
AGRICULTURAL SCIENCE CENTER AT FARMINGTON
NM
STATE

Notice to Users of This Report

This report has been prepared by Science Center staff to document the 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, and 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 formal report. Although staff members have made every effort to check the accuracy of the data presented, this report was not prepared as a formal release. None of the data is authorized for release or publication, without the written prior approval of the NMSU Agricultural Experiment Station.

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Conversion Table for English and Metric (SI) Units

The following conversion table is provided as an aid for those who may wish to convert data appearing in this report from English (U.S.) units to Metric (SI) units, or vice versa. (Calculations are approximations only.)

To convert English to Metric, multiply by	English (U.S.) units	Metric (SI) units	To convert Metric to English, multiply by
2.540	inches (in)	centimeters (cm)	0.394
0.305	feet (ft)	meters (m)	3.281
1.609	miles (miles)	kilometers (km)	0.621
0.093	square feet (ft2)	square meters (m2)	10.764
2.590	square miles (mile2)	square kilometers (km2)	0.386
0.405	acres (ac)	hectares (ha)	2.471
28.350	ounces (oz)	grams (g)	0.035
29.574	fluid ounces (fl oz)	milliliters (mL)	0.034
3.785	gallons (gal)	liters (L)	0.264
0.454	pounds (lbs)	kilograms (kg)	2.205
907.185	ton (2000 lbs) (t)	kilograms (kg)	0.001
0.907	ton (2000 lbs) (t)	metric tonnes (t) or Megagrams (Mg)	1.102
1.000	parts per million (ppm)	ppm (mg/kg)	1.000
1.121	pounds/acre (lbs/ac)	kilograms/hectare (kg/ha)	0.892
2.240	tons/acre (t/ac)	Megagrams/hectare (Mg/ha)	0.446
16.018	pounds per cubic feet (lbs/ft3)	kilograms per cubic meter (kg/m3)	0.062
0.070	cubic feet/acre (ft3/ac)	cubic meters/hectare (m3/ha)	14.291
73.078	ounces/acre (oz/ac)	milliliters/hectare (mL/ha)	0.014
62.710	bushels/acre (corn: 56# bu)	kilograms/hectare (kg/ha)	0.016
67.190	bushels/acre (wheat: 60# bu)	kilograms/hectare (kg/ha)	0.015
125.535	Cwt/acre (100 wt)	kilograms/hectare (kg/ha)	0.008
0.042	Langleys (Ly)	Megajoules (MJ)/m2	23.900
(°F-32)÷1.8	Fahrenheit (°F)	Celsius (°C)	(°C x 1.8) + 32

For additional helpful English-Metric conversions, see: https://www.extension.iastate.edu/agdm/wholefarm/html/c6-80.html and https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/null/?cid=stelprdb1043619

Executive Summary

The mission of the New Mexico State University Agricultural Science Center at Farmington is to conduct research, demonstration, and educational programs that will best fill the needs of the Agricultural community of San Juan County and the Navajo Nation in particular, and the State of New Mexico, Four Corners Region, and Nation in general. Projects reported here are in response to requests for research-based information and technical assistance. We are working to closely align our research and outreach activities under the general auspices of NMSU's College of Agricultural, Consumer & Environmental Sciences (ACES) Four Pillars: Water Use and Conservation, Family Development and Health of New Mexicans, Environmental Stewardship, and Foundational Education and Training: https://aces.nmsu.edu/about/pillars.html.You will find report briefs related specifically to daily weather collection, examining agronomic and horticultural crop adaptability to the Four Corners Region, diabetes risk reduction through the act of gardening and healthy eating, and farmland monitoring from the aftermath of the 2015 Gold King Mine Spill.

Operational and salary support of the work reported herein was funded in-part through the Hatch Act of 1887, which established funding to "conduct agricultural research programs at State Agricultural Experiment Stations in the 50 states, the District of Columbia, and the U.S. insular areas" and the Morrill Act of 1862, "an Act donating Public Lands to the several States and Territories which may provide Colleges for the Benefit of Agriculture and the Mechanic Arts" (land-grant system). Funding from the New Mexico Legislature is helping to make capital improvements to the facility, including the construction of a new greenhouse. Additional funding resources were obtained through competitive grants to federal and state agencies including the National Institutes of Health/National Cancer Institute, United States Department of Agriculture, the New Mexico Department of Agriculture, and the New Mexico Environment Department. Public/private partnerships that supported projects in 2020 included the Navajo Agricultural Products Industry (NAPI), Potatoes USA, Valley Irrigation Corporation, Wilbur-Ellis, and Navajo Mesa Farms. NAPI, along with Valley Irrigation (Lincoln, NE) has been very helpful in making possible the upgrade of two center pivots in 2020.

Projects reported herein are also multi-institutional and cross disciplinary and include, among others, researchers from Colorado State University (wheat and potato), Diné College, Fred Hutchinson Cancer Research Center/University of Washington (gardening and health), University of Minnesota (winter malted barley), U.S. Potato Genebank, NAPI, and the multiple public and private crop breeders from around the U.S. We are thankful to have partnered with collaborators including NMSU San Juan County Cooperative Extension Service (https://sanjuanextension.nmsu.edu/) and Soil and Water Conservation District (https://sanjuanswcd.com/). Outreach and dissemination activities associated with the projects are found in the Outreach section of this report.

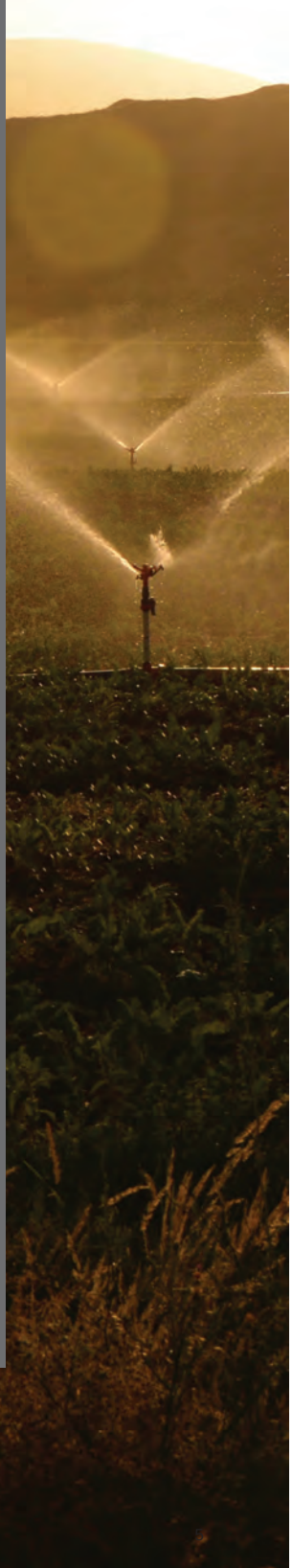
I would like to acknowledge the NMSU-ASC Farmington faculty and staff, NAPI, undergraduate and graduate students, and all other collaborators and funding mechanisms for helping make the efforts reported herein happen in 2020 despite major disruptions related to the COVID-19 pandemic. Thank you!

If you need help in interpreting the contents of this report OR have a question/research idea that we can help you to try to solve, please call us at 505-960-7757. Please check out our website and Facebook page for any updates at https://farmingtonsc.nmsu.edu/.

We encourage everyone to continue to stay safe and keep looking up as we all work together to improve our communities and nation.

Sincerely,

Kevin A. Lombard, Ph.D.
Associate Professor, Horticulture
Superintendent, New Mexico State University's Agricultural Science Center at Farmington



Mission

The mission of the New Mexico State University Agricultural Science Center at Farmington is to conduct research, demonstration, and educational programs that will best fill the needs of the agricultural community of San Juan County and the Navajo Nation in particular, and the State of New Mexico, Four Corners Region, and United States in general. -1968 Charter

Agricultural Science Center at Farmington

The Agricultural Science Center (ASC) at Farmington was established in 1967 on 253 acres leased from the Navajo Nation to meet the needs of the San Juan Valley and Four Corners region. Research at the ASC has supported fundamental and applied science to benefit New Mexico for over 50 years, with a specific focus in working with the Navajo Indian Irrigation Project (NIIP/ Navajo Agricultural Products Industry (NAPI).

Over 100 acres are under cultivation for crop research. Long-term variety crop trials are necessary for the primary clientele of the center. Navajo Agricultural Products Industry (NAPI) is a $50,000,000 operation producing major crops including alfalfa, corn, wheat, pinto beans, and potatoes. Variety trials for each of these crops form a long-term basis of evaluations. Seed companies submit entries for testing at the ASC and NAPI uses data from these for procurement decisions. Farmers in the San Juan valley rely on variety trial data to make informed decisions, specifically for alfalfa which remains the predominant economic crop grown in San Juan County.

Agricultural Experiment Station

What Is the Agricultural Experiment Station?

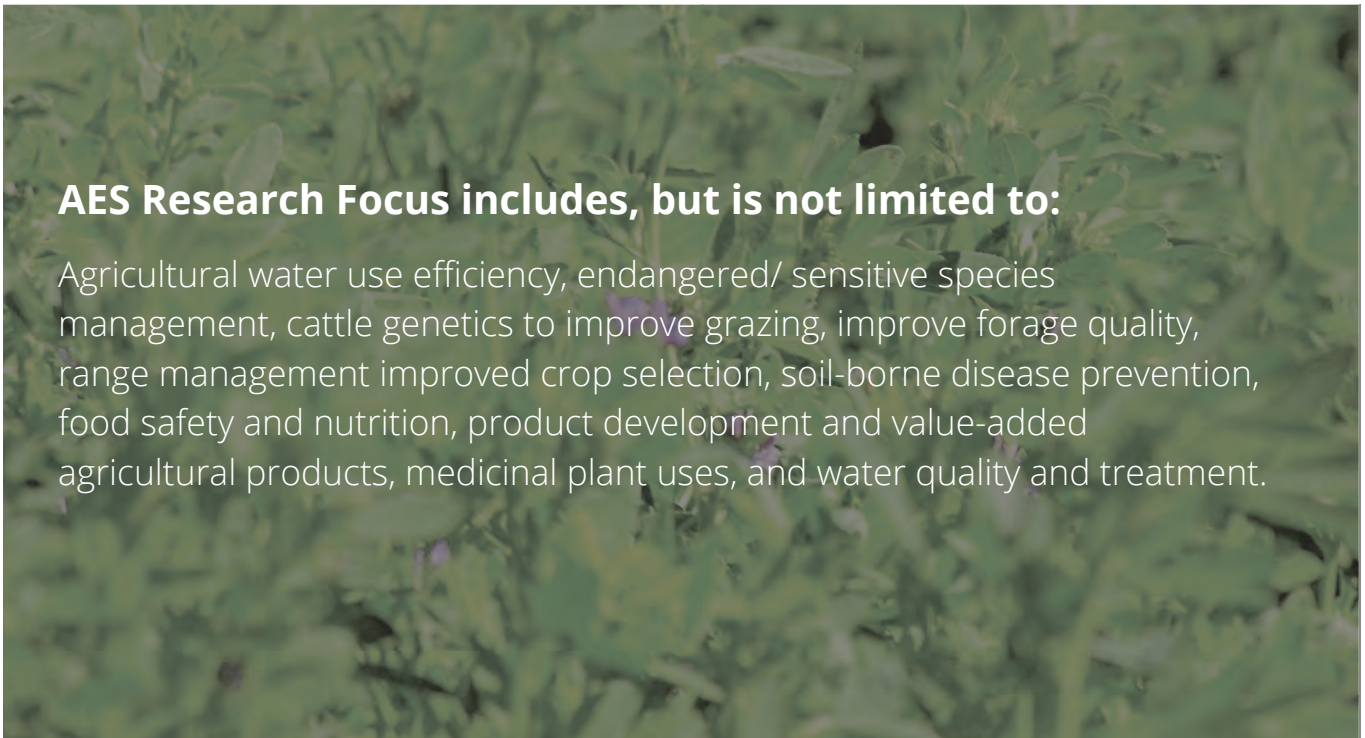
NMSU's Agricultural Experiment Station is the principal research unit of the College of Agricultural, Consumer and Environmental Sciences. All research faculty in the college have appointments in the Agricultural Experiment Station.

Mission

The Agricultural Experiment Station is not a physical site, but rather a system of scientists who work on facilities on the main campus in Las Cruces and at 12 agricultural science and research centers located throughout the state. The Agricultural Experiment Station system also interacts with other university research units and various state and federal agencies to provide opportunities for research that will benefit the citizens of New Mexico.

