College of Agricultural, Consumer and Environmental Sciences

Agricultural Science Center at Clovis

ANNUAL PROGRESS REPORT 2019

Agricultural Experiment Station

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2019
ANNUAL PROGRESS REPORT

New Mexico State University
Clovis Agricultural Science Center
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NOTICE TO USERS OF THIS REPORT

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

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

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

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Acknowledgements

Several individuals and companies donated products and services the Clovis Agricultural Science Center during 2019. Appreciation is expressed to the following persons and organizations for their Contributions.

Clovis Agricultural Science Center Advisory Committee Members

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Wood Equipment	Davis, C

INTRODUCTION

The New Mexico State University Agricultural Science Center at Clovis is Located 13 miles north of Clovis on State Road 288. The center is located in the Southern High Plains and is centrally located in the largest crop area in New Mexico. The center is comprised of 156 acres of land, which has an approximate 0.8% slope to the southeast. The center is located at 34.60^{o} N, -103.22^{o} W, at an elevation of 4,435 feet above sea level. The Olton clay loam soil at the center is representative of a vast area of the High Plains of New Mexico and the Texas Panhandle. Research at the center began in 1948, originally as dryland field research. Irrigation studies were initiated in 1960, when an irrigation well was developed. Water for irrigation is derived from the Ogallala Aquifer. Since 2005, the center has improved its irrigation delivery by developing two center pivot irrigation systems and subsurface and surface drip irrigation systems.

Center Events and Activities

Advisory Committee Meeting: The Clovis Agricultural Science Center Advisory Committee met on March 8, 2018 at the Center Conference Room.

Annual Field Day: The Center hosted its Annual Field Day on August 8, 2019 (around 120 attendees)

ACES Open House: The Clovis Ag. Science Center participated with Five posters in the ACES Open House, on April 6, 2019.

Cover Crops Field Tour at the Clovis Agricultural Science Center on April 11, 2019 (around 51 attendees).

FFA Judging Teams: The Clovis Agricultural Science Center hosted a field tour for FFA Judging Teams on April 22, 2019.

Malawi Group: The Clovis Agricultural Science Center hosted a field tour for the Malawi Group on August 21, 2019

NRCS Group: The Clovis Agricultural Science Center hosted a field tour for NRCS Group on September 19, 2019 (around 15 attendees)

Central Curry SWCD Regular Meeting. February 14, 2019

Cultivating Young Minds: Annual program targeting 5th grade students from Clovis Elementary Schools was cancelled due to rain.

Ongoing Research Projects

- Cover Crops in Limited Irrigation Wheat-Sorghum Fallow. Rajan Ghimire, Vesh Thapa, and Mark Marsalis. Evaluate the effects of diverse cover crops (single species vs mixtures) on (a) soil organic matter dynamics, (b) nutrient cycling, (c) soil water conservation, and (d) sustainable crop production.
- Sustaining Agriculture through Adaptive Management of the Ogallala Aquifer under a Climate Change. Rajan Ghimire, Mark Marsalis, Sangu Angadi, and Ram Acharya. Evaluate diverse crop and soil management strategies to improve soil health, soil water conservation, and economic viability of dryland and limited-irrigation agriculture in the Southern Ogallala Aquifer region.
- Winter cover crop-summer forage crop rotations for soil health and forage quality. Rajan Ghimire, Abdelaziz Nilahyane, Mark Marsalis, and Abdel Mesbah. Evaluate the soil health and forage quality under diverse winter cover crops in a forage corn-sorghum rotation.
- Nitrogen management in dryland sorghum. Rajan Ghimire, Sk. Musfiq US Salehin, and Aaron Scott. Evaluate N dynamics and system N budget under different rates of N fertilizer and compost application.
- Monitoring Greenhouse gas emissions and climate change mitigation potential of diverse cropping systems in eastern New Mexico. Rajan Ghimire, Abdelaziz Nilahyane, and Amy Ganguli. Evaluate CO_2 and N_2O emissions from diverse crop and forage production systems and use DAYCENT Model to simulate effects of conservation systems on soil C sequestration and GHG mitigation.
- Soil profile C and N dynamics in cover crops. Rajan Ghimire, Pramod Acharya, Cho Young. Understanding soil C and nutrient dynamics under diverse cover cropping practices in eastern New Mexico.
- Spatiotemporal variability of soil properties on forage corn production system. Rajan Ghimire, Mikayla Allan, Sultan Begna, and Sangu Angadi. Evaluating spatial and temporal differences in response of selected soil health indictors in corn field.
- Improving soil health and ecosystem services through circular grass buffer strips, cover cropping, and crop diversification in New Mexico. Rajan Ghimire, Sultan Begna, Sangu Angadi and Abdel Mesbah. Quantify changes in soil health in ongoing cover crop and buffer strip projects and help NRCS to improve the soil health assessment matrix.
- Vineyard soil health. William Giese and Rajan Ghimire. Evaluate effects of diverse cover crops and mixtures on soil health and grape quality in southern New Mexico.
- Strategic reduced-tillage management in long-term no-tillage systems. R. Ghimire, M.A. Marsalis, and A.O. Mesbah. Evaluate effects of occasional
- Enhancing the Breeding Potential of Valencia Peanut for Drought and Disease resistance in New Mexico. Naveen Puppala. The objective of this research is to breed for drought and disease resistant peanut suitable for eastern New Mexico and west Texas that are high yielding, high oleic and disease resistant.
- Valencia Peanut Breeding for Drought Tolerance. Naveen Puppala and Paxton Payton. The long-term goal is to restore back the predominant position of New Mexico by providing the peanut growers the Valencia peanut cultivars that produces more with less water and at the same time possesses good seed quality meeting standards of the in-shell peanut trade industry. Additionally, with the availability of high density genetic linkage map (based on

intra-specific cross) and markers linked with agronomic and seed quality traits will go a long way assisting peanut breeders to select progenies with beneficial traits in peanut breeding.

- An Integrated Inter-Regional Approach to Breeding Valencia Market Class of Peanut for Enhanced Productivity and Sustainability under Water Deficit. M. Burrow, C.E. Simpson, M. Baring, N. Puppala, S. Tallury, J. Chagoya, P. Payton and J. Mahan. The specific objectives are to (i) evaluate diverse Valencia peanut germplasm for transpiration efficiency, harvest index and pod weight from 288 RILs from F8 generation developed from a cross between Valencia-C and JUG03, (ii) field screening for two years under irrigated and water deficit conditions for pod yield and grade, (iii) marker analysis under separate funding will be performed on the populations to identify QTL's for these traits as well as yield and grade based on data that will be obtained in this project.
- Valencia Seed Treatment Study. Naveen Puppala and Soum Sanogo. The objective of this research is to evaluate best organic seed treatment for Valencia Peanut.
- Planting date effect on biomass and forage quality of cultivated peanut (*Arachis hypogaea* L.) Travis Witt, Leonard Lauriault and Naveen Puppala. The objective of this research is to determine the optimal planting date required to grow high quality peanut forage for the southern Great Plains (SGP) of the USA.
- Cotton Variety Evaluation. N. Puppala and Aaron Scott. The objective is to evaluate commercial cotton cultivars for seed cotton yield, lint yield and fiber qualities.
- Huskie herbicide for weed control in Sorghum. The objective of this study is to evaluate weed control and sorghum response to Huskie herbicide applied alone or in combination with other herbicides. Abdel Mesbah, Bryan Niece & Aaron Scott.
- Pre/postemergence weed control in Corn. The objective of this study is to evaluate weed control and corn response to several pre emergence herbicides followed by post emergence herbicides. Abdel Mesbah, Bryan Niece & Aaron Scott.
- Forage Variety Trials. Evaluate the performance of several new, old, and improved varieties of corn, sorghum, and winter wheat grown under dry land and irrigated conditions. Abdel Mesbah, Bryan Niece & Aaron Scott.
- Grain Variety Trials. Evaluate the performance of several new, old, and improved varieties of corn, sorghum, and winter wheat grown under dry land and irrigated conditions. Abdel Mesbah, Bryan Niece & Aaron Scott.
- Antitransiparants effect on winter canola seed and oil yield formation. Sultan Begna, Sangu Angadi, and Micheal Stamm. Antitranspirants have the ability to increase water use efficiency and productivity of crops. This field research will assess their effect on winter canola productivity in the Southern High Plains.
- Temperature and germination relationship of available guar cultivars. Jagdeep Singh, Sangu Angadi, Sultan Begna. Colder soil limits early planting of guar and also limits how far north the crops can be grown. Understanding the relationship and variations among guar cultivars will help to assess potential guar area expansion.
- Winter canola variety trial. Sangu Angadi, Sultan Begna, Micheal Stamm and others. The trial focuses on developing well adopted, higher yielding winter canola cultivars for the region. Winter canola is a new crop in the US and this coordinated project aims to identify suitable cultivars for each region.
- Effect of seeding rate on seed yield of open pollinated and hybrid winter canola. Sultan Begna and Sangu Angadi. Hybrid winter canola are new to the United States and most of

the cultivars are from European seed companies and seeds are expensive. Better understanding of response of both open pollinated and hybrid canola to management are needed to reduce inputs and related cost. The trial focused on wider row spacing and lower seed rate effect on winter canola yield formation.

- Winter canola pre-irrigation and critical stage based Irrigation Trial. Paramveer Singh, Sangu Angadi and Sultan Begna. Winter canola is becoming important alternative crop in the Southern Great Plains. The trial focuses on understanding winter canola growth and yield formation under critical stage based irrigation with or without soil moisture in the soil profile. It focuses on the ability of root system to relieve stress under critical stages by extracting soil moisture from deeper soil profile.
- Adopting DSSAT Crop Growth Simulation model to simulate winter canola growth and yield under range of water availabilities. Paramveer Singh, Sangu Angadi, Sultan Begna and Mike Stamm. The project assesses DSSAT crop growth model for simulation of winter canola under range of water availabilities.
- Nitrogen management in winter canola. Sangu Angadi, Sultan Begna, Rajan Ghimire and Murali Darapuneni. The project assesses best way to provide nitrogen to winter canola to reduce input cost and maximize productivity.
- Circles of perennial grass buffer strips in a center pivot for multiple benefits. Sangu Angadi, Sultan Begna, Rajan Ghimire and John Idowu. Due to declining well out puts and pumping restrictions, farmers are not able to irrigate their entire irrigated land in the Southern Great Plains. The project aims to assess multiple benefits of using the underutilized area in the partial pivot to rearrange them into multiple circles of perennial grasses to improve water cycle and improve crop microclimate.
- Guar: Deficit irrigation management study. Guar is a desert adopted alternative crop to improve bioeconomy of the South West. Jagdeep Singh, Sangu Angadi and Sultan Begna. With increasing demand for guar gum, we want to develop local guar supply to ensure the steady supply of quality gum for the industries. This will also develop a low input, highly heat and drought tolerant alternative crop for the region.
- Drought physiology of guar cultivars under range of water availabilities. Guar is a desert adopted alternative crop to improve bioeconomy of the South West. Sangu Angadi and Sultan Begna. With increasing demand for guar gum, we want to develop local guar supply to ensure the steady supply of quality gum for the industries. This will also develop a low input, highly heat and drought tolerant alternative crop for the region.
- Guar response to Rhizobium inoculation and Phosphorus fertilization. Idowu J. S.V. Angadi and S. Begna. This project assesses effectiveness of available rhizobium inoculum on nodulation and guar seed yield with or without phosphorous.
- Strategies for soil and water conservation and sustainable forage corn production system in New Mexico: Decreasing plant row spacing, increasing cutting height and forage quality considerations. Sultan Begna, Sangu Angadi, Rajan Ghimire, Abdel Mesbah and Zachary Cordel (a dairy producer and cooperator). This project is being conducted on producer’s field. The objective of this demonstration cum research project is to assess corn cutting height on corn forage production and forage quality. It also studies effect of different height stubble on soil quality, soil moisture content and wind dynamics.
- Forage Corn Variety, Cutting Height, Yield, Quality Relationships Trial. Sultan Begna, Sangu Angadi, Rajan Ghimire & Abdel Mesbah. The objective of this study is to evaluate

five forage corn varieties response to four silage corn cutting heights on forage yield, quality, and economic profitability.

- U.S. Dairy Education & Training Consortium. Robert Hagevoort, Armando Garcia & Shelly Spears
- Dairy Safety Training for dairy producers/employees in English & Spanish. Robert Hagevoort, Shelly Spears & Armando Garcia
- Antibiotic Residue Prevention training for dairy producers/employees in English & Spanish. Robert Hagevoort & Armando Garcia
- Dairy Leadership Development program for middle managers and front line supervisors. David Douphrate & Robert Hagevoort
- Maximizing voluntary compliance in antimicrobial stewardship programs: a critical factor for effective intervention. Armando Garcia & Robert Hagevoort
- Regional survey to better understand dairy worker history, association and understanding of TB in humans and cattle. Anabel Rodriguez, David Douphrate and Robert Hagevoort.

Grants and Sponsored Activities

- Marsalis, M.A. (PI), S. Angadi, R. Ghimire. Sustaining agriculture through adaptive management to preserve the Ogallala Aquifer under a changing climate. NMSU sub-award of USDA award# 2016-68007-25066, total funding: 15M. NMSU 2016-2021 budget: $187,795.
- Ghimire, R. (PI). Conservation tillage and cover crops for improving sustainability of semiarid dryland cropping systems in the south-western United States. USDA- National Institute of Food and Agriculture, Hatch project, 2016-2021.
- Ghimire, R. (PI), M. Marsalis, and A.O. Mesbah. Cover crops for improving soil health and forage production in eastern New Mexico. New Mexico NRCS, 2018-2023: $200,576.
- Ghimire, R. (PI), S. Begna, S. Angadi, and A.O. Mesbah. Improving soil health and ecosystem services through circular grass buffer strips, cover cropping, and crop diversification in New Mexico. New Mexico NRCS. 2018-2021: $49,000.
- Ganguli, A. (PI), R. Ghimire, D. Dubious, et al., Participatory approaches to agroecosystem resilience in times of drought (ARID): An example from the Southern Great Plains, PI:, USDA NIFA Resilient Agroecosystems, 2018-2022:$70,000.
- Novel approach to quantify nitrogen mineralization and nitrous oxide emissions in semiarid cropping systems. NMSU College of ACES, Agricultural Experiment Station, 2019-2020, $24,000 (Ghimire [PI]: $24,000)
- Sampling and analysis to address per- & polyfluoroalkyl contaminants at NM dairies. K.C. Carroll, S. Ivey, R. Hagevoort, J. Jarvis, R. Ghimire. NMSU College of ACES, Agricultural Experiment Station, 2019-2020, $50,000 (Ghimire [co-PI]: $7,797)
- R. Ghimire, M. Marsalis, and A.O. Mesbah. Strategic tillage management in dryland cropping systems of New Mexico: demonstration and evaluation of agronomic and soil health benefits. New Mexico NRCS, 2019-2023, $175,000 (Ghimire [PI]: $157,500)
- Begna, S**.** S. Angadi, R. Ghimire and A. Mesbah. 2017. **(1B).** Understanding Silage Corn Vertical Biomass Distribution and Quality Relationships for Developing Sustainable Production System. USDA-NRCS. $75, 000.

- Puppala, N. (PI). "Valencia Peanut Breeding for Drought Tolerance-Year 5". Sponsoring Organization: National Peanut Board, Sponsoring Organization: $ 6125 (January 1, 2019 - December 31, 2019).
- Puppala, N. (PI). An Integrated, Inter-Regional Approach to Breeding Valencia Market Class of Peanut for Enhanced Productivity and Sustainability under Water Deficit. Sponsoring Organization: NIFA – through Texas A&M University. $ 55,713 (March 15, 2017- March 14, 2020).
- Stamm, M. (KSU, PI), S.V. Angadi (Co-PI), S. Begna (Co-PI), and others (Multi-state). Development and management of canola in the Great Plains region, Sponsored by (United States Department of Agriculture- National Institute of Food and Agriculture- Supplemental and Alternative Crops (USDA-NIFA-SACC) (through Kansas State University), $29,640 (September 1, 2018 - August 31, 2019).
- Angadi, S.V. (Co-PI), Krishna Jagadish (Co-PI), and M. Stamm (PI), KSU. Heat and Drought Effects on the oil formation of southern Great Plains winter canola. Sponsored by South Central SunGrants (through Kansas State University), $42,500 (September 1, 2018 - March 31, 2019).
- Angadi, S. (Principal), Sponsored Research, "Diversifying Rainfed Cropping System in the Southern Great Plains to Improve Sustainability of Agriculture", Sponsoring Organization: US Department of Agriculture/Agricultural Research Service, $34,430, (August 1, 2018 - July 31, 2019).
- Begna, S. (PI), S. Angadi, R. Ghimire, and A.O. Mesbah. Strategies for soil and water conservation and sustainable forage corn production in New Mexico: cutting height, row spacing and forage quality considerations. New Mexico Conservation Innovation Grant. 2017-2019: $75,000.
- Angadi, S.V. (Co-PI), K. Ogden (PI), D. Ray, M. Downes, J. Idowu, C. Brewer and others. Sustainable bioeconomy for arid regions. Sponsored by USDA-NIFA-Sustainable Bioenergy and Bioproducts (through University of Arizona), $350,000 (September 1, 2017 to August 31, 2022).
- Hagevoort, G.R. (Co-PI), Garcia-Buitrago, A. (Co-PI). Maximizing Voluntary Compliance in Antimicrobial Stewardship Programs: A Critical Factor for Effective Intervention. Sponsored by USDA-NIFA (through Texas A&M University), $40,513 (January 15, 2016 to January 14, 2019).

Publications

Peer-reviewed journal papers

- Sainju U., R. Ghimire, U. Mishra, S. Jagadamma. 2020. Reducing nitrous oxide emissions and enhancing crop yield with crop rotation and nitrogen fertilization. Nutrient Cycling in Agroecosystems. DOI: 10.1007/s10705-020-10046-0.
- Acharya, R.N., R. Ghimire, A. GC, and D. Blayney. 2019. Effect of cover crop on farm profitability and risk in the Southern High Plains. Sustainability 11(24), 7119. DOI: 10.3390/su11247119.
- Bista, P., R. Ghimire, S. Machado, and L. Pritchett. 2019. Biochar effects on soil properties and wheat biomass vary with fertility management. Agronomy. 10.3390/agronomy9100623.

- Ghimire, R., P. Bista, and S. Machado. 2019. Long-term management effects and temperature sensitivity of soil organic carbon in grassland and agricultural soils. Nature Scientific Reports, (2019) 9:12151.
- Thapa, V.R., R. Ghimire, B. Duval, and M. Marsalis. 2019. Soil organic carbon and net ecosystem carbon balance in semiarid cropping systems. Agrosystems, Geosciences, and Environment. Agrosystems, Geosciences & Environment. 2:190022.
- Acharya, P., R. Ghimire, and Y. Cho. Linking soil health to crop production: Dairy compost application rates affect soil properties and sorghum biomass. Sustainability 2019, 11, 3552; DOI: 10.3390/su11133552.
- Ghimire R., V.R. Thapa, A. Cano, and V. Acosta-Martinez. 2019. Soil organic carbon and microbial community responses to croplands and grasslands management. Applied Soil Ecology. 141: 30-37.
- Muhammad, I., U.M. Sainju, A. Khan, F. Zhao, R. Ghimire, X. Fu, and J. Wang. 2019. Regulation of soil CO2 and N2O emissions by cover crops: a meta-analysis. Soil and Tillage Research. 192: 103-122.
- Mesbah, A.O., A. Nilahyane, B. Ghimire, L. Beck, R. Ghimire. 2019. Efficacy of cover crops on weed suppression, wheat yield, and water conservation in winter wheat-sorghum-fallow. Crop Science. 59: 1745-1752. DOI: 10.2135/cropsci2018.12.0753.
- Ghimire, R., B. Ghimire, A.O. Mesbah, U. Sainju, and O.J. Idowu. 2019. Cover crops effects on soil organic matter and nutrient dynamics in a winter wheat-summer fallow system. Agronomy Journal. 111: 2108-2115. DOI: 10.2134/agronj2018.08.0492.
- Sainju, U., R. Ghimire, and G. Pradhan. 2019. Dryland agroecosystem nitrogen balance with tillage, cropping sequence, and nitrogen fertilization. Journal of Plant Nutrition and Soil Science.182: 374-384. https://doi.org/10.1002/jpln.201800630.
- Gurleen Kaur, Phillip Lujan, Soum Sanogo, Robert Steiner and Naveen Puppala. 2019. Assessing in vitro efficacy of certain fungicides to control *Sclerotinia sclerotiorum* in peanut, Archives of Phytopathology and Plant Protection. 52:184-199. DOI:10.1080/03235408.2019.1603350.
- Phillip Lujan, Barry Dungan, Omar Holguin, Soum Sanogo, Naveen Puppala, and Jennifer Randall. 2019. The role of carbon sources in relation to pathogenicity of *Sclerotinia sclerotiorum* on Valencia peanut 99:824-833.
- Burow, M., M. R. Baring, J. Chagoya, C. Trostle, N. Puppala, C. E. Simpson, J. L. Ayers, J. Cason, A. M. Schubert†, A. Muitia, and Y. López. 2019. Registration of TamVal-OL14 Peanut. Journal of Plant Registration. 13:134-138
- Shi Meng, Yuqing Tan, Sam Chang,, Jiaxu Li, Soheila Maleki, Naveen Puppala. 2020. Peanut allergen reduction and functional property improvement by meansof enzymatic hydrolysis and transglutaminase crosslinking. Food Chemistry 302:
- Wunna Htoon, Wanwipa Kaewpradit, Nimitr Vorasoot, Banyong Toomsan, Chutipong Akkasaeng, Naveen Puppala, Sopone Wongkaew and Sanun Jogloy. 2019. Relationships between Nutrient Uptake and Nitrogen Fixation with Aflatoxin Contamination in Peanut under Terminal Drought. 9:419
- Mulindwa J, Kaaya NA, Tumuhimbise G and Naveen Puppala. 2019. Production and Characterization of Nutritious Peanut Butter Enhanced with Orange Fleshed Sweet Potato. Novel Techniques in Nutrition and Food Science 4:356-365.

- Abhishek Dasorea, Ramakrishna Konijeti, Naveen Puppala. 2019. Experimental Investigation and Mathematical Modeling of Convective Drying Kinetics of White Radish. Frontiers in Heat and Mass Transfer 13:21.
- Wambi, W, R.G. Nalugo, P. Tukamuhabwa, D.K. Okello and N. Puppala. 2019. Recovery of Valencia Groundnut (*Arachis hypogaea* L.) Traits in Early Segregating and Promising Late Leaf Spot Resistant Populations.
- Bhattara, B., S. Singh, S. V. Angadi, S. Begna, R. Saini, and D. Auld. 2019. Spring safflower water use patterns in response to preseason and in-season irrigation applications. 20 Feb. 2020.
- Katuwal, K., Y. Cho, S. Singh, M. Stamm and S. Begna. 2019. Soil water extraction pattern and water use efficiency of spring canola under growth-stage-based irrigation management. (Submitted to Ag. Water Management)
- Darapuneni, M. K., Idowu, O. J., Lauriault, L. M., Dodla, S., Pavuluri, K., Ale, S., Grover, K., Angadi, S. 2019. Tillage and nitrogen rate effects on corn production and residual soil characteristics. Agron. J. 111:1-9.

<u>Book Chapters</u>

- Ghimire, R., U. Sainju, and R. Acharya. 2020. Soil health for food security and agroecosystem resilience. Book: Sustainable, Safe and Healthy Food in Nepal: Principles and Practices of Food Security. Accepted for publication 3-2-2019.
- Sainju, U., R. Ghimire, G. Pradhan. 2019. Nitrogen Fertilization I: Impact on Crop, Soil, and Environment. Book: Nitrogen in Agricultural Systems. Intech Open. DOI: 10.5772/intechopen.86028.
- Sainju, U., R. Ghimire, G. Pradhan. 2019. Nitrogen Fertilization II: Management Practices to Sustain Crop Production and Soil and Environmental Quality. Book: Nitrogen in Agricultural Systems. Intech Open. DOI: 10.5772/intechopen.86646.
- Jyostna Devi, T.R. Sinclair, V. Vadez, A. Shekoofa and N. Puppala. 2019. Strageties to Enhance Drought Tolerance in Peanut and Molecular Markers for Crop Improvement. In: Genomics Assisted Breeding of Crops for Abiotic Stress Tolerance, Volume 2 edited by Vijay Rani Rajpal, Deepmala Sehgal, Avinash Kumar, S.N. Raina. Springer 131-145.

