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Agricultural Experiment Station

CLOVIS AGRICULTURAL SCIENCE CENTER

2023 ANNUAL REPORT

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

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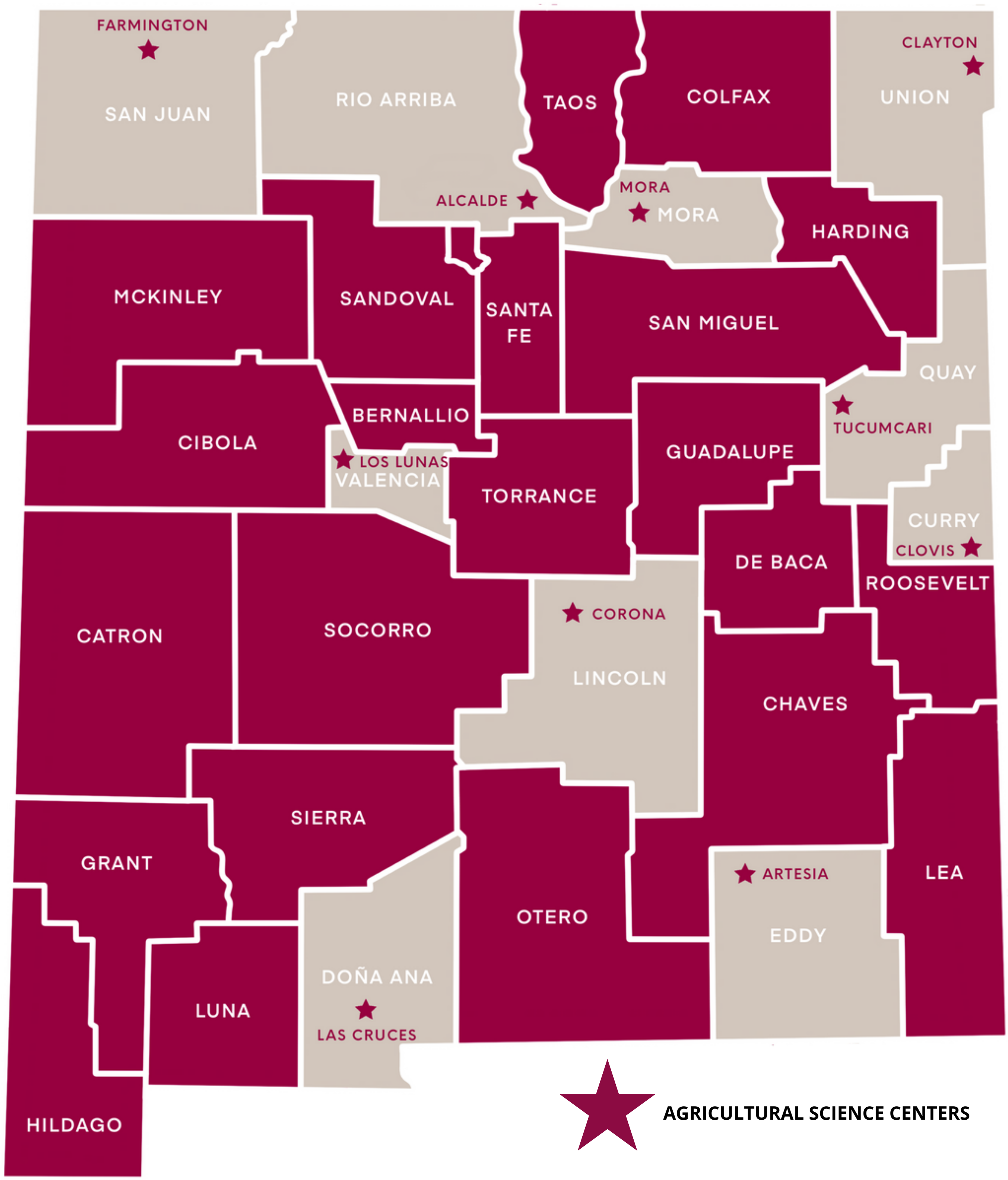
AGRICULTURAL SCIENCE CENTER LOCATIONS MAP



EXECUTIVE SUMMARY

The NMSU Agricultural Science Center at Clovis is centrally located in the largest crop production area of New Mexico and is uniquely qualified to conduct agricultural research and producer outreach (Extension) activities aimed at efficiently managing the area's limited water resources and increasing the economic viability and sustainability of agricultural production. The water management, soil health, and carbon management programs are some of the most productive research programs at NMSU. These research programs focus on improving the efficiency and profitability of agricultural systems and environmental quality by advancing our understanding of soil biogeochemical cycling, soil and environmental health, and sustainable crop production practices. A well-equipped soil laboratory that supports the Carbon Management Center and affiliated programs is housed at the Agricultural Science Center Clovis to implement statewide soil health and carbon management initiatives. This research program has state-of-the-art soil analysis equipment worth over $1 million consisting of a Dry Combustion Carbon Analyzer, Coulometer, high throughput flow-injection nitrogen analyzer, real-time greenhouse gas emissions monitoring systems by LI-COR and Gasmet, and soil sensors (water and nutrient).

RESEARCH HIGHLIGHTS

FOREST BIOCHAR APPLICATION FOR SOIL CARBON STABILIZATION

Investigators: Rajan Ghimire (rghimire@nmsu.edu), Prakriti Bista, and Sundar Sapkota

PROJECT OVERVIEW

Biochar is increasingly used in climate-smart agriculture, yet its impact on greenhouse gas (GHG) emissions and soil carbon (C) sequestration is poorly understood. We examined biochar-mediated changes in soil properties and their contribution to C stabilization and GHG mitigation by evaluating four types of biochar. Soil carbon dioxide (CO2) and nitrous oxide (N2O) emissions, soil chemical and biological properties, and soil organic carbon (SOC) mineralization kinetics were monitored using greenhouse and laboratory experiments. In the greenhouse experiment, three pine wood biochars pyrolyzed at 460 ˚C (PB-460), 500 ˚C (PB-500), 700 ˚C (PB-700), and one pine bark biochar from gasification at 760 ˚C (GB-760) were added to soil at 1% on a weight basis. Results show that pyrolyzed biochar reduced N2O emissions by 69% - 74%, compared to unamended control. While pyrolyzed biochar had a more decomposer community, the gasification biochar produced a greater yield.

