
AGRICULTURAL SCIENCE CENTER AT CLOVIS
NM STATE

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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.

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 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 34.60o N, -103.22o 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.

Meeting the needs of New Mexico

Declining Ogallala Aquifer is the most important challenge faced by agriculture in eastern New Mexico, the breadbasket of the state, and in the Southern Great Plains. Increasing climate variability with high rainfall and temperature extremes is expected to make rainfed or limited irrigation agriculture more challenging. With rising costs of inputs, producing traditional high-input crops is becoming riskier. Degrading ecosystem services, poor soil health, lack of biodiversity are all affecting the resiliency of our cropping systems. Our research addresses current challenges experienced by farmers and prepares them to face future challenges. We focus on crop diversification, deficit irrigation management, and designing novel cropping systems that are resource-use efficient and resilient to future climatic uncertainty.

- Cropping Systems and Soil Management Program
- Water Efficient, Low Input, Well Adapted, Alternative Crops to Diversify Cropping Systems in the Southern High Plains
- Deficit Irrigation Management of Alternative Crops to Sustain Ogallala Aquifer Desert Adopted Guar Crop for New Mexico
- Circular Buffer Strips of Native Perennial Grasses to Improve Resiliency and Ecosystem Services of Center Pivot Irrigated Agriculture
- Enhancing the Breeding Potential of Valencia Peanut for Drought and Disease resistance in New Mexico.
- Management of Weed and Weed Resistance in Corn, Sorghum, and Small grain.
- Variety Testing in Corn and Sorghum for Grain and Forage Production.

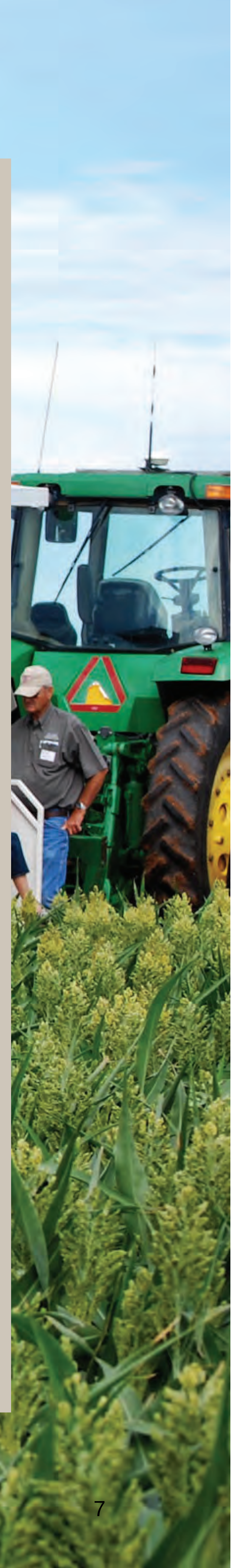
Mission

The mission of the Agricultural Science Center at Clovis is to conduct crop research and disseminate viable strategies that benefit New Mexico's citizens and agricultural production. We also aim to anticipate challenges, solve problems, build relationships, and secure funding.

Agricultural Science Center at Clovis

The NMSU Agricultural Science Center at Clovis is centrally located in the largest crop and livestock (dairy in particular) production area of New Mexico and is uniquely qualified to conduct agricultural research and producer outreach (Extension) activities aimed at efficiently managing the area's limited water resources and increasing the economic viability and sustainability of agricultural and dairy productions.

The research and outreach program at the Clovis Agricultural Science Center is guided by an Advisory Committee comprised of agricultural producers and business leaders from the area. In 2004, The Advisory Committee worked with center staff and college/university administration to develop a legislative initiative to enhance the research and extension programs offered at the Center. Since 2004, with the Advisory Committee leadership in this area the Clovis ASC has been successful in obtaining funds from the New Mexico Legislature.



Agricultural Experiment Station

What Is the Agricultural Experiment Station?

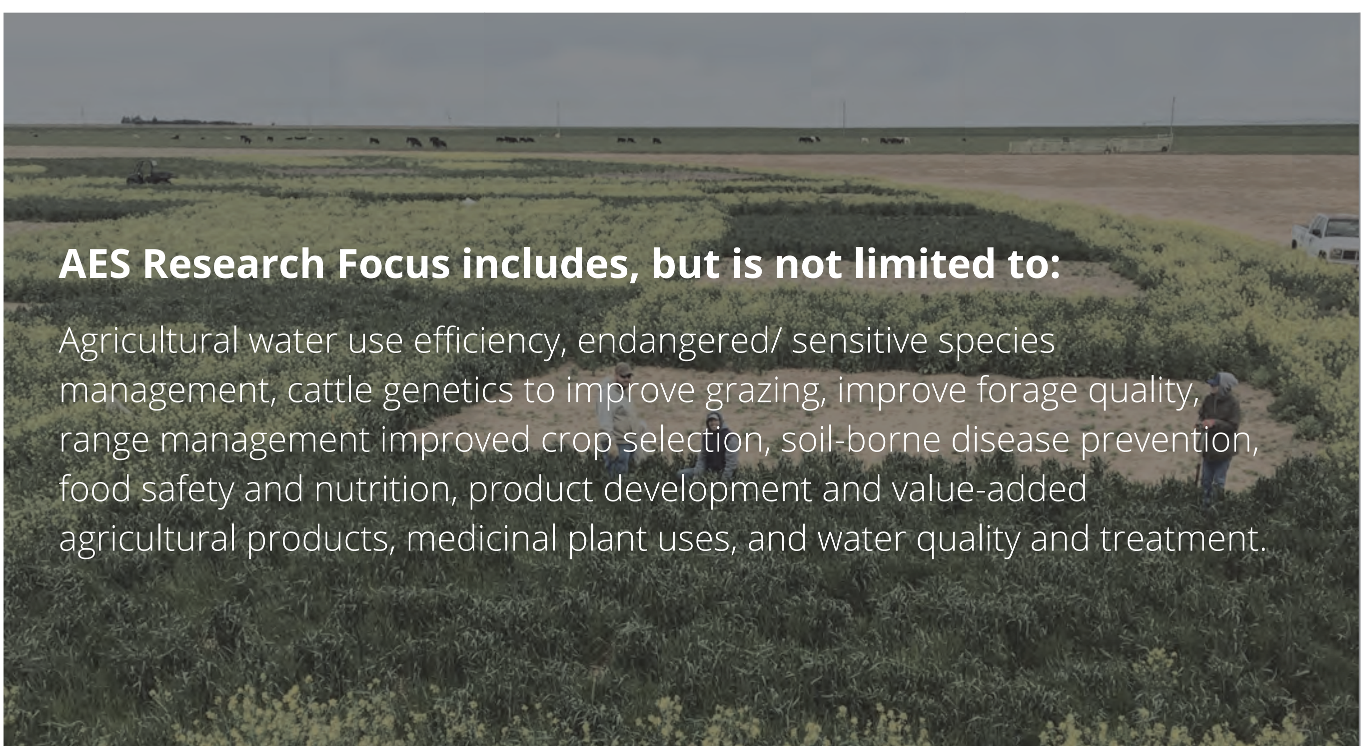
NMSU's Agricultural Experiment Station is the principal research unit of the College of Agricultural, Consumer and Environmental Sciences. All research faculty in the college have appointments in the Agricultural Experiment Station.

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:

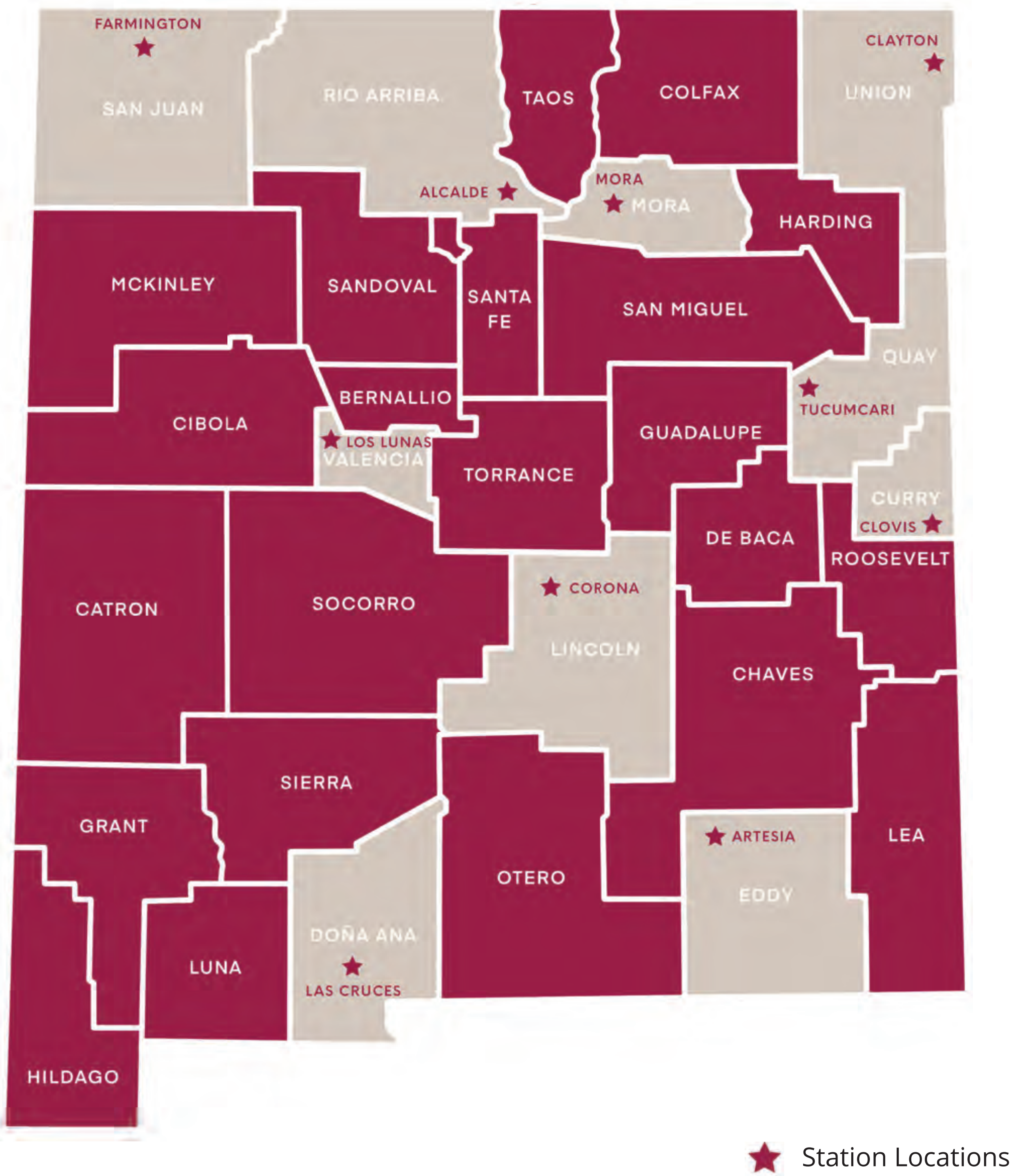
- Enhance agricultural profitability.
- Stimulate economic development using natural resources.
- Improve the quality, safety and reliability of food and fiber products.
- Sustain and protect the environment with ecologically sound practices.
- Manage and protect natural resources.
- Improve the quality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



Agricultural Science Center Clovis

Fiscal Year: **2020**

Fiscal Period: **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 Clovis	ALTERNATIVE FORAGE CROPPING	FORAGE & PERENNIAL CROPPING IN NM	$0.00	$200,000.00	$0.00	$200,000.00	
Ag Science Ctr at Clovis	CIRCLES OF LIVE BUFFER STRIPS TO EN	CIRCLES OF LIVE BUFFER STRIPS TO EN	$52,928.70	$500,000.00	$52,928.70	$447,071.30	
Ag Science Ctr at Clovis	COVER CROPS FOR IMPROVING SOIL HEAL	CLOVIS COVER CROP DEMONSTRATION	$29,116.75	$187,669.71	$29,116.75	$158,552.96	
Ag Science Ctr at Clovis	DEVELOPMENT AND MANAGEMENT OF CANOL	DEVELOPMENT & MGT/CANOLA GRT PLAINS	$403.43	$6,750.00	$403.43	$6,346.57	
Ag Science Ctr at Clovis	DIVERSIFYING RAINFED CROPPING SYSTM	DIVERSIFYING RAINFED CROPPING SYS	$30,008.24	$29,133.05	$30,008.24	($875.19)	
Ag Science Ctr at Clovis	DIVERSIFYING RAINFED CROPPING SYSTM	CS DIVERSIFYING RAINFED CRPPNG SYS		$3,130.00	$0.00	$3,130.00	
Ag Science Ctr at Clovis	HATCH FEDERAL APPROPRIATIONS FY 20	CONSERVATION TILLAGE & COVER SAL		$29,491.00	$21,136.39	$8,354.61	
Ag Science Ctr at Clovis	IMPROVING SOIL HEALTH AND ECOSYSTEM	IMPROVING SOIL HEALTH AND ECOSYSTEM		$42,573.84	$23,142.31	$19,431.53	
Ag Science Ctr at Clovis	IMPROVING SOIL HEALTH AND ECOSYSTEM	CS IMPROVING SOIL HEALTH AND ECOSYS		$49,000.00	$0.00	$49,000.00	
Ag Science Ctr at Clovis	STRATEGIC TILLAGE MANAGEMENT IN DRY	STRATEGIC TILLAGE MANAGEMENT DRYLAN		$175,000.00	$10,185.90	$164,814.10	
Ag Science Ctr at Clovis	SUSTAINABLE BIOECONOMY FOR ARID REG	SUSTAINABLE BIOECONOMY AR-ANGADI		$71,878.74	$57,902.50	$13,976.24	
Ag Science Ctr at Clovis	SUSTAINABLE BIOECONOMY FOR ARID REG	SUSTAINABLE BIOECON FOR AR-ANGADI		$12,186.03	$14,783.10	($2,597.07)	
Ag Science Ctr at Clovis	VALENCIA PEANUT BREEDING FOR YR2019	VALENCIA PEANUT BREEDING DRGHT 19		$6,125.00	$4,369.73	$1,755.27	
		Total Restricted Funds		**$1,312,937.37**	**$243,977.05**	**$1,068,960.32**	
Ag Science Ctr at Clovis	RESTR MAIN CURR USE GIFTS	FIELD DAY-AG SCIENCE CENTER-CLOVIS	$2,849.66	$0.00	$2,977.16	($2,977.16)	$0.00
Ag Science Ctr at Clovis	RESTR MAIN CURR USE GIFTS	CROP-WEED RESEARCH - MESBAH	$3,325.00	$0.00	$0.00	$0.00	($159,483.64)
		Total Gift Funds	**$6,174.66**	**$0.00**	**$2,977.16**	**($2,977.16)**	**($159,483.64)**
							* See note
Ag Science Ctr at Clovis	APPLIED CHARGES	IRRIGATION SERVICES ASC CLOVIS	$0.00	($2,000.00)	$10,075.72	($12,075.72)	($38,575.72)
Ag Science Ctr at Clovis	APPLIED CHARGES	VEHICLE SERVICES ASC CLOVIS	$0.00	($11,000.00)	$2,770.01	($13,770.01)	($9,539.49)
Ag Science Ctr at Clovis	APPLIED CHARGES	CLOVIS GREENHOUSE	$0.00	($500.00)	$7.08	($507.08)	($1,871.28)
Ag Science Ctr at Clovis	OTHER SOURCES	IMPROVING GREEN WATER-PARAMVEER S.	$0.00	$0.00	$0.00	$0.00	($6,470.82)
Ag Science Ctr at Clovis	OVERHEAD TRANSFERS	INDIRECT COST RECOVERY-CLOVIS	$0.00	$1,000.00	$5,193.23	($4,193.23)	($42,551.87)
Ag Science Ctr at Clovis	OVERHEAD TRANSFERS	START-UP ASC-CLOVIS-MESBAH	$0.00	$241.93	$241.93	$0.00	$0.00
Ag Science Ctr at Clovis	OVERHEAD TRANSFERS	START-UP ASC CLOVIS R. GHIMIRE	$0.00	$8,802.35	$2,745.52	$6,056.83	($6,056.83)
Ag Science Ctr at Clovis	SALES & SERVICE	CLOVIS ASC SALES	$73,174.13	$5,000.00	$44,170.96	($39,170.96)	($67,279.67)
		Total Sales and Service Funds	**$73,174.13**	**$1,544.28**	**$65,204.45**	**($63,660.17)**	**($172,345.68)**
							* See note
Ag Science Ctr at Clovis	STATE APPROPRIATIONS	ASC CLOVIS SALARY		$814,309.07	$714,205.59	$100,103.48	
Ag Science Ctr at Clovis	STATE APPROPRIATIONS	CONSERVATION TILLAGE AND COVER CROP		$88,472.87	$88,472.68	$0.19	
Ag Science Ctr at Clovis	STATE APPROPRIATIONS	CLOVIS ADMIN		$54,125.00	$53,471.35	$653.65	
Ag Science Ctr at Clovis	STATE APPROPRIATIONS	ENHANCEMENT CLOVIS-ANGADI		$6,000.00	$6,376.90	($376.90)	
Ag Science Ctr at Clovis	STATE APPROPRIATIONS	ENHANCEMENT CLOVIS		$50,218.00	$48,407.53	$1,810.47	
Ag Science Ctr at Clovis	STATE APPROPRIATIONS	CLOVIS EXPANSION-DAIRY		$35,000.00	$33,671.79	$1,328.21	
Ag Science Ctr at Clovis	STATE APPROPRIATIONS	CLOVIS SB		$14,930.00	$15,073.78	($143.78)	
Ag Science Ctr at Clovis	STATE APPROPRIATIONS	ENHANCEMENT CLOVIS-HAGEVOORT		$43,072.00	$75,042.33	($31,970.33)	
Ag Science Ctr at Clovis	STATE APPROPRIATIONS	ENHANCEMENT CLOVIS-MARSALIS		$25,000.00	$23,895.13	$1,104.87	
Ag Science Ctr at Clovis	STATE APPROPRIATIONS	ENHANCEMENT CLOVIS-PUPPALA		$46,600.00	$47,258.19	($658.19)	
Ag Science Ctr at Clovis	STATE APPROPRIATIONS	ENHANCEMENT CLOVIS-BEGNA		$2,556.00	$2,965.25	($409.25)	
Ag Science Ctr at Clovis	STATE APPROPRIATIONS	ENHANCEMENT CLOVIS-R. GHIMIRE		$25,000.00	$23,105.74	$1,894.26	
Ag Science Ctr at Clovis	STATE APPROPRIATIONS	AES GRADUATE RESEARCH AWARD		$24,000.04	$22,999.35	$1,000.69	
		Total State Appropirated Funds		**$1,229,282.98**	**$1,154,945.61**	**$74,337.37**	

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

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

PERFORMANCE OF DRYLAND GRAIN SORGHUM VARIETIES

Investigators: B. Niece1, A. Mesbah1, A. Scott1

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 17, 2020, 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 randomized 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 May 1, the planting area was fertilized with 60 lb N/ac, 9 lb/ac Sulphur, 30 lb/ac of P2O5, and 2 qt/ac of chelated Zinc. At plant herbicide applications included Atrazine (2.0 pt/ac),and Warrant (2 qt/ac).

