Fabian Garcia Research Center & Leyendecker Plant Sciences Center

2019 Annual Progress Report

BE BOLD. Shape the Future. **New Mexico State University**
College of Agricultural, Consumer and Environmental Sciences
Agricultural Experiment Station

2019 Annual Progress Report
Fabian Garcia Science Center
P.O. Box 30003, MSC 3Ley
Las Cruces, N.M. 88003-8003
Phone: 575-646-2729
Fax: 575-646-6247
Email: fgarcia@nmsu.edu

Leyendecker Plant Science Research Center
Physical: 7200 Plant Science Circle
Mailing: P.O. Box 30003, MSC 3LEY
Las Cruces, NM 88003-8003, N.M. 88003
Phone: (575) 646-2281
Fax: (575) 646-8137
Email: lyendeck@nmsu.edu

Compiled by: Steven Loring, Associate Director, Agricultural Experiment Station

Staff at Fabian Garcia Science Center
Anthony Aranda, Farm Manager
Diego Garcia
Jorge Garcia
Dante Ogaz
Liberato Valdez
Carlos Valles

Staff at Leyendecker Plant Science Research Center
Dave Lowry, Farm Manager
Rolando Gonzalez
Pablo Holguin
Autumn Martinez
Martin Melon
Orlando Moralez
Wade Robinson
Ralph Treviño

INTRODUCTION

Mission

The mission of the Leyendecker Plant Science Research Center and the Fabian Garcia Science Center is to improve the lives of New Mexicans, the nation, and the world through research, teaching, and Extension. The Leyendecker Plant Science Research Center serves as the outdoor agronomic laboratory for researchers located on the NMSU main campus in Las Cruces; the Fabian Garcia Science Center is oriented toward horticultural research.

History

The first deed signed for Fabian Garcia Research Center was in 1906. Currently the center has 41.1 acres of land available. Fabian Garcia, professor of Horticulture from 1906-1945, was named the first director of the State Agricultural Experiment Station in 1913. He produced the first reliable chile pod, which was the beginning of the hot "Sandia" pepper. Pioneering New Mexico State University chile breeder Fabian Garcia has been inducted into the American Society for Horticultural Science Hall of Fame. During a five-decade career at NMSU. Garcia laid the foundation for the state's $400 million chile pepper industry.

New Mexico State University purchased the 203-acre in 1969. Projects occurring at the Leyendecker Plant Science Center include: hoop house project, cotton, chile, alfalfa and onion plant breeding, precision farming, pecan research, drip irrigation research, and a multitude of other projects and programs.

Research at Fabian Garcia Science Center

1. Dr. Paul Bosland – Chile
2. Dr. Chris Cramer – Onions
3. Dr. Jinfa Zhang – Cotton
4. Dr. Ian Ray – Alfalfa
5. Dr. Stephanie Walker – Chile
6. Dr. Manoj Shukla – Pecans, soil
7. Dr. Richard Heerema – Pecans
8. Dr. Picchioni – Horticulture Forum
9. Dr. Gill Giese – Grapes
10. Dr. Rolston St. Hilaire – Maple trees
11. Dr. Dave Thompson – Weeds
12. Dr. Ryan Goss – Turf grass
13. Omar Holguin – Algae project
14. Dr. April Ulery – Soil, hemp
15. Dr. Kulbushan Grover – Guar

Events at Fabian Garcia

1. 4H classes - monthly
2. State Fair Board Meetings – monthly
3. Climate Control Workshops – Semi-monthly
4. Multiple classes held in lab and classroom each semester
5. Multiple tours throughout the year in chile demonstration garden
6. Plant Sale – April 8th – 10th, 2019
7. Deans Retreat – June 3rd and 6th, 2019
8. Sustainable Agriculture Field Day – June 26, 2019
9. Plant Diagnostics Workshop with Dr. Sanogo – October 14, 2019
10. Grape Field Day – October 30, 2019

FY 20

Sales	123710
Sales	$ 550.00
Fuel	$ 1,904.14
Fertilizer & Chemicals	$ 1,902.24
Supplies	$ 2,076.30
OFS Services	$ 320.85
Professional Services	
Stubbs Engineering	$ 2,164.09
South Plains	$ 3,043.40
EBID Taxes	$ 5,494.70