MEETING THE NEEDS OF NEW MEXICO

Despite several benefits of biochar, including soil health improvements and GHG emissions reduction, there is still a significant knowledge gap on quantifying GHG emissions with different biochar, how they influence soil physicochemical and biological properties, and their linkages with individual GHGs in arid and semi-arid environments of New Mexico. This pilot study provides foundational data for New Mexico farmers on biochar application in their crop and range lands. A series of field and laboratory experiments will be conducted in the next few years to gather more information for New Mexico farmers on biochar on ecosystem services.

IMPACT

Climate change caused by increased greenhouse gases (GHG) has negatively affected soil organic carbon (SOC), nutrients, agricultural production, and food security. The agriculture sector accounts for about 10% of total anthropogenic GHG emissions and 75% of non-CO2 GHG emissions in the United States, contributing to global warming. Biochar amendment could be a climate-smart agricultural strategy; pyrolysis pine wood biochar showed the greatest potential to reduce GHG emissions and enhance SOC storage and stability, and gasification biochar contributed more to SOC storage and increased crop yield.

COVER CROPPING AS NITROGEN MANAGEMENT TOOL IN SILAGE CROP PRODUCTION

Investigators: Rajan Ghimire (rghimire@nmsu.edu) and Pramod Acharya

PROJECT OVERVIEW

Excessive use of nitrogen (N) fertilizers in summer silage cropping systems can detrimentally impact the environment and soil health. Winter cover crops offer a solution by recycling excess residual N for the subsequent summer cropping season. This study assessed the impact of winter cover crops on available soil N at 0-to-80 cm depth along with the yield of subsequent silage crop and soil profile nitrogen use efficiency (NUE). Cover crop mixtures appear to reduce soil mineral N from the 0-to-80 cm profile by 78–89% compared to the control. However, silage corn and sorghum yields under cover crops were notably greater—up to 26% and 43%, respectively, than the control, resulting in 43 to 87% greater NUE with cover crops than without.

MEETING THE NEEDS OF NEW MEXICO

The dairy industry has a major share in New Mexico's agricultural economy. Therefore, sustainable silage production is crucial for maintaining the profitability of dairy industries. Although cover cropping is considered a sustainable approach, its adoption rate is low in the state. The greater silage yield observed under cover cropping could significantly contribute to the economic viability of regional dairy producers, thereby supporting the broader agricultural landscape in NM. Moreover, improved NUE associated with cover cropping implies a reduction in N losses, which plays a crucial role in preserving soil, water, and air quality—an essential aspect of sustainable agriculture in NM.

IMPACT

Introducing cover crops into nutrient- and water-exhaustive silage systems could be challenging, specifically in water-limited environments. This study demonstrated the synergistic benefits of cover cropping in silage production, promoting resilient and resource-efficient agricultural practices in water-limited environments. Despite frequent weather extremes and prolonged droughts during the study, strategic winter cover crop management improved NUE and silage productivity compared to crop-fallow systems. In contrast, the greater soil mineral N reserve in the absence of cover crops may be susceptible to leaching, gaseous transformations, and surface runoff.

FUNDING ACKNOWLEDGMENT:
Western Sustainable Agriculture Research & Education and USDA-NRCS

CHANGES IN SOIL CARBON AND NITROGEN WHILE TRANSITIONING FROM IRRIGATED CROPLANDS TO DRYLAND FORAGE PRODUCTION

Investigators: Rajan Ghimire (rghimire@nmsu.edu), Wooiklee S. Paye, Leonard Lauriault, and Pramod Acharya

PROJECT OVERVIEW

In arid and semi-arid regions, declining annual precipitation and irrigation water scarcity drive a shift from irrigated to dryland farming. This study investigated changes in soil carbon (C) and nitrogen (N) fractions post-irrigation retirement in a semi-arid environment, comparing four forage cropping systems. Results showed that under annual winter wheat forage (AWW) and perennial wheat forage (PW), soil available N and potentially mineralizable N were significantly greater than under native grasses (NG) and pasture crops (PC = NG + AWW). Potentially mineralizable C was greater under NG and PW than under AWW. Total forage dry matter yield and nutritive value favored perennial systems, particularly PW.