No irrigation was applied. Precipitation during the period after planting until the harvest was 6.7 inches.

The plots were harvested on November 4, 2020, 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 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 for the 2019 grain sorghum trial are presented in Table 1, Grain yields, for the 23 varieties in the trial, ranging from 102.9 to 33.0 bushel/acre with a trial average of 68.3 bushels/acre.

Table 1. New Mexico 2020 Dryland Grain Sorghum Performance Test - Agricultural Science Center at Clovis

Brand/Company Name	Hybrid/Variety Name	Grain Yield	Grain Yield	Harvest Moisture	Test Weight	Plant Height	Head Exertion	Lodging	Heading Date
		bu/a	lb/a	%	lb/bu	in	in	%	
Dyna-Gro Seed	GX17912	102.9 ***	5763 ***	10.7	56.1 *	15.6	0.5 *	0 *	15-Aug *
Dyna-Gro Seed	M57GB19	100.2 *	5610 *	10.5	52.8 *	16.7	0.8 *	0 *	16-Aug *
LG Seeds	2730B	94.1 *	5266 *	11.1 *	52.8 *	21.9 *	1.2 *	0 *	16-Aug *
Dyna-Gro Seed	GX19981	90.4 *	5064 *	10.5	54.3 *	22.6 ***	0.0	0 *	24-Aug *
Dyna-Gro Seed	M59GB94	84.6 *	4739 *	11.4 *	54.6 *	18.4 *	0.0	0 *	15-Aug *
S&W Seed Co.	SP 68M57	79.2 *	4437 *	13.3 ***	53.7 *	16.5	0.4	0 *	17-Aug *
LG Seeds	2620C	78.5 *	4396 *	11.4 *	51.7	17.3	1.0 *	0 *	15-Aug *
Dyna-Gro Seed	M59GB57	74.6 *	4181 *	11.2 *	58.3 ***	16.0	0.4	0 *	10-Aug *
Dyna-Gro Seed	M54GR24	74.4 *	4165 *	10.9	57.2 *	17.6	2.1 ***	0 *	14-Aug *
S&W Seed Co.	SP 43M80	72.5 *	4062 *	10.8	55.0 *	17.3	0.0	3 *	14-Aug *
Dyna-Gro Seed	GX18919	72.0 *	4031 *	11.3 *	57.8 *	16.4	1.6 *	0 *	6-Aug *
LG Seeds	1510C	71.1 *	3979 *	10.8	52.9 *	17.6	0.3	0 *	9-Jul
S&W Seed Co.	SP 31A15	68.0 *	3806 *	11.0 *	54.5 *	15.1	0.5 *	0 *	5-Jul
Dyna-Gro Seed	M74GB17	60.0	3359	12.1 *	54.1 *	16.8	0.0	0 *	25-Aug *
Dyna-Gro Seed	M71GR91	59.1	3309	12.2 *	46.5	20.9 *	0.0	0 *	25-Aug *
Dyna-Gro Seed	M72GB71	58.7	3287	10.8	54.4 *	19.8 *	0.3	0 *	26-Aug ***
LG Seeds	3180B	58.2	3261	13.2 *	50.0	17.6	0.3	0 *	21-Aug *
Dyna-Gro Seed	GX20564	58.1	3255	11.9 *	51.1	20.5 *	0.7 *	0 *	19-Aug *
Dyna-Gro Seed	M60GB31	56.5	3164	11.6 *	52.1 *	18.9 *	0.8 *	0 *	23-Aug *
Dyna-Gro Seed	M57GC29	52.3	2925	11.7 *	54.3 *	15.2	0.4	0 *	16-Aug *
Dyna-Gro Seed	M69GR88	50.8	2847	11.9 *	56.5 *	17.1	1.2 *	0 *	25-Aug *
Dyna-Gro Seed	M60GB88	45.2	2529	11.1 *	54.5 *	13.5	0.0	0 *	18-Aug *
S&W Seed Co.	SP 25C10	43.7	2447	10.6	48.7	17.2	2.1 ***	23 ***	5-Aug *
S&W Seed Co.	SP 33S40	33.0	1848	10.2	53.8 *	20.3	1.4 *	0 *	20-Aug *
	Trial Mean	68.3	3822	11.3	53.7	17.8	0.7	1.1	14-Aug
	LSD (P > 0.05)	35.4	1984.5	2.3	6.2	4.6	1.7	13.6	29.2
	CV	31.6	31.6	12.6	7.1	15.7	153.0	745.4	7.8
	F Test	0.231	0.2308	0.5933	0.9761	0.787	0.4722	0.2835	0.1651

*** Highest numerical value in the column.

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

8

PERFORMANCE OF FORAGE CORN VARIETIES

Investigators: B. Niece1, A. Mesbah1, A. Scott1

OBJECTIVE

To evaluate the 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 29 corn entries were planted on May 12, 2020, 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).

Before planting, the planting area was fertilized with 40 lb N/ac, 3 qt zinc and, 47 lb/ac of P2O5. Additional nitrogen was applied on May 13 (122 lb N/ac). Sulfur was applied on May 13 (22 lb/ac). Pre-plant herbicide applications included Panther, LV 6, and Glyphosate at rates of 2 oz/ac, 20 oz/ac, 32 oz/ac respectively. At plant herbicide applications included Atrazine (1 pt/ac), DiFlexx (16 oz/ac), Balance Flex (3 oz/ac) and Warrant (1.5 qt/ac). Diflexx and Warrant herbicides were applied on 1 July at 16 oz/ac and 1.5 qt/ac respectively. Onager miticide (16 oz/ac) was applied on 15 June. Two insecticides were applied on July 31 (Prevathon, 20 oz/ac; Oberon, 8 oz/ac).

The total irrigation amount was 18.9 inches applied from May to August at varying rates during the growing season. Monthly amounts were 2.5, 2.2, 6.25, and 7.9 inches for May, June, July, and August, respectively. Precipitation during the period after planting until the harvest was 5.7 inches.

Plots were harvested on September 4, 2020, 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. 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 ANAYLYSIS

Varieties/hybrids were assigned randomly to plots in a randomized complete block design with 3 replications. Data were subjected to SAS® procedures for a 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. The highest dry matter yields were above 9.8 tons/ac for the trial. The average dry matter yield was 8.6 tons/acre and significant differences existed among varieties for both dry and green forage yields. All forage nutritive value parameters differed ($P < 0.05$) among the varieties and estimates included moisture at harvest, crude protein, ADF, NDF, NDFD-48hr, starch, ash, milk/ton, milk/acre, and RFV.

Table 1. New Mexico 2020 Forage Corn Performance Test - Agricultural Science Center at Clovis

Brand/Company Name	Hybrid/Variety Name	Dry Forage	Green Forage	Harvest Moisture	CP	NDF	NDFD 48hr	Starch	Ash	TDN	NE_l	Milk/ Ton	Milk/ Acre
		t/a	t/a	%	%	%	%	%	%	%	Mcal/lb	lb/t	lb/a
BH Genetics	BH 8690VIP3111	9.8	26.3	62.9	9.1	40.5	66.2	32.2	3.4	70.6	0.730	3548	34625
Dekalb/Bayer	DKC70-64RIB	9.3	26.9	65.3	9.4	44.9	65.2	24.1	4.1	68.5	0.706	3388	31680
LG Seeds	LG68C59-3330	9.2	27.0	65.8	9.7	40.3	66.2	29.6	3.9	70.4	0.727	3532	32502
BH Genetics	BH 8400PCE	9.2	25.7	64.2	8.7	42.0	67.1	30.1	4.6	69.4	0.717	3471	31902
Dyna-Gro Seed	D57TC19	9.1	25.8	64.6	9.2	40.2	65.7	32.0	3.1	70.7	0.731	3550	32469
Dyna-Gro Seed	D52DC82	9.1	24.5	62.8	8.4	36.8	67.1	37.9	3.0	71.5	0.740	3624	33025
Dyna-Gro Seed	D55VC80	9.1	23.5	61.2	9.3	42.2	66.4	29.6	3.7	70.1	0.724	3514	31946
Dyna-Gro Seed	D58VC90	9.1	25.6	64.6	9.2	41.0	64.6	32.0	2.9	70.4	0.728	3522	31983
Integra	6720 SS	9.0	24.2	62.7	9.8	41.0	65.7	31.1	3.4	70.4	0.727	3529	31862
BH Genetics	BH 8721VIP3110	8.8	24.6	64.0	9.2	41.2	65.6	30.8	3.6	70.0	0.723	3501	30927
BH Genetics	BH 8780VT2P	8.8	23.1	61.7	9.6	40.8	65.4	29.9	3.5	70.4	0.727	3526	31142
Integra	6588 VT2P	8.8	24.6	64.2	9.3	40.8	65.8	30.0	3.4	70.4	0.727	3530	31045
BH Genetics	BH 8907VT2P	8.7	25.6	66.0	8.8	43.6	64.8	28.2	3.5	69.3	0.716	3447	29938
BH Genetics	BH 8732VT2P	8.7	23.4	62.8	9.2	41.2	66.6	30.2	3.3	70.8	0.732	3565	30929
Integra	9678 VT2P	8.6	24.0	64.0	10.2	39.7	64.6	31.4	3.5	70.3	0.726	3513	30414
Integra	6709 VT2P	8.6	24.7	65.0	9.3	43.9	65.2	25.6	3.9	68.9	0.710	3416	29479
Dekalb/Bayer	DKC69-16RIB	8.6	23.6	63.7	9.6	42.3	65.7	28.2	3.9	70.1	0.724	3510	30182
LG Seeds	LG66C28-3110	8.5	22.7	62.4	9.8	40.3	63.5	31.4	3.5	69.6	0.719	3456	29407
Dyna-Gro Seed	D54VC14	8.5	24.0	64.8	9.7	41.1	64.3	29.8	3.8	69.8	0.721	3477	29467
Integra	6880 VT2P	8.4	23.9	64.7	9.5	40.2	64.1	32.1	2.9	70.3	0.726	3508	29525
Master's Choice, Inc.	MCT6552	8.4	23.6	64.4	9.4	42.0	65.9	29.4	4.1	69.6	0.718	3472	29150
Integra	6621 DGVT2P	8.4	23.7	64.7	9.5	41.3	64.3	29.0	4.2	68.9	0.711	3410	28491
BH Genetics	BH 8704VIP3110	8.3	22.9	63.6	9.7	42.2	66.6	26.7	4.4	69.9	0.721	3499	29131
Dyna-Gro Seed	D58QC72	8.1	24.0	66.2	9.3	43.4	65.0	27.4	3.5	69.6	0.719	3469	28114
BH Genetics	BH 8555DG2P	8.0	22.2	63.9	9.3	40.3	65.0	30.4	4.0	69.7	0.719	3472	27806
Dekalb/Bayer	DKC64-44RIB	7.9	20.8	61.9	9.5	40.9	65.4	30.2	3.6	70.3	0.727	3524	27798
Dyna-Gro Seed	D58VC65	7.8	21.7	64.0	9.7	39.2	64.6	32.4	3.3	70.3	0.727	3516	27493
Dyna-Gro Seed	D53VC33	7.7	18.9	58.9	9.0	39.4	67.2	33.6	3.2	71.4	0.739	3618	28023
Master's Choice, Inc.	MCT6703	7.4	20.9	64.7	8.8	41.9	66.0	30.1	4.2	69.6	0.719	3478	25689
	Trial Mean	8.6	24.0	63.9	9.4	40.9	65.5	30.5	3.68	70.0	0.724	3503	30194
	LSD	0.8	1.9	0.03	0.57	3.4	1.23	4.15	0.89	1.41	0.016	108	3323
	LSD P >	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	CV	5.8	5.0	2.8	3.8	5.1	1.2	8.3	14.8	1.2	1.320	1.9	6.7
	F Test	0.0102	0.0002	<.0001	0.4839	0.0304	<.0001	0.2321	0.3226	0.0065	0.006	0.0024	0.0162

SMALL GRAIN WINTER FORAGE VARIETY TESTING

Investigators: B. Niece, A. Mesbah, A. Scott

OBJECTIVE

To evaluate the 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

This variety trial was planted on November 1, 2019. All 25 entries were planted into conventionally tilled flatbed plots. Soil type is an Olton clay loam. Individual plots consisted of 11 rows, 6.25 in. apart, and 8 feet long. Plots were planted at a rate of 100 lb/acre with a plot drill.

On September 30, 2019, the planting area was fertilized with a pre-plant mixture of 30, 40, and 3.3 lbs/acre of Nitrogen, Phos, and Sulphur respectively. On March 2, 2020, an additional application of Nitrogen and Sulphur was applied at rates of 90 lb/ac and 16.3 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 (1 pt/ac), and Prowl H2O (3pts/ac) on March 23, 2020. One application of Govern (1pt/ac.) was applied on March 23, 2020.

Plots were center-pivot irrigated throughout the season. Adequate precipitation through the fall and early winter required normal irrigation; 10.2 inches of water was applied after the post-planting watering event. (March 2.0 in., April 6.9 in., and May 1.3 in.).

These small grains were managed for a one-cut, silage-oriented harvest in the spring of 2020 (Table 1). Harvests began on April 24, 2020, with the earliest maturing species (rye and triticale) and continued through May 18. Plants were harvested at the 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 the 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 a 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 2019-2020 are presented in Table 1. Total precipitation and irrigation amounts were less in 2019-2020 (14.25 in.) than in the previous year (15.49 in.). Yields from the 2019-2020 season were slightly higher than 2018-2019 and averaged 16.1 tons/acre for green forage.

Table 1. Forage Harvest - Winter Annual Small Grain Forages - 2019-2020 - 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	triticale	18-May	7.2 ***	20.6 ***	75.7	2238	16177 *
Ehmke Seed	Thunder Tall	triticale	11-May	6.6 *	19.0 *	78.7 *	2499	16727 *
Texas A&M Agrilife	TX16VT68295	triticale	29-Apr	6.2	17.8	76.0	2953 *	18495 ***
Curtis & Curtis	Maximizer Plus	w/t	11-May	6.2	17.7	76.0	2316	14220
Texas A&M Agrilife	TX14VT70526	triticale	29-Apr	6.1	17.4	78.0 *	2564	15593 *
Watley Seed	T-011	triticale	29-Apr	6.0	17.2	75.6	2901 *	17389 *
Watley Seed	T-009	triticale	7-May	5.9	17.0	77.7	2690 *	15998 *
Ehmke Seed	Thunder Cale	triticale	29-Apr	5.9	17.0	78.0 *	2766 *	16270 *
Ehmke Seed	Thunder Tall II	triticale	11-May	5.9	16.9	79.0 *	2370	13969
Texas A&M Agrilife	TX12VT8222-3	triticale	29-Apr	5.8	16.6	76.7	2601	15112
Ehmke Seed	Thunder Cale V	triticale	29-Apr	5.8	16.6	80.0 *	2798 *	16228 *
Texas A&M Agrilife	TX17AT03	triticale	29-Apr	5.8	16.6	77.0	2430	14063
Ehmke Seed	Shortbeard Thunder	triticale	29-Apr	5.7	16.2	79.3 *	2958 ***	16739 *
Curtis & Curtis	Maximizer	w/t	7-May	5.6	16.0	76.3	2478	13835
Agri Pro	Bob Dole**	wheat	4-May	5.6	15.9	77.7	2512	14023
Curtis & Curtis	Smoothgrazer	w/t	4-May	5.6	15.9	79.3 *	2841 *	15766 *
Texas A&M Agrilife	TX14VT70473	triticale	29-Apr	5.5	15.8	76.3	2310	12821
Ehmke Seed	Thunder Green	rye	24-Apr	5.5	15.7	79.0 *	2734 *	15007
Ehmke Seed	Fredro	triticale	4-May	5.3	15.2	80.3 *	2455	13033
Agri Pro	SY Wolverine**	wheat	4-May	5.3	15.0	77.7	2704 *	14146
Curtis & Curtis	Smoothgrazer Plus	w/t	4-May	5.2	14.7	81.7 ***	2410	12391
Texas A&M Agrilife	TX17AT10	triticale	29-Apr	5.0	14.3	79.3 *	2641 *	13151
Agri Pro	09BC308-14-16**	wheat	29-Apr	4.5	12.9	75.3	2921 *	13323
Agri Pro	SY Grit**	wheat	4-May	4.2	12.0	78.3 *	2622	11028
Dyna-Gro	Long Branch	wheat	4-May	4.1	11.7	79.0 *	2853 *	11739
	Trial Mean			5.6	16.1	77.9	2623	14689
	LSD (0.05)			1.0	2.75	0.03	329	3190
	CV			10.4	10.4	3.0	7.7	13.2
	F Test			<.0001	<.0001	<.0001	<.0001	0.0017

†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.
** Planted 120 lb/ac
* Not significantly different from the highest value

PERFORMANCE OF GRAIN CORN VARIETIES

Investigators: Niece, A. Mesbah, A. Scott

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 12, 2020, 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 randomized 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.

Before planting, the planting area was fertilized with 40 lb N/ac, 3 qt zinc and, 47 lb/ac of P2O5. Additional nitrogen was applied on May 13 (122 lb N/ac). Sulfur was applied on May 13 (22 lb/ac). Pre-plant herbicide applications included Panther, LV 6, and Glyphosate at rates of 2 oz/ac, 20 oz/ac, 32 oz/ac respectively. At plant herbicide applications included Atrazine (1 pt/ac), DiFlexx (16 oz/ac), Balance Flex (3 oz/ac) and Warrant (1.5 qt/ac). Diflexx and Warrant herbicides were applied on 1 July at 16 oz/ac and 1.5 qt/ac respectively. Onager miticide (16 oz/ac) was applied on 15 June. Two insecticides were applied on July 31 (Prevathon, 20 oz/ac; Oberon, 8 oz/ac).

The total irrigation amount for the trial was 21.3 inches. Amounts were applied during May, June, July, August, September, and October. Monthly amounts were 2.5, 2.2, 6.25, 7.9, 2.2, and 0.20 inches, respectively. Precipitation during the period after planting until the harvest of the irrigated plots was 5.7 inches.

The plots were harvested on October 6, 2020, 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 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 for the 2017 grain corn trial are presented in Table 1, Grain yields, for the 12 varieties in the trial, ranging from 273.7 to 239.9 bushel/acre with a trial average of 254.6 bushels/acre.

