
AGRICULTURAL SCIENCE CENTER AT ARTESIA
NM
STATE

Notice to Users of This Report

This report has been prepared by Science Center staff to document the results of the various research projects from the past year and to record data for future reference. These are not formal Agricultural Experiment Station Report research results, and the reader is cautioned against drawing conclusions or making recommendations as a result of data in this report. In many instances, data represents only one of several years' results that will constitute the final formal report. Although staff members have made every effort to check the accuracy of the data presented, this report was not prepared as a formal release. None of the data is authorized for release or publication, without the written prior approval of the NMSU Agricultural Experiment Station.

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Conversion Table for English and Metric (SI) Units

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

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

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

Station Personel

Dr. Robert Flynn
Superintendent, Agronomist

Dr. Jane Pierce
Entomologist

Stephanie Tilton
Administrative Assistant, Associate

Patricia Monk
Research Assistant

Ruben Pacheco
Research Assistant

Martin Lopez
Farm Ranch Supervisor

Christopher Hill
Laborer, SR.

Southeastern New Mexico Agricultural Research Association

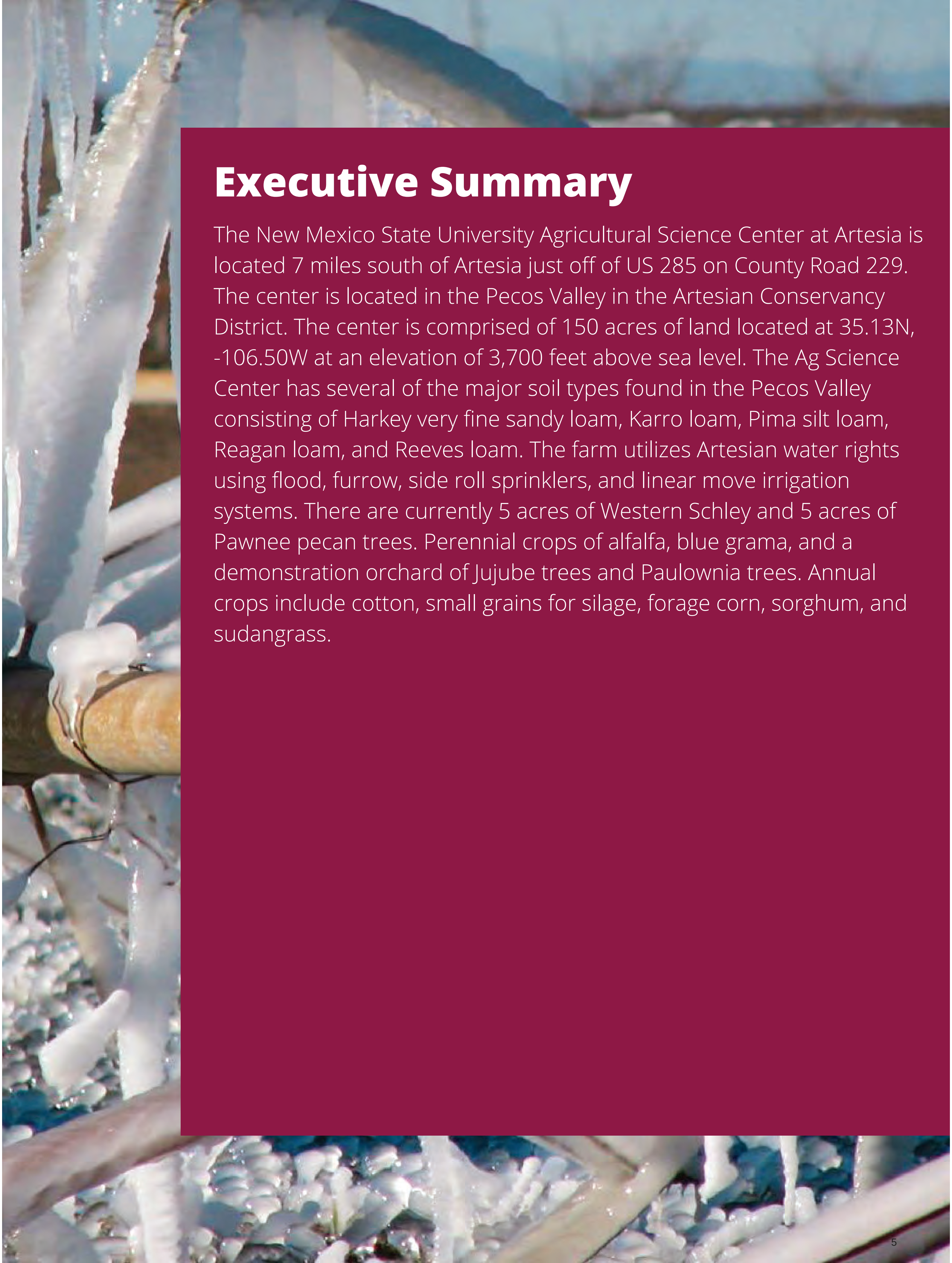
Chaves County	Eddy County	Lea County
Troy Thompson	David Torres	Wade Cavitt
Travis Gray	James Walterscheid, Vice Chair	John Norris
Doug Whitney	Alisa Ogden	Todd Roberson, Chairman

Extension Agents

Sandra Barraza/Troy Thompson	Woods Houghton	Wayne Cox

2020 HOWARD STROUP SCHOLARSHIP RECIPIENT

Cole Kincaid
Artesia High School
Major in Agriculture Education



Executive Summary

The New Mexico State University Agricultural Science Center at Artesia is located 7 miles south of Artesia just off of US 285 on County Road 229. The center is located in the Pecos Valley in the Artesian Conservancy District. The center is comprised of 150 acres of land located at 35.13N, -106.50W at an elevation of 3,700 feet above sea level. The Ag Science Center has several of the major soil types found in the Pecos Valley consisting of Harkey very fine sandy loam, Karro loam, Pima silt loam, Reagan loam, and Reeves loam. The farm utilizes Artesian water rights using flood, furrow, side roll sprinklers, and linear move irrigation systems. There are currently 5 acres of Western Schley and 5 acres of Pawnee pecan trees. Perennial crops of alfalfa, blue grama, and a demonstration orchard of Jujube trees and Paulownia trees. Annual crops include cotton, small grains for silage, forage corn, sorghum, and sudangrass.

History of Research

Founded in 1955 with a focus on the needs and interests of the Pecos River Valley, over the past twenty years the ASC at Artesia has expanded the scope of their research.

Entomology

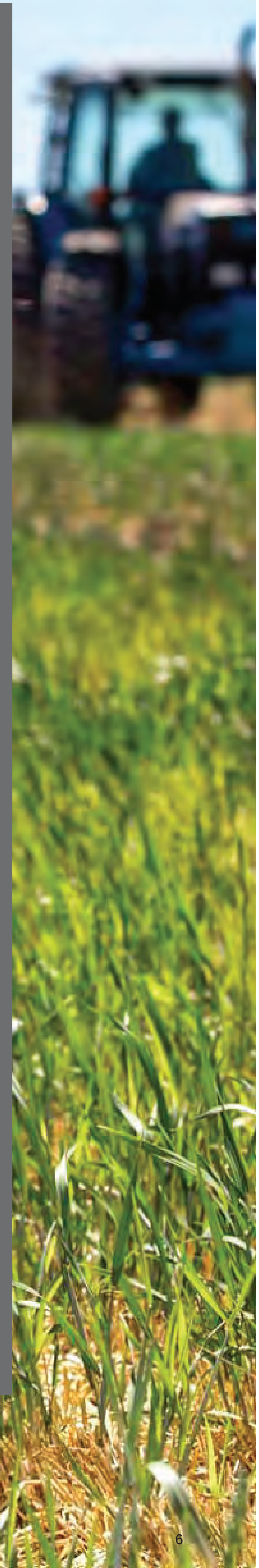
Years ago the emphasis in cotton entomology was on boll weevil and pink bollworm. These two pests have been successfully eradicated. In the past five years, growers have found it difficult to control thrips, fleahoppers, and cotton bollworm in Bt cotton. In response, ASC Artesia has evaluated resistance to seed treatments, representing a $2.7 million impact. Research and extension efforts concentrate on cotton, alfalfa, pecan and sorghum, or wherever there may be a need. One example of research determined that over 60% of kissing bugs are infected with the pathogen that causes Chagas disease.

High-Value Crops

Pecans: Increased acreage in SE New Mexico prompted research to reduce insecticide applications on pecan nut casebearer with biological control by predators. Ghost spiders were identified in 2012 and 2014 as a key predator controlling up to 73% of insect pests in pecan orchards. Control of pecan nut casebearer could save growers $2.7 million per year. A new proposal will address enhancing pecan weevil suppression with ghost spiders and birds.

Environmental Stewardship

Water treatment costs after contamination approach $43 million per year for a typical 2000 head dairy. To avoid groundwater contamination, an NMSU Nutrient Management workbook was developed using data collected at NM dairies. Land application rates and methods are outlined to prevent groundwater exceeding 10 ppm nitrate.



Mission

The Agricultural Science Center at Artesia (ASC-Artesia) faculty conduct research and extension programs in soil, water, crop and entomological sciences to enhance the agricultural, economic, environmental, and social well-being of southeastern New Mexico.

Our faculty collaborate in local, regional, national, and international research and extension efforts, and are often asked to bring their expertise to colleagues and clientele across the U.S. and in foreign countries. It is our goal to be the premier off-campus center for novel research and extension programming in integrated pest management, water management, soil health, soil fertility and remediation, and the evaluation of new crop genetic material.

Agricultural Science Center at Artesia

The Agricultural Science Center at Artesia focuses on agricultural research to meet the needs of southeastern New Mexico. Ongoing research includes insect pest management, crop performance evaluations, cotton genetic resistance to Fusarium wilt, energy crop production with produced water, and dairy nitrogen waste management to protect groundwater resources.

Founded in 1955 with a focus on the needs and interests of the Pecos RiverValley, over the past twenty years the ASC at Artesia has expanded the scope of their research.

This research impacts the agricultural industry which is critical for the state economy. Southeastern New Mexico is home to many high-value and drought-tolerant crops. Projects at the ASC focus on reducing damage from pests and managing water and soils to increase quality and yields for these crops. Research to decrease pests in cotton and pecan nuts save growers over $5 million per year.

Agricultural Experiment Station

What Is the Agricultural Experiment Station?

