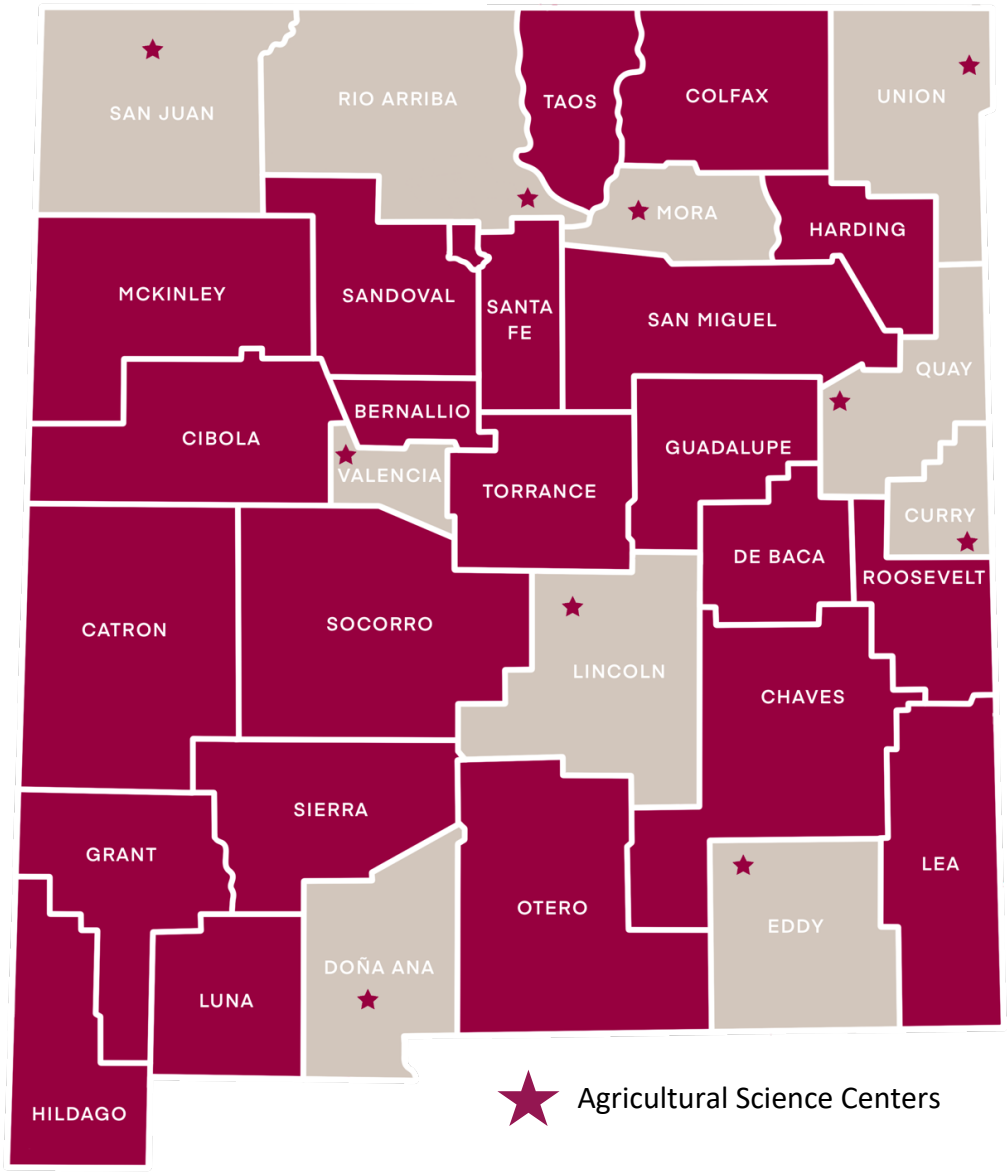
Agricultural Science Center Locations Map



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Executive Summary

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

The advisory committee has proposed an enhancement in research programs to include faculty, support staff, and research operations to conduct research and outreach/Extension activities related to the reuse of treated municipal wastewater for agricultural irrigation, rangeland soil health restoration, and low input horticultural crops for human food. Additionally, infrastructure replacement (dilapidated 100-year-old adobe buildings) and upgrades are at the forefront, as is the renewal of a New Mexico Environment Groundwater Discharge Permit to use treated municipal wastewater for agricultural irrigation and research.

Research Projects

Tucumcari Feed Efficiency Test – Investigators: Marcy Ward, Jason Box, and Leonard Lauriault

New Mexico Youth Beef Feeder Contest - Investigator: Marcy Ward

Other feed efficiency testing - Investigator: Marcy Ward

Grazing effects on field bindweed infestation in grass pastures - Investigators: Leonard Lauriault, Murali Darapuneni, Gasper Martinez, and Jason Box

Evaluation of alternate cropping systems in the arid and semi-arid New Mexico - Murali Darapuneni, Aquib Mohammed Ayman (graduate student), Leonard Lauriault, John Idowu, Koffi Djaman, Gasper Martinez, and Jason Box

Edible dry beans and guar potential in the arid and semi-arid New Mexico - Investigators: Murali Darapuneni, Aquib Mohammed Ayman (graduate student), Leonard Lauriault, John Idowu, Koffi Djaman, Gasper Martinez, and Jason Box

Guar seeding density and fertilizer requirements - Investigators: Murali Darapuneni, Aquib Mohammed Ayman (graduate student), Mohammed Omer, John Idowu, Leonard Lauriault, Gasper Martinez, and Jason Box

Pearl millet – Cowpea Forage mixture planting arrangements - Investigators: Leonard Lauriault, Murali Darapuneni, Gasper Martinez, and Jason Box

Sorghum – Legume forage mixtures to improve protein content - Investigators: Leonard Lauriault, Murali Darapuneni, Gasper Martinez, and Jason Box

Influence of irrigation with treated municipal wastewater on soil and crops - Investigators: Leonard Lauriault, Murali Darapuneni, Gasper Martinez, and Jason Box

