

New Mexico (New Mexico State University Main Campus) Annual Report - FY2021

Report Status: Approved as of 07/08/2022

Contributing Organizations

New Mexico State University Main Campus

Executive Summary

Overview

New Mexico State University's College of Agricultural, Consumer, and Environmental Sciences (ACES) has a mission to improve the lives of New Mexicans, the nation, and the world through research, teaching, and extension. Research and Extension programs focus on four identified critical issues for New Mexico that will also have a global impact. These programs are (1) Food & Fiber Production and Marketing, (2) Water Use and Conservation, (3) Family Development and Health of New Mexicans, and (4) Environmental Stewardship all of which are based on the foundation of education and training of qualified professionals in the field of agriculture.

NMSU Cooperative Extension Service has staff in all 33 counties and many Tribal areas in New Mexico and collaborates with over 1,000 organizations, state and federal agencies, other universities, and 10,000 volunteers.

Every year, Extension faculty reach over 550,000 New Mexicans—more than one-third of the state's population—who benefit from wide-ranging CES educational programs in areas such as economic and community development, human nutrition and health, agriculture, and environmental stewardship, and family and child development.

NMSU researchers and scientists conduct their research throughout the Agricultural Experiment Station (AES) system. This system consists of research on-campus and research conducted at agricultural science/research centers located around the state. New Mexico is unique with four crop production regions, 11 plant hardiness zones, 5 defined watersheds, and 126 distinct soil types. Therefore, agricultural production varies from north to south and east to west. Having strategically placed agricultural science centers allows NMSU research to inform agricultural producers from around the state about best practices and advancements specific to their climate zone.

Core programs and research areas are determined and guided by the identified critical issues in New Mexico. Researchers also respond to stake-holder requests throughout the year and respond to major scientific needs as they occur. In 2021, NMSU AES developed projects to respond to climate change and the intensification of severe weather events in New Mexico. Additionally, a project was developed to focus on the bioprocessing of agroindustrial by-products to increase focus on value-added production in the state.

Critical Issue: Environmental Stewardship

Rural and urban human activities affect land, water, and air. Through teaching, research, and extension programs, the College of ACES is committed to furthering our understanding, using science-based knowledge, of human impacts on the environment and supporting environmentally-sound agricultural and natural resource practices.

NMSU ACES was successful in the past year in establishing efforts in carbon management which will help develop demonstration sites and establish baseline soil and vegetation C storage and vegetation diversity in croplands, rangelands, forest, and urban landscapes. Additional projects related to soil health and bridging environmental stewardship with Food and Fiber Production & Marketing will be initiated in the coming year.

Critical Issue: Family Development and Health of New Mexicans

The family is the fundamental institution of society. The College of ACES researches human behavior, child and adolescent development, human nutrition and food science, clothing and textiles, and family resource management. The College's research and Extension programs on human nutrition and wellness are aimed at keeping people from becoming ill and are considered "preventive medicine"

programs.

Critical Issue: Food & Fiber Production and Marketing

This critical issue focuses on several key areas that support the growth and improvement of plant and animal agricultural products in Mexico. The College of ACES faculty and staff foster technological innovation to enhance competitiveness and security of New Mexico agriculture, and increase value-added products in the state.

In 2020, the total value of New Mexico's agricultural production was \$3 billion, slightly lower than 2019. The value of livestock production and crop value in NM decreased from the previous year. This is in part because the state is recovering from the COVID-19 pandemic and agricultural production is slowly building back up. Additionally, NMSU AES and CES adjusted to meet the needs of New Mexicans facing on-going severe drought and more intense weather patterns. Many research projects focus on identifying drought-tolerant and genetically improved varieties for crop producers. For beef producers, AES has projects ongoing to identify alternative nutrient strategies for calf health and performance and how to build sustainability for the beef and dairy industry.

Critical Issue: Water Use and Conservation

Water is the most limiting resource for New Mexico. All aspects of water use affect agricultural efficiency, profitability, and human health. Water management will become more critical as water demands for urbanization and industrialization increase.

NMSU ACES continues to identify water-wise strategies that can be implemented for agricultural producers and health and wellness factors for New Mexicans. NMSU AES has ongoing water related projects that overlap with the critical issue of Food & Fiber that focus on efficient irrigation water use, acequia water use, and reducing potable water use for New Mexican turfgrasses.

Merit and Scientific Peer Review Processes

Updates

None

Stakeholder Input

Actions to seek stakeholder input that encouraged their participation with a brief explanation

NMSU AES implemented a monthly updates newsletter to provide information to stakeholders about ongoing AES research. High-level research updates are provided and suggestions on how AES can continue to meet the needs of stakeholders is regularly sought.

All 33 County CES offices meet annually with the advisory board to review the previous year's work and to get input on programming needs for the coming year.

Methods to identify individuals and groups and brief explanation

None

Methods for collecting stakeholder input and brief explanation

None

A statement of how the input will be considered and brief explanation of what you learned from your stakeholders

NMSU AES received feedback from stakeholders in early 2021 that it would be beneficial if each agricultural science/research center hosted an in-person field day, after not being able to offer in-person events in 2020. In response to this request, each of the 12 ASCs across the state of NM offered an in-person field day to allow stakeholders to learn about research and view hands-on demonstrations.

Highlighted Results by Project or Program

Critical Issue

Environmental Stewardship

Learning to Live with Fire

Project Director

LaJoy Spears
Organization
New Mexico State University Main Campus
Accession Number
7002277



Learning to Live with Fire

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Every year, devastating wildfires burn across the United States. At the same time, a growing number of New Mexicans are living where wildfires are a real risk. Understanding fires will continue to happen, NMSU CES assists the community in protecting homes and neighborhoods while keeping families safe.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The "Learning to Live with Fire" program attracted 134 homeowners, volunteer fire fighters, home association members, and employees from county, state, and federal government agencies.

Briefly describe how your target audience benefited from your project's activities.

Ten months after the program, participants responding to the follow up survey reported (89%) developing immediate evacuation plans. In addition, 94% of participants safeguarded their property from wildfire.

Briefly describe how the broader public benefited from your project's activities.

The "Learning to Live with Fire" program has encouraged community members to thin dead, low hand branches, add water cubes to property, participate in fire wise forest clearing, and developing a guide to accomplish goals to protect their families and property.

Arthropod Biology and Biodiversity in New Mexico

Project Director
Charles Bundy
Organization
New Mexico State University Main Campus
Accession Number
1025935



Arthropod Biology and Biodiversity in New Mexico

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Little is known about the biology and biodiversity of many important insect groups in New Mexico. My research targets the bionomics and taxonomy of understudied insects and attempts to make information about these groups available to other scientists, students, and the general public.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Objective 1. Examine the bionomics and taxonomy of understudied insect taxa, with an emphasis on the true bugs (Heteroptera).

Several research projects are in various stages of completion. A research article was published on how to identify the immature stages of two species of stink bugs (*Mecidea*) that occur throughout much of the United States. These species may be confused with another group of stink bugs that is a major pest of rice. Research continues on several other projects. In particular, we are finalizing work on a checklist of jewel beetles found in Doña Ana County, New Mexico with Joel DuBois and Wayne Steffens. Research also continues on a revision of the assassin bug genus *Sinea* in North America with J. E. McPherson and Imtiaz Ahmad.

Objective 2. Curation of the NMSU Arthropod Collection.

We continue significant work on curating the insect material in the NMSU Arthropod Collection. Specifically, we databased and imaged thousands of specimens in the collection to make them and their data more accessible. We added thousands of new specimens to the collection representing insects found in the Southwest and other regions of the country. We also worked with several scientists throughout the world to provide access to our material for their research in the form of data, images, and loans. I receive hundreds of requests to make identifications of unknown insects and other arthropods each year. Specimens we curate in the collection allows us to make accurate identifications on these insects. We also provided access to our collection to thousands of students from pre-K through college and the general public.

Objective 3. Conduct research on educational tools related to entomology.

In a cooperative project with the NMSU Games Laboratory (Barbara Chamberlin and Pamela Martinez), we created an online insect spreading and pinning interactive to increase interest and accessibility to the field of entomology. This interactive targets middle school science classes. However, we have found that it is of strong interest for several other groups as well, including 4H, FFA, etc. This interactive is in its final stages and is available free to anyone. We are still working on evaluating its impact on teaching and accessibility.

Briefly describe how your target audience benefited from your project's activities.

Objective 1. Examine the bionomics and taxonomy of understudied insect taxa, with an emphasis on the true bugs (Heteroptera).

The primary target audience for this research is other researchers in the field of entomology. Our data provide the scientific community with important information on understudied insects. Our research on *Mecidea* provides much needed information on distinguishing these species, which is difficult for most non-taxonomists, from one another and from the related rice pest species. The checklist of jewel beetles provides needed data on this important group of beetles, which feed on trees. Many species in this family cause tremendous economic losses in both forest and urban situations. This is the first checklist of its kind for New Mexico.

Objective 2. Curation of the NMSU Arthropod Collection.

The data provided from our work in the NMSU Arthropod Collection strongly benefits researchers and the general public. Having the data from our specimens available in a database greatly increases the access of the collection to researchers from around the world. We see an increase in requests for access to the collection from these scientists as we continue to add more material online. The more we identify our material the greater our ability to answer questions on insect identification to researcher and the general public.

Objective 3. Conduct research on educational tools related to entomology.

Now that our insect pinning and spreading interactive is being made available online, we are seeing an increasingly strong interest by middle school teachers, 4H and FFA groups, etc. These target groups will benefit by having digital access to learn valuable techniques on pinning and spreading insects. We feel this will also foster an increased interest in insects and insect science.

Briefly describe how the broader public benefited from your project's activities.

The more that research like this becomes available on understudied insect groups the greater our understanding develops on insect biodiversity and its interactions with other groups of organisms, including humans. Documenting insect diversity allows everyone to see the importance of these groups. It also documents changes in diversity including habitat loss, species extinctions, etc that are important to every one.

Increasing awareness of the importance of insects to the general public, as tools that may be used to understand and teach science, etc. is strongly beneficial to all of our constituents.