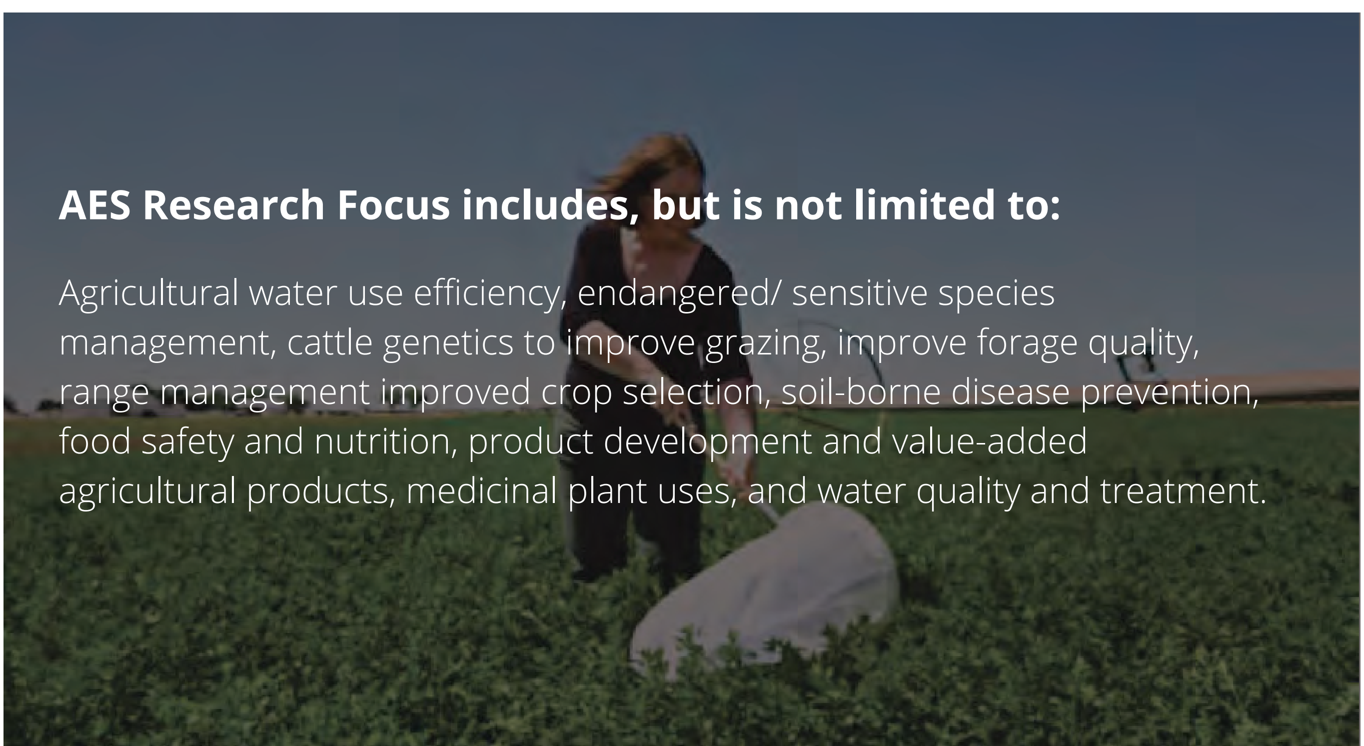
NMSU's Agricultural Experiment Station is the principal research unit of the College of Agricultural, Consumer and Environmental Sciences. All research faculty in the college have appointments in the Agricultural Experiment Station.

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:

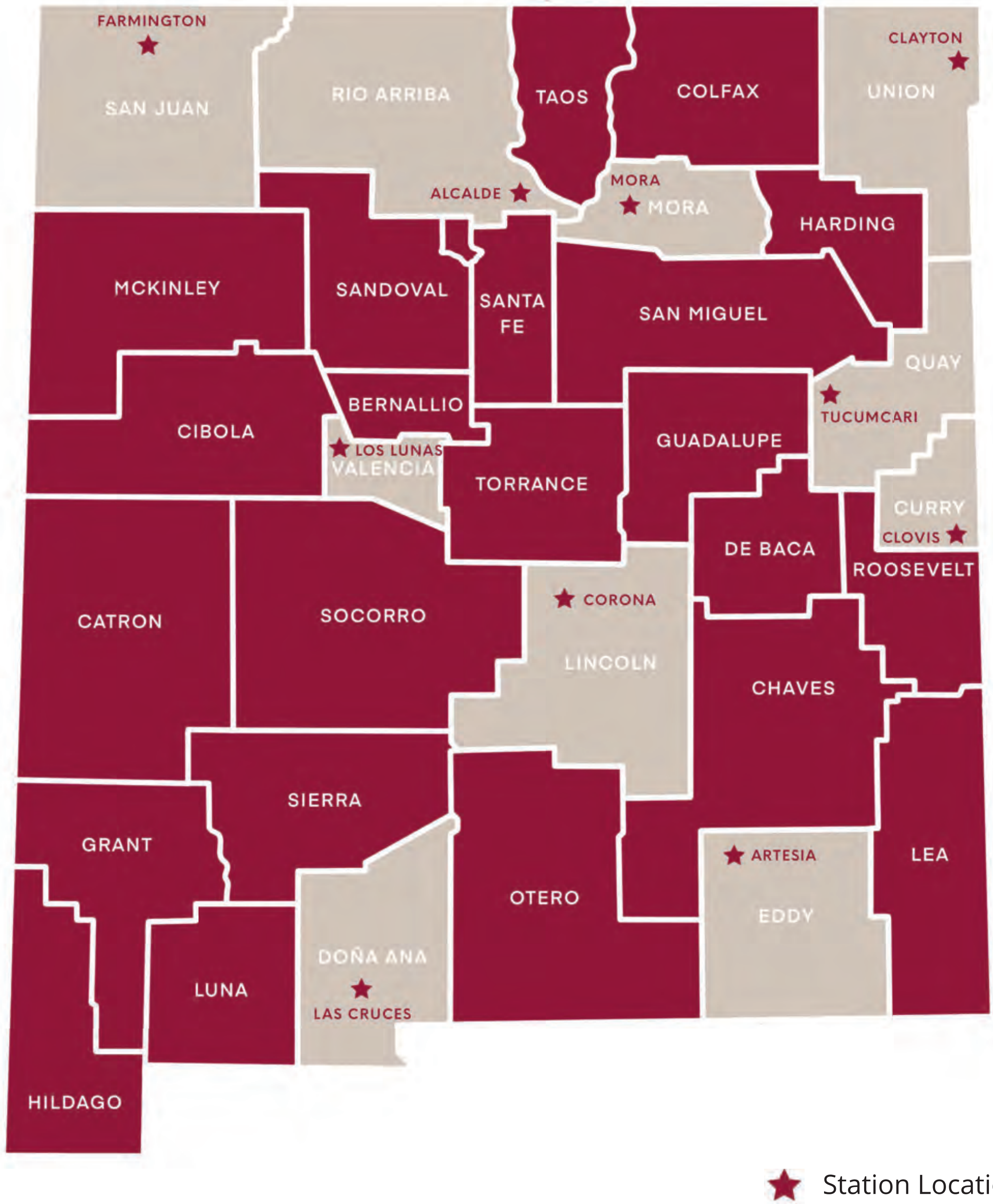
- Enhance agricultural profitability.
- Stimulate economic development using natural resources.
- Improve the quality, safety and reliability of food and fiber products.
- Sustain and protect the environment with ecologically sound practices.
- Manage and protect natural resources.
- Improve the quality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

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 Artesia	COMPARING POTENTIAL RESISTANCE TO S	COMPARE POTENTIAL RESISTANCE SEED		$6,000.00	$0.00	$6,000.00	
Ag Science Ctr at Artesia	EVALUATING INSECT PEST MANAGEMENT T	EVAL INSECT PEST MGT TOOLS-RE 1		$19,000.00	$2,726.69	$16,273.31	$0.00
		Total Restricted Funds		**$25,000.00**	**$2,726.69**	**$22,273.31**	
Ag Science Ctr at Artesia	APPLIED CHARGES	ASC ARTESIA VEHICLE	$0.00	($1,500.00)	$3,558.74	($5,058.74)	($6,175.56)
Ag Science Ctr at Artesia	OTHER SOURCES	ASC-ARTESIA LAND USE BY CEHMM	$30,839.82	$12,839.82	$31,167.31	($18,327.49)	($51,933.41)
Ag Science Ctr at Artesia	OVERHEAD TRANSFERS	INDIRECT COST RECOVERY-ARTESIA	$0.00	$2,000.00	$1,271.00	$729.00	($721.27)
Ag Science Ctr at Artesia	SALES & SERVICE	ARTESIA ASC SALES	$28,109.52	$2,000.00	$39,901.53	($37,901.53)	($26,391.44)
		Total Sales and Service Funds	**$58,949.34**	**$15,339.82**	**$75,898.58**	**($60,558.76)**	**($85,221.68)**
							* See note
Ag Science Ctr at Artesia	STATE APPROPRIATIONS	ASC ARTESIA SALARY		$363,760.58	$371,906.19	($8,145.61)	
Ag Science Ctr at Artesia	STATE APPROPRIATIONS	ARTESIA ADMIN		$85,086.00	$82,543.18	$2,542.82	
Ag Science Ctr at Artesia	STATE APPROPRIATIONS	NUTRIENT MGMT SOIL		$4,777.00	$6,020.88	($1,243.88)	
Ag Science Ctr at Artesia	STATE APPROPRIATIONS	OPTIMIZING INSECT PEST MANAGEMENT		$4,789.00	$4,809.64	($20.64)	
Ag Science Ctr at Artesia	STATE APPROPRIATIONS	AES GRADUATE RESEARCH AWARD		$20,000.04	$20,913.03	($912.99)	
Ag Science Ctr at Artesia	STATE APPROPRIATIONS	ARTESIA AGRICULTURAL EXPERIMENT STA		$50,000.00	$6,499.18	$43,500.82	
Ag Science Ctr at Artesia	STATE APPROPRIATIONS	EDDY COUNTY AGRICULT EXPERIMENT STA		$50,000.00	$0.00	$50,000.00	
		Total State Appropirated Funds		**$578,412.62**	**$492,692.10**	**$85,720.52**	

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

INTRODUCTION TO THE 2020 NEW MEXICO ALFALFA VARIETY TEST REPORTS

Investigators: Leonard Lauriault, Ian Ray, Chris Pierce, Owen Burney, Koffi Djaman, Robert Flynn, Mark Marsalis, Samuel Allen, Gasper Martinez, Charles Havlik, and Margaret West1

INTRODUCTION

Besides its value for hay, alfalfa also is the legume of choice in irrigated perennial pastures. Whether used as pasture or hay, the value of alfalfa to New Mexico is greatly magnified by its contribution to live-stock production and receipts from the sale of meat, milk, and other products generated by livestock enterprises.

Choosing a good alfalfa variety is a key step in establishing a highly productive stand of alfalfa, whether for hay or pasture. Differences between the highest and lowest-yielding varieties in established irrigated tests included in this report ranged from 0.99 to 2.41 tons per acre in 2019. If sold as hay, this translates to a potential difference in returns of $213 to $518 per acre due to variety, or an increase of at least $38 million for the industry in 2019 alone.

This report, which is a collaborative effort of New Mexico State University scientists at agricultural science centers throughout the state, provides yield data for alfalfa varieties included in yield trials in New Mexico. While consistently high yields compared to other varieties over several years and locations within a region is the best indication of varietal adaptation and persistence, other factors should be considered in the variety selection process (see NMSU's Cooperative Extension Service Circular 654, Selecting alfalfa varieties for New Mexico). In addition to fall dormancy and winter hardiness, high levels of pest resistance are critical to protecting an alfalfa stand for long-term production. Alfalfa grown in New Mexico should have at least a resistant (R) rating for bacterial wilt, Fusarium wilt, anthracnose, Phytophthora root rot, spotted alfalfa aphid, blue alfalfa aphid, pea aphid, stem nematode, and southern root knot (Meloidogyne spp.). Seed quality also should be high. Selecting an alfalfa variety based on seed cost is a gamble producers often lose. To be assured of achieving a long-lasting, highly productive stand, buy certified or Plant Variety Protected (PVP) seed, which guarantees genetics and performance. The best choice of seed of any variety is one that was treated with a fungicide and nitrogen-fixing bacteria before it was bagged.

DESCRIPTION OF TESTS

Replicated alfalfa variety tests included in this report were conducted under research controls at NMSU's Agricultural Science Centers at Artesia [2016 (late summer planted) and 2018 (spring-planted)], Tucumcari (2015 irrigated with treated municipal wastewater), Los Lunas (2016), and Farmington (2014). Weather data for 2018 and the long-term averages from all locations are presented in table 1.