The Agricultural Experiment Station supports research designed to:

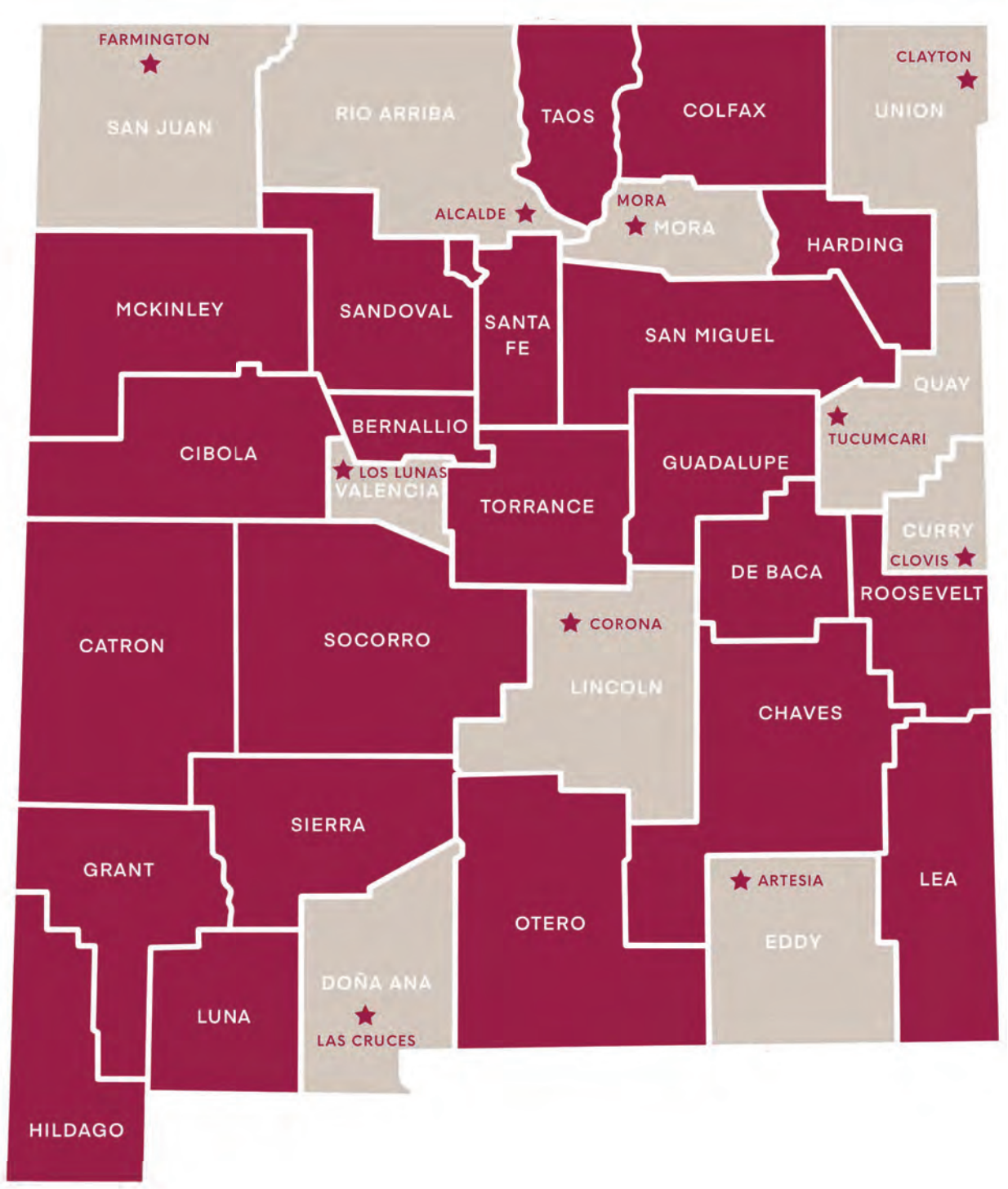
- Enhance agricultural profitability.
- Stimulate economic development using natural resources.
- Improve the quality, safety and reliability of food and fiber products.
- Sustain and protect the environment with ecologically sound practices.
- Manage and protect natural resources.
- Improve the quality of life for the people of New Mexico.



AES Research Focus includes, but is not limited to:

Agricultural water use efficiency, endangered/ sensitive species management, cattle genetics to improve grazing, improve forage quality, range management improved crop selection, soil-borne disease prevention, food safety and nutrition, product development and value-added agricultural products, medicinal plant uses, and water quality and treatment.

NMSU Agricultural Experiment Station



NMSU ASC Farmington Weather Conditions

2020 Weather Conditions

Weather data has been collected at the NMSU Agricultural Science Center at Farmington (ASCF) Weather Station 1 (WS-1) since 1969 for the National Weather Service (NWS) and at Weather Station 2 (WS-2) since 1985 for the New Mexico Climate Center (NMCC) (Figure 5). weather stations are disseminated for private and public end-users. End-users calculate irrigation scheduling for the Navajo Agricultural Products Industry. The City of Farmington incorporates rainfall events from ASCF weather stations in conjunction with other sites to monitor flood events for the city's storm water program in order to monitor the need for controlling sediment and pollutant runoff. Additionally, the weather data from both weather stations are used in agricultural production, recreational use, and research.

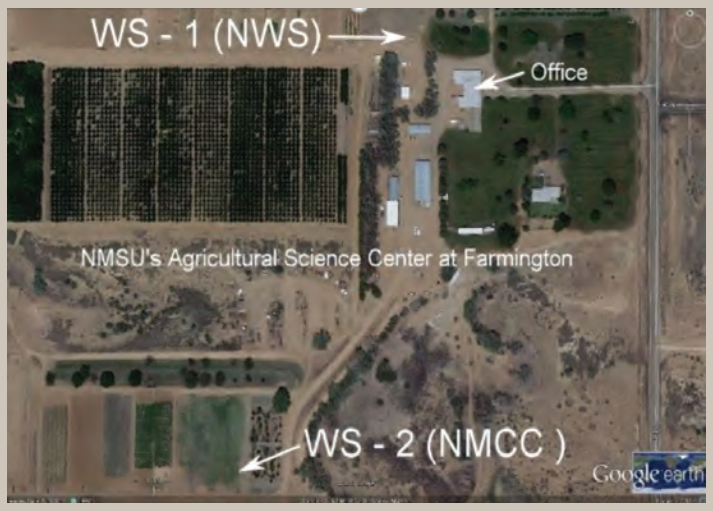
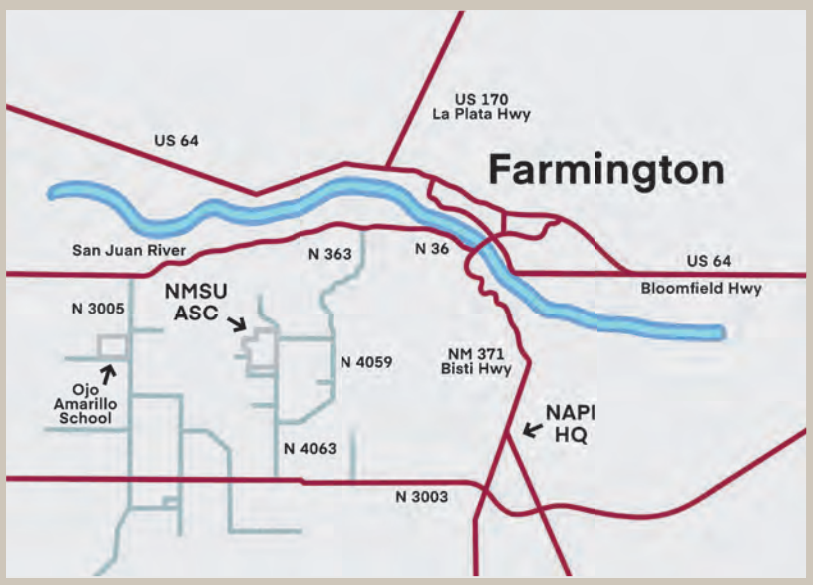


Figure 5. Weather stations in relation to main office building at NMSU ASC Farmington, NM, 2020. (Google Earth, 2015)

Summary

Climatological data summary for 2020 recorded at NMSU ASC Farmington. (Table 1) Precipitation received and reported to the National Weather Service from January 1 through November 30 was 3.80 inches. The mean maximum air temperature January through November was 79.8 °F and mean minimum was 39.6 °F (Note: 2020 Air Temperatures were recorded and reported the NMCC due to malfunctioning NWS Nimbus air temperature data logger.) There were 164 frost-free days (≤ 32 °F) between April 17 and September 29 for the 2020 growing season. The seven month (April 1 through October 31) evaporation total was 77.02 inches with a mean of 0.352 inches. Corn Growing Degree Days (GDD) mean from May 1 through first fall frost on September 29, 2020 was 591 and a total 2953 heat units. The seven month (April 1 through October 31) evaporation total was 77.02 inches with a mean of 0.352 inches.



NMSU ASC Farmington Capital Outlay Projects 2020

Pivot Upgrade Project, Phase 2

The NMSU Agricultural Science Center at Farmington (ASCF) uniquely has six center pivots. Each pivot is approximately 20 acres in size, enabling research under a more appropriate scale relevant to center pivot agriculture. The adjacent Navajo Agricultural Products Industry (NAPI) has over 600 center pivots. Prior to 2018, at the onset of Phase 1, pivots and controllers at ASCF consisted of several different brands, in various stages of functionality and out-of-date technology (some over 30 years old). Phase 2 of the NMSU/NAPI project enabled further enhancements that included new main-line and valve replacements to one pivot. These upgrades are helping ASCF to elevate research and learning opportunities in a safe and productive environment.

Electrical Grid Replacement Project

During summer 2020, the entire main electrical grid at ASCF was upgraded to improve safety and bring the facility up to modern code standards. Ross/Wes Electrical Services (Farmington, NM), Navajo Tribal Utility Authority (NTUA) and NMSU Facilities and Services undertook the project with funding provided in part through Nez Mexico legislative appropriations. The 6-month project entailed detailed planning and coordination to replace corroded service boxes, burying main lines, and pole replacements. The result has been a new system that should be safe, reliable and cost-effective for years to come.

New Greenhouse Project

An exciting new greenhouse project broke ground at ASC Farmington on October 14, 2020. The NMSU Facilities and Services Department is supporting the project as part of a larger capital improvement project occurring across the statewide Agricultural Experiment Station system. Funding is through the New Mexico legislature. This modern, state-of-the-art greenhouse will enhance the ASCF capacity to conduct year-round research and outreach within a modern, controlled environment.

Figure 2. (Left to right). Various stages of pivot upgrade project, phase 2, completed at ASC Farmington in collaboration with NAPI and Valley Irrigation. NMSU ASC at Farmington 2020.

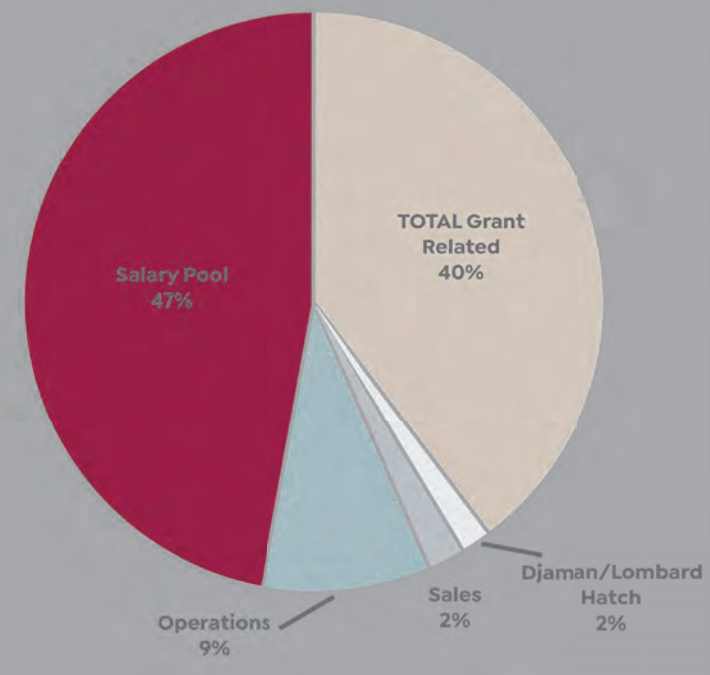
Figure 3. (Left to right). Various stages of electrical grid replacement project completed at ASC Farmington in collaboration with Ross/Wes Electrical Services, Navajo Tribal Utility Authority, and NMSU Facilities and Services. Removing old overhead lines, new buried main lines, new pole and transformers, upgrade from old to new main service panel (far right). NMSU ASC at Farmington 2020.

Figure 4. (Left to right). Breaking ground and foundation installation for the new greenhouse project (diagram at top right) under construction at ASC Farmington in collaboration with the NMSU Facilities and Services Department. Greenhouse construction is well underway with a slab foundation (bottom). The state-of-the-art facility will enable a wide variety of research and outreach activities for researchers and students year-round. NMSU ASC at Farmington 2020.

NMSU ASC Farmington Financials Summary 2020

Financial operating figures (Financials) for NMSU ASC Farmington for 2020 are divided into the following categories and are summarized in Figure 1 below.

- Agricultural Experiment Station supported salary pool for 2 faculty and 8 staff ($506,825).
- Agriculture Experiment Station supported operations ($99,448). Operations cover facilities maintenance, utilities, incidentals, and equipment purchases.
- Farm sales through left-over experimental plot work (approximately $22,726 rolled over from previous years). Farm sales are used for things like irrigation system repairs, seed purchases, equipment purchases, and to support general operations related to conducting pivot- and field-based research).
- Congressionally supported appropriations (Hatch Act funds) for Djaman and Lombard for the conduct of research (approximately $17,579). Hatch funds are derived from AES-supported operations and include $5,000 for each Principal Investigator and start-up funds for Djaman.
- Competitive/externally funded grants and contracts are generally team-based and managed among several cooperators. Funds are used to support the salary of full-time and temporary staff, fund sub-contracts with cooperating institutions, grant specific operations, and travel). Externally funded grants and contracts are through various agencies that in 2019/2020 included: .



- National Institutes of Health ($138,501)
- New Mexico Environment Department (approximately $78,795)
- Potatoes USA ($22,845)
- Foundation/Gift account (approximately $4,940 rolled over from previous years)
- Indirect cost recovery (sometimes termed “overhead”) are funds from grants and contracts that are returned to the ASC Farmington and used for things like supplementing operations, equipment purchases and maintenance, and further research support (approximately $49,247 rolled over from previous years).

Figure 1. ASC Farmington Financial Summary. NMSU ASC at Farmington 2020.