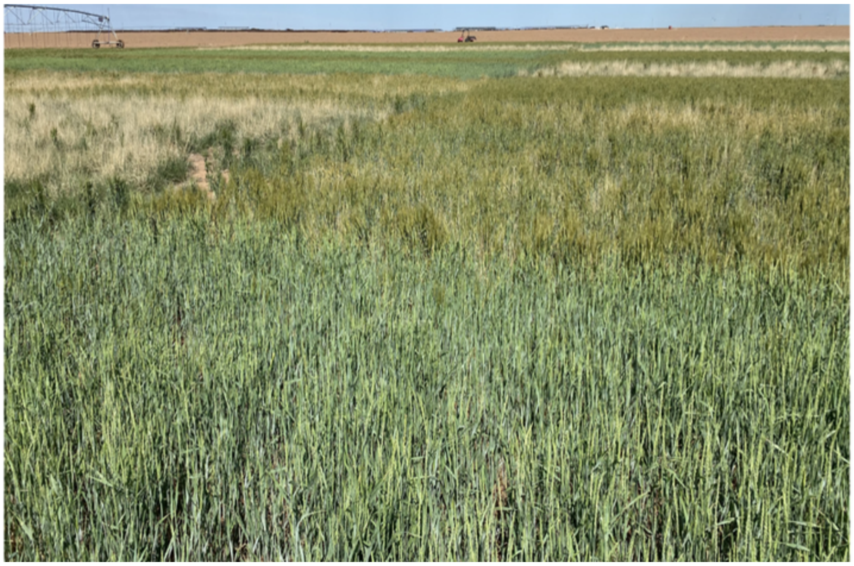
MEETING THE NEEDS OF NEW MEXICO

Forage production is typical for feeding beef and dairy cattle in eastern New Mexico. However, the declining levels of the Ogallala aquifer and inadequate precipitation remain the major challenges for producing forage, leading to forage agriculture transitioning from irrigated to dryland production. Sustainable forage production thus needs innovative solutions that could support the region's forage need and ensure forage quality measures. This study demonstrated that perennial systems such as perennial wheat can provide greater dry matter forage yield while regenerating low-fertility soils in the region by enhancing soil health and improving soil C and N mineralization.

IMPACT

This research highlighted that transitioning from irrigated to dryland farming could deteriorate soil health and affect forage production. A rapid decline in soil available N reserves was observed, emphasizing the need for nutrient management strategies during such transitions. Adopting perennial forage systems could increase soil C and N mineralization and maintain quality forage production. Perennial wheat or warm-season native grasses maintained soil health improved microbial activity, and increased carbon storage. This research provides valuable insights for farmers facing water scarcity, suggesting practices that balance forage production, soil health, and environmental sustainability.

FUNDING ACKNOWLEDGMENT:
USDA NRCS



TEMPORAL VARIABILITY IN SOIL HEALTH WITHIN LIMITED-IRRIGATION PERENNIAL FORAGE SYSTEMS

Investigators: Rajan Ghimire (rghimire@nmsu.edu), Mark A. Marsalis, Jourdan Bell, Pramod Acharya, and Anuoluwapo Ogunleye

PROJECT OVERVIEW

The water level of the Ogallala aquifer, the primary source for irrigated agriculture in eastern New Mexico, is declining each year, with a low recharge rate. This prompts a shift in forage cropping from full- to limited-irrigation or dryland practices, potentially reducing soil organic matter (SOM) levels. This study evaluated soil C and N pools each month under two winter-hardy Bermuda grass varieties, with and without inter-seeded alfalfa, using sorghum-sudangrass as a comparative check. The first-year results showed greater available soil N and potentially mineralizable N in sorghum-sudangrass during mid-summer (July and August) than in Bermudagrass monocultures and their mixtures with alfalfa.

MEETING THE NEEDS OF NEW MEXICO

Drought-tolerant perennial forage systems can supplement the forage need in the southern High Plains in declining water shortages. Also, perennial forages can store organic C in soil, improve soil health, reduce reliance on the Ogallala aquifer, and increase the economic value of limited irrigation acreages. Assessing labile soil C and N pools during the transition to limited irrigation could provide an early indication of long-term soil organic matter dynamics, which is valuable in designing forage systems to regenerate low-fertility NM soils.

IMPACT

The future of forage production systems supporting the local dairy industries relies on innovative management solutions. An improved understanding of seasonal dynamics in the labile C and N pools elucidates the long-term management-induced changes in soil organic matter. Preliminary results showed the potential of perennial grass over annual forage, i.e., sorghum-sudangrass, to maintain labile soil C and N pools. However, forage production (quantity) will be compromised with a decline in irrigation capacities.

SOIL PROFILE CARBON AND NUTRIENT RESPONSES TO COVER CROPS IN IRRIGATED FORAGE ROTATIONS

Investigators: Rajan Ghimire (rghimire@nmsu.edu), Atinderpal Singh, and Pramod Acharya

PROJECT OVERVIEW

Integrating cover crops into the irrigated forage production systems in arid and semi-arid regions offers a promising strategy to enhance soil health, particularly by increasing soil organic carbon (SOC) storage and optimizing nutrient cycling. However, assessments of the long-term use of cover crops in forage crop rotation in semi-arid environments of eastern New Mexico are still lacking. A four-year study evaluated the effects of cover crops on soil carbon and nitrogen (N) pools and nutrient concentrations in no-tillage corn (*Zea mays* L.) – sorghum [*Sorghum bicolor* (L.) Moench] rotation. Cover crop treatments included a mixture of grasses, brassicas, and legumes (GBL), grasses and brassicas (GB), grasses and legumes (GL), and no cover crop (NCC). Soil samples were collected from 0–30 inch profiles and measured for potentially mineralizable carbon (PMC), SOC, total labile N (TLN), inorganic N, available Phosphorus (P), Potassium (K), and other macro and micronutrients as soil health indicators. Soil PMC content under GB treatment was greater than NCC at 4–8 (85.5%) and 8–16 (70.5%) inch soil depth. The SOC was greater under GBL than under NCC at 0–24 inches (12 to 43%), while TLN was greater under GL than NCC at 0–8 inch depth (27 to 35%). In addition, the GBL mixture enhanced soil N, P, and K within the upper 0–4 inch soil layer. Cover cropping can increase SOC sequestration in irrigated cropping systems in semi-arid environments. Considerable increases in labile C and N components in the soil profile with cover cropping indicate long-term improvement in soil health.

MEETING THE NEEDS OF NEW MEXICO

The slow adoption of cover crops in forage production in New Mexico is associated with additional costs associated with cover cropping and the impacts on soil health. This study shows the benefits of cover cropping practices in a semi-arid environment by improving soil health and soil carbon storage. A mixture of grass with brassicas and legumes could be the best cover crop for semi-arid New Mexico.

IMPACT

This study revealed the benefits of winter cover crops in increasing SOC sequestration and improving soil fertility at various soil depths in the corn-sorghum cropping system. If adopted in irrigated acreage, a large amount of carbon could be stored with cover crop adoption, which can mitigate climate change while maintaining forage production. The details of this study are available at https://doi.org/10.1016/j.still.2024.106020.