Yield data (on a dry matter basis) are presented in tables 2-6. Varieties are listed in order from highest to lowest average annual production. Yields are given by cutting for 2018 and by year for each production year. Statistical analyses were performed on all alfalfa yield data (including experimental entries) to determine if the apparent differences are truly due to variety or just to chance. The variety with the highest numerical yield in each column is marked with two asterisks (**), and those varieties not significantly different from that variety are marked with one asterisk (*). Those are the varieties from which to make an initial selection. Otherwise, to determine if two varieties are truly different, compare the difference between the two varieties to the Least Significant Difference (LSD) at the bottom of the column. If the difference is equal to or greater than the LSD, the varieties are truly different in yield when grown under the conditions at a given location. If NS is given for the LSD, there was no statistical difference between the highest and lowest yielding varieties. The Coefficient of Variation (CV), which is a measure of the variability of the data, is included for each column of means. Low variability (<20 per-cent) is desirable, and increased variability within a study results in higher CVs and larger LSDs. There might be a difference between previously published data and the data given in this publication for the same tests because of differences in the programs used for statistical analysis.

Roundup Ready genetics, fall dormancy, winter survival (measured in the northern United States), pest resistance, and yield performance across years and locations for all varieties currently included in NMSU's alfalfa variety testing program. For information about other varietal characteristics, such as grazing, salt, or traffic tolerance, or GMO traits besides Roundup Ready® genetics, check the National Alfalfa and Forage Alliance website for the Alfalfa Variety Leaflet (https://www.alfalfa.org/varietyLeaflet.php). Varieties are listed alphabetically by the fall dormancy category. As in the data tables, the variety with the highest numerical yield in each column is marked with two asterisks (**), and those varieties not significantly different from that variety are marked with one asterisk (*). Remember good performance across several years and locations is the best indicator of broad adaptation, pest resistance, and persistence.

Seed labeled "common," "variety not stated," or "variety unknown", particularly that from other states, is of unknown genetic background and may or may not have the necessary disease or insect resistance. New Mexico Common and African Common seed used in all tests throughout the state has come from the same supplier and seed fields in New Mexico. Seed purchased from other dealers may or may not be of the same quality and performance.

SUMMARY

Consistent production of high alfalfa yields is the result of selecting good varieties and implementing good management techniques. Soil fertility should be maintained at recommended levels based on soil tests, irrigation should be properly applied, weeds and insects should be controlled using appropriate cultural and/or chemical methods, and harvest management should allow sufficient time to restock root energy before winter. For dormant (FD 1 to 3) and semi-dormant (FD 4 to 6) varieties, a 6-week rest period before a dormancy-inducing freeze (27°F) is recommended to allow plants to replenish root reserves for winter survival and initiate spring growth, after which harvesting might be done either mechanically or by grazing. Non-dormant (FD 7 to 9) varieties also might benefit from this rest period. Removing fall growth is beneficial to reducing weevil populations the following year as eggs are laid in and overwinter in stems. Harvesting established stands at early bloom would result in 3 to 5 cuttings per year before initiation of the rest period in most areas of New Mexico. More dormant varieties might not produce yields that can be baled during the rest period; however, these can still be grazed.

ASC ARTESIA ALFALFA RESULTS

Table 4. Dry matter yields (tons/acre) of sprinkler-irrigated alfalfa varieties sown September 16, 2016, at NMSU's Agricultural Science Center at Artesia†.

Variety Name	2017 Total	2018 Total	2019 Total	2020 Harvests 14-May	25-Jun	10-Aug	24-Sep	2020 Total	4-Year Average
SW7408	9.41**	8.28*	7.11*	1.42*	1.25*	2.18**	1.04*	5.96**	7.79**
African Commn	8.05*	8.45**	7.16**	1.35*	1.19*	1.97*	1.22*	5.71*	7.58*
NuMex Bill Melton	9.16*	8.22*	6.79*	1.45*	1.18*	2.11*	1.14*	5.70*	7.46*
SW8412	8.09*	8.20*	6.87*	1.44*	1.22*	1.79*	1.26**	5.89*	7.37*
HybriForce-3600	8.67*	8.42*	6.49*	1.47**	1.19*	1.78*	1.10*	5.53*	7.34*
SW8476	8.29*	7.96*	6.25*	1.47**	1.13*	1.96*	1.08*	5.82*	7.14*
Zia	7.64*	7.77*	6.76*	1.30*	1.34**	2.00*	1.24*	5.89*	7.06
SW7473	7.78*	7.64*	6.82*	1.34*	1.14*	1.64*	1.09*	5.45*	6.91
SW8409	8.08*	7.75*	6.58*	1.36*	1.17*	1.74*	1.08*	5.67*	6.87
New Mexico 11-1	7.63*	7.98*	6.73*	1.27*	1.26*	1.99*	1.10*	5.90*	6.86
MS sunstra 155204	7.99*	8.06*	6.24*	1.46*	1.15*	1.57*	1.03*	5.40*	6.84
NM Common	7.36*	7.71*	6.36*	1.31*	1.21*	1.82*	1.14*	5.46*	6.75
55VR08	7.78*	7.70*	5.58*	1.38*	1.16*	1.82*	1.00*	5.44*	6.61
Dona Ana	7.82*	6.67*	5.68*	1.34*	1.11*	1.69*	1.20*	5.54*	6.33
Mean	8.13	7.92	6.53	1.38	1.19	1.86	1.12	5.66	7.07
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	0.68
CV%	10.50	9.93	12.58	10.64	10.22	15.05	11.67	9.92	13.42

†Data were analyzed using analysis of covariance where check plots of AmeriStand 803T were used as the covariate.
2017 Harvest dates: 16-May, 22-Jun, 21-Jul, 24-Aug, and 16-Oct.
2018 Harvest dates: 8-May, 6-Jun, 3-Jul, 6-Aug, and 17-Sep. No 6th harvest was taken due to excessive precipitation.
2019 Harvest dates: 8-May, 17-Jun, 26-Jul, 12-Sep, and 23-Oct.
**Highest numerical value in the column.
*Not significantly different from the highest numerical value in the column based on the 5% LSD.
NS means that there were no significant differences between the varieties within that column at the 5% level.

ALFALFA STUDIES IN YIELD

Investigators: M.A. Marsalis1, R.P. Flynn2, L.M. Lauriault 3, A. Mesbah4, and K. Djaman5

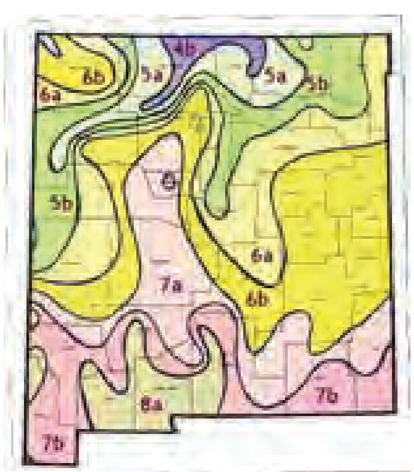
INTRODUCTION

Performance tests for grain corn, grain sorghum, forage corn, forage sorghum, and sorghum sudangrass were conducted at the Agricultural Science Centers at Artesia, Clovis, Farmington, and Tucumcari New Mexico in 2019 (Figure 1). This report contains information from all Agricultural Science Center corn and sorghum tests; however, it is possible that not all locations contain every test listed above.

The New Mexico corn and sorghum performance testing program is part of an ongoing program to provide farmers, extension workers, and seed industry personnel with reliable, unbiased, information that will allow a valid comparison of corn and sorghum varieties/hybrids at various locations throughout the state. The state of New Mexico encompasses eight climate zones, all of which have some form of agricultural production (Figure 2). Variability in climate, soils, water, and local production practices contribute to the need for crop performance tests throughout the state. Growers who use this report to make cropping decisions should rely primarily on results from tests near their location or in comparable climate zones.

Figure 1. Corn and sorghum testing locations

Figure 2. Climate zones In New Mexico



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				14-May	25-Jun	10-Aug	24-Sep		
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HybriForce-3600	8.67*	8.42*	6.49*	1.47**	1.19*	1.78*	1.10*	5.53*	7.34*
SW8476	8.29*	7.96*	6.25*	1.47**	1.13*	1.96*	1.08*	5.82*	7.14*
Zia	7.64*	7.77*	6.76*	1.30*	1.34**	2.00*	1.24*	5.89*	7.06
SW7473	7.78*	7.64*	6.82*	1.34*	1.14*	1.64*	1.09*	5.45*	6.91
SW8409	8.08*	7.75*	6.58*	1.36*	1.17*	1.74*	1.08*	5.67*	6.87
New Mexico 11-1	7.63*	7.98*	6.73*	1.27*	1.26*	1.99*	1.10*	5.90*	6.86
MS sunstra 155204	7.99*	8.06*	6.24*	1.46*	1.15*	1.57*	1.03*	5.40*	6.84
NM Common	7.36*	7.71*	6.36*	1.31*	1.21*	1.82*	1.14*	5.46*	6.75
55VR08	7.78*	7.70*	5.58*	1.38*	1.16*	1.82*	1.00*	5.44*	6.61
Dona Ana	7.82*	6.67*	5.68*	1.34*	1.11*	1.69*	1.20*	5.54*	6.33
Mean	8.13	7.92	6.53	1.38	1.19	1.86	1.12	5.66	7.07
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	0.68
CV%	10.50	9.93	12.58	10.64	10.22	15.05	11.67	9.92	13.42

†Data were analyzed using analysis of covariance where check plots of AmeriStand 803T were used as the covariate.
2017 Harvest dates: 16-May, 22-Jun, 21-Jul, 24-Aug, and 16-Oct.
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**Highest numerical value in the column.
*Not significantly different from the highest numerical value in the column based on the 5% LSD.
NS means that there were no significant differences between the varieties within that column at the 5% level.

CORN, SORGHUM, AND SOGHUM-SUDAN

The New Mexico corn and sorghum performance testing program is supported by paid fees from the cooperating companies. Personnel at each location determine which tests will be conducted at their site and seed companies are invited to participate in those tests. Because seed company participation in individual tests and locations is voluntary, many of the hybrids/varieties that are grown in the state are not included in the tests, and different groups of hybrids/varieties are evaluated at the different locations.

TEST PROCEDURES

To provide readers with easily accessible information, procedural data for individual tests are presented in the 'Test Description' tables that immediately precede the summary tables of results for the tests. The 'Test Description' tables contain information on location, test design, management practices, and growing conditions.

Test description tables are designated with an 'A' suffix.

All of the Agricultural Science Center performance tests were replicated randomized complete block designs (RBD). Where appropriate, statistical analyses were used to calculate measures of least significant difference (LSD), coefficient of variation (CV), and F test values. All LSD's are reported at the 95% probability level. If the F test value is greater than 0.05 the LSD is not used. When the F test value is less than 0.05, it is appropriate to use the LSD value as a measure of the magnitude by which one entry must differ from another to be considered significantly different. The CV is a measure of variability relative to the mean. A CV below 10 generally indicates reliable data or methodology. CVs of 10 to 20 are indicators of normal variability for grain and forage tests.

Yields for the grain tests are presented on a bushel-per-acre or pound-per-acre basis, adjusted to a standard moisture content and bushel weight. Corn yields are calculated at standard moisture of 15.5% and a bushel weight of 56 lb. Grain sorghum yields are calculated at standard moisture of 14% and a bushel weight of 56 lb.

Dry and green (fresh) forage yields reported for the forage tests are in tons per acre. Moisture at harvest was calculated from a representative sample (approximately 1 lb.) from harvested plots. Samples from variety tests at the Agricultural Science Centers were dried in a forced-air oven (125-150°F) for the determination of moisture content. Subsamples of the dried material from all locations were submitted to an NFTA-certified forage testing laboratory for nutrient composition analysis using near-infrared reflectance spectroscopy (NIRS). For these trials, milk production estimates were calculated using the University of Wisconsin Milk2000 and Milk2006 spreadsheet programs.

