TEXAS A&M AGRILIFE RESEARCH

Improving Life Through Science and Technology

Lubbock-Pecos-Halfway

Helm Research Farm

Summary Report

2019

Technical Report
20-3

Texas AgriLife Research / Dr. Patrick Stover, Director
The Texas A&M University System / College Station, Texas

Introduction

The Texas A&M University System purchased 373 acres of farmland from the estate of Ardella Helm in December 1999 for the purpose of conducting large scale research and extension programs to enhance producer profitability and sustainability in an irrigated environment. The farm is located 2 miles south of the Texas A&M AgriLife Research and Extension Center at Halfway in Hale County.

Current projects at the Helm Research Farm involve production options and economics of subsurface drip (SDI) and pivot irrigation. Other research includes weed and insect control, soil health, corn breeding and production systems projects. During the past year, irrigated experiments were conducted under the 130-acre center pivot and on 86-acres of SDI.

The soils are predominantly deep clay loams and silty clay loams, with 0-1% and 1-3% slopes, moderate to moderately slow permeable subsoils and high water and fertility holding capacities. Supplemental water for irrigation comes from six wells, 320 to 340 feet deep, pumping at rates of 100 to 200 gallons per minute each.

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Irrigation of Late-Planted, Low-Population Cotton using Subsurface Drip Irrigation (SDI) (Field 2)

James Bordovsky, Joe Mustian, Scott Jordan, and Heath Johnson

Objective: Determine cotton lint yield, fiber quality, and water productivity of low-population, late-planted cotton using three irrigation timing treatments.

Methodology: This study was conducted in a 12-acre area irrigated by SDI with 30-inch dripline spacing. On May 29th, following heavy rainfall, cotton was replanted at 44,000 seeds/ac. Due to a second heavy rainfall and blowing sand event in early July reducing plant stands to <14,000 plants per acre, the initial test protocol for the field was changed. Table 1 provides the final irrigation schedule for the three treatments. Yields, fiber quality and water productivity from the different treatments were determined. Irrigation amounts, field operations, varieties, pesticides and nutrient applications for 2019 are listed in the appendix.

Results: Annual rainfall through September was 14.74 inches with the seasonal irrigation of 1.56, 2.26 and 3.03 inches for the three respective treatments. Irrigation increased lint yields, with T3 resulting in the highest yield at 831 lb/ac. The seasonal irrigation water use efficiency (SIWUE) of T2 and T3 were essentially the same at 169 and 167 lb/ac-in, respectively, with decreased SIWUE in the T1 treatment at 154 lb/ac-in. The loan values among treatments ranged from $0.527/lb to $0.532/lb. In years of similar weather challenges, irrigation of damaged, low population cotton may be a better alternative than replanting with grain sorghum.

Table 1. Proposed irrigation schedule due to late replant and poor cotton stand, 2019.

Week of	2019 Updated Irrigation Events			
	T1	T2	T3	Check
Jul 29			X	
Aug 5	X	X	X	
Aug 12	X	X	X	
Aug 19		X		
Aug 26			X	

Table 2. Seasonal irrigation, lint yield, seasonal irrigation water use efficiency (SIWUE), relative water value, and lint quality data resulting from irrigation timing treatments using subsurface drip irrigation Helms Research Farm, 2019.

Treatment	Seasonal Irrigation (in)	Lint Yield (lb/ac)	SIWUE (lb/ac-in)	Water Value ($/ac-in)	Mic	Length	Unif.	Strength	Elon.	Rd	+b	Leaf	Loan Price (¢/lb)
Check	0.00	324			5.24	1.06	80.2	29.00	6.8	75.40	9.60	2	49.10
T1	1.56	564 c*	154	89	4.92	1.07	80.8	29.20	6.7	76.40	9.30	2.0	52.77 a
T2	2.26	707 b	169	96	4.99	1.10	81.7	31.03	7.0	76.10	9.53	1.3	53.20 a
T3	3.03	831 a	167	92	4.90	1.08	80.3	29.40	7.0	76.43	9.40	2.3	52.72 a

* Yield means in a column followed by the same letter are not significantly different (p<0.5, Tukey)

Irrigation Timing of Late-Planted, Low Population Cotton Using Subsurface Drip Irrigation (SDI) (Field 3)

James Bordovsky, Joe Mustian, Scott Jordan, and Heath Johnson

Objective: Determine cotton lint yield, fiber quality, and water productivity of late-planted, low-population cotton, using six SDI timing treatments.