Influence of irrigation with treated municipal wastewater on spring cereal forage crops - Investigators: Leonard Lauriault, Murali Darapuneni, Gasper Martinez, and Jason Box

Influence of irrigation with treated municipal wastewater on soil health under winter cover crops - Investigators: Leonard Lauriault, Murali Darapuneni, Gasper Martinez, and Jason Box

Performance of irrigated alfalfa varieties - Investigators: Leonard Lauriault, Gasper Martinez, and Jason Box

Performance of irrigated silage corn hybrids - Investigators: Leonard Lauriault, Gasper Martinez, and Jason Box

Performance of irrigated sorghum forage varieties - Investigators: Leonard Lauriault, Gasper Martinez, and Jason Box

Performance of irrigated upland cotton varieties - Investigators: Leonard Lauriault, Gasper Martinez, and Jason Box

Tucumcari Feed Efficiency Test

Investigators: Marcy Ward (maward@nmsu.edu), Jason Box, and Leonard Lauriault

Project Overview: The Tucumcari Bull Test has grown both in scope and scale since Dr. Marcy Ward, New Mexico State University's Extension Livestock Specialist, took over as the test director, in 2014. The number of animals tested has grown 100% 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 for leads to greater returns to 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.

Impact: 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 animals pass on their proven genetics to over 3,000 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. The 2022 sale was the best to date, selling 90% of the bulls offered at a sale average of $4,200 and resulting in the participating producers taking home $700 more per bull than the previous years.

Water Intake Stanchions in Large Growsafe Pen

Funding Acknowledgement: The Tucumcari Feed Efficiency Test, LLC, is the sole provider of funds for this project.

New Mexico Youth Beef Feeder Contest

Investigator: Marcy Ward (maward@nmsu.edu)

Project Overview: As a collaborative effort with the Tucumcari Feed Efficiency Test (TFET), LLC, the New Mexico Youth Beef Feeder Contest, held in the spring of 2022, allowed young people to raise a steer in a production system from weaning to harvest as an alternative 4-H project to showing at the fair. Ten steers were brought to the station to be feed efficiency tested and finished out. Participants from throughout New Mexico learned the value of efficiency in terms of actual feed conversion and cost of gain. They could monitor their calves from their home through a special software system.

Meeting the Needs of New Mexico: Helping youth learn about New Mexico's beef industry, including production management, develops skills to prepare them for the industry, thereby, strengthening New Mexico's beef cattle industry.

Impact: The positive relationship through the collaboration of TFET and youth programming has resulted in mentoring opportunities for producers to youth interested in the beef industry. It has also exposed young people to some of the technology available in the industry. Participants also learned the value of efficiency in terms of actual feed conversion and cost of gain.

Participants of the NM Youth Feeder Beef Contest

Other feed efficiency testing

Investigators: Marcy Ward (maward@nmsu.edu)

Project Overview: Two projects were conducted for private parties during the summer of 2022. The first project, 19 yearling bulls were tested for two producers from Texas who needed the information generated from the station to submit for the genetic evaluation of their bulls. After that, a 45-day trial with 80 dairy beef steers and heifers was conducted to measure water use and feed efficiency from dairy calves of known beef sires. One group's sire was a bull that won the winter bull feed efficiency test in 2020.

Meeting the Needs of New Mexico: Funds generated from private tests help to support the Tucumcari Feed Efficiency Test, LLC so that testing can continue to improve New Mexico's beef cattle herd. The second summer test was conducted to validate progeny of feed efficiency-tested bulls.

Impact: Funds generated from private tests help to support the Tucumcari Feed Efficiency Test, LLC so that testing can continue to improve New Mexico's beef cattle herd. The second summer test was conducted to validate progeny of feed efficiency-tested bulls.

John Heckendorn had the Top Efficiency Bull for 2022

Evaluation of alternate cropping systems in the arid and semi-arid New Mexico

Investigators: Murali Darapuneni (dmk07@nmsu.edu), Aquib Mohammed Ayman (graduate student), Leonard Lauriault, John Idowu, Koffi Djaman, Gasper Martinez, and Jason Box

Project Overview: Water for agriculture is becoming increasingly limited in New Mexico and other semiarid regions globally. Identifying water use efficient cropping systems in limited water environments is crucial to increase productivity and agricultural sustainability. Nine crop rotations with diverse crop selection are being evaluated at New Mexico State University's Rex E. Kirksey Agricultural Science Center at Tucumcari and Leyendecker Plant Science Research Center at Las Cruces for their water use and production capacity under limited irrigation conditions. The crop rotation options with winter wheat include grain/forage legumes, millet, and cover crops.

Meeting the Needs of New Mexico: New Mexico's agricultural production in arid and semi-arid environments has stagnated for decades due to a lack of advancements in cropping systems. Successful identification of efficient alternate cropping systems crops to replace the traditional semi-arid cropping systems will not only help the local NM farming community to achieve greater resource use efficiency (especially water) and productivity but also reduce the seasonal risk of crop failures due to water scarcity. This project addresses the productivity, sustainability, and food and forage security of New Mexico agriculture.

Impact: First-year data generation is in progress. Identification of alternate crops to replace fallow in the advanced arid and semi-arid cropping systems will have a potential production impact on more than 200,000 acres, accounting for approximately 27% of total agricultural production area in New Mexico and the impact can be much more substantial when applied to similar environments globally. Opportune cropping to achieve greater resource use efficiency (especially water and nutrients) and productivity will not only generate increased farm-level income for the producers but also promote broader marketing and economic opportunities in New Mexico.

Collaborating Agricultural Science Centers: Leyendecker Plant Science Research Center at Las Cruces and Agricultural Science Center-Farmington.