NEW MEXICO 2020 FORAGE SORGHUM PERFORMANCE TEST- AGRICULTURAL SCIENCE CENTER AT ARTESIA

Statistical Yield and Quality Not Available as of 1/15/2020

Forage Production Practices

Trial Description: Forage Sorghum Variety Trial.
2020 Planting at ASC-Artesia

Location:	
unty/Area:	Eddy
Longitude:	104 22 87W
Latitude:	32 45 203N
Elevation:	3356 ft
Soil Name:	Reagan
il Texture:	loam
Soil Depth:	32in
Test Design:	
eplication:	4
ot Lengths:	20
s per Plot:	4
w Spacing:	40in
Bench are	2.5

Management Practices:					
Previous Crop:	alfalfa				
Planting Rate:	50000				
Planting date:	6/1/2020				
Harvest Date:	10/1/2020				
Production Inputs			lbs/a		
Fertilizer:	Date	Rate	N	P	K
46-0-0	6/8/2020	120lbs/a	55.2		
11-52-0	6/8/2020	120lbs/a	13.2	62.4	
	Date	Rates			
Herbicides:					
Huskie	6/15/2020	16oz/a			

Growing Conditions:	Average Temp °F	Precip. in.	Irrigation arce in.
January	42.6	0.39	
February	42.9	0.56	
March	55.7	2.95	
April	61.1	0.04	
May	72.8		13.20
June	80.0	0.28	15.59
July	85.1	0.6	9.48
August	82.9	1.24	11.72
September	70.2	0.02	4.93
October	60.0	0.05	
November			
December			

Seasonal Precipitation:	6.13 in
Total Irrigtion:	61.0516 in
per acre	22.6 in
Date of Last Spring Frost:	4/13/2020
e of First Fall Frost or harvested:	10/27/2020
Frost Free Period:	197 days

Trial Description: Corn Variety Trial.
2020 Planting at ASC-Artesia

Location:	
County/Area:	Eddy
Longitude:	104 22 87W
Latitude:	32 45 203N
Elevation:	3356 ft
Soil Name:	Reagan
Soil Texture:	loam
Soil Depth:	32in
Bench 10	
Test Design:	
Replication:	4
Plot Lengths:	20
Rows per Plot:	2
Row Spacing:	40in
Bench area (acres)	2.5

Management Practices:					
Previous Crop:	alfalfa				
Planting Rate:	32000				
Planting date:	5/13/2020				
Harvest Date:	8/25/2020				
Production Inputs				lbs/a	
Fertilizer:	Date	Rate	N	P	K
11-52-0	5/29/2020	120lbs/a	13.2	62.4	
46-0-0	5/29/2020	165lbs/a	75.9		
46-0-0	7/9/2020	165lbs/a	75.9		
	Date	Rates			
Herbicides:					
rifle	6/5/2020	1pt/a			

Growing Conditions:	Average Temp °F	Precip. in.	Irrigation acre in.	
January	43	0.39		
February	42.9	0.56		
March	55.7	2.95		
April	61.1	0.04		
May	72.8	0	8.35	5.8
June	80	0.28	6.17	7.3
July	85.1	0.6	7.71	14.9
August	82.9	1.24		
September	70.2	0.02		
October	60	0.05		
November				
December				

Seasonal Precipitation:	2.12 in
Total Irrigation:	50.28 in
Date of Last Spring Frost:	4/13/2020
Date of First Fall Frost or harvested:	10/27/2020
Frost Free Period:	197 days

Trial Description: Sorghum Sudan Variety Trial.
2020 Planting at ASC-Artesia

Location:	
County/Area:	Eddy
Longitude:	104 22 87W
Latitude:	32 45 203N
Elevation:	3356 ft
Soil Name:	Reagan
Soil Texture:	loam
Soil Depth:	32in
Test Design:	
Replication:	4
Plot Lengths:	20
Rows per Plot:	2
Row Spacing:	40in
Bench area (acres)	2.5
Bench 16	Furrow Irrigation

Management Practices:					
Previous Crop:	oats				
Planting Rate:	50000				
Planting date:	6/1/2020				
Harvest Date:	8/3/2020	9/30/2020			
Production Inputs			lbs/a		
Fertilizer:	Date	Rate	N	P	K
46-0-0	6/8/2020	120lbs/a	55.2		
11-52-0	6/8/2020	120lbs/a	13.2	62.4	
46-0-0	8/12/2020	120lbs/a	55.2		
	Date	Rates			
Herbicides:					
Huskie	6/15/2020	16oz/a			

Growing Conditions:	Average Temp °F	Precip. in.	Irrigation arce in.
January	43	0.39	
February	42.9	0.56	
March	55.7	2.95	
April	61.1	0.04	
May	72.8		13.20
June	80	0.28	9.84
July	85.1	0.6	5.75
August	82.9	1.24	9.48
September	70.2	0.02	11.72
October	60	0.05	
November			
December			

Seasonal Precipitation:	2.14 in
Total Irrigtion:	52.1 in
per acre	19.3 in
Date of Last Spring Frost:	4/13/2020
e of First Fall Frost or Harvested:	10/27/2020
Frost Free Period:	197 days

COTTON

Twelve Cotton Genetics were entered with enough seed for four replicates. Jinfa Zhang Cotton Breeder Trial entered 138 cotton lines for bench two as it is the best spot to test for disease organisms. Jinfa grew 16 cotton varieties at Leyendecker with four replications. Bayer, Dow, Phytogen, and Plains Delinting had nine entries total. Twelve varieties were grown at Artesia, sixteen in Las Cruces 16, eight in Tucumcari, and varieties in Clovis.

Variety	Company	%Fiber	Boll Yld	Lint Yield	Seed Yield	Bales	TrashC	TrashA	Trash	Length	Unit	SFI	Str	Elg	Mic	Maturity	Rd	Yellow	color	grade	Net Loan	Gross Rtn
BX2116G LTP	Bayer	44.2	3263	1439	1734	3.00	2.3	0.2	10	1.10	81.7	8.9	29.0	6.1	5.2	84	77.6	8.1	31	2	49.63	2634
BX2141G LTP	Bayer	47.5	3216	1528	1661	3.19	2.5	0.3	13	1.14	80.4	9.0	30.6	5.8	4.5	83	80.0	7.7	26	2	51.91	2614
B1646B2 XF	Bayer	45.1	2919	1309	1431	2.73	2.0	0.2	13	1.19	81.2	8.5	29.8	8.2	4.7	82	79.8	7.8	26	2	51.54	2359
B1845B3 XF	Bayer	46.7	2661	1238	1356	2.58	1.5	0.2	9	1.17	82.8	8.4	32.1	7.9	4.6	82	80.4	7.7	26	1	52.41	2159
B2020B3 XF	Bayer	45.1	2655	1197	1406	2.49	2.3	0.3	18	1.16	81.4	9.3	28.6	5.3	4.5	83	79.1	8.2	26	1	52.04	2148
B2055B3 XF	Bayer	50.9	2999	1527	1426	3.18	1.0	0.1	8	1.15	81.1	8.6	27.0	8.0	4.5	81	80.0	7.7	31	1	52.00	2451
B2055B3 XF	Bayer	44.4	3156	1397	1685	2.91	1.0	0.1	5	1.18	82.2	9.1	29.6	7.2	4.7	82	81.7	8.2	14	2	52.28	2549
B341RFP IMA	Bayer	38.9	2895	1120	1683	2.33	1.5	0.2	9	1.35	86.4	6.0	47.7	6.1	4.1	83	71.6	11.5	28	2	52.84	2308
B359RFP IMA	Bayer	39.1	2727	1060	1574	2.21	2.0	0.2	9	1.31	86.3	5.7	49.9	6.2	4.3	83	70.4	12.2	28	3	52.79	2175
FM1830 GLT	Bayer	46.4	2890	1342	1490	2.80	1.8	0.2	11	1.18	83.2	7.9	31.0	6.1	4.6	83	80.0	7.8	26	2	52.39	2344
FM2334 GLT	Bayer	46.2	2771	1275	1460	2.66	1.3	0.1	6	1.15	82.1	8.6	28.7	5.6	5.0	84	80.7	7.7	21	2	50.54	2245
PHY400 W3FE	Phytogen	46.1	2887	1341	1531	2.79	1.8	0.2	13	1.12	80.5	9.9	30.8	6.8	4.5	82	80.7	7.6	26	2	52.30	2341
PHY480 W3FE	Phytogen	44.7	3546	1585	1915	3.30	1.5	0.2	12	1.13	83.5	7.1	31.2	9.2	4.8	81	79.3	8.5	24	2	52.41	2867
	Trial Mean	44.7	2962	1322	1752.0	2.75	1.8	0.1	10	1.18	82.6	8.2	33.2	6.7	4.6	83	7.8	8.6	3	2	51.92	2393
	LSD P < 0.05	3.0	NS	323	NS	0.67	0.8	0.1	6	0.06	2.1	0.8	2.5	0.9	0.3	1	1.7	0.7	NS	NS	1.17	NS
	CV	4.6	17.2	17.0	18.4	17.2	33.1	35.1	39.0	3.3	1.7	6.7	5.2	9.6	4.3	0.9	1.5	5.3	25.5	38.9	1.6	17
	F Test	0.0001	0.3583	0.0072	0.3096	0.0667	0.0314	0.0338	0.0145	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0010	0.0001	0.0001	0.4614	0.1044	0.0001	0.3301

2020 Artesia ASC Cotton Cultural Practice's and monthly weather averages.											
Location:		**Management Practices:**						**Growing Conditions**			
County/Area:	Eddy	Previous Crop:		Corn				Monthly Average Weather			
Longitude:	104 22.87W	Planting Rate:		40,000					Temp	Precip.	Irrigation
Latitude:	32 45.203N	Planting date:		5/10/2020					°F	in.	acre in.
Elevation:	3356 ft	Harvest Date:		11/23/2020				January	42.6	0.39	
Soil Name:	Karro loam (56%) and Reagan loam (44%)							February	42.9	0.56	
Soil Texture:	loam	**Production Inputs**				lbs/a		March	55.7	2.95	
Soil Depth:	78 in	Fertilize	Date	Rate lbs/ac	N	P	K	April	61.1	0.04	4.40
		46-0-0	4/23/2020	200	92			May	72.8	0	4.71
		11-52-0	4/23/2020	192	21	100	0	June	80.0	0.28	12.02
		46-0-0	6/10/2020	200	92			July	85.1	0.6	8.62
Test Design:								August	82.9	1.24	8.62
Replication:	4	Herbicide	Date	Rate				September	70.2	0.02	
Plot Lengths:	20 ft	none						October	60.0	0.05	
Rows per Plot:	2										
Row Spacing:	40in										
Bench area (acres)	2.3				-						
								Seasonal Precipitation:			6.13 in
								Total Irrigation:			16.7 in
								per acre			22.8 in
								Date of Last Spring Frost:			4/13/2020
								Date of First Fall Frost or harvested:			10/27/2020
								Frost Free Period:			197

ENTOMOLOGY RESEARCH TRIALS

Investigators: J Breen Pierce, P Yates Monk and I Tellez

Despite restrictions due to Covid-19 the entomology lab was able to conduct most of our planned field trials with an emphasis on funded cotton trials. One focus of our efforts was on evaluating resistance to Bt genes in H. zea and H. virescens populations by collecting insects in commercial fields and by evaluating performance in field trials. Another focus was evaluating the potential for okra leaf cotton as a control measure for bollworm in the face of increasing resistance by bollworm. This is a promising area since we have shown that our NM environment with high temperatures and low RH produces higher mortality when there is less canopy cover (Pierce et al 1999 and 2002). A closed canopy cover provides shade which lowers the canopy temperature and higher relative humidity from plant respiration. Okra leaf cotton will have more light penetration and air movement which will likely result in higher temperatures and lower RH more similar to our ambient desert conditions likely resulting in lower hatch rates. The third focus area for 2020 is evaluating resistance to seed treatments in New Mexico. This is a continuing study funded by Cotton Incorporated and is being done in conjunction with Texas A & M University entomologists.

The lab personnel included Jane Breen Pierce PI, Patricia Yates Monk, Research Associate, Ivan Tellez, graduate student, Quinn Tifton, and Chance Campbell high school student part-time/seasonal employees.