Farm Improvement	123721
Sales	$ 875.00
Supplies	$ 1,088.34
OFS Services	$ 913.36

Tractor	123724
Sales	$ 2,149.60
Fuel	$ 1,105.29
Supplies	$ 2,792.70
OFS	$ 42.78

FY 19

Sales	123710
Sales	$ 9,406.38
Fuel	$ 875.49
EBID Taxes	$ 5,190.55

Farm Improvement	123721
Sales	$ 2,300.00
Supplies	$ 5,442.12
OFS Services	$ 117.80

Tractor	123724
Sales	$ 4,980.00
Fuel	$ 3,656.67
Supplies	$ 2,782.87
OFS	$ 91.44

Research at Leyendecker Plant Science Research Center

Faculty/Industry	Scope of work
Bawazir, Salim	Weather Station trials
Bosland, Paul	Chile breeding
Brungard, Colby	Soil pits
Bundy, Scott	Cotton variety trial/seed treatment trial
Darden, Tim (NMDA)	Lettuce- Mock inspection
Darden, Tim (NMDA)	Cabbage- Mock inspection
Darden, Tim (NMDA)	Onions- Mock inspection
Darden, Tim (NMDA)	Broccoli- Mock inspection
Fernald, Alex	Pecans- soil moisture
Ferrenberg, Scott	Alfalfa- Cutter Bee movement
Hairgrove, William (UTEP)	Pecans- evaporation pans
Hamilton, Cary- IR-4	Chile
Hamilton, Cary- IR-4	Sun Flower
Hamilton, Cary- IR-4	Sugar Beet
Hamilton, Cary- IR-4	Cantaloupe
Hamilton, Cary- IR-4	Squash
Hamilton, Cary- IR-4	Snap Bean
Hamilton, Cary- IR-4	Sesame
Heerema, Richard	Pecans- Partial root zone drying
Heerema, Richard	Almond trial
Idowu, John	Glandless Cotton- Tillage
Idowu, John	Guayule- Freeze tolerance
Idowu, John	Glandless Cotton- Potassium trial
Idowu, John	Winter cover crops- Rye, wheat, barley- wind erosion
Idowu, John	Chile- Big Jim- phosphorous
Idowu, John	Sweet Corn- nitrogen and phosphorous rates
Idowu, John	Guar- nitrogen and phosphorous rates
Idowu, John	Guayule- irrigation shedules
Idowu, John	Alfalfa- Muriate of Potash/Triple Super Phosphate
Johnson, David	Cover crop rotation
Johnson, David	Cover crop as soil amendments
Kerr, Kevin (Pioneer)	Corn variety trials
Lenhoff, Eric	Mustard cover crop trials
Mounyo, Cole (Helena)	Corn variety trials
Pierce, Jane	Cotton-Variety/Insect pressure
Randall, Jennifer	Clone Pecan trees
Ray, Ian	Alfalfa Genetics
Ray, Ian	Alfalfa Breeding
Ray, Ian	Alfalfa- diploid/quadroploid
Sanogo, Soum	Chile trial with winter cover crop preceeding

Sanogo, Soum	Chile-microplots- soil viruses
Schutte, Brian	Chile Herbicide trials
Schutte, Brian	Chile- Mustard as a biofumigant
Schutte, Brian	Chile Herbicide trials
Schutte, Brian	Chile, stale bed trials
Sheppard, Chris (Golden Acres)	Corn variety trials
Shukla, Manoj	Pecan- moisture sensors
Walker, Stephanie	Seeded chile/Foliar spray regimine
Walker, Stephanie	Transplant chile/ Kaolin clay
Werm, Kurt	Surveying Monuments
Yao, Shengrui	Jujube trials
Zhang, Jinfa	Cotton breeding
Zhang, Jinfa	Glandless cotton breeding