FUNDING ACKNOWLEDGMENT:
New Mexico Department of Agriculture and USDA NRCS

SOIL HEALTH RESPONSES OF LANDS TRANSITIONING FROM IRRIGATED TO DRYLAND PRODUCTION

Investigators: Rajan Ghimire (rghimire@nmsu.edu), Atinderpal Singh, Prakriti Bista, and Barsha Sharma

PROJECT OVERVIEW

Areas shifting from irrigated to dryland agriculture risk losing considerable soil organic carbon as greenhouse gases and soil health degradation. We are evaluating the effects of winter cover crops on soil health and greenhouse gas emissions in irrigated and land transitioning from irrigated to dryland under forage corn-sorghum rotation. Treatments included no-cover crop control; grass only; grasses, brassica, and legumes mixture (residue retained); and mixtures of grasses, brassica, and legumes (residue removed). Physical, chemical, and biological soil health indicators and weekly greenhouse gas emissions during cropping season are being monitored in irrigated crop rotations and cropping systems transitioning to dryland production. Soil samples were collected in the summer of 2023 and analyzed for selected soil health indicators. Forage dry matter yield and nutritive value were also analyzed. Soil sensors were installed to monitor soil water and temperature continuously.

MEETING THE NEEDS OF NEW MEXICO

This study explains the role of diverse cover crops for their agronomic, environmental, and soil health benefits in irrigated forage production and changes in soil health when irrigation capacity is lost. New Mexico farmers will learn the best cover crop option for transitioning from irrigated to dryland crop production in semi-arid regions.

IMPACT

While this study is still in progress, the findings will offer valuable insights for beef and dairy farmers, furnishing them with management recommendations to enhance forage production and quality. Additionally, the project will highlight environmental benefits, including improvements in soil health and reductions in wind and water erosion. We expect to quantify the reduction in GHG emissions with cover and perennial cropping practices.

FUNDING ACKNOWLEDGMENT:

New Mexico Department of Agriculture and NMSU Research, Creativity and Economic Development Office

SIMULATING THE ROLE OF COVER CROPPING IN LONG-TERM SOIL CARBON STORAGE AND GLOBAL WARMING REDUCTION

Investigators: Prakriti Bista (pbisa@nmsu.edu), Vesh Raj Thapa, and Rajan Ghimire

PROJECT OVERVIEW

Crop-fallow systems common in the arid and semi-arid Southwestern US have minimal crop annual organic matter inputs and soil organic carbon (SOC) accumulation. Cover cropping can increase residue returned to the soil while reducing the long fallow period, increasing carbon sequestration, and mitigating global warming. However, whether cover cropping will be beneficial for dry regions is still debated. Using the DayCent ecosystem model, we estimated SOC storage and greenhouse gas (nitrous oxide (N2O) and methane (CH4)) emissions in no-till winter wheat (*Triticum aestivum* L.)-sorghum (*Sorghum bicolor* L. Moench)-fallow rotations with pea (*Pisum sativum* L.) and oat (*Avena sativa* L.) as cover crops and no-cover crop (fallow). Simulation results for three decades showed significantly higher SOC storage with cover cropping (25.87 % to 35.91 %) than fallow. Also, oats with low N2O emissions had greater greenhouse gas mitigation potential than fallow, while peas had greater N2O emissions than other treatments. Cover cropping could be a good strategy for long-term SOC storage, though the global warming potential varies with cover crop species in semi-arid regions.

MEETING THE NEEDS OF NEW MEXICO

The rapid decline of groundwater resources, including the Ogallala aquifer, is already a big challenge to crop production, impacting agricultural communities in New Mexico and the semi-arid southwest. On top of this, the extreme events associated with global warming, such as increased drought, intense rainfall, or heat stress, can increase nutrient loss, degrade soil fertility, and severely affect agriculture production in the region. Therefore, identifying best management practices that minimize carbon and nitrogen loss and build soil health can help farmers select sustainable crop production practices for dry regions.

IMPACT

A long fallow between crops (e.g., 23 months in winter wheat-sorghum-fallow rotation) results in nutrient and carbon loss due to minimum soil cover and lack of carbon inputs. Our study showed that replacing fallow for a short time (3 months) with cover crops can support SOC building-up and minimize carbon and nitrogen loss as greenhouse gases. Cover crops had similar cash crop yield, but grass (oat) cover crops with more residue than legume (pea) reduced the global warming impact. This study suggested that different cover crops can improve SOC storage, but cover crop species determine their environmental impact in semi-arid regions.

Cover crop study depicting no-till sorghum at Agricultural Science Center at Clovis, NM

FUNDING ACKNOWLEDGMENT:
USDA-NIFA and the New Mexico Department of Agriculture

IMPROVING SOIL WATER DYNAMICS IN SEMI-ARID CROPPING SYSTEMS WITH COMPOST AND COVER CROPS

Investigators: Prakriti Bista (pbista@nmsu.edu), Rajan Ghimire, Sangu Angadi, and Olufemi Adebayo

PROJECT OVERVIEW

Limited water resources in semi-arid areas make sustainable agriculture difficult. A study was designed to evaluate the effect of cover crop and compost application on the volumetric soil water content of a limited irrigated winter wheat (*Triticum aestivum*) -sorghum (*Sorghum bicolor*) cropping system under no-tillage at the Agricultural Science Center in Clovis, NM. Treatments included no-cover crop (fallow), pea (*Pisum sativum*), and a six-species mixture of cover crops (SSM) with and without compost application. Soil moisture was monitored using Onset HOBO digital sensors installed at 5 and 30 cm soil depths. Soil moisture content in fallow was greater than cover crops with and without compost at 5 cm. However, compost application with cover crops significantly improved soil water availability at a depth of 30 cm. Fallow with compost had a greater volumetric water content at the end of the sorghum season.