ENTOMOLOGY ASC- ARTESIA IMPACT STATEMENTS 2020

Developing tools for control of lepidopterous pests in the face of developing resistance to Bt genes

Virtually all corn and cotton growers in NM grow transgenic Bt varieties to control insect pests. Resistance to multiple Bt genes has been developing in the US including New Mexico. There are no genes in the pipeline to replace those currently available so alternates for controlling pests is an imminent need. In response to this issue, we are monitoring the level of resistance to Bt genes and developing alternative tools for controlling lepidopterous pests.

NMSU AES Associate Dean Leslie Edgar and AES funded graduate student Ivan Tellez inspecting okra leaf cotton trial in Artesia, NM.

In New Mexico, we have relatively high levels of environmental and biological control. Our desert environment has low relative humidity and high temperatures which often has a significant impact with 40-60% mortality. NMSU has produced many okra leaf cottons that have a more open canopy and could produce a microclimate that is hotter and drier than conventional cotton. This could result in higher mortality from desiccation in lepidopterous pests providing an alternative means of control to both Bt cotton or insecticides for NM cotton growers. Results from field trials in 2020 did indicate that bollworm mortality is often higher in okra leaf vs standard cotton varieties. Egg hatch rates averaged 36% lower in okra leaf cotton.

The development of resistance to Bt genes is also being monitored in New Mexico bollworm and budworm populations in commercial fields and research trials. VIP genes are still effective but even those most effective Bt genes have allowed the development of some bollworms in commercial corn fields indicating that resistance is inevitable and emphasizing the need to develop alternative controls.

Insecticides are available for control but reductions in insecticide use have numerous positive impacts for growers and the general public. Applicator safety, reduced environmental impacts, and increased biodiversity and conservation of beneficial arthropods are benefits in addition to the more apparent cost savings from reducing inputs. As current Bt genes become ineffective controls with the development of resistance, it is important to have alternatives to conventional insecticides with cultural and biological controls. Evaluations of natural control by insect predators in Bt and okra leaf cottons indicated control by beneficial predators in okra leaf cotton is similar to that in the standard canopy cotton. Predation was fortunately not lowered by the open canopy and subsequent changes in canopy microclimate.

NMSU AES funded graduate student Ivan Tellez placing bollworm eggs in okra leaf cotton trial at Artesia Ag Science Center to evaluate the potential for increased insect pest control in the okra leaf cotton canopy microclimate.

NMSU Associate Dean Leslie Edgar evaluating egg predation from okra leaf cotton field trial at Artesia Ag Science Center.

ALFALFA WEEVIL BIOLOGICAL CONTROL

IMPACT STATEMENT

Biological Control has the potential to control many insect pests but is frequently undervalued. Control of insect eggs alone is often 70-90% when populations of predators are not disrupted by frequent insecticide applications. Alfalfa weevil remains the most significant insect pest of alfalfa, routinely causing losses and necessitating insecticide applications. Periodically, losses can be extreme as illustrated. Insecticidal control is becoming increasingly difficult with resistance to many insecticides. One of the most effective remaining insecticides can be prohibitively expensive.

Alfalfa Weevil Damage to Hay

Control of alfalfa weevil with insect parasitoids and predators will save New Mexico growers over $2 million per year. The ASC farm at Artesia has maintained good control of alfalfa weevil with biological control for 20 years. Replicating this type of control in just alfalfa, sorghum and pecan will save growers $6.5 million per year in reduced losses and control costs. We have established some insectaries to increase populations in hayfields in NM. Recently we acquired an insectovac which will allow us to increase our rearing capacity of the most promising parasitoid to allow us to do more releases and in greater numbers throughout New Mexico. We were unable to use the insectovac this spring due to Covid-19 but did make some progress in this project by processing samples collected in previous years.

Alfalfa weevil adult and larva

EXTENSION/ OUTREACH IN 2020

Although travel and in-person visitation were limited in 2020, extension efforts were not as limited as expected. We were able to do pesticide training as usual with co-agents and the diagnostic lab in Las Cruces with the only difference that the presentations were conducted virtually by zoom. We also provided text to some existing presentations so agents could make their own presentations.

Spring 2020 there were far more calls for help than usual which was likely in part due to high populations of some very visible insects such as cutworm moths (aka miller moths) and blister beetles which were more numerous than we have seen in 24 years. Another area of particular interest to the public was evident in questions about the Giant Asian hornet (aka murder hornet). We also received numerous questions about other invasive insects including brown marmorated stink bug and emerald ash borer. The high volume of calls/texts on invasive insects etc may have been related to people under quarantine. On the other hand, many questions were related to actual infestations particularly alfalfa weevil blister beetles, cutworms, and various borers.

The Eddy Co agent and Lea Co agent retired so some calls were directed to us at the Ag Science Center due to their retirements. We worked with the diagnostic lab and/or specialists when the questions were outside our area of expertise for example working with Soum Sonogo on fungal plant diseases.

In an effort to provide content for 4H/K-12 students I maintained a colony of Black Swallowtail caterpillars and butterflies and posted about daily progress on development from an elementary school perspective.

Black Swallowtail Caterpillar shortly before it made a cocoon.

IMPACT OF OKRA LEAF TRAIT ON CANOPY MICROCLIMATE AND *HELICOVERPA ZEA* EGG HATCH

ABSTRACT

Microclimates within cotton (Gossypium sp.) canopies can vary due to many factors, including crop variety and plant architecture. Changes in microclimate conditions can also impact insect populations. Standard upland cotton (G. hirsutum) typically have large leaves that provide shade, effectively lowering the temperature and increasing the relative humidity within the canopy. These conditions allow pests, like the Cotton bollworm (Helicoverpa zea), to thrive. To observe how plant architectural traits could affect bollworm populations, a collaborative trial between New Mexico State University and Cotton Incorporated was conducted in eastern New Mexico. To elucidate potential influences of microclimate, they measured H. zea egg hatch in two upland cotton varieties with distinct architectures. Cotton varieties include an open canopy okra-leaf type (UA107), and a closed canopy Bacillus thuringiensis (DP1845B3XF) type with standard leaves. Using a laboratory colony, clusters of approximately 30-60 bollworm eggs, oviposited on fabric, were placed on leaf surfaces at mid-canopy. After 48 hours egg clusters were retrieved and brought to the laboratory where record larval hatch and predation were determined at 48, 72, and 96 hours. Air temperature and relative humidity in cotton canopies were measured and logged with remote monitoring sensors. Preliminary results showed higher egg hatch in the standard leaf cotton. These increases in egg hatch coincided with higher temperatures, suggesting that the warmer temperatures allow a higher proportion of eggs to successfully hatch. Utilizing okra-leaf cotton varieties can play an important role in pest management especially in the arid environment of New Mexico. With this information, cotton farmers may integrate open canopy varieties within their cotton systems to reduce the preferred environment of undesired pests.

INTRODUCTION

Upland cotton, Gossypium hirsutum, is a high-value fiber crop that was harvested on over 18,210 hectares with a value of $33,384,000 in 2019 in the state of New Mexico (USDA 2019). Upland cotton features distinct varieties that are differentiated by leaf shape and canopy structure which alter microclimates and insect habitats in the cotton canopy—especially in the hot, arid growing environment of the southwest United States. The presence of Lepidopteran pests in the Noctuidae family, including the pink bollworm, Pectinophora gossypiella (Saunders) and cotton bollworm, Helicoverpa zea (Boddie) cost growers millions of dollars in chemical control measures and yield losses from larval feeding on cotton fruiting bodies, squares and bolls (NCC, 2009; Anderson and Yeargan, 1998; Wilson et al, 1986). The polyphagous feeding nature of H. zea makes it one of the most economically important pests as they host on a wide variety of food, fiber, oil, and fodder crops. (Luttrell and Jackson, 2012; Sansone and Smith, 2001). The wide host range paired with the ability for wide dispersal makes H. zea one of the most damaging Lepidopteran pests in cotton (Olmstead, 2015).

Adult bollworms are 1.9 cm long and appear yellow-white to brown (UCIPM, 2013). While adults feed on nectar, the most destructive behavior comes from larval feeding on fruiting forms of the cotton plant—the squares and bolls (Bohmfalk et al, 1914). Newly hatched larvae feed on plant terminals and young squares and have a development period that ranges from 14-16 days and include six instar stages (Gianessi and Carpenter, 1999; Capinera, 2000). Larvae are much more difficult to control once they reach the third-instar stage compared with earlier instar stages (UCIPM, 2013). At the third instar stage, they are less susceptible to insecticidal treatments (UCIPM, 2013). The fifth instar stage damages more mature fruit or bolls before burrowing in the ground to pupate (Gianessi and Carpenter, 1999; UCIPM, 2013). The pupal stage lasts for approximately 13 days before adult moths emerge (Capinera, 2000). Larvae consume young plant material and squares which stunt development early in the cropping season as they target plant terminals (Gianessi and Carpenter, 1999). Later stage larvae devour the contents of larger bolls—which may be lost to rot—even if not consumed completely (Gianessi and Carpenter, 1999). Because it is difficult to control H. zea at adult and later larvae stages, it is advantageous to control such pests before they hatch. As an integrated pest management tool, choosing a resistant cotton variety can not only protect against problematic Lepidopteran pests like H. zea but also provide suitable habitat for predatory insects.

Okra-leaf varieties feature palmately-lobed leaves that grow to roughly 60-70% the size of the broad, standard leaf cotton variety (Andres et al, 2016). The smaller leaf size allows okra varieties to develop a relatively open canopy, permitting greater air circulation and light penetration (Andres et al, 2016). Okra-leaf cotton varieties are associated with higher mortality in square-feeding pests like the cotton boll weevil (Anthonomous grandis)—due to the desiccating effects from high temperatures under the open canopy (Jones et al 1976; Sorenson, 1995). However, studies with other Lepidopteran pests like the pink bollworm, P. gossypiella, noted no significant difference in egg hatch between okra- and standard leaf cotton varieties after P. gossypiella eggs were introduced to cotton fruiting bodies (Wilson et al 1986). Fye and Surber (1971) observed that reducing egg hatch in P. gossypiella, required temperatures above 35°C for over 4 days in a laboratory environment.

Under laboratory conditions, Pierce and Monk (2010) determined that H. zea eggs exposed to high temperature and low humidity had lower egg hatch. Very low egg hatch—down to 1%—was observed under the most extreme conditions of high temperature (35°C) and low humidity (17%) (Pierce and Monk, 2010). Under field conditions with daily maximum temperature exceeding 40°C in plant canopies, H. zea egg hatch rates were as high as 37% (Pierce and Monk, 2010). To manipulate temperature and humidity in the crop canopy, Pierce and Monk (2010) altered row spacing and orientation and noted that the location of H. zea eggs on leaves was influenced by microclimate conditions from leaf shading and plant respiration within the canopy. Although row spacing and orientation have been studied as control measures for H. zea egg hatch, there is little information on how H. zea egg hatch responds to microclimate conditions within cotton varieties of differing canopy structures.

Predation of H. zea eggs has not been explored in cotton agroecosystems but reports of predator abundance in soybeans may provide some insights applicable to cotton. Anderson and Yeargan (1998) showed the most common H. zea egg predators in soybeans systems were damsel bugs (F: Nabidae), big-eyed bugs (F: Geocoridae), minute pirate bugs (F: Anthocoridae), and miscellaneous spiders (O: Araneae). There were no differences in predator abundance or predation rates between open and soybean closed canopies (Anderson and Yeargan, 1998). Using traditional weekly sweep net sampling, Booze et al (2005) sampled predatory insect populations in okra-leaf and standard leaf cotton varieties and found no differences in predatory insect abundance between varieties. However, differentiating between the type of predators present by examining egg remains from in situ cotton field trials could provide insight into the presence of beneficial insect populations and biological control of H. zea.