LEYENDECKER PSRC

FY 19		FY 20		Amounts adjusted for time	% Change
SALES	**123698**	**SALES**	**123698**		
REVENUE	$ 107,928.60	REVENUE	$ 62,310.48	$70,909.09	-12.1%
EBID SALES	$ 4,000.00	EBID SALES	$ 4,500.00	$2,628.00	71.2%
FERT & SEED	$ 24,965.19	FERT & SEED	$ 7,726.89	$16,402.13	-52.9%
EBID BILL	$ 17,451.70	EBID BILL	$ 18,203.80	$11,465.77	58.8%
FUEL	$ 2,509.24	FUEL	$ 5,666.19	$1,648.57	243.7%
LABOR CREWS	$ 18,117.17	LABOR CREWS	$ 14,787.54	$11,902.98	24.2%
OFS SERVICES	$ 16,455.08	OFS SERVICES	$ 10,605.79	$10,810.99	-1.9%
ADMIN	**123706**	**ADMIN**	**123706**	$81,274.84	52.2%
EQUIPMENT CHARGES	$ 1,988.71	EQUIPMENT CHARGES	$ 1,044.78	$1,306.58	-20.0%
LINE CHARGES	$ 2,177.88	LINE CHARGES	$ 1,034.11	$1,430.87	-27.7%
DATA SERVICE	$ 1,759.44	DATA SERVICE	$ 1,217.93	$1,155.95	5.4%
ZIA GAS	$ 6,195.77	ZIA GAS	$ 2,788.05	$4,070.62	-31.5%
EL PASO ELECTRIC	$ 26,566.56	EL PASO ELECTRIC	$ 26,566.56	$17,454.23	52.2%
SW DISPOSAL	$ 1,653.95	SW DISPOSAL	$ 970.06	$1,086.65	-10.7%
IRRIGATION	**123723**	**IRRIGATION**	**123723**	$81,286.01	52.2%
FARM CHARGES	$ 4,286.85	FARM CHARGES	$ 11,852.70	$2,816.46	320.8%
EBID SALES	$ 4,970.00	EBID SALES	$ 3,375.00	$3,265.29	3.4%
ZIA GAS	$ 206.04	ZIA GAS	$ 140.29	$135.37	3.6%
EL PASO ELECTRIC	$ 10,147.21	EL PASO ELECTRIC	$ 4,597.16	$6,666.72	-31.0%
FERT	$ 1,608.00	FERT	$ 96.00	$1,056.46	-90.9%
SUPPLIES, MAINT	$ 1,573.06	SUPPLIES, MAINT	$ 738.42	$1,033.50	-28.6%
OFS SERVICES	$ 3,126.85	OFS SERVICES	$ -	$2,054.34	-100.0%

TRACTOR	**123727**
FARM CHARGES	$ 14,990.00
SUPPLIES & GPS	$ 10,427.09
FUEL	$ 14,109.26
REPAIR SERVICES	$ 3,233.23

TRACTOR	**123727**
FARM CHARGES	$ 6,542.00
SUPPLIES & GPS	$ 9,672.59
FUEL	$ 5,002.38
REPAIR SERVICES	$ 4,709.32

$81,288.64	52.2%
$9,848.43	-33.6%
$6,850.60	41.2%
$9,269.78	-46.0%
$2,124.23	121.7%

Events

1) USDA/FDA Mock Inspection- hosted 35 inspectors along with 15 supervisors, admin, etc., at Leyendecker for a 2-day training
2) Economic Development Press Conference- hosted Governor Lujan-Grisham along with other state and local dignitaries as she announced Rich Global's investment in New Mexico/Dona Ana County through Hemp production and processing.
3) Hosted Dr. Grover's crop production class
4) Hosted Dr. Brungard's soils class
5) Hosted a tour for Two Nations One Water conference, worked with Robert Sabie and Robert Flynn
6) Hosted Dr. Scott Angle, Director for USDA NIFA as part of a multi-farm tour

Development of NM Green Chile Cultivars for Mechanization

Extension Vegetable Program
Leyendecker Plant Science Research Center (2019)

Investigators: S.J. Walker, B. Tonnessen, Extension Plant Sciences

Potential Impact:

Commercial acreage of NM-type green chile is threatened due to inconsistent labor availability and the relatively high labor expense compared to competing countries. Mechanizing the harvest of green chile in NM would reduce the need for hand labor and is essential to maintaining large-scale, profitable production of this crop. Success in mechanizing NM green chile is anticipated to stop the loss and spur an increase in acres planted in NM. Each acre grown is worth approximately $7,000 in gross income to NM farmers, and just a 10% increase in the current level of acreage would result in

Method:

This program has conducted long-term efforts to develop new NM green chile cultivars efficient for mechanization, a critical component towards mechanizing harvest of the crop. Since 2010, breeding lines have been established at the Leyendecker Plant Science Research Center (PSRC) for evaluation of plant and fruit structure. Traits, including taller plants, fewer basal branches, higher primary branch angle heights, and thicker main stem diameters, were used as selection criteria in the development of advanced breeding lines. Seed increases using large seed cages were made on promising NM green chile lines so that ample seed was available to plant mechanical harvest trials. Additional critical traits important for mechanical harvest is easy removal of fruit from the plant and complete pedicel removal from the fruit, because the vast majority of processed chile must arrive at the processing plant 'destemmed' (with pedicel completely removed). In 2019, the two best NM green chile breeding lines (23W19 and 24W19) developed for mechanical harvest-efficient architecture were grown in a RCB design with five replications to evaluate fruit and pedicel removal. Commercial cultivars 'NuMex Joe E. Parker' and 'AZ-1904' (Curry Chile and Seed Co.) were planted as controls. Ten random, marketable green chile fruit were picked from each plot. Each fruit was rated on a '1' to '5' scale according to the relative force needed to remove it from the plant (1= easy to remove from plant and '5' very difficult to remove from plant). Force to remove pedicel from fruit was also measured on the fruit with a torque gauge (Tohnichi; Buffalo Grove, IL). A '1' to '5' rating system to classify pedicel removal efficiency from the fruit was developed ('1' describes a pedicel that was perfectly removed from the fruit through '5' indicated pedicel failed to be removed from the fruit.).

Results:

Standard control 'AZ-1904' fruit were significantly more difficult to remove from the plant compared to the two breeding lines (23W19 and 24W19) and 'NuMex Joe E. Parker' (Table 1).

For removal of pedicels from the fruit, ‘JEP’ took less force compared to the other three lines (Table 2); however, pedicel removal efficiency was the lowest in this commercial control cultivar (Table 3). Although the two mechanical harvest breeding lines required more torque to removal the pedicels, the pedicels were removed more efficiently and completely compared to either of the standard control cultivars (Table 2 & 3). The two breeding lines both exhibited relatively easy fruit removal from the plant and efficient, complete pedicel removal from the fruit. Both traits are favorable for overall mechanical harvest efficiency and contribute to the utility of these lines in a mechanical harvest system.

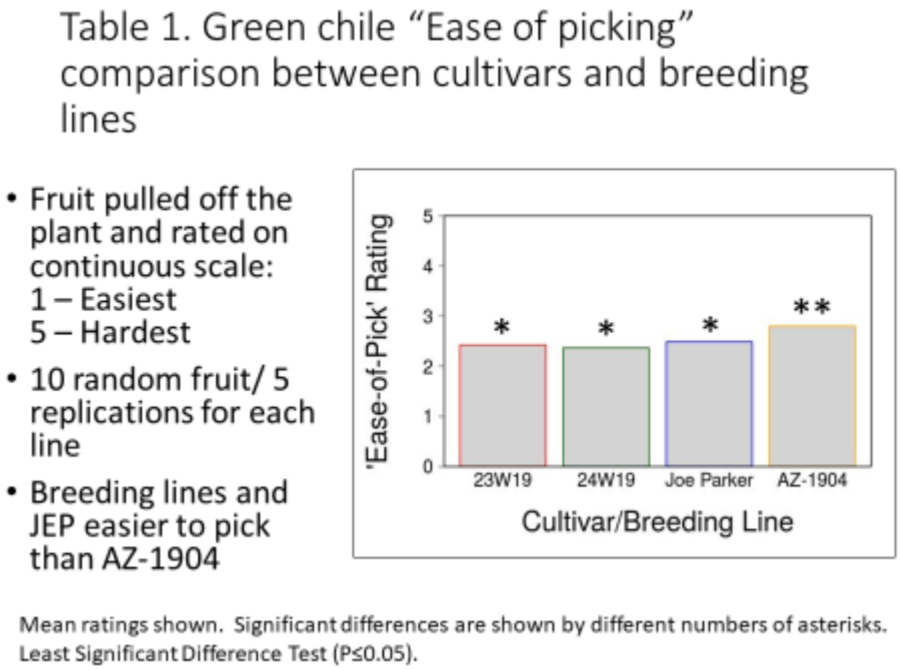

Table 1. Green chile “Ease of picking” comparison between cultivars and breeding lines

- Fruit pulled off the plant and rated on continuous scale:
  1 – Easiest
  5 – Hardest
- 10 random fruit/ 5 replications for each line
- Breeding lines and JEP easier to pick than AZ-1904

Mean ratings shown. Significant differences are shown by different numbers of asterisks. Least Significant Difference Test (P≤0.05).