Agricultural Science Center Farmington
Fiscal Year: 2020 **2020**
Fiscal Period: 30-Jun-20 **30-Jun-20**

Department	Acct Type	Account Index Desc	Revenue YTD	Expense Budget	Expense YTD	Budget Balance Available YTD	Fund Balance Dr/(Cr)
Ag Science Ctr at Farmington	HATCH FEDERAL APPROPRIATIONS FY 20	HORTICULTURE & HEALTH IN NW NM SAL		$26,687.00	$19,126.78	$7,560.22	
Ag Science Ctr at Farmington	POTATO USA SNAC TRIAL	POTATO USA SNAC TRIAL		$22,845.00	$756.50	$22,088.50	
		Total Restricted Funds		**$49,532.00**	**$19,883.28**	**$29,648.72**	
Ag Science Ctr at Farmington	RESTR MAIN CURR USE GIFTS	09661225S09061225PEST MGMT N	$0.00	$0.00	$554.08	($554.08)	($3,464.73)
Ag Science Ctr at Farmington	RESTR MAIN CURR USE GIFTS	ASC-FARMINGTON POTATO RESEARCH	$6,578.48	$0.00	$1,638.48	($1,638.48)	($4,940.00)
		Total Gift Funds	**$6,578.48**	**$0.00**	**$2,192.56**	**($2,192.56)**	**($8,404.73)**
							* See note
Ag Science Ctr at Farmington	APPLIED CHARGES	ASC-FARMINGTON VEHICLES	$0.00	($1,000.00)	($1,968.68)	$968.68	($35,349.38)
Ag Science Ctr at Farmington	OTHER SOURCES	ASC-FARMINGTON FARM EQUIPMENT	$0.00	$0.00	$2,611.36	($2,611.36)	($21,314.22)
Ag Science Ctr at Farmington	OVERHEAD TRANSFERS	INDIRECT COST RECOVERY-FARMINGTON	$19,047.87	$2,616.00	$7,094.92	($4,478.92)	($53,700.99)
Ag Science Ctr at Farmington	OVERHEAD TRANSFERS	START-UP FARMINGTON K. DJAMAN	$0.00	$21,887.79	$3,708.76	$18,179.03	($7,579.03)
Ag Science Ctr at Farmington	SALES & SERVICE	FARMINGTON ASC SALES	$12,930.00	$2,000.00	$6,082.36	($4,082.36)	($38,141.11)
		Total Sales and Service Funds	**$31,977.87**	**$25,503.79**	**$17,528.72**	**$7,975.07**	**($156,084.73)**
							* See note
Ag Science Ctr at Farmington	STATE APPROPRIATIONS	ASC-FARMINGTON SALARY		$586,140.99	$465,551.19	$120,589.80	
Ag Science Ctr at Farmington	STATE APPROPRIATIONS	HORTICULTURE AND HEALTH IN NW NM		$82,707.52	$60,652.26	$22,055.26	
Ag Science Ctr at Farmington	STATE APPROPRIATIONS	FARMINGTON ADMIN		$99,462.00	$65,245.28	$34,216.72	
Ag Science Ctr at Farmington	STATE APPROPRIATIONS	FARMINGTON ENHANCEMENT		$0.00	$0.00	$0.00	
Ag Science Ctr at Farmington	STATE APPROPRIATIONS	ASC FARMINGTON SB		$5,000.00	$1,290.00	$3,710.00	
Ag Science Ctr at Farmington	STATE APPROPRIATIONS	HORTICULTURE AND HEALTH IN NW NM		$5,000.00	$3,311.97	$1,688.03	
Ag Science Ctr at Farmington	STATE APPROPRIATIONS	AG EXPERIMENT STATION FARMINGTON		$200,000.00	$0.00	$200,000.00	
		Total State Appropirated Funds		**$978,310.51**	**$596,050.70**	**$382,259.81**	

Note: " ( ) " In the Fund Balance column
indicates a positive number

NMSU ASC Farmington Faculty and Staff

Faculty

Kevin A. Lombard, Ph.D.
Associate Professor and Superintendent

Koffi Djaman, Ph.D.
Assistant Professor

Staff

Samuel C. (Sam) Allen, Ph.D.
Associate Research Scientist

Dallen Begay
Farm Ranch Manager

Brandon Francis
Educational Resources Coordinator

Jonah Joe
Research Technician

Margaret M. West, M.A.
Associate Research Scientist

Clement Veneno
Associate Admin Assistant

Franklin (Jason) Thomas
Research Technician

Joseph E. (Joe) Ward, M.S.
Research Technician

Terrell F. Kosea
Educational Resources Coordinator

AES RESEARCH

NMSU's Agricultural Experiment Station research publications provide information to help improve production techniques and efficiencies for farmers, ranchers, dairies, and other agricultural producers.

Forestry

Agronomy

Dairy

Weather and Climate

Horticulture

Task Force Reports

Livestock and Range

Water

Economics

ENGAGING NAVAJO ELEMENTARY SCHOOLS IN RANDOMIZED CONTROLLED TRIAL OF YÉEGO HEALTHY EATING AND GARDENIN

Investigators: Kevin Lombard1, Shirley A.A. Beresford2, India Ornelas2, Mark Bauer3, Geraldine Garrity3, Sonia Bishop2, Desiree Deschenie1, Emily Brown2, Brandon Francis1, Linda Garcia3, Amber Begay3, Felix Nez3, Filiberto Vecenti3, Jenna Cope4, Lydia Kim4 and Eileen Rillamas-Sun2

RELEVANCE

Navajo families are at increased risk for obesity, diabetes and cancer in part due to low fruit and vegetable consumption. The prevalence of diabetes among the American Indian and Alaska Native populations (15.9%) is more than double the rates of the non-Hispanic/Caucasian population (7.6%; National Diabetes Statistics Report, 2014).

RESPONSE

The proposed study aims to increase fruit and vegetable consumption among Navajo families through a school-based intervention focused on gardening and healthy eating (Figures 6 and 7). The study builds on our longstanding collaboration with the Navajo Nation through which, we have shown that gardening is a culturally appropriate strategy for improving healthy eating in this population. Our previous research has highlighted the importance of family in shaping health behaviors, and a desire to protect the health of the next generation by encouraging healthy eating habits. We have developed and are currently pilot testing a healthy eating and gardening curriculum to promote both gardening and healthy eating among Navajo elementary school children. The intervention was developed based on social cognitive theory, literature on previous school-based gardening interventions, and our own formative work in Navajo communities. The integrated intervention comprises 1) a 24-unit curriculum on both healthy eating and gardening, and 2) a school garden, and aims to build students' self-efficacy to grow and eat fruits and vegetables, as well as making other healthy food choices. In the new proposed study, we will estimate the efficacy of the intervention using a small, randomized delayed intervention comparison trial in two Navajo Nation Chapters (towns), involving about six schools in all.

IMPACT

Current data analysis shows that students made modest changes in their confidence in eating fruits and vegetables. They also made modest changes in their confidence in growing a plant.
Public Value Statement – School garden projects offer an opportunity to reduce the risk of diabetes and improve the quality of life in Navajo communities.

ACES CRITICAL ISSUE (PILLARS)

This project is directly responsive to the Pillar 2: to support Family Development and Health of New Mexicans.

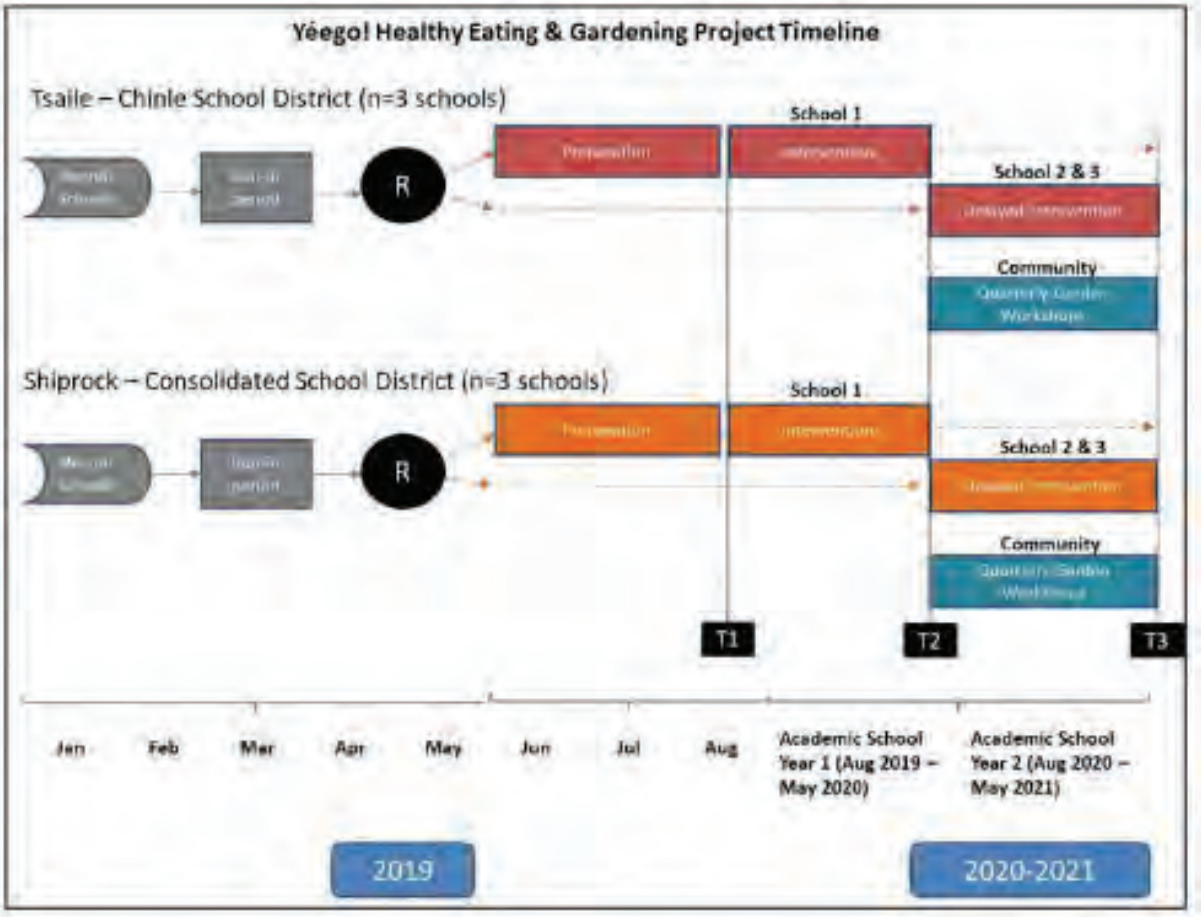


Figure 6. Overall design of the project: The small-randomized controlled design of the curriculum and school garden intervention are being implemented in elementary schools in Shiprock and Tsaile areas. "R" = randomization point after school recruitment. "T" = pre-, mid-, and post-assessment measures for nutrition and garden-based behaviors. NMSU ASC at Farmington 2020.

Figure 7. Yéego Garden instructor Brandon Francis (left) integrating the project concepts into student classroom learning; preparation of raised grow beds (center); students and teachers preparing for outdoor gardening experience (right). NMSU ASC at Farmington 2020.

PROJECT TITLE: HOPS (HUMULUS LUPULUS) AND WINTER MALTED BARLEY TO SUPPORT NEW MEXICO'S CRAFT BREWING AND MEDICINAL HERB INDUSTRIES

Investigators: K. Lombard, F.J. Thomas and K. Djaman

RELEVANCE

State-wide, New Mexico experienced a 344% increase in jobs related to the craft brewing industry between 2010 and 2016. In 2019 New Mexico, craft beer had a $391 million impact annually, having 94 craft breweries. New Mexico beers are increasingly winning awards at national events; some of these breweries are sourcing locally grown ingredients, including hops and malted barley. The objectives of these trials are to evaluate adaptability, post-harvest yield, quality and marketability of hops (Humulus lupulus) and winter malted barley grown in northwest NM. A second objective is to support education and outreach **(Figure 8)** that include the Los Ranchos Agriculture Center demonstration plot (Bernalillo County) and two beverage programs: Central New Mexico College (Albuquerque, NM and NMSUBrew (Department of Chemical Engineering, Las Cruces, NM).

RESPONSE

Hops Summary: There are two hops trials: Trial 1 consists of 9 industry standard cultivars that includes Willamette, Centennial, Cascade, Teamaker, CTZ, Nugget, Chinock, Vangard, and Crystal. Trial 2 consists of New Mexico native hops (H. lupulus neomexicanus) that include: Amalia, Multihead, Neo 1 and Latir. In 2020, Trial #1 was terminated and Trial #2 was not trellised due to staff reductions related to COVID-19 shutdowns. The mechanical hops picker, **(Figure 9)** however, was loaned to the Agriculture Center for their first year harvest and to support hop growers in the Albuquerque vicinity. Phytochemistry analysis of New Mexico native hops was completed in 2019 and the summary of that work appears in HortTechnology.

Winter Malted Barley (WMB) Summary: Thirty entries of 2-row and 6-row barley cultivars were obtained from the University of Minnesota, which coordinates the WMB multistate trial. The ASCF is one of 26 national cooperators. Plots were planted in October 2019 and harvested July 2020. Results will be forthcoming in a separate report.

IMPACT

The Project has helped catalyze a hops cooperative: New Mexico Hop Growers Association (NMHGA), and is helping to expand educational networks in beverage programs to include Central New Mexico College (Albuquerque, NM) and NMSUBrew (Las Cruces, NM).

PUBLIC VALUE STATEMENT

The work is helping to support the craft brewing industry which is a significant economic driver in New Mexico's service and tourism industries.

ACES CRITICAL ISSUE (PILLARS)

The work is directly responsive to Pillar #1: Food and Fiber Production and Marketing

Figure 8. Educational linkages with field, to classroom, to finished product in 2020. NMSU ASC at Farmington 2020.

Figure 9. Small-scale mechanical hops picker at the Los Ranchos Agricultural Center, July 2020. NMSU ASC at Farmington 2020.

PROJECT TITLE: NORTHWEST NEW MEXICO VITICULTURE RESEARCH

Investigators: K. Lombard, G. Giesse and S. Yao

RELEVANCE

There are 52 wine producers in New Mexico that in 2017 had nearly an $877 million economic impact through direct sales, employment opportunities and tourism (2017 economic impact report on the American wine industry John Dunham and Associates). A few wineries exist in Northwest NM and Southwest Colorado in a region with extensive agritourism potential (Durango Herald 2019 (https://durangoherald.com/articles/302329). While hot days and cool nights benefit berry ripening during the growing season, high elevation (>5,600 ft) Northwest NM grape growers are challenged by extremely low winter temperatures and killing spring frosts, pushing the boundaries of viticulture.

Figure 10. Table grape study planted in 2020. Funding is through the New Mexico Department of Agriculture Specialty Crop Block grant. The study is replicated in Los Lunas, Alcalde, and Farmington ASCs. NMSU ASC at Farmington 2020.

RESPONSE

Objectives of this research are to evaluate grape performance in three trials: 1) Vitis sp. Hybrids, which typically have higher cold tolerance, 2) grafted and non-grafted Vitis vinifera varietals, which typically have higher market potential than hybrids but less cold tolerance, and 3) table grapes for fresh markets (Figures 10 and 11). Results indicate that at the ASC Farmington location, once established, some varietals produce high quality juice conducive to fine wine making and fresh table markets. Growers are cautioned to select sites carefully before planting grapes and avoid low lying topography where possible, which are prone to frost pockets. An overview of this research with specific recommendations can be requested by emailing klombard@nmsu.edu.