Project Director

Colby Brungard

Organization

New Mexico State University Main Campus

Accession Number

1013062



Soils2026 and digital soil mapping – A foundation for the future of soils information in the United States

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Soils are our most critical natural resource. However, urgent social, economic, and environmental issues such as carbon sequestration, drought mitigation, and nutrient management are forcing us to seek answers to questions using incomplete soil data and/or inappropriate soil information. The United States (US) Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS), Soil and Plant Science Division has launched Soils2026, an ambitious initiative to provide a new inventory of soils and provisional ecological sites for all areas of the United States by 2026. Soils2026 aims to provide basic soil and ecological site information that will be useful to land managers, ecologists, modelers, and other natural resource professionals.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The USDA-NRCS Digital Soil Mapping Focus Team was formed to support Soils2026 and includes collaborating members from the National Cooperative Soil Survey representing the NRCS, US Geological Survey, USDA Forest Service, West Virginia University, and New Mexico State University. The DSM Focus Team is applying the latest DSM methods to produce continuous soil property predictions and estimates of uncertainty for all areas of the United States. Initially, the 30-m resolution products will include predictions for 12 key soil properties at six depth intervals, conforming to Global Soil Map specifications, with the option to expand properties or add class predictions as user needs demonstrate. Interpretations for use and management will be derived from the continuous properties products and provided to users. Fundamental pedology and communication of soil knowledge will be the primary focus of this effort, yielding a framework for delivery of seamless raster-based soils data for all areas of the United States on yearly cycles. This framework will foster an environment of continuous improvement and support a complete, consistent, correct, comprehensive, and current inventory of the soil resources of the United States.

Briefly describe how your target audience benefited from your project's activities.

Soils are foundational to informed land management decisions. Land managers will benefit from improved soil information by having more spatially detailed soil information.

Briefly describe how the broader public benefited from your project's activities.

The public benefits from improved soil information through improved agricultural and land management practices.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Results were published as "Soils2026 and digital soil mapping – A foundation for the future of soils information in the United States" in the *Geoderma Regional* journal:
<https://www.sciencedirect.com/science/article/abs/pii/S2352009420300432>

Impact Statement (Optional)

Use this space to talk about the impact that this result had, in layman's terms. Adding comments here will **not** change the content in the highlighted result.

Soil is foundational to the sustainability of New Mexican societies. Managing soil for social and natural ecosystems needs knowledge of baseline soil properties and conditions. We have pioneered methods to rapidly and accurately produce relevant soil information in the field and using a geographic information systems approach. This research is foundational for federal and state land managers, agricultural producers, private ranchers and foresters by providing the information necessary to assess site-specific land management decisions such as grazing intensity, brush management, or livestock rates.

Critical Issue

Family Development and Health of New Mexicans

Healthy Habits for NM Youth

Project Director

LaJoy Spears

Organization

New Mexico State University Main Campus

Accession Number

7002281



Healthy Habits

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Risk factors for childhood obesity include lack of or inadequate nutritious food and physical activity, lack of or inadequate support from the school and home environment to choose appropriate foods, and failure to make time to exercise. Poor nutrition and limited physical activity are risk factors for chronic diseases and play a role in a student's ability to learn thereby affecting scholastic success. Childhood obesity has significant impact on health care costs, quality of life, and may also result in the inability to produce a well-educated and prepared workforce.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

NMSU CES working alongside teachers promoted the Healthy Habits program to four area schools reaching 583 youth. The 8-hour educational program incorporated nutrition, physical activity, mental health awareness. To achieve program sustainability and reach underserved youth, CES agents train teen leaders to serve as Health Ambassadors.

Briefly describe how your target audience benefited from your project's activities.

After participating in the 8-hour Healthy Habits program, youth participants reported knowing how to keep a cooking area clean to stop the spread of germs (81%), reported they could use knives safely (87%), and 74% could follow a recipe. Regarding drinking water and exercising, 80% reported being aware of water intake and exercise per day.

Briefly describe how the broader public benefited from your project's activities.

- The Pojoaque Valley Middle School was able to provide snacks/meals and instruct the students on how to cook safely. Student's made pancakes, pretzels, and also hummus and smoothies from the Teen Cuisine recipes. Approximately 500 meals/snacks were provided for this group. In total, the agent was able to provide the teacher with \$1220.00 in school supplies to support the Pojoaque Valley Middle School Family and Consumer Sciences program.
- The Sierra Vista Elementary School opted to be taught virtually with a total of 200 students participating in a Healthy Habits Field trip.

Project Director
LaJoy Spears
Organization
New Mexico State University Main Campus
Accession Number
7002267



ICAN - Ideas for Cooking and Nutrition

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Thirty-eight percent of Many New Mexicans (38%) live at or below 185% of the federal poverty level. Over 72% of New Mexican students are eligible for free/reduced-price lunches, compared to the national average of 49.5%. And 17.16% of New Mexico households claim Supplemental Nutrition Assistance Program (SNAP) benefits. Poverty is a key driver of health, and it is vital to have programs that serve SNAP-eligible families. Helping families prevent chronic disease through the reduction of obesity reduces healthcare costs and improves quality of life. Thirty-six percent of youth in New Mexico's SNAP-eligible families are overweight or obese. Among SNAP-eligible adults, 69.3% are overweight or obese.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

In 2021, ICAN education expanded into virtual settings across the state, reaching over 10,000 New Mexicans with live virtual cooking and nutrition classes, food gardening classes, and other educational activities.

Briefly describe how your target audience benefited from your project's activities.

Adult graduates of ICAN series education claim several benefits. In 2021, 97% improved one or more diet quality indicators, 92% improved one or more food resource management practices such as cooking dinner at home, and 70% improved their food safety. With ICAN's expansion into virtual engagement, 140 cooking and food gardening videos were produced for platforms like YouTube and Facebook, with ICAN's Facebook posts reaching over 475,000 users. Significant strides were also made in community partnerships, with ICAN offering educational flyers to food pantries and other community sites, reaching over 214,000 clients with recipes and healthy lifestyle tips.

Briefly describe how the broader public benefited from your project's activities.

ICAN's mission is to help New Mexicans reach better health outcomes and enjoy a higher quality of life by providing evidence-based nutrition education that inspires healthy food and lifestyle choices. ICAN seeks to make those choices possible for SNAP-eligible families by creating a health-friendly environment. For clients, ICAN offers practical, money-saving skills and advice. For SNAP-eligible communities, ICAN facilitates the development of healthy public spaces. But this work helps everyone in New Mexico—through the reduction of healthcare costs stemming from obesity, through the strengthening of the labor force, and through the creation of communities that work for the people.

[Agricultural Sciences and its Impact Through Human Capital](#)

Project Director
Don Edgar
Organization
New Mexico State University Main Campus
Accession Number
1025542



Agricultural Sciences and its Impact Through Human Capital

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Understanding how best to develop and deliver information about agriculture in today's society is paramount to aid in solving the needs of our state, nation, and the world. Educating persons about agriculture, its value, and need in society is of the utmost need for society to continue to grow and prosper. Targeting learners at the secondary and postsecondary settings will provide a vital link to impact future adults and professionals about the need and understanding to be held towards the value of agriculture in our society.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Education and data collection began for this project in 2021. Data was gathered through local data acquisition of learners in an associated program in NM. Additional data is being gathered at another land grant institution to compare the findings of the project. The gathering of this data begins to indicate the impact of the project on Objectives 1-3 of the project. Further data gathering is ensuing and will begin to shape the findings of this project.

Briefly describe how your target audience benefited from your project's activities.

Initial results contend that teaching technical (STEM) based skills to populations of different gender is impactful. The participants in this initial study showed increased efficacy towards learning a technical skill. Further inquiry will further impact this initial finding or disprove it.

Briefly describe how the broader public benefited from your project's activities.

As initial findings lead towards a broader understanding of the goals of this project adaptations of audience understanding could lead towards increased efficacy towards learning about a technical skill. To date, no testing has been accomplished with the broader public.

Critical Issue

Food & Fiber Production and Marketing

Sustainable Fruit Production in Northern New Mexico

Project Director

Shengrui Yao

Organization

New Mexico State University Main Campus

Accession Number

7000601



Sustainable Fruit Production in Northern New Mexico

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Late frost is most critical factor affecting fruit industry in north and central New Mexico. This project will assist growers and home gardeners in northern New Mexico to diversify their operations with alternative crops or production methods to increase the profitability of their operations.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Objectives:

1. Continue the evaluation of jujube cultivars in different locations for their adaptation and productivity in New Mexico, promote jujubes and recommend cultivars.
2. Genotype jujube germplasm in New Mexico and El Paso, TX areas including cultivars and wild jujube germplasm.

3. Explore stone fruit production in high tunnels.

4. Continue the apple rootstock trials and high density fruit production in New Mexico.

5. Conduct table grape cultivar trial in northern New Mexico.

- Jujube cultivar trials at Alcalde, Los Lunas and Leyendecker sites were growing and producing well especially at Los Lunas in 2021. Due to health reason, I did one harvest at Leyendecker and our technician managed to finish the harvest for all three sites. PhD student Govinda Sapkota continued working on jujube fruit nutrient analysis and jujube fruit drying method comparison. MS student Dikshya Sapkota was on board since Fall 2021, working on jujube genotyping and morphological study. I was one of the keynote speakers through Zoom at the 5th International Jujube Symposium at Baoding, China on Sept 6-7, 2021.
- The organic apple rootstock trial also produced a reasonable crop in 2021. With Covid-19 and labor shortage, the apple plots had some irrigation issue early in the season. Later, we put new irrigation tapes in the apple plot and solve the issue.
- We tested the high tunnel for stone fruit production. Preliminary result indicates that February/March flower bud damage was still a problem.
- Replanted the table grape trial and plants grew well in 2021.
- Submitted one paper in HortTech and got published in first issue in 2022.

Briefly describe how your target audience benefited from your project's activities.

Growers can directly benefit from the results of jujube cultivar trials, table grape trial, organic apple rootstock trial in tall spindle system and high tunnel stone production projects. Growers can use those results to guide their own cultivar selection and production. We will summarize the results each year in our NMSU Alcalde Annual Report and published in peer-reviewed journals as appropriate. Growers can also visit us, attend workshops and Field days to learn the development of each project.

Briefly describe how the broader public benefited from your project's activities.