Sorghum as a potential rotation crop for winter wheat

Edible dry beans and guar potential in the arid and semi-arid New Mexico

Investigators: Murali Darapuneni (dmk07@nmsu.edu), Aquib Mohammed Ayman (graduate student), Leonard Lauriault, John Idowu, Koffi Djaman, Gasper Martinez, and Jason Box

Project Overview: Water scarcity and nutrient supply are the major problems of NM's arid and semi-arid agriculture. The introduction of resource-use-efficient crop selection will result in broader diversity in the existing cropping systems. An experiment was conducted at New Mexico State University's Rex E. Kirksey Agricultural Science Center at Tucumcari to test the yield potential, water use efficiency, and nitrogen dynamics of various edible dry beans and guar under limited irrigation.

Meeting the Needs of New Mexico: This strategy will not only serve the local agricultural/livestock needs but also help in the enhancement of the agriculture-based economy in New Mexico. Addressing the water issue of rainfed/limited irrigated semiarid agriculture in New Mexico through innovative solutions of cropping systems and crop selection is critical to achieve 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. Being legume crops, they will enrich the soil with nitrogen and other micronutrients if residue is incorporated into the soil after grain harvest.

Impact: Based on the data produced so far, guar produced greater seed yield and had greater water use efficiency under limited irrigation conditions; while black bean produced the highest seed and biomass yields under irrigated conditions. Guar is also considered to be a drought-resistant crop. The generation of more data is in progress. It is anticipated that identifying the most water-use-efficient edible dry bean/guar will increase the per-acre productivity in approximately 380,000 acres by rotating with traditional winter wheat or other semi-arid crops in New Mexico.

Collaborating Agricultural Science Centers: Agricultural Science Center-Farmington and Leyendecker Plant Science Research Center at Las Cruces.

Funding Acknowledgement: AES Competitive Operations Grant, New Mexico State University.

Guar Plants

Guar seeding density and fertilizer requirements

Investigators: Murali Darapuneni (dmk07@nmsu.edu), Aquib Mohammed Ayman (graduate student), Mohammed Omer, John Idowu, Leonard Lauriault, Gasper Martinez, and Jason Box

Project Overview: Guar is a potential drought-resistant crop with high water and nutrient use efficiency for the arid and semi-arid production regions of New Mexico. Determining the optimum seeding rate and fertilizer requirements for limited irrigated guar is necessary to achieve a targeted yield goal. Although guar, being a leguminous crop, is capable of producing self-sufficient nitrogen through symbiotic association with nodule-producing bacteria, dry conditions may inhibit the bacteria considerably; therefore, supplementation with a nitrogen fertilizer to limited irrigated guar may be necessary.

Meeting the Needs of New Mexico: Guar can be a valuable rotation crop for New Mexico due to its efficiency in water and nutrient use. Crop diversity in a rotation can minimize the risk of crop failure significantly. Guar is also a dual-purpose crop with numerous nutrient benefits and is capable of supplying soil nitrogen. Additionally, guar is a potential cash crop that produces guar gum used in the gas and oil industry. If appropriate management practices are developed for producers, guar can contribute significantly to the NM food and forage security and economic sustainability.

Impact: The United States imports $1 billion worth of guar gum or seed annually, most of which is utilized as fracking aid material for oil drilling. Growing guar domestically would not only reduce the cost of production and importation drastically but also encourage other economic activities related to guar-based products. Determining the optimum planting density and fertilizer requirements are crucial management decisions for guar production when resources are limited, especially water and fertilizers. Based on two-year data, using 140,000 seeds per acre produced the highest seed yield, and supplementing 50 lb of nitrogen per acre had no advantage over control.

Guar Seed Pods

Collaborating Agricultural Science Centers: Leyendecker Plant Science Research Center at Las Cruces.

Funding Acknowledgement: The Sustainable Bioeconomy for Arid Regions (SBAR) Grant-NIFA.

Pearl millet and forage sorghum – cowpea forage mixture planting arrangements

Investigators: Leonard Lauriault (lmlaur@nmsu.edu), Murali Darapuneni, Gasper Martinez, and Jason Box

Project Overview: A main goal of mixing grasses and legumes for forage is to improve the nutritive value of the harvested product, particularly crude protein; however, yield also is an important component for the mixture to be feasible. Pearl millet and cowpea are well-adapted and productive in the Southern High Plains, but their performance in mixtures under irrigation has not been thoroughly evaluated. Research conducted in 2022 indicated that pearl millet crude protein was increased when the species were planted in the same row or when alternating single or twin rows compared to monoculture pearl millet.

Meeting the Needs of New Mexico: Nitrogen is necessary to maximize productivity and nutritive value, particularly the protein content, of warm-season annual grass forages, such as pearl millet. Planting with legumes negates the need to apply nitrogen as fertilizer, which is expensive and must be imported into New Mexico. Increasing the protein content of harvested forage also reduces the need to supplement livestock rations with protein sources that also must be imported into New Mexico. Each scenario of negating inorganic fertilizer or protein supplement costs reduces the production costs for New Mexico's forage producers and maintains lower food costs for all New Mexicans.

Impact: Since 2019 acreage of hay other than alfalfa in New Mexico has increased by over 17%, much of which was likely warm-season annual grasses, such as sorghum forages and pearl millet, which require nitrogen to maximize productivity and nutritive value. Increasing the crude protein content of the harvested forage by planting with a legume could lead to reduced applications of nitrogen fertilizer as well as a reduced need to supplement livestock rations with protein to meet animals' requirements. Research conducted in 2022 indicated that pearl millet crude protein was increased when the species were planted in the same row or when alternating single or twin rows compared to monoculture pearl millet.

Pearl millet and cowpea in alternate rows for forage

Sorghum – legume forage mixtures to improve protein content

Investigators: Leonard Lauriault (lmlaur@nmsu.edu), Murali Darapuneni, Gasper Martinez, and Jason Box

Project Overview: Forage sorghum is commonly grown for silage in New Mexico for beef and dairy cattle feed, although it is low in crude protein. Planting legumes with forage sorghum may increase protein content and/or yield; nevertheless, only marginal improvements have been reported when utilizing cowpea or lablab. Consequently, additional legumes must be evaluated. Research at New Mexico State University's Rex E. Kirksey Agricultural Science Center at Tucumcari indicates that, with equal yields to monoculture forage sorghum harvested for silage, protein content was increased by growing sorghum with sesbania and tepary bean, as it had been with cowpea and lablab.