A cotton variety with a canopy that suppresses H. zea hatch and provides suitable habitat for predatory insects can be part of integrated management programs for problematic Lepidopteran pests like H. zea. The objectives of this study were to: 1) compare microclimates and H. zea egg hatch rates between two varieties of cotton, a palmately-lobed okra-leaf variety and a broad-leafed standard variety, additionally, and 2) assess the impact of predator populations on H. zea eggs in an okra leaf variety and a broad-leafed standard variety.

MATERIALS AND METHODS

Helicoverpa zea eggs were from a colony maintained in chambers set to 25°C and 50% relative humidity at the New Mexico State University Artesia Science Center insectary. Colony eggs originated from Frontier Agrosciences rearing facility in Newark, DE (Corn earworm eggs, E9394). Larvae were maintained on a wheat germ protein diet made up of a dry pre-mix for Lepidoptera larvae (Beet Army Worm Diet without aureomycin #F9221B, Frontier Agricultural Sciences, Newark, DE), 10% agar, and water as outlined in Food Machinery Corporation (FMC) diet protocol (unpublished). Larvae were kept in 227 ml paper cups with transparent lids (Ecotainer™ food container, Atlanta, GA) in groups of approximately 100 to 200 individuals. At later instar stages, individual larvae were moved to single 57 ml plastic containers (P200N portion cup, Dart Corporation, Mason, MI) with a 2x2x2 cm cube of the wheat germ protein diet to avoid cannibalization. Once larvae reached the pupal stage, 30 to 50 pupae were moved to adult oviposition chambers made of cylindrical, 3.7-liter cardboard ice cream containers covered with cheesecloth as outlined in FMC rearing protocol (unpublished). Eggs were collected by changing cheesecloth at 12-hour intervals once adults began oviposition (approximately 3 days after emergence); egg sheets were sterilized in a bleach solution (150 ml of Clorox® bleach with 7.4% sodium hypochlorite in 5000 ml of distilled water) for 5 minutes as outlined in FMC protocol and were temporarily stored at 4° C before use. Adults were fed on a sugar-water solution diet (10:1 water to sugar ratio) absorbed on a cotton ball and placed on top of oviposition chambers and covered with a 57 ml plastic container to help retain moisture.

Egg hatch and predation in field trials:

Figure 1: Cluster of H. zea eggs on cloth attached to pink index card before being placed in the field.

Three egg hatch and six predation field to lab bioassays were conducted at the Artesia Science Center from mid-July to mid-August of 2020 using two cotton varieties. The two varieties were planted on April 22, 2020—the palmately-lobed okra-leaf cotton (Cotton Cultivar UA107, University of Arkansas) and standard broadleaf (Bollgard® 3-DP1845B3XF, Monsanto Corporation) cotton. Experimental plots consisted of six, 15.2 m-long rows. Okra-leaf plots were replicated five times and the standard leaf plots were replicated four times on a randomized block design. Border rows comprised of standard leaf cotton separated blocks. The entire study was encased by additional border rows of standard leaf cotton that separated the study from other cotton cultivar trails at the study site.

For egg hatch trials, groups of 30-60 H. zea eggs on cheesecloth were stapled to bright 4x2 cm index cards before being placed in the field (Figure 1). Damaged eggs were removed from the cloth with forceps before the cloth was stapled to index cards. Index cards with eggs were stapled to leaves at mid-canopy and left in the field for 48 hours. Index cards with eggs were then collected from the field and were observed in the laboratory under a stereomicroscope (Zeiss Stemi 2000-C Stereo Microscope 6.5x - 50x) to assess egg hatch and predation. Undisturbed eggs (not fed upon by predators) were placed in 100x15 mm polystyrene Petri dishes with a 2x1x1 cm cube of diet and sealed with parafilm (parafilm M, laboratory film) and left under observation for an additional 48 hours. Larval egg hatch was assessed at 48, 72, and 96 hrs after eggs were introduced to the field and placed at mid-canopy.

Egg predation trials spanned 48 hours. Index cards were evaluated in the laboratory to determine the family of the predator which fed on the H. zea eggs. Classification of predatory damage was based on past work with sentinel eggs in cotton and sorghum (Pierce et al, 2017). Predators with sucking mouthparts like damsel bugs (F: Nabidiae) or big-eyed bugs (F: Geocoridae) left eggs deflated and collapsed. Predators with mandibles like ladybird beetles (F: Coccinellidae) or collops beetles (F: Melyridae) left chewed eggs or only partial remains. Lacewing larvae (F: Chrysopidae) left sucked-out, transparent eggs that retained their form (Figure 2). Predatory trials ended after a 48-hour assessment of egg masses noting predation and larval hatch.

Figure 2: Lacewing larvae (F: Chrysopidae) feeding on H. zea egg. Egg is left nearly transparent after feeding.

Welch two-sample t-test was conducted using R software to check for a difference in means and F-test for comparison of variances between cotton varieties. Data analyzed included those from individual egg hatch and predation trials as well as pooled egg hatch and predation trials.

Temperature and relative humidity:

Temperature and relative humidity were recorded throughout trials by placing two HOBO sensors (HOBO Pro v2, U23-001, Bourne, MA) in each field plot (n=18) attached to a meter-long PVC pipe. Sensors remained at mid-canopy height and recorded temperature and relative humidity every 30 minutes for the duration of the trials. Two out of eighteen sensors failed to record relative humidity data after the first trial, therefore data were not used from those sensors. Both temperature and relative humidity data were analyzed using Welch two-sample t-test to evaluate mean difference and F-test for were used to compare the variance between cotton varieties using R software.

Leaf area and light measurements:

Differences in plant leaf area were observed by collecting all leaves from ten random plants from the inner rows of each block were selected from both varieties of cotton (n=20). Petioles were removed and each leaf was spread and taped to a sheet of paper for scanning. Scanned images were analyzed with Easy Leaf Area and Canopy Cover open-source software (Copyright (c) 1991 - 1995, Stichting Mathematisch Centrum Amsterdam, The Netherlands) to measure total leaf area in cm^2 for each plant.

Light measurements were conducted on ten randomized plants in each plot (n=90) with a digital light meter (Model LT300, Extech instruments, Nashua, New Hampshire). Light readings were taken at mid-canopy at mid-day were measured in lux (1000 lux, 1 lux = $lumen/m^2$). Leaf area and light measurements were analyzed using Welch two-sample t-test to check for differences in means and F-test for equality of variance between cotton varieties using R software.

RESULTS

Egg hatch and predation in the field:

For two of the three trials, H. zea hatch was significantly lower in the okra-leaf variety of cotton (Table 1). Egg hatch from 48 hours was not included in table 1 as it was very low (n=12). Egg hatch was significantly lower in okra-leaf on July 13th with total percent hatch at 19% versus 51% in standard leaf cotton (t = 3.05, df = 5.94, p-value = 0.022). Egg hatch was also significantly lower in okra-leaf on August 17th with total percent at 27% versus standard leaf at 52% (t = 2.63, df = 4.89, p-value = 0.04). Egg hatch was not significant on the July 29th trial.

Table 1. Percent egg hatch between okra leaf and standard leaf cotton. Percent egg hatch tabulated at 48, 72, and 96 hours after eggs were introduced to the field and placed at mid-canopy.

	7/13/2020		7/29/2020		8/17/2020	
Hours	Okra (%)	Standard (%)	Okra (%)	Standard (%)	Okra	Standard
48	0	0	0.4	0	0	0
72	17	48	38	52	4	16
96	2	3	2	8	23	36
Total	19	51*	40	60	27	52*

*Percent egg hatch statistically significant p≤ 0.05.

On average 64 eggs hatched per plot in the okra-leaf cotton versus 92 in the standard leaf cotton. There was a difference in the percentage of hatched eggs across all egg trials (Figure 3; t = 3.06, df = 19.32, p-value = 0.006). Mean egg hatch in okra-leaf cotton was less at 20% compared to 36% in the standard leaf 72 hours after the eggs were introduced to the field. The difference was significant after 96 hours with the mean egg hatch at 31% in okra-leaf and 54% in standard leaf (t = 2.929, df = 19.001, p-value = 0.008).

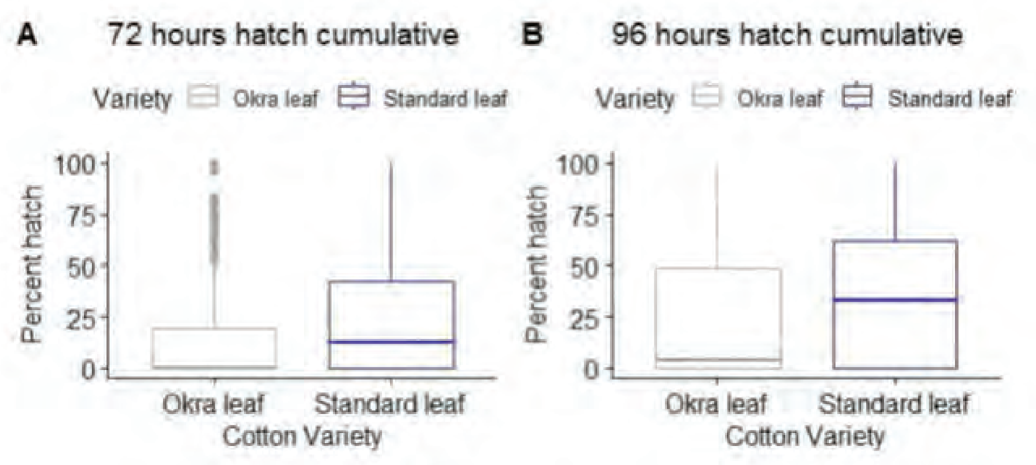


Figure 3: Percent egg hatch of H. zea 72 (A) and 96 hrs (B) after eggs were introduced to the field and placed at mid-canopy.

Observations of H. zea egg remains showed a higher number of collapsed or 'sucked out' eggs—in okra-leaf cotton compared with standard leaf cotton (t = 2.053, df = 1006.1, p-value = 0.040). There was also a significant difference in the number of H. zea eggs that were partially consumed or 'chewed,' in okra leaf cotton (Table 2; t = 2.132, df = 677.68, p-value = 0.033). However, overall predation was very similar across both cotton leaf varieties with 45% in okra leaf cotton compared to 46% in standard leaf cotton.

Table 2. Percent of *H. zea* eggs observed to be collapsed ("sucked out") or partially chewed by predators at 48 hours.

	Okra-leaf (%)	Standard leaf (%)
Sucked out*	7.1	6.1
Chewed*	0.5	0.1

*Egg predation statistically significant $p \leq 0.05$.

Temperature and relative humidity in the cotton canopy:

Temperature and relative humidity data from 16 HOBO data loggers showed significant differences in temperature (t = 3.2771, df = 9198, p-value = 0.001) and relative humidity (t = -3.0341, df = 9223.2, p-value = 0.002) between okra and standard leaf cotton. There were statistically significant differences in temperature and relative humidity in two trials on July 20 and July 29. On average a temperature difference of 2.5°C was observed in okra leaf cotton vs standard leaf cotton (Table 3).

Table 3 Average daily high temperatures and relative humidity in six microclimate trials with okra-leaf and standard leaf cotton.

	Temperature ° C			Relative humidity (%)		
	Okra leaf	Standard leaf	Difference	Okra leaf	Standard leaf	Difference
7/13/2020[1,2]	40	41	1	82	79	-3
7/20/2020[2]	36	39*	3	85	83*	-2
7/29/2020[1,2]	43	47*	4	98	100*	2
8/2/2020[2]	42	45	3	94	97	3
8/12/2020[2]	41	43	2	90	88	-2
8/17/2020[1,2]	38	37	-1	100	100	0
Averages	40	42	2.5	91	91	-0.3

[1]Egg hatch assay.
[2]Predation assay.