Table 1. New Mexico 2020 Grain Corn Performance Test - Agricultural Science Center at Clovis

Company Name	Variety Name	Grain Yield	Harvest Moisture	Test Weight	Plant Height	Ear Height	Silk Date
		bu/a	%	lb/bu	in	in	
Dyna-Gro Seed	D54VC34	273.7	14.8	60.7	93.3	45.7	25-Jul
Dyna-Gro Seed	D58VC65	269.4	16.4	61.1	92.0	44.9	20-Jul
Dyna-Gro Seed	D55VC80	267.8	16.1	59.9	97.0	48.9	24-Jul
LG Seeds	LG66C44VT	265.4	13.7	61.2	88.3	42.0	20-Jul
Dyna-Gro Seed	D57VC17	260.3	15.3	61.0	92.0	45.7	26-Jul
Dyna-Gro Seed	D52DC82	251.1	14.3	59.8	95.0	48.0	26-Jul
Dyna-Gro Seed	D54VC14	250.2	14.5	61.8	87.0	41.6	26-Jul
LG Seeds	LG66C32VT	248.9	16.3	61.6	85.3	42.9	27-Jul
LG Seeds	LG67C45ST	246.2	14.8	61.4	93.0	47.6	26-Jul
Dyna-Gro Seed	D54SS74	241.0	14.1	61.3	88.3	40.7	19-Jul
Dyna-Gro Seed	D58VC90	240.9	15.8	60.7	90.7	45.9	20-Jul
Dyna-Gro Seed	D53VC33	239.9	14.1	60.2	95.0	44.4	24-Jul
	Trial Mean	254.6	15.0	60.9	91.4	44.9	23-Jul
	LSD (P > 0.05)	25.0	2.13	1.71	4.5	3.7	2.8
	CV	5.79	8.39	1.66	2.92	4.90	0.81
	F Test	0.3795	0.2008	0.6862	0.0129	0.2165	0.2010

PERFORMANCE OF IRRIGATED FORAGE SORGHUM VARIETIES

Investigators: B. Niece, A. Mesbah, A. Scott

OBJECTIVE

To evaluate the 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 18 forage sorghum entries were planted on May 19, 2020, 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.

Before planting, the planting area was fertilized with a pre-plant mixture of 56 lb/ac, 35 lbs/ac, and 8.25 lb/ac of nitrogen, P2O5, and S respectively. Micronutrient zinc was applied pre-plant at rates of 2 qt/ac. Fertilizers were incorporated into the soil immediately after application.

The total irrigation amount was 13.7 inches applied from June to September at varying rates during the growing season. Atrazine, Panther, Glyphosate, and Dicamba herbicide were applied to plots for weed control prior to planting at a rate of 1 pt/acre, 1 oz/ac, and 48 oz/ac, and 8 oz/ac respectively. Buccaneer, Atrazine, Sharpen and Warrant were applied on May 21 at 1 qt/ac, 1 pt/ac, and 1.5 oz/ac, and 1.5 oz/ac respectively. Additionally, 90 lb/ac of nitrogen was applied on 21 May as well. Precipitation during the period after planting until the harvest of the plots was 6.2 in.

Plots were harvested on September 19, 2020, 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.

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 a 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 1. The highest yielding varieties exceeded 29.7 tons of green forage. Mean wet forage yields for the 18 varieties were 23.8 tons/acre, and varieties differed ($P < 0.05$) with respect to yield. All forage quality parameters were significantly different among the varieties. Nutritional analysis results are pending.

Table 1. New Mexico 2020 Irrigated Forage Sorghum Performance Test - Agricultural Science Center at Clovis

Company Name	Variety Name	Sorghum Type	Maturity Group	Dry Forage	Green Forage	Harvest Moisture	CP	NDF	NDFD 48hr	Ash	TDN	NE_l	Milk/ Ton	Milk/ Acre
				t/a	t/a	%	%	%	%	%	%	Mcal/lb	lb/t	lb/a
Dyna-Gro :	Super Sile	FS	ME	9.8	29.7	67.0	7.9	52.0	64.5	5.0	65.1	0.670	3142	30955
Dyna-Gro :	Fullgraze I	SxS	MF	9.6	30.1	68.3	6.8	59.6	70.3	5.3	64.0	0.653	3108	29674
Dyna-Gro :	Fullgraze I	SxS	MF	9.4	26.1	63.9	6.2	66.0	64.2	4.7	60.1	0.613	2782	26247
S&W Seed	SS405	FS	F	9.2	23.3	65.0	7.2	58.8	64.5	4.6	64.3	0.660	3084	28303
Dyna-Gro :	Super Sile	FS	MF	9.2	30.2	69.6	6.6	54.9	65.6	5.6	61.9	0.630	2920	26759
Dyna-Gro :	TopTon	FS	F	9.0	29.7	69.6	6.0	53.3	68.3	5.7	61.6	0.633	2919	26285
Dyna-Gro :	Danny Boy	SxS	PS	8.9	38.0	76.5	7.1	61.3	70.2	6.9	62.5	0.640	3001	26736
Dyna-Gro :	F72FS05 (	FS	ME	7.7	22.5	65.9	8.3	50.5	65.6	4.5	67.8	0.700	3343	25608
S&W Seed	NK300	FS	ME	7.4	18.5	59.6	8.4	47.6	68.2	4.5	69.8	0.723	3505	25990
S&W Seed	SP 3905 B	FS	ME	6.7	20.0	66.7	8.7	42.9	73.4	5.0	70.3	0.726	3584	23852
Dyna-Gro :	F71FS72 E	FS	E	6.6	19.6	66.8	8.5	43.6	73.9	5.4	70.7	0.730	3611	23667
Dyna-Gro :	F74FS23 E	FS	M	6.4	21.9	70.5	7.4	47.7	73.9	7.0	63.6	0.653	3107	20025
S&W Seed	SP 3904 B	FS	MF	6.4	23.8	72.9	8.9	50.8	71.3	6.3	68.2	0.700	3415	21978
Dyna-Gro :	F70FS91 E	FS	E	6.3	20.2	68.8	7.1	54.3	74.1	5.9	65.9	0.680	3270	20655
Dyna-Gro :	F72FS25 E	FS	M	6.1	22.5	72.8	9.2	50.4	70.9	6.7	67.6	0.696	3373	20689
Dyna-Gro :	Super Swe	SxS	ME	5.6	17.4	68.0	7.6	53.8	65.0	5.9	62.8	0.646	2981	16566
Dyna-Gro :	Dynagraze	SxS	ME	5.2	15.0	65.7	8.5	53.3	64.8	5.0	65.4	0.673	3167	16535
Dyna-Gro :	First Graze	SxS	ME	5.2	16.5	68.6	7.8	55.2	64.7	6.2	62.4	0.640	2948	15262
	Trial Mean			7.5	23.8	68.1	7.7	53.1	68.5	5.56	65.2	0.670	3181	23654
	LSD			1.1	3.1	3.6	0.92	4.8	2.43	0.79	2.81	0.030	209	4131
	LSD P >			0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	CV			9.2	7.8	3.2	7.2	5.5	2.1	8.6	2.6	2.760	4.0	10.5
	F Test			0.3839	0.1703	0.299	0.0024	0.3278	0.325	0.1437	0.1245	0.094	0.1309	0.1788

PERFORMANCE OF DRYLAND FORAGE SORGHUM VARIETIES

Investigators: B. Niece, A. Mesbah, A. Scott

OBJECTIVE

To evaluate the 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 15 forage sorghum entries were planted on June 14, 2020, 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.

On May 1, the planting area was fertilized with 60 lb N/ac, 9 lb/ac Sulphur, 30 lb/ac of P2O5, and 2 qt/ac of chelated Zinc. At plant herbicide applications included Atrazine (2.0 pt/ac),and Warrant (2 qt/ac).

Glyphosate, Atrazine, and Verdict herbicides were applied to plots for weed control before 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. No irrigation was applied. Precipitation during the period after planting until the harvest was 6.7 inches.

Plots were harvested on September 21, 2020, 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 a 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 1. The highest-yielding varieties exceeded 8.5 tons of green forage. Mean wet forage yields for the 15 varieties were 8.5 tons/acre, the varieties differed ($P < 0.05$) with respect to yield. Nutritional analysis results are pending.

Table 1. New Mexico 2020 Dryland Forage Sorghum Performance Test - Agricultural Science Center at Clovis

Company Name	Variety Name	Sorghum Type	Maturity Group	Dry Forage	Green Forage	Harvest Moisture	CP	NDF	NDFD 48hr	Ash	TDN	NE_l	Milk/ Ton	Milk/ Acre
				t/a	t/a	%	%	%	%	%	%	Mcal/lb	lb/t	lb/a
Dyna-Gro Seed	F70FS91 BMR	FS	E	3.6	11.9	69.3	9.3	48.1	75.6	5.6	65.7	0.676	3269	11736
Dyna-Gro Seed	Fullgraze II	SxS	MF	3.5	12.2	70.8	9.3	55.2	71.3	6.2	63.0	0.646	3044	10620
Dyna-Gro Seed	Super Sile 30	FS	ME	3.2	11.0	70.7	10.4	53.4	73.1	6.1	62.8	0.643	3043	9697
Dyna-Gro Seed	Fullgraze II BMR	SxS	MF	2.9	10.7	72.2	9.7	50.5	74.5	6.3	63.5	0.650	3099	9074
Dyna-Gro Seed	TopTon	FS	F	2.8	9.5	70.4	9.7	51.4	71.4	6.0	63.9	0.656	3109	8733
Dyna-Gro Seed	Dynagraze II	SxS	ME	2.8	7.3	61.4	8.1	51.9	69.1	5.1	64.7	0.663	3150	8811
Dyna-Gro Seed	F74FS23 BMR	FS	M	2.6	9.5	72.0	9.7	48.0	78.8	7.1	64.6	0.666	3212	8491
Dyna-Gro Seed	Danny Boy II BMR	SxS	PS	2.4	9.6	74.7	11.0	51.4	76.3	7.1	65.1	0.670	3232	7601
Dyna-Gro Seed	Super Sweet 10	SxS	ME	2.3	6.2	62.8	9.0	50.5	70.4	4.7	65.4	0.673	3208	7342
Dyna-Gro Seed	Super Sile 20	FS	MF	2.3	8.1	71.8	10.8	52.3	74.2	6.5	64.0	0.656	3138	7120
Dyna-Gro Seed	F71FS72 BMR	FS	E	2.2	6.8	67.1	9.5	46.7	77.3	6.4	65.2	0.670	3248	7258
Dyna-Gro Seed	F72FS05 (SCA)	FS	ME	2.2	7.3	70.0	10.3	52.4	72.3	6.1	62.9	0.643	3047	6633
Dyna-Gro Seed	First Graze	SxS	ME	2.1	6.4	67.5	9.2	50.5	70.0	5.4	63.6	0.653	3079	6449
Dyna-Gro Seed	F72FS25 BMR	FS	M	1.9	6.7	70.4	10.7	50.2	76.4	6.8	64.8	0.663	3208	6180
Browning Seed, Inc.	Browning 300	FS	M	1.4	4.0	65.1	10.0	48.5	69.3	5.1	64.9	0.666	3164	4356
	Trial Mean			2.5	8.5	69.1	9.8	50.7	73.3	6.01	24.3	0.660	3150	8006
	LSD			1.2	4.8	5.0	1.30	3.1	3.06	1.18	1.94	0.023	138	3799
	LSD P >			0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	CV			28.8	33.6	4.3	8.0	3.6	2.5	11.8	1.8	2.160	2.6	28.4
	F Test			0.1301	0.1676	0.7604	0.4916	0.7123	0.3378	0.8424	0.6399	0.5122	0.5199	0.1325

SOIL HEALTH BENEFITS OF STRATEGIC TILLAGE MANAGEMENT IN DRYLANDS OF NEW MEXICO

Investigators: Rajan Ghimire, Vesh R. Thapa, and Wooiklee S. Paye

OBJECTIVE

To evaluate changes in soil health and nutrient cycling with strategic tillage management practices in NT agroecosystems.

MATERIALS AND METHODS

Conservation tillage systems have been increasingly adopted to improve the agronomic, environmental, and economic efficiencies of cropping systems. High residue accumulation under a continuous no-tillage (NT) system could delay seedling germination and stand establishment, ultimately affecting soil health and crop production. Producers in eastern New Mexico have started an innovative approach of strategically reduced tillage (SRT) on continuously no-tillage (NT) ground to maximize agronomic and economic benefits while maintaining soil health and environmental quality. Therefore, a four-year study was established in fall 2019 at the NMSU-Agricultural Science Center Clovis. The study has a randomized complete block design with five treatments and four replications in a dryland corn-sorghum rotation. Both phases of the crop rotation are present each year. Individual plot size was 20 ft x 60 ft for SRT and NT and 40 ft x 60 ft for conventional tillage (CT) and strip-tillage (ST) systems. The 40 ft x 60 ft plots with CT, ST, and NT management were established in 2013 with corn-sorghum rotation for four years, followed by winter wheat-fallow in 2018/19. The strategic tillage was started in 2019 (Table 1).

Table 1. A detailed description of the management strategy under each tillage system.

S.N.	Treatment	Description
1	CT	Conventional tillage corn-sorghum-winter wheat rotation in previously tilled plots
2	NT	Continuous no-tillage management of corn-sorghum-winter wheat rotation in previously no-tilled plots
3	SRT	One reduced-tillage operation in fall 2019 on corn-sorghum-winter wheat rotation after five years of no-tillage management
4	ST	Continuous strip-tillage corn-sorghum-winter wheat rotation in previously strip-tilled plots

The first tillage operation in SRT plots occurred on September 7, 2019, with stubble mulch tillage. On the same date, the conventional tillage plots were tilled with disk (4-inch deep) followed by tillage with DMI Ripper (8-10 inches deep) on November 11, 2019, sweep blades (4-inch deep) on March 15, 2020, and land finisher on June 7, 2020. Corn and Sorghum were planted in June second week.

Soil samples were collected from each plot before tillage and immediately after tillage of SRT and CT plots and seven months after tillage in SRT plots. Four soil cores were collected from 0-6 and 6-12 inch depths of each plot using soil sampling tubes, composited by depth, and analyzed for various soil processes indicators are being monitored. The indicators used for assessing soil health include a range of soil physical, chemical, and biological properties (Table 2). These soil properties, along with soil C and N fractions, will be analyzed for four years to understand the possibility of using strategically reduced tillage in long-term NT systems in semiarid agroecosystems.

Table 2. Soil health parameters monitored in tillage management study.

Physical	Chemical	Microbial/biochemical
• Bulk density • Gravimetric water content • Particulate organic carbon and nitrogen	• Soil pH • Soil organic carbon (SOC) • Total N • Inorganic N	• 72-hr C mineralization • Labile organic N • Microbial biomass

RESULTS

The conventional tillage plots had lower inorganic N, total labile N, potentially mineralizable carbon (PMC), and microbial biomass carbon (MBC) compared to no-tillage and ST plots. There was no significant change in labile C and N components after two days of strategic tillage (SRT) in long-term no-tillage plots (Table 3). However, all tilled plots had higher labile N components than NT plots in seven months after strategic tillage, with the greatest increase in labile C and N components under 0-6 inch depth of CT plots. In 6-12 inch depth, the PMC and MBC were greater only in ST plots, suggesting no effects of one-time tillage (SRT) on long-term NT plots at this depth. Monitoring of soil parameters will continue during the second through fourth years of the project to see the response of these tillage systems on soil health and crop production.

Table 3. The response of different tillage systems on selected soil health parameters before and after strategic tillage.

Sampling date	Sampling depth (inch)	Treatment	Inorganic N (mg/kg)	Total labile N (mg/kg)	PMC-72hr (mg/kg)	MBC (mg/kg)
Three days before tillage (9-4-2020)	0-6	CT†	1.61	3.91	33.5	177
		NT	1.75	5.04	52.1	214
		SRT	2.04	4.73	76.8	217
		ST	1.89	9.71	47.1	245
	6-12	CT	1.35	2.07	19.8	129
		NT	1.01	2.69	29.8	158
		SRT	1.21	2.47	27.1	153
		ST	0.94	4.01	43.0	195
Two days after tillage (9-9-2019)	0-6	CT	2.67	4.57	44.6	84
		NT	2.02	3.69	27.0	133
		SRT	1.75	3.02	29.3	135
		ST	2.47	5.91	38.7	125
	6-12	CT	2.31	3.39	19.4	128
		NT	1.92	3.09	30.0	118
		SRT	1.45	2.40	31.4	132
		ST	1.91	2.00	50.8	146
Seven months after tillage (4-7-2020)	0-6	CT	12.2	12.1	56.7	443
		NT	6.84	8.90	34.3	310
		SRT	8.45	9.45	38.2	312
		ST	6.81	9.25	34.3	338
	6-12	CT	5.39	6.01	18.7	278
		NT	7.75	8.04	30.9	277
		SRT	6.60	7.38	24.8	280
		ST	6.23	7.10	37.3	329

†CT = conventional tillage, NT = no-tillage, SRT = strategic reduced tillage, ST = strip tillage, PMC = potentially mineralizable carbon, MBC = microbial biomass carbon.

GREENHOUSE GAS MITIGATION IN CENTER PIVOT IRRIGATED CROPPING SYSTEMS THROUGH GRASS BUFFER STRIPS

Investigators: Rajan Ghimire, Sk. Musfiq-Us- Salehin, Sangu Angadi, and John Idowu

OBJECTIVE

To evaluate greenhouse gas emissions from circular grass buffer strips and adjacent corn strips in the center-pivot irrigated agroecosystems.

MATERIALS AND METHODS

The study was conducted at the New Mexico State University Agricultural Science Center at Clovis, NM, in 2019 in the study plots established in 2016 with five perennial grass buffer strips (30 ft) alternating with five corn strips of 60 ft width in a quarter circle area under an irrigation pivot. This study was conducted in four grass strips along with at 5 ft, 15 ft, and 30 ft distances from the edges of each grass strip in the adjacent corn strip (Fig. 1). The soil sampling locations, center of grass buffer strips (GBS) and corn strips at 5 ft (C-1), 15 ft (C-2), and 30 ft (C-3) from grass edges were the four treatments, while four grass buffer strips and four corn strips constituted the four replications in this study.

A mixture of six perennial grasses was sown on August 9, 2016, which included four warm-season grasses and two cool-season grasses. Warm-season grasses were Switchgrass, Big Bluestem, Sideoats Grama, Indiangrass, Sand Bluestem, and two cool-season grasses were Tall Wheatgrass, Western Wheatgrass. More water was needed at the beginning to establish the grasses. The grasses are mowed to 4 inches from the ground and bailed once in August 2018 and 2019.

Corn (Zea mays L.) variety Pioneer 1151 AquaMax was sown in the second week of May each year at a seeding rate of 22,000 seeds/acre. Corn plots were fertilized with 207 kg ha-1 nitrogen (N), 80 lbs/acre phosphorus (P), 30 lbs/acre sulfur (S), and 8 lbs/acre zinc (Zn), a few days before planting each year. The corn strips were maintained with conventional tillage in which fields were first tilled with a disk in the winter followed by plowing to the depth of 9 inches by DMI Ripper in early spring and land finisher in May, a week before corn planting. Corn was planted with a John Deere four-row planter. Corn was harvested in mid-October at physiological maturity.