Meeting the Needs of New Mexico: Nitrogen is necessary to maximize the productivity and protein content of forage sorghum. Planting grasses, like forage sorghum, with legumes negates the need to apply nitrogen as fertilizer, which is expensive and must be imported into New Mexico. Increasing the protein content of harvested forage also reduces the need to supplement livestock rations with protein sources that also must be imported into New Mexico. Each scenario of negating inorganic fertilizer or protein supplement costs reduces the production costs for New Mexico's forage producers and maintains lower food costs for all New Mexicans.

Impact: Acreage of haylage (non-alfalfa) in New Mexico has increased by approximately 50%, much of that is warm-season annual grasses, such as forage sorghum grown for silage, which requires nitrogen, a major component of protein, to maximize productivity and protein content. Legumes fix nitrogen from the atmosphere and provide it to companion crops. Increasing the protein content of the harvested forage sorghum by planting with a legume could lead to reduced applications of nitrogen fertilizer as well as a reduced need to supplement livestock rations with protein to meet animals' requirements. Research conducted in 2022 indicated that forage sorghum protein was increased when planted with cowpea, lablab, sesbania, or tepary bean compared to monoculture forage sorghum. Growing forage sorghum with cowpea or sesbania increased the land equivalency ratio by 32 or 57%, respectively, compared to growing the sorghum and legumes separately, indicating a yield increase on the same amount of land.

Forage sorghum with lablab to improve nutritive value

Influence of irrigation with treated municipal wastewater on soil and crops

Investigators: Leonard Lauriault (lmlaur@nmsu.edu), Murali Darapuneni, Gasper Martinez, and Jason Box

Project Overview: Corn and sorghum forages were sprinkler-irrigated with treated municipal wastewater containing nitrogen above allowable limits. Soil samples collected monthly from May through October and analyzed for moisture, chloride, salts, and nitrogen indicated a gradient of increasing moisture, total nitrogen, chloride, and salts associated with slope, suggesting a more lateral than downward movement of water. No such trend existed for plant-available nitrogen as most crops utilized more than the total nitrogen applied through the wastewater and as fertilizer. In any case, values measured for this field were well within levels suitable for crop growth under sprinkler irrigation.

Meeting the Needs of New Mexico: Municipalities seek uses for their treated municipal wastewater. A study at New Mexico State University's Rex E. Kirksey Agricultural Science Center at Tucumcari, NM USA, is evaluating the fate of nitrogen in treated municipal wastewater used for agricultural irrigation. Potentially, corn and sorghum forage producers near municipalities can use wastewater for irrigation to potentially reduce applied nitrogen fertilizer applications. Municipalities can benefit by providing water as an alternative source of agricultural irrigation, even when it carries nitrogen over current limits, as opposed to more costly disposal methods, and reduce the use of potable water for agricultural irrigation.

Impact: 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 low application rate/frequent application irrigation could reduce the amount of inorganic nitrogen fertilizers required to maximize the production of corn and sorghum forage crops.

Collecting Soil Samples

Influence of irrigation with treated municipal wastewater on spring cereal forage crops

Investigators: Leonard Lauriault (lmlaur@nmsu.edu), Murali Darapuneni, Gasper Martinez, and Jason Box

Project Overview: Spring barley, oat, rye, and triticale were planted in March 2022 and sprinkler-irrigated with treated municipal wastewater in a study at New Mexico State University's Rex E. Kirksey Agricultural Science Center at Tucumcari, NM USA. Soil sampling in the surface 12 inches at planting indicated no difference in soil nutrients among cereals. While soil manganese levels decreased from March to June, salts, sodium, sulfur, and chlorine in the soil increased with no effect due to cereals. Soil phosphorus decreased under barley, but remained unchanged under the other cereals, and barley forage harvested in mid-June contained the greatest phosphorus content.

Meeting the Needs of New Mexico: Municipalities seek uses for their treated municipal wastewater, but some contaminants include plant nutrients that can become groundwater concerns when overapplied. Potentially, municipalities can benefit by providing 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. Additionally, agricultural producers can grow spring cereal crops harvested as forage and mitigate groundwater contamination with some plant nutrients.

Impact: Excessive phosphorus content in treated municipal wastewater could be a concern in agricultural production and due to environmental impacts. In addition to being a more environmentally friendly method to dispose of the water, its reuse through low application rate/frequent application irrigation could reduce the amount of inorganic phosphors fertilizers required to maximize the production of spring cereal forage crops.

Remote soil moisture measuring

Influence of irrigation with treated municipal wastewater on soil health under winter cover crops

Investigators: Leonard Lauriault (lmlaur@nmsu.edu), Murali Darapuneni, Gasper Martinez, and Jason Box

Project Overview: Selected winter cereal and legume cover crops were established in September 2022 and sprinkler-irrigated with treated municipal. Soil samples were collected immediately post-planting and monthly through December and analyzed for nutrient content by 1-ft depth increments and initial soil microbial activity in the surface foot. Baseline soil sampling generally indicated no difference between cover crop treatments for soil nutrients, microbial activity, or concerns assessments, specifically, water infiltration and compaction. Soil salt levels decreased over time in the surface 2 ft and organic matter increased over months.

Meeting the Needs of New Mexico: Municipalities seek uses for their treated municipal wastewater and winter cover cropping is known to protect the soil between summer seasons and improve soil health. A study at New Mexico State University's Rex E. Kirksey Agricultural Science Center at Tucumcari, NM USA, is evaluating the influence of treated municipal wastewater irrigation on winter cover crops. Potentially, municipalities can benefit by providing 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. Additionally, agricultural producers, including those growing human food crops can grow winter cover crops between main crops and potentially apply treated wastewater to the cover crops to be used as a killed mulch, tilled-in green manure crop, or harvested as forage.

Impact: 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 low application rate/frequent application irrigation could reduce the amount of inorganic nitrogen fertilizers required to maximize the production of corn and sorghum forage crops.