Methodology: This study was conducted in a 16-acre test area irrigated by SDI with 60-inch dripline spacing. On May 29th, following a heavy rainfall event, cotton was replanted at 44,000 seeds/ac. Due to a second heavy rainfall and blowing sand event in early July reducing plant stands to <14,000 plants per acre, the initial experiment was changed. Table 1 provides the final irrigation schedule for the six treatments. Yields, fiber quality, and water productivity from these treatments were determined.

Results: Annual rainfall through September was 14.7 inches with total seasonal irrigation quantities ranging from 1.6 to 4.7 inches. Lint yields ranged from 680 to 1065 lb/ac (Table 1) within the six irrigated treatments. As irrigation quantities increased, lint yield increased and seasonal irrigation water use efficiency (SIWUE) decreased. The three treatments that received the most irrigations (T1, T4, and T6) resulted in the highest fiber quality, with T6 having the highest loan value at $0.564/lb. In years of similar weather challenges, irrigation of damaged, low population cotton may be a better alternative than replanting with grain sorghum.

Table 1: Irrigation timings, seasonal irrigation amounts, cotton lint yields, and seasonal water use efficiency of irrigation treatments using SDI at the Helm Research Farm, Halfway, TX, 2019.

Treatment	Weeks of Scheduled Irrigations for Each Treatment						Seasonal Irrigation	Lint Yield	SIWUE
	Jul 29	Aug 5	Aug 12	Aug 19	Aug 26	Sep 2	(in)	(lb/ac)	(lb/ac-in)
Check							0.00	338	
T2		X		X			1.59	679 d*	215
T3		X		X	X		2.35	801 c	197
T5		X	X		X		2.36	801 c	196
T1		X	X	X	X		3.14	922 b	186
T6		X	X	X	X	X	4.03	994 ab	163
T4	X	X	X	X	X	X	4.69	1066 a	155

* Yield means in a column followed by the same letter are not significantly different (p<0.5, Tukey)

Table 2: Cotton lint fiber quality characteristics and loan values of irrigation treatments using SDI at the Helm Research Farm, Halfway, TX, 2019.

Treatment	Mic	Length	Unif	Strength	Elon.	RD	+b	Leaf	Loan Price (¢/lb)
Check	5.20	1.04	79.9	27.35	6.7	75.60	9.65	2.0	49.90
T2	5.05	1.09	81.5	29.90	6.9	77.70	9.40	1.3	52.90 a
T3	4.95	1.12	81.4	30.33	6.9	76.45	9.33	1.3	53.90 a
T5	4.95	1.11	81.9	30.65	7.0	77.03	9.40	1.3	53.40 a
T1	4.97	1.13	82.3	31.08	7.0	77.43	9.38	1.0	54.00 a
T6	5.59	1.14	81.6	31.03	7.2	78.20	9.15	1.0	56.40 a
T4	4.75	1.13	81.4	31.40	7.7	78.03	9.18	1.0	55.00 a

* Loan price means in a column followed by the same letter are not significantly different (p<0.5, Tukey)

Continuous Cotton Response to Tillage and Irrigation Level (Field 5a)
James Bordovsky, Casey Hardin, Joe Mustian, and Scott Jordan

Objective: Determine yield, fiber quality, water use efficiency of continuous cotton at three irrigation levels under conventional and reduced tillage.

Methodology: These results are part of a comprehensive crop rotation-tillage-irrigation study conducted on 125 acres irrigated by LEPA. In this 22-acre test area continuous cotton has been grown since 2014. Each pivot span was divided into three sections with each section delivering different irrigation amounts. The irrigation levels were designated as the base irrigation rate (1.0 BI); 50% of base irrigation rate (0.5 BI); and 150% of base irrigation rate (1.5 BI). Field operations, irrigation amounts, varieties, pesticides and nutrient applications are listed in the appendix.