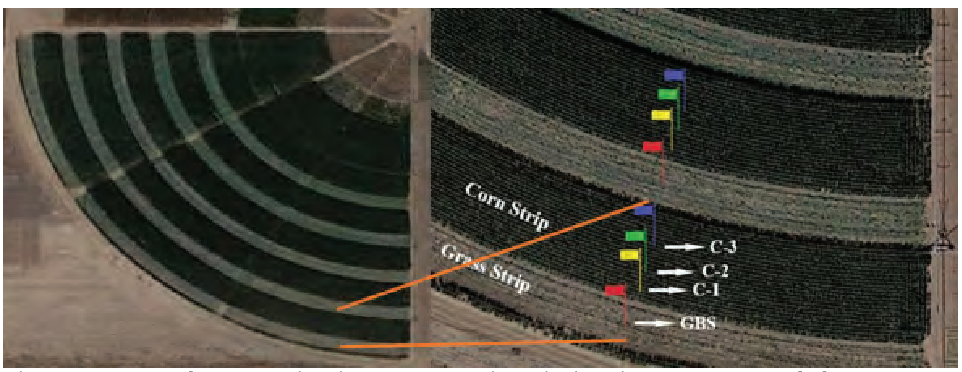


Fig 1: Grass And corn strips in a center pivot irrigation system and the sampling locations within each strip.

The CO2 and N2O emissions were measured using an EGM-5 portable CO2 gas analyzer (PP Systems, Amesbury, MA) and MIRA Pico CO/N2O portable analyzer (Aeris Technology, Hayward, CA). For this method, a polyvinyl chloride (PVC) ring of 4-inch height and 4-inch inside diameter was installed in each plot up to 3.5-inch deep into the soil. It was installed in May after planting corn and occasionally removed for field operations (fertilization, spaying, etc.), and reinstalled immediately afterward. The frequency of gas sampling was once per week throughout the growing season.

Sampling occurred between 0900 and 1100 h to reduce variability in CO_2 and N_2O flux due to diurnal fluctuation in temperature, and sampling was not conducted until after 24 h in case any rainfall or other soil disturbance events occurred. Plants or weeds inside the PVC ring were hand clipped or removed before each sampling to avoid CO_2 gas contribution from aboveground plant parts. A soil respiration gas chamber of 15 cm height and 10 cm diameter was installed on the top of the PVC ring each time while taking the gas readings and waited for 5 minutes to take the CO_2 and N_2O gas readings. Gas samples were collected from the chamber headspace using an SRC-2 Soil Respiration Chamber connected to the EGM-5 analyzer and MIRA Pico Analyzer. Net flux was calculated by subtracting the air CO_2 and N_2O concentration from measured values. Both CO_2 and N_2O give the measurement in ppm by volume. The cumulative emission of CO_2-C and N_2O-N was estimated by linear interpolation of weekly emissions rates and numerical integration of individual data points. Soil and air temperatures (oC) and soil moisture (%) were also monitored from the 0-0.05 m depth at the time of gas flux measurements using a hydra probe (Stevens Water Monitoring Systems, Portland, OR) attached to the EGM-5 analyzer.

RESULTS

Greenhouse gas emissions varied among the treatments, and it was higher during summer and fall for all the treatment plots (Figure 1) than in the GBS. Grass buffer strip treatment had the lowest cumulative CO_2-C emission (2.15 ton/acre), and the emission increases with distance from the grass edge in the corn strip from C-1 to C-3. Among the sampling locations within the corn strip, C-3 had the highest total emissions of CO_2-C and was 35.3% higher than C-1 and 34.4% higher than C-2.

GBS had the lowest N_2O-N emission (0.08 kg ha-1), and the emission increased linearly with increasing distance from the grass edges. Cumulative N_2O-N emission was higher in C-2 and C-3 than GBS, but C-1 was not significantly different than the GBS. C-3 had the highest N_2O-N emission, which was considerably higher than GBS and C-1.

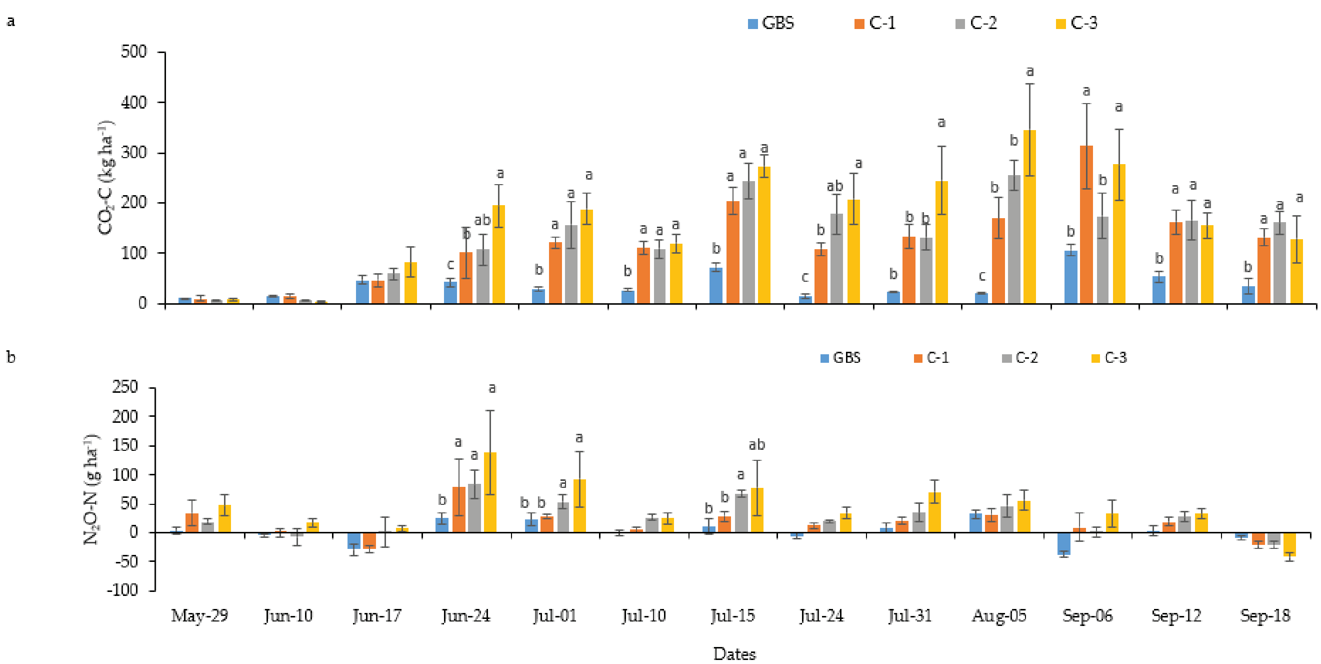


Figure 1. CO_2-C (A) and N_2O-N (B) emissions during the growing season in 2019 under different treatments and sampling dates. Different lowercase letters indicate a significant difference among the treatments within a measurement date. GBS, grass buffer strip, C-1, C-2, and C-3 represent sampling locations in corn strips at 5 ft, 15 ft, and 30 ft away from the grass edge.

SOIL ORGANIC CARBON AND NITROGEN DYNAMICS UNDER DRYLAND SORGHUM PRODUCTION

Investigators: Rajan Ghimire, Sk. Musfiq-US- Salehin, Sangu Angadi, and Abdel Mesbah

OBJECTIVE

To evaluate the effects of different N management practices, such as compost and four different N fertilizer rates, on soil C and N pools and crop yield in dryland sorghum production.

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 area has a semiarid climate and Olton clay loam (fine, mixed, super active, thermic Aridic Paleustolls) soils. The experimental field was in no-tillage winter wheat -sorghum-fallow rotation since 2014 and followed for 11 mo before planting sorghum each year. The study had a randomized complete block design with five treatments and four replications. The size of an individual plot was 30 by 30 ft. The N management treatments were N0, N20, N40, and N60, which represented 0, 20, 40, and 60 lbs/acre of N application, respectively, as liquid urea-ammonium nitrate (UAN: 32–0–0) and a 6 tons/acre dairy compost application. The compost was obtained from a dairy farm West of Clovis, NM, and was applied with a hand spreader. The liquid UAN was used with a 9.14 m (30 ft) long liquid sprayer-boom mounted behind a tractor. Grain sorghum (Pioneer 86P20) was planted on 21 May in 2018 and on 23 May in 2019 and harvested on 22 October in 2018 and 25 September in 2019 at grain moisture <12%. In both years, planting was done by a four-row no-till planter (John Deere 1700 planter) with 30 in. row spacing at a rate of 27,000 seeds/acre.

Composite soil samples were collected with a soil core sampler of one-inch diameter from 0- to 4- and 4- to 8-in 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 soil samples were collected from five randomly selected spots within each plot, homogenized, and composited by depth (0- to 4- and 4- to 8-in). Laboratory analysis for baseline samples included gravimetric soil water content, inorganic N, and potential nitrogen mineralization (PNM) in 72 h of aerobic incubation. Soil samples collected at harvest were analyzed for soil water content, inorganic N, PNM, and total soil nitrogen (TSN). Labile organic nitrogen (LON) was also measured in soil samples collected in 2019. Soil inorganic N was analyzed as a sum of potassium chloride (KCl) extractable NO3- and NH4+ in an automated flow injection N analyzer (Timberline Instruments, LLC). Approximately 5 g of aerobically incubated samples were used to determine PNM by extracting soils with KCl as described for inorganic N. About 5 g of unincubated soil samples were boiled in a water bath for 4 h in Pyrex glass tubes, and the extract was analyzed as inorganic N.

RESULTS

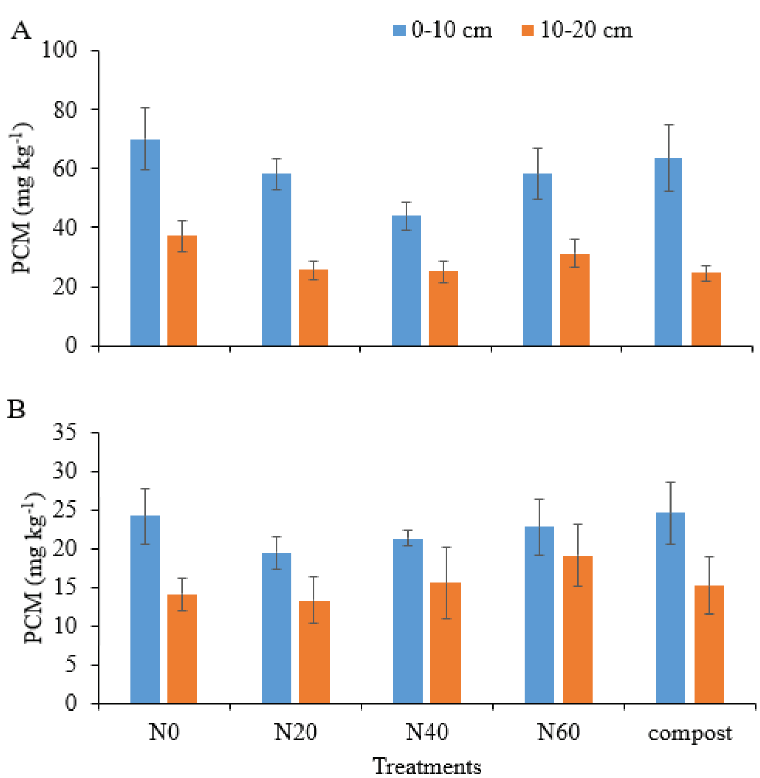
Soil inorganic N and PNM at sorghum harvest were not significantly different between treatments, soil depths, and treatment interaction × soil depth in both years (2018 and 2019). Soil inorganic N was in the range of 1.36-3.21 mg kg-1 in 2018 and 1.00-1.30 mg kg-1 in 2019, whereas PNM was in the range of 0.55-1.23 mg kg-1 in 2018 and 0.69-0.80 mg kg-1 in 2019 (Table 1). Total soil N varied between soil depths but not between treatments and treatment × soil depth interaction in 2018. In 2019, there was no significant difference between N treatments and N treatment × soil depth interaction, but 0 to 4-inch soil had 14.8% more TSN than 4 to 8-inch soil when averaged across all treatments (Table 1).

Table 1. Inorganic N, potential nitrogen mineralization (PNM), labile organic nitrogen (LON), and total soil nitrogen (TSN) as influenced by treatments in 0- to 10-cm and 10- to 20-cm depths.

Parameters	Treatments	2018		2019	
		0–4 inch	4-8 inch	0–4 inch	4-8 inch
Inorganic N, mg kg^{-1}	N0	3.09 ± 0.88	1.39 ± 0.23	1.08 ± 0.05	1.13 ± 0.12
	N20	1.86 ± 0.34	2.07 ± 0.86	1.26 ± 0.20	1.30 ± 0.20
	N40	1.74 ± 0.09	1.36 ± 0.46	1.10 ± 0.07	1.16 ± 0.07
	N60	2.62 ± 0.89	3.09 ± 0.62	1.09 ± 0.07	1.10 ± 0.08
	Compost	3.03 ± 0.48	3.21 ± 1.81	1.00 ± 0.09	1.08 ± 0.05
	Baseline	1.76	5.44	13	10.14
PNM, mg kg^{-1}	N0	1.02 ± 0.40	0.55 ± 0.07	0.78 ± 0.06	0.75 ± 0.05
	N20	0.75 ± 0.15	0.81 ± 0.32	0.78 ± 0.09	0.69 ± 0.03
	N40	0.71 ± 0.06	0.64 ± 0.15	0.78 ± 0.03	0.71 ± 0.04
	N60	0.95 ± 0.25	1.14 ± 0.18	0.75 ± 0.05	0.68 ± 0.03
	Compost	1.06 ± 0.20	1.23 ± 0.57	0.80 ± 0.05	0.77 ± 0.06
	Baseline	25.52	7.22	12.83	9.61
LON, mg kg^{-1}	N0	–	–	4.55 ± 0.11	3.47 ± 0.41
	N20	–	–	4.81 ± 0.15	3.67 ± 0.39
	N40	–	–	4.36 ± 0.13	2.65 ± 0.33
	N60	–	–	4.44 ± 0.32	4.00 ± 0.49
	Compost	–	–	4.68 ± 0.18	3.37 ± 0.44
	Baseline	–	–	13.96	9.37
TSN, g kg^{-1}	N0	0.77 ± 0.02	0.68 ± 0.01	0.87 ± 0.05	0.75 ± 0.01
	N20	0.73 ± 0.01	0.65 ± 0.01	0.82 ± 0.03	0.77 ± 0.03
	N40	0.73 ± 0.02	0.64 ± 0.01	0.87 ± 0.04	0.76 ± 0.02
	N60	0.72 ± 0.01	0.68 ± 0.02	0.83 ± 0.05	0.75 ± 0.01
	Compost	0.75 ± 0.01	0.66 ± 0.01	0.96 ± 0.02	0.76 ± 0.01

Note. Data presented as a mean ± standard error.

Figure 1. Potential carbon mineralization (PCM) under different treatments in 0- to 4- and 4- to 8-inch depths of soil. The N fertilizer rates under N0, N20, N40, and N60 were 0, 20, 40, and 60 lb/acre, respectively.



COVER CROPS EFECTS ON SUBSEQUENT SORGHUM YIELD: RESULTS OF A FIVE YEAR STUDY

Investigators: Rajan Ghimire, Vesh Thapa, and Mark Marsalis

OBJECTIVE

To evaluate the response of diverse winter cover crops and mixtures on and sorghum grain yield under limited irrigation winter wheat-sorghum-fallow rotation

MATERIALS AND METHODS

This study was conducted during 2016-2020 at the New Mexico State University Agricultural Science Center (ASC) Clovis, NM. The study has a randomized complete block design with a split-plot arrangement of treatments in each crop rotation phase of winter wheat-sorghum-fallow rotation. Cover crop treatments included fallow (no cover crop), three sole cover crops: pea (Pisum sativum), oat (Avena sativa) and canola (Brassica napus L.), four cover crop mixtures pea+oat [POM], pea+canola [PCM], pea+oat+canola [POCM], and a six-species mixture [SSM] of pea+oat+canola+hairy vetch (Vicia villosa) +forage radish (Raphanus sativus L.) +barley (Hordeum vulgare L). Cover crops were planted in the last week of February in a fallow field using a plot drill. All cover crops were maintained in plots for three months before chemically terminated at the flowering stage of oat (85-90 d).

Winter wheat variety (TAM 113) was planted in the second week of October using a plot drill (Great Plains 3P600, Salina, KS) at a seeding rate of 62 kg ha-1 with the drill spacing maintained at 0.25 m. All the experimental plots received 67 kg N ha-1 and 12 kg S ha-1 each year through fertigation. Irrigation water (average 300 mm) was applied at the critical growth stages of wheat; for example, jointing, booting, heading, and grain filling stage.

Sorghum cultivar (NK 5418) was planted in the first week of June using a no-till drill (John Deere, Moline, IL) at a seeding rate of 50,000 seeds acre-1 (i.e. 123, 553 seeds ha-1) in all phases of the rotation with the row spacing maintained at 0.76 m. All sorghum plots received 97 kg N ha-1 and 15 kg S ha-1 from a mixture of urea, ammonium nitrate, and ammonium thiosulfate in liquid form at the time of planting each year. The experiment was maintained under limited irrigation conditions.

Sorghum was harvested at physiological maturity in the last week of October 2016, 2017, 2018, and 2019 by hand-harvesting a bundle grain sample from 6th and 7th row of 20 ft length whereas stalk was harvested from same rows of 5 ft length, leaving approximately 5 ft from the plot border in each plot. Sorghum aboveground biomass (head and stalk) was collected in plastic bags, brought to the laboratory, took fresh weight, and thrashed head using a plot combine thresher (Wintersteiger) to separate grains. The moisture content of sorghum grain was determined with a moisture meter, whereas stalks were oven-dried at 65°C for 72 hours to determine moisture content. Sorghum grain yield, HI, and 1000-grain weight were then adjusted to 12% moisture. Harvest index (HI) was calculated by dividing sorghum grain yield by total biomass (head + stalk) after adjusting total biomass yield on an oven-dried basis.

RESULTS

Sorghum yield varied significantly between treatments and years. No difference was observed between treatments and years on sorghum grain yield during 2016-2018 (Table 1). Observations from the interaction effect showed no significant differences in sorghum grain yield between treatments in 2016, 2017, and 2018 while the sorghum grain yield in 2019 was the greatest under oats, which was significantly greater than the grain yield under canola. In 2020, sorghum yield significantly decreased with cover cropping, irrespective of cover crop species composition. The year 2020 was relatively dry, leading to significant moisture stress on sorghum following cover crop treatments. Five-year (2016-2020) average yield was 6-12% lower in cover crop plots than in fallow plots.

Table: 1 Sorghum grain yield under various cover crop treatments from 2016 to 2020.