IMPACT

The work is supporting site specific varietal recommendations to include hybrids for vineyards having high frost risk in low lying river valleys, and viniferous cultivars for upland mesa sites where water is accessible.

PUBLIC VALUE STATEMENT

The work is helping to support northwest New Mexico wineries which has a significant economic impact in New Mexico's service and tourism industries. The work is also evaluating potential table grape varieties for fresh market sales and consumption.

ACES CRITICAL ISSUE (PILLARS)

The work is directly responsive to Pillar #1: Food and Fiber Production and Marketing

Figure 11. 2008-planted trial; harvesting 'Refosco' vines to produce a rosé-type wine. NMSU ASC at Farmington 2020.

OTHER SPECIALTY CROPS RESEARCH

Investigators: Kevin Lombard and others

"Specialty crops" are defined in statute as "fruits and vegetables, tree nuts, dried fruits, horticulture, and nursery crops (including floriculture)" as part of the Specialty Crops Competitiveness Act of 2004, as amended (P.L. 108-465, 7 U.S.C. 1621 note).1. USDA estimates that the value of farm-level specialty crop production totals nearly $60 billion, representing about one-fourth of the value of all U.S. crop production." Figure 12 describes specialty crops at NMSU ASC Farmington (2020).

Grafted Cherry Trial

Relevance: Cherries have a long history of production in the Four Corners area with recent renewed interest.
Response: Six grafted cultivars were planted in March 2014 as bare-root, 3-year old tree seedlings. Cherry trees are among the first fruit trees to break dormancy at our location and have been prone to spring frost damage resulting in flower death almost yearly since planting.
Public Value Statement: Gowers are cautioned to avoid sites subject to frost pockets and may want to consider alternative fruit trees like Jujube, that flower after the last danger of frost.

Northwest New Mexico Hemp Project: Year 2

Relevance: Legal Hemp (Cannabis sativa with a THC value of 0.3%) is receiving renewed attention after New Mexico legalized hemp in 2019. Permitted growers in Northwest NM are requesting data on the feasibility, cultivar adaptability, and post-harvest quality.
Response: 5 cultivars were evaluated in 2020 after permitting was obtained through the New Mexico Department of Agriculture which included criminal background check, NMDA Permit, and Navajo Nation approval.
Impact: All five cultivars were compliant, having a THC content below 0.3%. Hemp presents challenges in terms of public perception. Growers are cautioned to understand the markets before considering hemp.
Public Value Statement: The work is expanding our understanding of hemp performance in NW NM.
ACES Critical Issue (Pillars): This project is directly responsive to Food & Fiber Production and Marketing.

Field Evaluation of Megapops Specialty Potatoes

Relevance: A native potato species originating in the Four Corners states and western Texas. The species is of interest for research and breeding by virtue of its resistance traits for pests, such as extreme late blight, nematodes, and insects. The tubers have long dormancy, freezing tolerance and are exceptionally nutritious, containing high levels of antioxidants that inhibit prostate cancer.
Response: We grew 130+ populations from across the natural range at ASC Farmington during the 2016, 2017, 2019, and 2020 seasons.

GOLD KING MINE LONG-TERM MONITORING PROJECT

Investigators: K.A. Lombard1, A. Ulery2, D.C. Weindorf3, G. Jha2, B. Francis1, B. Hunter2, M. Whiting2, A. Mathews4 and S. Fullen2Funds provided by the United States Department of Agriculture Natural Resources Conservation Service, New Mexico Environment Department, and the New Mexico Water Resources Research Institute.

RELEVANCE

The Gold King Mine Spill of August 5, 2015 caused uncertainty about water, soil and crop safety among Northwest New Mexico and Navajo Nation farmers.

RESPONSE

Soil, crop and water samples have been collected from irrigation ditches and crop-land annually for heavy metal analysis utilizing field-based portable X-ray fluorescence (PXRF) spectrometry (Figure 13) and lab-based Inductively Coupled Plasma Optical Emission spectroscopy (ICP-OES) methods. Five graduate students have contributed to thesis and dissertations and peer reviewed journal articles.

IMPACT

Northwest, NM including the Navajo Nation relies almost exclusively on surface water from the La Plata, Animas, and San Juan rivers for crop irrigation. Fruitland, Hogback, and Shiprock Chapters of the Navajo Nation, alone, irrigate over 500 farms and

SUMMARY

The objective of this study was to perform a spatiotemporal analysis of elemental concentrations in agricultural soils to determine any potential threat to agronomic production and food safety following the Gold King Mine spill of August 5, 2015. Several irrigated fields irrigated from the Animas and San Jan Rivers (below the confluence with the Animas) were scanned using portable X-ray fluorescence (PXRF) spectrometry to monitor the spatial and temporal variability of nine heavy metals including Pb, As, Cu, and Cr (Figure 14). Irrigation ditches and crops were also monitored. The sampling range extends from the New Mexico/Colorado border to Shiprock on the Navajo Nation. After five years of monitoring, the data suggests that, in general, the risk is low and that irrigation water and soil are generally healthy concerning nine heavy metals being monitored. Further monitoring is recommended, along with an assessment of potential sociological impacts of the spill on regional farming.

ACES CRITICAL ISSUE (PILLARS)

(Pillars 1) Food & Fiber Production and Marketing, 2) Family Development and Health of New Mexicans, 3) Environmental Stewardship, and 4) Water Use and Conservation. This project is directly relevant to all Four Pillars of ACES.

Figure 13. Portable X-ray fluorescence (PXRF) spectrometry to monitor the spatial and temporal variability of nine heavy metals including Pb, As, Cu, and Cr. NMSU ASC at Farmington 2020.

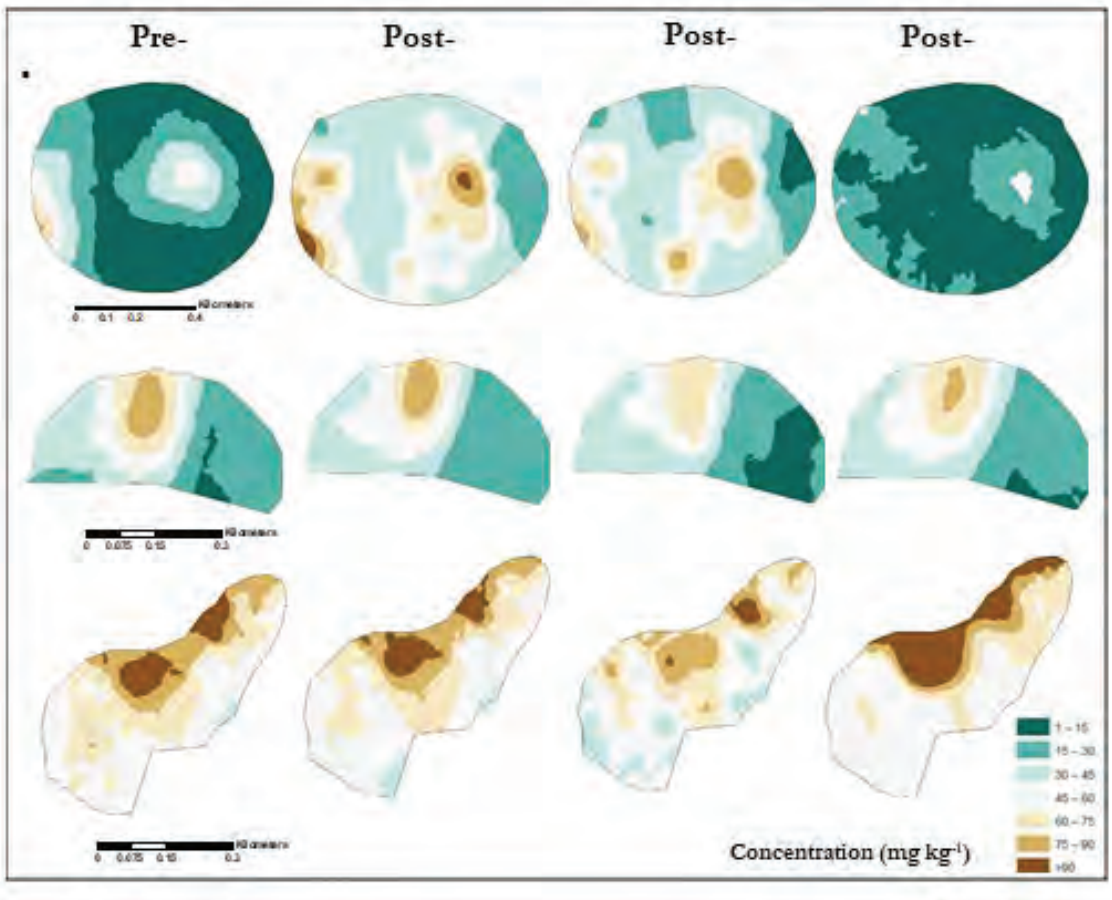


Figure 14. Example of spatiotemporal analysis of elemental concentrations in agricultural soils of the Animas River valley. NMSU ASC at Farmington 2020.

NORTHWESTERN NEW MEXICO ADAPTIVE CROP RESEARCH

Investigators: K. Djaman, S.C. Allen and D. Begay1

IMPACT

Alfalfa (Medicago sativa) is a major hay crop in New Mexico and in San Juan County. It is important to know which varieties have the best long-term yields and pest tolerance under local conditions. This information is helpful for alfalfa growers who wish to maximize yields in light of varying seed costs and production inputs.

SUMMARY

The 2018-Planted Alfalfa Variety Trial is part of a statewide testing program to help determine which entries will perform best in the area they are tested. This trial was coordinated through the NMSU Plant and Environmental Sciences Department2. The trial consists of 16 varieties from public varieties and private seed companies. The 2020 mean seasonal total yield for this trial was 11.52 tons per acre. (Table 2) The numerically highest total yielding entry of 12.63 tons per acre was SW5207, an advanced breeding line entry. Other entries performed similarly well for the season, including FSG415BR, SW3407, FSG 423ST, SW3407, 6422Q, FSG524 and Lahontan, among others. Higher yields and greater varietal yield differences are expected in years 3 and 4 of the study.

Figure 15. Alfalfa harvest at ASC Farmington. NMSU ASC at Farmington 2020.

MATERIALS AND METHODS

The trial was established on August 28, 2018 and consists of 16 varieties arranged in a randomized block design with four replications. Two additional varieties (SS120 and Zia) served as a north-end border, along with Lahontan as a trial-wide border. Individual plots were six 8-inch rows by 16-foot-long rows (64 ft2). Planting rate was 20 pounds per acre. The planter was a Kincaid 6-row cone seeder equipped with discs that closed the seed trench directly after the seeds were dropped in the small furrow opening at a depth of about 0.25 inches. The plot area was not fertilized in 2019 and 2020, and did not receive insecticides; however, Pursuit herbicide was applied once at 6 oz/acre in April each year for weed control. Irrigation method was solid-set sprinkler lines. Irrigation frequency was 1 to 3 times per week during irrigation season (early April through early September), with an estimated irrigation amount of 42.0 inches. Total precipitation during this period was 2.6 inches. Plots were cut four times during the 2020 growing season June 09, July 22, August 26, and October 7. Plots were cut with an Almaco forage harvester and whole-plot green weight was recorded (Figure 15). At cutting, fresh samples were hand-collected from select plots and dried to determine dry matter content.

RESULTS

Yield results for the 2020 growing season of the 2018-Planted Alfalfa Variety Trial are presented in Table 2. Yields for each cut along with the seasonal total yields are shown for each entry as dry tons per acre. The 2020 mean seasonal total yield for this trial was 11.52 tons per acre (Table 2). The numerically highest total yielding entry of 12.63 tons per acre was SW5207, a public entry. Other entries performed similarly well for the season, including FSG415BR, SW3407, FSG 423ST, SW3407, 6422Q, FSG524 and Lahontan, among others. Higher yields and greater varietal yield differences are expected in years 3 and 4 of the study.

Table 2. 2018 - Planted Alfalfa Variety Trial results for the 2020 growing season†. New Mexico State University (NMSU) Agricultural Science Center at Farmington, NM, 2020.

Variety Name	Company or Brand Name	Fall Dormancy	Yield (dry tons/acre)						
			Total Yield 2019	Jun 9 2020	Jul 22 2020	Aug 26 2020	Oct 7 2020	Total Yield 2020	Two Year Average
SW5207	S&W Seed Co.	5	8.82	4.12	3.54	2.71	2.26	12.63	10.73
SW3407	S&W Seed Co.	3	9.43	4.17	3.16	2.50	2.10	11.93	10.68
FSG 415BR	Allied Seed, LLC.	4	9.17	3.85	3.56	2.79	1.98	12.17	10.67
6422Q	NEXGROW	4	9.40	4.33	3.01	2.71	1.83	11.88	10.64
WL 365HQ	W-L Research	5	9.09	4.20	3.26	2.43	2.09	11.97	10.53
FSG 423ST	Allied Seed, LLC.	4	9.44	3.86	3.12	2.43	2.12	11.52	10.48
SW4107	S&W Seed Co.	4	8.82	3.97	3.32	2.46	1.94	11.69	10.25
FSG 426	Allied Seed, LLC.	4	9.21	3.44	3.07	2.70	1.87	11.09	10.15
Lahontan	Public	6	8.48	3.83	3.59	2.41	1.95	11.78	10.13
FSG 524	Allied Seed, LLC.	5	8.22	4.00	3.60	2.39	1.94	11.92	10.07
6585Q	NEXGROW	5	8.17	4.29	2.97	2.37	1.94	11.57	9.87
Ranger	Public	3	9.51	3.54	2.82	2.19	1.67	10.21	9.86
AmeriStand 518NT	America's Alfalfa	5	8.04	3.87	3.67	1.84	2.11	11.49	9.77
FSG 403LR	Allied Seed, LLC.	5	8.52	4.16	3.21	1.83	1.73	10.94	9.73
NM Common	Roswell Seed Co.	NA	8.19	3.57	3.12	2.32	2.00	11.01	9.60
WL 377HQ	W-L Research	5	8.37	3.23	3.39	2.13	1.77	10.51	9.44
Mean			8.80	3.90	3.27	2.39	1.96	11.52	10.16
LSD (0.05)			NS	NS	NS	NS	0.29	NS	NS
CV%			10.26	15.86	13.98	18.86	10.43	10.25	11.76

†Data were detrended using nearest neighbor analysis, and analyzed using analysis of variance.
NS, no significant differences detected among varieties within the column at the 5% level.