Impact of okra leaf cotton on canopy microclimate and survival of bollworm
Integrated Pest Management

Investigator: Jane Pierce, Plant & Environmental Sciences/Extension Plant Sciences

Acala 1517 and an okra leaf cultivar developed by the NMSU cotton breeding program were compared for possible impacts on bollworm egg hatch given that okra leaf cotton might be associated with lower canopy relative humidity and higher temperatures. There was little difference in relative humidity and temperature in this trial. However, sentinel bollworm eggs in okra leaf cotton hatched faster but had lower hatch rates overall compared to the standard Acala 1517 cultivar.

Developing New Strategies for Controlling Weeds in Chile Pepper

Project 1: Ensuring Safe Applications of Flumioxazin in Furro-Irrigated Chile Pepper in New Mexico

Investigators: Brian Schutte, Ed Morris; Department of Entomology, Plant Pathology and Weed Science; New Mexico State University, Las Cruces, NM 88003

Background: Previous studies determined that post-directed, row middle applications of flumioxazin controlled weeds and did not cause either severe crop injury or yield reductions in chile pepper. This study provided additional information needed for a Special Local Need (SLN) registration for post-directed applications of flumioxazin in New Mexico chile pepper. Specifically, this study determined that post-directed, row middle applications of flumioxazin did not result in fruits with residues greater than U.S. federal tolerances for flumioxazin residues on chile peppers (0.02 ppm; Code of Federal Regulations, CFR 180.568). Pending SLN registration, flumioxazin is expected to provide farmers new opportunities to reduce expenses in chile pepper production.

Methods: The field site for this study featured sandy loam soil. Following a sequence of field preparatory procedures, the chile pepper cultivar NM 6-4 was seeded into raised beds spaced 1.0 m apart. 'NM 6-4' was selected for this study because 'NM 6-4' was previously determined to have the capacity for flumioxazin root uptake. Chile pepper was grown with flood-furrow irrigation and management practices typical for the region. Aside from experimental herbicide treatments, the weed control program consisted of combinations of cultivation and hand hoeing. This weed control program resulted in near weed-free conditions throughout the growing season.

The study included the following four treatments: (1) an untreated control, (2) flumioxazin at 70 g ai ha^{-1} applied to furrows between raised beds at 3 weeks after crop thinning, (3) flumioxazin at 70 g ai ha^{-1} applied to furrows between raised beds at 3 and 5 weeks after crop thinning, and (4) flumioxazin at 107 g ai ha^{-1} applied to furrows between raised beds at 3 weeks after crop thinning. These flumioxazin treatments were previously shown to not cause visible injury or yield loss in chile. Following label guidelines, flumioxazin was applied with a nonionic surfactant at 1% v/v and was incorporated with irrigation. Flumioxazin treatments were applied on July 30, 2019 and August 19, 2019.

The experimental design was a randomized complete block with four replications. Experimental units were plots with dimensions equal to 6 m length, three beds width. On each side of center beds, a herbicide treatment was applied using a CO_2-powered backpack sprayer equipped with a hooded, even-flat nozzle (TeeJet 8002EVS, TeeJet Technologies, Wheaton, IL) and calibrated to deliver 187 L ha^{-1}. Herein, center beds with herbicide treatments are referred to as "treatment rows." Beds flanking treatment rows were designated as border rows. Marketable green chile were harvested by hand from treatment rows. Fresh weights of marketable chile were determined in the field. For each combination of treatment and replicate, harvested subsamples were sent to a commercial laboratory (South Dakota Agricultural Laboratories, Brookings, SD). This laboratory quantified flumioxazin residues in green chile fruits. Peppers for residue analysis for harvested, stored and shipped following IR-4 protocols. Chile peppers were harvested on October 4, 2019.