Funding Acknowledgement: New Mexico Healthy Soil Program

Measuring water infiltration rates and soil compaction to 24"

Performance of irrigated alfalfa varieties

Investigators: Leonard Lauriault (lmlaur@nmsu.edu), Gasper Martinez, and Jason Box
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 2022.

Meeting the Needs of New Mexico: Alfalfa hay has long been the #1 cash field crop in New Mexico. New Mexico's alfalfa growers can increase gross returns at nearly the same input costs when hay yield is increased through variety selection.

Impact: To assist New Mexico's alfalfa growers select varieties, results from statewide testing in 2022 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 estimated the average 2022 price of $267/ton for alfalfa hay, differences between the highest- and lowest-yielding varieties at Tucumcari (0.96 tons/acre) led to a difference in gross returns of $256/acre for the last four of six cuttings of irrigated hay. Yield differences in established, irrigated tests statewide ranged from 0.96 to 4.60 tons per acre in 2022. If sold as hay, this translated to a potential difference in returns of $256 to $1228 per acre due to variety, or an increase of at least $32 million for New Mexico's alfalfa industry.

Collaborating Agricultural Science Centers: Artesia, Farmington, Las Cruces, Los Lunas, and Tucumcari

Funding Acknowledgement: Entry fees paid for sponsoring companies.

Alfalfa variety performance evaluation

Performance of irrigated silage corn hybrids

Investigators: Leonard Lauriault (lmlaur@nmsu.edu), Gasper Martinez, and Jason Box

Project Overview: Hybrid selection is a critical first step in producing high yields of corn silage with high nutritive value at nearly the same production costs. Silage corn hybrids (9 entries) were grown at Tucumcari in 2022 under irrigation.

Meeting the Needs of New Mexico: Milk production is driven by the yield and nutritive value of corn silage. New Mexico's corn silage growers can increase gross returns through variety selection without any cost increase to their customer dairies.

Impact: To assist New Mexico's sorghum forage growers with variety selection, results from statewide testing in 2022 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 estimated November 2022 prices of 7.5 bushels of grain/ton of silage x $6.65/bushel ($50/wet ton) for 65% moisture corn for silage, the 7.3 wet ton/acre yield difference at Tucumcari in 2022 would increase returns per acre by $365 to producers who use the highest yielding variety rather than the lowest yielding variety in the test.

Forage corn performance evaluation

Collaborating Agricultural Science Centers: Artesia, Clovis, Farmington, Los Lunas, and Tucumcari

Funding Acknowledgement: Entry fees paid for sponsoring companies.

Performance of irrigated sorghum forage varieties

Investigators: Leonard Lauriault (lmlaur@nmsu.edu), Gasper Martinez, and Jason Box

Project Overview: Variety selection is a critical first step in producing high yields of sorghum forage with high nutritive value at the same production costs. Forage sorghum (10 entries) harvested once for silage and sorghum x sudangrass (6 entries) harvested three times for hay were grown at Tucumcari in 2022 under irrigation.

Meeting the Needs of New Mexico: Livestock production for meat or milk is the goal of sorghum forage production, as driven by forage yield and nutritive value. New Mexico's forage growers can increase gross returns at nearly the same input costs when production is increased through variety selection.

Impact: To assist producers with sorghum forage variety selection, results from statewide testing in 2022 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 November 2022 prices of $128/ton for sorghum hay, an irrigated 2.5 ton/acre yield difference measured at Tucumcari in 2022 would increase gross returns per acre by $320 to the producer if they use the highest yielding variety rather than the lowest yielding variety. At $38/ton of 65% moisture forage sorghum silage, a 10.3 wet ton/acre yield difference measured in 2022 at Tucumcari would increase gross returns by $391/acre.

Collaborating Agricultural Science Centers: Artesia, Clovis, Farmington, Los Lunas, and Tucumcari

Funding Acknowledgement: Entry fees paid for sponsoring companies.

Harvesting sorghum forage performance evaluations

Performance of irrigated upland cotton varieties

Investigators: Leonard Lauriault (lmlaur@nmsu.edu), Gasper Martinez, and Jason Box

Project Overview: Variety selection is a critical first step in producing high yields of cotton with high quality at the same production costs. Seven cotton varieties were grown at Tucumcari in 2022 under irrigation.

Meeting the Needs of New Mexico: Cotton has been a staple crop throughout eastern and southern New Mexico that has helped sustain local economies.

Impact: Results from statewide testing conducted in 2022 were provided to companies with cotton variety marketing. Although no yield differences were noted among the seven cotton varieties tested, yield compensation differences were observed across a broad range of plant populations.

Collaborating Agricultural Science Centers: Artesia, Clovis, Las Cruces, and Tucumcari

Funding Acknowledgement: Entry fees paid for sponsoring companies.

Cotton performance evaluation

Grants and Contracts

Contracts, Grants, and Sponsored Research (Total funded: $38,277)

- Beck, L. L. (Principal), Marsalis, M. A. (Co-Principal), Lauriault, L. M. (Co-Principal), Sponsored Research, "Evaluation of the Efficacy of Saflufencacil Tank-Mixes and Sequential Applications for the Control of Plaintain (Plantago spp.) and Field Bindweed (Convolvulus arvensis) in Alfalfa Fields", Sponsoring Organization: National Alfalfa & Forage Alliance, Sponsoring Organization Is: Other, Research Credit: $1,913.85, PI Total Award: $38,277.00, Current Status: Funded. (October 15, 2020 - October 15, 2022).