<u>Extension/Outreach publications</u>

- Walsh, O., M. Marsalis, R. Ghimire, S. Norberg, and S. Kesoju. 2019. Recap of the 2019 Western Society of Crop Science Meeting. CSA News, September 2019.
- Ghimire, R., V.R. Thapa, and M.A. Marsalis. 2019. Cover crops in semiarid southern High Plains. Ogallala Water Resource Guide Series.
- Acosta-Martinez, V., K.B. Bhandari, R. Ghimire, M. Schipanski, and A. Nunez. 2019. Soil Health. Ogallala Water Resource Guide Series. Retrieved from http://ogallalawater.org /soil-health.

Meeting abstracts and presentations

- Ghimire, R., V.R. Thapa, V. Acosta-Martinez, M. Schipanski. 2019. Soil health and agroecosystem carbon dynamics in the southern Ogallala Aquifer region. American Geophysical Union. San Francisco, CA.

- Salehin, S.M., R. Ghimire, A. Nilahyane, S. Angadi, O.J. Idowu. 2019. Soil N dynamics and N2O emissions in dryland sorghum field with compost and fertilizer nitrogen application. ASA-CSSA-SSSA International Annual Meetings, San Antonio, TX (second place in student competition).
- Begna, S., S. Angadi, R. Ghimire, A.O. Mesbah, and M. Darapuneni. 2019. Nitrogen Application Timing and Winter Canola Seasonal Biomass Production and Seed Yield. ASA-CSSA-SSSA International Annual Meetings, San Antonio, TX.
- Nilahyane, A., R. Ghimire, P. Acharya, A.O. Mesbah, M. Marsalis. 2019. Effect of cover crops on soil water conservation and crop yield. ASA-CSSA-SSSA International Annual Meetings, San Antonio, TX.
- Acharya P., R. Ghimire, and Y. Cho. 2019. Cover crop and compost effects on soil organic matter dynamics: examples from the southern Great Plains region. ASA-CSSA-SSSA International Annual Meetings, San Antonio, TX.
- Ghimire R., B.R. Khanal, A. Ganguli. 2019. Soil organic carbon and nitrogen cycling in semiarid southern High Plains agroecosystems. ASA-CSSA-SSSA International Annual Meetings, San Antonio, TX.
- Begna, S., S. Angadi, R. Ghimire, and A. Mesbah. 2019. Understanding silage corn vertical biomass distribution and quality relationships for developing sustainable production system. ASA-CSSA-SSSA International Annual Meetings, San Antonio, TX.
- Maas, E., U. Mishra, S. Gautam, Y. Wang, R. Ghimire, and R. Lal. 2019. A model ensemble approach to predicting future sorghum cropping system effects at the field level. ASA-CSSA-SSSA International Annual Meetings, San Antonio, TX.
- Thapa, V.R., and R. Ghimire. 2019. Soil health in semiarid drylands of eastern New Mexico. SSSA International Annual Meeting, San Diago, CA.
- Allan, M., R. Ghimire, C. Brungard, S. Begna, S. Angadi. 2019. Spatial variability of selected soil health indicators in a forage corn production system. SSSA International Annual Meeting, San Diago, CA.
- Sainju, U., and R. Ghimire. 2019. Dryland agroecosystem nitrogen balance with cropping sequence and nitrogen fertilization. SSSA International Annual Meeting, San Diago, CA.
- Tonnis, B., M.L. Wang, S. Tallury, X.Li, Y. Yu, N. Puppala and J. Wang. 2019. Analysis of Genotype and Environment Interaction Revealed Oleic Acid Plasticity in Peanuts. American Peanut Research and Education Society, Williamsburg - VA, July 9-11, 2019.
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Annual Weather Summary

Table 1. Historical monthly precipitation (in) for Agricultural Science Center at Clovis

	2011	2012	2013	2014	2015	2016	2017	2018
January	0.00	0.00	0.45	0.00	1.23	0.08	1.11	0.00
February	0.30	0.25	0.79	0.06	0.64	0.16	0.36	0.90
March	0.01	0.14	0.03	0.20	0.61	0.00	0.93	0.04
April	0.00	0.33	0.00	0.17	0.61	0.49	0.49	0.69
May	0.00	2.52	0.45	3.32	7.45	1.53	2.08	1.60
June	1.46	1.31	1.67	3.08	1.77	4.26	1.02	1.71
July	0.23	0.50	3.26	2.23	3.40	0.48	2.18	3.05
August	1.96	1.86	1.49	0.61	4.00	3.25	7.87	3.94
September	1.04	2.06	4.25	2.65	2.54	2.05	4.13	1.80
October	1.22	0.43	0.12	0.35	8.20	0.01	2.04	3.99
November	0.08	0.00	1.03	0.22	0.86	1.00	0.00	0.17
December	1.72	0.08	0.28	0.04	0.61	0.17	0.00	0.14
Total	8.02	9.48	13.82	12.93	31.92	13.48	22.21	18.03

Table 2. Historical average monthly temperatures (^{0}F) for Agricultural Science Center at Clovis

	2011	2012	2013	2014	2015	2016	2017	2018
January	35.8	40.6	35.3	35.1	31.1	35.8	36.5	35.2
February	36.5	39.1	38.0	38.4	38.8	42.8	45.8	40.3
March	51.2	51.4	46.9	45.1	46.0	49.3	51.7	49.4
April	58.1	59.9	52.4	53.6	54.2	53.6	55.5	52.8
May	64.4	65.6	63.8	62.9	59.3	59.9	61.4	69.4
June	77.9	75.9	74.7	73.2	72.2	72.8	74.1	76.1
July	80.3	77.4	73.8	75.2	75.7	78.9	77.0	76.5
August	80.2	76.0	75.3	75.1	74.8	72.7	71.1	74.5
September	69.1	68.7	68.8	66.9	72.6	67.3	66.8	68.5
October	58.3	57.1	55.1	60.0	58.2	61.8	56.4	56.0
November	45.3	50.4	42.5	40.7	44.7	49.5	50.1	43.0
December	32.5	40.4	34.9	37.5	38.9	35.5	38.1	37.5
Average	57.4	58.5	55.1	55.3	55.5	56.6	57.0	56.5

Table 3. Historical average monthly maximum temperatures (^{0}F) for Agricultural Science Center at Clovis

	2011	2012	2013	2014	2015	2016	2017	2018
January	52.3	56.4	50.4	52.0	41.2	48.5	49.1	51.5
February	52.3	52.7	53.5	55.0	53.3	59.7	62.2	58.0
March	68.8	69.2	64.6	63.6	60.5	66.7	70.3	66.5
April	76.0	77.3	71.5	72.6	70.9	70.4	71.6	71.0
May	80.4	82.3	82.6	78.2	72.8	75.8	78.3	86.5
June	94.8	92.5	91.5	87.6	85.8	87.7	91.1	92.2
July	95.3	92.8	88.1	88.0	89.3	95.3	91.7	91.0
August	94.9	91.6	91.6	88.9	89.1	86.6	82.3	88.0
September	84.3	84.4	83.6	77.8	86.6	80.4	80.0	82.0
October	74.1	74.0	72.9	74.4	69.6	78.3	71.0	68.0
November	61.0	69.4	56.8	55.7	59.2	63.6	65.7	56.0
December	41.7	57.2	50.2	51.5	51.8	49.8	53.5	51.0
Average	73.0	75.0	71.4	70.4	69.2	71.9	72.2	71.8

Table 4. Historical average monthly minimum temperatures. (^{0}F) for Agricultural Science Center at Clovis.

	2011	2012	2013	2014	2015	2016	2017	2018
January	19.2	24.8	20.2	18.1	21.0	23.0	23.9	18.8
February	20.7	25.4	22.5	21.8	24.2	25.8	29.3	22.5
March	33.5	33.5	29.2	26.6	31.4	31.9	33.1	32.1
April	40.1	42.4	33.2	34.5	73.4	36.8	39.4	34.5
May	48.3	48.8	45.0	47.5	45.8	43.9	44.5	52.3
June	60.9	59.3	57.8	58.7	58.5	57.9	57.1	59.9
July	65.2	62.0	59.5	62.4	62.0	62.4	62.2	62.0
August	65.4	60.4	58.9	61.2	60.5	58.7	59.8	61.0
September	53.8	52.9	54.0	56.0	58.6	54.2	53.6	55.0
October	42.4	40.2	37.2	45.6	46.8	45.3	41.8	44.2
November	29.5	31.3	28.1	25.6	30.2	35.3	34.4	30.6
December	23.3	23.5	19.6	23.4	26.0	21.1	22.7	24.0
Average	41.9	42.0	38.8	40.1	44.9	41.4	41.8	41.4

Table1. NMSU Agricultural Science Center at Clovis, Approximate Operational Revenues and Expenditures (2018-19).

FY 18-19	SALES	OPERATIONS ENHANCEMENT	INDIRECT COST	START UP	IRRIGATION	TRACTOR VEHICLE	GREENHOUSE	GRANT	GIFT	TOTAL
REVENUE										
Apropriation	-	302,501.00	-	-	-	-	-	-	-	302,501.00
Carry Over FY 17-18	43,420.33	-	48,884.80	22,541.37	47,632.84	48,395.98	895.05	185,776.63	171,722.79	569,269.79
Gants & Gifts	-	8,931.24	-	-	-	-	-	470,672.48	4,275.00	483,878.72
Sales/Fees	63,829.06	-	-	-	-	-	-	-	-	63,829.06
Irrigation Usage	-	-	-	-	17,235.50	-	-	-	-	17,235.50
Tractor/Veh Usage	-	-	-	-	-	25,086.49	-	-	-	25,086.49
Green House Usage	-	-	-	-	-	-	2,100.00	-	-	2,100.00
Inderict Cost	-	-	12,285.46	-	-	11,784.00	-	-	-	24,069.46
TOTAL REVENUE	107,249.39	311,432.24	61,170.26	22,541.37	64,868.34	85,266.47	2,995.05	656,449.11	175,997.79	1,487,970.02
Travel Totals	1,497.35	65,685.30	9,032.84	8,415.49	-	-	-	31,714.01	5,362.68	121,707.67
Salary/Labor	3,981.24	88,734.83	-	1,535.17	-	-	-	139,452.85	9,100.00	242,804.09
SUPPLIES										
Auto/Tractor	385.00	355.27	-	-	-	1,574.10	-	-	-	2,314.37
Fuel	294.32	7,700.98	-	115.56	160.00	4,932.29	-	494.92	-	13,698.07
Office	-	564.65	-	-	-	-	-	-	-	564.65
Other	1,258.68	6,493.15	-	-	-	59.97	854.82	14,659.45	-	23,326.07
Linen	-	395.35	-	-	-	-	-	-	-	395.35
Lab Supplies	-	1,882.11	-	27.95	-	-	-	678.38	-	2,588.44
Computer	-	851.84	-	-	-	-	-	271.12	-	1,122.96
Cleaning	-	994.18	-	-	-	-	-	-	-	994.18
Photo	-	1,585.76	-	-	-	-	-	-	-	1,585.76
Safety	399.50	1,523.83	-	-	-	-	-	-	-	1,923.33
Seed/Fertilizer	19,039.36	10,683.46	-	-	-	-	-	3,940.44	-	33,663.26
Business Meals	-	3,842.61	-	18.86	-	-	-	-	1,789.40	5,650.87
Pub/Films	-	108.00	-	-	306.00	-	-	-	-	414.00
Books	-	242.44	-	182.49	-	-	-	-	-	424.93
Newspapers	-	-	-	-	-	-	-	-	-	-
Keys	-	33.83	-	-	-	44.50	-	-	-	78.33
Furn/Equip LT 5000	3,514.96	17,967.62	-	-	-	-	-	9,206.09	-	30,688.67
Parts R &M	-	5.07	-	-	-	-	-	448.63	-	453.70
Building R & M	-	378.00	-	-	-	-	261.87	-	-	639.87
Equip R & M	-	3,036.74	-	-	1,760.56	770.77	-	823.99	-	6,392.06
Computer R & M	-	-	-	-	-	-	-	-	-	-
Vehicle R & M	-	-	-	-	-	-	-	-	-	-
SUPPLIES TOTAL	24,891.82	58,644.89	-	344.86	2,226.56	7,381.63	1,116.69	30,523.02	1,789.40	126,918.87

Table 1. (Continued) NMSU Agricultural Science Center at Clovis, Approximate Operational Revenues and Expenditures (2018-19).

FY 18-19	SALES	OPERATIONS ENHANCEMEN	INDIRECT COST	START UP	IRRIGATION	TRACTOR VEHICLE	GREEN HOUSE	GRANT	GIFT	TOTAL
Services										
Training	-	330.00	-	82.50	-	-	-	-	-	412.50
Postage	-	496.69	-	-	-	-	-	-	-	496.69
Phone/Cell Phone	-	4,886.00	-	-	-	-	-	-	-	4,886.00
Advertising	-	5,353.04	-	-	-	-	-	-	-	5,353.04
Insurance	-	1,214.16	49.85	-	-	2,643.75	-	-	-	3,907.76
Printing	-	694.30	-	2,842.11	-	-	-	1,274.50	-	4,810.91
General Rental	-	456.01	-	-	-	-	-	202.85	-	658.86
Hardware Equip Rentals	-	2,494.66	-	-	-	-	-	-	-	2,494.66
Non Building R & M	4,409.31	13,619.43	-	-	290.74	2,088.32	-	1,809.51	-	22,217.31
Building R & M	-	14,740.17	-	-	-	-	-	-	-	14,740.17
Electric	-	15,889.36	-	-	13,687.97	-	-	-	-	29,577.33
Trash	-	1,113.70	-	-	-	-	-	-	-	1,113.70
OFS Services	-	26.48	-	-	-	-	-	-	-	26.48
Dues,Fees,Taxes	3.33	2,591.89	-	128.21	11.63	-	-	-	3.10	2,738.16
Memberships	-	2,737.88	-	100.00	-	-	-	-	-	2,837.88
NMGRT-NM	-	-	-	48.75	-	-	-	-	-	48.75
Professional Services	-	20,390.37	-	-	-	-	-	-	-	20,390.37
Legal Fees	-	-	-	-	-	-	-	-	-	-
Medical Fees	-	85.00	-	-	-	-	-	-	-	85.00
Lab Analysis	1,863.17	3,012.69	-	-	-	-	-	9,376.12	-	14,251.98
Farm & Ranch	15,369.85	4,714.66	-	-	-	-	-	26,349.72	-	46,434.23
Freight	124.82	1,359.85	-	-	-	-	-	1,446.44	-	2,931.11
Software	2,495.00	3,992.75	-	-	-	-	-	-	-	6,487.75
Grant Overrun	-	-	-	-	-	-	-	-	-	-
Service Totals	24,265.48	100,199.09	49.85	3,201.57	13,990.34	4,732.07	-	40,459.14	3.10	186,900.64
Inter Dept. Transfers	-	-	-	-	-	-	-	-	-	-
Sub Contract	-	-	-	-	-	-	-	-	-	-
Indirect Costs General	-	-	-	-	-	-	-	79,642.93	-	79,642.93
Non Mandatory Transfers	14,337.00	-	-	-	-	11,784.00	-	-	-	26,121.00
Furn/Equip GT 5000	-	-	13,027.30	-	-	-	-	11,481.86	-	24,509.16
Inter Dept. Transfers Tota	14,337.00	-	13,027.30	-	-	11,784.00	-	91,124.79	-	130,273.09
TOTAL REVENUE	107,249.39	311,432.24	61,170.26	22,541.37	64,868.34	85,266.47	2,995.05	656,449.11	175,997.79	1,487,970.02
TOTAL EXPENSES	68,972.89	313,264.11	22,109.99	13,497.09	16,216.90	23,897.70	1,116.69	333,273.81	16,255.18	808,604.36
Difference	38,276.50	(1,831.87)	39,060.27	9,044.28	48,651.44	61,368.77	1,878.36	323,175.30	159,742.61	679,365.66

Performance of Dryland Grain Sorghum Varieties

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Objective

To evaluate grain yield components of dryland grain sorghum varieties submitted for testing in the New Mexico Corn and Sorghum Performance Trials.

Materials and Methods

The grain sorghum variety trial was planted June 14, 2019 in 30-inch rows under center pivot irrigation. Soil type is an Olton silty clay loam and elevation is 4,435 feet. Individual plots consisted of two, 30-inch rows 20 feet long. There were three replications for each entry, planted in a random complete block. Individual plots were planted at a rate of 29,000 seeds/acre. Plots were planted with a John Deere Max Emerge planter fitted with cone metering units.

On April 16, the planting area was fertilized with 50 lb N/ac, 8 lb/ac Sulphur, 20 lb/ac of P_2O_5,and 3 qt/ac of chelated Zinc. At plant herbicide applications included Atrazine (1.5 pt/ac), Verdict (10 oz/ac), and, Glyphosate (32 oz/ac). Huskie herbicide was applied on 12 June at 1 pt/ac, as well as Atrazine and Warrant at 1 pt/ac, and 1.5 qt/ac, respectively. Two insecticides were applied, Sivanto, at 10.5 oz/ac, and Onager at 20 oz/ac on August 30.

No irrigation was applied. Precipitation during the period after planting until harvest was 19.0 inches.

The plots were harvested on October 11, 2019 with a WinterSteiger combine. Individual plot weights were recorded using a Harvest Master HM 800 Classic Grain Gage, which was also used to determine percent moisture and test weight (lb/bu). Reported yields are adjusted to standard 14.0% moisture and bushel weight of 56 pounds.

Statistical Analysis

All data were subjected to SAS® procedures for test of significance difference between varieties. Mean separation procedures ((protected ($P<0.05$) least significant differences)) were used to determine where differences exist.

Results and Discussion

Yield data for the 2019 grain sorghum trial are presented in Table 1, Grain yields, for the 23 varieties in the trial, ranged from 140.7 to 101.9 bushel/acre with a trial average of 120.1 bushel/acre.

New Mexico 2019 Dryland Grain Sorghum Performance Test - Agricultural Science Center at Clovis										
Brand/Company Name	Hybrid/Variety Name	Grain Yield	Grain Yield	Moisture at Harvest	Test Weight	Plant Height	Head Exertion	Lodging	Heading Date
		bu/a	lb/a	%	lb/bu	in	in	%	
Dyna-Gro	GX18395	140.7 ***	7881 ***	15.6 ***	60.7 *	22.0	2.7	0	7-Aug
Dyna-Gro	GX19981	139.6 *	7818 *	14.3 *	61.9 *	24.7	2.0	0	11-Aug *
Dyna-Gro	M69GB38	135.8 *	7608 *	14.6 *	62.0 *	27.3 *	8.3 *	0	10-Aug *
Dyna-Gro	GX18991	134.4 *	7527 *	14.2 *	63.1 ***	26.3 *	4.0	0	10-Aug *
Dyna-Gro	M57GB19	129.5 *	7254 *	11.8	59.2	22.0	6.0	0	4-Aug
Dyna-Gro	M69GR88	129.1 *	7227 *	14.9 *	60.8 *	26.3 *	5.0	0	12-Aug ***
Golden Acres	2730B	125.1 *	7005 *	11.8	57.0	21.0	7.0 *	0	1-Aug
Advanta Seeds	ADV G2106	122.7 *	6869 *	13.1	56.2	20.3	4.7	0	5-Aug
Dyna-Gro	M60GB31	121.5	6803	12.6	58.8	23.0	4.3	0	6-Aug
Golden Acres	2620C	121.2	6784	12.3	58.7	21.7	6.3	0	30-Jul
Advanta Seeds	AG 1203	118.7	6645	11.9	61.3 *	22.3	2.3	0	8-Aug *
Golden Acres	3020B	117.2	6561	13.4	61.3 *	25.7	5.3	0	8-Aug *
Dyna-Gro	GX17973	117.0	6554	12.2	60.9 *	28.7 ***	6.3	0	6-Aug
Advanta Seeds	AG 1201	115.9	6489	12.0	58.2	20.3	2.7	0	2-Aug
Dyna-Gro	M74GB17	115.6	6471	14.3 *	58.6	25.0	5.7	0	10-Aug *
Sorghum Partners	SP 68M57	114.4	6406	12.6	58.0	21.0	4.0	0	2-Aug
Sorghum Partners	SP 43M80	114.3	6399	13.2	57.0	18.7	3.3	0	27-Jul
Sorghum Partners	SP 31A15	113.7	6366	12.5	57.3	20.0	3.7	0	5-Aug
Dyna-Gro	M62GB77	112.2	6284	13.4	59.7	22.3	6.0	0	6-Aug
Advanta Seeds	ADV XG9127	111.8	6259	14.6 *	59.0	24.3	8.7 ***	0	9-Aug *
Advanta Seeds	ADV XG629	106.9	5982	12.3	57.4	19.7	2.0	0	3-Aug
Advanta Seeds	ADV G1150	103.9	5816	12.3	54.7	20.7	7.0 *	0	8-Aug *
Sorghum Partners	SP 33S40	101.9	5706	11.5	59.46	21.7	6.0	0	1-Aug
	Trial Mean	120.1	6727	13.1	59.2	22.8	4.9	0.0	5-Aug
	LSD (P > 0.05)	19.0	1064.8	1.9	3.1	2.7	1.9	0.0	4.8
	CV	9.6	9.6	8.8	3.2	7.3	23.9	0.0	1.3
	F Test	0.0037	0.0036	0.0006	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

*** Highest numerical value in the column.

* Not significantly different from the highest numerical value in the column based on the 5% LSD.

Performance of Dryland Forage Sorghum Varieties

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Objective

To evaluate dry matter and green forage yield and nutritive value of dryland forage sorghums submitted for testing in the New Mexico Corn and Sorghum Performance Trials.

Materials and Methods

All 13 forage sorghum entries were planted on June 4, 2019 into 30-in rows under center pivot irrigation. Soil type is an Olton clay loam and elevation is 4,435 ft. Individual plots consisted of two, 30-inch rows, 20 feet long. Plots were planted with a two-cone planter at a rate of 50,000 seeds/acre.

Prior to planting, the planting area was fertilized with a pre-plant mixture of 78 and 20 lbs/acre of nitrogen and P_2O_5, respectively. Micronutrients of sulfur and chelated zinc also were applied pre-plant at rates of 8 lbs/ac and 3 qt/acre, respectively. Fertilizers were incorporated into soil immediately after application.

Glyphosate, Atrazine, and Verdict herbicides were applied to plots for weed control prior to plant at rates of 32 oz/acre, 1.5 pt/ac, 10 oz/ac, respectively. Huskie, Atrazine, and Warrant were applied for weed control on July 10 at rates of 1 pt/ac, 1 pt/ac, and 1.5 qt/ac, respectively. Sivanto and Onager were applied on August 30 at rates of 10.5 oz/ac and 20 oz/ac.

Precipitation during the period after planting until harvest of the plots was 11.5 inches.

Plots were harvested on October 24, 2019 with a tractor-drawn commercial forage chopper and forage material was collected in a large basket where plot weight was determined. After plot weight was recorded, approximately 500 grams of freshly cut forage were placed in brown paper bags for later estimation of moisture content and nutritive value. Samples were dried for 72 hours prior to dry matter determination.

Statistical Analysis

Varieties/hybrids were assigned randomly to plots in a randomized complete block design with 3 replications. Data were subjected to SAS® procedures for test of significance for differences ($P < 0.05$) among entries and mean separation procedures (protected least significant difference) were used to determine where differences occurred.

Results and Discussion

Data for the forage sorghum performance trial are presented in Table 2. Highest yielding varieties exceeded 22.8 tons of green forage. Mean wet forage yields for the 13 varieties were 15.2 tons/acre, the varieties differed ($P < 0.05$) with respect to yield.