Treatment†	Yield (lbs/acre)						
	2016	2017	2018	2019	2020	2016-2020 av.	% yield loss
Fallow	6534	7410	7554	7910	8587	7599	-
Pea	6561	6733	6870	8003	5388	6711	11.7
Oat	6657	6202	6845	8661	7230	7119	6.32
Canola	6727	6293	8786	6190	6786	6957	8.45
POM	7024	6516	7255	7789	7139	7145	5.98
PCM	6640	6235	7716	6911	7086	6917	8.97
POCM	6354	7206	7828	7509	6384	7057	7.14
SSM	7186	5891	7604	7210	5630	6704	11.6

†POM: pea+oat, PCM: pea+canola, POCM: peat+oat+canola, and SSM: six-species mixture of pea+oat+canola+hairy vetch+forage radish+barley

NITROGEN APPLICATION TIMING EFFECT ON WINTER CANOLA YIELD AND NITROGEN USE EFFICIENCY

Investigators: Rajan Ghimire, Wooiklee Paye, Sangu Angadi, Sultan Begna, and Paramveer Singh

OBJECTIVE

To evaluate the effect of nitrogen (N) application timing on winter canola growth, yield, nitrogen use efficiency, and forage quality.

MATERIALS AND METHODS

The study was conducted at New Mexico State University Agricultural Science Center near Clovis, NM, during crop years 2018 and 2019. The experimental design was a randomized complete block with a split-plot arrangement of eight treatments, replicated four times. Canola varieties were considered the main plots, whereas N application timing was considered subplots. Two winter canola varieties: Riley, an open-pollinated variety, and 46W94, a hybrid variety, were used for this study. For the 2018 crop year, winter canola was drilled-seeded on September 20, 2017, and harvested on June 21, 2018; and drilled-seeded on September 11, 2018, and harvested on June 19, 2019, for the 2019 crop year. In both years, the seeding rates were 4 lbs/acre for Riley and 6.7 lbs/acre for the 46W94 hybrid variety. The plot-size for an individual treatment was 11 x 30 ft. The previous crop in both years was winter wheat.

Based on the soil analysis result of the baseline soil samples, the recommended fertilizer application rate was 120-35-0-40 lbs/acre (N-P-K-S). The four N application timing compared as subplots were: F100 (100% of N applied in fall), S100 (100% of N applied in spring), FS50 (50% N applied in fall and 50% in spring), and FSB25 (25% N applied in fall, 25% in spring and 25% before 50% flowering stage). The FSB25 treatment application received 25% less N than the other treatments. In the 2018 crop year, fall N was applied on October 20, 2017, in the F100, FS50, and FSB25 treatments, followed by spring N application on February 23, 2018, in the S100, FS50, and FSB25 treatments, and a final N application on April 10, 2018, in the FSB25 treatment. Similarly, in the 2019 crop year, fall N was applied on October 11, 2018, in the F100, FS50, and FSB25 treatments, followed by spring application on February 13, 2019, in the S100, FS50, and FSB25 treatments, with final N application in the FSB25 treatment on April 8, 2019. Urea ammonium nitrate (UAN) was used as the source of N. Soils and plant-biomass samples and was collected from each plot before the spring N application and at harvest. Four randomly selected soil cores were taken from each plot, homogenized and composited by depth (0-15 and 15-30 cm), and analyzed for total N.

At harvest, a 10.7 m2 section of each plot was harvested with a plot combine harvester (Wintersteiger, Ried, Austria) to estimate total dry matter production and seed yield. Seed moisture content was adjusted to a standard moisture content of 10%. Nitrogen use efficiency was calculated as partial factor productivity, the ratio of seed produced per unit N applied.

RESULTS

The soil NO3-N in the 0-30 cm profile measure before the spring N application was significantly higher in the F100 than the other N treatments in both crop years 2018 and 2019 (Figure 1a). The lowest soil N was measured in the S100 treatment, which received no N during the fall application. The soil N measured in the spring of 2019 did not differ among the S100, FS50, and FSB25 treatments. After harvest, the residual soil N was significantly lower in the F100 application than the S100 and FS50 treatments but not different from the FSB25 treatment. The post-harvest soil N did not differ among N treatments in 2019 (Figure 1b).

Canola seed yield, harvest index, oil and protein yields as well as NUE were also significantly ($p < 0.05$) affected by N application timing. Seed yield was highest, 2265 lbs/acre in the S100, which was not significantly different from the FS50 and FSB25 treatments (Table 1). The F100 application had the lowest seed yield of 1968 lbs/acre). Canola harvest index, Oil, and seed protein yields followed the same trend. Nevertheless, NUE was significantly ($p<0.05$) higher in the FSB25 treatment, which only received 75% of total N applied in the other treatments, producing 23.8 kg of seed per unit N applied, compared to 18.6, 19.0, and16.5 kg of seed per unit N applied in the FS50, S100, and F100 respectively.

Figure 1. Effect of nitrogen application timing on soil N status in spring (a) and at harvest (b). Bars with the same letter within a year are not significantly different

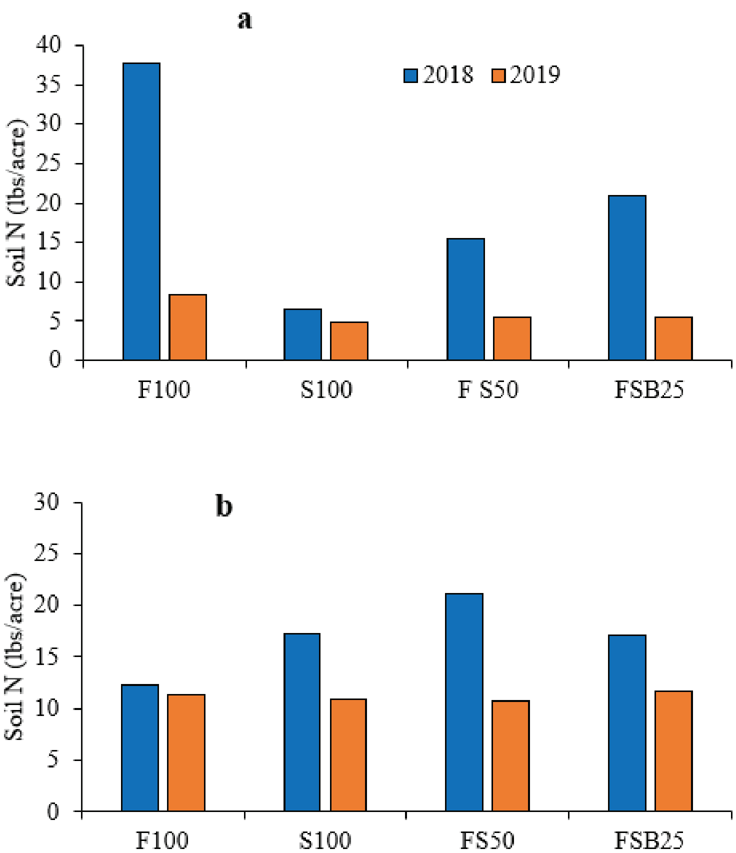


Table 1. Effects of nitrogen application timing, year, and variety on canola yield parameters and nitrogen use efficiency

Sources of Variation	Level	Seed Yield (lbs/acre)	Harvest index	Oil Yield (lbs/acre)	Protein Yield (lbs/acre)	Seed Protein Content(%)	NUE (lbs yield /lbs N)
Treatments	F100	1968	0.2	771	519	26.51	16.5
	S100	2265	0.23	895	591	26.3	18.9
	FS50	2222	0.21	860	597	26.91	18.6
	FSB25	2143	0.2	837	574	26.91	23.8
Year	2018	2046	0.2	769	590	28.85	18.5
	2019	2253	0.22	911	551	24.47	20.4
Variety	Hybrid	2200	0.21	863	575	26.25	19.9
	Riley	2099	0.21	817	566	27.1	18.9

COVER CROPS AFFECT GREENHOUSE GAS EMISSIONS AND CROP YIELD IN IRRIGATED FORAGE PRODUCTION

Investigators: Rajan Ghimire, Pramod Acharya, and Wooiklee Paye

OBJECTIVE

To evaluate soil C and N components and greenhouse gas emissions and forage yield in cover crops integrated forage rotation under irrigated conditions.

MATERIALS AND METHODS

The study was conducted at the New Mexico State University Agricultural Science Center at Clovis, NM, during 2018-2020. The study had a Split plot design with crop rotation phases (forage corn and sorghum) as the main plot factor, cover crop treatments as the sub-plot factor, and four replications. Cover crop treatments included (1) grass + brassica + legume (GBL) mixture of annual ryegrass, triticale, daikon radish, turnip, Austrian winter pea, and berseem clover, (2) grass + legume (GL) mixture, (3) grass + brassica (GB) mixture, and (4) no-cover cropping fallow. Cover crops were no-till planted in the third week of September and chemically terminated in April of the following year. Main crops, corn, and sorghum were planted in May and harvested in September as silage. Soil fertility management was based on soil tests in the first year. Weed, pest, and irrigation management were based on standard practices for forage corn and sorghum as needed.

The CO2 and N2O emissions were measured using an EGM-5 portable CO2 gas analyzer (PP Systems, Amesbury, MA) and MIRA Pico CO/N2O portable analyzer (Aeris Technology, Hayward, CA). For this method, a polyvinyl chloride (PVC) ring of 10 cm height and 10 cm inside diameter was installed in each plot up to 9 cm deep into the soil. It was installed in September 2018 after cover crop planting and occasionally removed for field operations (fertilization, spaying, etc.) and reinstalled immediately. The frequency of gas sampling was once per week throughout the cash crop growing season and once in three to four weeks during fallow/cover crop growing periods. Sampling occurred between 0900 and 1100 h to reduce variability in CO2 and N2O flux due to diurnal fluctuation in temperature, and sampling was not conducted until after 24 h in case any rainfall or other soil disturbance events occurred. Plants or weeds inside the PVC ring were hand clipped or removed before each sampling to avoid CO2 gas contribution from aboveground plant parts. A soil respiration chamber of 15 cm height and 10 cm diameter was installed on the top of the PVC ring each time while taking the gas readings and waited for 5 minutes to take the CO2 and N2O gas readings. Gas samples were collected from the chamber headspace using an SRC-2 Soil Respiration Chamber connected to the EGM-5 analyzer and MIRA Pico Analyzer. Net flux was calculated by subtracting the air CO2 and N2O concentration from measured values. Both CO2 and N2O give the measurement in ppm by volume. Soil and air temperatures (oC) and soil moisture (%) were also monitored from the 0-0.05 m depth at the time of gas flux measurements using a hydra probe (Stevens Water Monitoring Systems, Portland, OR) attached to the EGM-5 analyzer.

RESULTS

Soil CO2 and N2O emissions indicate loss of valuable organic matter and nutrients to the environment affecting both crop production and the environment. Soil CO2 emissions were lower in fallow plots than cover crop plots during the cover cropping period. However, such a difference was not observed in the main crop phase. The soil CO2 fluxes showed a consistent trend of elevated emissions during the crop (main crop and cover crops) growth period in both years, indicating the influence of root respiration. Soil N2O fluxes were inconsistent in the trend and showed negative fluxes mostly during cover crop phases, possibly due to consumption of N2O by denitrifiers. Overall GHG fluxes (CO2 and N2O) averaged higher during the main crop phases than cover crop/fallow phases, irrespective of cover cropping treatments. The trend of GHG emissions, soil moisture, and air temperature showed a positive relationship between GHG emissions and soil moisture and temperature, specifically in N2O production.

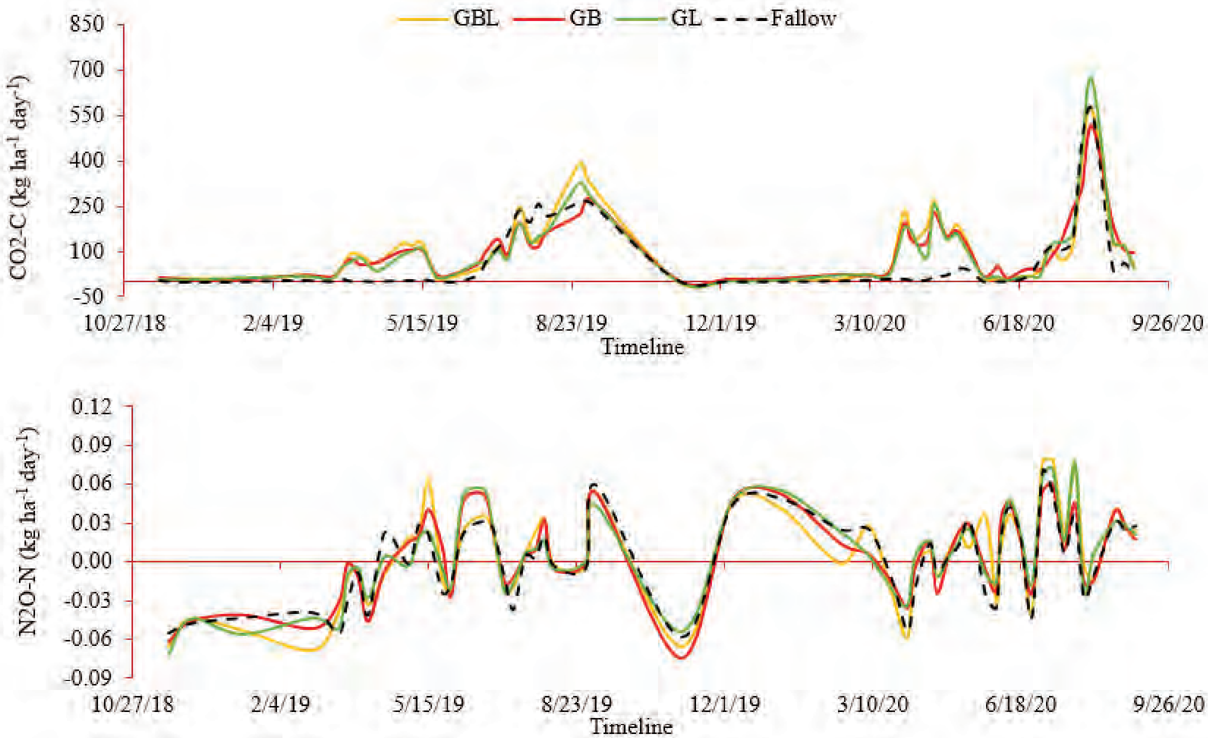


Figure 1. Soil CO2 and N2O emissions during cover crop and main crop growth in 2018-2020 study period. GBL = grass + brassica + legume (GBL) mixture of annual ryegrass, triticale, daikon radish, turnip, Austrian winter pea, and berseem clover, GL = grass + legume mixture, and GB = grass + brassica (GB) mixture

CROP GROWTH STAGE BASED DEFICIT IRRIGATION MANAGEMENT IN GUAR CROP

Investigators: Sangu Angadi, Jagdeep Singh, Shivam Chawla, and Sultan Begna

RATIONALE

With the declining Ogallala Aquifer, eastern New Mexico and West Texas cannot support high water using crops like corn, alfalfa, and forage sorghum. The region needs well-adopted, alternative crops that need much more water than most of our traditional crops. Guar is a desert-adapted crop that is mostly grown in the deserts of India and Pakistan. It is a multi-purpose crop used as green manure, vegetable, and forage, but growing the crop for grain production for industrial use is increasing worldwide. Guar gum, an extract from guar seed, is extensively used in mining, hydraulic fracturing, food, pharmaceutical, and other industries. Guar is a drought-tolerant crop with lower water requirements than many of the world's annual crops.

Alternative crops have to compete with heavy water using conventional crops like corn and forage sorghum. However, deeper root systems of alternative crops may allow the extraction of water and nutrient below the rooting depth of conventional crops. We are assessing pre-season irrigation (to refill soil profile) and critical stage-based deficit irrigation strategies to assess traits of guar. If we can grow alternative crops like guar without competing with main commercial crops like corn, the adoption of those crops will easier. For this, we need to assess water use and yield relations for these alternate crops under different deficit irrigation strategies. Therefore, this study evaluates pre-season irrigation and critical stage-based irrigation methods for reducing irrigation water use by guar.

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

The 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). Due to Covid19 in 2020, we could not hire a new graduate student. We also lost technical helpers during the year. Although we managed to get most of the fieldwork done and collect all field samples, we are behind in processing samples and analyzing the data.

Design: Strip block design with three factors.

Irrigation Treatments: (with 2020 irrigation amounts)

Main plot: 1) Pre-irrigation (125 mm)
2) No pre-irrigation (0 mm)

Main plot: Four in-season irrigation treatments
1) Fully irrigated (FI) (278 mm)
2) Irrigation water stress at vegetative stage (Vst) (178 mm)
3) Irrigation water stress at the reproductive stage (Rst) (185 mm)
4) Rainfed/Dryland (RD) (85 mm; to establish)

Rainfall: The year was extremely dry and we received about 60% of long-term average rainfall. That affected guar seed yield.

Sub plot: Guar cultivars (Kinman and Monument).

Date of sowing: July 3, June 12, and June 2 in 2018, 2019, and 2020, respectively.

Spacing: Row to row distance was 30 inches.

Seed rate: 8 lbs/acre.

Replications: 4 (Four replicas of each treatment)

RESULTS AND DISCUSSION

During the first two years of the study (2018 and 2019), pre-irrigation increased seed yield by 27% more and 9% over no-pre-irrigation treatment, respectively (Table 1). However, during the extremely dry year of 2020, the seed yield increase due to pre-irrigation was 71% higher compared to no-pre-irrigation. This indicates that preseason irrigation to refill soil profile works best in guar when in-season water availability is low. The harvest index (HI) was not significantly different in 2018, but pre-irrigated plots recorded lower HI in 2019. HI in pre-irrigated plots was numerically higher in 2018 also. We are waiting to process 2020 data. This indicates that guar was not able to contribute the pre-season irrigation into seed yield formation effectively (Table 1). The effort to further reduce irrigation water applications by skipping irrigations during vegetative (Vst) or reproductive (Rst) stages had different effects on guar seed yield. Cutting back irrigation by 30 to 40% in 2018 and 2019 did not have any significant difference between Vst or Rst. Surprisingly, seed yield reduction was very small with Vst or Rst compared to full irrigated guar in the first two years. But during 2020, due to extreme drought, skipping irrigation at Rst reduced seed yield by 38%, while the same yield reduction during Vst was only 14%. Fully irrigated treatment recorded the highest seed yield in all years. This shows that guar responds to irrigation only during most stressful years. Overall, both cultivars performed similarly, and Kinman had a higher seed yield than Monument.

Application of pre-irrigation improved the aboveground biomass significantly in 2018, while the effect of pre-irrigation in 2019 was not significant. We need to analyze 2020 data and interpret the results (Fig 2). 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. Afterward, Vst treatment surpassed the Rst treatment and recorded higher aboveground biomass at the end of the crop season. There were significant differences recorded for the aboveground biomass of cultivars. Kinman recorded higher biomass than Monument. This might be due to the non-branching and early maturing habit of the Monument (Figure 2).