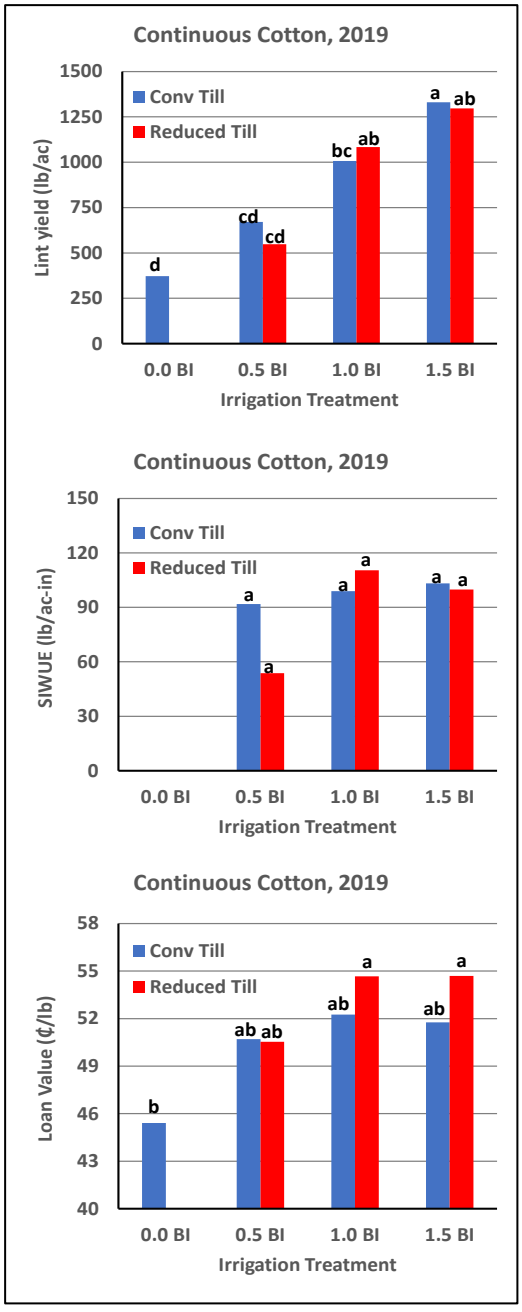


Figure 1. Cotton lint yield, seasonal irrigation water use efficiency, and cotton lint loan value from irrigation levels in two tillage systems at Helms Research Farm, 2019.

Results: Annual rainfall for 2019 through September, was 14.74 inches and the combined preplant and seasonal irrigations in the three respective irrigation treatments were 5.60, 8.85, and 11.60 inches. As irrigation increased, cotton lint yield increased in both tillage systems and increased seasonal irrigation water use efficiency (SIWUE) in the conventionally tilled areas. However, in the reduced tillage areas, irrigation at the 1.5 BI level reduced the SIWUE compared to the 1.0 BI level. Fiber quality, as reflected in the lint loan value, of the 0.5 BI treatments were similar in both the conventionally tilled and reduced tilled areas. At the 1.0 BI and the 1.5 BI levels, conventional compared to reduced tillage reduced loan values by 4.4% and 5.4% respectively.

Figure 2. Planting cotton in the reduced tillage treatment area of tillage-irrigation experiment, Helms Farm, 2019.

Cotton / Wheat Grain Rotation Response to Tillage and Irrigation Levels (Field 5c)
James Bordovsky, Casey Hardin, Joe Mustian, and Scott Jordan

Objective: Determine lint yield, fiber quality, and water productivity of cotton following a wheat / fallow period with cotton irrigated at three levels under conventional and reduced tillage systems.

Methodology: These results are part of a comprehensive crop rotation-tillage-irrigation study conducted on 125 acres irrigated by LEPA. In this 22-acre test area, cotton (in 2019) was planting following wheat harvest for grain and summer fallow period (in 2018). Two tillage systems, conventional tillage (even center pivot spans) and reduced tillage (odd spans) were used. In addition, each span was divided into three sections, with each section delivering different irrigation quantities. The irrigation levels were designated as base irrigation rate (1.0 BI); 50% of base irrigation rate (0.5 BI); and 150% of base irrigation rate (1.5 BI). Field operations, irrigation amounts, varieties, pesticides, and nutrient applications are listed in the appendix.