Results: Postemergence (relative to chile crop), row middle applications of flumioxazin did not reduce chile pepper fruit yield (**Table 1**). Further, these POST-directed applications of flumioxazin did not result in chile pepper fruits with flumioxazin residues greater than U.S. federal tolerances (0.02 ppm; Code of Federal Regulations, CFR 180.568). In fact, all chile pepper samples lacked detectable residues of flumioxazin (**Table 1**).

Conclusions: This study indicated that POST-directed, row middle applications of flumioxazin do not result in chile pepper fruits with detectable levels of flumioxazin. Pending additional research and SLN registration, POST-directed applications of flumioxazin may be a new weed control technology that does not impact the safety of the harvested product.

Table 1. Chile pepper fruit yield and fruit residue analyses following POST-directed, row middle applications of flumioxazin.

Treatment Name	Mean fruit yield[a]	Flumioxazin residue on chile fruits[b]
Weed-free, nonsprayed control	5020.0 a	Not detected
Flumioxazin at 70 g ai ha^{-1} with a nonionic surfactant at 1% v/v; 3 weeks after crop thinning	5252.8 a	Not detected
Flumioxazin at 70 g ai ha^{-1} with a nonionic surfactant at 1% v/v; 3 & 5 weeks after crop thinning	3977.5 a	Not detected
Flumioxazin at 107 g ai ha^{-1} with a nonionic surfactant at 1% v/v; 3 weeks after crop thinning	6072.5 a	Not detected

[a] Fresh weight (grams) of marketable chile peppers harvested from 4-m section of crop row. Data are means, n = 4. Means with the same letter are not significantly different according to Tukey's HSD test (α =0.05).

[b] Chile fruits were analyzed for flumioxazin by South Dakota Agricultural Laboratories (1335 Western Ave, Brookings, SD 57006). Residues were not found at the parts per billion detection level. U.S. federal tolerances for flumioxazin residues on chile fruits: 0.02 ppm (Code of Federal Regulations, CFR 180.568). Peppers were harvested, stored and shipped following IR4 guidelines

Potential Impact(s): Flumioxazin may provide chile farmers new opportunities to reduce production expenses by using a herbicide in place of hand hoeing. However, prior to this research, there was no information on this herbicide's effects on the safety of the harvested product. In collaboration with a laboratory with expertise in detecting and quantifying flumioxazin residues, we determined that POST-directed applications of flumioxazin did not produce flumioxazin residues in chile pepper fruits. Accordingly, this study provided information supporting a Special Local Need registration for POST-directed applications of flumioxazin in New Mexico chile pepper.

Developing New Strategies for Controlling Weeds in Chile Pepper

Project 1: Mustard Seed Meal to Manage Mid-Season Weeds in Chile Pepper

Investigators: Brian Schutte, Soum Sanogo, John Idowu, Ed Morris, Asmita Nagila; New Mexico State University, Las Cruces, NM 88003

Background: Chile farmers who want to reduce reliance on both synthetic herbicides and hand hoeing have few options for controlling weeds that emerge in the middle of the growing season. To develop an approach for controlling mid-season weeds without herbicides and hoeing, we evaluated the weed suppressive potential of mustard seed meal (MSM), which is the solid residue of Brassicaceae seeds after such seeds have been pressed for oil. Results indicated that MSM soil amendments after chile crop thinning provided pre-emergence control of weeds and did not reduce chile fruit yield. Thus, this biocidal tactic may provide chile farmers new opportunities to control weeds without synthetic herbicides or hand hoeing.

Methods: A field study was conducted in chile pepper fields at two NMSU research farms (Leyendecker Plant Science Research Center, Agricultural Science Center at Los Lunas) and two commercial farms (Deming, Las Uvas). At each site, two MSM rates (4400 kg ha^{-1}, 2200 kg ha^{-1}) were each applied to four plots paired with non-treated control plots. At the time of application, chile plants were 36 to 42 cm tall. Based on insights obtained from our greenhouse studies, MSM was applied and incorporated in soil between neighboring chile rows. Immediately following MSM incorporation, all plots were watered by hand with sprinkling canisters. The irrigation volume was 15 L plot^{-1}, which was sufficient to saturate the upper 3 cm of soil. To ensure that the MSM rates were sufficient for weed control, we measured weed responses to MSM with two response variables: 1) ambient weed emergence from 0.25 m^2 quadrats centrally located in study plots, and 2) Palmer amaranth emergence from PVC pipes positioned in study plots after MSM application, but prior to irrigation. Each PVC pipe contained 50 Palmer amaranth seeds buried 1-3 cm from the soil surface. Response variables also included visual assessments of MSM injury to chile at 14 and 28 days after application, as well as chile pepper yield.