New Mexico 2019 Dryland Forage Sorghum Performance Test - Agricultural Science Center at Clovis

Results

Brand/Company Name	Hybrid/Variety Name	Sorghum Type	Maturity Group	Dry Forage	Green Forage	Moisture at Harvest	CP	NDF	NDFD 48hr	Ash	TDN	NE_l	Milk/ Ton	Milk/ Acre
				t/a	t/a	%	%	%	%	%	%	Mcal/lb	lb/t	lb/a
Sorghum Partners	SP1880	FS	MF	6.2	22.8	72.8	8.1	55.3	68.9	6.9	61.8	0.632	2937	18153
Sorghum Partners	SS405	FS	M	5.8	17.9	67.6	7.7	52.6	65.1	6.4	62.4	0.639	2953	17178
Sorghum Partners	SS506	FS	MF	5.5	20.3	73.1	8.3	52.8	69.2	6.8	61.1	0.624	2889	15795
Dyna-Gro	Top Ton	FS	MF	4.9	17.7	72.3	7.7	50.0	70.7	6.8	61.3	0.627	2919	14308
Sorghum Partners	NK300	FS	ME	4.8	11.4	58.2	8.1	49.2	65.8	6.6	65.6	0.674	3186	15230
Dyna-Gro	Fullgraze II BMR	SS	M	4.6	16.8	72.7	8.3	52.2	73.7	8.0	61.4	0.627	2946	13639
Sorghum Partners	SP2774	FS	ME	4.5	13.2	66.1	8.5	49.4	69.2	6.4	66.6	0.686	3290	14728
Dyna-Gro	Super Sile 20	FS	M	4.4	14.5	69.3	8.2	48.6	66.0	6.3	63.0	0.645	3000	13326
Dyna-Gro	Super Sile 30	FS	ME	4.3	14.1	69.1	8.2	50.2	67.0	7.1	62.9	0.645	3005	13058
Dyna-Gro	Fullgraze II	SS	M	4.3	13.2	67.7	6.6	55.8	67.6	6.5	60.7	0.620	2853	12143
Dyna-Gro	FX19172	FS	M	3.7	13.3	72.1	9.1	50.7	73.6	8.1	64.1	0.657	3137	11669
Sorghum Partners	SP3904	FS	MF	3.7	13.1	72.1	9.0	49.7	73.9	7.8	63.3	0.648	3083	11307
Dyna-Gro	F75FS13	FS	M	3.6	9.6	63.1	8.1	46.3	64.6	6.6	65.5	0.672	3168	11408
	Trial Mean			4.6	15.2	68.9	8.1	51.0	68.9	6.93	63.1	0.646	3028	13995
	LSD			0.7	1.8	2.2	0.70	3.4	3.05	0.62	1.63	0.018	132	2207
	LSD P >			0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.050	0	0.05
	CV			9.1	6.9	1.9	5.1	4.0	2.6	5.3	1.5	1.660	3	9.4
	F Test			0.0002	<.0001	<.0001	<.0001	0.0003	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

Performance of Irrigated Forage Sorghum Varieties

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Objective

To evaluate dry matter and green forage yield and nutritive value of irrigated forage sorghums submitted for testing in the New Mexico Corn and Sorghum Performance Trials.

Materials and Methods

All 24 forage sorghum entries were planted on May 29, 2019 into 30-in rows under center pivot irrigation. Soil type is an Olton clay loam and elevation is 4,435 ft. Individual plots consisted of two, 30-inch rows, 20 feet long. Plots were planted with a two-cone planter at a rate of 75,000 seeds/acre.

Prior to planting, the planting area was fertilized with a pre-plant mixture of 120 lb/ac, 30 lbs/ac, and 20 lb/ac of nitrogen, P_2O_5 and S respectively. Micronutrient zinc was applied pre-plant at rates of 3 qt/ac. Fertilizers were incorporated into soil immediately after application.

Total irrigation amount was 7.5 inches applied from June to September at varying rates during the growing season. Monthly amounts were 1.00, 3.80, 2.65, inches for June, July, and August respectively. Atrazine, Brawl and Glyphosate herbicide was applied to plots for weed control at plant at a rate of 2 pt/acre, 1.5 pt/ac and 40 oz/ac respectively. Huskie, Atrazine and Brawl were applied on July 10 at 1 pt/ac, 1 pt/ac and 1.5 qt/ac, respectively. Sivanto at 10.5 oz/ac, and Onager at 20 oz/ac were applied on August 30 and September 24

Precipitation during the period after planting until harvest of the plots was 11.5 inches.

Plots were harvested on September 17, 2019 with a tractor-drawn commercial forage chopper and forage material was collected in a large basket where plot weight was determined. After plot weight was recorded, approximately 500 grams of freshly cut forage were placed in brown paper bags for later estimation of moisture content and nutritive value.

The Irrigated Forage Sorghum tests at Clovis were harvested and fresh weights were obtained. However, a drying oven fire consumed all the subsamples used for estimating dry matter and nutritive value parameters. Hence, no DM yield or quality results are reported for these

Statistical Analysis

Varieties/hybrids were assigned randomly to plots in a randomized complete block design with 3 replications. Data were subjected to SAS® procedures for test of significance for differences ($P < 0.05$) among entries and mean separation procedures (protected least significant difference) were used to determine where differences occurred.

Results and Discussion

Data for the forage sorghum performance trial are presented in Table 2. Highest yielding varieties exceeded 28.7 tons of green forage. Mean wet forage yields for the 24 varieties was 20.6 tons/acre, and varieties differed ($P < 0.05$) with respect to yield. All forage quality parameters were significantly different among the varieties.

New Mexico 2019 Irrigated Forage Sorghum Performance Test - Agricultural Science Center at Clovis

Results

Brand/Company Name	Hybrid/Variety Name	Sorghum Type	Maturity Group	Dry Forage	Green Forage	Moisture at Harvest	CP	NDF	NDFD 48hr	Ash	TDN	NE_l	Milk/ Ton	Milk/ Acre
				t/a	t/a	%	%	%	%	%	%	Mcal/lb	lb/t	lb/a
Warner Seed	WXF-1737	FS	M	8.9	28.7	68.9	7.9	51.3	64.0	6.7	63.7	0.653	3038	26992
Sorghum Partners	SP1880	FS	MF	8.7	30.6	71.7	7.0	61.4	64.1	6.3	61.7	0.631	2895	25070
Sorghum Partners	SS405	FS	M	8.5	24.9	66.0	7.4	55.7	62.1	6.6	62.5	0.640	2935	24990
Dyna-Gro	Super Sile 20	FS	M	8.2	27.3	70.0	8.2	52.2	64.5	7.1	64.2	0.658	3077	25157
Dyna-Gro	Top Ton	FS	MF	8.1	27.2	70.4	8.1	48.6	68.9	6.7	65.4	0.672	3195	25720
Dyna-Gro	Fullgraze II BMR	SS	M	7.8	26.6	70.5	7.7	57.0	70.4	7.1	63.3	0.649	3058	23898
Dyna-Gro	Fullgraze II	SS	M	7.5	21.2	64.3	7.5	58.1	66.2	7.0	62.9	0.644	2996	22603
Sorghum Partners	SS506	FS	MF	7.5	26.4	71.6	7.3	61.0	62.0	6.7	60.5	0.618	2791	20905
Dyna-Gro	Super Sile 30	FS	ME	7.3	23.1	68.5	8.7	49.6	64.7	7.2	64.5	0.662	3101	22481
Advanta Seeds	ADV XF033	FS	M	6.7	19.7	66.2	8.4	52.3	63.4	7.2	63.2	0.647	2995	19976
Warner Seed	WXF-1714	FS	M	6.7	20.0	66.7	8.6	50.7	62.6	6.9	62.9	0.645	2970	19823
Advanta Seeds	AF 8301	FS	M	6.6	16.7	60.7	8.3	51.5	63.4	7.3	63.3	0.648	3002	19692
Sorghum Partners	SP2774	FS	ME	6.5	19.4	55.5	8.3	52.4	67.5	7.3	65.8	0.676	3213	20868
Advanta Seeds	AF 7201	FS	ME	6.3	15.2	58.7	7.7	51.1	66.7	7.7	65.4	0.673	3184	20207
Dyna-Gro	F75FS13	FS	M	6.2	16.8	63.1	8.6	49.5	63.5	8.4	64.0	0.657	3057	18914
Warner Seed	W7706-W	GS	E	5.9	16.3	63.6	8.3	47.7	68.3	7.1	66.1	0.680	3244	19234
Advanta Seeds	AF 7401	FS	ML	5.7	20.5	72.4	9.2	50.7	73.2	8.5	66.5	0.684	3300	18682
Sorghum Partners	SP3904	FS	MF	5.5	21.8	74.6	9.3	52.2	71.2	8.7	66.4	0.683	3285	18156
Dyna-Gro	FX19172	FS	M	5.5	20.9	73.7	8.7	52.8	72.3	8.4	66.7	0.687	3318	18270
Warner Seed	W7051	GS	E	5.3	13.8	61.6	8.1	50.0	67.4	7.2	65.6	0.674	3201	17013
Advanta Seeds	ADV XF025	FS	ME	5.0	12.4	59.5	7.8	52.6	67.9	8.0	65.7	0.676	3211	16104
Advanta Seeds	ADV F7232	FS	M	4.9	18.2	73.0	9.5	52.2	70.1	8.4	65.1	0.666	3182	15722
Sorghum Partners	NK300	FS	ME	4.9	11.6	57.3	8.1	51.7	65.2	8.3	63.5	0.651	3030	14896
Mojo Seed Enterprises	x033	FS	M	4.6	15.0	69.6	8.8	52.3	66.2	7.1	65.1	0.668	3154	14415
	Trial Mean			6.6	20.6	67.0	8.2	52.7	66.4	7.41	64.3	0.660	3101	20407
	LSD			1.1	3.2	3.0	0.94	4.8	2.97	0.96	1.91	0.021	153	3718
	LSD P >			0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.050	0	0.05
	CV			10.4	9.5	2.7	7.0	5.6	2.7	7.9	1.8	1.950	3	11.1
	F Test			0.0002	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

Performance of Grain Corn Varieties

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Objective
To evaluate grain yield components of corn varieties submitted for testing in the New Mexico Corn and Sorghum Performance Trials.

Materials and Methods
The grain corn variety trial was planted May 22, 2019 in 30-inch rows under center pivot irrigation. Soil type is an Olton silty clay loam and elevation is 4,435 feet. Individual plots consisted of two, 30-inch rows 20 feet long. There were three replications for each entry, planted in a random complete block. Individual plots were planted at a rate of 27,000 seeds/acre. Plots were planted with a John Deere Max Emerge planter fitted with cone metering units.

On February 6, the planting area was fertilized with 18 lb N/ac, 3 qt zinc and, 60 lb/ac of P_2O_5. Additional nitrogen was applied pre-plant (103 lb N/ac) and May 17 (90 lb N/ac). Sulphur was applied pre-plant (25 lb/ac). Immediately after planting 90 lb/ac of N and 3 lb/ac of P_2O_5 were applied. Pre-plant herbicide applications included Atrazine, Balance Flexx, LV 6, and Glyphosate at rates of 1 pt/ac, 3 oz/ac, 1 pt/ac and 32 oz/ac respectively. At plant herbicide applications included Atrazine (1 pt/ac), Glyphosate (32 oz/ac), and Verdict (10 oz/ac). Diflexx Duo and Warrant herbicides were applied on 1 July at 32 oz/ac and 2 qt/ac respectively. Onager miticide (16 oz/ac) was applied on 1 July. Two insecticides were applied on July 30 (Prevathon, 20 oz/ac; Oberon, 8 oz/ac). One fungicide application on 30 July included Stratego Yeild at 5 oz/ac.

Total irrigation amount for the trial was 16.0 inches. Amounts were applied during May, June, July, August and, September. Monthly amounts were 1.4, 3.2, 5.3, 4.4, and 1.7 inches, respectively. Precipitation during the period after planting until harvest of the irrigated plots was 15.9 inches.

The plots were harvested on November 1, 2019 with a WinterSteiger combine. Individual plot weights were recorded using a Harvest Master HM 800 Classic Grain Gage, which was also used to determine percent moisture and test weight (lb/bu). Reported yields are adjusted to standard 15.5% moisture and bushel weight of 56 pounds.

Statistical Analysis
All data were subjected to SAS® procedures for test of significance difference between varieties. Mean separation procedures ((protected ($P<0.05$) least significant differences)) were used to determine where differences exist.

Results and Discussion
Yield data for the 2017 grain corn trial are presented in Table 1, Grain yields, for the 11 varieties in the trial, ranged from 270.5 to 226.0 bushel/acre with a trial average of 255.0 bushel/acre.

New Mexico 2019 Grain Corn Performance Test - Agricultural Science Center at Clovis

Company Name	Variety Name	Grain Yield	Moisture at Harvest	Test Weight	Plant Height	Ear Height	Silk Date
		bu/a	%	lb/bu	in	in	
Dyna-Gro	D55VC80	270.5	13.3	61.4	120.3	48.4	31-Jul
Dyna-Gro	D54VC14	265.6	13.3	62.2	122.7	57.0	29-Jul
Dyna-Gro	D57VC17	264.1	14.0	61.7	106.0	43.3	30-Jul
Dyna-Gro	D57VC51	262.9	14.8	61.8	112.3	51.2	30-Jul
Dyna-Gro	CX18116	262.0	13.7	60.7	111.7	50.8	28-Jul
Dyna-Gro	D58VC65	256.1	14.2	62.1	115.3	52.6	30-Jul
Dyna-Gro	D53TC19	255.0	13.4	61.4	105.3	50.1	26-Jul
Dyna-Gro	CX18413	252.1	13.5	60.8	120.0	49.1	28-Jul
LG Seeds	LG64C30TRC	249.5	13.8	62.0	109.0	48.8	27-Jul
LG Seeds	LG66C32VT2PRO	244.2	14.3	61.7	123.0	47.5	30-Jul
Dyna-Gro	D52VC15	226.0	12.9	61.4	106.7	47.4	27-Jul
	Trial Mean	255.0	13.7	61.6	113.0	49.7	30-Jul
	LSD (P > 0.05)	33.0	0.86	0.79	2.4	2.2	4.3
	CV	91.00	3.66	0.75	1.22	2.58	1.20
	F Test	0.3664	0.0066	0.0100	<.0001	<.0001	0.2116

Performance of Forage Corn Varieties

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Objective

To evaluate dry matter and green forage yield and nutritive value of forage corn submitted for testing in the New Mexico Corn and Sorghum Performance Trials.

Materials and Methods

All 34 corn entries were planted on May 22, 2019 in 30-inch rows under center pivot irrigation. Soil type is an Olton clay loam and elevation is 4,435 ft. Individual plots consisted of two, 30-inch rows, 20 feet long. Plots were planted at a rate of 27,000 seeds/acre with a two-cone planter (Table 1).

On February 6, the planting area was fertilized with 18 lb N/ac, 3 qt zinc and, 60 lb/ac of P_2O_5. Additional nitrogen was applied pre-plant (103 lb N/ac) and May 17 (90 lb N/ac). Sulphur was applied pre-plant (25 lb/ac). Immediately after planting 90 lb/ac of N and 3 lb/ac of P_2O_5 were applied. Pre-plant herbicide applications included Atrazine, Balance Flexx, LV 6, and Glyphosate at rates of 1 pt/ac, 3 oz/ac, 1 pt/ac and 32 oz/ac respectively. At plant herbicide applications included Atrazine (1 pt/ac), Glyphosate (32 oz/ac), and Verdict (10 oz/ac). Diflexx Duo and Warrant herbicides were applied on 1 July at 32 oz/ac and 2 qt/ac respectively. Onager miticide (16 oz/ac) was applied on 1 July. Two insecticides were applied on July 30 (Prevathon, 20 oz/ac; Oberon, 8 oz/ac). One fungicide application on 30 July included Stratego Yeild at 5 oz/ac.

Total irrigation amount was 15.2 inches applied from May to August at varying rates during the growing season. Monthly amounts were 1.6, 2.0, 5.75, and 5.0 inches for May, June, July, and August, respectively. Precipitation during the period after planting until harvest was 10.7 inches. Plots were harvested on September 5, 2019 with a tractor-drawn commercial forage chopper and forage material was collected in a large basket where plot weight was determined. After plot weight was recorded, approximately 500 grams of freshly cut forage was placed in brown paper bags for later estimation of moisture content and nutritive value. Samples were dried for 72 hours prior to dry matter determination. Dry forage was ground with a Thomas-Wiley Mill to pass a 1 mm screen and ground material was sent to the University of Wisconsin for quality analyses via near infrared reflectance spectroscopy (NIRS) and Milk 2006 technology.

Statistical Analysis

Varieties/hybrids were assigned randomly to plots in a randomized complete block design with 3 replications. Data were subjected to SAS® procedures for test of significance for differences ($P < 0.05$) among entries and mean separation procedures (protected least significant difference) were used to determine where differences occurred.

Results and Discussion

Data for the forage corn performance trial are presented in Table 2. Highest dry matter yields were above 7.7 tons/ac for the trial. Average dry matter yield was 7.3 tons/acre and significant differences existed among varieties for both dry and green forage yields.

New Mexico 2019 Forage Corn Performance Test - Agricultural Science Center at Clovis

Results

Brand/Company Name	Hybrid/Variety Name	Dry Forage	Green Forage	Moisture at Harvest	CP	NDF	NDFD 48hr	Starch	Ash	TDN	NE_l	Milk/ Ton	Milk/ Acre
		t/a	t/a	%	%	%	%	%	%	%	Mcal/lb	lb/t	lb/a
Dyna-Gro	D55VC80	7.7	24.6	68.5	8.9	46.2	65.0	27.1	4.9	67.2	0.692	3294	25589
Dyna-Gro	D58QC72	7.7	26.7	71.1	8.8	48.0	63.4	24.3	4.9	66.3	0.682	3219	24836
Wilbur-Ellis Integra	6709 VT3P	7.7	26.6	71.1	8.8	47.4	64.2	25.1	5.0	66.6	0.686	3250	24947
Blue River Organic Seed	74B75	7.6	26.8	71.5	8.7	43.4	67.8	31.1	5.4	67.6	0.697	3350	25593
LG Seeds	LG67C01VT2PRO	7.6	26.5	71.4	8.9	47.6	64.8	24.1	5.7	66.3	0.682	3232	24684
LG Seeds	LG5717VT2PRO	7.6	25.3	70.0	9.3	44.9	65.2	26.6	5.6	67.1	0.691	3287	24917
LG Seeds	LG66C28-3110	7.6	25.5	70.4	9.5	48.0	63.0	23.6	5.6	65.1	0.669	3132	23689
Masters Choice, Inc.	MCT 6552	7.5	25.7	70.8	9.2	43.6	64.9	30.0	4.8	67.5	0.696	3317	24825
Dyna-Gro	D58VC65	7.5	24.7	69.8	9.2	45.2	61.1	29.4	5.2	64.9	0.666	3097	23108
Wilbur-Ellis Integra	6720 VT2P	7.4	23.9	69.1	9.5	47.4	62.9	24.6	5.4	65.5	0.673	3159	23365
Masters Choice, Inc.	MCX 19940	7.3	25.7	71.8	9.0	46.5	63.3	24.7	5.3	66.0	0.068	3198	23229
Wilbur-Ellis Integra	6880 VT2P	7.3	24.4	70.1	8.7	45.3	63.3	28.1	4.7	66.8	0.688	3252	23557
LG Seeds	ES7698-3110	7.2	26.0	72.1	9.3	48.6	61.7	24.7	5.3	64.7	0.665	3093	22417
Blue River Organic Seed	70N16	7.2	24.6	70.7	8.3	44.8	66.4	29.0	4.9	67.8	0.699	3350	24231
Dyna-Gro	D57VC51	7.2	25.3	71.5	8.8	46.4	62.5	29.1	4.9	65.5	0.673	3153	22740
Dyna-Gro	D57VC17	7.2	23.1	69.0	9.6	46.3	62.6	25.3	5.8	65.3	0.671	3143	22597
Wilbur-Ellis Integra	CX801115 DGVT2P	7.1	24.2	70.7	9.1	44.4	64.1	28.5	5.3	66.6	0.685	3243	22962
Wilbur-Ellis Integra	9678 VT2P	7.0	24.5	71.4	9.2	45.7	60.9	28.3	4.8	65.6	0.674	3149	22076
Masters Choice, Inc.	MCT 6653	7.0	23.4	70.2	9.2	46.5	64.2	27.2	5.4	66.1	0.680	3211	22398
Dyna-Gro	D58RR70	7.0	25.3	72.4	9.0	49.0	63.6	23.0	5.6	65.4	0.672	3157	22004
Masters Choice, Inc.	MCT 6733	6.9	23.5	70.4	9.1	46.8	64.2	24.9	5.3	66.5	0.684	3238	22492
Masters Choice, Inc.	EXP 672T	6.7	22.2	69.8	8.3	45.7	64.4	28.3	5.3	66.4	0.683	3231	21698
Wilbur-Ellis Integra	6498 STP RR	6.0	17.6	65.8	9.4	46.3	63.6	25.4	5.7	66.0	0.678	3198	19221
	Trial Mean	7.3	24.6	70.4	9.0	46.3	63.8	26.6	5.24	66.2	0.681	3215	23355
	LSD	0.8	2.3	0.02	0.69	3.1	2.28	3.70	0.80	1.77	0.019	142	3013
	LSD P >	0.1	0.05	0.05	0.05	0.05	2.17	0.05	0.05	0.05	0.050	0	0.05
	CV	6.7	5.7	1.9	4.6	4.0	3.8	8.5	9.2	1.6	1.750	3	7.8
	F Test	0.0001	0.0001	0.0004	0.0438	0.1344	0.0192	0.0368	0.0761	0.0736	0.073	0.0587	<.0001

Small Grain Winter Forage Variety Testing

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Objective
To evaluate ensilage production potential through dry matter harvests and nutritive value of cool-season, small grain varieties submitted for testing at the Agricultural Science Center at Clovis.

Materials and Methods
This variety trial was planted on November 21, 2018. All 31 entries were planted into conventionally tilled flat bed plots. Soil type is an Olton clay loam and elevation is 4,435 ft. Individual plots consisted of 11 rows, 6.25 inches apart and 8 feet long. Plots were planted at a rate of 100 lb/acre with a plot drill.
On September 29, 2018, the planting area was fertilized with a pre-plant mixture of 35, 30 and 5 lbs/acre of Nitrogen, Phos and Sulphur respectively. On February 28, 2019 an additional application of Nitrogen and Sulphur were applied at rates of 73 lb/ac and 13 lb/ac respectively. All fertilizer applications were based on soil test results and recommendations. Herbicides applied during the study period included Affinity BroadSpec (0.6 oz/ac), Lo-Vol 6 (12 oz/ac), and Prowl H2O (3pts/ac) on March 25, 2019. One application of Govern (1pt/ac.) was applied on 3/25/2019. Plots were center pivot irrigated throughout the season. November and December irrigation consisted of 1.5 inches of water to aid in establishment. Adequate precipitation through the fall and early winter required normal irrigation; and 9.2 inches of water was applied after the post-planting watering event. These irrigations occurred in January (0.60 in.), February (1.0 in.), March (1.2 in.), April (2.8 in.), and May (3.6 in.).
These small grains were managed for a one-cut, silage oriented harvest in spring of 2019 (Table 1). Harvests began on May 2, 2019 with the earliest maturing species (rye and triticale) and continued through May 24. Plants were harvested at boot stage (Feekes scale: 10.0-10.3; Zadoks scale: 45-53) for maximum forage quality. Although yield is maximized at later growth stages, cutting earlier at boot to early head stages allows for a balance of good yields and optimum nutritive value. Considering the high nutritional needs of dairy cattle in the region and the common practice of double cropping with corn or sorghum, an early cutting of forages was deemed most appropriate for the area. All plots were harvested with a sickle bar mower set at a height of 2 inches, and total plot weights were obtained to estimate yield on both a green forage and dry matter basis. Canopy height and lodging data were collected at harvest.

Statistical Analysis
Species/varieties were assigned randomly to plots in a completely randomized block design with 3 replications. Data were subjected to SAS® procedures for test of significance for differences ($P < 0.05$) among entries and mean separation procedures (protected least significant difference) were used to determine where differences occurred.

Results and Discussion: Yield data for 2018-2019 are presented in Table 2. Total precipitation and irrigation amounts were less in 2018-2019 (15.49 in.) than in the previous year (19.51 in.). Yields from the 2018-2019 season were slightly lower than 2017-2018 and averaged 13.3 tons/acre for green forage.