Results: Annual rainfall for 2019 through September was 14.74 inches and the combined preplant and seasonal irrigations in the three respective irrigation treatments were 5.60, 8.60, and 11.60 inches. On May 29th, following a heavy rainfall event, cotton was replanted. As irrigation quantity increased, lint yield increased in both tillage systems. Under reduced tillage, the 0.5 BI and 1.5 BI treatments resulted in 16.6% and 17.0% higher respective lint yields, and 38.8% and 24.2% higher respective seasonal irrigation water use efficiencies (SIWUEs) than corresponding conventionally tilled treatments. Fiber quality, as reflected in the lint loan value, of reduced tillage treatments increased as irrigation increased, however in the conventionally tillage areas, the loan value decreased as irrigation was applied above the 1.0 BI level.

Figure 1. Cotton planted into harvested wheat in tillage x crop rotation x irrigation level experiments at the Helms Research Farm, Halfway, TX 2019.

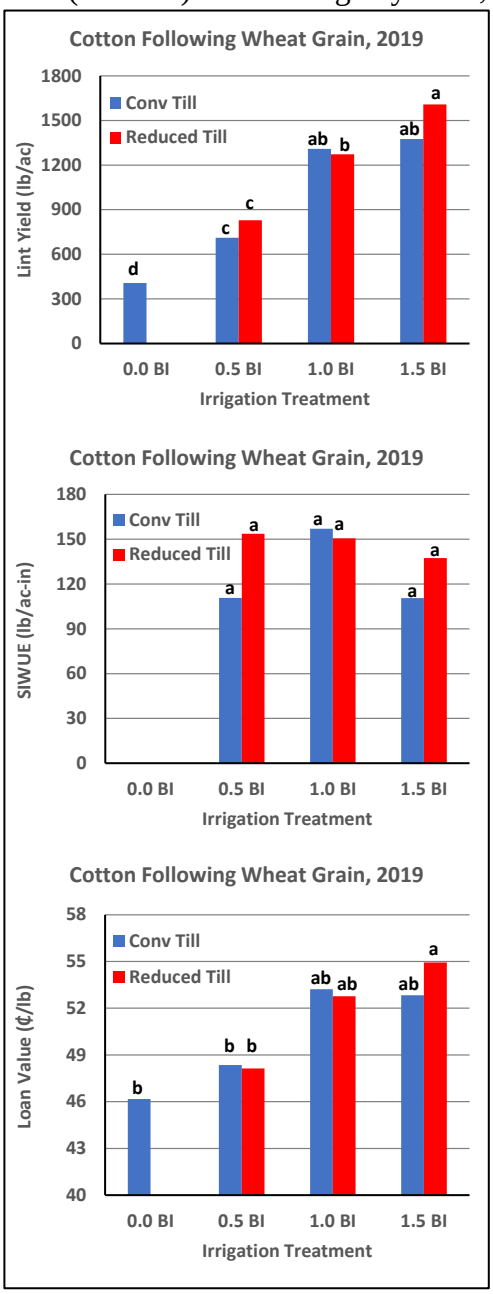


Figure 2. Cotton lint yield, seasonal irrigation water use efficiency, and cotton lint loan value from irrigation levels in two tillage systems at Helms Research Farm, Halfway, TX, 2019.

Cotton in Terminated Wheat Response to Tillage and Irrigation Levels (Field 5d)
James Bordovsky, Casey Hardin, Scott Jordan, and Joe Mustian

Objective: Determine yield, fiber quality, and water productivity of cotton planted into terminated wheat at three irrigation levels under conventional and reduced tillage systems, and with traditional and delayed (late) seasonal irrigation start dates.

Methodology: These results are part of a comprehensive crop rotation-tillage-irrigation study being conducted on 125 acres irrigated by LEPA. In this 22-acre test area, cotton has been planted into terminated wheat for the past several years. Two tillage systems, conventional tillage (in even numbered center pivot spans), and reduced tillage (in odd numbered spans) were used. Each pivot span was divided into three sections, with each section providing different irrigation quantities. Also, seasonal irrigations on the west half of this wedge were delayed until August 3rd, verse a July 23rd start on the east half to document effects on seasonal irrigation timing. Irrigation amounts, varieties, pesticides, and nutrient applications for 2019 are listed in the appendix.