MEETING THE NEEDS OF NEW MEXICO

In the semi-arid Southern Great Plains, the biggest hurdles for crop production are high evapotranspiration rates that exceed precipitation and declining groundwater resources. Soil amendments such as compost and alternative crop management practices like cover crops can minimize evapotranspiration, increase infiltration, maintain the soil temperature, improve soil water storage, and conserve soil moisture. The findings of this study will provide much-needed information on the impact of compost and cover crops on soil water dynamics and crop production. This knowledge will help farmers in water-limited regions decide the best management practices.

IMPACT

This study suggested that at the top 5 cm depth, soil moisture content was lower in cover crop treatments than fallow with or without compost, possibly from plant water uptake by cover crops. However, compost application with cover significantly improved soil water storage in the deeper soil depth (30cm).

The result of this study highlighted the role of compost application along with cover crops for improving soil water storage in the soil profile. Seasonal and annual soil moisture monitoring will help further understand the role of cover crops and compost on cash crop production

Cover crop and compost study depicting digital soil moisture sensors at Agricultural Science Center at Clovis, NM

FUNDING ACKNOWLEDGMENT:
USDA-NIFA

PERFORMANCE OF VALENCIA PEANUT VARIETIES

Investigators: N. Puppala (npuppala@nmsu.edu) and M. Ojha

PROJECT OVERVIEW

The program is actively improving the nutritional quality of the Valencia peanuts with increased high oleic content to increase the shelf life. Screen germplasm for protein, oil, fatty acid, and amino acid composition, combining disease resistances to web blotch, pod rot, and stem rot diseases, Using new breeding technologies, like marker-assisted selection, genomic selection, and high throughput phenotyping, and working closely with the seed companies to maintain the seed purity of the released cultivars. The research is conducted in a multi-state variety testing program, including private and public varieties. Each year, varieties are tested in at least four major peanut-producing counties, namely Portales, New Mexico, and three locations in Texas: Lubbock, Morton, and Plains. This project aims to evaluate Valencia peanut varieties commercially grown in eastern New Mexico and west Texas for pod yield and grade.

MEETING THE NEEDS OF NEW MEXICO

Superior varieties will help growers benefit from high yields and high oleic peanuts, which will help ensure longer shelf life, disease resistance, and good nutritional qualities.

IMPACT

The newly developed peanut varieties resulted in lower production costs, increased shelf life, and good nutritional qualities. Ten elite breeding lines developed from this program are showing promising results. This will assist the seed companies in decision-making depending on the trait of interest. As this data is across different environments and years, one can select a line that is performing better and know what can be expected in the pipeline compared to the existing check varieties.

SCREENING OF VALENCIA PEANUT LINES FOR STEM ROT DISEASE RESISTANCE

Investigators: N. Puppala (npuppala@nmsu.edu), S. Subedi, M. Ojha, D. Lozada, S. Madugula, S. Sanogo, and R. Steiner

PROJECT OVERVIEW

Stem rot disease caused by *Athelia rolfsii* is a devastating disease of peanuts, which can cause severe yield losses of 10-40% and even up to 80% at higher temperatures and moisture conditions. Developing and planting resistant germplasm has been considered an effective disease management strategy. Resistant varieties development is the most effective, economically viable, and environmentally sound strategy to manage this disease. This work aims to identify and standardize the effective technique of inoculating *Athelia rolfsii*, a fungal pathogen, on peanut plants to screen stem rot-resistant and susceptible germplasm. In addition, this project seeks to screen advanced breeding lines of Valencia peanuts for stem rot disease resistance under greenhouse conditions.

MEETING THE NEEDS OF NEW MEXICO

Disease-resistant peanuts will help the growers reduce the input cost of fungicides, and organic growers will benefit from a stem rot-resistant peanut as no chemicals can be applied.

IMPACT

Producers can benefit from growing stem rot-resistant varieties, reducing the input cost of fungicides, and fostering environmentally safe practices. This will benefit the growers by allowing them to get greater net returns. Eleven accessions showed moderate resistance in both environments in which they were evaluated. Among these moderately resistant accessions, five were common to Bennett and Chamberlin's studies, and less than 10% stem rot incidence was observed. Results from the current study may help peanut breeders identify genes of interest, understand the molecular mechanism underlying this trait, and help develop stem rot-resistant commercial varieties.

FUNDING ACKNOWLEDGMENT:

Department of Plant and Environmental Sciences- Teaching Assistantship, New Mexico Peanut Research Board, and National Peanut Research Board

SCREENING OF VALENCIA PEANUT LINES FOR DROUGHT TOLERANCE

Investigators: N. Puppala (npuppala@nmsu.edu) and M. Ojha

PROJECT OVERVIEW

Global warming and its impact on climate change affect crop plants' growth, development, and productivity. Developing new lines that are adaptable to climate change and able to withstand stress is critical. The productivity of several crop species, including peanuts, has been negatively influenced by abiotic stresses and intensifies the problem of malnutrition and poverty across the globe. Drought and high temperatures are major abiotic constraints on peanut-growing regions. Mid and end-of-season droughts are crucial as they directly impact the pod yield and maturity. Water availability during the critical stage is the most important criterion for crop productivity in irrigated and dryland conditions. Without proper irrigation, peanuts may be frequently subjected to drought stress, resulting in yield loss of up to 20% each year. This research aims to screen advanced breeding lines of Valencia peanut for drought tolerance in eastern New Mexico and west Texas.

MEETING THE NEEDS OF NEW MEXICO

Drought-tolerant varieties will help growers conserve water by reducing the transpiration rate as the soil dries.

IMPACT

This work can benefit producers by encouraging the growth of drought-tolerant varieties and helping conserve water later in the growing season if the drought worsens. It can also reduce the risk of aflatoxin. The tolerant variety pod yield under full irrigated conditions was 1450 lb./ac, and under 50% stress conditions, it was 1091 lb./ac. Irrigating the crop at 50% stress conditions resulted in a yield reduction of 24.8%. Three NMSU breeding lines performed better than the tolerant check variety.