Results: Post-emergence applications of MSM provided varying degrees of weed control, with weed control generally higher for MSM at 4400 kg ha^{-1} (**Table 1**) compared to MSM at 2200 kg ha^{-1} (**Table 2**). For both rates and at all sites, post-emergence applications of MSM did not cause visual injury and did not reduce chile pepper yield (**Table 1, Table 2**).

Conclusions: These results are promising because (1) this represents one of the first reports of safe, effective application of MSM after crop emergence, (2) if not controlled, weeds that emerge during the middle phases of the chile pepper season severely reduce both yield and harvest efficiency, and (3) farmer collaborators on this project specifically asked for assistance in developing a strategy for applying MSM after chile pepper emergence. Although cost-benefit analyses are required, the results from this study suggests that MSM amendments after crop emergence are suitable for chile pepper production in New Mexico.

Table 1. The effects of mustard seed meal (MSM) at 4400 kg ha^{-1} on weeds and chile pepper fruit yield at four sites in southern New Mexico. Data are means with standard error. Means with the same letter are not significantly different according to paired t-tests (α =0.05).

Site	Treatment	Weed control		Chile pepper fruit yield
		Palmer amaranth	Ambient weeds	
		% of non-treated		kg $4m^{-1}$
Deming	MSM	83.3	100^4	14.3 a
	Non-treated	--	--	14.9 a
Las Uvas	MSM	100	91.7	4.8 a
	Non-treated	--	--	5.2 a
Leyendecker	MSM	100	86.1	3.0 a
	Non-treated	--	--	4.6 a
Los Lunas	MSM	100	54.2	4.5 a
	Non-treated	--	--	4.8 a
	Weighted mean[5]	95.8	80.6	

Table 2. The effects of mustard seed meal (MSM) at 2200 kg ha^{-1} on weeds and chile pepper fruit yield at four sites in southern New Mexico. Data are means with standard error. Means with the same letter are not significantly different according to paired t-tests (α =0.05).

Site	Treatment	Weed control		Chile pepper fruit yield
		Palmer amaranth	Ambient weeds	
		% of non-treated		kg $4m^{-1}$
Deming	MSM	50.0	100	18.4 a
	Non-treated	--	--	15.9 a
Las Uvas	MSM	66.7	66.7	4.7 a
	Non-treated	--	--	5.2 a
Leyendecker	MSM	100	78.3	4.8 a
	Non-treated	--	--	5.1 a
Los Lunas	MSM	20.8	61.1	5.8 a
	Non-treated	--	--	4.9 a
	Weighted mean[5]	60.3	74.9	

Potential Impact(s): Conventional and organic chile production requires novel methods for managing soil-borne pests. This project evaluated a promising, but untested, technique for chile pest management: mustard seed meal (MSM) soil amendments. Result indicated that MSM amendments after chile emergence reduce weed seedling emergence and protect crop yield. Because MSM is a non-herbicidal method for weed management, the results of this study are expected to benefit all chile farmers striving to reduce reliance on synthetic pesticides.

Progeny Selection of Bigtooth Maples *(Acer grandidentatum)*

Horticulture Research

Researcher: Rolston St. Hilaire, Plant and Environmental Sciences

Bigtooth maple (*Acer grandidentatum* Nutt.) is a woody deciduous tree that is indigenous only to North America. The plant is valued for its fall foliage color, but it is not widely used in managed landscapes. The plant has a wide contiguous geographic range than covers 18° degrees of latitude and includes regions in Utah, Idaho, Wyoming, Arizona, New Mexico, and Texas. This extensive range gives the bigtooth maple taxa one of the largest ecological ranges among the North American *Acer* genus. Because the plant is small and adaptable to many soils, horticulturists to speculate that bigtooth maple merits more use in managed landscapes.

In 2004, we planted a replicated block of bigtooth maples at the Fabian Garcia Agricultural Science Center. Seedlings for the planting block were grown from mature seeds of bigtooth maples collected from trees occurring in natural stands in New Mexico, Utah, and Texas. Seedlings were previously assessed for resilience to environmental stresses such as drought, salinity, and irradiance. Plants are being observed for desirable ornamental traits such as fall foliage color and plant architecture. Clonal material from promising material in the planting block is being selected and through material transfer agreements, the material is being assessed by external partners.