Table 2. Forage Harvest - Winter Annual Small Grain Forages - 2018-2019 - NMSU Agricultural Science Center at Clovis

Company Name	Variety Name	Species†	Harvest Date	Dry Forage	65% Moisture Forage	Moisture at Harvest	Milk/ Ton	Milk/ Acre
				T/ac	T/ac	%	lb/ton	lb/ac
Watley Seed Co.	Slicktrit II	T	24-May	6.8 ***	19.3 ***	76.3	2780	18648 ***
Sharp Brothers Seed Co.	Trit 813	T	17-May	6.4 *	18.2 *	82.7 *	2720	17329 *
Ehmke Seed	Thunder Tall II	T	24-May	6.1 *	17.4 *	77.0	2681	16295 *
Sharp Brothers Seed Co.	Trit Flex 719	T	14-May	6.1 *	17.3 *	78.7	2900	17566 *
Ehmke Seed	Thunder Tall	T	17-May	5.8 *	16.6 *	81.3	3048	17739 *
Curtis and Curtis Seed	Smooth Grazer Plus	W/T	14-May	5.4	15.4	82.3 *	3005	16227 *
Curtis and Curtis Seed	Trical 813	T	14-May	5.1	14.5	81.7 *	3056	15573 *
Curtis and Curtis Seed	Bearded Trit	T	20-May	5.1	14.5	78.0	2624	13316
Curtis and Curtis Seed	Smooth Grazer	W/T	14-May	5.0	14.4	80.3	3034	15306
Texas A&M Agrilife	tx14vt70526	T	8-May	5.0	14.2	83.3 *	3222	15998 *
Curtis and Curtis Seed	Trical 348	T	14-May	4.9	13.9	82.3 *	3118	15170
Texas A&M Agrilife	tx16vt68295	T	8-May	4.8	13.7	81.7 *	3111	14906
Texas A&M Agrilife	tx12vt8222-4	T	8-May	4.7	13.5	81.7 *	3031	14316
Agri Pro	Bob Dole	W	8-May	4.7	13.4	78.7	2757	13024
Ehmke Seed	Thunder Cale V	T	8-May	4.6	13.0	83.0 *	3035	13901
Ehmke Seed	Thunder Cale	T	8-May	4.5	12.9	84.0 ***	3125	14074
Texas A&M Agrilife	tx14vt70473	T	8-May	4.4	12.7	81.0	2974	13225
Dyna-Gro	Underwood	W	8-May	4.4	12.6	79.3	3141	13789
Ehmke Seed	Short Beard Thunder	T	8-May	4.4	12.5	83.3 *	3112	13655
Ehmke Seed	Fredro	T	8-May	4.3	12.3	83.0 *	3290 *	14204
Watley Seed Co.	Tam 112	W	8-May	4.3	12.3	78.3	3079	13210
Sharp Brothers Seed Co.	Trit 135	T	8-May	4.3	12.3	83.3 *	3082	13237
Agri Pro	SY Grit	W	2-May	4.0	11.4	79.0	3069	12270
Ehmke Seed	Thunder Green	R	2-May	4.0	11.4	83.7 *	3473 ***	13775
Texas A&M Agrilife	tx14vt70446	T	8-May	4.0	11.3	82.0 *	3042	12080
Curtis and Curtis Seed	Beardless wheat	W	8-May	3.9	11.1	80.0	3297 *	12807
Dyna-Gro	Long Branch	W	8-May	3.7	10.6	80.7	3360 *	12425
Agri Pro	SY Wolverine	W	8-May	3.7	10.5	79.3	3381 *	12318
Texas A&M Agrilife	tx14vt70487	T	2-May	3.5	10.1	83.0 *	3325 *	11757
Watley Seed Co.	Tam 204	W	8-May	3.4	9.7	80.7	3326 *	11399
Agri Pro	SY Monument	W	8-May	3.1	8.9	79.7	3346 *	10467
	Trial Mean			4.6	13.3	80.9	3082	14193
	LSD (0.05)			1.0	2.8	3.00	239	3334
	CV			13.1	13.1	1.9	4.7	14.4
	F Test			<.0001	<.0001	<.0001	<.0001	0.0002

†B=barley; T=triticale; W=wheat, R=Rye

Plots were harvested at Feekes stage 10.0-10.3; 10.0=sheath of flag leaf completely grown out, ear not visible;
10.3= half of heading process complete.

*** Highest numerical value in the column.

* Not significantly different from the highest value

Table 3. Forage Harvest - Winter Annual Small Grain Forages - 2018-2019 Various Dates - NMSU Agricultural Science Center at Clovis									
Company Name	**Variety Name**	**Species†**	**Harvest Date**	**CP**	**ADF**	**NDF**	**dNDF Dig. 48h**	**TDN**	**RFQ**
				% of DM	% of DM	% of DM	% of NDF	% of DM	
Watley Seed Co.	Slicktrit II	T	24-May	14.0	37.5	60.9 *	58.2	60.8	116
Sharp Brothers Seed Co.	Trit 813	T	17-May	13.4	39.8 *	63.2 ***	58.5	59.9	111
Ehmke Seed	Thunder Tall II	T	24-May	13.6	38.3 *	61.6 *	56.7	59.6	111
Sharp Brothers Seed Co.	Trit Flex 719	T	14-May	13.4	37.5	61.1 *	60.1	62.2	121
Ehmke Seed	Thunder Tall	T	17-May	15.5	35.5	58.1	62.7	64.0	133
Curtis and Curtis Seed	Smooth Grazer Plus	W/T	14-May	15.2	35.8	57.6	61.9	63.5	132
Curtis and Curtis Seed	Trical 813	T	14-May	14.9	35.4	57.5	61.7	64.2	133
Curtis and Curtis Seed	Bearded Trit	T	20-May	12.7	40.1 ***	63.0 *	56.7	58.8	107
Curtis and Curtis Seed	Smooth Grazer	W/T	14-May	14.7	35.2	57.7	61.0	64.0	132
Texas A&M Agrilife	tx14vt70526	T	8-May	17.0	34.7	57.4	66.7 *	66.0	145
Curtis and Curtis Seed	Trical 348	T	14-May	14.7	35.2	57.3	63.1	64.9	137
Texas A&M Agrilife	tx16vt68295	T	8-May	15.6	34.2	57.0	63.6	64.8	138
Texas A&M Agrilife	tx12vt8222-4	T	8-May	14.9	35.9	58.7	62.1	63.8	131
Agri Pro	Bob Dole	W	8-May	15.0	33.8	55.1	61.1	60.1	128
Ehmke Seed	Thunder Cale V	T	8-May	15.6	36.4	59.0	62.7	63.8	132
Ehmke Seed	Thunder Cale	T	8-May	16.7	35.0	57.4	63.8	65.0	138
Texas A&M Agrilife	tx14vt70473	T	8-May	15.7	35.6	58.3	61.7	63.1	129
Dyna-Gro	Underwood	W	8-May	17.1	32.9	54.2	64.6	65.1	146
Ehmke Seed	Short Beard Thunder	T	8-May	15.6	34.9	57.5	63.4	64.8	137
Ehmke Seed	Fredro	T	8-May	18.3 *	31.2	51.7	66.6 *	66.9 *	159 *
Watley Seed Co.	Tam 112	W	8-May	16.0	32.7	54.9	63.8	64.3	142
Sharp Brothers Seed Co.	Trit 135	T	8-May	16.6	35.5	57.0	63.4	64.4	137
Agri Pro	SY Grit	W	2-May	16.8	32.7	53.6	63.7	64.2	144
Ehmke Seed	Thunder Green	R	2-May	19.5 ***	30.7	52.6	67.1 *	69.4 ***	163 ***
Texas A&M Agrilife	tx14vt70446	T	8-May	16.2	35.3	57.9	61.5	64.1	132
Curtis and Curtis Seed	Beardless wheat	W	8-May	16.4	31.9	53.1	65.8 *	67.1 *	155 *
Dyna-Gro	Long Branch	W	8-May	17.2	31.0	51.6	67.4 *	67.8 *	162 *
Agri Pro	SY Wolverine	W	8-May	16.6	30.7	53.3	67.7 ***	68.1 *	159 *
Texas A&M Agrilife	tx14vt70487	T	2-May	17.6	32.6	54.1	65.7 *	67.5 *	154 *
Watley Seed Co.	Tam 204	W	8-May	16.3	32.1	53.9	65.5 *	67.6 *	154 *
Agri Pro	SY Monument	W	8-May	17.1	31.3	52.3	66.9 *	67.7 *	160 *
	Trial Mean			15.8	34.5	56.7	63.1	64.4	138
	LSD (0.05)			1.8	2.5	3.2	2.7	3.1	15
	CV			6.9	4.4	3.5	2.6	2.9	6.5
	F Test			<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

†B=barley; T=triticale; W=wheat; R=Rye

Plots were harvested at Feekes stage 10.0-10.3; 10.0=sheath of flag leaf completely grown out, ear not visible; 10.3=half of heading process complete.

*** Highest numerical value in the column.

* Not significantly different from the highest value

Unless otherwise indicated, all entries planted at 100 lb/ac rate.

Irrigated and Dryland Wheat Variety Trial

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Objective

Test the adaptability and yield performance of newly developed wheat varieties and selections grown under irrigated and dryland conditions at Clovis, New Mexico.

Materials and Methods

The irrigated winter wheat trial was planted November 20, 2018 into conventionally tilled flat bed plots for center pivot irrigation. Soil type is an Olton clay loam and elevation is 4,435 feet. Individual plots consisted of 11 rows, 6.25 inches apart, 30 feet long. There were three replications for each entry, planted in a randomized complete block design. Individual plots were planted at a rate of 70 lb/ac irrigated and 30 lb/ac dryland. Plots were planted with a Great Plains solid stand plot drill (3600).

The irrigated planting area was fertilized with a pre-plant mixture of 74, and 30 lb/ac of nitrogen, and P_20_5 respectively and 13 lb/ac of Sulphur. Fertilizers were incorporated into soil immediately after application. Additional nitrogen was applied on February 28, 2019 at a rate of 73 lb/ac. Affinity, Lo-Vol6 (2,4-D), and Prowl H20 herbicides were applied at a rate of 0.6 oz/ac and 12 oz/ac, and 3 pt/ac respectively on March 25, 2019. Govern (chlorpyrifos) insecticide was applied at a rate of 1 pt/ac on March 25, 2019.

Total irrigation amount for the trial was 11.3 inches. The amounts were applied during November, December, February, March, April and May. Precipitation during the period after planting until harvest of the irrigated plots was 8.1 inches.

Height, lodging, and date of bloom measurements were collected during the growing season. The trial was harvested on July 2, 2019 with a WinterSteiger combine. A Harvest Master HM 800 Classic Grain Gage was used to determine percent moisture and test weight (lb/bu).

The dryland trial was planted on Noember 9, 2018 in the same manner as described above, except at a seeding rate of 30 pounds/acre. The planting area was not furrowed. 36 lb/ac of nitrogen was applied pre-plant. Fertilizers applied on February 28, 2019 were 30 lb/ac, and 5.5 lb/ac of nitrogen and sulphur respectively. Herbicides applied on April 4, 2019 include Affinity BS, Lo-Vol6 (2,4-D), and Prowl H20 at a rate of 0.6 oz/ac and 12 oz/ac, and 3 pt/ac respectively. Precipitation during the period after planting until harvest was 8.1 inches. Dryland plots were harvested on July 2, 2019 in the same manner as described above for the irrigated trial.

Statistical Analysis

Data were subjected to SAS® procedures for tests of significance for differences between entries. Mean separation procedures [protected ($P<0.05$) least significant differences] were used to determine where differences occurred.

Results and Discussion

Yield data for 2018-2019 are presented in Tables 1 and 2 for the irrigated and dryland trial. Grain yields for the irrigated trial averaged 63.8 bushel/acre. The dry land trial produced an average yield of 26.7 bushel/acre.

Dryland Wheat Variety Trial, NMSU Agricultural Science Center at Clovis, 2019							
Variety Name	Owner	Grain Yield[1]	Bushel Weight	Harvest Moisture	Plant Height	Lodging	Head Date
		bu/a	lb/bu	%	in	%	date
PlainsGold Canvas	CSU	30.9 ***	60.4 *	9.8 ***	23.7 *	0	5/11
CP7909	Croplan	30.7 *	59.6 *	9.7 *	22.7 *	0	5/8
LCS Mint	Limagrain	30.5 *	59.3 *	9.7 *	24.3 *	0	5/12 *
TAM 114	Warner Seed	30.2 *	60.9 *	9.6 *	24.3 *	0	5/7
CPX79-10	Croplan	29.2 *	61.9 ***	9.4 *	21.7	0	5/9
CP7869	Croplan	29.2 *	60.2 *	9.4 *	22.3	0	5/13 *
TAM 113	Warner Seed	29.0 *	60.5 *	9.3 *	23.7 *	0	5/13 *
TX12V7415	TAMU	28.9 *	61.9 *	9.2 *	24.0 *	0	5/8
Smith's Gold	OSU	28.3 *	59.5 *	9.1 *	23.0 *	0	5/11
Dyna-Gro Long Branch	Dyna-Gro	28.0 *	57.7	9.1 *	22.3	0	5/12 *
TX11A001295	TAMU	27.9 *	58.5 *	9.0 *	22.0	0	5/14 *
TAM 112	Watley Seed	27.9 *	59.8 *	9.0 *	22.7 *	0	5/10
Winterhawk	Westbred	27.6 *	61.8 *	8.9 *	25.3 ***	0	5/10
08BC379-40-1	Syngenta	27.5 *	59.1 *	8.9 *	22.7 *	0	5/8
WB 4792	Westbred	27.4 *	56.8	8.9 *	25.0 *	0	5/12 *
Gallagher	OSU	26.6 *	56.4	8.6 *	22.0	0	5/10
Lonerider	OSU	26.2 *	58.9 *	8.5 *	21.7	0	5/11
TAM 204	Watley Seed	25.4 *	54.9	8.3 *	22.7 *	0	5/13 *
WB-Grainfield	Westbred	24.8	59.9 *	8.1	23.3 *	0	5/8
OK12716	OSU	24.7	57.0	8.1	23.0 *	0	5/8
WB 4721	Westbred	24.4	61.8 *	8.1	23.3 *	0	5/11
LCS Pistol	Limagrain	24.4	56.2	8.1	24.7 *	0	5/10
SY Grit	Syngenta	24.3	61.2 *	8.0	22.3	0	5/9
LCS Link	Limagrain	23.8	59.1 *	7.9	22.0	0	5/8
SY Flint	Syngenta	23.3	60.1 *	7.7	22.0	0	5/7
PlainsGold Langin	CSU	23.1	57.9	7.7	20.7	0	5/15 ***
Iba	OSU	22.0	57.7	7.4	21.0	0	5/13 *
DH12HRW27-3	Limagrain	20.7	55.2	7.1	19.7	0	5/11
Trial Mean		26.7	59.1	8.7	22.7	0.0	5/10
LSD (P> 0.05)		5.5	3.9	1.5	2.9	0.0	3.05
CV		12.5	4.1	10.3	7.8	0.0	1.43
F Test		<.0001	<.0001	<.0001	0.06	<.0001	<.0001

[1]Yields adjusted to 60 lb standard bushel wieght and 13.5 % moisture.

*** Highest numerical value in the column.

* Not significantly different from the highest numerical value in the column based on the 5% LSD.

[2] No lodging reported

Irrigated Wheat Variety Trial, NMSU Agricultural Science Center at Clovis, 2019							
Variety Name		Grain Yield[1]	Bushel Weight	Harvest Moisture	Plant Height	Lodging	Head Date
		bu/a	lb/bu	%	in	%	date
CP7909	Croplan	72.8 ***	62.4 *	9.5	35.3 *	0	5/10
CPX79-10	Croplan	70.4 *	63.5 ***	10.7 ***	33.0	0	5/13
TAMW-101	TAMU	69.5 *	61.7 *	9.5	33.7 *	0	5/11
WB 4418	Westbred	67.9 *	59.6 *	9.0	33.0	0	5/12
WB 4792	Westbred	67.8 *	60.2 *	9.4	34.3 *	0	5/18 *
Winterhawk	Westbred	67.5 *	63.1 *	9.8	34.7 *	0	5/12
PlainsGold Canvas	CSU	67.2 *	61.9 *	9.4	34.3 *	0	5/15
TAM 114	Warner Seed	66.8 *	62.4 *	9.9 *	36.0 ***	0	5/14
CP7869	Croplan	66.4 *	59.0 *	9.3	31.3	0	5/18 *
PlainsGold Langin	CSU	66.2 *	61.0 *	9.4	32.3	0	5/9
PlainsGold Avery	CSU	65.9 *	60.1 *	9.1	36.0 *	0	5/15
TX12V7415	TAMU	65.7 *	63.1 *	9.9 *	34.3 *	0	5/11
Lonerider	OSU	65.4 *	61.7 *	9.5	30.7	0	5/17 *
SY Monument	Syngenta	65.4 *	59.4 *	8.6	32.7	0	5/17 *
08BC379-40-1	Syngenta	64.8 *	63.2 *	10.4 *	31.7	0	5/12
LCS Link	Limagrain	63.9	59.3 *	9.1	33.0	0	5/16
TAM 111	Gayland Ward	63.5	50.2	8.7	35.0 *	0	5/11
SY Grit	Syngenta	63.2	59.1 *	8.8	34.3 *	0	5/13
WB 4303	Westbred	62.8	58.7 *	8.7	31.3	0	5/15
SY Rugged	Syngenta	62.5	60.6 *	9.1	31.0	0	5/16 *
SY Flint	Syngenta	62.4	59.9 *	8.9	33.3 *	0	5/10
TAM 204	Watley Seed	62.2	57.9 *	9.0	33.3 *	0	5/16
TAM 113	Warner Seed	61.3	62.0 *	10.0 *	35.3 *	0	5/12
Gallagher	OSU	61.1	60.7 *	9.0	33.7 *	0	5/15
OK12716	OSU	61.0	58.7 *	8.7	34.3 *	0	5/14
TAM 304	TAMU	60.9	57.5 *	8.9	32.3	0	5/12
Iba	OSU	60.4	60.8 *	7.8	32.3	0	5/19 ***
Smith's Gold	OSU	60.4	61.9 *	9.4	33.3 *	0	5/16
Dyna-Gro Long Branch	Dyna-Gro	59.7	58.9 *	8.9	33.3 *	0	5/16
LCS Pistol	Limagrain	59.6	57.7 *	8.8	32.0	0	5/15
TX11A001295	TAMU	59.4	61.0 *	9.1	32.0	0	5/17 *
TAM 112	Watley Seed	59.3	62.7 *	9.4	32.3	0	5/14
DH12HRW27-3	Limagrain	53.3	59.8 *	8.7	30.0	0	5/16 *
Trial Mean		63.8	60.3	9.2	33.2	0.0	5/14
LSD (P> 0.05)		8.5	6.6	0.9	2.8	0.0	2.85
CV		8.2	6.8	6.1	5.2	0.0	1.30
F Test		0.04	0.35	<.0001	<.0001	<.0001	<.0001

[1]Yields adjusted to 60 lb standard bushel wieght and 13.5 % moisture.

*** Highest numerical value in the column.

* Not significantly different from the highest numerical value in the column based on the 5% LSD.

[2] No lodging reported

Cover Crop Effects on Soil Microbial Community Structure and Functions

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Objective

The main objective of this study was to evaluate the response of different cover crops on soil microbial communities and enzymatic activities under a limited-irrigation winter wheat-sorghum-fallow.

Materials and Methods

The microbial community structure and functions were monitored in 2017 and 2018 at the New Mexico State University Agricultural Science Center (ASC), Clovis, NM. The study had a randomized complete block design in which eight cover crop treatments and three replications were tested in winter wheat (*Triticum aestivum*)- sorghum (*Sorghum bicolor*)-fallow rotation. The cover crop treatments were three sole cover crops: pea (*Pisum sativum*), oat (*Avena sativa*) and canola (*Brassica napus* L.), four mixtures including pea + oat (POmix), pea + canola (PCmix), pea + oat + canola (POCmix), pea + oat + canola + hairy vetch (*Vicia villosa*) + forage radish (*Raphanus sativus* L.) + barley (*Hordeum vulgare* L.) (diverse-mix), and a fallow (no cover crop). The size of the individual plot was 40 ft × 60 ft. The experiment was established under no-tillage management in 2015 in the field that was previously under conventional management of irrigated corn and sorghum for several years.

Soil samples were collected from 0 to 6-inch depth of all phases of crop rotation at the time of wheat harvest (July 2017 and 2018). Three soil cores were collected diagonally from each plot using core sampler, composited, thoroughly homogenized, and all visible plant materials (roots, stems, and leaves) and crop residues were removed by hand. The soil samples were transported to the laboratory, and approximately 20-g subsamples were used for soil water estimation, and 100-g subsamples were stored in a -20ºC freezer for soil microbial community analysis. The rest of the samples were air-dried and ground to pass through a 2-mm sieve for the soil enzyme activity analysis. In a laboratory, gravimetric soil water content was estimated by oven drying 20-g soil samples at 105°C for 24-hrs. Soil microbial community structure was characterized via ester-linked fatty acid methyl ester (EL-FAME) analysis, and soil microbial activity were analyzed by measuring soil enzymes.

Results

Cover crops affected soil microbial community; abundance of Mycorrhiza was significantly different between cover crop treatments with the highest value under oats and diverse-mix (6.83 nmol g^{-1} soil) and lowest value under fallow (3.71 nmol g^{-1} soil). Saprophytic and total fungi were also significantly different between cover crop treatments. The abundance of saprophytic fungi was highest under diverse-mix and lowest under fallow. The fungal sum was

47.8 nmol g^{-1} soil under oats and 47.7 nmol g^{-1} soil under diverse mix, which was significantly greater than 34.0 nmol g^{-1} soil under fallow. Among cover crops, pea, canola, POmix, PCmix, and POCmix remained intermediate of oat and diverse-mix. The abundance of the saprophytic and total fungi was 19.9% and 24.7% higher in 2018 than in 2017, respectively, irrespective of cover crop treatments.

The abundance of gram-positive bacteria (mostly beneficial bacteria that are more abundant in natural grasslands) was more abundant under diverse-mix of cover crops than other treatments. The abundance of actinobacteria ranged from 11.4 nmol g^{-1} soil to 14.5 nmol g^{-1} soil, and no difference was observed between years, while gram-negative bacteria were 25.7% greater in 2018 than in 2017 (Table 1). Gram-positive bacteria to gram-negative bacteria ratio was significantly different between sampling years, but not between cover crop treatments. It was 26.5% lower in 2018 than in 2017, regardless of cover crop treatments. Total fungi to total bacteria ratio were not significantly different between cover crop treatments and sampling years, indicating the same proportion over the years. Soil protozoa community was significantly different between sampling years that their abundance doubled in 2018 than in 2017.

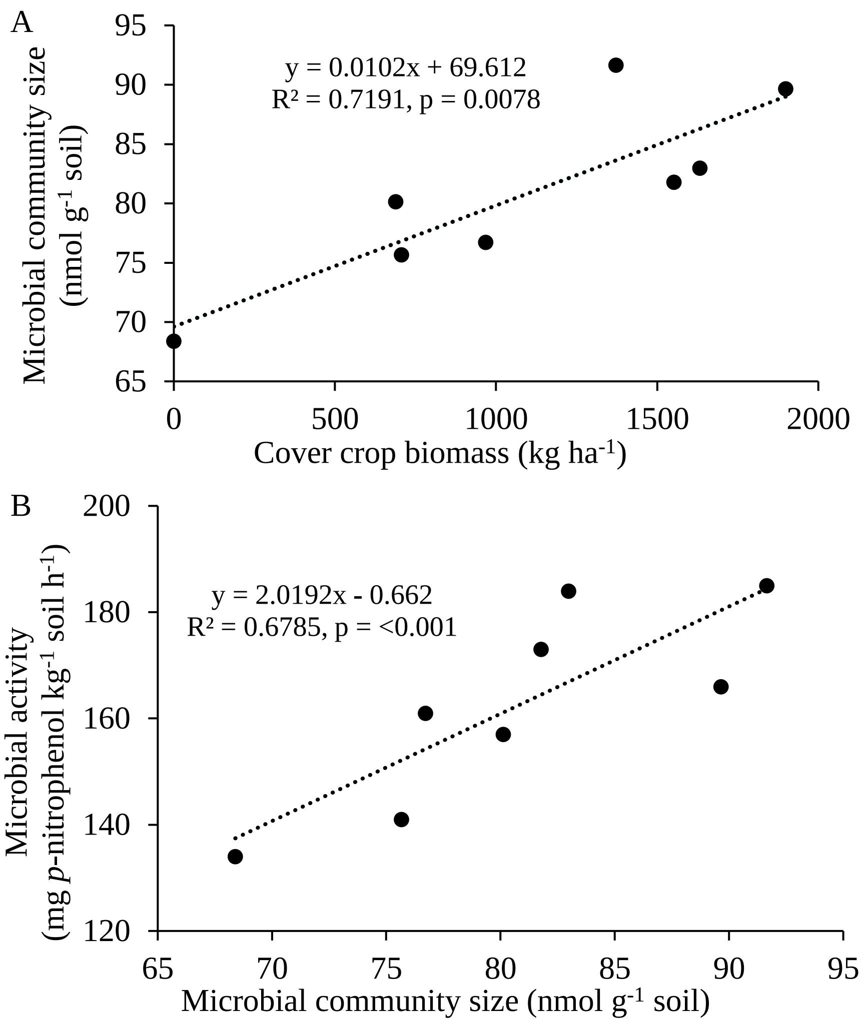
Soil enzyme activities also varied between cover crop and fallow treatments. The combined enzyme activity was the greatest under diverse-mix (185 mg PNP kg^{-1} soil h^{-1}), which was statistically similar to enzyme activities under POmix but significantly greater than the fallow. The combined enzyme activity under pea, oat, canola, PCmix, and POCmix remained in-between diverse-mix, POmix, and fallow. Combined enzyme activity under diverse-mix was significantly greater than enzyme activity under fallow in 2018 while other cover crop treatments such as pea, oat, canola, POmix, PCmix, and POCmix remained intermediate of diverse-mix and fallow. There was no difference in enzyme activity between cover crop treatments in 2017. Soil microbial growth and activity were related to cover crop biomass and species composition (Figure 1).

Table 1. Soil microbial community structure and enzyme activities under various cover cropping treatments.