2020 CORN PERFORMANCE TRIALS FOR EARLY SEASON, FULL SEASON AND FORAGE CORN

Investigators: K. Djaman, S.C. Allen, M.M. West, D. Begay, J. Joe and F.J. Thomas1

IMPACT

The 2020 Corn Performance Tests are part of a statewide entry-fee testing program2. Performance tests for grain corn and forage corn are essential in order to provide local growers, Extension faculty and seed industry personnel with accurate, up-to-date information on varietal health and performance under local conditions. Given that corn and corn products are a key commodity in northern New Mexico, information from performance testing is helpful for many different types of growers who wish to increase yields and make the most of production and harvest costs.

SUMMARY

Three separate corn trials were conducted at ASC Farmington in 2020. The Early Season Corn trial had 7 entries, the Full Season Corn trial had 6 entries, and the Forage Corn trial had 4 entries. All trials were planted under the same center pivot on May 13 and replicated 4 times in a randomized block design. Plot dimension was 20 feet by 10 feet with 4 rows per plot and 30 inch row spacing. Seeding rate was 36,590 seeds per acre. Forage corn was hand harvested on September 10 in a 10-ft subsample. Full season and Early season corn combine-harvested areas were 2 rows 20 feet long, with Full season corn harvested on December 3 and 10, and Early season corn harvested on December 10. Figure 16 depicts various steps in the corn performance trials. Year-end test results for these three trials are described in detail in Marsalis et al. (2021)2.

These studies help to identify promising corn varieties for the semi-arid conditions of northern New Mexico.

Figure 16. (top to bottom). Various steps in corn performance trials: planting corn plots; weighing hand-harvested forage corn; grinding forage corn for milk and nutrient analysis; combine-harvesting early and full season corn for crop yield determination to see which varieties performed the best in our semi-arid area. NMSU ASC at Farmington 2020.

CORN FIRST-YEAR RESPONSE TO NITROGEN FERTILIZER FOLLOWING FIVE-YEAR ALFALFA PRODUCTION

Investigators: K. Djaman and D. Begay

IMPACT

Many growers do not differentiate nitrogen fertilizer rate applied to corn as a sole continuous crop or in rotation following alfalfa. This study aims to develop nitrogen fertilizer recommendation in rotation with alfalfa production. The outcome of this research suggests the use of 0 to 47% of the recommended nitrogen fertilizer in corn following alfalfa with 53% to 100% saving in nitrogen fertilizer. This leads to an increase of corn growers' net economic return and reduce soil and groundwater pollution nitrates.

SUMMARY

Alfalfa and corn are important crops grown in rotation across the US. The beneficial effects of growing legumes in rotation with cereals have been proven for providing considerable amounts of nitrogen to the subsequent cereal crop, improving soil organic matter, weed control, breaking up diseases and pest cycles, etc. However, crop producers may underestimate the nitrogen credit of perennial alfalfa and seldom reduce nitrogen fertilization rates to corn grown after alfalfa and as nitrogen fertilizer price increases, producers may consider managing nitrogen fertilizer and taking advantage of the nitrogen credit left after a perennial alfalfa is terminated or other legume crops. The main objective of this research is to establish the first year optimum nitrogen fertilizer rate of corn after a 4- to 5-year irrigated alfalfa production in the northwest New Mexico. 2014 planted alfalfa was terminated in December 2019 and planted in corn in the 2020 growing season. Nitrogen fertilizer (urea) rates as 0, 75, 120, 160 kg N /ha were applied to plots a month after planting according to a randomized complete bloc design with three replications. The nitrogen rates 0, 75, and 120 kg/ha obtained statistically similar plant height and leaf area index (Table 3). Plant height and leaf area index significantly decreased at the nitrogen rate of 160 kg/ha while it obtained similar grain yield as the treatment with no nitrogen fertilizer. Corn grain yield showed a quadratic relationship with he applied nitrogen rates. These preliminary results demonstrated that a low to null nitrogen fertilizer rate is required by corn following alfalfa.

MATERIALS AND METHODS

Field experiments were conducted in 2020 at ASC Farmington, and a selected five-year alfalfa crop was terminated and plowed in December 2019 and disked and harrowed in April 2020. Corn hybrid DKC53-45RIB was planted on May 18, 2020 at the rate of 88,000 plant per hectare. Irrigation, based on actual crop evapotranspiration, was managed at the optimum to avoid water stress. Nitrogen rates were 0, 75, 120, 160 kg N /ha. Urea fertilizer was applied to the plot a month after planting according to a randomized complete block design with three replications. All plots received uniform dose of 50 kg/ha of P2O5 and K2O. The experimental unit size was 18.3 m long by 6.84 m. Maximum corn plant height and leaf area index were measured at the tasseling- milk stage. At crop physiological maturity, 10 plants per treatment and replication, randomly selected were cut, and ears harvested for yield components. The central three corn rows were combine-harvested per plot. Plot weight and grain moisture content were measured and yield was extrapolated after moisture adjustment to a standard moisture content of 14%. The analysis of variance was applied to the plant height, leaf area index and grain yield for significant effect of nitrogen applied rates using CoSTAT software and the means were cross-paired and compared using Fisher's protected LSD at 95% level of probability to identify significant differences between N rates in term of plant height, leaf area index and grain yield.

RESULTS

Nitrogen fertilizer 0, 75, and 120 kg/ha obtained statistically similar plant height and leaf area index (Table 3). Plant height and LAI significantly decreased at the N rate of 160 kg/ha. Nitrogen applied rates of 0 and 160 kg N/ha obtained statistically similar grain yield. Corn grain yield had a quadratic relationship with N applied rate (Figure 17). These initial results demonstrated that a low to null N fertilizer rate is required in corn following alfalfa production. Economic analysis might provide more insight information on economic viable nitrogen rate to be applied to corn following alfalfa for production profitability and sustainability.

Table 3. Corn response to nitrogen fertilizer following 5-year alfalfa production. New Mexico State University (NMSU) Agricultural Science Center at Farmington, NM, 2020.

Treatments	Leaf area index	Plant height (cm)	Grain yield (kg/ha)
T-0	6.69 ±0.10 a	264.795 ±6.62 a	15438.94 ±575.74 a
T-75	6.765 ±0.19 a	267.5467 ±5.94 a	15686.76 ±433.73 b
T-120	6.755 ±0.10 a	275.336 ±9.61 a	15831.31 ±805.84 b
T-160	6.165 ±0.06 b	256.54 ±5.92 b	15420.1 ±313.23 a

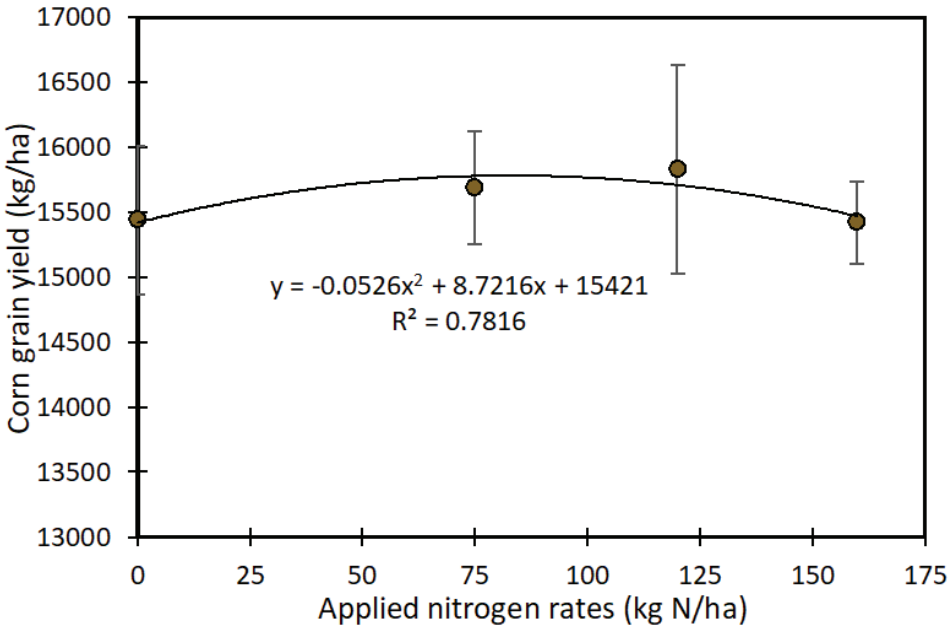


Figure 17. Relationship between corn grain yield and the applied nitrogen rates. New Mexico State University (NMSU) Agricultural Science Center at Farmington, NM, 2020.

CONCLUSIONS

This study provides corn producers with information the nitrogen fertilizer rate to be applied to optimize corn yield the first year succeeding a 5-year alfalfa forage production. Corn response curve to nitrogen fertilizer after alfalfa for the first year was developed. These preliminary results demonstrated that a low to null nitrogen fertilizer rate is required by corn following alfalfa. This research will continue and alfalfa nitrogen credit, nitrogen fertilizer recommendation for corn following alfalfa and the net economic return as function of nitrogen rate will be provided to corn growers in New Mexico.

EFFECT OF PLANT DENSITY AND PLANTING DATE ON MAIZE CROP GROWTH, YIELD AND YIELD COMPONENTS, AND WATER USE EFFICIENCY

Investigators: K. Djaman, D. Begay and S. Allen

IMPACT

Corn planting date and plant density evaluation is very important under changing climate conditions. It provides local growers, extension workers and seed industry personnel with accurate, up-to-date information on planting window and optimum plant population under local conditions for avoiding crop failure and improving resource use efficiency. Given that corn and corn products are an important commodity in northern New Mexico, information from corn planting window and optimum plant population is helpful for growers to increase corn yields, improve water productivity, and obtain the maximum economic returns from their corn production.

SUMMARY

Weather conditions in the Four Corners region are variable and influence crop growing periods across the region with late spring frosts and early fall frosts. Thus, the frost free and the killing frost free periods are variable and can significantly impact cropping seasons. With the development of new maize hybrids, field maize grain yield, evapotranspiration, and crop water productivity can be substantially impacted by planting density and planting date. Thus, it is critical that the optimum plant density and planting date for maximum economic returns be researched and determined for local conditions. Field experiments were conducted at the NMSU ASC in 2020 to evaluate six plant densities (54700, 64600, 74600, 88000, 101700 and 120100 plants per hectare (pph) under seven planting dates (weekly from April 21 to June 10) for determination of their effects on crop yield and growth parameters (Figure 18). Plots were sprinkler irrigated and water and crop management was similar across all planting dates, and the irrigation scheduling was based on actual evapotranspiration. The results showed that crop height and leaf area index varied with both plant density and planting date. Grain yield also varied with plant density and planting date. The highest grain yield (17.77 Mg/ha) was observed under plant density of 88,000 plants/ha and the May 18 planting provided the best grain yield and the greatest WUE while the late planting improved seasonal crop water use efficiency.

Figure 18. Test corn plot. NMSU ASC at Farmington 2020.

MATERIALS AND METHODS

Sequential weekly corn planting was performed at the ASCF in 2020. Six plant densities (54,700; 64,600, 74,600; 88,000; 101,700; and 120,100 plants/ha) were evaluated under seven planting dates (April 21, April 30, May 7, May 18, May 27, June 3 and June 10). Hybrid corn DKC53-45RIB was the testing hybrid with a relative maturity of 103 days, growing degree units at mid-pollination of 1265 ºC and black layer at 2530 ºC. After chisel ripping, the plots were harrowed. The experiment was set up under split-split plot design with three replications. An experimental unit size was 9.14 m by 6.10 m. A John Deere 7200 two-row planter with 76-cm row spacing was used for sowing. Plots were solid set sprinkler irrigated and the irrigation scheduling was based on corn actual evapotranspiration estimated by the two-step FAO approach (ETa = kc ETo). Dry fertilizer was applied before planting at a rate of 56 kg/ha of the mix of MAP (11-52-0), KCl (0-0-60) and urea (46-0-0). Nitrogen was timely applied throughout maize vegetative and reproductive phases by fertigation and the total applied rate of N was 140 kg N/ha as liquid urea (ammonium nitrate, 32-0-0). Weeds were controlled by glyphosate herbicide application at recommended rate. Plant height and leaf area index were measured weekly during the growing season. At crop maturity, three central corn rows of each experimental unit were combine-harvested and the grain weight and grain moisture content were measured. Plot yield was reported in Mg/ha after grain moisture adjustment to a standard grain moisture content of 14%. Plant height, leaf area index and grain yield were analyzed by ANOVA in CoStat and means were paired compared using the Fisher's protected LSD at 5% significance to identify potential significance between the planting dates and the plant densities.

RESULTS

Maize emergence varied with planting date as the effect of soil and air temperature on the seed metabolism. Maize seasonal actual evapotranspiration varied with planting date and was 675, 678, 668, 656, 647, 632 and 610 mm for the April 21, April 30, May 7, May 18, May 27, June 3 and June 10 plantings, respectively. Plant leaf area index increased with plant density while plant height did not show significant dependence to the plant density but overall increased with delayed plantings. Maize plant growth period decreased with increasing plant density for the same planting date and yield plant population and planting dates (Table 4); number of kernels by plant decreased with increasing plant density (Figure 19). Overall, grain yield showed strong quadratic correlation with plant density and it increased from 54700 pph to about 88,000 pph and decreased at 107,100 and 120,100 pph (Figure 20). The highest grain yield (17.77 Mg/ha) was observed under the plant density of 88,000 plants/ha and the May 18 planting provided the best grain yield and the greatest WUE while the late planting improved seasonal crop water use efficiency (Table 5).

CONCLUSIONS

The results of this study showed:

· Increasing plant density or delaying planting date significantly affected maize leaf area index.

· Maize kernel number per plant decreased with increasing plant density.

· Grain yield showed strong quadratic correlation with plant density. Overall the maximum yield and water use efficiency were obtained at 88,000 pph and the May 18 planting registered the best yield.

Table 4. Trend in maize grain yield (tons/ha) as a function of planting dates and plant densities. NMSU ASC at Farmington, NM, 2020.