*Temperature and relative humidity statistically significant $p \leq 0.05$.

Light penetration, density, and leaf area:

Light penetration measurements were taken at mid-canopy in both varieties of okra-leaf and standard leaf in September when canopies were fully formed. Illumination, measured in lux (1 lumens per meter squared), differed between okra-leaf and standard leaf varieties ($t = 6.102$, $df = 88$, p-value = 1.37E-8). On average okra-leaf had an illumination measure of 37.1 Klux, more than double the average measurement in standard leaf canopies at 17.1 Klux. There was no significant difference in average plant heights, number of nodes, or plant density between each cotton variety (n=90). The average okra-leaf leaf area was 441.1 cm^2, much less than the average standard leaf area which was 798.3 cm^2.

DISCUSSION

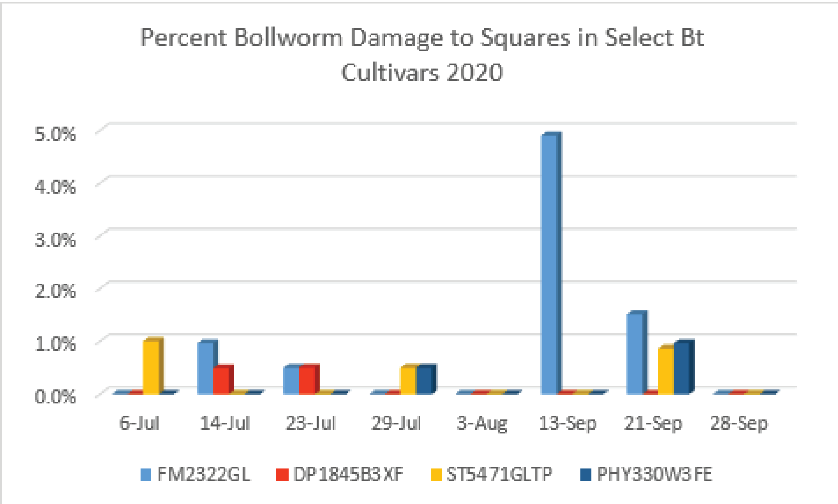
Fewer eggs hatched in the okra-leaf treatment than the standard leaf treatment. Forensic analysis of egg remains from all six predatory trials showed that cotton variety did not influence the total number of eggs consumed by predators. However, there was a difference between varieties in incidences of H. zea eggs either fed on by predators with sucking mouthparts—damsel or big-eyed bugs— or large mandibles—ladybird or collops beetles.

The reduced H. zea egg hatch in okra-leaf canopies is consistent with work by Jones et al (1976) which demonstrated the open canopies of new okra-leaf varieties, 'Gumbo' and 'Pronto,' show higher mortality of late-season Lepidopteran pest infestations. Jones et al. (1976) concluded that the canopy architecture of okra-leaf allowed cotton plants and soil surfaces to become warmer and dryer than standard leaf canopies. However, our data showed that temperature in standard leaf cotton canopies was, on average, 2.5° C higher than canopy temperature in okra-leaf cotton. These findings also contradict work by Pierce and Monk (2010) which showed reduced egg hatch of H. zea in warmer cotton canopies. It is unclear if these warmer temperatures provided a more suitable habitat for H. zea hatch. With other Lepidopteran pests in okra-leaf varieties, Wilson et al (1979) showed lower P. gossypiella pressure due to the early maturity of the cotton plants. This would likely not apply to this study as canopies of both okra-leaf and standard cotton were fully formed at the beginning of the trials. Other factors such as disturbances from wind and canopy aerodynamics need to be further researched to see if there is some relationship to H. zea egg hatch and okra leaves as suitable habitats.

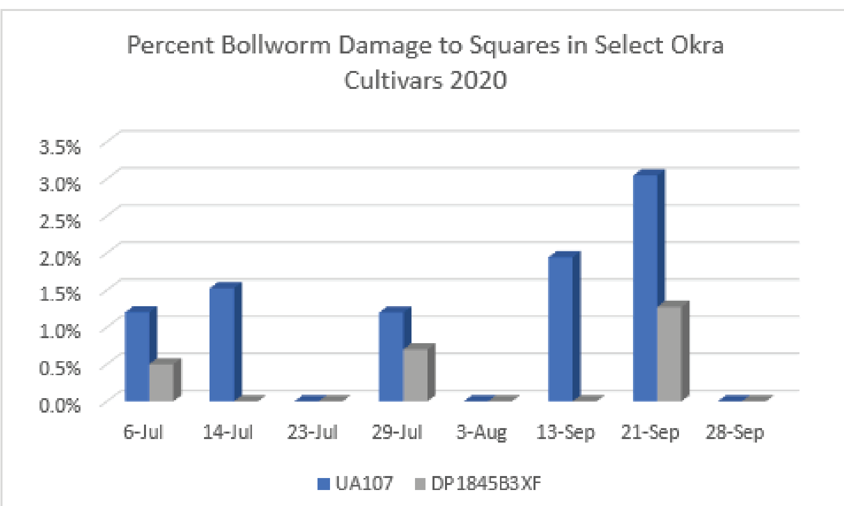
Total predation of H. zea eggs showed no significant differences between both okra-leaf and standard cotton varieties. This parallels studies in soybean systems by Anderson and Yeargan (1998) that showed no differences in predator abundance or predation of H. zea eggs in open and closed crop canopy treatments. However, there was a significant difference in the amount of collapsed or 'sucked out' and partially consumed or 'chewed' eggs. These differences can point to better host-seeking behavior by these predators or perhaps larger populations in the okra-leaf canopies.

Weekly sweep net samples need to be tabulated and analyzed to see if this is a possible reason for this difference in 'sucked out' or 'chewed' predation; perhaps due to some other factors such as seasonality or other difference in canopy microclimate. The presence of certain types of predatory insects in okra-leaf cotton provides biological control measures to H. zea and other Lepidopteran pests in cotton systems and is useful information to growers to inform management interventions. Specifically, growers managing okra-leaf cotton should carefully consider insecticide applications because the use of insecticides would provide an adverse effect to predatory insect populations. While the exact mechanism of microclimates within the cotton canopy controlling H. zea egg is not known, the potential for controlling Lepidopteran pests makes okra-leaf cotton an attractive variety to plant in arid cotton-growing regions like New Mexico.

BOLLWORM SQUARE DAMAGE IN FIELD TRIALS OF SELECTED BT COTTON CULTIVARS



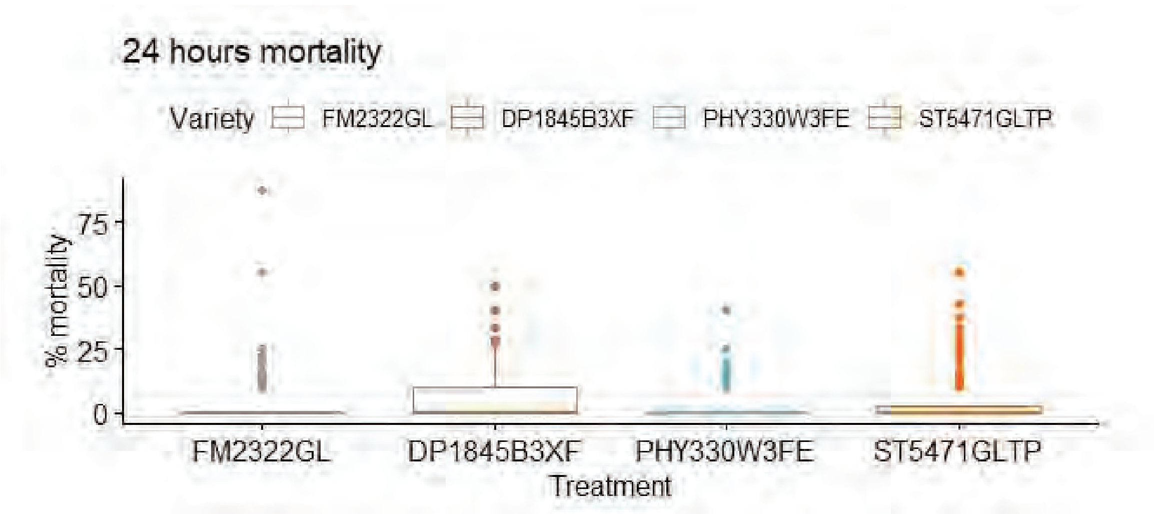
There was very low bollworm pressure in 2020 in Artesia and Las Cruces. Bollworm damage was evaluated every week in the Bt cotton trial in Artesia with 50 squares collected per plot or 200 per variety. Damaged squares were only above 1% on two dates in 2020, September 13 and 21st. On September 13 damage in the control non-Bt variety was almost 5% but zero in all other varieties. However the following week there was 1.5% damage in the non-Bt variety and .9-1% damaged squares in ST5471GLTP and PHY33OW3FE varieties. On the one hand, it is promising that there was rarely damage in the Bt cultivars when there was some in the non-Bt cultivar. On the other hand, the Bt varieties all had three genes so any damage at all particularly under very low pressure is a concern.



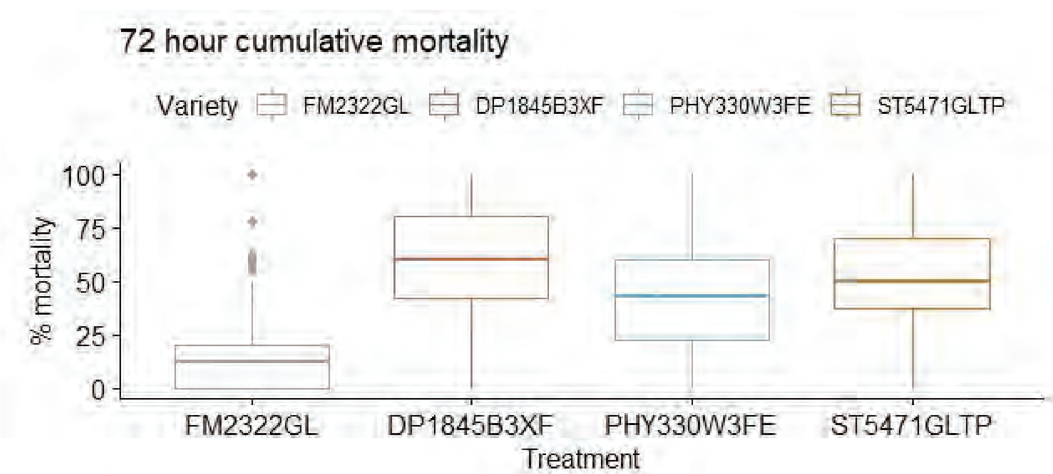
Bollworm damage to okra leaf and Bt cotton in the okra leaf trial in Artesia was similar to damage in the Bt variety trial. Damage ranged from 0-1% season long in the Bt variety but 0-3% in the okra leaf variety. As in the Bt trial, the highest damage was September 13 and 21st. The highest damage was on Sept 21 when there was 3% damage in the okra leaf cotton vs 1% in the Bt cotton.

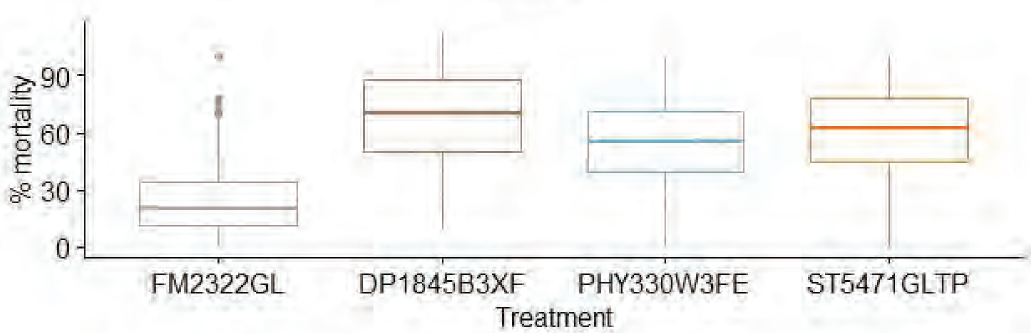
SURVIVAL OF BOLLWORM LARVAE FROM FIELD TO LAB BIOASSAY OF BT CULTIVARS

To evaluate the survival of early instar larvae, field-to-lab assays were conducted with Bt cultivars. Ten neonate larvae were placed in Petri dishes with 2 field-collected squares for each variety. There were 15 plates per plot of 60 per variety due to 4 reps in field plots. Results of one assay are presented here. At 24-48 hours, there was no significant difference in mortality. At 72 -96 hours, mortality was significantly higher in the non-Bt control variety compared to all Bt varieties.