Variable	Contrast 1		Contrast 2	
	Fallow	Cover crops	Monoculture	Diverse-mix
	Nmol/g soil		Nmol/g soil	
Mycorrhiza	3.71	5.76	5.67	6.83
Saprophytic fungi	30.2	36.7	36.3	40.9
Total fungi*	**34.0**	**42.5**	**42.1**	**47.7**
Gram-positive bacteria	17.5	20.5	20.3	22.3
Gram-negative bacteria	4.36	4.95	4.80	5.57
Actinobacteria	11.4	13.4	13.3	14.5
Total bacteria	**33.2**	**38.8**	**38.4**	**42.3**
Protozoa	1.31	1.44	1.46	1.69
Gram-positive/Gram-negative bacteria ratio	4.01	4.44	4.72	4.05
Fungi/Bacteria ratio	1.02	1.09	1.09	1.13

*Large numbers in total fungi show better soil structure and good soil health.

Figure 1. Relationship between cover crop biomass, microbial community size, and microbial activity in the cover crops study.



Cover Crop Effects on Soil Carbon Dioxide Emissions

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Objective

The aim of this study was to examine the effect of cover crops on soil CO_2 emissions in limited-irrigation cropping systems in the semiarid environment of the SHP.

Materials and Methods

The study was conducted at the New Mexico State University, Agricultural Science Center, Clovis during 2017 and 2018. The study had a randomized complete block design with eight treatments and three replications. Treatments consisted of fallow (no cover crop), oat, pea, canola, pea + oat mixture (POmix), pea + canola mixture (PCmix), pea + oat + canola mixture (POCmix), and six species mixture of pea + oat + canola + hairy vetch + forage radish + barley (SSmix). Cover crops were planted in the last week of February using a no-till drill (Great Plains 3P600, Moline, IL) and terminated by applying herbicides in the third week of May each year. The monoculture seeding rate for oat, pea, canola, barley, hairy vetch, and forage radish was 40, 20, 4, 40, 10, and 4 lbs/acre, respectively. The seeding rates were 50, 33, and 16.5% of the monoculture rates for two species, three species, and six species mixtures. The individual plot size was 40 ft × 60 ft. Before cover crop planting, the field was fallowed following sorghum harvest in October of the previous year, and cover crop residues were maintained after cover crop termination until winter wheat planting in October in both years. Cover crops did not receive irrigation or fertilizers. Winter wheat was planted in October 2017 and 2018. At planting, winter wheat received 62 lbs/acre N and 11 lbs/acre sulfur. Winter wheat received limited irrigation (7 to 10 inches) at critical growth stages. Sorghum before cover cropping received 86 lbs/acre N and 13 lbs/acre sulfur each year. Cover crops and fallow fields did not receive any irrigation during the CO_2 measurement period.

Soil CO_2 emissions were measured weekly during April (early growth stage of the cover crops) through the first week of October (before wheat planting) each year using a Soil Respiration Chamber (SRC-2) connected to an Environmental Gas Monitoring System (EGM-5; PP Systems, Haverhill, MA) (Figure 1). Before measurements, 4-inch-deep × 4-inch diameter PVC rings were installed between cover crop rows (row spacing 10 inches for cover crops and 30 inches for sorghum) at the center of each plot. The rings were removed during field operations and reinstalled immediately after each field operation. Any living plant inside the chamber was hand clipped and removed before each sampling to avoid CO_2 contributions from aboveground plant parts. However, root and heterotrophic respiration could not be separated in this study. Therefore, CO_2 measured included emissions from all soil processes. During each measurement, an SRC-2

Figure 1

chamber was placed into a PVC ring for five minutes, and gas accumulated in the chamber headspace was measured directly into the EGM-5 analyzer connected to the chamber. Soil temperature and water content at 0-5 cm depth were measured using probes (Stevens Water Monitoring Systems, Portland, OR) attached to the EGM-5 analyzer. Daily precipitation and air temperature were recorded from a weather station near the study site.

Results

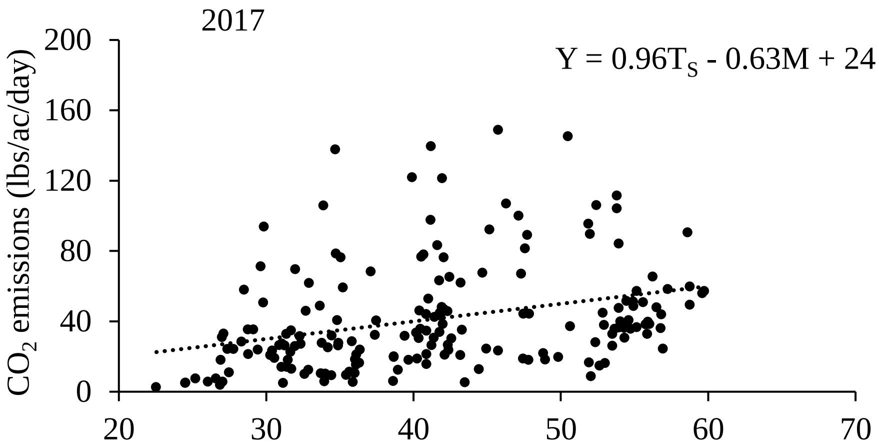
Total precipitation received during the study period (April to October) accounted for 70% of the annual precipitation. In 2017, 503 mm of precipitation was received during this period compared to 417 mm in 2018. Soil temperatures varied among cover crop treatments (Table 1). There was also a temporal variation in soil temperature that it decreased in May 2017 following precipitation, increased from June to August, and then declined. In 2018, soil temperature increased from May to August and decreased after that.

Soil water content increased immediately following precipitation events in both years. Soil water content was higher under fallow than cover crops from April to August 2017. In 2018, soil water content was higher under oats than other cover crops from May to July, but lower in August. Soil water content was higher with fallow than cover crops in 2017 (Table 1).

Soil CO_2 emissions differed among measurement dates and cover crops, with a significant cover crop × measurement date interaction in both years, except for cover crops in 2018 (Table 1). In 2017, CO_2 emissions were greater with pea and PC than other cover crops in June and August to October. The flux was lower with fallow for most of the measurement dates. In 2018, CO_2 emissions were greater with POC in June and with fallow, PC, and SSM in July and August than other cover crops. Lower emissions occurred with peas in May and August and with oat in July. Averaged across measurement dates, the CO_2 emissions were greater with pea than fallow, canola, and PO in 2017, but cover crops did not affect gas emissions in 2018 (Table 1). Multiple regression analysis showed that soil temperature and moisture have a great role in how much soil carbon is released as CO_2 (Figure 1). Daily soil CO_2 emissions increased with an increase in temperature it decreased with an increase in soil water content.

Table 1. Means of soil temperature, soil water content, and daily CO_2 emissions during 2017 and 2018 at Clovis, NM.

Cover crop	Soil temperature		Soil water content		Soil CO_2 release	
	2017	2018	2017	2018	2017	2018
	^oC		$cm^3\ cm^{-3}$		lbs/ac	
Fallow	28.1	30.3	20.0a	17.8	16.3	31.4
Canola	28.5	30.5	15.4b	18.1	27.3	20.3
Oat	28.9	31.1	15.9b	18.8	40.1	20.2
Pea	28.2	30.0	15.6b	18.0	54.3	16.9
PCmix	29.0	31.2	15.6b	16.7	44.7	32.2
POmix	29.0	31.4	17.1b	16.1	29.4	26.9
POCmix	29.5	31.5	15.9b	16.8	41.5	31.6
SSmix	29.3	30.8	16.9b	17.6	41.2	36.5



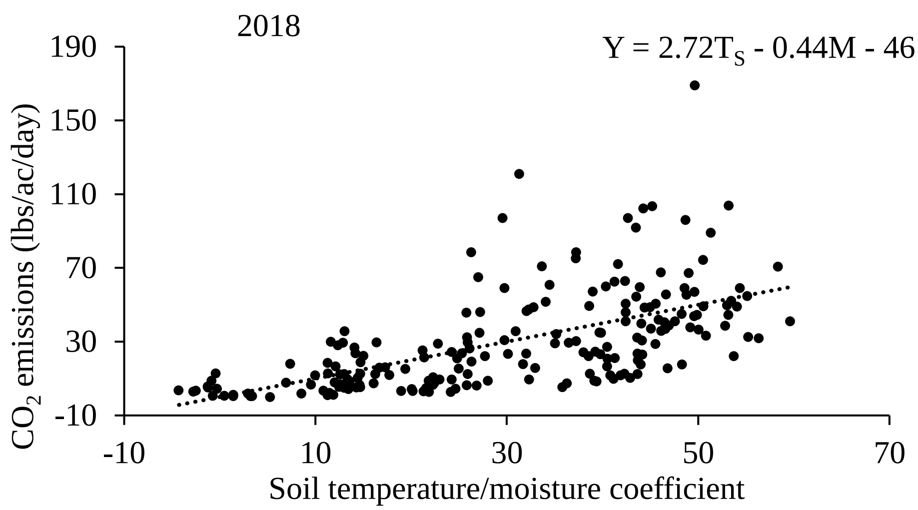


Figure 1. Relationship between soil temperature (T_S), soil water content (M), and soil CO_2 release during 2017 and 2018.

Nitrogen Fertilizer and Compost Effects on Soil Nitrogen Dynamics and Crop Yield in Dryland Sorghum

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Objective

To evaluate the effects of compost and different rates of synthetic N fertilizers on soil N dynamics and crop yield in dryland sorghum

Materials and Methods

The study was conducted at the New Mexico State University Agricultural Science Center at Clovis, NM in 2018 and 2019. The study plots were established in a no-tilled dryland winter wheat (*Triticum aestivum* [L.])-sorghum (*Sorghum bicolor* [L.] Moench)-fallow field with a randomized complete block design of five treatments and four replications. The fertility management treatments were randomized within each block. The size of an individual plot was 30 ft × 30 ft. The fertility management treatments were 0, 20, 40, and 60 lbs/acre N application as liquid Urea-Ammonium nitrate (UAN: 32-0-0) and 6 tons/acre compost application. The nitrogen (N) treatments are labeled as N0, N20, N40, N60, and Compost. Treatments were applied a few days before planting sorghum in both years. Liquid UAN was used with a 30 ft long liquid sprayer-boom mounted behind a tractor, and the compost was applied with a hand spreader. The experimental field was in winter wheat-sorghum-fallow rotation since 2014 and fallowed for 11 months before the planting of sorghum each year. Grain sorghum (Pioneer 86P20) was planted in mid-May in both years and harvested in the third week of October in 2018 while it was harvested in September last week in 2019. In both years, planting was done by a John Deere 4-row planter with 30 inches row spacing and approximately 8 inches spacing between the seeds at a rate of 30K seeds/acre. Seeds were planted about 2 inches deep into the soil. Hand harvesting was done for 10 ft of 2 rows for grain yield.

Composite soil samples were collected from 0-4 and 4-8 inch depths of study plots before fertilizer application and planting of sorghum each year. Soil samples were collected again from individual plots at the time of the sorghum harvest. The at-harvest soil samples were collected from randomly selected five spots within each plot, homogenized, and composited by depth (0-4 and 4-8 inch). All soil samples were stored at 4ºC in a refrigerator before laboratory analysis, which was done within a month of soil sampling. Laboratory analysis included inorganic N, and potential N mineralization (PNM) in 72-hr of aerobic incubation and total soil N by dry combustion. Labile N content by hot KCl extraction was also measured in soil samples collected in 2019.

Results

Soil inorganic N and PNM at sorghum harvest were not significantly different between treatments, soil depths in both study years (2018 and 2019) (Table 1). Soil inorganic N was in the range of 0.54 to 1.89 mg kg^{-1} in 2018 and 0.76 to 1.02 mg kg^{-1} in 2019, whereas the PNM was in the range of 0.35 to 2.90 mg kg^{-1} and 0.60 to 1.01 mg kg^{-1} in 2018 and 2019, respectively. The LON was measured only in 2019, and it was not significantly different between treatments, but it was significantly different between soil depths. Labile N was 33.1% higher in 0 to 4-inch depth than 3.43 mg kg^{-1} in 4 to 8-inch depth. The ranges of Labile N in different treatments were 3.87 to

5.19 mg kg^{-1} and 2.00 to 5.19 mg kg^{-1} in 0-4 and 4-8 inch depths, respectively. Total soil N (TSN) varied between soil depths and treatments only in 2018. The control treatment had 5.76% and 5.51% higher total N than N20 and N40, respectively.

Grain yield, biomass yield, biomass N, and grain N were not significantly different between treatments in 2018 and 2019 (Table 2). Biomass N ranged from 0.79 to 1.44 % of dry matter in 2018, and in 2019, it was from 1.74 to 2.24 % of dry matter. Grain N was from 1.55 to 1.82 % dry matter in 2018 and 0.70 to 1.05 % dry matter in 2019.

Grain and biomass N increased with increasing N fertilizer rate, although the effect was not statistically significant, suggesting that it could increase the quality of sorghum than yield itself.

Table 1. soil inorganic N, potential N mineralization (PNM) in 72 hr incubation, labile N, and total soil nitrogen (TSN) in two depths of soil

Parameters	Treatments	2018		2019	
		0-4 inch	4-8 inch	0-4 inch	4-8 inch
Inorganic N (mg kg^{-1})	N0	3.09	1.39	1.08	1.13
	N20	1.86	2.07	1.26	1.30
	N40	1.74	1.36	1.10	1.16
	N60	2.62	3.09	1.09	1.10
	Compost	3.03	3.21	1.00	1.08
	Baseline	1.76	5.44	13.0	10.1
PNM (mg kg^{-1})	N0	1.02	0.55	0.78	0.75
	N20	0.75	0.81	0.78	0.69
	N40	0.71	0.64	0.78	0.71
	N60	0.95	1.14	0.75	0.68
	Compost	1.06	1.23	0.80	0.77
	Baseline	25.5	7.22	12.83	9.61
Labile Organic N (mg kg^{-1})	N0	-	-	4.55	3.47
	N20	-	-	4.81	3.67
	N40	-	-	4.36	2.65
	N60	-	-	4.44	4.00
	Compost	-	-	4.68	3.37
	Baseline	-	-	13.96	9.37
Total soil N (g kg^{-1})	N0	0.77	0.68	0.87	0.75
	N20	0.73	0.65	0.82	0.77
	N40	0.73	0.64	0.87	0.76
	N60	0.72	0.68	0.83	0.75
	Compost	0.75	0.66	0.96	0.76

Table 2. Grain yield, biomass yield (lbs/acre) and biomass and grain nitrogen (% dry matter) in response to N management

Parameter	Treatments	2018	2019
Grain Yield (lbs/acre)	N0	4854	4000
	N20	4585	3430
	N40	5609	3784
	N60	5558	4094
	Compost	5046	3416
Biomass Yield (lbs/acre)	N0	5358	4225
	N20	4966	3224
	N40	5053	3877
	N60	5880	4269
	Compost	5750	3572
Biomass N (% DM)	N0	0.93	1.94
	N20	1.00	1.98
	N40	0.99	2.04
	N60	0.99	1.97
	Compost	1.15	2.10
Grain N (% DM)	N0	1.66	0.91
	N20	1.73	0.90
	N40	1.74	0.94
	N60	1.65	0.88
	Compost	1.68	0.89

Short-Term Carbon Mineralization as Early Indicator of Soil Health in Silage Corn Production System

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Objective

The main objectives of the research were to evaluate the effects of cutting heights, row spacing, and cover crop treatments on these indicators.

Materials and Methods

The study was conducted at farmer's field west of Clovis on a 60-acre field under a half-circle of an irrigation pivot. The study had five treatments and four replications. The treatments included a cover crop [cereal rye (*Secale cereal* L.) and Austrian winter pea (*Pisum sativum* L.) mixture], two row-spacing [narrow (38 cm) and wide (76 cm)], and two corn silage cutting height [short stubble (SS – 6 inch) and tall stubble (TS – 18 inch)] treatments. The cover crop treatment had a narrow row spacing and short silage cutting height (38SSCC). The experiment was done in a half-circle of the irrigation pivot and spread across all seven spans of the pivot. Spans 1-3 had 38SSCC treatments, 4 and 6 had a narrow row spacing treatments, and span 5 and 7 had wide row spacing treatments. The cutting height treatments were nested within each row-spacing treatment in spans 4 to 7. Corn was planted in the second week of May using a John Deere commercial planter. The corn variety '9678VT3P' was used for both years of the study and planted at 21,500 seeds/acre. Soil fertility management was based on a soil test at the beginning of the experiment. Liquid blended urea and ammonium nitrate fertilizer (187 lbs/acre) was applied each year for the corn, and no fertilizer was applied for the cover crop. The field was irrigated on critical growth stages of corn with limited water available for irrigation in the study area. The cereal rye and Austrian winter pea cover crop mixture (70% rye+30% pea) was planted in October last week, at the seeding rate of 40 lbs/acre and were chopped for silage in April second week. Weed control on the cash crop was done by using herbicides Glyphosate and Keystone NXT at 2.34 L and 3.27 L ha^{-1} in May and Glyphosate and Status at 2.34 L and 4.68 L ha^{-1} on June each year.

Laboratory analysis included soil pH, EC, total N, soil organic carbon (SOC), potentially mineralizable carbon (PMC), and 72-hr C mineralization. Soil pH and EC were measured in a 1:1 soil to water ratio. The SOC and total N measured using a dry combustion analyzer, soil available P (Olsen), and K was analyzed at a commercial laboratory. Soil PMC content was measured by aerobic incubation of 20 g soils for two weeks in a quart-size Mason jar ™ modified to hold a 1.5 cm long butyl rubber stopper. The CO_2 produced in a jar was measured in an infrared gas analyzer (LI-COR Inc., Lincoln, NE). Effects of cutting height, row spacing, cover cropping treatments on labile SOC and N components were analyzed using PROC MIXED procedure in the Statistical Analysis System (SAS version 9.4, SAS Institute Inc. 2013) for randomized experiments.

Results

The baseline soil analysis for pH, EC and SOC showed slight alkaline pH with low organic matter content. There was no significant difference between soil properties even in the third year of the project. Soil pH was in the range of 7.8 – 7.9, soil EC in the range of 0.20 –

0.29 ds m^{-2}, available P 45.7 – 60 mg kg^{-1}, available K 279 – 357 mg kg^{-1}, total N 1.29 – 1.48 g kg^{-1}, and 11.9 – 13.3 g kg^{-1} and not significantly different between treatments (Table 1). The little or no difference between treatments is not unexpected given the semiarid climatic conditions (high temperature and minimal precipitation) in eastern New Mexico.

The short term soil C mineralization varied with cropping practices and cover cropping treatments in the first and third years but not in the second year (Figure 1a). In the first year, 72-hr C mineralization was significantly greater in treatment with tall stubble and wider spacing treatment whereas it was significantly greater with cover cropping and narrow spacing in the third year of the study. All other treatments were not significantly different in either year. The PMC followed the same trend as 72-hr C mineralization in the third year of the study that cover cropping treatment had more PMC than all other treatments (Figure 1b). However, the response was not consistent in the first and second years. There was no difference between treatments on PMC in the first year. In the second year, the PMC was significantly higher in narrow row spacing with tall stubble treatment than short stubble and wide row- spacing treatment. By estimating the response rate of PMC to 72-hr C mineralization, we demonstrated that later can serve as a quick measure to measure microbially available carbon and their activity in soils (Figure 2). The 72-hr C mineralization could help in the rapid estimation of soil health.

Table 1. Baseline and third-year data on soil properties under various treatments.

Treatment	Soil pH	Electrical Conductivity (ds m^{-1})	Available P (mg kg^{-1})	Available K (mg kg^{-1})	Total N (g kg^{-1})	SOC (g kg^{-1})
Baseline	7.9	0.31	-	-	-	11
15SSCC*	7.9±0.06	0.21±0.01	52.6±4.02	357±8.68	1.48±0.02	13.1±0.51
15SSNC	7.9±0.03	0.20±0.03	45.7±4.17	279±14.3	1.29±0.05	11.9±0.56
15TSNC	7.9±0.08	0.25±0.03	59.4±5.93	328±33.8	1.40±0.08	12.4±0.83
30SSNC	7.9±0.03	0.23±0.04	60.0±3.51	308±17.4	1.46±0.02	13.2±0.50
30TSNC	7.8±0.06	0.29±0.07	58.8±5.37	332±26.3	1.46±0.07	13.3±0.75

*The notations 15 and 30 indicate narrow and wide row spacing, SS and TS indicate short (6 inches) and tall (18 inches) stubble height, and CC and NC indicated cover crop and no cover crop.

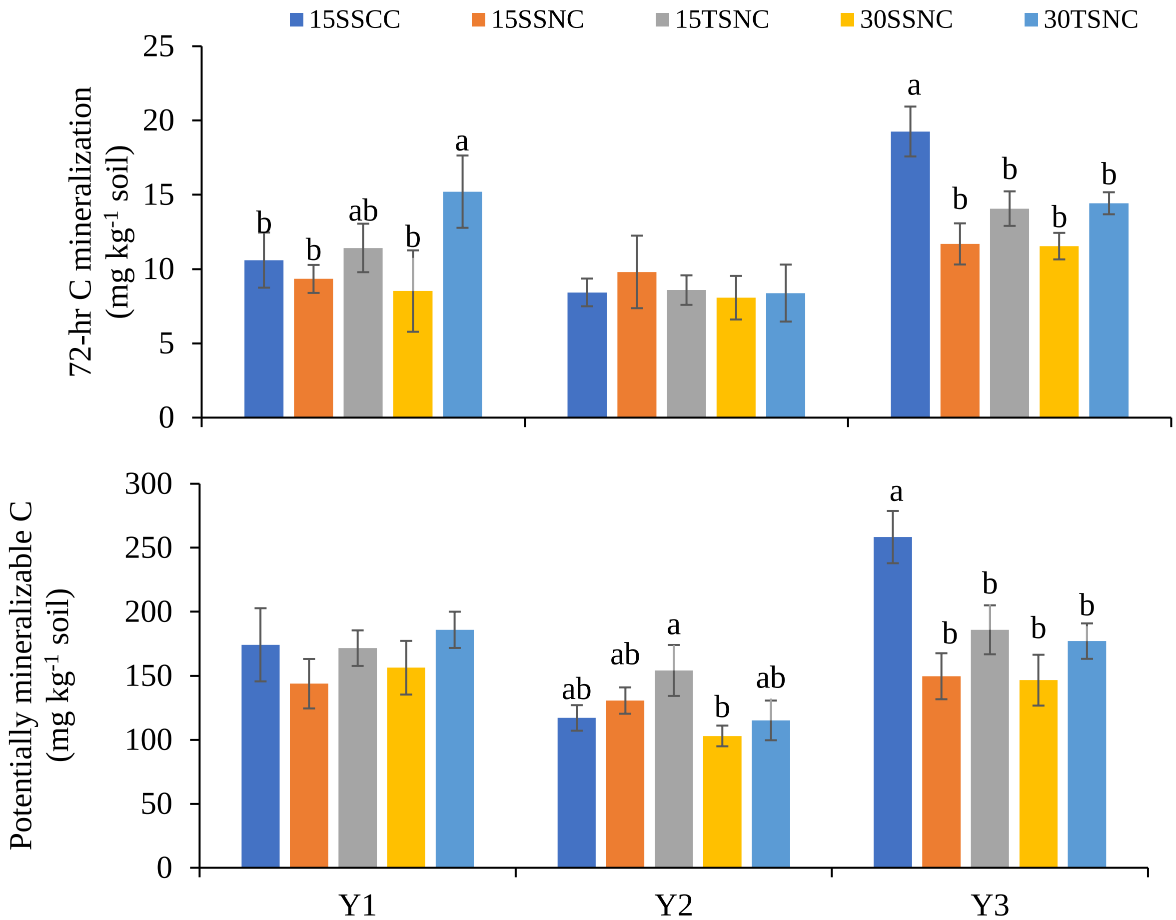

Figure 1. Soil carbon mineralization in 72-hrs and potentially mineralizable carbon in two-week-long incubation with different row spacing, stubble height, and cover crop treatments.