Sponsorships, Other Funding - Non ARGIS (Total funding for 2022 with total alfalfa fees divided by 4: $86,271)

- Lauriault, L.M., Darapuneni, M.K. "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.
- Darapuneni, M.K., Lauriault, L.M. "Water use efficiency, nitrogen dynamics, and yield potential of edible dry beans and guar in a traditional winter wheat cropping system," NMSU Agricultural Experiment Station-Competitive Operations Grant, $49,672.00, Status: Funded, Effective Start Date: July 1, 2021, Effective End Date: June 30, 2022.
- Lauriault, L.M., Ray, I, Pierce, C, Djaman, K., Flynn, R.P., Marsalis, M.A. "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.
- Lauriault, L.M., Ray, I, Pierce, C, Djaman, K., Flynn, R.P., Marsalis, M.A. "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.
- Lauriault, L.M., Ray, I, Pierce, C, Djaman, K., Flynn, R.P., Marsalis, M.A. "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.
- Lauriault, L.M., Ray, I, Pierce, C, Djaman, K., Flynn, R.P., Marsalis, M.A. "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.
- Lauriault, L.M., Ray, I, Pierce, C, Djaman, K., Flynn, R.P., Marsalis, M.A. "Fee-based alfalfa variety testing, 2019," Multiple seed companies, $3,675.00, 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: September 2019, Effective End Date: November 2022.

- Marsalis, M.A. Lauriault, L.M., Djaman, K., Flynn, R.P., Mesbah, A.O. "Fee-based corn and sorghum performance evaluations, 2022," Multiple seed companies, $5,050.00, Description: Entry fees for corn and sorghum forage and grain cultivars compared in 2021 at Tucumcari, Status: Funded, Effective Start Date: April 1, 2022, Effective End Date: December 31, 2022.
- Flynn, R.P., Lauriault, L.M., Puppala, N. "Fee-based cotton performance evaluations, 2022," Multiple seed companies, $1,050.00, Description: Entry fees for cotton cultivars compared in 2022 at Tucumcari, Status: Funded, Effective Start Date: April 1, 2022, Effective End Date: December 31, 2022.
- Lauriault, L.M. "Donations: Field Day Fund," Local businesses, $1,600.00, Description: Funds solicited from local businesses to provide a meal for the annual field day. The meal is catered by a 4-H club as a fundraiser for the club, Status: Funded, Effective Start Date: January 1, 2022, Effective End Date: December 31, 2022.
- Beck, L. L. (Principal), Marsalis, M. A. (Co-Principal), Lauriault, L. M. (Co-Principal), Sponsored Research, "Evaluation of the Efficacy of Saflufencacil Tank-Mixes and Sequential Applications for the Control of Plaintain (Plantago spp.) and Field Bindweed (Convolvulus arvensis) in Alfalfa Fields", Sponsoring Organization: National Alfalfa & Forage Alliance, Sponsoring Organization Is: Other, Research Credit: $1,913.85, PI Total Award: $38,277.00, Current Status: Funded. (October 15, 2020 - October 15, 2022).
- Lauriault, L.M. "Donations: Field Day Fund," Local businesses, $1,600.00, Description: Funds solicited from local businesses to provide a meal for the annual field day. The meal is catered by a 4-H club as a fundraiser for the club, Status: Funded, Effective Start Date: January 1, 2022, Effective End Date: December 31, 2022.

Research Publications

Peer Reviewed Journal Articles – Accepted or Published (students are underlined)

- Creegan, E., Flynn, R. P., Torell, G., Brewer, C. E., VanLeeuwen, D., Acharya, R., Heerema, R., Darapuneni, M. K. (2022). Pecan (*Carya illinoinensis*) and dairy waste stream utilization: properties and economics of on-farm windrow systems. Sustainability, 14(5), 2550. (Tucumcari/Las Cruces multi-disciplinary (EPS/ PES/AEAB/EIB (College of Business)/CHME (College of Engineering) collaboration, with a student)
- Darapuneni, M. K., Lauriault, L. M., Martinez, G., Idowu, O. J., Djaman, K. (2022). Yield potential and water use efficiency of alternate rotation crops in the semiarid environment of southwestern USA. Applied Engineering in Agriculture, 38(6), 845-851. https://doi.org/10.13031/aea.15030. (Tucumcari/Las Cruces/Farmington collaboration)
- Djaman, K., Allen, S., Djaman, D., Koudahe, K., Irmak, S., Puppala, N., Darapuneni, M. K., Angadi, S. (2022). Planting date and plant density effects on maize growth, yield, and water use efficiency. Environmental Challenges. https://doi.org/10.1016/j.envc.2021.100417. (Farmington/Clovis/Tucumcari multi-state collaboration)
- Djaman, K., Darapuneni, M. K., Irmak, S. (2022). Soil water dynamics, effective rooting zone, and crop evapotranspiration of sprinkler irrigated potato in a sandy loam soil. Agronomy, 12(4), 20. https://www.mdpi.com/2073-4395/12/4/864. (Farmington/Tucumcari multi-state collaboration)
- Lauriault, L. M., Guldan, S. J., Popiel-Powers, F., Steiner, R. L., Martin, C. A., Falk, C. L., Petersen, M., May, T. (2022). Relay intercropping winter cover crop effects on spring forage potential of sweet maize stover and yearling cattle performance. MDPI Animals Special Issue: Warm- and Cool-Season Annual Pastures for Growing Ruminants in Semiarid Regions, 12(1923), 1-10. https://doi.org/10.3390/ani12151923 (Alcalde/Las Cruces/Tucumcari, interdisciplinary PES/ANRS/AEAB/EIB (College of Business) interdisciplinary collaboration, with a student)
- Lauriault, L. M., Marsalis, M. A., Cox, S. H., Duff, G. C. (2022). Seasonal mass, performance under grazing, and animal preference for irrigated winter cereal forages under continuous stocking in a semiarid, subtropical region. MDPI Grasses, 1(1), 1-11. 10.3390/grasses1010001 (Tucumcari/Los Lunas/Corona/Clayton, interdisciplinary PES/EPS/ANRS collaboration)
- Lauriault, L. M., Pietrasiak, N., Darapuneni, M. K., Dominguez, A., Martinez, G. K. (2022). Comparison of surface water or treated municipal wastewater irrigation on alfalfa establishment, soil fertility, and soil microbial conditions. MDPI Soil Systems, 6(67), 1-15. https://doi.org/10.3390/ soilsystems6030067 (Tucumcari/Las Cruces collaboration)
- Lauriault, L. M., Schmitz, L. H., Cox, S. H., Duff, G. C., Scholljegerdes, E. J. (2022). A comparison of native grass and triticale pastures during late winter for growing cattle in semiarid regions. MDPI Agronomy Special Issue: Management of Grasslands - Forage Growth and Nutritive Composition, Livestock Grazing and Performance, 12(545), 1-10. 10.3390/agronomy12030545 (Tucumcari/Las Cruces/Corona/Clayton, interdisciplinary PES/ANRS collaboration, with a student)
- Pratt, R. C., Grant, L., Velasco-Cruz, C., Lauriault, L. M. (2022). Field performance of selected and landrace tepary bean varieties in diverse Southwestern USA irrigated