For the broader public, most people are aware of the late frost issue challenging fruit production in central and northern New Mexico. After 12+ research and extension efforts, most people realize jujube is a reliable crop with nutritious fruit in New Mexico. They do need to be selective in cultivars especially for those growers in northern NM or high elevations.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

We disseminate our results through our Field days, workshops, NMSU Alcalde Annual Report, and peer-reviewed publications. Growers can also visit us for specific project. For the jujube project, we established a NMSU jujube website with 50+ cultivar information, peer-reviewed publications, extension publications, a grafting video plus a YouTube jujube talk. Visitors nationwide and internationally can access it. <https://aces.nmsu.edu/jujube/>

In 2022, we will continue our jujube cultivar trials at three locations, apple rootstock trial and table grape cultivar trial. We will put our high tunnel in use in late March/April. For the genotyping project, we will finish the sampling in 2022.

Impact Statement (Optional)

Use this space to talk about the impact that this result had, in layman's terms. Adding comments here will **not** change the content in the highlighted result.

There are 5-6 commercially available jujube cultivars in the United States with Li as the dominant one. Both growers and consumers demand for more cultivar choices for various purposes. NMSU's cultivar trials at northern, central and southern New Mexico have provided cultivar performance at different locations. The data collected will improve the jujube cultivar composition in New Mexico and influence growers nationwide. The newer cultivars would generate \$1-2/lb more revenue. We are collaborating with tissue culture nurseries to propagate those cultivars. Thousands of home gardeners are planting jujubes and commercial growers are adopting jujubes in their operation across the country.

Supporting Southern and Northern Pueblos in New Mexico

Project Director

LaJoy Spears

Organization

New Mexico State University Main Campus

Accession Number

7002263



Supporting Southern and Northern Pueblos in New Mexico

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

There are over 8,500 self-identified Native American producers in New Mexico. Among the counted Native producers, 11 Southern Pueblos are considered beginning farmers and ranchers with a total of 100 producers from the Southern and Northern Pueblos. These producers are active and need support beyond grant programs. NMSU CES (Cooperative Extension Service) Pueblo Extension works in collaboration with community leaders to provide education and technical assistance to producers in the area.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

A total of five educational workshops focused on range management, soil health, and beef genetic selection was offered to the producers from the Southern and Northern Pueblos. A total of 155 producers attended the workshop series.

Briefly describe how your target audience benefited from your project's activities.

With a focus on environmental stewardship, producers identified new skills and strategies to improve their farming and ranch operations.

Briefly describe how the broader public benefited from your project's activities.

County agents partnered with Southern and Northern Pueblos to provide educational and technical assistance programs to their community members. Program participants engaged in agricultural and natural resources education to increase their skills and knowledge awareness of best practices.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Overall, the community is the center of Pueblo life as the community offers history, culture, language, and core values, which shape members and communities. This understanding will take the traditional concept of community development further by implementing culturally appropriate programming in communities. NMSU's identified components of leadership, economic development, and community service will be received well, whereas public policy will need to be tailored to include Indigenous perspectives as Pueblo dynamics involve traditional knowledge and sovereignty. Pueblo leadership supports

efforts to increase their tribal food sovereignty, promote positive stewardship of the land, teach their youth about their cultures and language, and to educate their members to return to their communities to lead and strengthen their Han-Nu (Keres word for "the people").

Genetic Improvement in the NM Cow Herd

Project Director

LaJoy Spears

Organization

New Mexico State University Main Campus

Accession Number

7002255



Genetic Improvement in the NM Cow Herd

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

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

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The Tucumcari Bull test has doubled its capacity in efficiency testing bulls since 2015, reaching over 1000 producers from 5 states.

Briefly describe how your target audience benefited from your project's activities.

The average value of bulls sold through the Tucumcari Bull Test has increased by \$500.00 per animal, improving the profitability of New Mexico purebred cattle producers.

Briefly describe how the broader public benefited from your project's activities.

The genetic selection seminars coupled with The Tucumcari Bull Test has improved the profitability of New Mexico purebred cattle producers.

New Mexico Dairy Workforce Development and Training

Project Director

LaJoy Spears

Organization

New Mexico State University Main Campus

Accession Number

7002249



New Mexico Dairy Workforce Development and Training

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Herd size of New Mexico dairies is more than ten times the U.S. average. With limited educational opportunities, effective training of current and future employees is imperative. The program seeks to raise safety awareness and improve job performance. Safety awareness training will be provided to about one-third of the NM dairy workforce.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Approximately 3,500 employees have directly been trained on dairy safety and animal handling. Training is provided in a preferred language available (English, Spanish, or K'iche). Training effectiveness is key evaluation metric.

Briefly describe how your target audience benefited from your project's activities.

NMSU's dairy workforce development program is now considered a leading example, with program details being utilized on some of the largest dairy operations in the U.S.

Briefly describe how the broader public benefited from your project's activities.

Idaho Dairywomen's Association (IDA) adopted the program with significant processor and co-op support. Due to processor and customer demands, National Milk Producers Federation (NMPF) created a Workforce Development Task Force (2017), which developed a Dairy Safety Reference Manual in English and Spanish.

NM Farm to School

Project Director

LaJoy Spears

Organization

New Mexico State University Main Campus

Accession Number

7002256



NM Farm to School Program

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Many New Mexico schools and institutionalized residences have limited access to nutritious, high quality, fresh produce. To address part of this issue, the New Mexico State Legislature has funded the NM Farm to School and Farm to Institution program, reimbursing schools, and institutions for purchasing New Mexico grown fresh fruits and vegetables. In addition, farmers were required to attend food safety trainings and conduct risk assessments.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

NMSU CES developed a three-pronged approach to assisting local farmers. Farmers were offered food safety trainings as well as the development of on-farm risk assessments and food safety plans.

Briefly describe how your target audience benefited from your project's activities.

A total of 125 farmers completed produce and food safety trainings. Approximately 90 producers and food hubs submitted food safety plans. In 2019-2020, 64 producers and food hubs sold to schools and institutions totaling \$1.2 million in sales. Of those sales, \$450,000 was reimbursed to schools.

Briefly describe how the broader public benefited from your project's activities.

The reimbursement dollars help schools to purchase locally grown, quality produce while providing a market for local producers to sell their product. Aside from the NM Farm to School program, this program is now being recognized by Whole Foods, various CO-OP Markets, and grocery stores who are purchasing NM grown produce from farmers who participated in food safety trainings and develop plans for market.

Project Director
LaJoy Spears
Organization
New Mexico State University Main Campus
Accession Number
7002522



Educating Youth in Agriculture in New Mexico

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The average age of the New Mexico livestock producer is 60.5 years old (USDA NASS, 2017). Given this reality, youth education and involvement in agriculture is needed to sustain and grow this particularly important industry.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

NMSU CES hosts a series of engagement opportunities for youth in New Mexico. Since 2010, over 400 New Mexican youth have participated in the series.

- **New Mexico Youth Ranch Management Camp:** five-day camp emphasizing all aspects of ranching.
- **New Mexico Youth Quality Assurance:** an educational training focused on exhibiting livestock, health management, nutrition, and showmanship.
- **New Mexico Youth Beef Project:** program provides youth assistance in raising steer from weaning to finishing while being introduced to different strategies and approaches to supply chain management in the beef industry.
- **Ag Tech Camp:** three-day camp highlighting the use of technology in agriculture with the goal of improving yield, efficiency, and profitability.

Briefly describe how your target audience benefited from your project's activities.

Three New Mexico Ranch Management Camp participants are now veterinarians or studying to be a large animal veterinarian. In addition, 60% of participants decided to attend NMSU and major in an agriculture related option, after participating in one of the listed programs.

Briefly describe how the broader public benefited from your project's activities.

Of those who graduated from the program, 90% have remained in the agriculture industry.

[Effects of arginine supplementation during early gestation on fetal development](#)

Project Director
Eric Scholljegerdes
Organization
New Mexico State University Main Campus
Accession Number
1025673



Effects of arginine supplementation during early gestation on fetal development

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Nutritional restriction during early pregnancy can negatively impact how the placenta and the fetus develop. This is a critical time for the proper development blood vessels that supply the fetal tissues with nutrients. Provision of supplements that can stimulate blood vessel development could offset any deleterious impact that poor maternal nutrition could have on the fetus and pregnancy success.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Heifers were harvested at 60 days of pregnancy and reproductive tissues and fetal tissues were analyzed for proteins and hormones that control vascular growth. These heifers were fed at 70% of what is required for maintenance, and were compared to those that were fed 100% of their requirements and within these groups a subset received arginine or no arginine. This ongoing work confirmed that nutrient restriction to 70% did reduce key proteins that stimulate blood vessel development and supplemental arginine (an amino acid that can stimulate blood vessel growth) slightly improved the production of this protein when animals were fed a restricted diet. This information has provided insight into other proteins and hormones that also need to be investigated and this lab work is currently being conducted.

Briefly describe how your target audience benefited from your project's activities.

This work demonstrates that when beef cattle are consuming winter forages or drought stricken forages that are of low quality, a supplement that includes high levels of arginine can ensure that the placenta and its blood vessels develop properly so that the fetus can receive the appropriate amount of nutrients during development and thereby improving lifetime offspring productivity.

Briefly describe how the broader public benefited from your project's activities.

This positively impacts a broader public because it ensures that animals develop properly during pregnancy and after birth will require fewer resources to grow them to harvest. In addition, it also has implications on animal health, in which, a healthier animal potentially requires fewer antibiotics and that is desirable by the end consumer.

Impact Statement (Optional)

Use this space to talk about the impact that this result had, in layman's terms. Adding comments here will **not** change the content in the highlighted result.

Improving the development of the fetus ensures a healthy and productive offspring. During times of drought or poor forage quality nutrient limitations can hinder proper fetal development. Improving the productivity of offspring benefits the livestock producer's sustainability. Feeding supplemental rumen protected arginine during early pregnancy (first 60 days) positively influences blood vessel growth factors. This was also observed when dietary intake was restricted to 70% of requirements. The use of arginine as a supplement when nutrient intake is limiting (e.g. drought or dormant season) can help alleviate problems associated with malnourishment as it relates to the developing fetus.