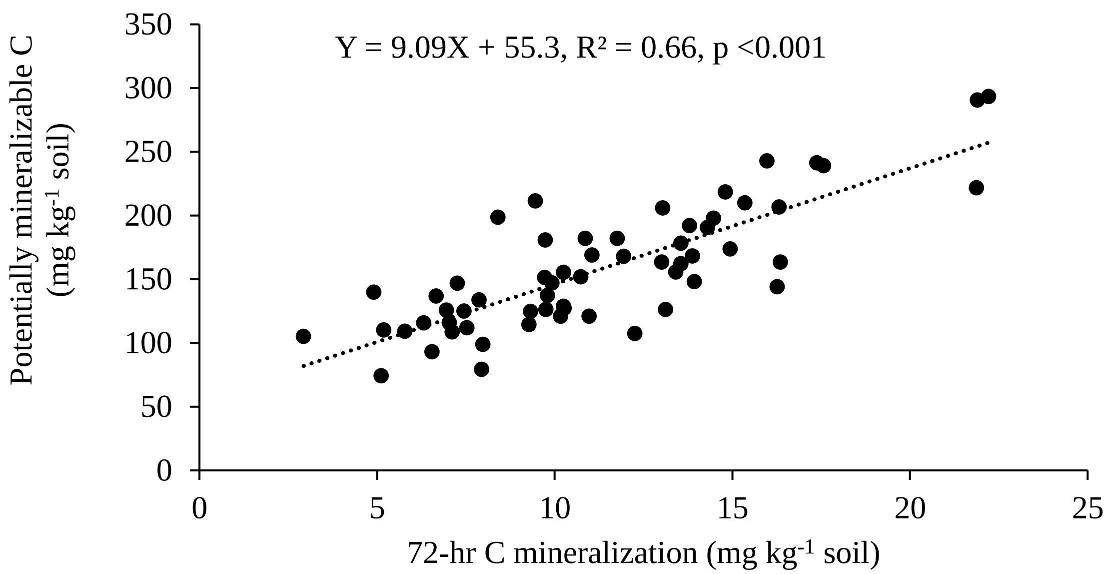

Figure 2. Relationship between 72-hr C mineralization and potentially mineralizable carbon

Valencia Peanut Breeding – Advanced Breeding Lines

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Objective

To develop a variety that can yield high, produce three or more kernels per pods, resistant to diseases, maintain red skin and taste of Valencia with high oleic chemistry.

Material and Methods

The experimental trial was planted on June 4, 2019, in 36-inch rows under center pivot irrigation. The study site was on a commercial peanut grower's field in Portales, New Mexico. Soil type is an Amarillo-Acuff-Olton, and elevation is 4006 feet. Individual plots consisted of two rows, 36-inch rows with 500 feet long. There were four replications for each entry, planted in a randomized complete block. Individual plots were planted at a seed rate of five seeds/foot. Plots were planted with a John Deere Max Emerge planter fitted with cone metering units. About 2 tons of compost was applied over the field in April 2019. The previous crop was a CRP grass.

The irrigation amount was roughly 1.5 inches per week except at planting when 3 inches of water was applied. The total irrigation amount, including precipitation received during the growing season, was roughly 20 inches. Peanuts were dug on October 12, 2019, and left for a week for drying. Peanuts were thrashed with a Lilliston big thrasher. Individual plot weights were recorded after drying the samples to 8% moisture. The plot yield was converted to pounds per acre and the results are reported in Table 1. Peanut quality, as measured by Total Sound Mature Kernels (TSMK), was graded using 500 grams of pods.

Statistical Analysis

Data for each variable were analyzed using the PROC MIXED model in SAS 9.3 (SAS Institute). An LSD t-test was used for mean separation involving entries (Steele and Torrie, 1989).

Results and Discussion

Three advanced breeding lines, namely CR-27, CR-47, and CR-19, showed higher pod yield compared to the check cultivar, Valencia-C (Table 1). All these materials were high oleic except the check Valencia-C. The grade ranged from 70 to 74 percent. The net return was higher for the breeding line CR-19 ($813.94), followed by CR-47 ($757.14) and CR-27 ($720.46). The average yield for the trial was 3365 lb/ac.

Table 1. High Oleic Valencia Advance Breeding Materials Tested at Portales, New Mexico in 2019

S.No	Name of the Cross or Line	Pod Yield (lb/ac)	Grade (TSMK)	Net Return[¶]
1	CR-27 (309 x Hart)	3707	72	720.46
2	CR-47 (308 X Perry)	4008	70	757.14
3	CR-19 (308 X Serenut 5R)	4075	74	813.94
4	CR-79 (309 X Serenut 6T)	3020	70	570.60
5	CR-50 (308 X Perry)	3146	70	602.86
6	CR- 55B (308 X Perry)	2817	71	532.19
7	CR-101 (M3 X 309-2)	3040	70	590.66
8	Valencia - C	3105	72	603.39
	Mean	3365	71	646.55

[¶]Net return calculated based on Valencia-type peanuts 5.398 per percent or $ 359.80 per ton https://www.fsa.usda.gov/news-room/news-releases/2018/nr_2018_0625_rel_0107

Organic Seed Treatment for Soilborne Pathogens Control in Valencia Peanut

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Objective

To minimize the impact of soilborne pathogens on Valencia peanut by treating seeds with commercially available organic seed treatment products.

Materials and Methods

The experimental trial was planted on June 3, 2019, in 36-inch rows under center pivot irrigation. The study site was on an organic peanut grower's field in Lingo, New Mexico. Soil type is an Amarillo-Acuff-Olton, and elevation is 3986 feet. Individual plots consisted of two rows, 36-inch rows with 20 feet long. There were four replications for each entry, planted in a randomized complete block. Individual plots were planted at a seed rate of five seeds/foot. Plots were planted with a John Deere Max Emerge planter fitted with cone metering units.

The details of the seed treatments are provided in Table 1, along with the application type (seed treatment or liquid) and the rate of application. The list of treatments evaluated included a chemical (Dynasty) product for comparison. About 2 tons of compost along with chicken manure at the rate of 50 lb/ac was applied over the field in April 2019. The previous crop was a CRP grass.

The irrigation amount was roughly 1.5 inches per week except at planting when 3 inches of water was applied. The total irrigation amount, including precipitation received during the growing season, was roughly 25 inches. Peanuts were dug on October 18, 2019, and left for a week for drying. Peanuts were thrashed with a small plot thrasher. Individual plot weights were recorded after drying the samples to 8% moisture. The plot yield was converted to pounds per acre and the results are reported in Table 2. Peanut quality, as measured by Total Sound Mature Kernels (TSMK), was graded using 500 grams of pods.

Statistical Analysis

All data were subjected to SAS® procedures for a test of significant difference between varieties. Mean separation procedures ((protected ($P<0.05$) least significant differences)) were used to determine where differences exist.

Results and Discussion

Peanut pod yield data along with TSMK for the 2019 seed treatment study are presented in Table 2. The average pod yield for the trial was 1406 lb/ac. The highest pod yield was recorded when the peanut seeds were treated with Cilus plus (1626 lb/ac). A preparation of Bacillus velezensis, commercial in Europe. Application of Cilus plus resulted in an increase of 363 lb/ac or 28.7% compared to the Untreated Check (1263 lb/ac). The chemical check Dynasty (1406 lb/ac) which was significantly not different from the organic seed treatments Trilogy (1478 lb/ac.), AKX 618 (1408 lb/ac), and Mycostop (1466 lb/ac.). By treating the Valencia peanut seeds with organic products a grower can benefit anywhere from $ 236 with AKX-602 to $ 315 with Cilus. Estimatednet result will give a true picture based on the cost of the product and the rate of application. We plan to repeat this study again in the 2020 growing season.

Table 1. List of ten organic seed treatments and one chemical seed treatment applied to experimental plots in a Valencia peanut field in Lingo, New Mexico.

S.No	Company	Product Name	Product Description	Application Type	Application Rate
# 1	Untreated Check	Untreated check	Raw Peanut Seed	N/A	N/A
#2	AgriEnergy Resources	Neem Combo	BioFungicide	Liquid IF	3%
# 3	AgriEnergy Resources	Trilogy	BioFungicide	Liquid IF	3%
#4	AgriEnergy Resources	Neem Combo + SP-1	BioFungicide	Liquid IF	3%
# 5	Agro-K	AKX-602	BioFungicide	Liquid IF	1 Qt/Acre
# 6	Agro-K	AKX-612	BioStimulant	Liquid IF	1 Pt/Acre
# 7	Agro-K	AKX-618 (AKX 602 +AKX 612)	BioStimulant	Liquid IF	1 Qt/Acre + 1 Pt/Acre
# 8	Lallemand (Distributed by AgBio Inc.)	Cilus	BioStimulant	Seed treatment	1 gram /kg seed
# 9	Lallemand (Distributed by AgBio Inc.)	Mycostop	BioFungicide	Seed treatment	12 g per 100 lb seed
# 10	Lallemand (Distributed by AgBio Inc.)	Prestop	BioFungicide	Liquid IF	0.25 g/sq meter
# 11	Chemical Check	Dynasty	Raw Peanut Seed	Seed treatment	1 gram /kg seed

Table 2. The one-year average for pod yield, total sound mature kernels (TSMK), and net return in plots planted to Valencia peanut seeds treated with ten organic and one chemical products.

S.No	Company	Product Name	Pod Yield	Grade (TSMK)	Net Return¶	Ranking
			lb/a		$/a	
1	Untreated Check	Untreated check	1263fe§	68.8b	234.63d	11
2	AgriEnergy	Neem Combo	1241f	70.8ab	237.20cd	9
3	AgriEnergy	Trilogy	1478bc	72.0ab	287.13ab	4
4	AgriEnergy	Neem Combo + SP-1	1394cd	71.3ab	267.95b	6
5	Agro-K	AKX-602	1267def	69.0b	235.68d	10
6	Agro-K	AKX-612	1380cde	71.3ab	265.30bc	8
7	Agro-K	AKX-618	1408bc	72.0ab	273.68b	5
8	**Lallemand**	**Cilus**	**1626a**	**71.8ab**	**314.95a**	**1**
9	Lallemand	Mycostop	1466bc	72.8a	287.89ab	3
10	Lallemand	Prestop	1534ab	70.0ab	290.14ab	2
11	Chemical Check	Dynasty	1406bc	70.0ab	265.58bc	7
12	**Mean**		1405.71	70.9	269.10	
	CV		6.43	3.2	7.37	
	LSD 0.05		130.44	3.28	28.65	
	Pr>F		<0.0001		<0.0001	

§Means followed by the same letter are not different at the *p*=0.05 level of probability
¶Net return calculated based on Valencia-type peanuts 5.398 per percent or $ 359.80 per ton

Rhizobium Inoculation Study in Valencia Peanut

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Objective

To evaluate commercially available rhizobium inoculants on peanut yield and grade.

Materials and Methods

The experimental trial was planted on June 3, 2019, in 36-inch rows under center pivot irrigation. The study site was on an organic peanut grower's field in Lingo, New Mexico. Soil type is an Amarillo-Acuff-Olton, and elevation is 3986 feet. Individual plots consisted of two rows, 36-inch rows with 20 feet long. There were four replications for each entry, planted in a randomized complete block. Individual plots were planted at a seed rate of five seeds/foot. Plots were planted with a John Deere Max Emerge planter fitted with cone metering units.

The details of the seed treatments are provided in Table 1, along with the application type (seed treatment or liquid) and the rate of application. The list of treatments evaluated included a chemical (Dynasty) product for comparison. About 2 tons of compost along with chicken manure at the rate of 50 lb/ac was applied over the field in April 2019. The previous crop was a CRP grass.

Irrigation amount was roughly 1.5 inches per week except at planting when 3 inches of water was applied. The total irrigation amount, including precipitation received during the growing season was roughly 25 inches. Peanuts were dug on October 18, 2019, and left for a week for drying. Peanuts were thrashed with a small plot thrasher. Individual plot weights were recorded after drying the samples to 8% moisture. The plot yield was converted to pounds per acre, and the results are reported in Table 2. Peanut quality, as measured by Total Sound Mature Kernels (TSMK), was graded using 500 grams of pods.

Statistical Analysis

All data were subjected to SAS® procedures for a test of significant difference between varieties. Mean separation procedures ((protected ($P<0.05$) least significant differences)) were used to determine where differences exist.

Results and Discussion

Peanut pod yield data along with TSMK for the 2019 Rhizobium treatment study are presented in Table 2. The average pod yield was higher when the seeds were treated with Rhizobium inoculants Terrasym (4329 lb/ac), Primo GX2 (4302 lb/ac), and Vault (4274 lb/ac). All these three inoculants were significantly not different from the chemical check, Abound (4538 lb/ac). The average pod yield for the trial was 3777 lb/ac. By treating the Valencia peanut seeds with rhizobium inoculants resulted in a significantly higher grade (69 to 72.8%) compared to the control (69%). The estimated net result was higher with Biological exceed, Terrasym, and VauLt inoculants.

Table 1. Details of rhizobium inoculant and rate of application.

S.No	Company	Product name	Application type	Application Rate
1	Untreated Check	Untreated check	None	N/A
2	Monsanto	Tag Team + Active Powder	Liquid IF + Granular	15 Oz/ac + 5.7 g/ac
3	Monsanto	Optimize Lift	Liquid IF	15 OZ/ac
4	Verdesian	Primo Power	Liquid IF	7.5 Oz/ac
5	BASF	Vault	Liquid IF	17.7 Oz/a + 10.6 mL/ac
6	Verdesian	Primo GX2	Granular	5.4 lb/ac
7	Visjon Biologics	Biological Exceed	Liquid IF	15 Oz/ac
8	New Leaf Symbiotic	Terrasym	Powder	5.4 lb/ac
9	Syngenta	Abound (Chemical)	Liquid IF	18.5 OZ/ac
10	Verdesian	Peanut Powder (Hopper box mixed)	Powder	10.0 Oz/ac

Table 2. One year average pod yield, total sound mature kernels (TSMK) grade and net return ($)

S.No	Inoculant	Pod Yield (lb/ac)	Grade (TSMK)	Net Return ($)
1	Control	**2605 e**	65.2 b	468.6 e
2	Tag Team	3576 c	70.8 ab	643.3 c
3	Optimize Lift	3630 c	72.0 ab	653.04 c
4	Primo Power	3049 d	71.3 ab	548.6 d
5	Vault	4274 a	69.0 b	770.6 a
6	Primo GX2	3957 b	71.3 ab	711.8 b
7	Biological Exceed	4302 a	72.0 ab	773.8 a
8	Terrasym	4329 a	71.8 ab	778.7 a
9	Abound	4538 a	72.8 a	816.3 a
10	Peanut Powder	3512 c	70.0 ab	673.2 c
	Mean	**3777**	**70.80**	**679.6**
	LSD 0.05	299.45	2.90	53.87
	Pr > F	<0.0001	0.1810	<0.0001

± Means followed by the same letter are not different at the *p*=0.05 level of probability

¶Net return calculated based on Valencia-type peanuts 5.398 per percent or $ 359.80 per ton https://www.fsa.usda.gov/news-room/news-releases/2018/nr_2018_0625_rel_0107

Performance of Cotton Varieties

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Objective

To evaluate commercial cotton varieties suitable for eastern New Mexico.

Materials and Methods

The cotton variety trial was planted on May 3, 2019, in 30-inch rows under center pivot irrigation. Soil type is an Olton silty clay loam, and elevation is 4,435 feet. Individual plots consisted of single, 30-inch rows 30 feet long. There were four replications for each entry, planted in a completely random block. Individual plots were planted at a seed rate of 5 seeds/foot. Plots were planted with a John Deere Max Emerge planter fitted with cone metering units.

On May 14, the planting area was treated with herbicides Caprol @ 1.6 pt/ac and Prowl H2O @ 2 pt/ac as pre-emergence application. After planting on June 15, 2019, herbicides Panther SC (3 Oz/ac), and Brawl (1 pt/ac) were sprayed and irrigated. Fertilizer applied was 28-0-0-5 N:P:K + Sulphur at the rate of 30 gallons per acre. Growth regulators applied were, Prevathon 20 Oz/ac, Pix 24 Oz/ac, Prep @ 20 Oz/ac and Def 6 2 pt/ac.

The total irrigation amount was 4.5 inches applied over the growing period. Precipitation received during the growing period was 19.0 inches. The plots were harvested on November 22, 2019, with a cotton stripper. Individual plot weights were recorded. For fiber quality, each individual plot was hand-harvested with 25 bolls randomly picked within a plot. The fiber samples were sent to the Louisiana State University ginning lab after calculating the lint percent from 25 boll samples.

Statistical Analysis

All data were subjected to SAS® procedures for a test of significant difference between varieties. Mean separation procedures ((protected ($P<0.05$) least significant differences)) were used to determine where differences exist.

Results and Discussion

Yield data along with quality traits for the 2019 cotton trial are presented in Table 1, lint yield for the 7 varieties in the trial, ranged from 1728 to 2570 lb/ac with a trial average of 2119 lbs/acre. The estimated net return was $ 656 for PHY 210W3FE, followed by $ 542.5 for DP 1820 B2XF. The average net return was $ 524.

Table . 1. New Mexico 2019 Cotton Variety Performance Test - Agricultural Science Center at Clovis

Company Name	Variety Name	Seed cotton lbs/a	Lint yield lbs/a	Bales per a	Lint %	Boll wt g	Length	Uniformity	SFI	Strength	Elongation	MIC	Maturity	Loan Value cents/lb.	Estimated net return $/a	Rank
BASF	FM 2498 GLT	2142	1071	2.2	44.7	2.8	1.20	84.7	8.0	30.2	4.2	4.5	83.0	53.9	510.8	5
BASF	FM 2574 GLT	1866	933	1.9	44.9	2.8	1.22	84.1	8.3	33.4	3.8	4.3	82.8	56.4	467.3	6
Phytogen	**PHY 210W3FE**	**2570**	**1285**	**2.7**	**46.1**	**2.8**	**1.21**	**85.8**	**7.2**	**33.5**	**4.2**	**#**	**81.8**	**57.1**	**656.3**	**1**
Phytogen	PHY 250W3FE	2214	1107	2.3	45.2	2.7	1.18	84.5	7.8	34.1	4.7	4.1	81.8	54.6	537.5	3
BASF	DP 1646 B2XF	2142	1071	2.3	45.9	2.4	1.27	84.7	7.8	31.1	6.6	4.5	81.3	56.6	542.5	2
BASF	DP 1820 B2XF	1728	864	1.8	46.9	2.5	1.26	85.7	7.2	35.1	3.9	4.5	83.3	55.0	424.5	7
BASF	DP 1612 B2XF	2178	1089	2.3	44.3	2.5	1.22	84.8	7.4	33.8	7.4	4.3	80.0	55.1	528.3	4
	Trial Mean	**2119**	**1060**	**2.2**	**45.4**	**2.6**	**1.22**	**84.9**	**7.7**	**33.0**	**5.0**	**#**	**81.9**	**55.5**	**523.9**	
	CV	15.1	15.1	16.1	7.78	7.8	2.99	1.28	9.57	4.33	9.84	5	0.75	3.74	13.8	
	Pr>F	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0	0.05	0.05	0.05	
	LSD0.05	475.75	237.96	0.53	5.10	0.30	0.05	1.62	1.09	2.12	0.73	0.29	0.91	3.10	107.22	
	Pr>F	0.0892	0.089	0.136	0.98	0.107	0.055	0.342	0.432	0.006	<0.0001	0.015	<0.0001	0.4215	0.0226	

Corn Growth and Yield in Perennial Grass Buffer Strips (CBS) in a Center Pivot

Sangu Angadi, Paramveer Singh, M.R. Umesh, Sultan Begna, Gary Marek, Prasanna Gowda and Rajan Ghimire

RATIONALE: Bringing underutilized/unirrigated part of partial pivots under multiple circular strips of perennial grasses can protect soil, soil water, and plants against hot and dry winds. This system may improve long term sustainability and profitability of irrigated agriculture in the region, while reversing the degraded soil quality and ecosystem over time.

Objectives:

- To assess the effect of circular buffer strips on wind speed experienced by corn at soil surface.
- To evaluate the effect of circular grass buffer strips on corn physiological processes.
- To evaluate growth, and yield of corn with and without circular grass buffer strips.

Materials and Methods

A long-term project was initiated at the New Mexico State University Agricultural Science Center, Clovis (34.60˚N, 103.22˚W, elevation 1331m). A mixture of native warm season and cool season grasses (seven species) were planted on August 8, 2016 on a quarter section of a pivot. The quarter facing southwest direction was selected as it is the pre-dominant wind direction CBS (Fig 1a). A Quarter section of nearby pivot facing the same direction without CBS served as control (Fig 1a). Outer most strip in the pivot was 30 ft wide grass strip, which alternated with 60 ft wide crop strips. Encouraged from preliminary results in 2017 and 2018, the trial was continued in 2019. Pioneer 1151 cultivar of corn was planted on 05/08/2019 with 0.76 m row spacing. Each crop strip in CBS had 24 corn rows. A total of 270 mm of irrigation was applied to corn in CBS and control. Grass strips of CBS received two irrigations of 51 mm each, one on 15th March 2019 to initiate grass growth and second on 25th May 2019 because it was extremely dry. In August 2019, as the corn was grown above grass height (benefit of CBS is minimum on corn), grass was swathed and baled.

Wind sensors were installed at a 1.5 m, 9.1 m, and 16.5 m distance from the edge of first grass strip and the outer edge of control pivot. They were installed close to soil surface to monitor the effect of grass buffer strips on wind speed. Physiological (photosynthetic rate, water potential, and chlorophyll florescence) and agronomic measurements (plant height and biomass) were taken at V-4, V-6, V-8, and tasseling stage at 2-weeks interval. In addition, agronomic measurements were also taken at R3 and maturity. Physiological measurements were taken at noon, on a fully opened corn leaf. LI-COR6400 portable photosystem was used to measure leaf photosynthetic rate. A continuous source fluorometer (Model OS 30p, Opti-Science) was used to measure fluorescence. A pressure bomb apparatus was used to measure leaf water potential. Both physiological and agronomic measurements were taken at various distances from the outer edge in both CBS and control. In CBS, all these observations were taken only in the first crop strip.

For biomass sampling, 4 plants from different rows were harvested, chopped and fresh weight was recorded. Samples were oven dried at 65̊C for 72 h. Dry biomass weight was recorded when a constant dry weights were obtained after drying for three days. At maturity, 10 plants were hand harvested for biomass. To assess the effect on large plots and integrate effects on different locations in the edge, 12 passes of 8 rows wide were harvested in CBS pivot and control pivot. In CBS, each crop strip had 3 passes, two sharing edges with grass strips and one in the middle (Fig 1b). The seed yield was adjusted to a standard seed moisture content.

Results and Discussion

The first corn strip in CBS experienced lower wind speed at the soil surface than control (Fig 2). This indicates that grass buffers can reduce impact of wind on plants, soil, and soil evaporation. Moderation of wind by grass buffer had a positive effect on corn growth and development. Leaf water potential, chlorophyll florescence, and photosynthetic rate of corn at tasseling (considered as the most drought-sensitive growth stage of corn) was higher in CBS than control (Table 1). This suggests that corn in control pivot experienced higher-level of water stress than CBS, even though both received same amount of irrigation. The growth and development of corn was better in CBS, especially near the outer edge. At 1.5 m from the outer edge, corn plants produced 32% more biomass and were 16% taller in CBS than control (Table 2). Overall, CBS produced 15% higher corn biomass than control. Attributing to improved physiological response and growth, corn yield was 9%, 20%, and 15% higher at outside, middle, and inside edge (8-row passes) in CBS. Results indicates that alternate grass buffer strips improved corn growth, yield, and water use efficiency (higher yield with same amount of irrigation and rainfall) by minimizing wind stress which is known to increase evapotranspiration demand, especially in hot and dry conditions. In addition, perennial grass buffer strips were used by birds to lay eggs (Fig 4). Thus, by converting under/un-utilized part of partial pivots may not only improve agricultural productivity but also can increase water use-efficiency and wildlife activity.

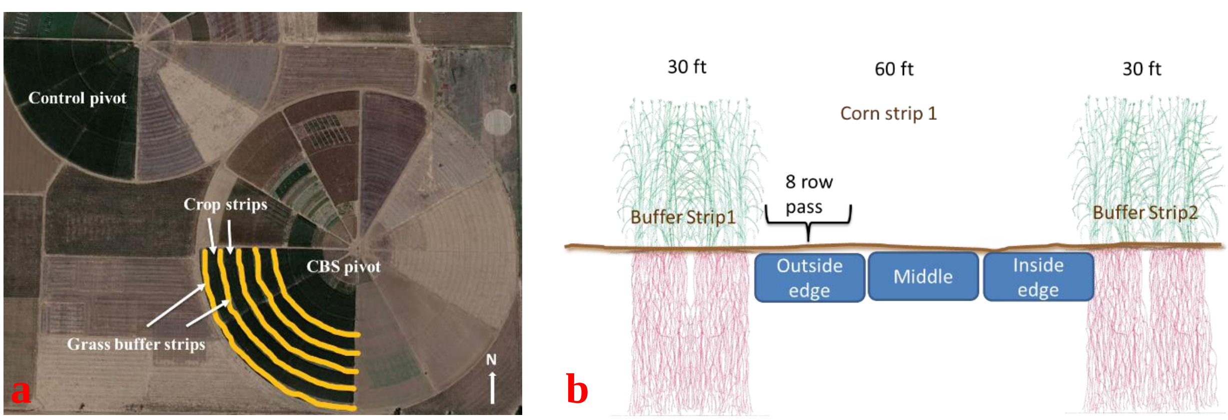

Fig 1. (a) Location of CBS and control pivot at ASC, Clovis. (b) Three harvest passes (each having 8 rows) of corn strip in CBS. Since, there were 4 corn strips, a total 12 passes were harvested. Similar number of passes were harvested in control pivot.