Plant density	Planting dates (2020)						
	21-Apr	30-Apr	7-May	18-May	27-May	3-Jun	10-Jun
54700	11.87	13.41	12.91	13.35	12.97	12.78	13.18
64600	13.42	13.65	14.23	15.09	14.47	13.38	14.70
74600	14.03	14.17	14.71	16.24	14.84	14.61	14.91
88000	15.52	15.36	17.00	17.77	16.12	16.01	16.03
101700	14.89	13.89	16.60	17.34	15.10	15.48	15.37
120100	14.71	12.98	14.91	17.46	14.28	13.61	13.67

Table 5. Maize water use efficiency (kg/m3) as a function of planting dates and plant densities. NMSU ASC at Farmington, NM, 2020.

Plant density	Planting dates (2020)						
	21-Apr	30-Apr	7-May	18-May	27-May	3-Jun	10-Jun
54700	1.76	1.98	1.93	2.03	2.01	2.02	2.16
64600	1.99	2.01	2.13	2.30	2.24	2.12	2.41
74600	2.08	2.09	2.20	2.48	2.29	2.31	2.44
88000	2.30	2.27	2.55	2.71	2.49	2.53	2.63
101700	2.21	2.05	2.49	2.64	2.33	2.45	2.52
120100	2.18	1.92	2.23	2.66	2.21	2.15	2.24

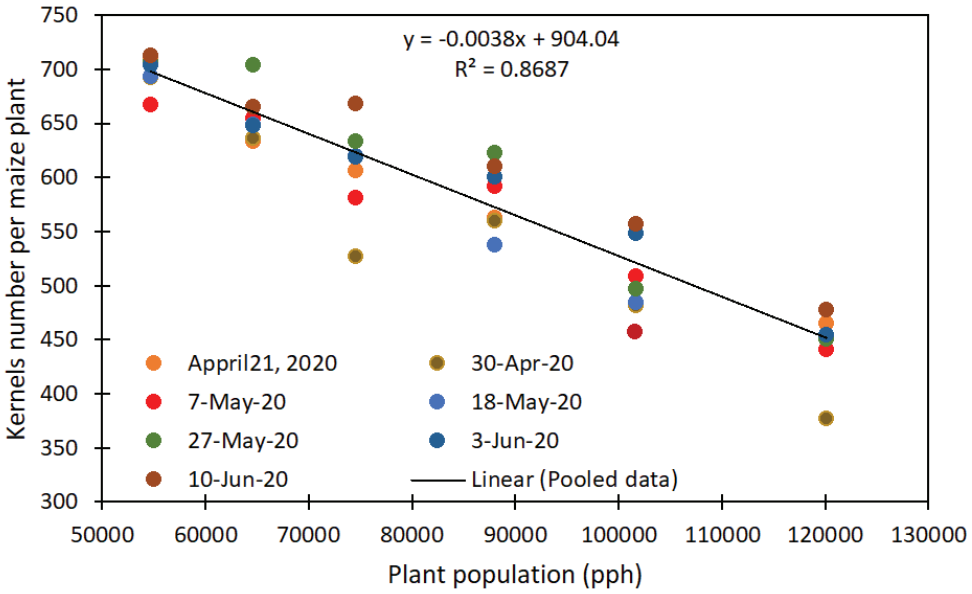


Figure 19. Relationship between maize plant population and grain yield (Megagrams per hectare) under different planting dates. NMSU ASC at Farmington, NM, 2020.

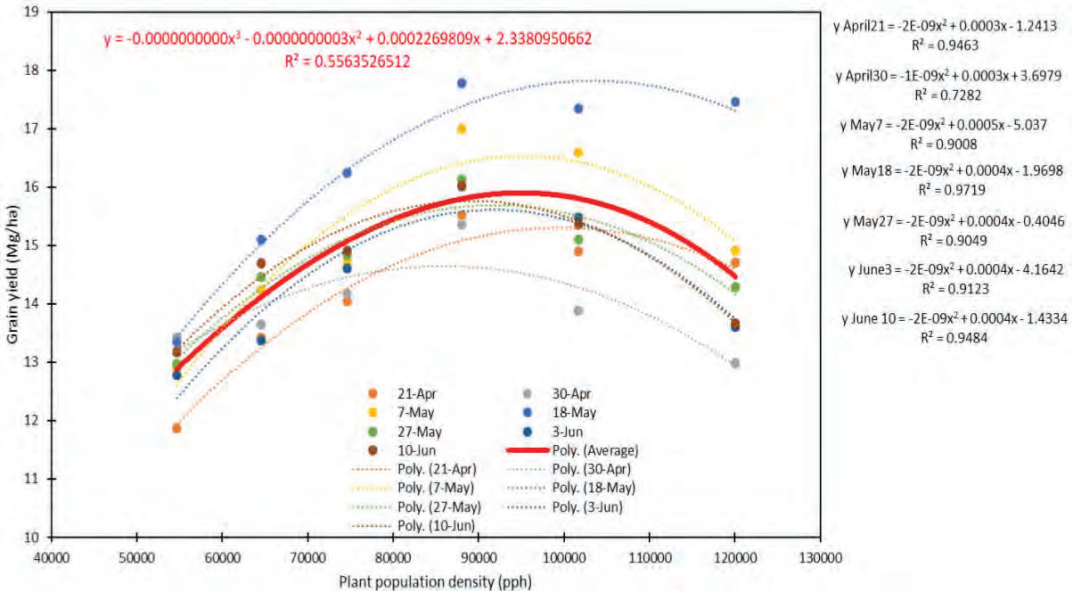


Figure 20. Relationship between maize plant population and grain yield (Megagrams per hectare) under different planting dates. NMSU ASC at Farmington, NM, 2020.

2020 CHIP POTATO VARIETY TRIAL

Investigators: K. Djaman, M.M. West, S.C. Allen, D. Begay and K.A. LombardSponsored by Potatoes USA, who provided grant of $22,845.

IMPACT

Navajo Agricultural Products Industry (NAPI) and Navajo Mesa Farms (NMF) are large-acreage potato producers in the Four Corners region. Chip potato varietal research is necessary to find better storage varieties other than the checks of Atlantic, Lamoka and Snowden. The chip potato research data, such as yield, maturity date, specific gravity, chip color, sugars and more is entered into the Potatoes USA database for use by all growers, processors and breeders. https://potatoesusa.mediusag.com

SUMMARY

Specific gravity is always good at Farmington compared to lower elevation producing areas. Thus this area is a valuable supply source for processing plants in Texas, Arizona and California. High specific gravity or high-solids indicates the chips will not absorb too much oil during frying. The cultivars CO11037-5W and CO11023-9W exceeded the check varieties in marketable yield at 524 and 501 cwt/a, respectively. The remaining 14 cultivars ranged from 189 to 481 cwt/a. Sucrose and glucose s levels are stable for this time of the year. Monthly sugars, fry defects, and chip color will be monitored throughout the post-harvest nine-month storage season.

Figure 21. Potatoes. NMSU ASC at Farmington 2020.

MATERIALS AND METHODS

Potatoes consisted of 16 entries (plus fillers) planted within four replications on April 30, 2020 (Figure 21). Seed potatoes were cut into 2.5 ounce average size and planted at eleven inch spacing using a two-row potato planter in Pivot 6 field. Vine kill was September 5, 2020. Potatoes were harvested on September 10-14, 2020 and processed October 30, 2020 at Navajo Mesa Farms (NMF) laboratory. Plot irrigation was scheduled according to site evapotranspiration rate. The irrigation was applied via a center pivot irrigation system. Fertilizer was applied according to soil test results. Wilbur-Ellis provided fertilizer which was applied at 180 pounds per acre N, 120 pounds per acre P2O5, and 300 pounds per acre K2O. Chip Potato Trial pesticide applications were scheduled and posted with NMSU 24 hours in advance. Wilbur-Ellis provided chemicals and application services. Potato psyllids (Bactericera Cockerelli) were monitored weekly by five replicates of yellow sticky traps (Figure 22).

Figure 22. Potato field with yellow sticky traps for monitoring potato psyllid counts. NMSU ASC at Farmington 2020.

RESULTS

Sixteen potato cultivars were harvested from each of the four replications. Marketable yield for the Chip Potato Variety trial ranged from 189 to 524 cwt/acre. The cultivar CO11037-5W was the top performer at 524 cwt/a followed by a check variety CO11023-9W501 cwt/a. The remaining 14 varieties ranged from 189 to 481 cwt/a in marketable yield. Specific gravity ranged from 1.088 to 1.098 percent with a 16-variety average of 1.095 percent (Table 6). The highest tuber number per plant was obtained by B2869-29 with 18 tubers per plant. The average number of tubers per plant was 10.66. The chip processing results in Table 7 show total defects (external and internal defects) as percent of 200 grams. The 16-variety total defects percent average was 7.5 %. Variety CO11023-9W had the greatest percent of external defects at 14% while B2869-29 had the greatest internal defect percent at 9.4 %. The tuber sucrose levels ranged from 0.340 to 1.167 mg/g. The cultivar MSX540-4 had the highest level of sucrose. Potato glucose content varied from 0.001 to 0.074 mg/g and the cultivar B2869-29 had the highest glucose content.

Table 6. Chip potato variety trial yield and other components. NMSU ASC at Farmington, 2020.

Entry	NAME	% canopy	Specific gravity	Solid content	Defects fresh	Total yield	Marketable yield	Tuber per plant	<1 7/8"	>1 7/8" and <3.5"	>3.5"
				(%)		(cwt/a)	(cwt/a)				
AF5040-8		68.5%	1.096	20.6	0.4%	518	422	9.0	5.3%	81.0%	13.1%
Atlantic	Atlantic	1.5%	1.096	19.7	0.7%	549	481	11.4	7.2%	87.6%	5.2%
B2869-29		1.7%	1.096	25.5	0.0%	503	189	18.1	21.7%	77.4%	0.9%
CO11023-2W		24.7%	1.093	19.1	0.0%	523	438	11.3	7.3%	83.7%	9.0%
CO11023-9W		76.1%	1.097	20.8	0.4%	594	501	10.8	4.9%	84.4%	10.6%
CO11037-5W		38.3%	1.088	18.1	0.0%	608	524	10.4	5.4%	86.2%	8.3%
Lamoka	Lamoka	24.2%	1.098	19.6	0.8%	506	428	8.7	4.9%	84.6%	10.5%
MSV030-4	Petroskey	24.7%	1.089	19.0	0.3%	402	360	9.4	8.3%	89.8%	1.9%
MSW474-1		83.9%	1.097	20.1	0.0%	528	435	13.6	11.8%	82.3%	5.9%
MSX540-4	Mackinaw	48.2%	1.097	20.2	0.0%	341	288	5.8	3.8%	84.5%	11.7%
MSZ063-2		15.2%	1.093	18.0	5.0%	511	454	11.2	7.6%	88.9%	3.5%
MSZ242-13		84.4%	1.098	22.8	0.4%	419	335	6.8	3.9%	80.0%	16.0%
ND7519-1		3.7%	1.093	18.2	0.0%	419	363	10.6	11.6%	86.7%	1.7%
NY163		82.0%	1.091	19.1	0.0%	476	428	10.6	8.7%	89.8%	1.5%
Snowden	Snowden	52.3%	1.097	20.0	0.0%	455	391	12.2	11.6%	85.9%	2.5%
Winterset	Winterset	80.8%	1.098	20.1	0.5%	572	444	9.7	4.4%	77.5%	18.1%
Average		44.4%	1.095	20.1	0.005	490	402	10.660	0.083	84.90%	6.8%

Table 7. Chip potato variety trial processing data. NMSU ASC at Farmington, 2020.

Entry	Name	Sucrose (mg/g)	Glucose (mg/g)	UC	Internal defects (%)	External defects (%)	Green	Total defects (%)	Chip color	COMMENTS
AF5040-8		0.553	0.008	0.0%	0.0%	10.0%	0.0%	10.0%	1.0	few yellowish chips
Atlantic	Atlantic	0.675	0.019	0.0%	0.0%	7.9%	0.0%	7.9%	1.0	nice bright chips
B2869-29		0.743	0.074	0.5%	9.4%	0.0%	0.0%	9.9%	2.0	few undesirable color
CO11023-2W		0.664	0.017	0.0%	0.0%	8.5%	0.0%	8.5%	1.0	few bruise, nice
CO11023-9W		0.491	0.007	0.0%	0.0%	14.0%	0.0%	14.0%	1.0	few bruise, nice
CO11037-5W		0.483	0.008	0.0%	0.0%	0.1%	0.0%	0.1%	1.0	nice bright chips
Lamoka	Lamoka	0.853	0.017	0.0%	0.0%	4.9%	0.0%	4.9%	1.0	very few stem end
MSV030-4	Petoskey	0.439	0.001	0.0%	0.0%	5.8%	0.0%	5.8%	1.0	very few stem end
MSW474-1		0.512	0.007	0.0%	0.0%	9.4%	0.0%	9.4%	1.0	few blisters, bruises
MSX540-4	Mackinaw	1.167	0.008	0.0%	0.0%	13.0%	0.0%	13.0%	1.0	few bruise
MSZ063-2		0.631	0.012	0.0%	0.0%	5.8%	0.0%	5.8%	1.0	few vascular
MSZ242-13		0.685	0.008	0.0%	0.0%	10.8%	0.0%	10.8%	1.0	few bruise, blisters
ND7519-1		0.719	0.014	0.0%	0.0%	3.5%	0.0%	3.5%	1.0	nice bright chips
NY163		0.340	0.010	0.0%	0.0%	3.3%	0.0%	3.3%	1.0	nice bright chips
Snowden	Snowden	0.842	0.017	0.0%	0.0%	9.2%	0.0%	9.2%	1.0	few bruise
Winterset	Winterset	0.818	0.014	0.0%	0.0%	13.5%	0.0%	13.5%	1.0	few bruise
Average		0.663	0.015	0.0%	0.0%	7.5%	0.0%	7.5%		

2020 TABLE POTATO VARIETY TRIAL

Investigators: K. Djaman, K.A. Lombard, D. Begay, M.M. West and S.C. Allen

IMPACT

Navajo Agricultural Products Industry (NAPI) and Navajo Mesa Farms (NMF) are large-acreage potato producers in the Four Corners region. Potato varietal research is necessary to find the locally adapted and high yielding cultivars for potato growers of the Four Corners region.

FFigure 23. Table potatoes. NMSU ASC Farmington 2020.