[Sustainable Agriculture in North-Central New Mexico](#)

Project Director

Steven Guldán

Organization

New Mexico State University Main Campus

Accession Number

1025617



Effects of COVID-19 on Organic Farmers

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The COVID-19 pandemic greatly affected the food production system. There is little data on how producers were affected by the pandemic.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

We collaborated with public health researchers to conduct a cross-section survey of certified organic operators/producers that assessed COVID-19 prevalence and preventative behaviors. Infection rate among producers was 6.4%. Women reported more use of prevention methods. Farms of ≥ 50 certified organic acres reported less use of prevention methods.

Briefly describe how your target audience benefited from your project's activities.

Study results can be used to inform public health interventions and policies for the benefit of organic and other producers as well as for general Extension programming for farmer audiences. To our knowledge, this is the first study reporting on the effect of COVID on certified organic producers.

Briefly describe how the broader public benefited from your project's activities.

All of the public depends upon the food production system. When this system is challenged or threatened, the public can have restricted food choices and/or food prices can be higher. The COVID-19 pandemic was and could still be such a challenge/threat. Understanding how producers responded to the health challenges brought on by COVID can help them and the food system be better prepared for similar threats in the future.

Impact Statement (Optional)

Use this space to talk about the impact that this result had, in layman's terms. Adding comments here will **not** change the content in the highlighted result.

There is little data on how producers were affected by the pandemic. We collaborated with public health researchers to conduct a cross-section survey of certified organic operators/producers that assessed COVID-19 prevalence and preventative behaviors. Infection rate among producers was 6.4%. Women reported more use of prevention methods. Farms of ≥ 50 certified organic acres reported less use of prevention methods. Study results can be used to inform public health interventions and policies as well as for general Extension programming for farmer audiences. To our knowledge, this is the first study reporting on the effect of COVID on certified organic producers.

GENOMICS-ASSISTED BREEDING FOR THE IMPROVEMENT OF CHILE PEPPERS (CAPSICUM SPP.) IN NEW MEXICO

Project Director

Dennis Nicuh Lozada

Organization

New Mexico State University Main Campus

Accession Number

1025360



GENOMICS-ASSISTED BREEDING FOR THE IMPROVEMENT OF CHILE PEPPERS (CAPSICUM SPP.) IN NEW MEXICO

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

In recent years, the overall chile pepper production in the state has been declining due to abiotic stresses, constraints related to manual harvest, and the presence of pests and diseases. The current project is focused on the using genomics-assisted breeding to develop chile pepper cultivars with improved yield and resistance to *Phytophthora capsici* root rot.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Using a genetic mapping approach, we recently identified genes associated with resistance to *P. capsici*. We also validated and confirmed results from previous studies and found similar regions controlling the disease, resulting in a deeper understanding of its genetic basis. Information from the ongoing research will be used to drive breeding, selection, and management decisions for the development of chile pepper cultivars with improved resistance to *P. capsici*.

Briefly describe how your target audience benefited from your project's activities.

Chile pepper root rot, caused by *P. capsici*, remains one of the most damaging diseases affecting the total chile pepper production in New Mexico. Growers, therefore, will benefit from using resistant cultivars that will be developed through genomics-assisted breeding approaches.

Briefly describe how the broader public benefited from your project's activities.

P. capsici root rot is also considered a major disease in many chile pepper growing areas. Similarly, through the current project, growers in other areas can use the resistant pepper cultivars that will be developed using genomics breeding.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

One of the major constraints encountered was the manual harvest of chile pepper fruits in the field, particularly for collecting yield and yield component data for genetic mapping. As the majority of the chile peppers for evaluation are not amenable to machine-driven harvest, we have reduced the number of lines for field trials this growing season. Results have been disseminated through publications in peer-reviewed journals.

Impact Statement (Optional)

Use this space to talk about the impact that this result had, in layman's terms. Adding comments here will **not** change the content in the highlighted result.

While crop rotation and management can mitigate the effects of *P. capsici*, identifying sources of resistance alleles and using resistant cultivars remains the most cost-effective approaches to minimize the effect of this pathogen to farmers and producers. Using a population of chile pepper recombinant inbred lines, quantitative trait loci (QTL) mapping dissected the genetic architecture of *P. capsici* resistance and candidate genes linked to resistance were identified. Genetic mapping identified QTL associated with *P. capsici* root rot resistance in chromosomes P5, P8, and P9. The role of chromosome P5 as major genomic region containing *P. capsici* resistance QTL was established. Through candidate gene analysis, biological functions associated with disease response and epigenetic mechanisms such as DNA methylation were identified. Results support the genetic complexity of the *P. capsici*-*Capsicum* pathosystem. Significant genomic regions and candidate genes were identified which allow for a deeper understanding of the genetics of *Phytophthora* root rot resistance. These results will be used as a basis for future molecular marker development and validation toward the development of *P. capsici* resistant cultivars of New Mexican chile pepper.

Sustainability of New Mexico Beef and Dairy Livestock Sector

Project Director

Maryfrances Miller

Organization

New Mexico State University Main Campus

Accession Number

1023910



Sustainability of New Mexico Beef and Dairy Livestock Sector

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This project focuses on helping equip the New Mexico livestock industries with information and tools to mitigate threats to their economic or environmental sustainability. This has included farmer-focused assistance with providing information to help producers track their costs and compare production decisions. It ranges up to state-level efforts to increase preparedness for potential Foreign Animal Diseases.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

I helped prepare a state-wide plan for carcass disposal in a mass livestock mortality event. My specific focus in this area has been creating a producer survey and analyzing responses related to current practices of disposal. As a different focus on threats to range livestock, I have also worked on projects related to invasive species and their impact. I have also given several talks related to the need for keeping financial records as a part of doing business.

Briefly describe how your target audience benefited from your project's activities.

The reason for including a producer survey in the mass livestock mortality state plan was to ensure that New Mexico producers had a way of offering input into the planning process for emergency disposal. The survey was a small way of characterizing customs and procedures that are commonly used as well as the envisioned preferences of farmers and ranchers during an emergency event.

I am working on developing a new reporting framework to improve the ability to capture New Mexico costs of production, and to increase the ability for New Mexico producers to utilize financial benchmarking to better understand the financial strengths and weaknesses of their own operation.

Briefly describe how the broader public benefited from your project's activities.

The development of a statewide plan for emergency mass livestock disposal could have dramatic impacts for protecting public health - this could prevent water and air pollution, it could potentially help arrest the spread of an introduced disease. In addition to the environmental benefits, an expedited response to disease mitigation could also limit the economic impact of a Foreign Animal Disease outbreak.

The assistance to farmers and ranchers in better understanding costs, and associated opportunities and threats, can help maintain the economic base of some of our state's rural economies. The sense of control of finances can contribute to overall mental health for farmers and ranchers.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

The work completed on the economic impact of feral swine was presented as a poster at the Society of Range Management.

A paper on feral swine was submitted and accepted in the Western Economic Forum.

A discussion of the opportunities to retain ownership of calves was accepted for publication with the NMSU Cooperative Extension Service.

Livestock record keeping was included as a part of a new project for New Mexico youth, the NM Feeder Beef Contest. Similar information was presented at the New Mexico Youth Ranch Management Camp.

[Examining Farm Financing and Risk Management Strategies in New Mexico](#)

Project Director

Madhav Regmi

Organization

New Mexico State University Main Campus

Accession Number

1024211



Industrial Hemp Industry Trends before and during the Covid-19 Disruptions

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

There has been increasing interest in promoting the cultivation and production of industrial hemp in the United States. The study aims to compare overall changes in production trends of industrial hemp production before and during Covid-19 disruptions. The major focus is to understand these trends in New Mexico and compare them with national and regional

trends.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

As indicated in my non-technical summary, one key objective of the project is to "evaluate the differential impacts of policies on the different aspects of the farm economy" with a key focus on the New Mexico agricultural sector. The 2018 Farm Bill removed hemp from the list of "controlled substances" allowing states to issue permits for commercial cultivation, processing, marketing, and sales. This policy intervention increased the investment interest of stakeholders throughout the hemp supply chain. The industrial hemp producers, however, faced several production and marketing challenges. The Covid-19 pandemic caused further disruptions. Using New Mexico as an example, this study particularly identifies the changes in the trends of production acreage, the number of grower permits, and the intended use of industrial hemp before and during the pandemic.

Briefly describe how your target audience benefited from your project's activities.

The project identifies changes in production trends, particularly shifts in the intended use of hemp in New Mexico, which should be of interest to all industrial hemp industry participants in the state. Further, this research will provide policy recommendations discussing several determinates of national and regional shifts in production trends of industrial hemp.

Briefly describe how the broader public benefited from your project's activities.

This study will provide a broad perspective on the potential impacts of the 2018 Farm Bill and the Covid-19 disruptions pandemic on the changes in the production of industrial hemp both in New Mexico and in the United States.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

This particular study related to trends in industrial hemp production is a collaborative work with another faculty in the Department of Agricultural Economics and Agricultural Business. We plan to present the findings of this research work at a regional agricultural economics conference.

[Management factors influencing beef cattle productivity, longevity, and producer profitability](#)

Project Director

Adam Summers

Organization

New Mexico State University Main Campus

Accession Number

1022130



[Influence of undegradable protein level in supplements on beef heifer performance and ovarian parameters](#)

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Infertility, specifically the inability of a cow to produce and raise a calf is one of the main factors that limit producer profitability and cow longevity. Using nutrition during the post-weaning to breeding time of a heifer's life can help improve the probability of pregnancy success. Additionally, identifying specific nutrients that may optimize fertility could increase

longevity in beef cattle.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Heifers were offered one of two supplements with differing levels of undegradable protein (50% or 36% -protein that is not broken down in the rumen) for 90 days prior to ovariectomy, which coincided with the beginning of the breeding season. Previous research conducted at the Corona Range and Livestock Research Center found heifers fed a 50 undegradable protein supplement had greater pregnancy rates than those fed a control diet or a 36% undegradable protein supplement. Our goal was to determine the effect of the supplements at the level of the ovary to determine if an improved ovarian environment due to diet was the cause of this improvement. Although the 50% supplement allowed for a higher daily gain than the 36%, all measurements collected from the ovary (size, follicle numbers and density) were similar among treatments. It should be noted that the initial studies conducted utilized supplements that were made from animal proteins sources, while the current study utilized plant-based sources.

Briefly describe how your target audience benefited from your project's activities.