FUNDING ACKNOWLEDGMENT:

New Mexico Peanut Research Board and National Peanut Research Board

ORGANIC SEED TREATMENT STUDY IN VALENCIA PEANUT

Investigators: N. Puppala (npuppala@nmsu.edu), M. Ojha, and S. Sanogo

PROJECT OVERVIEW

The largest producers of organic peanut production in the U.S. among the arid southwestern states are New Mexico and Texas. The increasing demand for organic peanuts is the fastest-growing sector in the United States. Growers are attracted to organic peanut production because of higher price premiums for certified organic over conventional peanuts. Organic peanut production is traditionally confined to Valencia cultivars, mainly in the southwest part of the U.S. The USDA certifies food as organic if it has been grown in soil that has not been covered in synthetic fertilizer or pesticides for three years before the crop harvest. Many growers are interested in growing certified organic peanuts for organic processed peanut foods, but a wide range of biotic and abiotic stressors affect its production. This project aims to evaluate commercially available organic seed treatments on peanut yield and grade.

MEETING THE NEEDS OF NEW MEXICO

Organic peanut growers can benefit from seed treatment studies that help to reduce the stand establishment loss due to fungal seedling diseases.

IMPACT

Producers can benefit from yield gains and grade, lower production costs due to early stand establishment, lesser weed competition, and greater net returns in an environmentally safe manner with no pesticides and chemicals. Our one year of results has shown that using organic seed treatments has increased peanut yields compared to the untreated control. The mean pod yield for the trial was 3449 lb./ac. The highest pod yield was recorded when the soil was sprayed with an organic labeled fungicide (3559 lb./ac), which was 197 pounds more than the control treatment (3362 lb./ac), and resulted in a 6% increase in yield or a $104 increase in net return over the control treatment.

FUNDING ACKNOWLEDGMENT:

CERTIS Biologicals

COTTON VARIETY TRIAL

Investigators: N. Puppala (npuppala@nmsu.edu), M. Ojha, and A. Scott

PROJECT OVERVIEW

Cotton production is increasing in Roosevelt and Curry counties due to prevailing drought conditions. Growers always need crops that can perform better under limited irrigation conditions. This research aims to evaluate commercial varieties from seed companies and provide unbiased data on yield, quality, and net return from each variety tested in the 2023 growing season. Improved seed technology and the technology fee associated with purchasing seeds challenge growers in deciding which varieties give good returns. This study will benefit the growers by comparing the production, quality, and economics associated with selecting the variety and the time to mature, as growers are interested in short-season maturing varieties that can yield higher. This work aimed to evaluate seventeen commercial cotton varieties suitable for eastern New Mexico.

MEETING THE NEEDS OF NEW MEXICO

The results from this trial will help the growers decide which varieties perform better in Clovis and surrounding areas for yield, grade, and net return.

IMPACT

Selecting a high-yielding variety of cotton based on the traits of interest can benefit a grower. The average seed cotton yield across the trial was 3183 lb./ac, with the highest-yielding variety, 3952 lb./ac. Lint yield for seventeen varieties in the trial ranged from 1059 to 1581 lb./ac with a trial average of 1273 lb./ac. The highest lint yield was 1581 lb./ac. The estimated net return at USD 811. The average net return of an experimental trial was USD 656.

FUNDING ACKNOWLEDGMENT:
BASF, Bayer, and Phytogen

DEVELOPING WINTER CANOLA AS A LOW-INPUT ALTERNATIVE CROP FOR THE REGION

Investigators: Sangu Angadi (angadis@nmsu.edu), Guru Yadahalli, Dinesh Kumar, Harjot Sidhu and Mike Stamm (KSU)

PROJECT OVERVIEW

Crop diversification can address many challenges faced by annual agriculture. Winter canola, which can be used as a source of fodder, edible oil, and protein-rich meal, is a potential crop for the region. It can correct the monocot weed problems that we have created with extensive cereal-based monocropping in the region. It is a tap-rooted broad-leaf crop that has herbicide tolerance technologies incorporated into it. Winter canola is relatively new in the US. More recently, with the involvement of European companies, canola hybrids are being introduced into the country. Therefore, research is needed to identify suitable cultivars and hybrids for the region to expand the canola industry.

MEETING THE NEEDS OF NEW MEXICO

Developing winter canola will have many benefits for the crop and cattle industry in New Mexico. It is a good source of protein supplement and forage crop for our large cattle population. As a rotational crop, it will improve resource efficiency by helping to control grassy weeds. In addition to edible oil, the seed meal is a highly sought-after supplement for the cattle industry in the state and is currently imported from Canada. It is also a low-water-using, low-input crop that can sustain the Ogallala Aquifer longer.

IMPACT

Canola is a low-input, rotational crop that can play a major role in controlling grassy weeds in winter wheat-based rotation. The cattle industry in the region needs protein, and growing canola will produce seed meal protein supplement locally for our large cattle industry, alleviating the need to import it. It also has the potential to produce biodiesel that could run farm vehicles to help the environment and save money. It is a deep-rooted, low-water-using, broad-leaf crop, which will have many benefits.

FUNDING ACKNOWLEDGMENT:
USDA-NIFA-SACC Program

CIRCULAR BUFFER STRIPS (CBS) OF NATIVE PERENNIAL GRASSES IN A CENTER PIVOT

Investigators: Sangu Angadi (angadis@nmsu.edu), Rajan Ghimire, John Idowu, Ram Acharya, Paramveer Singh, Sundar Sapkota, Mickie Wilkinson, Guru Yadahalli, and John Holman (KSU)

PROJECT OVERVIEW

Irrigated agriculture in the Southern High Plains (SHP) of the United States is threatened by declining Ogallala Aquifer (OA) and increasing variability in rainfall and temperature. Due to decreased well outputs, using a portion of the pivot circle for dryland or very limited irrigation production is becoming more common in the region. The region is also facing the loss of many ecosystem services. A novel concept of reintroducing native perennial grasses as circles of buffer strips alternating with crop strips is being evaluated in the project with USDA-NIFA funding to improve water cycle efficiency, productivity, soil health, and many other ecosystem services.