Results: As irrigation increased, cotton lint yields increased in both tillage systems and both seasonal irrigation timing treatments. Regardless of the seasonal irrigation timing treatment, irrigation above the 0.5 BI level significantly increased lint yield. Within an irrigation level for a given season irrigation timing treatment, there were no significant differences due to tillage treatments in yield, seasonal irrigation water use efficiency (SIWUE), or loan value. Delaying seasonal irrigation resulted in decreased yields by an average of 5.6% but resulted in increased SIWUE, due to less total irrigation, compared to corresponding earlier irrigation start treatments. This is partially attributed to reducing evaporation losses by delaying irrigation start. Postponing seasonal irrigation decreased fiber quality in all treatments.

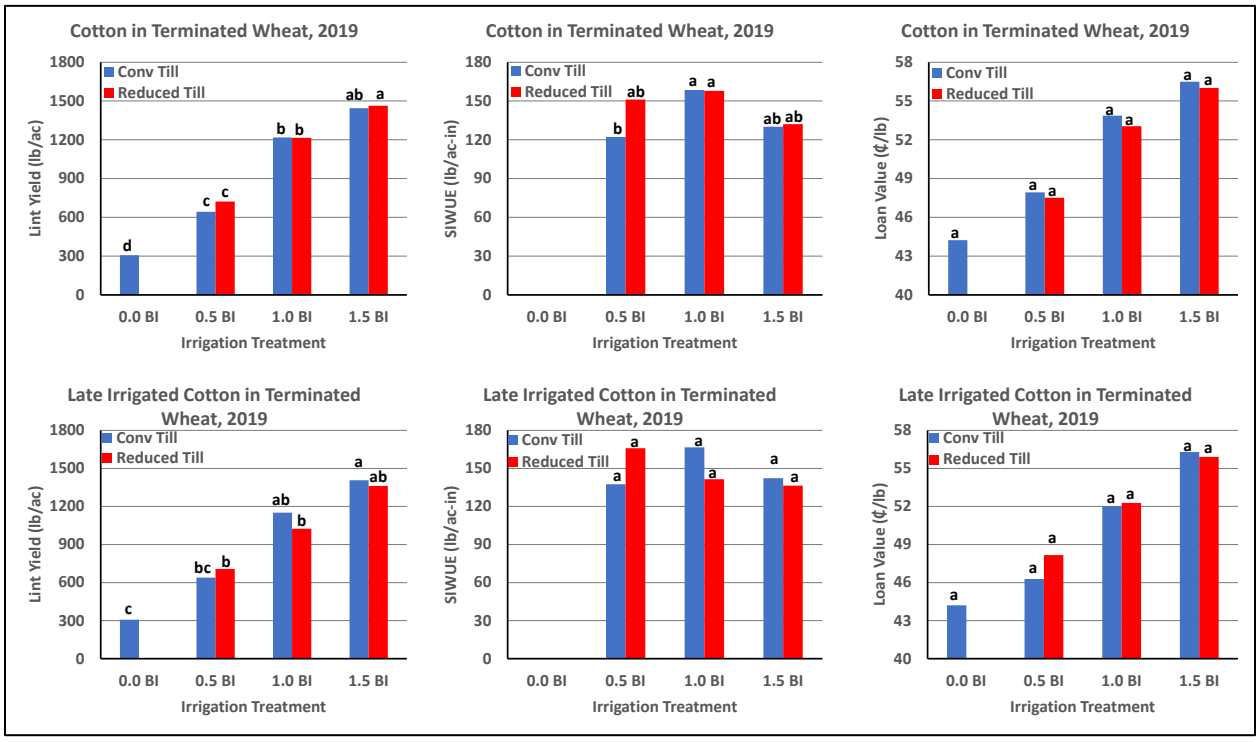


Figure 1. Cotton lint yield, seasonal irrigation water use efficiency (SIWUE), and lint loan values from treatments having two irrigation start dates, two tillage methods, and three irrigation levels at Helms Research Farm, 2019.