This work demonstrates that providing a diet with an increased level of undegradable protien during the development period allowed heifers grazing native range to increase average daily gains, while maintaining the ovarian environment.

Briefly describe how the broader public benefited from your project's activities.

The results from this study can be utilized to improve the efficiency in which cattle are raised on native range. In the event, these heifers are not retained for breeding females, the added weight gain during development results in an increase in pounds of beef produced while limiting the resources needed.

Impact Statement (Optional)

Use this space to talk about the impact that this result had, in layman's terms. Adding comments here will **not** change the content in the highlighted result.

Improving beef heifer fertility is vital to increase producer profitability and cow longevity. Previous research conducted at the Corona Rangeland and Livestock Research Center suggested feeding a diet with 50% rumen undegradable protein (RUP; compared to 36%) increased fertility and cow longevity; however, mechanisms to determine how this was happening were not investigated. To further understand these data, heifers were fed either a 50% or 36% RUP diet and ovarian measurements and histology recorded, along with animal performance. Providing a diet higher in rumen undegradable protein concentration increased average daily gain but did not alter the ovarian microenvironment.

[Discovering, Developing, and Delivering Forage Management Solutions to Meet Changes in New Mexico Agriculture](#)

Project Director

Leonard Lauriault

Organization

New Mexico State University Main Campus

Accession Number

1021538



FY 21 Report

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The forage industry plays a vital role in New Mexico's agricultural economy and the demand for forages in New Mexico and the surrounding region has increased over the past few decades due sustained livestock industries. Coupled with that, since the end of the 20th Century, particularly in the Western USA, the nation's grazing livestock industry has been decimated due to little or no grass growth or stored feed production because of drought, although a resurgence of that industry has taken place in the previous five years. These and other factors are leading to a heightened awareness that will likely continue throughout

the remainder of the 21st Century of the needs for (1) better environmental stewardship toward sustainable agriculture, (2) food security for a growing global population, and (3) the demands of revitalized grazing and confined livestock industries. Solutions must be discovered, developed, and delivered to stakeholders to meet these challenges.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The research program relies on the year round availability of treated municipal wastewater for agricultural irrigation and the availability of canal water from the Arch Hurley Conservancy District on a year-by-year basis. Previous field research continued to be hampered by COVID-19 restrictions into 2021 and irrigation water was not available due to ongoing drought (canal water) and noncompliance matters at the wastewater treatment plant. Consequently, time was spent writing manuscripts related to each of the concerns stated above: (1) better environmental stewardship toward sustainable agriculture, (2) food security for a growing global population, and (3) the demands of revitalized grazing and confined livestock industries.

Briefly describe how your target audience benefited from your project's activities.

A growing livestock industry requires improved management strategies to increase productivity with limited land and other resources, including water, to feed an increasing population. Genetic improvement of beef cattle for increased feed efficiency also contributes significantly to "stretching" forage resources to increase beef production. This technology also may be transferrable to other classes of livestock.

Briefly describe how the broader public benefited from your project's activities.

Global, national, and local food security is a widespread concern. Providing agricultural producers and those who provide technical assistance with new discoveries related to improved management for environmental stewardship that lead to sustainable food production serves the global population.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

A major challenge continued due to residual effects of COVID-19 restrictions 2021. This was exacerbated because irrigation water was not available throughout 2021 due to ongoing drought (canal water) and noncompliance for total nitrogen content at the wastewater treatment plant.

Professional development opportunities included:

"2021 Pesticide Applicators Workshop," NMSU Cooperative Extension Service, Online: pesticide.nmsuondemand.nmsu.edu, NM, USA. (September 2, 2021 - September 3, 2021).

"Annual Meeting," Western Society of Crop Science, Online/Virtual. (June 22, 2021 - June 23, 2021).

"40th Annual Kentucky Alfalfa and Stored Forage Conference," University of Kentucky and Kentucky Forage and Grassland Council, Virtual/Online. (March 2, 2021 - March 4, 2021).

"Cultivating a Hemp Based Business in New Mexico: Production, Processing and Profitability," NMSU Cooperative Extension Service, Online, NM, USA. (February 25, 2021).

"Biological control of corn rootworm with native NY entomopathogenic nematodes," Texas AgriLife Extension, Online, USA. (February 18, 2021).

"Society for Range Management Annual Meeting," Society for Range Management, Online, USA. (February 15, 2021 - February 18, 2021).

The following publications were generated during the fiscal year 2021:

Refereed Journal Articles

Lauriault, L. M., Schmitz, L. H., Cox, S. H., Scholljegerdes, E. J. (2021). A comparison of pearl millet and sorghum-sudangrass pastures during the frost-prone autumn for growing beef cattle in semi-arid regions. *MDPI Agriculture*, *11*, 541. doi.org/10.3390/agriculture11060541

Djaman, K., O'Neill, M. K., Lauriault, L. M., Marsalis, M. A., Koudahe, K., Darapuneni, M. K. (2021). The dynamics of forage yield of different fall dormancy rating alfalfa cultivars in a semiarid climate. *Agricultural Research/Springer Publishing*, *10*(1), 378-389. <https://link.springer.com/article/10.1007/s40003-020-00518-8>

Darapuneni, M. K., Idowu, O. J., Sarihan, B., Dubois, D. W., Grover, K., Sanogo, S., Djaman, K., Lauriault, L. M. (2021). Growth characteristics of summer cover crop grasses and their relation to soil aggregate stability and wind erosion control in arid Southwest. *ASABE Applied Engineering in Agriculture*, *37*(1), 11-23. <https://doi.org/10.13031/aea.13972>

Ibrahim, M., Jameel, M., Ul Haq, T. R., Nadeem, M. M., Rehmani, M. I. A., Abbas, A. N., Ahmad, S., Shabir, M. A., Iqbal, M. M., Lauriault, L. M. (2020). The influence of integrated organic and inorganic fertilizers on forage yield and nutritive value of maize and soil properties. *East African Scholars Journal of Agriculture and Life Sciences*, *3*, 383-388. doi: 10.36349/easjals.2020.v03i12.001

Beck, L. L., Marsalis, M. A., Lauriault, L. M., Serena, M. (2020). Efficacy of various herbicides for the control of perennial *Plantago* spp. and effects on alfalfa damage and yield in alfalfa. *MDPI Agronomy*(10), 1710. doi:10.3390/agronomy10111710

Conference Proceedings

Lauriault, L. M., Schmitz, L. H., Cox, S. H., Scholljegerdes, E. J. (2021). Using pearl millet vs. sorghum-sudangrass pastures during the frost-prone autumn for growing beef cattle in semiarid regions. In Craig Gifford, Marcy Ward, et al. (Ed.), *Proceedings of the 2020 NMSU ACES Beef and Livestock Update* (vol. 1, pp. 12-13). Las Cruces, NM: ACES-CES. <https://aces.nmsu.edu/nmbeef/documents/2020-nmsu-beef-and-livestock-research-update-proceedings-ads-comp-v2.pdf>

Gifford, C. A., Torres, P. W., Dean, T. L., Flores, N., Ward, M. A., Torell, G., Blayney, D., Lauriault, L. M., Gutierrez, P., Sanchez, L. (2021). *Proceedings of the 2020 NMSU ACES Beef and Livestock Update* (vol. 1, pp. 54). Las Cruces, NM: ACES-CES. <https://aces.nmsu.edu/nmbeef/documents/2020-nmsu-beef-and-livestock-research-update-proceedings-ads-comp-v2.pdf>

Other

Ellison, E.-D., Blaser, B., Darapuneni, M. K., Rhodes, M., Lauriault, L. M. (2021). *Forage grasses intercropped with cowpea in the semi-arid Texas High Plains*. Salt Lake City, UT: ASA-SSSA-CSSA Meetings.

Farber, B., Darapuneni, M. K., Lauriault, L. M., Fields, R., Meakin, R. (2021). *Yield and quality of alfalfa growth with a POLY4 fertilizer programme in New Mexico*. Salt Lake City UT: ASA-SSSA-CSSA Meetings.

Darapuneni, M. K., Lauriault, L. M., Martinez, G., Djaman, K. (2021). *Yield potential and water use efficiency of various summer and winter alternate crops in a semi-arid environment*. Salt Lake City UT: ASA-SSSA-CSSA Meetings.

Ward, M. A., Smallidge, S. T., Gifford, C. A., Jennings, R. S., Box, J., Jennings, J., Lauriault, L. M., TFET, LLC (2021). *Evaluation of water and feed intake of purebred cattle at the Tucumcari Bull Test, and its implications on selection principles* (pp. 1). Tucumcari, NM: Field Day, Rex E. Kirksey Agricultural Science Center.

Lauriault, L. M., Schmitz, L. H., Cox, S. H., Darapuneni, M. K. (2021). *Using pearl millet vs. sorghum-sudangrass pastures during the frost-prone autumn for growing beef cattle in semiarid regions to create a more sustainable economy*. Madison, WI: Western Society of Crop Science.

Marsalis, M. A., Flynn, R. P., Lauriault, L. M., Mesbah, A., Djaman, K. (2021). *New Mexico 2020 Corn and Sorghum Performance Tests*. Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. https://aces.nmsu.edu/pubs/variety_trials/20CornSorghumRpt.pdf

Lauriault, L. M., Ray, I., Pierce, C., Djaman, K., Flynn, R. P., Marsalis, M. A., Allen, S., Havlik, C., Martinez, G. (2020). *The 2020 New Mexico Alfalfa Variety Test Report* (pp. 13 pp.). Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. https://aces.nmsu.edu/pubs/variety_trials/AVT20.pdf

Lauriault, L. M., Pratt, R. C., Grant, L. (2020). *BL 810, Forage nutritive value of selected tepary bean varieties in the Southwest Desert Basin and Southern High Plains regions of New Mexico* (pp. 8). Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. <https://aces.nmsu.edu/pubs/research/agronomy/BL810.pdf>

The following presentations were made to various stakeholder and academic audiences during the fiscal year 2021:

Lauriault, L. M., Farm Day for Tatumcari Elementary Schools, "Good bugs, bad bugs," NMSU Rex E. Kirksey Agricultural Science Center, Tatumcari, NM. (September 30, 2021).