production environments. Legume Science, 4(157), 1-8. http://doi.org/10.1002/leg3.157 (Tucumcari/Los Lunas/Alcalde/Las Cruces collaboration)

- Pratt, R. C., Velasco-Cruz, C., Darapuneni, M. K., Montgomery, R., Grant, L. (2022). Southwest-adapted maize germplasm as potential genetic resource for selection of salinity tolerant cultivars. Crop Science, 62, 286-300. ttps://doi.org/10.1002/csc2.20654. (Tucumcari/Las Cruces collaboration, with a student)
- Umesh, M. R., Angadi, S., Begna, S., Gowda, P. H., Hagevoort, G. R., Lauriault, L. M., Darapuneni, M. K. (in press). Intercropping and species interactions on physiological and light use characteristics of forage cereals-legumes combinations in semi-arid regions. To appear in Field Crops Research. (Tucumcari/Clovis interdisciplinary PES/EASNR multi-state collaboration)

Experiment Station Publications

- Lauriault, L. M., Ray, I., Pierce, C., Djaman, K., Flynn, R. P., Marsalis, M. A., Havlik, C., Martinez, G., West, M. (2022). 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/alfalfa_2022.pdf (Tucumcari/Las Cruces/Artesia/Los Lunas/Farmington EPS/PES collaboration)
- Marsalis, M. A., Flynn, R. P., Lauriault, L. M., Mesbah, A., Djaman, K. (2022). New Mexico 2021 Corn and Sorghum Performance Tests. Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. https://pubs.nmsu.edu/variety_trials/corn_sorghum_2021.pdf (Los Lunas/Clovis/Tucumcari/ Artesia/Farmington PES/EPS collaboration)

Extension Publications (*denotes the corresponding author)

- Sutherland, C. A., Skidmore, A., Lauriault, L. M.*, Marsalis, M. A., Pierce, J. B. (2022). Circular 659 (revision), Whitefringed Beetle in New Mexico Alfalfa (pp. 8 pp). Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. https://pubs.nmsu.edu/_circulars/CR659/index.html (Las Cruces/Artesia/Los Lunas/Tucumcari EPS/PES collaboration)

Other Publications Not Noted Above

- Darapuneni, M. K., Idowu, J., Lauriault, L. M. (2022). Dry bean production and yield potential in the semiarid environment of New Mexico. ASA-CSSA-SSSA Annual Meeting, Baltimore, MD. November 6-10. (Tucumcari/Las Cruces collaboration)
- Lauriault, L. M., Darapuneni, M. K., Martinez, G. K. (in press). Soil moisture and the fate of nitrogen applied through treated municipal wastewater by sprinkler irrigation to fine sandy loam soils (pp. 19 pp). Santa Fe, NM: New Mexico Environment Department, Date Accepted: December 15, 2022 (Groundwater discharge permit update).
- Lauriault, L. M., Darapuneni, M. K., Martinez, G. K. Mitigating excessive nitrogen in treated municipal wastewater through crop uptake, 1st qtr report (19 pp). Las Cruces, NM: New Mexico Department of Agriculture, Date Submitted: December 15, 2022 (Grant research update).

- Lauriault, L. M., Marsalis, M. A., Miller, F. (2022). Alfalfa Planting Date Influences Nutritive Value in the Semiarid US Southwest. Proceedings of the 2022 World Alfalfa Congress (pp. 1 page). St. Paul, MN: National Alfalfa and Forage Alliance. https://alfalfa.org/events/pdf/Speakers/Lauriault.pdf (Tucumcari/Los Lunas/Las Cruces, interdisciplinary PES/EPS/EAEB collaboration)
- Omer, M., Idowu, O., Angadi, S., Darapuneni, M. K. (2022). Guar growth and yield as affected by cultivar and seeding density in New Mexico. ASA-CSSA-SSSA Annual Meeting, Baltimore, MD. November 6-10. (Clovis/Tucumcari/Las Cruces collaboration)
- Shrestha, B., Djaman, K., Darapuneni, M. K., Stringam, B., Lombard, K. (2022). Effects of Irrigation and Nitrogen Management on Potato (Solanum tuberosum L.) Growth, Yield, Quality, and Water Use Efficiency. New Mexico Water Resources Research Institute, Las Cruces, NM. October 26-27. (Farmington/Tucumcari/Las Cruces collaboration)

Cooperators and Collaborators

NMSU Campus-based faculty

- Agricultural Business and Agricultural Economics: Ram Acharya, Don Blayney, Paul Gutierrez, Frannie Miller, Greg Torell, Connie Falk (emeritus)
- Animal and Range Sciences: Eric Scholljegerdes, Leah Schmitz (former student), Mark Peterson (former faculty), Tammy May (former staff), Luis Ochoa (student)
- Entomology, Plant Pathology, and Weed Science: Kristen Bowers, Soum Sanogo, Dave Thompson, Erik Lehnhoff
- Extension Animal Sciences and Natural Resources: Craig Gifford, Lena Sanchez (student), Sam Smallidge, Marcy Ward, Casey Spackman
- Extension Family and Consumer Sciences: Nancy Flores
- Extension Plant Sciences: Leslie Beck, Richard Heerema, John Idowu, Jane Pierce, Carol Sutherland, Ciro Velasco-Cruz, Phillip Lujan
- Economics, Applied Statistics & International Business: Robert Steiner, Dawn VanLeeuwen
- Family and Consumer Sciences: Efren Delgado
- Plant and Environmental Sciences: Andrew Dominguez, David DuBois, Lois Grant, Kulbhushan Grover, Omar Holguin, Nicole Pietrasiak, Rich Pratt, Ian Ray, Manoj Shukla, Caitriana Steele, Emily Creegan (student), Mohammed Omer (Post-Doc), Aquib Mohammed Ayman (student), Pramod Acharya (student), Bhimsen Shrestha (student)