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

	2018		2019		2020*	
Treatments	Seed yield (kg/ha)	HI (%)	Seed yield (kg/ha)	HI (%)	Seed yield (kg/ha)	HI (%)
Pre-irrigation (P)						
Yes	1024 a	30.8 a	302 a	26.6 b	761 a	27.5 a
No	807 b	35.8 a	330 a	33.3 a	448 b	31.3 a
Growth Stage-Based (S)						
FI	983 a	29.1 c	365 a	27.8 b	815 a	27.3 b
Vst	811 a	32.3 bc	364 a	29.8 ab	702 a	27.3 b
Rst	977 a	34.3 ab	290 ab	30.0 ab	507 b	31.4 a
RD	893 a	37.4 a	246 b	32.2 a	392 b	31.7 a
Cultivars (C)						
Kinman	956 a	32.0 a	368 a	31.0 a	668 a	29.6 a
Monument	876 a	34.6 a	265 b	28.9 a	541 b	29.3 a
Interactions						
P*S	NS	NS	NS	NS	NS	NS
P*C	NS	NS	NS	NS	NS	NS
P*C	NS	NS	NS	NS	NS	NS
P*S*C	NS	NS	NS	NS	NS	NS
PS: The data from 2020 is still being processed.						

Fig. 1. Aboveground biomass of guar during crop season under different irrigation treatments in 2018-19. Bars having different letters are statically different at a 5% p-value. Data from 2020 is being processed.

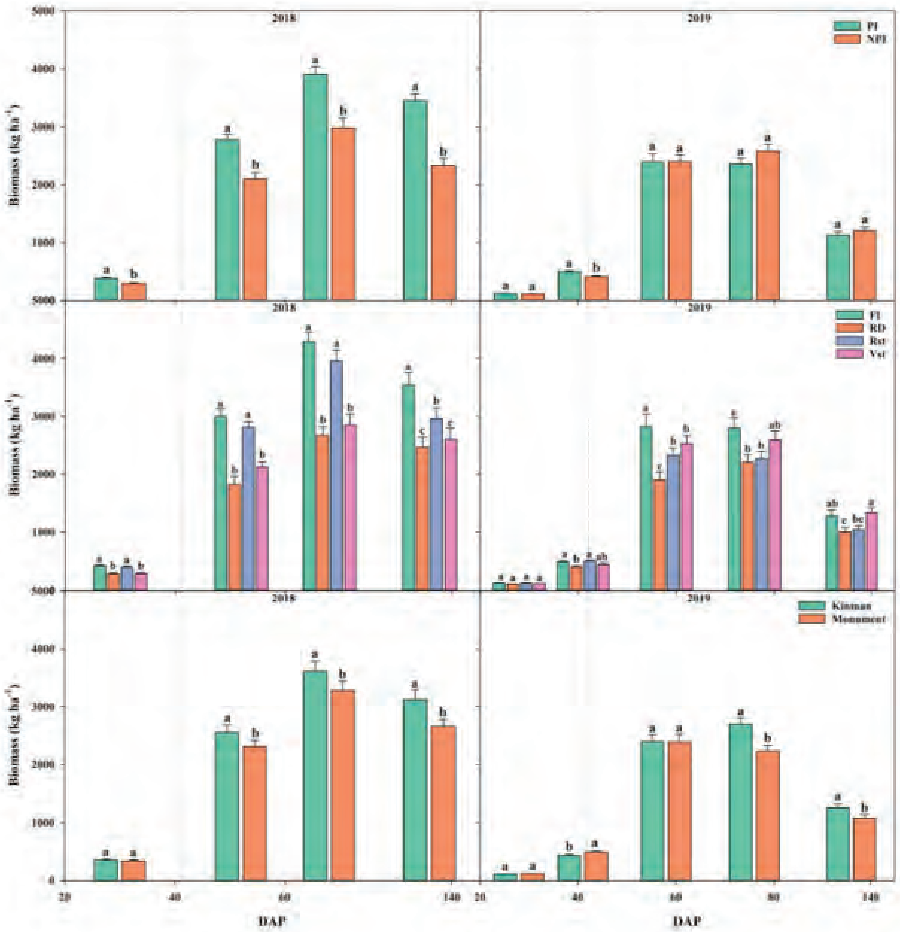
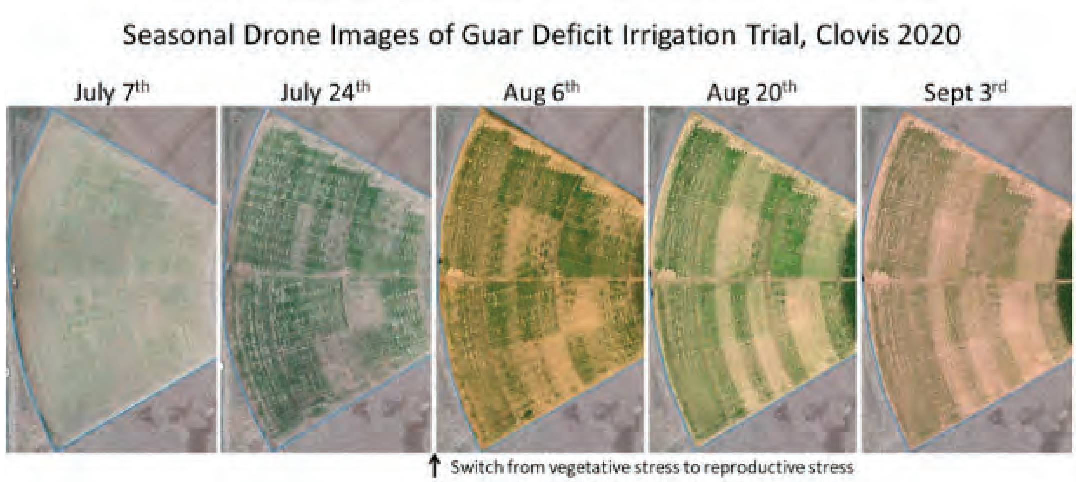


Fig. 2. Drone images from the 2020 deficit irrigation trial showing the seasonal effect of irrigation management on guar growth. We need to analyze NDVI and other growth indices and try relating them to biomass and seed yield.



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

Investigators: Sangu Angadi, Paramveer Singh, Rajan Ghimire and John Idowu

RATIONALE

Degrading ecosystem services under declining irrigation water resources and increasingly variable climate are threatening the sustainability of Ogallala Aquifer irrigated agriculture in the Southern Great Plains. Decreasing well outputs have created partial pivots in the region, where part of the pivot is used for rainfed or minimally irrigated crops. In this USDA-NIFA funded project, we are evaluating the novel concept of rearranging the rainfed part of the pivot in the form of concentric circles of grass buffers alternating with crop strips to offer multiple benefits to the systems. Planting buffers with a mixture of native cool and warm season grass species brings the system closure to natural grass prairie, which was resilient and sustainable for a long period. Even with relatively short, 4-5 ft tall grasses, the design allows spreading most benefits on the entire pivot, which is not possible with a line of tall tree rows growing on one side of the field.

Each component of the design (perennial species, buffer strip, circular design, and multiple circles) could add or improve benefits to the system. Expected efficiencies in the water cycle include 1) reduced evaporation and runoff losses of rainfall and irrigation water, 2) conserving high-intensity precipitation, off-season rainfall, and snowfall, 3) improved soil water storage and crop water use efficiency. CBS could improve food productivity through reduced stress (e.g. water, wind, temperature), less crop damage (windblown soil abrasion), improved resource use efficiency (e.g. transpiration fraction, reduced input losses), improved soil health (e.g. soil structure, organic matter content, infiltration rate, water holding capacity) and biodiversity (e.g. pollinators, beneficial insects, nutrient cycling). CBS is also expected to reduce greenhouse gas emissions by reducing production inputs to perennial grasses, and improving resource-use efficiency, CO2 fixation, and sequestration. Also, producers get some management benefits (e.g. well pressure management, pivot maintenance). Preliminary results are promising with improvements in grain yield (>20%), microclimate, water conservation, and biomass production in border rows. This system may improve the 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 single and multiple circular buffer strips on the seasonal microclimate of corn.
- To evaluate the effect of circular grass buffer strips on the physiology of corn.
- To compare 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 the native warm-season and cool-season grasses (Warm-season grasses were sideoats grama, big bluestem, Blackwell switchgrass, indiangrass, and cool-season grasses were Jose tall wheatgrass and western wheatgrass) were planted on August 8, 2016 (started with a USDA-NIFA seed grant) on a quarter section of a pivot. The quarter-facing southwest direction was selected as it is the predominant wind direction in the region (Fig 1a). A Quarter section of nearby pivot facing the same direction without CBS served as control. The outermost strip was grass strip (30 ft wide), which alternated with 60 ft wide crop strips. Preliminary results from 2017 to 2019 are very promising. With new USDA-NIFA funding, the trial was continued in 2020. Pioneer 1151 cultivar of corn was planted on 05/02/2020 with 0.76 m row spacing. Each crop strip in CBS had 24 cornrows. A total of 390 mm of irrigation was applied to corn in CBS and control. Grass strips of CBS didn't receive any irrigation this year. As the corn grew above grass height (the benefit of CBS is minimum on corn), the grass was swathed on 16 July 2020.

Wind sensors were installed at a 1.5 m, 9.1 m, and 16.5 m distance from the edge of the first grass strip and the outer edge of the control pivot. They were installed close to the soil surface to monitor the effect of grass buffer strips on wind speed. Physiological (photosynthetic rate, water potential, and chlorophyll fluorescence) and agronomic measurements (plant height and biomass) were taken at V-4, V-6, V-8, and tasseling stage at 2-weeks interval. Agronomic measurements were also taken at R3 and maturity. Physiological measurements were taken at noon, on a fully opened corn leaf. LI-COR 6400 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 65°C for 72 h. Dry biomass weight was recorded when 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 the impact of wind on plants, soil, and soil evaporation. The photosynthetic rate of corn at tasseling was greater in CBS than CT at all sampling distances, indicating enhanced physiological activity (Table 1). Less negative leaf water potential suggests that corn in the control pivot experienced a higher-level of water stress than CBS, even though both received the same amount of irrigation. The growth and development of corn were better in CBS at sampling distances. Corn was 20%, 14%, 9%, and 10% taller at 1.5, 3.8, 9.1, and 14.5 m from the outer edge in CBS than CT (Table 2). In CBS, corn had 29%, 2%, 37%, 2%, and 15% more dry mass at 1.5, 3.8, 9.1,14.5, and 16.7 m distance from outer edge. This season was extremely dry and without any irrigation, grass growth suffered. As a result, the winderation effect reduced, while competition for water resources with nearby corn rows increased. Nozzles on the grass strips were closed during irrigation. Since nozzles overlap, the first three rows next to the grass strip received less irrigation than inner rows. Dry weather, reduced grass growth, competition, and relatively less irrigation attributed to 20% lower seed yield at outside 8-row passes in CBS. Middle and inside 8-row pass corn in CBS had 38 and 7% than CT. Results indicate that even under extremely dry conditions alternate grass buffer strips improved corn growth, yield, and water use efficiency (higher yield with the same amount of irrigation and rainfall) Additionally, perennial grass buffer strips were used by birds to lay eggs. Thus, converting under/un-utilized part of partial pivots may not only improve agricultural productivity but also can increase water use-efficiency and wildlife activity.

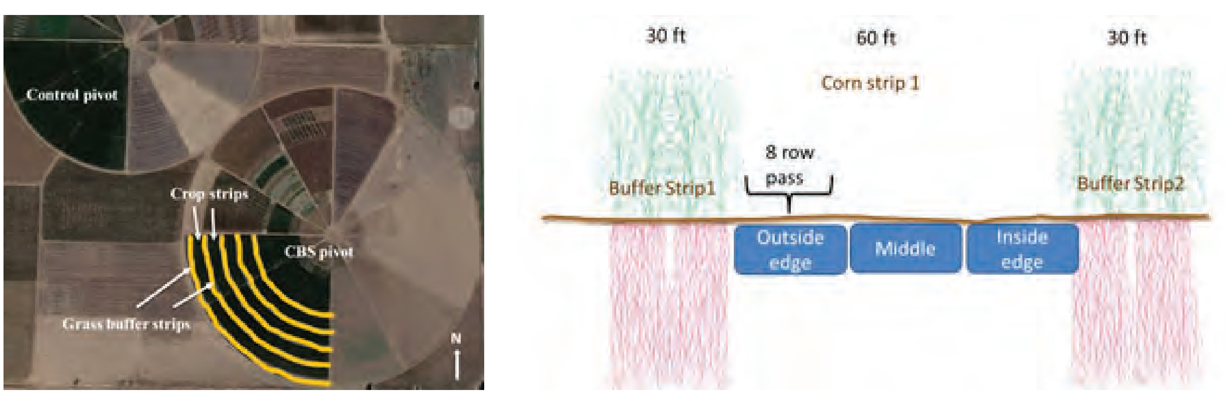


Fig 1. (a) Location of CBS and control pivot at ASC, Clovis. (b) Three harvest passes (each having 8 rows) of corn strip in CBS. Since there were 4 corn strips, a total of 12 passes were harvested. A similar number of passes were harvested in the control pivot.

Table 1. Comparison of mid-day photosynthesis, leaf water potential, and chlorophyll fluorescence 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 and 2020 at ASC, Clovis.

Distance from the 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
2019						
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
2020						
1.5	27.1	26.8	-14.2	-15.5	0.76	0.79
3.8	28.9	24.8	-13.1	-14.8	0.78	0.79
9.1	30.4	26.0	-11.8	-13.0	0.81	0.79
14.5	30.3	27.3	-12.6	-12.3	0.80	0.80
16.7	33.0	30.5	-12.3	-11.9	0.79	0.79

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 (top) and 2020 (bottom) at ASC, Clovis.

Distance from the outer edge (m)	Plant Height (cm)			Biomass at maturity (Kg ha^{-1})	
	Buffer	Control		Buffer	Control
	2019				
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
	2 2020				
3 1.5	4 142	5 118	6	7 3843	8 2977
9 3.8	10 179	11 156	12	13 4305	14 4211
15 9.1	16 194	17 177	18	19 6907	20 5029
21 14.5	22 186	23 184	24	25 6268	26 6132
27 16.7	28 179	29 183	30	31 6382	32 5540

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

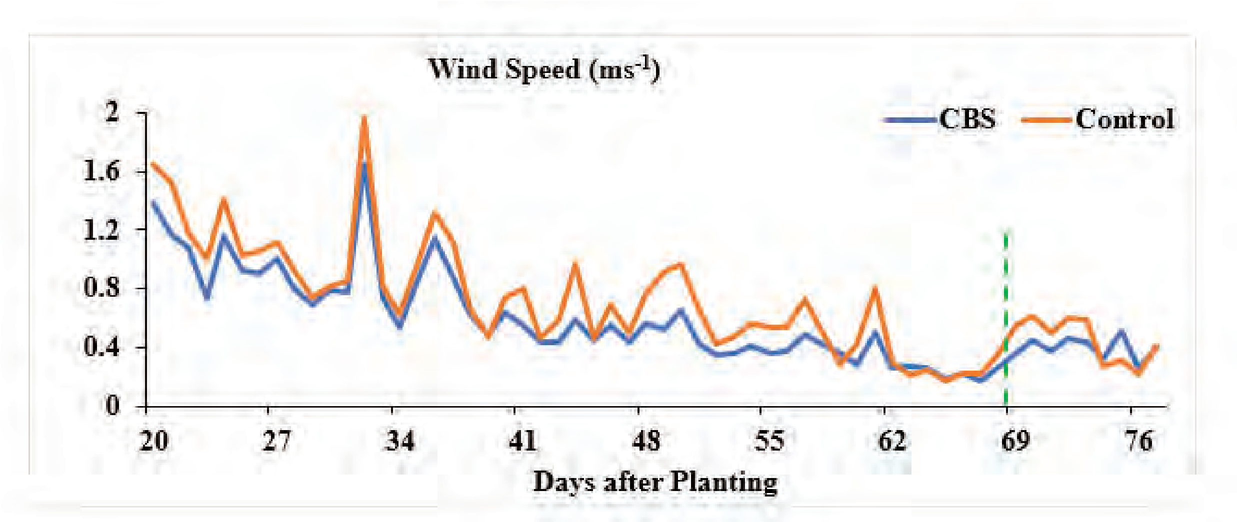
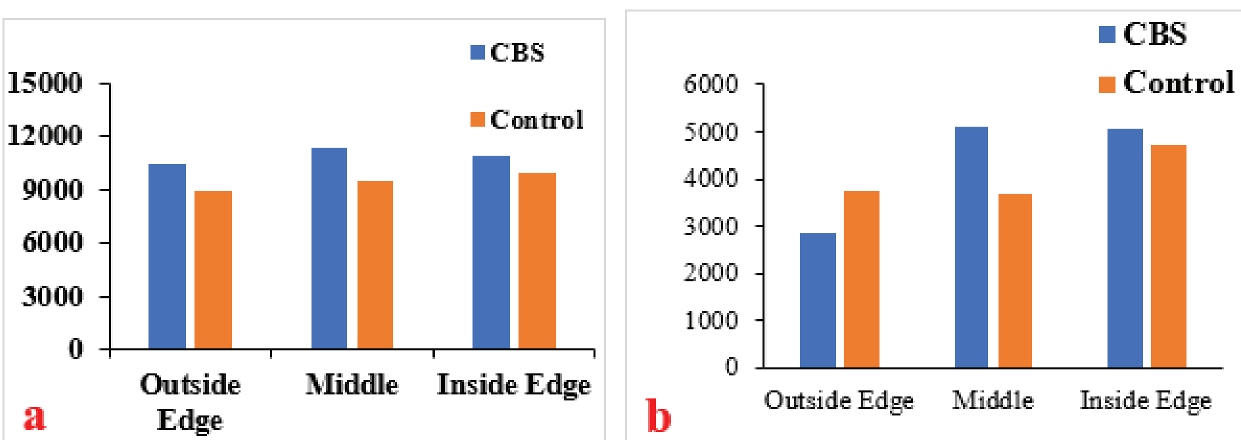


Fig 3. (a) Combine seed yield (kg ha-1) in control and circular buffer strip pivots in 2019 (a) and 2020 (b). The outer edge, middle, and inside edge combine passes covered 8 cornrows each.



IDENTIFY GUAR CULTIVARS SUITABLE FOR COOLER NORTHERN LATITUDES OF SOUTHERN GREAT PLAINS

Investigators: Jagdeep Singh, Sangu Angadi, and Sultan Begna

RATIONALE

Guar [Cyamopsis tetragonoloba (L.) Taub.] is a summer annual legume crop that is mainly grown in the deserts of India and Pakistan. Demand for galactomannan gum from guar, commonly known as guar gum, has exponentially increased in the last few decades due to increased use in oil and natural gas, food, cosmetics, paper, and other industries. The United States of America is the major importer of guar gum in the world and the import bill has exceeded a billion dollars in recent decades. Guar gum is needed for fracking to efficiently extract natural gas from shale reserves. Therefore, demand for guar gum is predicted to increase in many parts of the world with fossil fuel reserves in the shale formation. There is a need to increase guar production in non-traditional areas to ensure steady supply and reduce market volatility. Temperature is the main environmental factor affecting germination and early crop growth and adaptation of crop species beyond their area of origin. Expanding guar acreage into cooler regions of the southern Great Plains or in similar agroclimatic regions of the world is an attractive option. Therefore, a study was conducted in incubators to assess genetic variations among currently available guar cultivars for germination and early growth under cooler temperature ranges.