MEETING THE NEEDS OF NEW MEXICO

The project attempts to address major challenges faced by irrigated agriculture in New Mexico and surrounding states, which include declining water resources, increasing climatic variability, strong winds, loss of natural resources, deteriorating soil health, sequestering carbon, and biodiversity. The system is expected to improve water cycle efficiency by improving the conservation of precipitation as well as the efficiency of using it. It is also expected to improve crop microclimate, reduce crop stress, increase productivity, soil health, biodiversity, and climate resiliency, and reduce greenhouse gas emissions, biodiversity, and climate resiliency. In addition, it offers a few management benefits for farmers including well-pressure management and ease of pivot maintenance.

IMPACT

This is the first project to assess circular buffer strips of native perennial grasses. Microclimate improvements with grass buffer strips were affected by distance, the growth stage of the annual crop, and buffer growth. Stress experienced by the crop was reduced. Conservation of high-intensity rainfall with corn grown in circular buffer strips increased by 91 to 139% over the control in two years of observation. Increased ponding, reduced runoff, and improved soil health might have contributed to the improvement in rainfall conservation. The conserved water was used at 50 to 63% higher efficiency with circular buffer strips. These observations have a significant impact in the region, where the fraction of rainfall received as high-intensity rain events is increasing and our annual agricultural land is typically unable to conserve that water. Improving the crop growing environment with circular buffer strips increased combined harvested corn yield by 4 to 20% in three years of observation.

BY THE NUMBERS

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- Acharya, P., **R. Ghimire,** M.A. Marsalis, E.A. Lehnhoff. 2023. Cover crops forage potential and subsequent forage sorghum yield and quality in water-limited environments. Agronomy Journal. https://doi.org/10.1002/agj2.21334.
- Acosta-Martinez, V., J. Cotton, L.C. Slaughter, **R. Ghimire**, W. Roper. 2023. Soil health assessment to evaluate conservation practices in semi-arid cotton systems at the producer site scale. Soil Systems.https://doi.org/10.3390/soilsystems7030072.
- Antonanzas, J., Idowu, O. J., Ray, D. T., Angadi, S., Grover, K., Seavert, C., Summers, H. M., Quinn, J. C. (2023). Assessment of guar gum production cost and environmental impact in the US Southwest. *Industrial Crops and Products, 203*, 117116.
- Bista, P., M. Eisa, D. Ragauskaitė, S. Sapkota, J. Baltrusaitis, and **R. Ghimire**, 2023. Effect of urea-calcium sulfate cocrystal N-fertilizer on sorghum productivity and soil N2O emissions. Sustainability, 15, 8010. https://doi.org/10.3390/su15108010.
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- Gyawali A.J., H.L. Neely, J. Foster, C. Neely, K. Lewis, G. Bodine, J. Pintar, **R. Ghimire**, P. Bekewe, A.P. Smith. 2023. Assessing soil health in a thermic region of the southern great plains, using the Soil Management Assessment Framework (SMAF). Soil Security. https://doi.org/10.1016/j.soisec.2023.100115
- Lara-Pérez, L.A., G. Villanueva-López, I. Oros-Ortega, D.R. Aryal, F. Casanova-Lugo, **R. Ghimire**. 2023. Seasonal variation of arthropods diversity in agroforestry systems in the humid tropics of Mexico. Arthropod-Plant Interactions. https://doi.org/10.1007/s11829-023-10001-0.
- Liu, Y., L. Rui, R. Ghimire, N. Zhang, S. Zhou, F. Zhao, J. Wang. 2023. Linking soil phosphorus fractions to associated microbial functional profiles under crop rotation on the Loess Plateau of China. Soil and Tillage Research, 233, 105809, https://doi.org/10.1016/j.still.2023.105809.
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- Nilahyane, A., **R. Ghimire**, B.S. Acharya, M. Schipanski, C. West, and A. Obour. 2023. Overcoming agricultural sustainability challenges in water-limited environments through soil health and water conservation: insights from the Ogallala Aquifer Region, USA. International Journal of Agricultural Sustainability. https://doi.org/10.1080/14735903.2023.2211484.
- Oguneleye, A., V.R. Thapa, **R. Ghimire**, V. Acosta-Martinez and D.R. Aryal. 2023. Microbial community response to cover cropping varied with time after termination. Agricultural and Environmental Letters. https://doi.org/10.1002/ael2.20118.
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- Thapa, V.R., R. Ghimire, W.S. Paye, D. VanLeeuwen. 2023. Soil organic carbon and nitrogen respond to occasional tillage in a continuous no-tillage system. Soil and Tillage Research.
- Witt, T., B. Northup, M. Ojha and N. Puppala. 2023. Forage accumulation and nutritive value of four peanut (Arachis hypogaea L.) market types in the US Southern Great Plains. Legume Science. pages 2-1. /doi/pdf/10.1002/leg3.198
- Zhang, N., U.M. Sainju, F. Zhao, R. Ghimire, C. Ren, and J. Wang. 2023. Mulching decreased the abundance of microbial functional genes in phosphorus cycling under maize. Applied Soil Ecology.