Lauriault, L. M., 2021 Pesticide Applicators Workshop, "FORAGE: Preventive Management for Alfalfa Pest Control," New Mexico Cooperative Extension Service, Online: pesticide.nmsuondemand.nmsu.edu. (August 9, 2021).

Lauriault, L. M., Field Day, "A comparison of pearl millet and sorghum-sudangrass for autumn pastures," Rex E. Kirksey Agricultural Science Center, Tatumcari. (August 3, 2021).

Lauriault, L. M. (Presenter), Schmitz, L. (Other), Cox, S., Scholljegerdes, E. J. (Other), Annual Meeting of the Western Society of Crop Science, "Using pearl millet vs. sorghum-sudangrass pastures during the frost-prone autumn for growing beef cattle in semiarid regions to create a more sustainable economy," Western Society of Crop Science, Online. (June 23, 2021).

Lauriault, L. M., Field Trip to the Rex E. Kirksey Agricultural Science Center, "History of the Rex E. Kirksey Agricultural Science Center," Tatumcari Historical Research Institute, Tatumcari. (May 22, 2021).

Lauriault, L. M., Beginning Farmer/Rancher Workshop, "Soil fertility and fertilizers," TableTop Food Co-op, Tatumcari. (March 30, 2021).

Lauriault, L. M. (Presenter), Schmitz, L. (Other), Scholljegerdes, E. J. (Other), 2020 NMSU Beef/Livestock Research Update, "A comparison of pearl millet and sorghum-sudangrass pastures during the frost-prone autumn for growing beef cattle in semiarid regions," NMSU Cooperative Extension Service, Online. (November 17, 2020).

Darapuneni, M. K., Martinez, G., Lauriault, L. M., ASA-SSSA-CSSA Annual Meeting, "Strip-till manure application under dryland grain sorghum production," ASA-SSSA-CSSA Societies, Virtual meeting. (November 12, 2020).

Lauriault, L. M., Virtual Farm Day for Tatumcari Elementary Schools, "Chewing cud, belching cows, and climate change," NMSU Rex E. Kirksey Agricultural Science Center, Tatumcari, NM. (November 4, 2020).

For the future, pending approval of a 120-day waiver to apply wastewater containing nitrogen levels greater than previously permitted and renewal of the groundwater discharge permit in 2022, a study is scheduled for late winter 2022 to determine if the wetting front of applied water moves nitrogen below the spring cereal grass root zone under sprinkler irrigation. Additionally, studies deferred from 2020-21 to evaluate annual grass - legume mixtures and intercropping of winter crops with corn and sorghum for silage will continue to completion. An offsite grazing study to evaluate the effect of competition by winter cereals on field bindweed growth in perennial warm-season grass pastures will also restart after an interruption to install overhead irrigation systems funded through EQIP. Potential new studies include alfalfa-grass-perennial forage Kochia and cereal-canola dual purpose intercrops.

Closing Out (end date 09/07/2023)

[**Alternative nutrient supplementation strategies for calf health and performance**](#)

Project Director

Clint Loest

Organization

New Mexico State University Main Campus

Accession Number

1018106



Alternative nutritional management strategies for calf health and performance.

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The problem is that bovine respiratory disease (BRD) is a significant health concern in the cattle industry, affecting more than 20% of cattle and costing the US beef industry more than \$600-million annually. Typically, calves entering feedlots are at high risk because they are under stress associated with weaning, comingling, and transportation. These calves are often dehydrated and malnourished, which compromises their immune systems and increases their vulnerability to BRD. We hypothesize that highly stressed and immune-challenged calves will have altered rumen microbial nutrient metabolism in addition to altered host animal nutrient metabolism, and that supplementation of nutrients known to support immune function via alternative methods (i.e. oral drench) will improve calf health and performance.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Results from our research showed that anaerobic fermentation and nutrient digestibility are altered when rumen microorganisms are exposed to salivary cortisol and catecholamines in an in vitro system.

Briefly describe how your target audience benefited from your project's activities.

Our target audience are national and international animal scientists and stakeholders who are cattle industry decision-makers from cow-calf through feedlot sectors of the beef industry. Results from our research demonstrated that fermentation of feeds by rumen microbes is directly affected by exposure to mammalian stress hormones (cortisol, epinephrine, and norepinephrine) in saliva.

Briefly describe how the broader public benefited from your project's activities.

Our research focuses on alternative nutritional management strategies to better prepare immune-compromised calves to fight infections and help reduce the United States beef industry's \$600-million to \$900-million in annual economic losses due to the cost of BRD in feedlot cattle. If nutritional strategies utilizing specific nutraceuticals are developed to increase immunity and reduce BRD in cattle by 5% annually, this could save the US beef industry more than \$30-million annually.

Impact Statement (Optional)

Use this space to talk about the impact that this result had, in layman's terms. Adding comments here will **not** change the content in the highlighted result.

Bovine Respiratory Disease (BRD) is a significant health concern in the cattle industry, affecting more than 20% of cattle and costing the US beef industry more than \$600 million per year. Typically, metaphylactic antibiotic use is employed to prevent feedlot calves from succumbing to BRD. However, consumer pressure to minimize antibiotic use in food producing animals demands exploration of alternative strategies to prevent BRD and improve animal health. If nutritional strategies utilizing specific nutraceuticals can be developed to increase immunity and reduce BRD in cattle by 5% annually, this could save the US beef industry more than \$30 million annually.

[Genetic Improvement of Alfalfa \(*Medicago sativa* L.\) Germplasm for New Mexico](#)

Project Director

Ian Ray

Organization

New Mexico State University Main Campus

Accession Number

1012275



[Genetic Improvement of Alfalfa \(*Medicago sativa* L.\) Germplasm for New Mexico](#)

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Seventy percent of the U.S. alfalfa acreage resides within drought prone environments in the Great Plains and western regions. Much of this acreage relies on irrigation for successful hay production. However, frequent occurrence of drought and rapidly diminishing water resources for irrigation in this region often limit alfalfa productivity. Consequently, the development of alfalfa cultivars which can remain productive during drought stress is imperative. In this regard, the New Mexico alfalfa breeding program will utilize conventional breeding procedures and DNA marker assisted selection methods including marker assisted introgression, association mapping and genomic selection, to maximize opportunities to improve alfalfa productivity in drought-prone environments.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Objective 1: Evaluating and enhancing alfalfa germplasm productivity by traditional breeding strategies. The NMSU drought-resilient alfalfa variety, NuMex Bill Melton, continues to perform very well in statewide variety trials. It is being commercially grown in NM and generates an estimated \$500,000 annually in hay sales. Industry and public alfalfa varieties were evaluated in forage yield trials at 5 NM locations. Our program conducted all statistical analyses for the NM state-wide alfalfa variety trials (89 populations and 5 locations) and provided summary reports to develop the NM Alfalfa Variety Test Report for 2020. Trial results were published to help NM, TX, and AZ hay growers identify varieties best suited for their farms. In summer 2021, seed was increased for 9 new elite alfalfa germplasms derived from thousands of seedlings and hundreds of mature plants that were previously subjected to selection for drought resilience, resistance to phytophthora root rot and anthracnose diseases, and differing fall dormancies. Several of these new lines are performing well at 3 NM locations under well-watered conditions at Farmington, Las Cruces and Los Lunas, NM, and under summer irrigation termination at Las Cruces, NM.

Objective 2: Application of traditional and advanced DNA marker assisted selection (MAS) approaches within elite germplasm to improve alfalfa productivity in drought prone environments. Twenty-seven elite NMSU alfalfa germplasms possessing 75% genetic background from 3 cultivars were developed in 2016 using DNA MAS over two generations for markers that were previously demonstrated to impact biomass production during drought stress. Forage yields of these new materials were evaluated in 2018-2020 under a summer irrigation termination regime, where no water was applied during July through early September. Results suggest that MAS impacted productivity in the elite germplasms. This outcome likely reflected changes in allele frequencies that occurred at targeted genome regions involving both the introgressed new biomass alleles and alternate alleles of similar size that were already present within the three cultivars evaluated. In a second experiment, association analyses (AA) for various traits were conducted on 220 to 260 elite NMGS alfalfa families that were genotyped with 12,884 DNA markers. AA identified 11 significant markers affiliated with seed germination salt tolerance in NMGS over two years. AA for forage yield over 3 years in NM and CA detected four significant markers in NMGS under summer irrigation termination. AA also identified 27 NMGS markers associated with 10 forage quality traits at NM. Several of these significant markers reside in genome regions previously reported to impact alfalfa yield, quality, and salt-stress response traits. These outcomes illustrate the usefulness of AA to detect some chromosome regions with reasonably large effects for improvement of quantitative traits in alfalfa. We also used the AA approach to determine the influence for each of 12,884 DNA markers on forage yield and nutritional value under deficit irrigation management over three years in CA, NM, and WA. Results from a recently-developed data analysis approach indicate that this trait-specific marker effect information can be integrated into genomic selection models to predict alfalfa yield and nutritional quality with 60 to 90% accuracy. Future research is required to confirm these outcomes. If validated, we estimate that DNA-marker based selection approaches can approximately double the rate at which new alfalfa cultivars can be developed with improved resilience to climate change. Such new varieties will help U.S. farmers conserve water and meet the livestock industry's feed demands. In future work, identification of "superior" plants for developing new breeding lines will be based on conventional phenotypic selection, AA, or genomic selection approaches. Performance of populations developed by these different breeding strategies will be comparatively evaluated to determine their effectiveness towards improving alfalfa, yield, quality and abiotic stress tolerance traits.

Objective 3: Evaluate the potential of inbred diploid ($2x$; $2n=2x=16$) alfalfa germplasm to enhance productivity of commercial tetraploid ($4x$; $2n=4x=32$) populations. We hypothesize that natural $2x$ populations of alfalfa may provide an enriched source of favorable alleles to benefit productivity of commercial $4x$ cultivars. Furthermore, opportunities to enhance favorable allele frequencies may be greater in diploids where inbreeding can purge deleterious alleles much faster than in tetraploids. Once superior noninbred or inbred $2x$ plants are identified, regular occurrence of unreduced gamete production (i.e., $2n$ gametes) in diploids can be used to transfer their desirable alleles to commercial $4x$ populations. In this study, 194 noninbred $2x$ alfalfa populations were phenotypically evaluated in the greenhouse in 2018. They were also self-pollinated for one generation to develop $2x$ inbred lines.