Table 1. Comparison of mid-day photosynthesis, leaf water potential, and chlorophyll florescence of corn at tasseling between first crop strip of CBS and control at different distances from the outer edge of respective center pivot circles in 2019 at ASC, Clovis.

Distance from outer edge (m)	**Photosynthetic rate at tasseling ($\mu molm^{-2}s^{-1}$)**		**Leaf water potential at tasseling (bar)**		**Florescence (F_v/F_m)**	
	Buffer	**Control**	**Buffer**	**Control**	**Buffer**	**Control**
1.5	8.5	3.4	-19.0	-22.8	0.76	0.70
3.8	12.0	6.9	-18.5	-21.1	0.80	0.69
9.1	21.0	11.9	-18.2	-19.9	0.79	0.75
14.5	17.1	14.1	-19.0	-19.6	0.81	0.76
16.7	13.9	15.3	-18.7	-19.8	0.81	0.70

Table 2. Comparison of plant height and biomass of corn at maturity between first crop strip of CBS and control at different distances from the outer edge of respective center pivot circles in 2019 at ASC, Clovis.

Distance from outer edge (m)	**Plant Height (cm)**		**Biomass at maturity (Kg ha^{-1})**	
	Buffer	**Control**	**Buffer**	**Control**
1.5	140	120	2911	2193
3.8	160	152	4736	3472
9.1	176	164	6111	4859
14.5	160	162	6012	6052
16.7	167	138	5599	5443

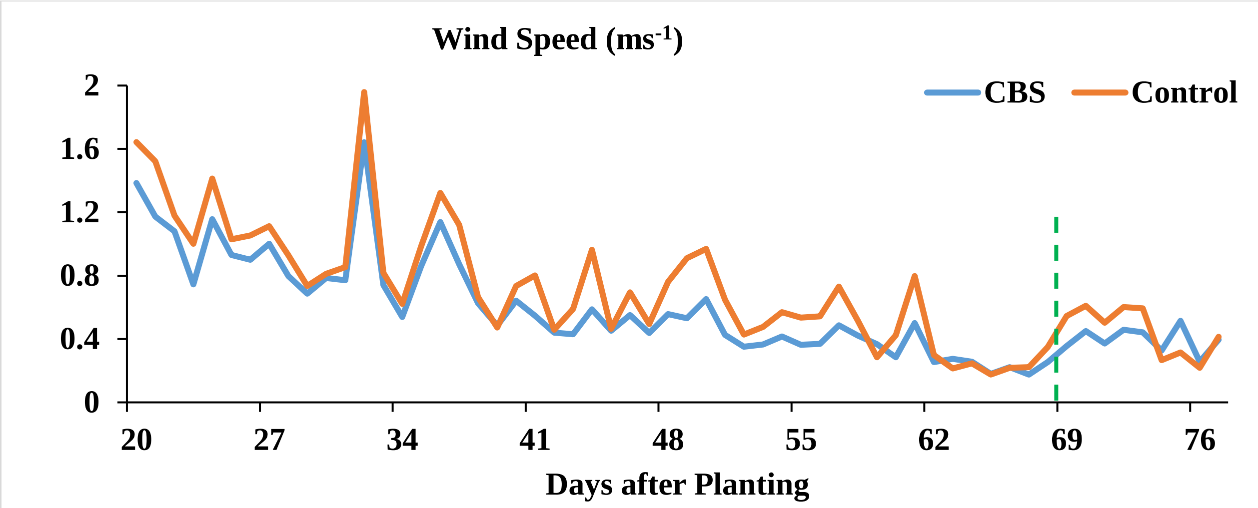

Fig.2 Comparison of wind speed experienced by corn in CBS and control during 2019 growing season at ASC, Clovis. Green dotted line represents tasseling stage.

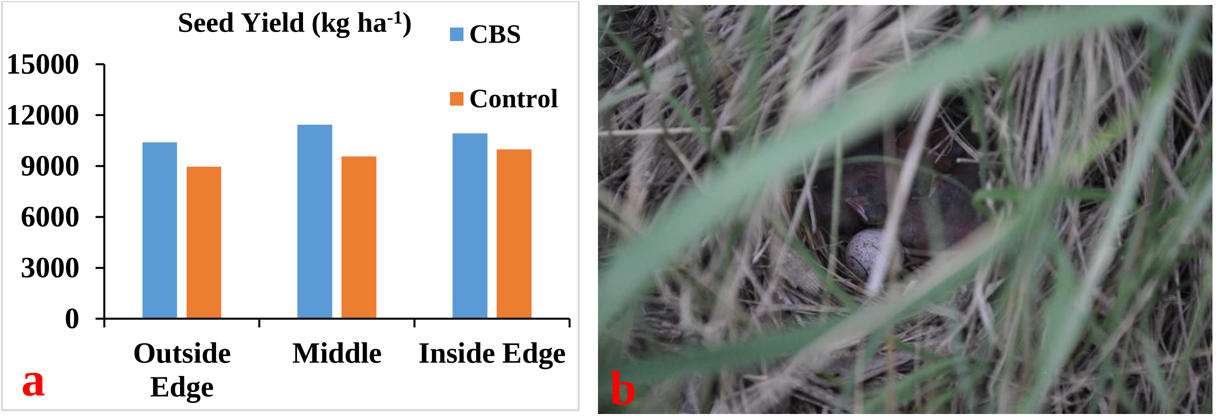

Fig 3. (a) CBS vs Control for mean corn yield across three 8-row passes in 2019. (b) Hatchlings and eggs were found in a small nest in one of the grass buffer strip at ASC, Clovis.

Identify Guar Germplasm Suitable for Cooler Northern Latitudes of Southern High Plains

Jagdeep Singh, Sangu Angadi, and Sultan Begna
Agricultural Science Center, New Mexico State University, Clovis, NM

Objective

To examine the effect of different temperatures on the initial growth of different commercial available guar cultivars.

Material and Methods

This was an incubator study conducted at NMSU Agricultural Science Center in Clovis NM (34° 35' N, 103° 12' W and elevation of 1348 m above mean sea level).

Design: Split plot design.

Treatments:

Main plot: Six different temperatures (13°C, 16°C, 19°C, 22°C, 25°C and 28°C).

Sub plot: Six different guar cultivars (Kinman, Monument, Judd 69, Matador, Lewis and Santa Cruz).

Results and Discussion

Temperature improved the final seed germination in all cultivars. Most of the cultivars recorded highest germination in 19° - 25°C temperature range. The germination percentage was decreased both at above and below this temperature range. A drastic decline was observed in germination percentage in most of the cultivars when temperature decreased from 22°C to 19°C. At the lowest temperature (13°C), Kinman had germination percentage above 75%, while other cultivars recorded lower than 45% germination. Kinman showed consistent germination percentage at all temperatures from 16 to 28°C. Matador recorded lowest germination percentage at lower temperature ranges (13 to 19°C), but as temperature increases, germination percentage of Matador surpassed the germination percentage of Monument, Lewis and Santa Cruz and reached 95% at the highest temperature (28°C). This shows the germination potential of Kinman at lower temperature and suggest high variability present among available guar cultivars.

In general, seed vigor index was increased with increase in temperature. Kinman had higher seed vigor index at lower temperature ranges (16 to 19°C) and Matador had lowest seed vigor index at temperature range of 13 to 22°C. The mean germination time also showed some interesting trend. The mean germination time was decreasing with increase in temperature. At temperature range of 13 to 19°C, Kinman was the fastest while Monument and Matador were the slowest cultivars and they took longer time to germinate as compared to other cultivars. Further increase in temperature, changed the mean germination time of Monument drastically and it was fastest to germinate at the highest temperature (28°C). This illustrates that Kinman could prove a better cultivar for the areas having cooler temperatures.

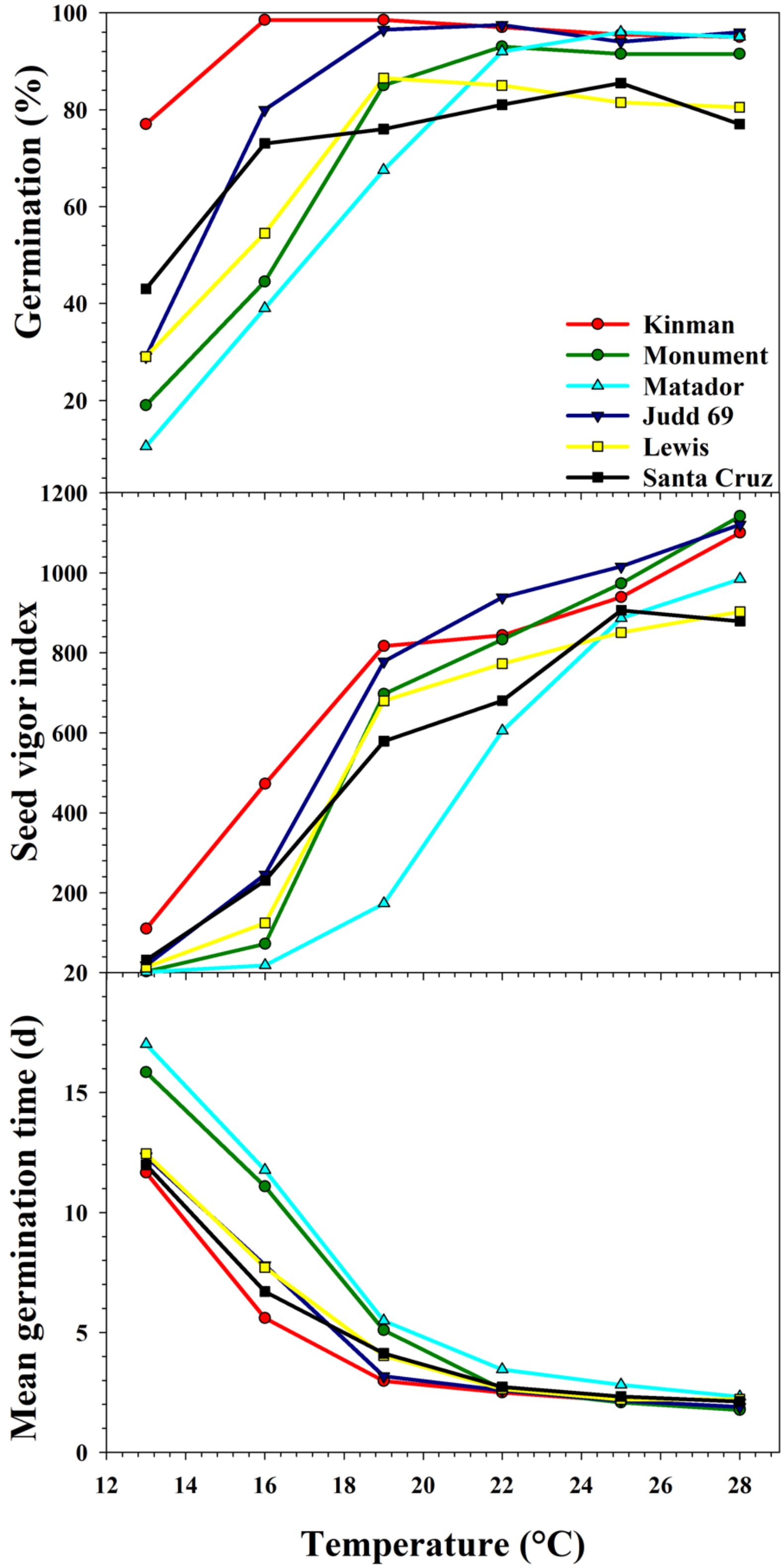

Fig.1 Evaluating the effect of temperature and cultivars on seed germination percentage, seed vigor index and mean germination time (*MGT*) of six guar cultivars grown in a dark growth chamber at temperature range of 13°C – 28°C.

Crop Growth Stage Based Deficit Irrigation Management in Guar Crop

Sangu Angadi, Jagdeep Singh, Sultan Begna
Agricultural Science Center, New Mexico State University, Clovis, NM

Objective

To examine the effect of critical stage based deficit irrigation on in-season biomass, seed yield and harvest index under pre-irrigation and no pre-irrigation conditions.

Material and Methods

Experiment location was NMSU Agricultural Science Center in Clovis NM (34° 35' N, 103° 12' W and elevation of 1348 m above mean sea level).

Design: Strip block design with three factors.

Treatments:

Main plot: 1) Pre-irrigation.

2) No pre-irrigation.

Main plot: Four in season irrigation treatments [Fully irrigated (FI), Irrigation water stress at vegetative stage (Vst), Irrigation water stress at reproductive stage (Rst) and Rainfed/Dryland (RD)].

Sub plot: Guar cultivars (Kinman and Monument).

Date of sowing: July 3 and June 12 in 2018 and 2019 respectively.

Spacing: Row to row distance was 30 inches.

Seed rate: 8 lbs/acre.

Replications: 4 (Four replica of each treatment)

Results and Discussion

Seed yield under pre-irrigation treatment recorded 27% more and 9% less than seed yield under no pre-irrigation treatment in 2018 and 2019 respectively (Table 1). The harvest index (HI) was recorded lower in pre-irrigated plots in both years. This indicates that guar was not able to contribute the pre-season irrigation into seed yield formation effectively (Table 1). We did not observe any significant differences for final seed yield between Rst and Vst treatments. Fully irrigated treatment recorded the highest seed yield in both years, although not significantly different than other stress treatments, excluding RD in 2019. This shows the drought tolerance of guar. Overall, both cultivars performed similarly, and Kinman had higher seed yield than Monument.

Application of pre-irrigation improved the aboveground biomass significantly in 2018, while effect of pre-irrigation in 2019 was not significant. The fully irrigated treatment had higher aboveground biomass and rainfed treatment recorded the lowest aboveground biomass in both years. The Rst treatment had higher aboveground biomass than Vst treatment throughout the season in 2018. During 2019, the Rst treatment recorded higher aboveground biomass in the initial vegetative growth stage. Afterwards, Vst treatment surpassed the Rst treatment and recorded higher aboveground biomass at the end of crop season. There were significant differences recorded for the aboveground biomass of cultivars. Kinman recorded higher biomass than Monument. This might be due to non-branching and early maturing habit of Monument (Figure 2).

Table 1. Seed yield and harvest index (HI) two guar cultivars under different irrigation treatments in 2018-2019.

	2018		2019	
Treatments	Seed yield (kg/ha)	HI (%)	Seed yield (kg/ha)	HI (%)
Pre-irrigation (P)				
Yes	1024 a	30.8 a	302 a	26.6 b
No	807 b	35.8 a	330 a	33.3 a
Growth Stage-Based (S)				
FI	983 a	29.1 c	365 a	27.8 b
Vst	811 a	32.3 bc	364 a	29.8 ab
Rst	977 a	34.3 ab	290 ab	30.0 ab
RD	893 a	37.4 a	246 b	32.2 a
Cultivars (C)				
Kinman	956 a	32.0 a	368 a	31.0 a
Monument	876 a	34.6 a	265 b	28.9 a
Interactions				
P*S	NS	NS	NS	NS
P*C	NS	NS	NS	NS
P*C	NS	NS	NS	NS
P*S*C	NS	NS	NS	NS

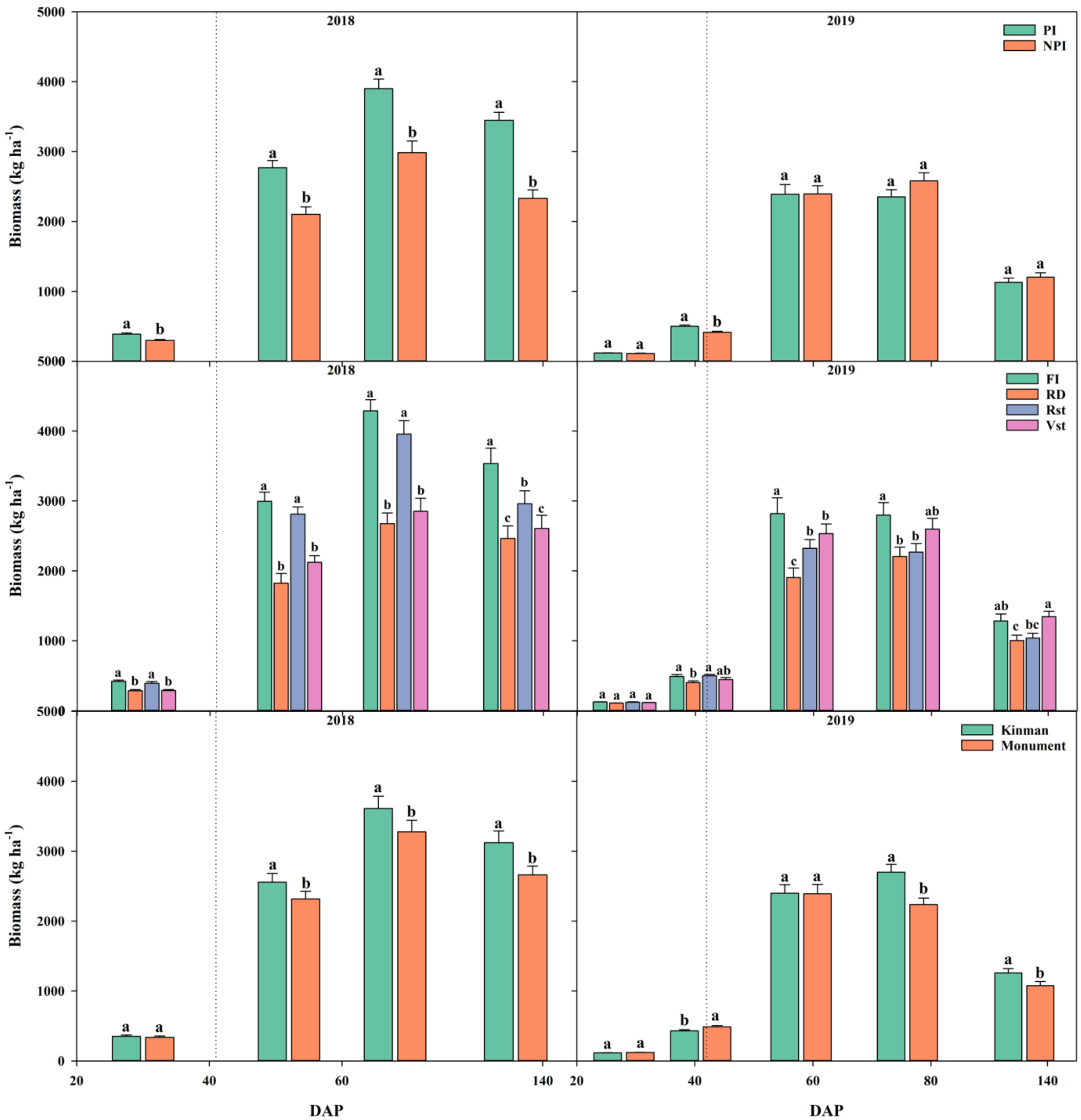

Fig. 1. Aboveground biomass of guar during crop season under different irrigation treatments in 2018-19. Bars having different letters are statically different at 5% p-value.

Winter Canola under Different Irrigation Strategies in the Southern High Plains of the USA

Paramveer Singh, Sangu Angadi, Sultan Begna, Dawn VanLeeuwen, and Brian Schutte

Objective

- To evaluate the effect of irrigation strategies on seasonal growth of winter canola cultivars.
- Assess the impact of water stress at different growth stages on growth and yield.

Materials and Methods

The experiment was conducted for three years (2016 to 2018) at the New Mexico State University Agricultural Science Center, Clovis (34.60˚N, 103.22˚W, elevation 1331m). Three cultivars of winter canola (*Brassica napus* L.) were planted under a center-pivot irrigation system in rotation with wheat. Field was disked and ploughed to prepare it for planting and to incorporate wheat residue. The experiment was planted on September 20th, 12th, and 12th of 2016, 2017, and 2018 respectively using an eleven-row drill (John Deer Maximizer). The plot size was 9.1 m × 1.7 m with one pass per plot. Crop was planted at 15 cm row spacings at a 4.5 Kg ha^{-1} seed rate. Split block design with split-split arrangement was used with

- Dormant period irrigation (DI: applied, and NDI: not applied) as main plot treatment
- Growth-Stage Based irrigation (Irr – fully irrigated, VStss – no irrigation during vegetative growth, RStss – no irrigation during reproductive period, RD - rainfed) as sub-plot treatment.
- Three winter canola cultivars (Riley, Hekip, and DKW-46-15) as sub-sub plot treatment

Irrigation treatments were started after crop was well established. A total of 99 mm, 33 mm, and 33 mm of irrigation was applied for establishment in 2016-17, 2017-18, and 2018-19 respectively (Table 1). To evaluate seasonal growth of winter canola, aboveground biomass samples were collected several times during the growing season. An area of 0.25 m^2 was hand harvested and oven dried at 65̊ C for 72 h. Dry biomass weight was recorded when a constant dry weight was obtained after drying for three days. At maturity, an area of 1 m^2 was hand harvested to calculate harvest index. Plant samples were oven-dried, weighted, and then were thresehed using a plot combine (Model Elite Plot 2001, Wintersteiger, Reid, Austria) to obtain seed yield. Harvest index was calculated as the ratio of seed yield to total dry plant biomass. For final seed yield, an area of 9.2 m^2 was harvested using the above-mentioned plot combine. The seed yield was adjusted to a standard 10% seed moisture.

Results and Discussion

Applying irrigation during dormant period significantly increased aboveground biomass in 2016 and 2017 but did not had similar effect in 2018 (Table 2). Relatively higher biomass in DI increased canola's capacity to intercept photosynthetic active radiation (PAR). This advantage of DI over NDI was of greater magnitude in first two years than the third year. In 2018-19, NDI plots were on the downhill side of field slope. Therefore, these plots were better placed to receive more rainwater (runoff). Winter canola was able to recover from early vegetative-stage water stress-like condition. Biomass accumulation was increased in VStss, once the irrigation was resumed after flowering. Attributing to improved growth, VStss produced 8%, 11%, and 20% more seed yield than RStss in 2016-17, 2017-18, and 2017-18 respectively (Table 2). Dormant irrigation did not influence oil content (OC) and harvest index (HI) (Table 3). Compared to Irr, harvest index was significantly reduced in RStss and RD in all three years. While, HI for VStss and Irr treatment was similar in 2017-18 and 2018-19 (Table 3). Out of three cultivars, Hekip performed better during three seasons. Winter canola seems to be performing well in southern High Plains and can prove a viable option in the face of water scarcity. Farmers can further reduce water inputs by restricting irrigation during vegetative stage without much yield loss.

Table 1. Amount of irrigation (mm) applied for winter canola establishment and to each irrigation treatment during 2016-17, 2017-18, and 2018-19 season at Clovis, NM.

Purpose	2016-17	2017-18	2018-19
Establishment	99	33	33
Dormant period irrigation			
DI	140	152	107
NDI	0	0	0
Growth-stage based irrigation			
Irr	193	229	203
VStss	86	112	127
RStss	107	127	76
RD	0	0	0

Irr: Fully irrigated, VStss: No irrigation during vegetative stage, RStss: No irrigation during reproductive stage, RD: Rainfed

Table 2. Final biomass (BM), and seed yield (SY) of three winter canola cultivars under different irrigation treatments in 2016-17, 2017-18 and 2018 at Clovis, NM.

Treatments	2016-17		2017-18		2018-19	
	BM (kg ha^{-1})	SY (kg ha^{-1})	BM (kg ha^{-1})	SY (kg ha^{-1})	BM (kg ha^{-1})	SY (kg ha^{-1})
Dormant irrigation						
Applied (DI)	8975 a †	1635 a	10826 a	2025 a	11523 a	2971 a
Not applied (NDI)	7267 b	1154 a	9270 b	1626 b	9861 a	2756 a
Growth stage-based irrigation						
Fully irrigated	9143 a	1951 a	12199 a	2489 a	12360 a	3339 a
Stress at vegetative stage	8486 ab	1638 a	10596 b	1992 b	10830 b	3179 a
Stress at reproductive stage	7950 bc	1179 b	9791 b	1730 c	10379 bc	2544 b
Rainfed	6905 c	809 c	7605 c	1091 d	9198 c	2394 b
Cultivars						
Hekip	8910 a	1429 a	9926 ab	1966 a	10988 a	31340 a
DKW46-15	7309 c	1316 a	9759 b	1569 b	10343 a	2658 b
Riley	8143 b	1438 a	10458 a	1941 a	10746 a	2794 b

†Values within a column followed by same the letter are not significant different at P≤0.05.

Table 2. Harvest index (HI), and oil content (OC) of three winter canola cultivars under different irrigation treatments in 2016-17, 2017-18 and 2018 at Clovis, NM.