GRANTS AND CONTRACTS

- Ghimire R (NMSU PI), Norris-Pairs (Co-PI), Zhang (Co-PI) “Developing Effective adaptation strategies to enhance the resilience of farmers under changing climate,” National Science Foundation, $6,000,000.00, Ghimire as PI, $1,190,000.00, Status: Active, October 2023 to September 2027.
- Ghimire R (NMSU PI), Partnership: A Dual Function Engineered Biochar: Catalyze Co-Precipitation of Excess Phosphorus in Soils and Tune the Slow Release for the Plant Needs, Adhikari et al.. USDA NIFA Agricultural Systems and Technologies, 800,000.00, Ghimire as PI, $225,000.00, Status: Active, June 2023 to May 2027.
- Idowu, O. J. (PI), Ghimire (Co-PI), Expanding STAR program in Colorado and the western states. USDA NIFA Climate Smart Commodities, 25,000,000.00; Ghimire as PI: 200,000.00, Status: Active, Nov. 2023 to Oct. 2028.
- Ghimire, R. (PI), Identifying Drivers of Soil Carbon and Nitrogen Cycling in Semi-arid Agroecosystems,: US Department of Agriculture/Agricultural Research Service, Total Award: $25,000.00, Current Status: Active. (July 1, 2023 - June 30, 2025).
- Puppala, N. Seed multiplication for Hampton Seed Farm. Total Award: $ 64,236. (September 2022 to December 2023).
- Puppala, N. Sponsored Research, "Valencia Peanut Breeding for Drought Tolerance - the Year 2022", National Peanut Board, Total Award: $15,200. (January 1, 2023 - June 30, 2023).
- Puppala, N., "Evaluating Corteva Breeding lines for cotton yield and fiber analysis. Total Award: $10,745, (March 2023 - December 31, 2023).
- Puppala, N. Peanut Self-propelled Thrasher for Harvesting Breeding Plots. Total Award: $64,579. (September 2023 to December 2023).
- Puppala, N. Puppala, N. Organic in-furrow fungicide evaluation on peanut pod yield, grade, and disease. Total Award: $ 5,000. (January 2023 to December 2023).
- Angadi, S.V. (NMSU,Co-PI), Tringe, S. (Principal), T. Northen (Berkley Lab, PI), S. Sevanto, T. Dale (LANL) and and others (Multi-state), RESTOR-C: Center for RESTORation of soil Carbon by precision biological strategies, Sponsored by DOE (through LANL/Berkley National Lab), (Total Award: $19,000,000) October 1, 2023 - September 30, 2027).
- Angadi S.V., Kehlet C. (Principal) (Pratt Institute), H. Takai, John Idowu (NMSU, PI), and others (Multi-state), AquaSteady, an Alginate-based Hydrogel for Sustainable Agriculture in a Changing Climate, Sponsored by NSF Program (through Pratt Institute), (Total Award: $5,000,000) January 2024 - December 2026).
- Angadi, S., M. Stamm (KSU, PI), "Development and Management of Canola in the Great Plains Region", Sponsoring by USDA-NIFA (through Kansas State University), Total Award: $15,000. (September 1, 2020 - August 31, 2021).
- Lorenzo Dominguez (Producer and PI) and Angadi, S.V. (Technical Advisor), Regreening the Waterfall Meadow at Hacienda Dominguez & Chelenzo Farms, Sponsored by USDA-WSARE-Producer Grant, (Total Award $25,000) (April 1, 2023 - March 31, 2024).

OUTREACH ACTIVITIES

- Eastern New Mexico University Ag. Day. September 30, 2023. Clovis ASC participated with Display.
- Clovis ASC Annual Field Day. August 1, 2023.
- Cultivating Young Minds Program, Clovis ASC, NM. October 11-12, 2023. Approximately 732 students participated from 17 elementary schools.
- College of ACES Open House Workshop, Las Cruces, NM. April 6, 2023. The Clovis ASC participated with a display and three posters.
- YouTube Videos, Circular Buffer Strips of Native Perennial Grasses at NMSU Clovis. (January 26, 2022) (https://youtu.be/utKl1yq78CA).

2023 FIELD DAY

AUGUST 1ST


Field Day 2023


Cultivating Young Mind Program:
October 11th & 12th, 2023

ENMU Ag. Day: September 30th, 2023

OUTREACH ACTIVITIES

ASC Clovis participated with a display and three posters at ACES Open House: April 1st, 2023

PEOPLE

COOPERATORS AND COLLABORATORS

COLLABORATING OUTSIDE NMSU CAMPUSES

- Colorado State University
- Kansas State University
- Texas A&M University
- Northwest University, China
- Agricultural and Forestry University Nepal
- South Dakota State University
- University of Delaware
- Auburn University
- University of Central Missouri
- University of New England, Australia
- Manaaki Whenua - Landcare Research, Palmerston North, New Zealand
- Texas A&M Agri-life Lubbock
- Texas Tech University
- Auburn University
- University of Georgia, Athens, Georgia
- ICRISAT, India
- Nutriset, France
- Dharward University, India
- Kansas State University
- Montana State University
- University of Arizona

USDA LOCATIONS

- Upendra Sainju, USDA-ARS Sydney MT
- Veronica Acosta-Martinez, USDA-ARS Lubbock TX
- Maysoon Mikha, USDA-ARS, Akron CO
- Stephen DelGrosso and Melania Hartman, USDA ARS Fort Collins, CO
- Renee Arias, USDA-ARS, National Peanut Research Lab, Dawson Georgia
- Emendack, Yves, USDA-ARS, Cropping System Research Lab, Lubbock, Texas
- Prasanna Gowda, USDA-ARS, Stoneville, MS
- Robert Lascano, USDA-ARS, Lubbock, TX

COOPERATORS AND COLLABORATORS

NATIONAL LAB

- Umakant Mishra, Argonne National Laboratory
- Courtland Kelly, Livermore National Laboratory

INDUSTRY AND LOCAL NON-GOVERNMENT ORGANIZATIONS (CONTRIBUTORS IN RESEARCH)

- Curtis and Curtis Seeds, Clovis NM
- Quivera Coalition, Santa Fe NM
- New Mexico Health Soils Program

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- Mickie Wilkinson

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- Pramod Acharya
- Gurappa Yadahalli
- Atinderpal Singh
- Juan Frene

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Superintendent

NAVEEN PUPPALA

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