Seventy-nine vigorous noninbred lines were identified and 62 of these also produced sufficient self-pollinated seed. The 79 noninbred populations and 62 of their corresponding inbred lines were planted in the field in fall 2019. They were phenotypically evaluated multiple times during 2020 and 2021 under summer irrigation termination management. This evaluation will continue in 2022 with future phenotypic selection based on plant vigor and persistence. Selected diploid plants from phenotypically superior lines will be advanced for additional inbreeding. They will also be mated with elite tetraploid cultivars. Their $2x$ - $4x$ interploidy hybrid progeny will then be evaluated for yield and other traits under well-watered and deficit irrigation management regimes to determine if their performance exceeds that of conventional commercial tetraploid populations.

Briefly describe how your target audience benefited from your project's activities.

Assisted with coordinating a virtual New Mexico Future Farmers of America Agronomy Career Development Event (April 14) due to COVID19 restrictions which prevented face-to-face meetings.

Provided research progress updates to NM Hay Association Board of Directors (9 individuals) via conference calls on May 7 and September 24, 2021. Was not able to assist with organization, coordination, and moderating of 2021 Southwest Hay and Forage Conference which was cancelled due to COVID19.

Annual reports of our research progress have been provided to a key alfalfa industry collaborator who financially supports our research and is very interested in utilizing DNA marker assisted selection (MAS) to improve alfalfa drought resilience and forage nutritional quality. In addition, two virtual meetings (April 7 and June 3) were conducted with alfalfa breeders and research leaders in private industry to discuss (1) recent advancements and research opportunities to employ genomic selection/prediction to improve alfalfa drought resilience and forage quality, and (2) field-based phenotyping approaches to improve alfalfa drought resilience.

Served as Chair of the Western Regional Technical Advisory Committee of the USDA-National Plant Germplasm System (NPGS). Collaborated with USDA-ARS personnel to organize/host a virtual annual regional workshop to discuss status of multiple NPGS sites in the western U.S. Audience: USDA-ARS NPGS staff and state Agricultural Experiment Station representatives for the western U.S. (June 15, 2021).

Presented research results on a genome-wide association study for forage yield and forage quality traits in elite alfalfa germplasm to a professional audience at the Crop Science Society of America Annual Meetings, Nov. 9-12 (Virtual meeting).

Kaur, H., Medina-Culma, C., Pierce, C., Singh Gill, A., Reich, J., Yu, L-X., Ray, I. (2020). Association analyses for forage yield and quality under deficit irrigation management in elite alfalfa (*Medicago sativa* L.) germplasm. Crop Science Society of America Annual Meeting Abstracts.

One peer-reviewed manuscript discussing “Strategies to increase prediction accuracy in genomic selection of complex traits in alfalfa” was published to discuss molecular approaches to benefit development of superior autopolyploid crop varieties, including alfalfa.

Medina, C., Kaur*, H., Ray, I., Yu, L.-X. L. (2021). Strategies to Increase Prediction Accuracy in Genomic Selection of Complex Traits in Alfalfa (*Medicago sativa* L.). Cells. <https://doi.org/10.3390/cells10123372>

Briefly describe how the broader public benefited from your project's activities.

Four courses were taught to diverse NMSU student population (25 undergraduate and 1 graduate students) including Caucasian, Hispanic, Black, Asian, female and male students during Fall 2020 and Spring 2021. These courses included Molecular Genetics (GENE 315, synchronous online), Genes and Genomes (GENE 486, synchronous online), University Teaching Experience (AGRO 697, synchronous online), Doctoral Dissertation (AGRO 700, synchronous online).

Each year the program helps publish an Experiment Station Research Report (2020 New Mexico Alfalfa Variety Test Report; https://aces.nmsu.edu/pubs/variety_trials/AVT20.pdf) that describes alfalfa variety performance results across the state. This report is made available online, as well as, in hard copy at the Southwest Hay and Forage Conference to provide hay growers in NM, AZ, and TX with information to help them identify the most suitable varieties for their particular growing region.

Presented two field day presentations on alfalfa genetic technologies and variety development to 80 farmers at Las Cruces and Artesia, NM (August 25 and 26).

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

OPPORTUNITIES FOR TRAINING AND PROFESSIONAL DEVELOPMENT (2021)

One PhD graduate student received training in phenotype data collection for forage biomass, forage quality sampling, seed germination salt tolerance, and disease resistance traits using 220 to 260 elite alfalfa populations. This student received training in conducting genome-wide association analysis (AA) and genomic selection (GS) for these traits in these populations which were genetically fingerprinted with >11,000 DNA markers. Based on AA, significant DNA markers for all traits have been identified in this Ph.D. dissertation research. Data analyses for other traits are in progress. The PhD student has also participated in a high-throughput computing workshops, received training in statistical analysis of data using splines to account for spatial variation in field research studies, and use of statistical software to determine best linear unbiased predictors and estimates (BLUP/BLUE) for multiple alfalfa populations being evaluated for diverse traits. Expertise was also gained in managing and analyzing large datasets (including DNA sequence and phenotype data) relevant to our research program. Extensive training was provided towards evaluating different data analyses approaches utilizing AA and GS to predict alfalfa forage yield potential and nutritional value.

In an graduate course, Topics in Agronomy: Genome Data Analysis (AGRO 698), the above Ph.D. candidate served as an instructor to provide advanced training to another Ph.D. candidate from the NMSU onion breeding program. Hands-on training focused on 4 key areas that are affiliated with genome data analysis for marker development and application to plant breeding. These included: (1) management of large raw DNA sequences (genotype-by-sequencing data) from large populations including filtering and quality control evaluation, (2) alignment of sequence data to reference genomes for single nucleotide polymorphism (SNP) marker development, (3) development and filtering of SNP markers, and (4) Integration of DNA marker (genotype) data with phenotype data for conducting Genome Wide Association Studies (GWAS) in important crops.

One NMSU undergraduate student received extensive “hands-on” training in agronomy, plant breeding and genetic research techniques as a part-time employee with the alfalfa genetics/breeding program..

In a Genetics Internship course (GENE 391), one NMSU undergraduate student generated four experimental alfalfa populations by intermating approximately 20 plants each that were predicted to possess either high or low seedling germination salt tolerance based on their DNA marker profiles. The student conducted a replicated laboratory experiment to evaluate these materials under no salt-stress and high-salt stress conditions during seed germination. Results indicated that predictive use of DNA markers in a genomic selection models were able to improve seedling salt-tolerance by 2 to 10% depending on the quality of the phenotype dataset that was used to train the genomic selection models.

In an Agronomy Special Topics course (AGRO 449, Drone Technology in Agriculture), one student received training in different aspects of utilizing Unmanned Aerial Systems (UAS, aka. Drones) in production agriculture and agricultural research. Training topics included an overview of different uses for UAS in agriculture, the basic principles of unmanned aircraft, aircraft operations, and sensor technologies that are utilized for agricultural monitoring and research. Some aspects of imagery processing and imagery analysis were also covered. As a technical assistant and observer trainee, the student also participated in several UAS imagery mapping flights of alfalfa research plots. Instruction was provided on aircraft pre-flight inspection, setup, and operations. Hands-on opportunities included setup of the aircraft and sensor system. All piloting was conducted by a certified UAS pilot. Student was also provided with information on UAS regulations as set by the Federal Aviation Administration (FAA). A brief overview on the current process and requirements for obtaining an FAA Part 107 Pilot Certificate was provided.

Mentored 10 undergraduate genetics majors and 4 undergraduate agronomy majors. Provided recommendations on behalf of multiple undergraduate advisees to help them secure professional positions or pursue graduate studies.

Impact Statement (Optional)

Use this space to talk about the impact that this result had, in layman's terms. Adding comments here will **not** change the content in the highlighted result.

Alfalfa genetics research impacts food and fiber production, and water use and conservation: Limited water resources threaten New Mexico's \$153 million alfalfa industry. To accelerate drought- resilient alfalfa variety development, NMSU, private industry, and USDA are cooperatively evaluating 200 elite populations with >10,000 DNA markers. Each marker's influence on forage yield and nutritional quality is being determined in deficit-irrigated field studies in CA, NM, and WA. By incorporating trait- specific marker effect information into statistical models, the researchers could predict yield and quality with 60 to 90% accuracy. If these outcomes can be confirmed, it is estimated that DNA marker-assisted breeding approaches could double the rate at which new drought-resilient alfalfa cultivars can be developed.

Critical Issue

Water Use and Conservation

Maize response to irrigation regimes, different planting date, plant density and nitrogen fertilizer for improving crop water productivity and nitrogen use efficiency

Project Director

Koffi Djaman

Organization

New Mexico State University Main Campus

Accession Number

7000817



Corn response to nitrogen fertilizer following five-year alfalfa production

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Alfalfa and corn are important crops grown in rotation across the US. The beneficial effects of growing legumes in rotation with cereals have been proven for providing considerable amounts of nitrogen to the subsequent cereal crop, improving soil organic matter, weed control, breaking up diseases and pest cycles, etc. However, many growers do not differentiate between the nitrogen fertilizer rate applied to grain corn as a sole continuous crop vs. the rate applied in a rotation scenario following alfalfa or sweet corn. As consequences, there is soil and ground water pollution by nitrate and reduction in net return of the production system with increase in the production cost.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

A field of 2014-planted alfalfa was terminated in December 2019 and planted in corn in the 2020 and 2021 growing seasons. A 2019 sweet corn was also planted with corn in 2020 and 2021. Nitrogen fertilizer (urea) rates at 0, 75, 120 and 160 kg N/ha were applied to plots a month after planting according to a randomized complete block design with three replications. The results showed that the effectiveness of the applied nitrogen fertilizer occurred during the second year of field corn production. The nitrogen rates 0, 75 and 120 kg/ha obtained statistically similar plant height and leaf area index while these growth parameters increased with nitrogen rate during the second year of corn production. Corn grain yield showed a quadratic relationship with the applied nitrogen rates mostly during the second years of continuous corn production after alfalfa or sweet corn. The study indicated a rate as low as 75 kg N/ha might be applied to corn the first year after a five-year alfalfa or on season sweet corn production. For the second year of continuous corn production after alfalfa or sweet corn, the recommended N fertilizer rate is 120 kg N/ha, which maximizes corn nitrogen use efficiency (NUE).