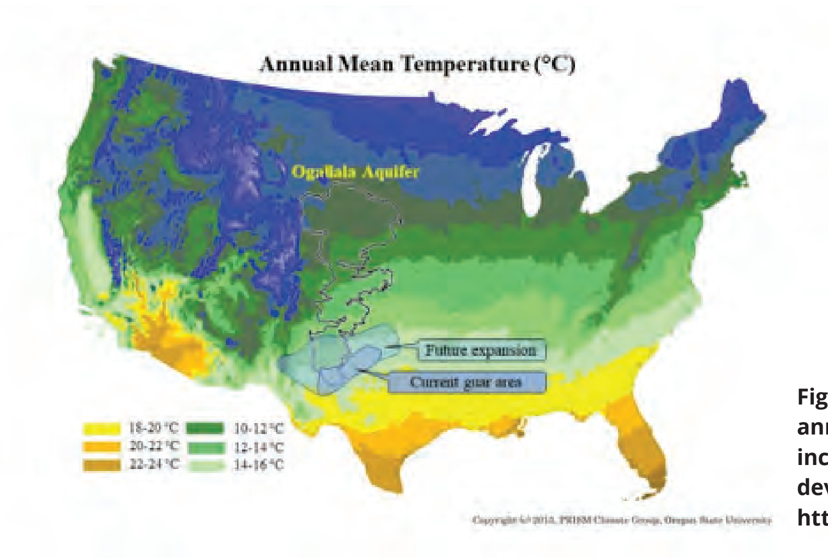


Fig.1: Current guar acreage in the US concerning average annual temperature (from 1981 to 2010) and potential to increase guar area if cold-tolerant cultivars are developed. The annual average map was retrieved from http://prism.oregonstate.edu. (From Singh et al., 2021).

OBJECTIVE

- To assess commercially available guar cultivars for genetic variation for germination and early growth under a range of temperatures.
- To identify suitable guar cultivar for planting in cooler regions or early planting options to expand guar acreage in the southern Great Plains.

MATERIALS AND METHODS

This was an incubator study conducted at the Agricultural Science Center in Clovis NM of New Mexico State University. Two identical incubators (Precision Incubator, Model 818, Thermo Scientific, Grand Island, NY, USA) were used for the study.

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

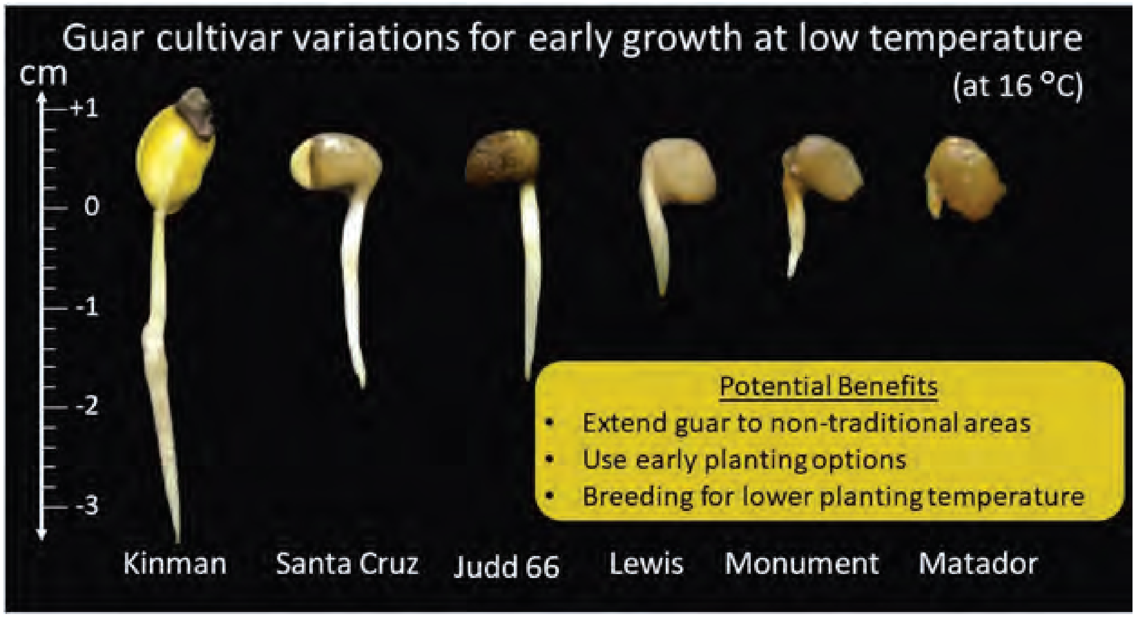


Fig. 2. Visual presentation of guar cultivar differences for early growth at 16 °C (Singh et al., 2021).

Guar cultivars exhibited significant variations in germination percentage, mean germination time, and seed vigor index under lower temperatures, which narrowed as the temperature increased closer to the optimum. Kinman with a higher germination percent, higher seed vigor index, and faster germination is suitable for lower temperature regions or early planting in the SGP, while Matador was least suitable for the purpose among all the cultivars used in this study. Temperature improved the final seed germination in all cultivars. Most of the cultivars recorded the highest germination in the 19° - 25°C 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 a 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 the lowest germination percentage at lower temperature ranges (13 to 19°C), but as temperature increases, the 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 temperatures and suggests high variability present among available guar cultivars.

In general, parameters associated with seed vigor index increased with an increase in temperature. Kinman had higher seed vigor indices at lower temperature ranges (16 to 19°C) and Matador had the lowest seed vigor index at a temperature range of 13 to 22°C. The mean germination time also showed some interesting trends. The mean germination time decreased with an increase in temperature. At a temperature range of 13 to 19°C, Kinman was the fastest to emerge, while Monument and Matador were the slowest cultivars to emerge and they took a long 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.

Name of Cultivar	Year	Organization	References
Kinman	1975	TAES, OAES, and USDA	Stafford and Ray (1985)
Santa Cruz	1984	AAES and USDA	Ray and Stafford (1985)
Lewis	1984	TAES, AAES, and USDA	Stafford and Ray (1985)
Matador	2004	TTU and HES	Abidi et al. (2015)
Monument	2004	TTU and HES	Abidi et al. (2015)
Judd 69	No official information, anecdotal evidence suggests farmers' selection and more recent origin (2010s)		

Table 1: Details of guar cultivars used in the study.

*TOAES = Texas Agricultural Experiment Stations; OAES = Oklahoma Agricultural Experiment Stations; AAES = Arizona Agricultural Experiment Station; TAES = Texas Agricultural Experiment Stations; TTU = Texas Tech University; HES = Halliburton Energy Services, Inc.

References: Jagdeep Singh, Ivette Guzman, Sultan Begna, Calvin Trostle, Sangu Angadi. 2021. Germination and early growth response of guar cultivars to low temperatures. Industrial Crops and Products 159:113082.

Table 2: Interaction effects of temperature and cultivar on final seed germination percentage (top) and primary root length (bottom) of six guar cultivars grown in a dark growth chamber at a temperature range of 13-28°C. The standard error of means is shown in parentheses.

Cultivars	Final seed germination percentage (%)						
	Temperature						
	13 (°C)	16 (°C)	19 (°C)	22 (°C)	25 (°C)	28 (°C)	Average
Kinman	77.6 (6.3) aB	98.5 (1.0) aA	98.5 (1.0) aA	97.0 (1.3) aA	95.5 (1.9) aA	95.0 (1.7) aA	93.9 (1.7) a
Monument	19.1 (1.0)	45.7 (6.6) eC	85.0 (1.3) bB	93.0 (1.3) aA	91.0 (1.0	91.6 (3.0) aA	75.3 (4.9) c
Judd 69	32.1 (10.1) cC	80.0 (1.6) bB	96.5 (1.7) aA	97.5 (1.3) aA	93.5 (1.7) aA	96.0 (1.4) aA	85.2 (4.0) b
Matador	11.8 (3.6) dD	39.2 (2.9) eC	67.7 (3.4) dB	92.1 (2.2)	96.0 (1.8) aA	95.0 (1.7) aA	72.7 (5.5) cd
Lewis	29.8 (5.0) cC	54.9 (4.0) dB	86.5 (1.3) bA	85.1 (2.9)	81.5 (0.5) cA	80.7 (3.7) bA	72.1 (3.8) d
Santa	43.9 (5.5) bD	73.1 (2.6) cC	76.0 (0.8) cBC	81.1 (2.4)	85.5 (1.7) bcA	77.0 (1.3)	73.7 (2.6) cd
Average	40.1 (5.4) D	67.6 (4.4) C	85.6 (2.3) B	91.1 (1.4) A	90.6 (1.2) A	89.5 (1.7)	
	Primary root length (cm)						
Kinman	0.8 (0.2) aE	3.2 (0.2) aD	5.9 (0.1) aC	6.2 (0.4)	7.1 (0.3) aAB	8.0 (0.3) abA	4.8 (0.6) a
Monument	0.1 (0.01)	0.9 (0.2) dC	5.5 (0.3) aB	6.3 (0.2) abB	7.6 (0.03) aA	8.6 (0.7) aA	3.8 (0.8) d
Judd 69	0.3 (0.1) bE	2.0 (0.1) bD	5.6 (0.1) aC	6.9 (0.5) aB	7.6 (0.3) aAB	8.0 (0.6) abA	4.3 (0.7) b
Matador	0.1 (0.02) dE	0.3 (0.03) eD	1.6 (0.1) bC	4.3 (0.5) cB	6.2 (0.3) bA	6.9 (0.2) cA	2.3 (0.6) e
Lewis	0.2 (0.1) bcD	1.3 (0.1) cC	5.4 (0.4) aB	6.2 (0.5) abA	7.2 (0.2) aA	7.5 (0.2) bcA	3.9 (0.7) cd
Santa	0.4 (0.1) bD	2.0 (0.1) bC	5.3 (0.3) aB	5.9 (0.2) bB	7.3 (0.5) aA	7.7 (0.3)	4.1 (0.7) bc
Average	0.2 (0.1) F	1.4 (0.2) E	4.7 (0.4) D	5.9 (0.2) C	7.1 (0.2) B	7.8 (0.2) A	

Values within a column followed by the same lowercase letters are not significantly different at $p \leq 0.05$.
Values within a row followed by the same uppercase letters are not significantly different at $p \leq 0.05$.

Table 3: Interaction effects of temperature and cultivar on seed vigor index (top) and mean germination time (bottom) of six guar cultivars grown in a dark growth chamber at a temperature range of 13-28°C. The standard error of means is shown in parentheses.

Cultivars	Seed vigor index						
	Temperature						
	13 (°C)	16 (°C)	19 (°C)	22 (°C)	25 (°C)	28 (°C)	Average
Kinman	105 (6) aD	471 (27) aC	817 (23) aB	841 (50) abB	938 (44) abB	1099 (55)	653 (83) a
Monument	3 (0.4) cdE	67 (21) dD	696 (29) abC	832 (27) abB	974 (21) abB	1133 (116)	469 (111) c
Judd 69	16 (9) bE	245 (13) bD	778 (26) abC	934 (81) aB	1014 (61) aAB	1115 (93)	570 (107) b
Matador	1 (1) dE	18 (3) eD	171 (22) dC	598 (75) dB	883 (61) abA	983 (46) bcA	300 (87) d
Lewis	13 (4) bcD	123 (16) cC	678 (43) bcB	770 (57)	849 (42) bA	900 (51) cA	453 (91) c
Santa	30 (8) bD	230 (17) bC	578 (30) cB	680 (24) cdB	904 (54) abA	878 (30) cA	473 (80) c
Average	19 (6) F	161 (30) E	592 (54) D	772 (31) C	926 (21) B	1015 (33) A	
Cultivars	**Mean germination time (day)**						
Kinman	11.6 (0.5) bA	5.6 (0.3) cB	3.0 (0.1) cC	2.5 (0.1) bCD	2.1 (0.1) bDE	1.8 (0.1) bcE	3.5 (0.5) d
Monument	15.8 (0.8) aA	11.0 (0.9) aB	4.9 (0.7) aC	2.6 (0.1) bD	2.1 (0.1) bE	1.8 (0.1) cE	4.5 (0.8) b
Judd 69	12.3 (0.8) bA	7.7 (0.7) bB	3.2 (0.1) cdC	2.6 (0.1) bD	2.1 (0.1) bDE	1.9 (0.1) bcE	3.8 (0.6) c
Matador	17.0 (0.1) aA	11.7 (0.4) aB	5.5 (0.1) aC	3.4 (0.2) aD	2.8 (0.1) aE	2.3 (0.02) aF	5.4 (0.8) a
Lewis	12.4 (0.6) bA	7.6 (0.5) bB	3.9 (0.6) bcC	2.6 (0.1) bD	2.2 (0.1) aDE	2.1 (0.4) abE	4.1 (0.6) c
Santa	11.9 (0.7) bA	6.7 (0.4) bB	4.0 (0.5) bC	2.7 (0.1) bD	2.3 (0.1) aDE	2.1 (0.1) abE	4.0 (0.5) c
Average	13.3 (0.5) A	8.1 (0.5) B	4.0 (0.2) C	2.7 (0.1) D	2.3 (0.1) E	2.0 (0.1) F	

Values within a column followed by the same lowercase letters are not significantly different at $p \leq 0.05$.
Values within a row followed by the same uppercase letters are not significantly different at $p \leq 0.05$.

Table 6: Interaction effects of temperature and cultivar on the speed of germination index of six guar cultivars grown in a dark growth chamber at a temperature range of 13-28°C. The standard error of means is shown in parentheses.

Cultivars	Speed of germination index (day^{-1})						
	Temperature						
	13 (°C)	16 (°C)	19 (°C)	22 (°C)	25 (°C)	28 (°C)	Average
Kinman	0.72 (0.04) aE	2.06 (0.11)	3.78 (0.18) aC	4.33 (0.12)	4.88 (0.14) aB	5.92 (0.32)	3.33 (0.41)
Monument	0.12 (0.01)	0.59 (0.15) dE	2.36 (0.21) cD	3.90 (0.20)	4.96 (0.34) aB	5.92 (0.54)	2.40 (050)
Judd 69	0.24 (0.07)	1.42 (0.13)	3.54 (0.15)	4.25 (0.08) aB	4.77 (0.28) aB	5.76 (0.18)	2.89 (0.47)
Matador	0.06 (0.02) dE	0.39 (0.03)	1.55 (0.10) dC	3.04 (0.22) cB	3.87 (0.16) cA	4.37 (0.04)	1.74 (0.38)
Lewis	0.27 (0.03) bE	1.07 (0.08)	3.10 (0.35) bC	4.14 (0.26) aB	4.66 (0.35)	4.88 (0.74)	2.62 (0.44)
Santa	0.38 (0.05) bE	1.32 (0.09)	2.48 (0.22) cC	3.36 (0.14)	4.12 (0.18) bcA	4.30 (0.08)	2.39 (0.34)
Average	0.26 (0.04) F	1.07 (0.12) E	2.75 (0.18) D	3.82 (0.12) C	4.53 (0.12) B	5.17 (0.21) A	

Values within a column followed by the same lowercase letters are not significantly different at $p \leq 0.05$.
Values within a row followed by the same uppercase letters are not significantly different at $p \leq 0.05$.

VALENCIA PEANUT BREEDING

Investigators: N. Puppala and M. Ojha

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.

MATERIALS AND METHODS

The experimental trial was planted on May 16, 2020, in 40-inch rows under center pivot irrigation. The study site was on a commercial peanut grower's field in Morton, Texas. Soil type is an Amarillo loamy fine sand (fine-loamy, mixed, superactive, thermic Aridic Paleustalfs), and elevation is 3760 feet. Individual plots consisted of two rows, 40-inch row spacing with 12 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 previous crop was cotton.

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 14, 2020, and left for a week for drying. Peanuts were thrashed with a small plot thrasher manufactured by Kingaroy Engineering Works (KEW, Kingaroy, Australia). 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. As measured by Total Sound Mature Kernels (TSMK), peanut quality 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 promising Valencia breeding lines, namely NMSU-2057, NMSU-2017, and NMSU-2047, showed higher pod yield (Table 1). All these materials were high oleic chemistry. The grade ranged from 69.6 to 61.8 percent. The net return was higher for the breeding line NMSU-2057 ($ 420), followed by NMSU-20017 ($ 404) and NMSU-2042 ($ 391). The average yield for the trial was 1968 lb/ac.

Table 1. One year average pod yield, total sound mature kernels (TSMK) grade, and net return ($)

S.No	Entry #	Pod Yield (lb/ac)	Grade (TSMK)	Net Return ($)
1	**2017**	**2204**	**68.2**	**404**
2	2024	2029	69.5	380
3	2025	1940	64.4	338
4	2031	2086	65.4	371
5	2032	1757	65.8	315
6	**2042**	**2080**	**69.6**	**391**
7	2045	1853	66.0	330
8	2047	2148	66.9	385
9	2049	1976	67.8	360
10	2050	1790	63.7	309
11	2051	1298	61.1	216
12	2052	2051	65.0	361
13	2053	2179	64.8	382
14	2055	1897	62.7	321
15	2056	1842	61.8	309
16	**2057**	**2359**	**66.0**	**420**
	Mean	**1968**	**66.0**	**350.0**
	LSD 0.05	705.47	2.90	53.87
	Pr > F	0.0106	0.1810	NS

± 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

GENOME-WIDE TRANSCRIPTOME AND PHYSIO-BIOCHEMICAL ANALYSIS PROVIDED NEW INSIGHTS ON DROUGHT RESPONSIVE MECHANISMS IN PEANUT

Investigators: Sailaja Bhogireddy, Abishek Xavier, Vanika Garg,$, Nancy Layland, Renee Arias, Paxton Payton, Spurthi N. Nayak, Manish K.Pandey, Naveen. Puppala,, and Rajeev K. Varshney,**

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OBJECTIVE

To identify the best suitable peanut cultivar under water deficit irrigation (WDI) in the West Texas region and eastern New Mexico.

MATERIALS AND METHODS

Ten different peanut genotypes used in this study were obtained from all four different market types: Spanish, Virginia, Runner, and Valencia (Supplementary Table S1). Six genotypes- TMV2, TAMSPAN-90, ICGV 86051, ICGV 86388, Serenut-5T, and Serenut-6R belong to the Spanish market type, while ICGS 76 and belong to the Virginia bunch. Further, C76-16 (C-76) belongs to the Runner type, while Val-C and COC-041 belong to the Valencia market type. Details of crop management, weather and meteorological conditions, soil moisture, and temperature conditions were provided in Supplementary Doc 1). The field trials were conducted on a grower's peanut field (Delwin Marrow farm) in Terry County, Brownfield, Texas, USA (33°18'N; 102°16'W; altitude 1009 m). Two treatments, one with full-irrigation (F.I.) and the other with deficit irrigation (D.I.), were imposed. Full-irrigation received 50% available water content (AWC), while deficit irrigation received 25% AWC throughout the growing season during the years 2013 to 2015. The experiment was conducted based on a split-plot design using main plots with irrigation as the factor, and each genotype was replicated four times.