Genetic Improvement of Alfalfa (*Medicago sativa* L.) Germplasm for New Mexico

Agronomy Research

Researcher: Ian Ray, Plant and Environmental Sciences

NMSU plant breeding research uses conventional and molecular approaches to improve alfalfa drought tolerance so that farmers can conserve irrigation water resources while meeting the feed demands of the U.S. livestock industry. Since 2016,the NMSU drought-resilient alfalfa variety, NuMex Bill Melton, has been grown in NM, generating an estimated $500,000 annually in hay sales. Nine new alfalfa populations have been developed and are being evaluated in statewide field trials under well-watered and drought-stressed field conditions to identify those with superior performance in both environments. The program also helps conduct statewide forage yield evaluations of approximately 75 industry and public varieties. Results of these trials are published annually to help NM, AZ, and TX farmers identify the most suitable varieties for their particular growing region. State-of-the-art molecular breeding strategies are being applied to >200 experimental populations to evaluate their potential to accelerate development of drought-resilient alfalfa varieties with high nutritive value and disease resistance. Since irrigated soils tend to have high salt levels, these molecular tools are being assessed for improvement of seed germination salt tolerance. Opportunities to utilize unique relatives of alfalfa to improve productivity of commercial varieties are being investigated. Undergraduate and graduate teaching and research activities helped train future generations of agronomists and plant breeders to benefit agricultural sustainability.

Onion Genetic Improvement

Agronomy Research

Investigator: Christopher Cramer

Open-pollinated, male-sterile, maintainer, and pollinator breeding lines were screened for disease resistance, bulb yield, bulb quality, maturity date, and bulb color. Promising breeding and hybrid lines and released cultivars were compared to commercial cultivars and experimental lines using observational trials. One hundred thirteen different lines were evaluated this past year. Seeds of 113 different lines were produced in this year. This work contributes to the progress of developing a commercial onion cultivar that can be used by growers. Fusarium basal rot (FBR) is a soil-borne fungal disease that causes a disintegration of the onion bulb basal plate(compressed stem) thus killing a plant growing in the field. Once a bulb becomes infected with the fungal pathogen, the disease and the resulting decay it causes cannot be halted. Any plants exhibiting foliage symptoms consistent with the disease must be discarded, thus reducing yield. Soil fumigation, although costly, and crop rotation cycles of five years or more can reduce the frequency of the disease, but will not prevent it from occurring. FBR-resistant cultivars currently do not exist. Since onions have been grown in New Mexico for more than 100 years, many fields have had multiple onion crops in their history. In addition, as agricultural land becomes sequestered into residential development or perennial agricultural crops, such as pecan, the number of fields available for adequate rotation decreases and the rotation time between successive onion crops decreases to three years or less. The FBR pathogen also has the ability to infect other plant species and to survive on dead plant matter in the soil, thus increasing its longevity in the soil and decreasing the benefits of crop rotation.

As in the previous year, the inoculation method was very effective at causing disease in most bulbs. This effectiveness is very important for selecting FBR resistant bulbs. The susceptible check entries exhibited a high level of disease severity and incidence while the resistant check exhibited less disease severity. Of the FBR-selected populations, recent selections of 'NuMex Crimson', 'NuMex Crispy', 'NuMex Sweetpak', 'NuMex Vado', and 'Serrana' exhibited less disease consistently over years than previous generations and the susceptible checks. The most recent FBR-resistant selection of 'NuMex Camino','NuMex Chaco', and 'NuMex Mesa' exhibited less disease than the susceptible checks. In some instances, the most recent selection exhibited less disease than the FBR-resistant check. This result indicates that breeding for FBR resistance has been successful in producing germplasm that is more resistant than currently-available short-day commercial cultivars.

Our results from this past year confirm that the developed inoculation protocol is successful at identifying resistant bulbs. This protocol could be used by other onion breeding programs to develop FBR resistant cultivars. If the levels of FBR resistance observed this past year is consistent over years, FBR-resistant germplasm will be released to commercial breeding programs for the development of FBR-resistant cultivars.