Treatments	2016-17		2017-18		2018-19	
	HI (%)	OC (%)	HI (%)	OC (%)	HI (%)	OC (%)
Dormant irrigation						
Applied (DI)	15 a	38.74 a	20 a	35.44 a	25 a	39.42 a
Not applied (NDI)	15 a	37.93 a	18 b	35.36 a	23 a	39.34 a
Growth stage-based irrigation						
Fully irrigated	20 a	39.67 a	23 a	37.01 a	25 a	40.81 a
Stress at vegetative stage	16 b	38.42 b	21 ab	35.38 b	27 a	40.11 ab
Stress at reproductive stage	15 bc	38.35 b	19 b	35.06 b	22 b	39.62 ab
Rainfed	13 c	36.90 c	13 c	34.22 b	22 a	37.02 b
Cultivars						
Hekip	17 a	37.61 c	19 ab	35.07 b	25 a	39.48 ab
DKW46-15	14 b	39.34 a	17 b	35.96 a	21 b	39.10 b
Riley	17 a	38.04 b	20 a	35.24 b	26 a	39.60 a

Strategies for Soil and Water Conservation and Sustainable Forage Corn Production in New Mexico: Increasing Cutting Height, Decreasing Row Spacing and Forage Quality Considerations

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Rational:
Dairy industry's contribution to New Mexico's agricultural revenues is huge (~40%, $1.3 billion) and vital for state's economy. Forage corn is the main row crop for dairy industry, but production system removes most of the vegetation out of field living soil exposed to wind and water erosion. With wide row spacing of 30", 3 to 6" silage cutting height and long fallow period, the system is inefficient to conserve soil and water resources and hence corn silage system is unsustainable. Recent observations are also suggesting that bottom portion of the stem in corn is of lower quality and it lowers overall quality of forage. We hypothesized that increasing corn cutting height and decreasing row spacing has the potential to conserve soil and water and also improve forage quality without affecting forage yield significantly.

Objective:
On-farm **demonstration/**research to evaluate effect of increased forage corn cutting height (6 vs. 21") and reduced row spacing (15 vs. 30") on forage yield, forage quality, soil quality (soil organic matter components), soil moisture, wind dynamics and economics.

Materials and Methods
The second year of the project was established in spring of 2018 in dairy producer's (co-operator, Heritage Dairy Farm) field near Clovis, NM in a half-circle of a center pivot (6o acres). The field has seven spans encompassing two corn row spacing, two forage corn (silage) cutting height. The experimental design is a split-plot design with four replications (span 4, 5, 6 and 7); row spacing and silage cutting height as main and sub-plots, respectively. Corn was planted on May 12 and 17, in 2017 and 2018 respectively. In 2017 corn was planted into no-tilled field (previous crop canola), while in 2018 was into previous corn field using commercial planter (model DB60, John Deer Planter, Moline IL, USA). The corn variety '9678VT3P' was selected for the trial for both years. It was planted at 22,000 seeds ac^{-1} in both years. Liquid fertilizer blend (32-0-0) was pumped through sprinkler at a rate of 5.35, 6.58 and 5.59 tons in June 16, 24 and July 27, 2018 resulting in total equivalent of 187 lbs ac-1 of nitrogen. Herbicide Glyphosate and Keystone nxt at 32oz and 1.4 qt ac-1 in May 13 and Glyphosate and Status at 32 oz and 2 oz qt ac-1 in June 24, 2017 were applied for weed control.
The field operation follows producer's management practices. Crop was irrigated although the availability of irrigation water was limited (13 inches in total). Soil samples were taken in May 18, 2017 before fertilizer application and after final harvest in fall of both years. Samples were taken by a graduate student (partially funded by this grant) guided by supervisor (Co-PI) with the GPS grid mapping approach prepared earlier. Samples processing/analysis for soil organic matter components (such as mineralizable carbon, nitrogen, available phosphorus, and inorganic N (NH4 and NO3) taken in October of 2017 and 2018 after forage harvest. Soil quality, forage

yield and quality were assessed each year. A strip of 20 ft wide in the center of each plots of varying length depending on the span size (ranging from 1983 ft to 3680 ft) was harvested using producer's commercial forage chopper and collected in a separate truck. Plot weights were determined by weighing the truck with and without forage from the plot. Two samples of about 500 grams were collected from each plot harvest and placed in paper bags and plastic bags for estimation of moisture content and nutritive value. After fresh weights were recorded, samples were dried to a constant weight at 65˚C. Dried and fresh weights were used to estimate forage biomass production per acre. The dried samples were ground to pass through a 1-mm screen using a Wiley Mill (Thomas Manufacturing) and submitted to the certified Laboratory in University of Wisconsin to estimate nutritive values using near-infrared spectroscopy and Milk 2000 technology.

A cover cropping (Rye-winter pea mixture, variety Elbon and Austrian, respectively) treatment was also added in the section of the field (span 1, 2 and 3) in conjunction with short cut/stubble height and narrower spacing after forage harvest for comparisons with other treatments mentioned above. The rye-pea mixture (65:35 %) was planted at 41 lbs ac-1 rate. Cover crop was planted in November of 2017. Once cover crop was established sensors were set for wind and soil moisture dynamics monitoring.

Sensors (wind and soil temperature) for microclimate observations were set in December of 2017 and 2018 and monitoring of wind, temperature and periodical soil moisture readings (with portable soil moisture reader) under the different corn cutting/stubble height-row spacing combination treatments including cover crop treatment is underway.

Since the project is being conducted in producer's field it involves a lot of coordination. Collection of production records (such as seeding rate, seed type, irrigation events, and nutrient and pesticide applications) is going on and a process to continue until the middle of 2019 the time most of the data and information will be compiled and analyzed for publication.

Data Analysis

Forage yield and quality data were analyzed using SAS procedure on combined two years' data (SAS 9.3, SAS Institute Inc.). Statistical analysis was performed on the basis of split-plot design (row spacing as main and silage cutting height as sub-plot factors). To detect differences between row spacing treatments and their interactions with silage cutting heights types, PROC GLM procedures were used. Significance was considered at $P < 0.05$, and Fisher's protected LSD was used to separate means.

Results and Discussion

Forage yield and quality results involving row spacing and silage cutting heights are presented in Table 1. Significant difference was detected between 15" than 30" row spacing for dry and green forage yield, moisture at harvest, starch content and milk production per acre (Table 1). The two row spacings, however, were not significantly different for the other measured parameters.

Dry forage yield was higher with 15 than 30" row spacing (7.7 vs. 6.0 t/ac) which was also reflected in milk production per acre (25179 vs. 19720 lbs/ac; an increase in milk by 22%). Similarly, significant differences were detected between 6" than 21" silage cutting heights for dry and green forage yield and moisture at harvest and milk production per acre. Dry forage yield production per acre were reduced by 20 % with silage cutting height of 21" compared to the 6" (6.2 vs. 7.6 t/ac). This was also reflected in milk production per acre as well. However, cutting height had no significance effect on milk production per ton. In general, a significant improvement in forage quality was observed with increasing silage cutting height (reduction in fiber by 6 to 8%, increase in starch by 11% and reduction in nitrate by 39%). In a separate trial conducted at NMSU-Agricultural Science Center at Clovis in 2017 involving three silage cutting heights (6, 13, 21") and five corn varieties revealed similar reduction in dry forage yield with the highest silage cutting height. However, yield reduction with 13" cutting height was only 5% suggesting the possibility of raising cutting height to 13" with minimum yield loss. In the long run, tall stubble (with higher silage cutting heights) in conjunction with narrow row spacing is expected to leave more plant residue in field potentially resulting in better soil coverage, improvement in soil conservation and moisture retention, carbon sequestration, and in overall improvement and sustainability of forage corn production and hence dairy farming systems and rural economies in New Mexico.

Table 1. Effects of corn row spacing and silage cutting height on forage yield and quality on producer's field near Clovis

Row Spacing (inch)	Green Forage (t/ac)	Dry Forage (t/ac)	Harvest moisture	CP	ADF	NDF	Starch	Ash	TDN	Nitrate (ppm)	NEl (Mcal/lb)	Milk (lb/t)	Milk (lb/ac)
						(%)							
15	18.3a+	7.7a	59.9b	9.4a	22.6a	41.8a	29.6a	4.1a	67.2a	41.6a	0.716a	3266a	25179a
30	14.7b	6.0b	60.9a	9.6a	23.2a	42.1a	27.7b	4.6a	67.3a	56.2a	0.718a	3281a	19720b
Silage cutting height (in)													
6	18.3a	7.6a	62.3a	9.5a	23.9a	43.3a	27.0b	4.4a	66.6b	60.8a	0.707a	3229a	24279a
21	14.6b	6.2b	58.5b	9.5a	21.9b	40.6a	30.2a	4.1b	67.8a	37.0a	0.727a	3318a	20620b

Crud protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrient (TDN), net energy for lactation (NEl)

+Values within a column followed by the same letter are not significantly different at $P<0.05$

Forage Corn Vertical Biomass Distribution and Quality Relationships

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Objective:

To assess the relationships between forage corn vertical biomass distribution and forage quality of diverse corn varieties. This information can be useful for developing optimum silage corn harvesting height recommendations that could be used as a strategy/tool for farmers to harvest silage corn sustainably, conserve soil and water resources.

Materials and Methods

The study was conducted at NMSU-Agricultural Science Center at Clovis in 2018. Based on soil test results recommended fertilizer was applied at rate of 18 (N), 60 (P_2O_5) lbs ac^{-1}, 3qt ac^{-1} (Zn) in February16 and 122 (N), 22 (S) lbs ac^{-1} as pre-plant and 30 (N) and 5.5 (S) lbs ac^{-1} at plant. Herbicide mixture Atrazine, Balance Flex, Diflex, Glyphosate was applied pre-plant at 1 pint, 3 oz, 5 oz, and 40 oz ac^{-1}, respectively. Additional herbicide mixture of Diflex and Brawl at 8 oz and 1.3 pint ac^{-1} was applied for weed control in June 20, 2018. Insecticides Onager (16 oz ac^{-1}) in June 20 and Prevathon (20 oz ac^{-1}) and Oberon (8 oz ac^{-1}) in August 1, 2018 were applied for insect control.

The experimental design followed a randomized complete block design with three replications. The study involved five corn varieties [9678VT3P, 1151AQ, D58QC72, P1449xr (brown mid rib, BMR) and 1197P]. Corn was planted in May 19, 2018 at the seeding rate of 27,000 seeds ac^{-1}. For plant portions/sections contribution to biomass yield and quality determination, a 1m length of row of whole plant samples were harvested at 6" height from soil surface for each plot of each variety. Whole plant samples were then brought indoor and cut/partitioned into four portions (H7, H16, H32, and AE) for each plot and variety. Besides these four portions, ear/cobs were kept separate and considered as additional plant portion. Plant portions H7, H16 and H32 represents below ear and AE represents above the ear portion of the plan. Forage sample were harvested in September, typical time period when silage corn is commonly harvested. After fresh weight were recorded, sample portions were chopped and a subsample of known weight from each sample was dried to a constant weight at 65°C. Dry and fresh weights were used to estimate plant portions biomass and contributions to total forage biomass yield per acre. Dry subsamples were ground to pass through a 1-mm screen using a Wiley Mill (Thomas Manufacturing) and submitted to a certified laboratory (Ward Laboratories, Kearney, NE) to estimate forage quality using near-infrared spectroscopy

Data Analysis

Forage (dry- and green-biomass) yield and quality data of the different plant portions were analyzed using SAS procedure. To detect differences between variety and their interactions with plant portions, PROC GLM procedures were used (SAS 9.3, SAS Institute Inc.). Significance was considered at $P < 0.05$, and Fisher's protected LSD was used to separate means.

Results and Discussion

Forage (dry- and green-biomass) yield and quality results involving plant portion and variety are presented in Tables 1. Plant portion× variety interaction effect was not significant for forage yield, quality and milk production. Varieties were not significantly different for most of the measured parameters. However, significant difference was detected between the different plant portions for forage yield, quality characteristics, and milk production (Table 1). Corn ear/cob contributed the highest (58%) to total forage yield (10.8 t/ac) while the least contribution (5%) came from the bottom H7 plant portion. This was also reflected in milk production (Table 1). Moisture content in plant parts was the lowest in ear/cob while the highest moisture content was recorded in plant portion H32 followed by H16 and H7 (Table 1).

Forage quality of ear/cob and above the ear plant portions were significantly higher than below ear plant portions indicating the significant importance of ear and above ear plant portions in the overall corn forage quality and hence feed value in animal feed ration. Similarly, fiber and nitrate content of plant portions of below the ear are significantly lower than corn ear/cob and above the ear plant portions further enforcing the insignificant importance of this plant portions in animal feed value. This suggests that raising silage corn cutting height to as high as H7 to H13 (5 to 11 % reduction in yield) can be used as a strategy to sustainably harvest silage corn with minimum forage yield loss and improved forage quality that can and potentially conserve soil and water resources in forage corn production systems. In the long run, tall stubble (with higher silage cutting heights of at least 13") in conjunction with a corn variety of producer's choice is expected to leave more plant residue in the field potentially resulting in better soil coverage, improvement in soil conservation and moisture retention, carbon sequestration, and in overall improvement and sustainability of forage corn production and hence dairy farming systems in New Mexico. The study will be repeated in 2019.

Table 1. Forage corn biomass yield, quality and milk production of the different plant parts at NMSU-Agricultural Science Center, Clovis 2018.

	Corn plant parts					
Variables	H7	H16	H32	Ear/cob	Above the ear	
						Total
Green Forage (t/ac)	2.1e	2.6d	4.4c	12.1a	9.0b	30.1
Moisture at harvest (%)	75ab	77ab	78a	47.9c	73b	
Dry Forage (t/ac)	0.5d	0.6cd	1.0c	6.3a	2.4b	10.8
CP (%)	4.9e	5.4d	6.1c	8.b	9.4a	
Starch (%)	8.8bc	8.2bc	6.7c	52.4a	9.5b	
ADF (%)	39.5a	38.5a	38.0a	11.7c	32.7b	
NDF (%)	56.4c	59.1b	58.8b	65.2a	60.0b	
Nitrate (ppm)	412a	200ab	64b	22b	27b	
NE_l (Mcal/lb)	0.51d	0.54c	0.55c	0.84a	0.60a	
Milk/Ton (lbs/t)	2291d	2459c	2462c	3682a	2675b	
Milk/ac (lbs/ac)	1210c	1464c	2372c	23221a	6526b	

Plant parts H7, H16 and H32 represents portions from the bottom up 6 to 13”, 13 to 22” and 22 to 32’” cuttings.

Providing the next generation with dairy educational opportunities: The U.S. Dairy Education & Training Consortium

ISSUE: New Mexico dairies are the largest in the nation with an average herd size of 2,300 cows, more than ten times the average U.S. herd size (app. 223 cows). NM dairy owners employ approximately 1 employee/100 cows: predominantly hired, immigrant labor with limited experience in working in agriculture. Dairying is vastly becoming a highly technical, highly automated industry characterized by extended periods of very low margins. Highly skilled and technically proficient labor is an absolute must for optimal performance. However, limited educational opportunities exist for training and educating the ***next generation of owners, managers and employees*** to prepare and refine a skilled and able dairy workforce to continue to provide wholesome dairy products for New Mexico, the nation and the world, while sustainably managing animals, employees and the environment.

WHAT HAS BEEN DONE: Given the unlikelihood of re-establishing an on-campus dairy herd for training and education, NMSU Dairy Extension established in 2008 the U.S. Dairy Education and Training Consortium (USDETC) together with the Univ. of Arizona and Texas A&M Univ. The USDETC, located in Clovis, NM utilizes Clovis Community College facilities and commercial dairy operations in the New Mexico and Texas border region to teach the next generation of dairy owners and managers during a 6-week, hands-on, capstone summer class advanced dairy herd management (ANSC 468). Students are instructed by leading faculty in the nation. The program is an intensive combination of classroom instruction, laboratory training, on-farm practice and allied industry input. Many of the students leave Clovis with internships and job opportunities in hand. Area dairy producers, center to the success of the program, fully recognize and support the unique value, freely allowing students access and insight to their operations.

REACH: Reach of the program in 11 years: 498 students from 51 different universities. A survey of former students was conducted in 2017 to determine the impact of the consortium on their careers (62% response rate). Of the 213 respondents, 99 were currently still enrolled at a university, 111 were employed and 3 were not employed. Of the students enrolled at a university 37% were undergraduate students, 30% were working towards advanced degrees and 30% were obtaining a veterinary degree. Of those employed, 87 students had obtained a BS, while 11 completed their MS, 2 students were Ph.D.'s and 9 students had graduated with a DVM degree. Key finding: of the students who had entered the job market 34% had found employment on a dairy, 33% were employed in a dairy related position (allied industry), 5% were in a non-dairy livestock positon, 6% were in a non-dairy ag position and 21% were employed outside of agriculture. In short: 4 out of 5 former USDETC students are employed in agriculture, 2 out of 3 students are employed in the dairy industry, and 1 out of 3 students are working on, or managing a dairy.

IMPACT: When asked "What impact attending the consortium had on their current status", 92% replied important, very important or extremely important. When asked about the impact the classes and experiential learning experiences had on their course work and subsequent careers, 44% replied extremely helpful, 35% very helpful and 15% helpful. When asked to rank the consortium classes as compared to other courses taken, 55% gave the consortium an A+ and 36% an A. When asked for comments, the hands-on experience and access to exceptional faculty were the student's main responses. In short: the USDETC has proven to be a positive alternative, or complementary education opportunity for students who do not or have limited access to dairy courses or the related experiential learning experiences at their home universities.

NEXT: with the Dairy Consortium as a capstone dairy course, NMSU's College of Agricultural, Consumer and Environmental Sciences in June of 2017 reinstated an undergraduate minor in Dairy Science. As the Dairy Consortium continues to grow opportunities for expansion are being considered to in addition to the open-lots of the Southwest, add learning experiences in the barns of the Midwest and the free-stall operations of the West. All with the goal to provide the next generation of dairy owners and managers with excellent educational opportunities.

FUNDING: CES funds, USDA NIFA funding , and allied industry contributions.

Development and implementation of a dairy safety awareness program

ISSUE: New Mexico dairies are the largest in the nation with an average herd size of 2,300 cows, more than ten times the average U.S. herd size (app. 223 cows). NM dairy owners employ approximately 1 employee/100 cows: predominantly hired, immigrant labor. A large majority of dairy employees have or had little or no experience working in agriculture or with large animals or large equipment. Agriculture, Forestry and Fishing AFF) ranks among the most dangerous industrial sectors with an incident rate of 5.7 non-fatal occupational injuries per 100 FTE's and a rate of 23.2 fatal work injuries per 100,000 FTE's (BLS). In addition, about one-fifth of fatalities in 2016 were to foreign-born workers and roughly two-thirds of fatal work injuries were foreign-born Latino or Hispanic workers. Effective training and education of both ***current and future dairy employees*** is imperative for both safety and performance. However, limited educational opportunities exist to train and certify a skilled and able dairy workforce.

WHAT HAS BEEN DONE: Beginning in 2011-12 with the development of two dairy safety awareness training DVD's in English and Spanish to accomplish multiple goals: 1. being able to document employees are trained on dairy safety issues, 2. improve job performance through understanding the "why" of work- and safety-procedures and 3. to prevent safety incidents through heightened safety awareness. To date approximately 6,000 copies have been distributed worldwide, and the International Rescue Committee (IRC) subsequently translated the DVD's into a number of other languages for placement of refugees on dairies. The remaining question: what is the training effectiveness of viewing a DVD? Delivery of training content became center in training effectiveness evaluation. In collaboration with Dr. David Douphrate, UT School of Public Health, San Antonio Campus, small interactive video/audio vignettes were created in Articulate 360 and subsequently loaded on an IPad for individualized training purposes (m-learning).

REACH: As part of two DOL Susan Harwood projects a total of 2,090 dairy employees in 7 states on 60+ farms were trained using mobile technology on iPads. The large majority of trainees were foreign-born with the majority from Mexico (52.4%), and 27.4% from Guatemala, Honduras and El Salvador. About 88% male and 12% female. Average age 34.4 ± 12.0. About 6% had not received any education, 28% had attended (some) elementary school, 24% (some) middle school, 29% (some) high school, and 13% had received (some) higher education. As anticipated, reading comprehension was a challenge, making the video/audio delivery method critical. We realized soon that many of the Central American trainees didn't speak any English or Spanish, but communicated in a Mayan language (K'iche). Training effectiveness evaluation (Kirkpatrick Four-Level Training Evaluation) analysis suggests that participants rated the m-learning training favorably (level-1). Pre-test to post-test scores changed from a 74.2% to a 92.5% (level-2). Interview results at about 3-6 months post-training (level-3) indicate workers were applying the knowledge gained from the training in their work activities, as well as reporting safety hazards when identified. Findings suggest the utilization of m-learning techniques is an effective means to deliver safety awareness training content to dairy workers in remote and challenging work environments.

IMPACT: NMSU Dairy Extension has now provided safety awareness training to about one-third of the NM dairy workforce. We have added safe animal handling with live demonstration to our training tools, training which is picking up traction. In 2016 as a result of a several highly publicized dairy fatalities in the Northwest, Idaho Dairymen's Association (IDA) took the lead in adopting our program with significant processor and co-op support. We were asked to help recruit and prepare a dairy safety specialist for IDA. The person was hired in July of 2017, and is currently providing safety awareness training for Idaho dairy producers. Recognizing we were missing about 1 out of 3-4 workers due to language issues, we just completed full translation and voiceover of all video materials into K'iche, a menu option to be added to the iPad library. As part of the NMPF FARM – Workforce development effort we have been charged with the development of a Dairy Safety Manual, which is at the date of this writing (Feb 2019) is nearing completion.

Sparked by consumer questions, National Milk Producers Federation representing the majority of the U.S. milk supply formed (Nov. 2017) a Dairy Safety Task Force looking at national adaptation and implementation of the program. Continued content development: safe feeds and feeding (2018) , safe young stock handling, safe hospital care and safe maternity care are the next items on our list. In Feb. 2018 a 5-yr. leadership development project was initiated, addressing the needs of frontline supervisors and middle managers to learn more about managing people vs. managing cows. In two separate groups, approximate 50 middle managers have now completed the 13-week training program of this project.

NEXT: Another project to be initiated in March 2019 is geared to evaluate the understanding of dairy workers of TB as a zoonosis, with the goal to develop appropriate educational tools for dairy workers. TB has been a reoccurring issue in the NM-West TX dairy shed over the last decade or so and even though most of the DNA seems to trace back to Mexican feeder steers, there is the potential of transmission, a persistent health risk both for humans and cows.

FUNDING: DOL Susan Harwood funding and allied industry contributions.

Maximizing voluntary compliance in antimicrobial stewardship programs: a critical factor for effective intervention

ISSUE: Antimicrobial resistance has risen over the past few decades leading to the reduced effectiveness in the treatment of some infectious diseases. Each year in the United States, 2 million people are infected with antimicrobial resistant organisms resulting in 23,000 deaths and 70 billion dollars in medical costs. As resistance becomes more common, cost is expected to continue to rise in order to fight infections. To combat resistance, the Obama administration generated The National Action Plan for Combating Antibiotic-Resistant Bacteria aimed at better surveillance of antimicrobial resistance, better diagnostic testing, and the development of new vaccines and antibiotics, among other things.

Antimicrobial drug resistance is of great concern for both animal and human health. Using antimicrobials to treat illness is a key element used by veterinarians and physicians alike to combat bacterial diseases. The Food and Drug Administration (FDA) is charged with evaluating both the effectiveness and safety of these compounds. During the process of approving new animal drugs, a slaughter withdrawal period is established for each drug. The slaughter withdrawal time is the number of days between the last time an animal is treated and when the animal can be slaughtered for meat to go into the human food supply. To date, the slaughter withdrawal time has been based upon the duration of time when a drug is still in the animal tissue. There has been little to no consideration as to what management practices might be needed to minimize the risk of antimicrobial drug resistance.

WHAT HAS BEEN DONE: This research project is to evaluate whether a voluntary extended withdrawal time could potentially reduce the level of bacteria resistant to an antibiotic (the specific antibiotic used for this study will be ceftiofur) that are being shed at time of slaughter. The ultimate goal of the project is to identify viable management options for producers to reduce the potential exposure of consumers to resistant bacteria and to develop strategies that result in voluntary adoption of those management options. Overall, the goal is to ensure cattle are released to slaughter with levels of antibiotic resistant microbial populations comparable to their resistance level before being given an antibiotic. A decision-making tool will subsequently be created and made available for dairy farmers and veterinarians to use for the development of antimicrobial stewardship programs. Additionally, developing a stewardship protocol beneficial to farmers, ranchers, and veterinarians is important for food safety.

REACH: Lab work and data analysis has been completed and manuscripts have been submitted for publication. Expectations are we will be able to present take-home messages to producers in the spring of 2019.

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