NMSU Off-campus research facilities

- Alcalde: Steve Guldan, Del Jimenez, Shengrui Yao, Fernanda Popiel-Powers (former student), Charles Martin (former agricultural specialist)
- Artesia: Jane Breen-Pierce, Robert Flynn
- Clayton: Glenn Duff, Bianca Birkenstock (student)
- Clovis: Sangu Angadi, Rajan Ghimire, Robert Hagevoort, Abdel Mesbah, Naveen Puppala, Wooiklee Paye (former post-doc)
- Corona: Shad Cox
- Farmington: Samuel Allen, Koffi Djaman, Kevin Lombard, Margaret West
- Los Lunas: Mark Marsalis, Amanda Skidmore (former faculty), Marisa Thompson, Charles Havlik
- Most Cooperative Extension Service County and District Faculty
- New Mexico:
- Arch Hurley Conservancy District: Franklin McCasland
- Phillip & Kathleen Box, Box Farms, Tucumcari
- Canadian River Soil and Water Conservation District: Supervisors. Diana Cassidy (former district manager), and Tana Garnett (current district manager)
- City of Tucumcari: Mark Martinez (former city manager)/Paula Chacon (current city manager), City Commission, and Calvin Henson
- Tim & Andrea Clark, Clark Farms, Tucumcari
- Conversations about Soil Health (CAST): Marie Nava, Tucumcari
- Sam Gonzales, Los Terrenos Ranch, Farmington
- Greater Tucumcari Economic Development Corporation, Patrick Vanderpool, and the Board of Directors

- Mesalands Community College, Tucumcari: Gregory T. Busch, Manny Encinias
- Natural Resources Conservation Service: Relissa Nials and Team 6 Tucumcari
- New Mexico Economic Development Department: Tim Hagaman
- New Mexico Hay Association: Board of Directors
- New Mexico State Legislature: Senator Pat Woods and Representative Jack Chatfield
- New Mexico Water Trust Board
- Quay County Cotton Boll Weevil Control District
- Quay County Government: County Commission, Larry Moore, and Richard Primrose
- Quay County Sun: Ron Warnock
- Quay County TableTop Food Co-op: David White and others
- Southwest Quay Soil and Water Conservation District: Supervisors and Lynnae Abarca (district manager)
- Tucumcari Bio-Energy and Aquaponics: Bob Hockaday and David White
- Tucumcari Feed Efficiency Test, LLC (TFET, dba Tucumcari Bull Test): Leadership and Members
- Tucumcari Public Schools: Tonya Hodges and Veronica Hernandez
- Tucumcari/Quay County Chamber of Commerce: Scott Crotzer

USA

- Desert Research Institute: Xuelian Bai, Erick Bandala, Richard Jasoni, Erica Marti, Kristin VanderMolen
- Elson Shields
- National Science Foundation
- Louisiana State University, Baton Rouge: Syam Dodla
- Mississippi State University, near Starkville: Rocky Lemus
- Morehead State University, Morehead, KY: Amanda Skidmore (formerly at NMSU)
- South Dakota State University, Brookings: David Clay
- Southern California Coastal Water Research Project: Alvina Mehinto
- Texas A&M University, College Station
- Texas A&M University, College Station, TX: Vanaja Kankarla (former student)
- Texas AgriLife Research and Extension: Jourdan Bell (Amarillo), Pat Porter, and Calvin Trostle (Lubbock)
- University of Nebraska, Scottsbluff: Gary Hergert, Jeff Bradshaw, and Robert Harveson
- USDA: Blair Waldron (ARS, Logan, UT), 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
- Colorado State University: Jessica Davis, Jeffrey Davidson, Kevin Larson, Sophia Linn, Daniel Mooney
- University of Arizona: Jose Dias, Debankur Sanyal
- Utah State University- Earl Creech

India:

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

Pakistan:

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

- Faculty at MNS University of Agriculture, Multan

Punjab:

- The Islamia University of Bahawalpur

Togo:

- ADA Consulting Africa: K. Koudahe
- United Kingdom:
- Anglo American Crops, Scarborough: Brad Farber, Rachel Fields

Outreach Activities

- March 12: Hosted Annual Bull Sale
- March 19: Hosted 4H Youth Beef Contest speeches
- June 10: Hosted equipment tour for Quay Co. 4H Agronomy Team
- August 2: Hosted Annual Field Day
- September 29: Hosted Farm Day Program for 4th & 5th Grades
- October 22: Hosted Great Pumpkin Giveaway

Advisory Committee

- Mr. Phillip Box
- Mr. Will Cantrell
- Mr. Donald Carter
- Mr. Paul Estrada
- Mr. Cooper Glover
- Ms. Janet Griffiths
- Mr. Devin Kanapilly
- Mr. Robert Lopez, Chairman
- Mr. Franklin McCasland, Vice Chairman
- Ms. Marie Nava
- Mr. Jim Norris
- Mr. Cedar Rush
- Mr. Elmer Schuster
- Mr. Tom Sidwell
- Mr. Donald Walker

Personnel

- Leonard Lauriault, College Professor/Superintendent and Forage Crop Management Scientist
- Murali Darapuneni, Associate Professor/Semiarid Cropping Systems Specialist
- Patricia Cooksey, Part-time Administrative Assistant
- Gasper Martinez, Research Assistant
- Jason Box, Farm/Ranch Manager
- Open, Assistant Farm/Ranch Manager
- Open (2), Science Center Laborers