At 72 hours there was significantly higher H. zea mortality feeding on all Bt cultivars compared to the non-Bt cultivar. H. zea mortality ranged from 50-62% in the Bt cultivars vs 14% in the non-Bt cotton.



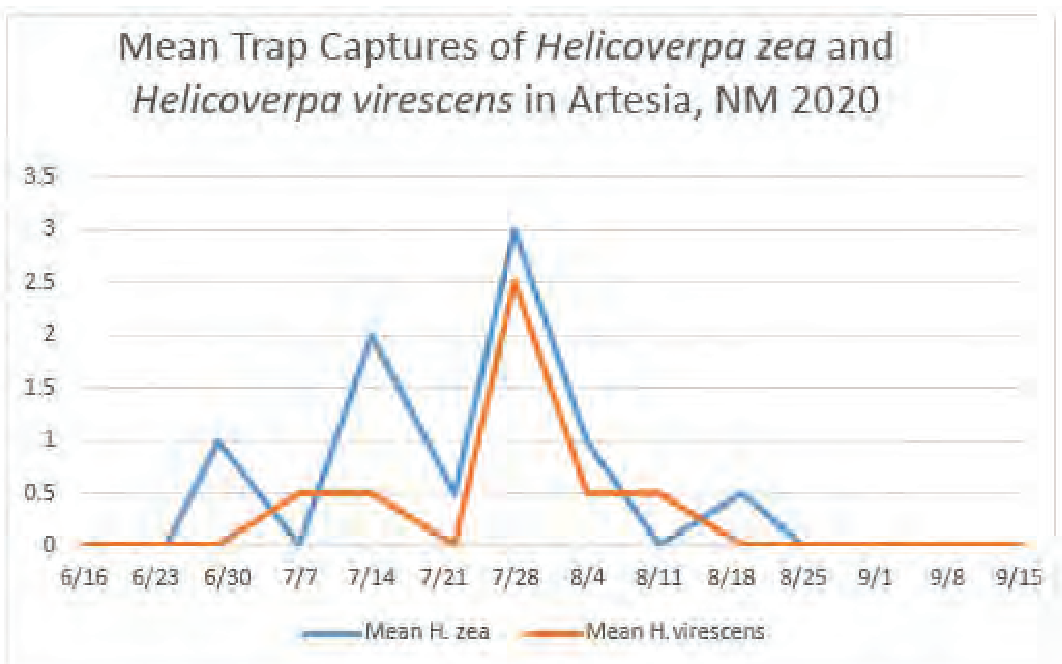


H. ZEA AND *H. VIRESCENS* POPULATIONS IN NEW MEXICO AS MEASURED BY ADULT RAP CAPTURES IN PHEROMONE TRAPS

Populations of several lepidopterous pests were monitored with pheromone traps. Trapping data of H. zea and H. virescens is important to compare changes in the prevalence of H. virescens over time and to provide a heads-up for growers in years where trap captures are particularly high. While trap captures do not correlate extremely well with field damage, there is some correlation particularly in years with extremely high damage. (Greene et al 2018)

Also, Helicoverpa armigera is a concern although it has not yet been found in nearby Texas. We collected data from traps to determine baseline levels of H. zea and H. virescens, in part, to have a comparison if H. armigera makes an incursion into NM.

Four traps for H. zea and H. virescens were maintained in Artesia to evaluate populations in comparison to other areas and over time in New Mexico. The maximum captures in one week were 5 H. zea and 5 H.
virescens both in the same week of 7/28/2020.



COMPARING POTENTIAL RESISTANCE TO SEED TREATMENTS FOR THRIPS IN THE NEW MEXICO MESILLA AND PECOS VALLEYS

The objective of this project is to determine the efficacy of neonicotinoid insecticide seed treatments to thrips in the Mesilla and Pecos Valleys of New Mexico. 2. Survey of thrips populations infesting cotton in different cotton production regions of New Mexico for a better understanding of regional thrip's complex compositions.

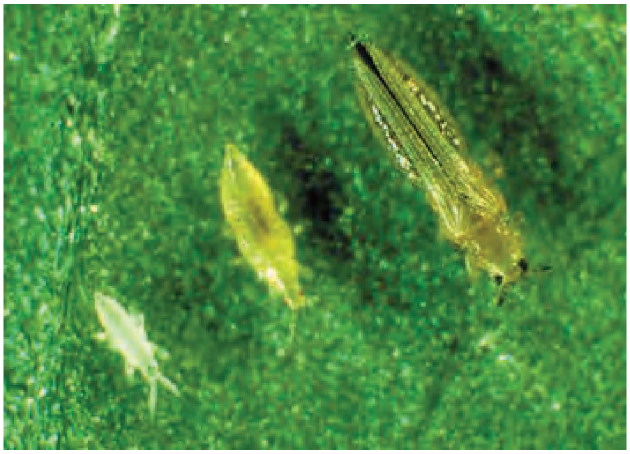
SIGNIFICANCE

In New Mexico, optimal cotton production is often dependent on managing pre-flowering insect pests including thrips. Thrips feed in the terminal bud of cotton and cause leaves to have a crinkled, tattered appearance as they expand. Heavily damaged foliage often is stunted and curls upward at the margins. Another characteristic of thrips damage is the silvery appearance of leaves at the feeding sites. Cotton damaged by these pests may have reduced photosynthesis capacity, attenuated growth, and plant death (Boyd et al. 2004). Reductions in stand density, poor early season crop growth, and delayed crop maturity can reduce lint quality and cotton yields. These reductions have been observed to vary across cotton production regions, justifying expansion to a multiple location study in New Mexico. Early-season pest management in cotton was primarily achieved with an in-furrow treatment of aldacarb (Temik®). In 2010, the Environmental Protection agency and Bayer CropScience reached an agreement to terminate the production and use of aldacarb in the United States (EPA Newsroom, 2010). Consequently, to achieve cotton production goals growers had to adopt alternative practices for early-season pest management. Neonicotinoid insecticide seed treatments have become the primary solution to managing early-season pests of cotton. Thiamethoxam and imidacloprid are two common systemic insecticide seed treatments applied to commercial cottonseed. Although the two insecticides belong to the same insecticide group, their physical and chemical properties vary and may affect mortality among target pests. Resistance to neonicotinoid seed treatments has been reported, particularly in the Southeastern US, thus it is important to evaluate efficacy in New Mexico. Some evaluations in Artesia with low thrip pressure (Figure 1) have suggested that the seed treatments are effective there but more definitive work is needed.

MATERIALS AND METHODS

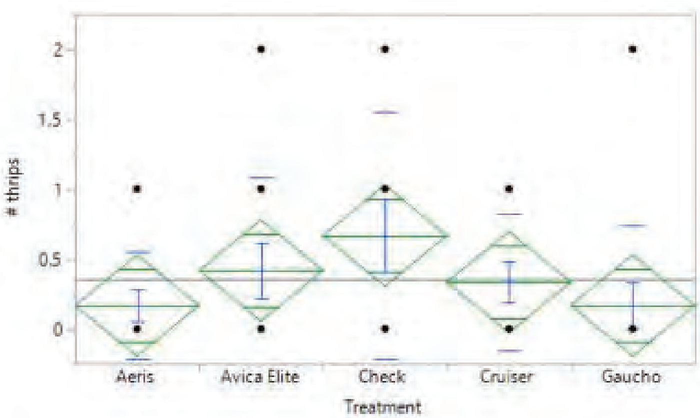
Cotton seeds were treated with two different neonicotinoid insecticides (imidacloprid and thiamethoxam) in various combinations for 4 seed treatments total to evaluate their current efficacy against thrips to determine if there might be resistance to these products as we have seen in other areas in the US. The variety DP1612B2XF was used for the treated and untreated seed. The control treatment had no insecticide seed treatment but did have a base fungicide for protection against fungal pathogens. No nematicide (such as thiodicarb) was added to the seed treatment to avoid possible interactions with the insecticides. The field trial consisted of five different treatments (four insecticide seed treatments and one untreated control), replicated four times. Each treatment plot size was 4 rows by 50 feet. This arrangement allowed us to determine the agronomic and entomological values of neonicotinoid seed treatments. The planting date was slightly late due to covid-19 restrictions. Efforts will be made to minimize the effect of management practices. After seedling emergence, we sampled thrips. Several plant parameters were recorded. A washing method was used to determine thrips populations instead of a visual sampling method to reduce sampling variability. Plant samples were collected at four different time/growth periods; cotyledon, 2-leaf, 3-leaf, and 4-leaf stages. For each sampling date and experimental plot, 10 randomly selected cotton seedlings of each respective growth stage, were cut above the soil and preserved in a quart-size glass jar, half-filled with 75% ethanol. Samples were brought to the laboratory and processed to extract thrips (both adults and immatures) for each sampling date. Adult and nymph counts were recorded separately for each plot and at each location. Fourth leaf stage cotton plant height was measured from 10 random plants per plot. Additionally, 5 plants per plot (12 plots/location) were measured for their root length and root vigor at the 4-leaf stage to estimate the below-ground effect of seed treatment.

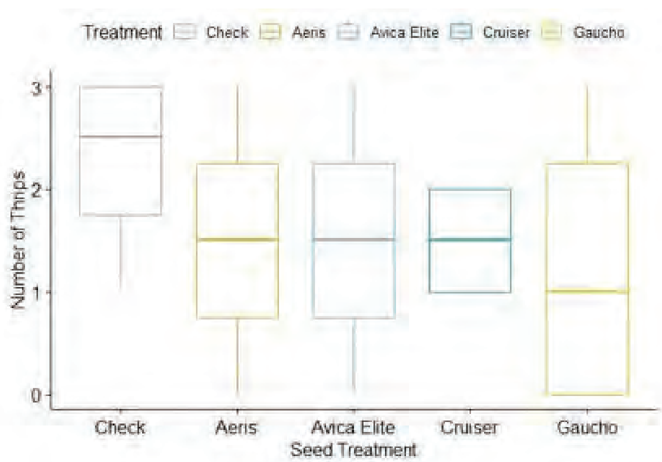
A second objective was to determine thrips species composition infesting cotton seedlings in two geographic regions of New Mexico. Adult thrips were collected from cotton seedlings at four different crop growth stages: cotyledon stage, 2-true leaf stage, 3-true leaf stage, and 4-true leaf stage. After the 2020 field season thrips from each sample will be mounted on glass slides for species identification using a compound microscope and following the dichotomous keys available for thrips identification. The result of this research will be used to determine thrips identification to document current and changing species composition in New Mexico in locations where thrips are a major early-season pest.



RESULTS TO DATE

Relative numbers showed a difference in treated seed vs the control on all dates. The first three dates had very low thrip numbers as illustrated in this graph of thrips from cotyledon to 3 leaves however differences were not significant.





The last date had the best data with the highest thrip numbers. Again there were relative differences but no significant differences in thrip numbers. We are as of this date (January 2021) continuing to work on processing samples collected to identify thrip species. We are also processing additional data collected during the field season.

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CONSTRUCTION ON ROOF OF SHOP BUILDING 2020-2021


SHOP

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