SUMMARY

Sixteen table potato cultivars were grown for tuber yield and yield component at ASC Farmington (Figure 23). Tuber yield varied from 402 cwt/a to 608 cwt/a and highest yield was obtained by Soraya followed by Alegria. Wendy had the most small tubers (< 2.0") and Alegria had the most large tubers (≥ 3.5") followed by Soraya.

MATERIALS AND METHODS

Twelve table potato cultivars were planted within four replications on April 30, 2020. Seed potatoes were cut into 2.5 ounce average size and planted at eleven inch spacing. Vine kill was September 5, 2020. Potatoes were harvested on September 10-14, 2020 (Figure 24). Plot irrigation was scheduled based on site evapotranspiration rate. Irrigation was applied via center pivot irrigation. Fertilizer was applied according to soil test results. Wilbur-Ellis provided chemical applications and fertilizer, applied at 180 pounds per acre N, 120 pounds per acre P2O5 and 300 pounds per acre K2O.

Figure 24. Potato harvester. NMSU ASC Farmington 2020.

RESULTS

Twelve cultivars were harvested from each of four replications. Tuber yield varied from 402 cwt/a to 608 cwt/a and the highest yield was obtained by Soraya followed by Alegria (Table 8). The lowest tuber yield was obtained by Wendy with the most small tubers (< 2.0"). Alegria had the most large tubers (≥ 3.5") followed by Soraya.

Table 8. Table potato yield and other components. NMSU ASC at Farmington, NM, 2020.

Cultivars	Yield	< 2.0"		< 2.5"		< 3.0"		< 3.5"		> 3.5"	
		Ct	Wt	Ct	Wt	Ct	Wt	Ct	Wt	Ct	Wt)
	(cwt/ acre)		(lb)		(lb)		(lb)		(lb)		(lb)
Wendy	402	260	21.85	43	10.3	7	3	0	0	0	0
Soraya	624	47	6.6	46	13.15	46	20.55	16	11.35	3	2.95
MN13142-32	469	101	19.15	48	19.3	4	2.55	0	0	0	0
Alegria	608	76	8.2	50	12.65	44	18.55	24	13.8	0	0
Sunset Russet	502	124	14.8	53	19.15	16	8.15	3	1.85	0	0
Reveille Russet	457	63	11.05	46	16.25	16	8.35	5	4.35	0	0
CO100085-1RU	441	116	11.05	44	13.2	23	12.25	3	2.05	0	0
CO100085-1RU	573	123	22.95	38	15.7	13	7.2	4	4.25	0	0
NAPI Russet	417	24	7.9	31	11.05	21	12.85	5	4.7	0	0
Russet Norkotah TX296	478	67	12.85	44	18.35	14	9.45	1	1.2	0	0
CO11266-1W/Y	427	185	13.6	94	18.6	13	4.6	1	0.55	0	0
CO11250-1WY	528	115	9.65	125	27.1	21	8.3	2	1.15	0	0
Average	494	108.42	13.30	55.17	16.23	19.83	9.65	5.33	3.77	0.25	0.25

HEADING DATE AND GRAIN YIELD OF EIGHTEEN WINTER WHEAT CULTIVARS

Investigators: K. Djaman, S. Haley and D. Begay

IMPACT

The winter wheat performance tests are essential in order to provide local growers, extension workers and seed industry personnel with accurate, up-to-date information on wheat varietal health and performance under local conditions. In 2019, 360,000 acres of winter wheat were seeded in New Mexico (NASS, 2019)3. Given that wheat and products are an important commodity in northern New Mexico, information from performance testing is helpful for growers who wish to increase yields and make the most of production and harvest costs.

SUMMARY

Eighteen winter wheat cultivars were evaluated for their heading date and grain yield under sprinkler irrigation at the Farmington Agricultural Experimental Station during the 2019-2020 winter wheat growing season. The 18 cultivars were organized in a randomized complete block design with four replications. The results showed that Langin was the earliest cultivar with heading on Julian day 122 while Whistler was the latest cultivar with heading on Julian day 129. Average grain yield varied from 3,793 kg/ha obtained by BrawlCLPlus to 4,740 kg/ha obtained by CO14A055-258. The top yielding cultivars were CO14A055-258, Whistler, Monarch, Breck, CO15D098R and CrescentAx.

MATERIALS AND METHODS

Eighteen winter wheat cultivars were evaluated for their heading date and grain yield under sprinkler irrigation. The 18 cultivars were organized in a randomized complete block design with four replications. Wheat was planted on September 28, 2019 and harvested on July 2, 2020. The planting rate was 1.2 million seeds per acre and the experimental unit plot size was 5 ft over 20 ft (100 ft2). The plot was sprinkler irrigated from planting to October 20, 2019 and from April 15, 2020 to late June 2020 through a center pivot, and the irrigation scheduling was based on wheat actual evapotranspiration. Herbicide (Pursuit) was applied at the recommended rate in late April 2020 to control a combination of mustard and Canadian thistle, and some manual weeding was occasionally practiced to keep the plots weed free. Plots were combine harvested on July 2, 2020 when the moisture content of the grain was lower than 10%, and plot weights were adjusted to a standard moisture content of 14%; yield was determined in kg/ha. Figure 25 presents the overview of the research plot in June 2020. Yield data was analyzed by analysis of variance (ANOVA) using CoStat software and the means were separated using Fisher's protected least significance difference (LSD) test at the 95% level of probability.

Figure 25. Wheat plot overview on June 15, 2020. NMSU ASC at Farmington, NM, 2020.

RESULTS

Average heading date of each wheat cultivar is presented in Figure 26. The heading date varied with wheat cultivar and ranged from 122 to 129 Julian day. Langin was the earliest cultivar while Whistler was the latest cultivar. Winter wheat grain yield varied with cultivar and ranged from 3,793 kg/ha to 4,740 kg/ha (Figure 27). The latest cultivar BrawlCLPlus obtained the lowest grain yield, and the highest grain yield was obtained by cultivar CO14A055-258. Top yielding wheat cultivars were CO14A055-258, Whistler, Monarch, Breck, CO15D098R and CrescentAx making them good candidates for adoption in the Four Corners; however, best management practices are recommended for optimal production sustainability and yield potential.

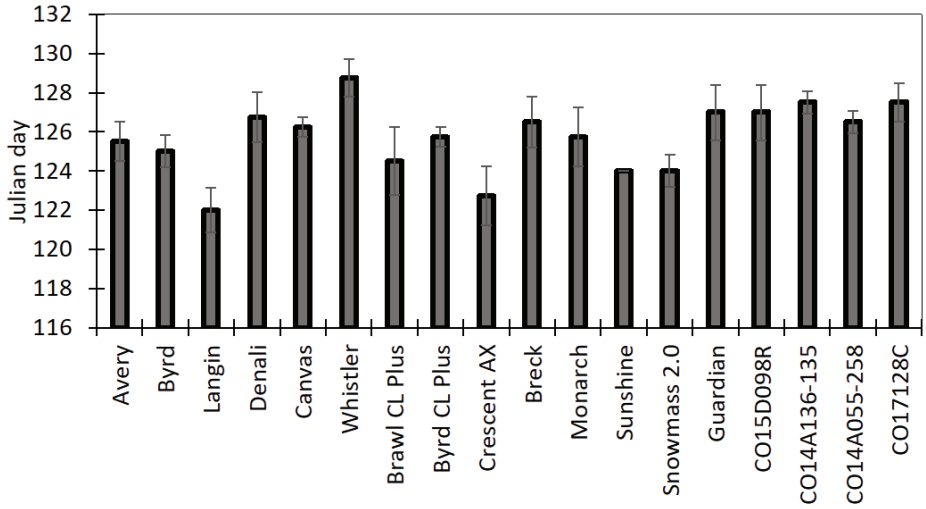


Figure 26. Heading dates of winter wheat cultivars evaluated during the 2019-2020 season. New Mexico State University (NMSU) Agricultural Science Center at Farmington, NM, 2020.

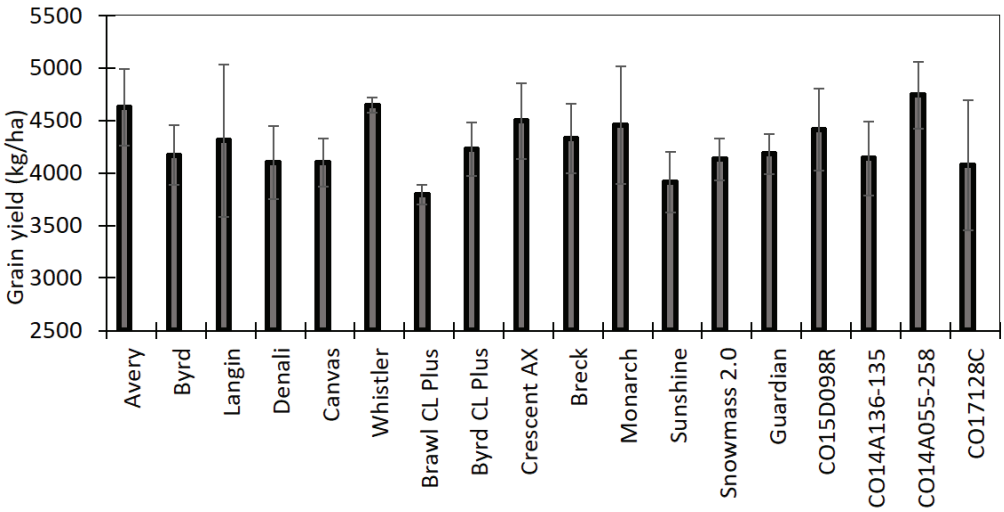


Figure 27. Final grain yield of 18 winter wheat cultivars evaluated during the 2019-2020 season. New Mexico State University (NMSU) Agricultural Science Center at Farmington, NM, 2020.

OUTREACH REPORT: ASC STAFFERS SERVING AS SUPERVISORS FOR NATIONAL CORN AND WHEAT YIELD CONTESTS

Investigators: S.C. Allen

For many years now, ASC Farmington has provided Navajo Agricultural Products Industry (NAPI) with local judges (supervisors) for the National Corn Yield Contest, and more recently, the National Wheat Yield Contest. Both contests are nationwide competitions among private growers to see who can produce the highest yields in different farming categories. And for many years, NAPI has performed well in the corn category, competing well with growers in the Corn Belt and other more fertile regions of the country.

Our current NMSU judging team consists of ASC staffers Sam Allen, Jonah Joe, Joe Ward and Dallen Begay. Wheat judging usually occurs in August, and the corn judging usually in October/November. We coordinate the harvest times with the respective NAPI crop managers and with representatives of the corn breeders (Pioneer and Bayer), who usually wish to be present for the contest harvests. The contest rules require that a team of impartial certified judges be on hand to supervise the field measurements, harvest procedures and yield measurements, which are then submitted to the respective national contest (Figure 28).

In 2019, NAPI placed first in the state in corn in the Irrigated Strip/No-Till Category at 311 bushels/acre, making 3 years in a row to place first in this category. NAPI has also participated in the national wheat contest in 2018 and 2019, and it is anticipated that they will be competitive in this category as well. NMSU is honored to serve NAPI in this unique and important capacity, and we look forward to more collaboration in the future.

Figure 28. (top to bottom). Wheat contest harvest at NAPI; measuring off an official corn contest plot; contest corn being loaded for delivery to the weigh station and official verification of yield. NMSU ASC at Farmington, NM, 2020.

DISSEMINATION AND PROFESSIONAL DEVELOPMENT

COMMUNITY PRESENTATIONS

Lombard, K.A., Francis, B., Shiprock Area Food Access Coalition November Meeting, "Engaging Navajo Elementary Schools in Randomized Controlled Trial of Yéego! Health Eating & Gardening: Three phases of development," Shiprock Area Food Access Coalition, Virtual. (November 17, 2020).

Lombard, K.A., Rocky Mountain Public Broadcasting Service Water Week, "Hops Updates," Rocky Mountain Public Broadcasting Service, Durango, CO. (February 28, 2020).

Lombard, K.A., Agri-Brew Roundtable, "Hops Updates," New Mexico Hops Coalition, Albuquerque, NM. (February 20, 2020).

Lombard, K.A., Rocky Mountain Public Broadcasting Service Water Week, "Hops Updates," Rocky Mountain Public Broadcasting Service, Durango, CO. (February 28, 2020).

Lombard, K.A., Agri-Brew Roundtable, "Hops Updates," New Mexico Hops Coalition, Albuquerque, NM. (February 20, 2020).

DEMONSTRATIONS AND FIELD DAYS

Lombard, K.A., NM Organic Conference, "Hops and Hops Harvester Demonstration," New Mexico Department of Agriculture, Albuquerque, NM. (February 21, 2020).

ASC Staff, NMSU Agricultural Science Center at Farmington Virtual Field Day. NMSU ASC Facebook (September 11, 2020).

POLICY AND PROFESSIONAL TESTIMONIES AND MEETINGS

Lombard, K.A., Francis, B., Shiprock Area Food Access Coalition November Meeting, "Engaging Navajo Elementary Schools in Randomized Controlled Trial of Yéego! Health Eating & Gardening: Three phases of development," Shiprock Area Food Access Coalition, Virtual. (November 17, 2020).

Lombard, K.A., Francis, B., Health, Education and Human Services Committee of the 24th Council of the Navajo Nation Special Session, "Gold King Mine Spill of 2015 Update and Yeego Gardening Project Update," 24th Council of the Navajo Nation, Shiprock, NM, Navajo Nation. (February 24, 2020).

Lombard, K.A., 24th Council of the Navajo Nation Special Session Hearings, "NMSU Hemp Pilot Project testimony," 24th Council of the Navajo Nation, Navajo Nation Council Chambers, Window Rock, Navajo Nation. (January 2020).

Lombard, K.A., Francis, B., Health, Education and Human Services Committee of the 24th Council of the Navajo Nation Special Session, "Gold King Mine Spill of 2015 Update and Yeego Gardening Project Update," 24th Council of the Navajo Nation, Shiprock, NM, Navajo Nation. (February 24, 2020).

Lombard, K.A., 24th Council of the Navajo Nation Special Session Hearings, "NMSU Hemp Pilot Project testimony," 24th Council of the Navajo Nation, Navajo Nation Council Chambers, Window Rock, Navajo Nation. (January 2020).