Briefly describe how your target audience benefited from your project's activities.

Crop growers was invited to the field day and data was shared. The results are also shared through the station annual progress report.

Briefly describe how the broader public benefited from your project's activities.

The results will be presented at the local, regional and nationwide professional meetings.

Water Conservation: Home, Yard, Farm & Ranch

Project Director

LaJoy Spears

Organization

New Mexico State University Main Campus

Accession Number

7002279



Water Conservation: Home, Yard, Farm & Ranch

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

In a recent study published in "Nature Climate Change," climate scientists found the last two decades in the Southwest were the driest period in at least 1,200 years. As a result of the prolonged drought in New Mexico, the environment, economic stability, or health of many New Mexicans has been negatively impacted. To address the issue, NMSU CES partnered with the New Mexico Bureau of Geology & Mineral Resources to provide community education programs focused on water conservation best practices.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

A six-part weekly online seminar series was developed to increase knowledge and use of water conserving techniques. Programming focused on xeriscaping strategies, alternative water sources, water harvesting and precision irrigation for homeowners. Water-wise vegetable gardening, water conservation and management solutions were offered to farmers and ranchers. In addition, information about the hydrology, water cycle and geology of New Mexico was presented. All sessions were recorded and posted on the NMSU ACES Mora Water Conservation webpage along with relevant resources.

Briefly describe how your target audience benefited from your project's activities.

Of the 178 New Mexicans registered for this series, 65 participants responded to the survey.

96% reported the topics were strongly or somewhat relevant to their needs.

85% reported they would change a practice to save water based on what they learned.

Briefly describe how the broader public benefited from your project's activities.

Offering collaborative solutions, NMSU CES with the New Mexico Bureau of Geology & Mineral Resources delivers trainings on current research and issues relevant to New Mexicans. The partnership promotes water conservation education and water efficiency solutions to families, individuals from industry, and the commercial sector.

Reducing Potable Water Use for New Mexican Turfgrasses

Project Director

Ryan Goss
Organization
New Mexico State University Main Campus
Accession Number
1025314

 **Reducing Potable Water Use for New Mexican Turfgrasses**

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Turfgrasses and other ornamental landscape plants are needed to improve the quality of life and health of New Mexicans. However, these personal oases require water to provide those human benefits. This research project evaluates ways to reduce potable water used for these landscapes to ensure potable water supplies are available for other essential human needs.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Two major achievements were accomplished in the previous year. First, we were able to initiate a field research project that determined the ability to reduce water use during the establishment of turfgrasses in New Mexico through the application of products that release currently unavailable but needed soil nutrients. The additional nutrients improve turfgrass establishment with less irrigation. Second, we were able to renovate additional areas that will be used for future research. A renovation was required due to the quality loss during lockdown restrictions.

Briefly describe how your target audience benefited from your project's activities.

Citizens of New Mexico and other semi-arid regions of the world will benefit from the project because they will have additional tools and techniques to reduce water use while maintaining a successful turfgrass and landscape plant establishment. Turfgrass managers including athletic field, homeowners and golf course superintendents will be able to reduce water use and costs. Lastly, more turfgrass locations will remain open because of reduced water use and financial costs associated with establishing and maintaining turfgrasses.

Briefly describe how the broader public benefited from your project's activities.

The broader public will have physical, mental and social benefits because recreational and relaxation areas can remain open with fewer input costs. The health benefits of gardening, landscape maintenance, recreation, relaxation and nature escapes are numerous and necessary. In addition, the ability to maintain these landscapes with less potable water ensures better water security for drinking water and other essential human activities in the region.

Type	Projects / Programs
Projects / Programs without a Critical Issue	3

Closing Out (end date 09/07/2023)

Evaluating resource selection by mammal species of concern in New Mexico

Project Director
Jennifer Frey
Organization
New Mexico State University Main Campus
Accession Number
1018939

 **Evaluating resource selection by mammal species of concern in New Mexico**

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

A host of federal and state laws, regulations and policies require actions to prevent negative impacts to wildlife. While these laws and policies provide guidance about how wildlife resources should be managed, this task is often difficult or impossible due to significant gaps in knowledge about wildlife species. This project aims to fill knowledge gaps about habitat selection by wildlife species of concern.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

During the past year, we collected data that will allow us to understand the habitat requirements and make management recommendation for two species of chipmunks that are endemic to the Organ Mountains and Oscura Mountains of southern New Mexico. These small mammals are listed as threatened by the state of New Mexico and are regarded as Species at Risk by Fort Bliss Military Reservation and White Sands Missile Range. In addition, we completed studies on habitat relationships of the Peñasco least chipmunk, which is endemic to the Sacramento Mountains of southern New Mexico, and which was proposed for listing on the U.S. Endangered Species Act.

Briefly describe how your target audience benefited from your project's activities.

Our research on habitat requirements by the Organ Mountains chipmunk and Oscura Mountains chipmunk will be used to make management recommendations to ensure that Fort Bliss Military Reservation and White Sands Missile Range maintain military readiness. They also will be used by the state of New Mexico to evaluate and mitigate threats to the species. Information from our studies on the Peñasco least chipmunk is being used by the U.S. Fish and Wildlife Service for consideration of the proposed listing of the species on the Endangered Species Act and proposed designation of Critical Habitat. The Bureau of Land Management and Forest Service will use the information from these studies to guide management of lands under their jurisdiction to avoid negative impacts to the species.

Briefly describe how the broader public benefited from your project's activities.

The public will benefit from a U.S. armed forces that maintains its military readiness, which can be achieved in part by insuring that the needs of these species are met while not impacting military activities. The public can be assured that state and federal wildlife management agencies and federal land management agencies have high quality information and management recommendations that can assure these species will persist over the long term. Finally, this research fills knowledge gaps on the most basic aspects of a species biology—its habitat. The public can gain an appreciation for how these animals live—animals that occur nowhere else than New Mexico.

Integrated Onion Pest and Disease Management

Project Director

Christopher Cramer

Organization

New Mexico State University Main Campus

Accession Number

1015428



Integrated onion pest and disease management

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Onion stakeholders have identified onion thrips, *Iris yellow spot virus*, and Fusarium basal rot as the greatest pest and disease threats to onion yield and economic sustainability. The onion industry in the US is valued at farm gate annually at \$900-1,000 million. Onion germplasm is being developed and evaluated that is less impacted by onion thrips, Iris yellow spot, and Fusarium basal rot.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

When inoculated with the disease causing pathogen, our breeding lines exhibit a lower Fusarium basal rot (FBR) incidence and severity than a commercial FBR-resistant cultivar. Our breeding efforts have shown a reduction in FBR disease severity and incidence with each cycle of selection. When exposed to high onion thrips pressure conditions conducive for Iris yellow spot (IYS) disease development, other breeding lines exhibited fewer thrips/plant, lower disease severity, and greater bulb size than a commercial cultivar grown under the same conditions.

Briefly describe how your target audience benefited from your project's activities.

Our research demonstrated that our evaluation method was successful in reliably producing disease symptoms which is essentially for disease resistance development. Germplasm has been developed that expresses lower disease severity as a result of selection. Our target audience can use this information and germplasm to develop disease resistant onion cultivars. Based upon a conducted economic analysis, onion germplasm resistant to onion thrips and/or IYS could increase profits by \$1,000 per ha per year when compared with current marketable yields and management practices. Based up the annual hectarage of onions grown in the US, the promising resistant breeding lines from our program could increase grower profits for the US industry by \$54 million.

Briefly describe how the broader public benefited from your project's activities.

With onion cultivars that are resistant to FBR, thrips, and Iris yellow spot, fewer onion bulbs will be lost to diseases and pests. With fewer bulb losses, fewer acres of onions will need to be grown to satisfy domestic onion demand. Fewer onion acres with higher productivity reduces environmental impacts while increasing economic sustainability.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Training of graduate and undergraduate students with regards to trait measurement, instrument use, plant pathogen maintenance, inoculum preparation, pathogen inoculation, disease screening, seed cleaning, proper seed storage, statistical analysis, and data collection. Hosted 2 high school students as interns for 6 weeks to work on research project. Hosted undergraduate student enrolled in the minority ENHANCE program to work on research project.

Stakeholder field presentation for La Semilla Food Center Farmer Fellowship Training Program. Title: Agroecological Farmers for a Hotter, Drier Future in the Chihuahuan Desert. June 23, 2021, 18 participants. Four manuscripts were published during the reporting period and five presentations were made. Six manuscripts were published during the reporting period and eight presentations were made. One article was in a trade publication. Five onion breeding lines with reduced IYS symptom expression were made available to stakeholders.

Interactions of vadose zone properties irrigated with conventional and unconventional waters in Arid Areas

Project Director

M Shukla

Organization

New Mexico State University Main Campus

Accession Number

1021354



Effects of irrigation water salinity on soil properties

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

This study is designed to evaluate effects of traditional and nontraditional irrigation water salinity on soil properties and effects of the water and salinity (abiotic) stresses on yield and quality of some of the Pecan and other crops. This study will determine the actual crop ET, crop coefficients and leaching fractions under various abiotic stress levels, determine threshold abiotic stress levels for sustaining production, and quantify pore-clogging and other soil property changes due to the application of saline water.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The study helped us determine the tolerance of some of the important crops of New Mexico to irrigation with brackish (salty) groundwater. We were also able to establish the salt accumulation that can potentially occur when we continuously irrigate crops with salty waters. The project also provided insight to the benefits of desalination as well as growing different crops for different levels of irrigation water salinity.

Briefly describe how your target audience benefited from your project's activities.

The students of ES370 learned about the detrimental impacts of continuous irrigation with salty waters on soil, plant and environment. The growers saw value in cleaning the water prior to application as well as expected changes in soils salt content in the future. The multistate salinity coalition was provided some of the results to be included in their document on salinity tolerance of different crops.

Briefly describe how the broader public benefited from your project's activities.

We gave presentations during the College of ACES, NMSU field day in Fabien Garcia Science Center. Stakeholders and growers benefited through a series of questions and answers sessions on costs of desalination, salinity tolerance of different crops, and efficient irrigation scheduling.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Results were presented during international conferences within USA and abroad, multistate meetings, and in class.