RESULTS

This study revealed C76 -16 genotype as the best performing runner market type, while Valencia-C as least performing under deficit irrigation. Further, RNA-seq in both contrasting genotypes deciphers the transcriptome changes under WDI. About 369 million raw reads were generated from four different libraries constructed from fully irrigated (F.I.) and WDI samples, out of which 329 (90.2%) filtered reads were mapped to the peanut genome. The analysis revealed the differential expression of 4508 genes, 1554 transcription factors, and 514 SNPs/Indels. Further, comparative expression analysis revealed the basal and integral tolerance of C-76 by activating critical genes related to "ABA and sucrose metabolism." Besides unraveling the underlying complex mechanisms associated with contrasting genotypes under water deficit conditions at the pegging and fruit development stage, the study would also be useful in molecular marker development to select drought-responsive genotypes through marker-assisted breeding deploying SNPs information.

Based on the phenotyping results from the annual analysis of variance, the irrigation treatment (T) was significant in 2013, 2014 (P-value <0.0001), and 2015 (P-value <0.01)). These results indicate that each year the yield was significantly different depending on the T, genotype (G), and T × G (Supplementary Table S2). In 2013, the fully irrigated plot (F.I.) produced about 2828 kg/ha−1, while the deficit irrigated plot generated about 1879 kg/ha−1, a reduction of about 34% compared to the fully irrigated plot. Further, yield reduction in the deficit-irrigated plots was about 67% and 13% in 2014 and 2015, respectively (Supplementary Table S3). Overall, in three years, the best genotypes obtained under full irrigation conditions in West Texas were Tamspan-90, ICGS 76, and C76-16 (C-76), and low yielders were Valencia-C (Val-C), ICGV 86388, and TMV-2. On the other hand, under the conditions of water deficit, C-76 showed better response accounted by its mean yield of 3278 kg ha−1, higher among the different genotypes followed by Tamspan-90, ICGS 76, COC-041, ICGV 86051, and Val-C (Table 1).

Table 1: Yield response of different peanut genotypes under contrasting irrigation treatments

		2013		2014		2015		Average	
	Genotype	**Full**	**Deficit**	**Full**	**Deficit**	**Full**	**Deficit**	**Full**	**Deficit**
	Units	Kg ha^{-1}	Kg ha^{-1}	Kg ha^{-1}	Kg ha^{-1}	Kg ha^{-1}	Kg ha^{-1}	Kg ha^{-1}	Kg ha^{-1}
1	ICGS 76	3667	2410	5719	1423	4978	3777	4788	2537
2	**C76-16**	**3856**	**3827**	**4761**	**1715**	**5431**	**4292**	**4683**	**3278**
3	COC-041	3244	1673	4279	1246	3623	4354	3715	2424
4	ICGV 86051	2652	1667	4537	1818	4412	3574	3867	2353
5	SR-5	3085	1379	2972	1194	3636	2965	3231	1846
6	SRT-6	2808	1513	4856	1478	4011	3075	3892	2022
7	TMV-2	2882	1719	4273	1075	3512	3512	3556	2102
8	ICGV 86388	1487	873	4738	972	3043	3168	3090	1671
9	Tamspan-90	3472	2598	4951	2083	4838	3621	4420	2767
10	Valencia-C	1131	1131	3982	1692	3824	3792	2979	2205
	Mean	**2828**	**1879**	**4507**	**1469**	**4131**	**3613**	**3822**	**2320**
	LSD	**487.78**		**827.32**		**886.45**		**748.53**	

PEANUT *FAD2* GENOTYPE AND GROWING LOCATION INTERACTIONS SIGNIFICANTLY AFFECT THE LEVEL OF OLEIC ACID IN SEEDS

Investigators: Brandon Tonnis, Ming Li Wang, Xianran Li, Jianping Wang, Naveen Puppala, Shyam Tallury, Jianming Yu

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OBJECTIVE

The objectives of this study were to (1) determine the *FAD2* gene (G) effect on the level of oleic acid, (2) determine the location (E) effect on the level of oleic acid, (3) determine the *FAD2* gene x location (G x E) interaction effect on the level of oleic acid, and (4) elucidate the molecular mechanism of G x E interaction on the level of oleic acid.

MATERIALS AND METHODS

Selection of Germplasm Accessions and Collection of Seeds from Growing Locations

Fifty-two peanut germplasm accessions with varying levels of oleic acid were selected after screening the entire USDA cultivated peanut germplasm collection from the USDA- ARS, Plant Genetic Resources Conservation Unit (PGRCU) in Griffin, GA. Three locations (Citra, FL; Byron, GA; and Clovis, NM) with different environmental conditions were selected as the experimental growing locations. Twenty seeds from each accession were planted in two-row, 10-ft long plots with two replicates in each location for two years (2017 and 2018). Among the 52 accessions, seven were subsequently identified as either morphological mixtures or *FAD2* SNP genotypic mixtures, and thus excluded from further analysis. Seeds from 45 accessions (Table 1) representing three locations and two years were harvested at the physiological maturity stage (observation based on most accessions), dried, and used for fatty acid composition analysis.

Genotype with *FAD2* SNP by Real-Time Polymerase Chain Reaction and Classification into Different Groups

The real-time polymerase chain reaction (PCR) assays for genotyping the *FAD2A* functional mutation (G448A) on the A sub-genome and *FAD2B* functional mutation (one base pair insertion at position 442, or 442A) on the B sub- genome followed previously published methods (Barkley et al., 2010; Barkley et al., 2011). DNA was extracted from fresh plant tissue with the Omega-BioTek kit (Doraville, GA). DNA concentration was quantified on a Nanodrop 2000c (Thermo Fisher Scientific, Norcross, GA), checked on a 1% agarose gel, and subsequently diluted to 10 ng/μL for real-time PCR. All reactions were performed on an Applied Biosystems QuantStudio3™ real-time PCR machine (Thermo Fisher Scientific, Norcross, GA). For targeting the *FAD2A* SNP, PCR primers and fluorescently labeled TaqMan® probes were modified from the original assay. The forward and reverse primers' sequences were 50 CGC CAC CAC TCC AAC ACC 30 and 50 ACC ATG ATA CCT TTG ATT TTG GTT TT 30, respectively. The "448G" SNP probe sequence was 50 6FAM ACT TCG TCG CGG TC MGBNFQ 30, and the "448A" SNP probe was 50 NED ACT TCG TTG CGG TCG MGBNFQ 30. For targeting the *FAD2B* SNP, the forward and reverse PCR primers were 50 GCC GCC ACC ACT CCA AC 30 and 50 TGG TTT CGG GAC AAA CAC TTC 30, and fluorescently labeled TaqMan® probes were 50 6FAM ACA GGT TCC CTC AGA C MGBNFQ 30 for the insertion and 50 VIC ACA GGT TCC CTC GAC MGBNFQ 30 for the wild type. *FAD2A*: A = A/A or G = G/G at 488; *FAD2B*: W = no insertion A or A = insertion A at 442.

Five peanut seeds were crushed together, and oil from a small meal was extracted and converted to fatty acid methyl esters by alkaline transmethylation. The fatty acid composition was determined on an Agilent 7890A G.C. equipped with a flame ionization detector and auto-sampler. Oleic and linoleic acid percentages were determined by calculating the corresponding peak area within the total peak area.

STATISTICAL ANALYSIS

Pearson's coefficient analysis was performed to determine significant correlations among different seed chemical composition traits. An ANOVA was performed on the data, and means were separated using Tukey's multiple comparison procedure (SAS, 2008, Online Doc® 9.2, SAS Institute Inc, Cary, NC, USA).

RESULTS

Among four individual factors (gene, location, accession, and year), the year effect was sig- nificant ($P < 0.01$**) for differences in oleic acid but not for linoleic acid. The results from the other three individual factors (gene, location, and accession) were highly significant ($P < 0.0001$***). Based on F and Pr values, genotype had a larger effect than location, which had a more considerable impact than accession. Significant two-factor interaction effects were also observed. The interaction effects from year (Y) x location (L) and year (Y) x accession (A) were not significant, but the interaction effects from L x G, Y x G, and L x A were highly significant ($P < 0.0001$***). The L x G effect was more significant than the Y x G effect, which was greater than the L x A effect. There were some three-factor interaction effects on the levels of oleic and linoleic acids (either $P < 0.05$* or $P < 0.01$**), but the 2-years results were not consistent (Table 2). Therefore, three-factor interaction effects are not discussed further here.

COMPARISON OF FIELD EMERGENCE AND THERMAL GRADIENT TABLE GERMINATION RATES OF SEED FROM HIGH OLEIC AND LOW OLEIC NEAR-ISOGENIC PEANUT LINES

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OBJECTIVE

To examine the high oleic trait on peanut seed germination in field plots and the laboratory on a thermal gradient table.

MATERIALS AND METHODS

Plant Materials and Field Evaluation. Plant materials included in these studies are listed in Table 1. Each entry's lineage can be found in the registration article of each cultivar or germplasm line except the high-oleic valencia line NM 308-2, low oleic line ARSOK S140-1, and the high oleic runner line 62-15. The NIL pairs were generated by the traditional crossing method to incorporate the high oleic trait, followed by subsequent backcrossing of progeny to the recurrent parent to the BC6 generation while selecting for the high oleic quality. High oleic line 308-2 resulted from a cross between New Mexico Valencia A and the high oleic cultivar Olin. Low oleic line ARSOK S140-1 resulted from a cross between Tamspan 90 and F435 and was determined to be non-high oleic. ARSOKS140-1 was then used as a recurrent parent in the development of OLé. High oleic line 62-15 resulted from a cross between Tifguard and cultivar Florida-07.

The seed of each genotype was increased annually in plots at the Caddo Research location of the Oklahoma Agricultural Experiment Station located near Ft. Cobb, Oklahoma, and distributed to cooperating sites for planting in replicated field trials. Each year, before planting and after harvesting, seed from each plot was tested for oleic acid content at the USDA ARS Market Quality and Handling Research Unit in Raleigh, NC, to ensure purity (high oleic or low oleic). The oil quality of all seeds was as expected at the time of planting and harvest (data not shown). At each location, a randomized complete block (RCB) design with three replications was used to plant twin-row plots using twin rows 4.6 x 0.9 m, seeded at a rate of 15 seeds/row meter. Stand counts (indicating field emergence) were taken at 7, 14, 21, and 28 days after planting (DAP) to determine the germination rate. Spanish and valencia plots were harvested at 120 DAP. Virginia and runner plots were harvested at 145 DAP. Peanuts were placed in a forced-air dryer until moisture reached 10 percent. Percent total sound mature kernels (%TSMK or grade) were determined on a 200 g sample from each plot, and the estimated yield in kg ha-1 was calculated. Seed from each annual harvest was then sent to the University of Georgia for thermogradient table germination and vigor testing.

Statistical analysis for field data was performed. Repeated measures analysis of variance was used to assess the factors (variety, H.O., DAP) on the germination percentage using PROC MIXED [28]. The response variable was transformed using an arcsine square root transformation to alleviate normality and heterogeneity of variance. DAP was considered the repeated factor, and simple effect tests of H.O. given variety and DAP were assessed with planned contrasts. Means and standard errors were reported, but none were significant at a 95% confidence level.

Table 1. Near-isogenic genotype pairs for each peanut market type used in these studies.

Genotype	Oil [1]	Market Type	Original Source
Tifguard	LO	Runner	[26]
62-15	H.O.	Runner	C.C. Holbrook
ARSOK S140-1	LO	Spanish	K. Chamberlin
OLé	HO	Spanish	K. Chamberlin
Bailey	LO	Virginia	T. Isleib
Bailey II	HO	Virginia	T. Isleib
NM Valencia A	LO	Valencia	D. His
NM 308-2	HO	Valencia	N. Puppala

RESULTS

Average germination across all temperatures (12 to 36 ºC) varied by peanut type and cultivar each year. Seed germination across all peanut types and temperatures was 71.1%. ANOVA indicated significant differences in germination by each state for all cultivars, except for GA in 2017. With respect to peanut type, valencia parent NM Val A consistently had the most significant germination across states and years. In contrast, Virginia type HO Bailey II always had the lowest germination across states and years. Runner and Spanish peanut seed germination rates were between Valencia and Virginia types across locations and years, with parents' trend always having higher germination than the near-isogenic H.O. lines. Field studies have previously noted the difference in emergence for peanut types as runner > Virginia.

Thermal gradient table experimental results demonstrated a lag in germination in high oleic genotypes compared to normal oleic counterparts in all market-types. Still, the effect was lowest in the runner-type pair. These experiments will increase the understanding of the agronomic properties of high-oleic peanut cultivars and could influence the modification of standard protocols used by state agencies to test high-oleic peanut germination for registered seed quality labeling.

PERFORMANCE OF COTTON VARIETIES

Investigators: N. Puppala, M. Ojha and A. Scott

OBJECTIVE

To evaluate twelve commercial cotton varieties suitable for eastern New Mexico.

MATERIALS AND METHODS

The cotton variety trial was planted on April 30, 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. The number of entries that were evaluated in 2020 was twelve (Four varieties from Phytogen, and eight varieties from BASF seed company). 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.

Fertilizer applied was 56-35-0-8 N:P: K + Sulphur at the rate of 30 gallons per acre on April 21. On April 23, the planting area was treated with herbicides Caprol (1.6 pt/ac) and Prowl H2O (3 pt/ac) as pre-emergence applications. After planting on June 8, 2020, herbicides Warrant (3.2 Q/ac) and Volunteer (14 Oz/ac) were sprayed and irrigated. An insecticide Acephate 90S (4 Oz/ac), was applied on June 8, for control of thrips. Leverage (3 Oz/ac) was applied on June 25 and Prevathon @ 20 Oz/ac was applied on July 25. Growth regulators applied were, Pix (10 Oz/ac) on June 25 along with Stanz (2 Oz/ac). The stance was again applied (3 Oz/ac) on July 7 and on July 14 (4 Oz/ac) Defoliants Superboll (1 Q/ac) and Folez 6 (1 pt/ac) was sprayed on October 12.

The total irrigation amount was 13.7 inches applied over the growing period. Precipitation received during the growing period was 6.2 inches. The plots were harvested on November 12, 2020, with a cotton stripper. Individual plot weights were recorded. For fiber quality, each 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. USDA loan calculator was used for estimating loan value and estimated net return $ per acre.

RESULTS AND DISCUSSION

Yield data and quality traits for the 2020 cotton trial are presented in Table 1, lint yield for the 12 varieties in the trial, ranging from 980 to 1479 lb/ac with a trial average of 1278 lbs/acre. The estimated net return was $ 747 for DP 2020 B3XF, followed by $ 742 for PHY 2E053FE. The average net return was $ 646.

Table. 1. New Mexico 2020 Cotton Variety Performance Test - Agricultural Science.

Company Name	Variety Name	Seed cotton lbs/a	Lint yield lbs/a	Bales per a	Lint %	Boll wt g	L	Uni.	SFI	Str	Elon	MIC	Mat	Loan Value cents/lb.	Est net ret. $/a	Rank
Phytogen	PHY 210 W3FE	3032	1226	2.6	40.6	5.33	1.15	84.1	7.15	29.9	6.70	4.13	81.3	57.4	619	8
Phytogen	PHY 250 S3FE	2856	1157	2.4	40.5	4.95	1.15	84.3	7.73	28.7	6.88	4.15	81.3	57.3	584	10
Phytogen	PHY 2C14 W3FE	3522	1398	2.9	39.7	4.73	1.12	84.5	7.48	31.5	8.75	4.25	80.0	57.0	699	4
Phytogen	**PHY 2E05 W3FE**	**3465**	**1469**	**3.1**	**42.4**	**5.23**	**1.12**	**84.5**	**6.73**	**31.9**	**7.68**	**4.65**	**82.0**	**57.0**	**742**	**2**
BASF	FM 1830 GLT	2936	1228	3.1	41.8	4.65	1.22	85.2	7.18	28.9	7.20	3.98	80.8	57.9	630	7
BASF	**FM 2334 GLT**	**3359**	**1394**	**2.6**	**41.5**	**4.78**	**1.21**	**84.7**	**7.20**	**28.6**	**6.80**	**3.93**	**80.8**	**57.8**	**712**	**3**
BASF	DP 1646 B2XF	2563	1105	2.9	43.1	4.90	1.19	83.9	7.95	28.3	9.73	4.00	78.5	57.6	567	11
BASF	DP 1845 B3XF	3183	1253	2.3	39.4	5.00	1.22	83.4	7.85	29.2	9.90	3.30	76.8	55.5	605	9
BASF	**DP 2020 B3XF**	**3708**	**1479**	**3.1**	**39.9**	**4.85**	**1.19**	**84.6**	**7.23**	**28.2**	**7.18**	**3.70**	**79.8**	**57.5**	**747**	**1**
BASF	DP 2055 B3 XF	2409	980	2.0	40.7	4.68	1.20	84.3	7.70	28.4	8.53	3.53	78.5	57.1	495	12
BASF	BX 21410 GLTP	3261	1346	2.8	41.3	4.78	1.20	85.9	6.28	31.2	7.28	4.10	80.8	58.0	691	5
BASF	BX 2116 GLTP	3352	1302	2.8	38.9	4.83	1.17	84.8	7.43	28.4	7.30	3.90	80.3	57.7	657	6
	Trial Mean	**3137**	**1278**	**2.7**	**40.8**	**4.89**	**1.18**	**84.5**	**7.33**	**29.4**	**7.83**	**3.97**	**80.1**	**57.3**	**646**	
	CV	11.9	11.8	11.9	2.34	12.5	1.48	1.08	7.89	3.76	9.07	6.19	1.96	0.999	4.13	
	Pr>F	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
	LSD0.05	536.03	217.4	0.46	1.38	0.88	0.025	1.31	0.83	1.59	1.02	0.35	1.38	1.19	0.43	
	Pr>F	0.0004	0.001	0.0012	<0.0001	0.9107	<0.0001	0.0836	0.0117	0.0001	<0.0001	<0.0001	<0.0001	0.1148	<0.0001	

PROVIDING THE NEXT GENERATION WITH DAIRY EDUCATIONAL OPPORTUNITIES: THE U.S. DAIRY EDUCATION & TRAINING CONSORTIUM

Investigators: Robert Hagevoort

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 into 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 position, 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, expansion opportunities 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 to provide the next generation of dairy owners and managers with excellent educational opportunities.

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Industry and non-government organizations

1. Curtis and Curtis Seeds, Clovis NM
2. Quivera Coalition, Santa Fe NM
3. New Mexico Peanut Research Board
4. National Peanut Research Board
5. Daniel Liptzin, Soil Health Institute

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