SCIENTIFIC COMMUNITY PRESENTATIONS

Djaman, K., Begay, D., Djaman, D.S., Allen, S., 2020 ASA, CSSA and SSSA International Annual Meeting, "Effect of planting date and plant density on crop growth, yield and yield components and resources use efficiency of maize under sprinkler irrigation," ASA, CSSA and SSSA, Phoenix, AZ. (November 10, 2020).

Djaman, K., Research and Creativity Week 2020, "Effect of planting date and plant density on crop growth, yield and yield components and resources use efficiency of maize under sprinkler irrigation," New Mexico State University, Las Cruces. (November 10, 2020).

Djaman, K., West, M.M., Allen, S., Lombard, K.A., O'Neill, M.K., Research and Creativity Week 2020, "Fifty-one Years of Meteorological Data (1969–2019): NMSU Agricultural Science Center at Farmington," New Mexico State University, Las Cruces. (November 10, 2020).

Djaman, K., Research and Creativity Week 2020, "Long-term Trend Analysis in Annual and Seasonal Precipitation, Maximum and Minimum Temperatures in the Southwest United States," New Mexico State University, Las Cruces. (November 10, 2020).

Francis, B. (Presenter), Lombard, K.A. (Presenter), Beresford, S. A.A., Ornelas, I., Bishop, S., Deschenie, D., NMSU Research and Creativity Week, "Engaging School and Family in Navajo Gardening for Health," New Mexico State University, Virtual (Originally Las Cruces, NM). (November 10, 2020).

Francis, B. (Presenter), Lombard, K. A. (Presenter), Beresford, S. A.A., Ornelas, I., Bishop, S., Deschenie, D., NMSU Research and Creativity Week, "Engaging School and Family in Navajo Gardening for Health," New Mexico State University, Virtual (Originally Las Cruces, NM). (November 10, 2020).

Lombard, K.A. (Presenter), Francis, B.J. (Presenter), SSSA Annual Meetings, "Pivoting from Face-to-Face Outreach to Digital in the Face of COVID-19 to Disseminate Garden-Based Information on the Navajo Nation," NMSU ASC Farmington, Virtual. (November 9, 2020).

Lombard, K.A. (Presenter), Thomas, F.J., Haskie, L., Holguin, F.O., Goldberg, N.P., American Society for Horticultural Sciences Annual Meeting, "Navajo Agricultural Products Industry-New Mexico State University Memorandum of Understanding – Hemp Pilot Project 2019 (Year 1)," American Society for Horticultural Sciences, Virtual (originally in Orlando, FL). (August 9, 2020).

Lombard, K.A. (Presenter), Francis, B.J. (Presenter), SSSA Annual Meetings, "Pivoting from Face-to-Face Outreach to Digital in the Face of COVID-19 to Disseminate Garden-Based Information on the Navajo Nation," NMSU ASC Farmington, Virtual. (November 9, 2020).

Lombard, K.A. (Presenter), Thomas, F.J., Haskie, L., Holguin, F.O., Goldberg, N.P., American Society for Horticultural Sciences Annual Meeting, "Navajo Agricultural Products Industry-New Mexico State University Memorandum of Understanding – Hemp Pilot Project 2019 (Year 1)," American Society for Horticultural Sciences, Virtual (originally in Orlando, FL). (August 9, 2020).

Lombard, K.A. (Presenter), Ulery, A.L., Allen, S., 5th Annual Conference on Environmental Conditions of the Animas and San Juan Watersheds Past, Present and Future. Water Resources Research Institute, "Revisiting composted biosolids as a fertilizer source: The case of iron deficiency in a hybrid poplar-based agroforestry system in northwest New Mexico," Water Resources Research Institute, Farmington, NM. (June 15, 2020).

Lombard, K.A., NM Organic Conference, "Hops and Hops Harvester Demonstration," New Mexico Department of Agriculture, Albuquerque, NM. (February 21, 2020).

Whiting, M., Jha, G., Ulery, A.L., Lombard, K.A., 65th Annual New Mexico Water Conference, "Monitoring toxic metal uptake by corn grown in agricultural fields across Animas and San Juan Rivers," New Mexico Water Resources Research Institute, Virtual. (October 28, 2020).

EXTENSION CIRCULARS, RESEARCH REPORTS AND TRADE MAGAZINES

Marsalis, M.A., Flynn, R.P., Lauriault, L.M., Mesbah, A., Djaman, K. (2020). New Mexico 2019 Corn and Sorghum Performance Tests. Las Cruces, NM: Agricultural Experiment Station and Cooperative Extension Service, New Mexico State University. https://aces.nmsu.edu/pubs/variety_trials/19CornSorghumRpt.pdf

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Bamberg, J., Lombard, K.A., Palta, J.P., Workmaster, B.A., Atucha, A. (2020). Survival of Solanum jamesii Tubers at Freezing Temperatures. To appear in American Journal of Potato Research.

Djaman, K.; Koudahe, K.; Bodian, A.; Diop, L.; Ndiaye, P.M. (2020). Long-Term Trend Analysis in Annual and Seasonal Precipitation, Maximum and Minimum Temperatures in the Southwest United States. Climate 8(12), 142; https://doi.org/10.3390/cli8120142

Djaman, K., Koudahe, K., Bodian, A., Diop, L., Ndiaye, P. M. Long-term trend analysis in annual and seasonal precipitation, maximum and minimum temperatures in the southwest United States. Climate, MDPI.

Djaman, K., Darapuneni, M.K., O'Neill, M.K. (2020). Relationship between Relative Maturity and Grain Yield of Maize (Zea mays L.) Hybrids in Northwest New Mexico for the 2003–2019 Period. MDPI, 10(9), 290. https://www.mdpi.com/2077-0472/10/7/290

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Djaman, K., Koudahe, K. (2020). Discussion of "Evaluation of Temperature-Based Methods for the Estimation of Reference Evapotranspiration in the Yucatán Peninsula, Mexico" by Victor H. Quej; Javier Almorox; Javier A. Arnaldo; and Rubén Moratiel. To appear in Journal of Hydrological Engineering.

Djaman, K., Owen, C., O'Neill, M.K. (2020). Evaluation of Different Fall Dormancy-Rating Alfalfa Cultivars for Forage Yield in a Semiarid Environment. Agronomy, 10(1), 146. https://www.mdpi.com/2073-4395/10/1/146

Djaman, K. (2020). Assessment of Irrigation Water Requirement for Major Vegetable Crops using FAO-56 Penman-Monteith and Alternative Climatic Data models in Northern Togo. To appear in Journal of Agriculture and Horticulture Research, 3(2), 43-52.

Djaman, K., O'Neill, M.K., Lauriault, L.M., Marsalis, M.A., Koudahe, K., Darapuneni, M.K. (in press). The dynamics of forage yield of different fall dormancy rating alfalfa cultivars in a semiarid climate. To appear in Agricultural Research.

Djaman, K., Diop, L., Koudahe, K., Boodian, A., Ndiaye, P.M. (2020). Evaluation of temperature-based solar radiation models and their impact on Penman-Monteith reference evapotranspiration in a semiarid climate. International Journal of Hydrology, 84-95.

Koubodana, D., Adounkpe, J., Atchonouglo, K., Agboka, K., Djaman, K., Kougbaname, D. (2020). Assessing water balance components contribution variation in the Mono River Basin, West Africa. To appear in International Journal of Water Science and Environment Technologies. http://jistee.org/journal-international-sciences-et-techniques-de-leau-et-de-lenvironnement/

Koubodana, D., Djaman, K. Streamflow simulation and comparison under different land use, climate variability and dam management in the Mono River Basin, Togo-Benin, West Africa. The International Journal of River Basin Management.

Koudahe, K., Djaman, K. Impact of cover cropping on soil properties: a review. Agronomy, MDPI.

Matthews, A., Rogus, S., Jha, G., Ulery, A.L., Delgado Licon, E., Lombard, K.A. (2020). Heavy metal content of produce grown in San Juan County (New Mexico, USA). Journal of Environmental Science and Health, Part B: Toxic/Hazardous Substances and Environmental Engineering, 55(10), 889-897.

Ndiaye, P. M., Bodian, A., Diop, L., Deme, A., Dezetter, A., Djaman, K. (2020). Evaluation and Calibration of Alternative Methods for Estimating Reference Evapotranspiration in the Senegal River Basin. Hydrology, MDOI, 7(2), 24. https://www.mdpi.com/2306-5338/7/2/24

Ndiaye, P.M., Bodian, A., Diop, L., Dezetter, A., Djaman, K., Ogilvie, A. (2020). Trend and sensitivity analysis of reference evapotranspiration in the Senegal River Basin Using NASA meteorological data. To appear in Water, MDPI.

Rheay, H., Lombard, K.A., Brewer, C.E., Holguin, F.O. (2020). Phytochemical Characterization of Native New Mexico Hops. HortTechnology (On-line first), 3.

CONTRACTS, GRANTS AND SPONSORED RESEARCH (ACTIVE 2020)

Djaman, K. (Principal), Lombard, K.A. (Co-Principal), "Potatoes USA SNAC Trial," Sponsored by Potatoes USA, Other, $22,845.00. (July 1, 2019 - December 31, 2020).

Djaman, K. (Principal), Lombard, K.A. (Co-Principal), Sponsored Research, "Potatoes USA SNAC Trial", Sponsoring Organization: Potatoes USA, Other, Research Credit: $6,853.50, PI Total Award: $22,845.00, Current Status: Funded. (July 1, 2019 - June 30, 2020).

Giese, W., Lombard, K.A., Yao, S., "Field Evaluation and Marketability of 15 Table Grape Varieties for New Mexico," New Mexico Department of Agriculture, $52,818.00, Description: New Mexico State University will evaluate table grape production and varietal options to enhance sustainability of small farmers, home owners and community gardens by evaluating and comparing the vineyard performance, berry composition/quality and consumer acceptance of 15 table grape varieties. Effective Start Date: September 30, 2019, Effective End Date: September 29, 2022.

Hopkins, B., Lombard, K.A., "Northwest New Mexico New Farmer Network: Connecting Beginning Farmers to Land and Resources," New Mexico Department of Agriculture, $158,870.39, Description: The Northwest New Mexico (NWNM) New Farmer Network will be a collaborative effort between the San Juan County Extension Office, Tribal Extension, the Agricultural Science Center (ASC) at Farmington, and the Farmington Food Hub at San Juan College to address both the aging farmer crisis in our region and the increasing demand for local specialty crop products at regional markets. The project will be administered by San Juan County-based NMSU staff Dr. Kevin Lombard and Bonnie Hopkins, and most of the general tasks will be completed by the TBD Program Coordinator. Status: Funded, Effective Start Date: September 30, 2019, Effective End Date: September 29, 2022.

Lombard, K.A. (Principal), "Internal Award - PACR Yeego3 Healthy Eating & Garden," Other, $129,036.00. (September 1, 2018 - August 31, 2020).

Lombard, K.A. (Principal), Ulery, A.L. (Co-Principal), "Sediment and Agricultural Sampling," Sponsored by NM Environment Department, Local, $236,386.00. (November 30, 2016 - September 30, 2020).

Cooperators/Collaborators

Government Agencies, Institutions and Industry Collaborations and Sponsorships

1. Basin Cooperative, Durango, CO
2. Colorado State University Soil and Crop Sciences, Fort Collins, CO
3. Diné College, Tsaile, AZ
4. Dream Diné Charter School, Shiprock, NM
5. Fort Lewis College, Durango, CO
6. Higgins Farms, Inc., Farmington, NM
7. Indian Health Services (Shiprock, NM)
8. National Cancer Institute/National Institutes of Health
9. Navajo Agricultural Products Industry (NAPI), Farmington, NM
10. Navajo Nation Human Research Review Board
11. Navajo Mesa Farms, Farmington, NM
12. Navajo Nation 24th Council, President and Vice Presidents Office, Window Rock, AZ
13. Navajo Technical University, Crownpoint, NM
14. New Mexico Department of Agriculture, Las Cruces, NM
15. New Mexico Environment Department, Santa Fe, NM
16. New Mexico State University, College of Agricultural, Consumer and Environmental Sciences, Las Cruces, NM
17. New Mexico State University, College of Engineering, Las Cruces, NM
18. New Mexico State University San Juan County Cooperative Extension Service, Aztec, NM
19. Ohio Northern University, Pharmaceutical and Biomedical Sciences, Ada, OH
20. Potatoes USA, Denver, CO
21. Quality Irrigation Solutions, Cortez, CO
22. San Juan College, Farmington, NM
23. San Juan Soil and Water Conservation District, Aztec, NM
24. Texas Tech University Department of Plant and Soil Sciences, Lubbock, TX
25. United States Department of Agriculture/National Institute of Food and Agriculture
26. University of Minnesota Department of Agronomy and Plant Genetics, St. Paul, MN
27. University of Washington School of Public Health/Fred Hutchinson Cancer Research Center, Seattle, WA
28. USDA Agricultural Research Service, US Potato Genebank, Sturgeon Bay, WI
29. USDA NRCS, New Mexico, San Juan County Soil and Water Conservation District 1, Aztec, NM
30. Valley Irrigation (Valmont Industries), Valley, NE
31. Wilbur-Ellis, Farmington, NM

Thank you for your support and collaboration.

APPENDIX 1 - ADVISORY BOARD AND STUDENTS

ASC Farmington Advisory Board Participants

Mr. Bart Wilsey
Mr. Karl Garling
Ms. Vicki Lake
Dr. Carol Cloer, Cloer Hay Farm
Dr. Don Hyder, San Juan College – retired
Mr. Jim Dumont
Mr. Elbert Hamblin
Ms. Melissa May, NRCS
Ms. Shelly Hathorn, SJC Extension
Ms. Bonnie Hopkins-Byers, SJC Extension
Navajo Agricultural Products Industry Reps. (3)
Navajo Nation Representative (1)
Mr. Thomas Montoya
Mr. Lewis Montoya
Mr. Robert Lake

Graduate and Undergraduate Students

Gaurav Jha, Ph.D.
NMSU Plant and Environmental Sciences

Hanah Rheay, M.S. candidate
NMSU Plant and Environmental Sciences

Michael R. Whiting, M.S. candidate
NMSU Plant and Environmental Sciences

Bianca Wright
NMSU Plant and Environmental Sciences

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