Cotton / Sorghum Rotation Response to Tillage and Irrigation Levels (Field 5e)
James Bordovsky, Casey Hardin, Joe Mustian, and Scott Jordan

Objective: Determine yield, fiber quality, and water productivity of cotton following grain sorghum in a two-year rotation with irrigation at three levels under conventional and reduced tillage.

Methodology: These results are part of a comprehensive crop rotation-tillage-irrigation study being conducted at Helms Research Farm. In this 22-acre test area, cotton was planted following grain sorghum in a two-year rotation. Two tillage systems, conventional tillage (in even center pivot spans) and reduced tillage (in odd spans) were used. In addition, each pivot span was divided into three sections with each section delivering one of three irrigation levels. The irrigation levels were designated as base irrigation rate (1.0 BI); 50% of base irrigation (0.5 BI); and 150% of base irrigation (1.5 BI). Irrigation amounts, field operations, varieties, pesticides and nutrient applications for 2019 are listed in the appendix.

Results: Due to heavy rainfall and blowing sand, cotton was replanted on May 31st. 2019 cotton yields increased over those in 2018 due, in part, to increased 2019 rainfall. Seasonal irrigations of the three respective irrigation treatments were reduced from 3.3, 7.8, and 11.3 in 2018 to 3.25, 6.25, and 9.25 in 2019. Lower seasonal irrigation and higher lint yields resulted in increased seasonal irrigation water use efficiency (SIWUE) from 2018 to 2019. The reduced tillage treatments resulted in higher cotton yields across all three irrigation amounts. Fiber quality, as reflected in the lint loan value, in the conventional compared to reduced tillage areas increased by 1.6% and 4.7% at the 0.5 BI and 1.5 BI levels respectively but decreased by 1.1% at the 1.0 BI level (data not shown).

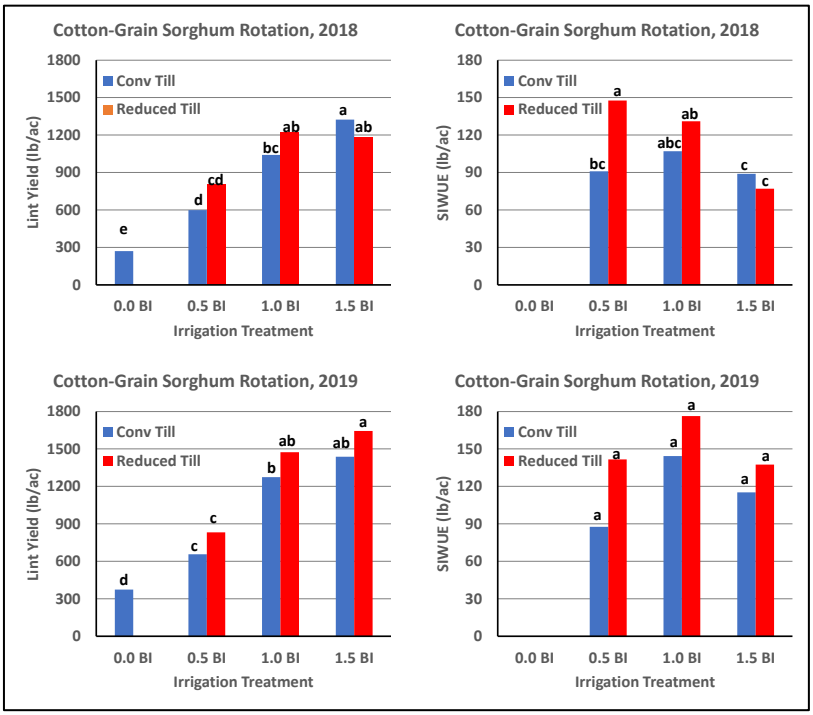


Figure 1: Lint yield and seasonal irrigation water use efficiency (SIWUE) of irrigated cotton treatments following grain sorghum using conventional and reduced tillage systems at three irrigation levels at the Helm Research Farm, 2018 -2019.

Grain Sorghum / Cotton Rotation Response to Tillage and Irrigation Levels (Field 5f)
James Bordovsky, Casey Harden, Joe Mustian, and Scott Jordan

Objective: Determine yield and water productivity of grain sorghum following cotton in a two-year rotation irrigated at three levels under conventional and reduced tillage systems.

Methodology: These results are part of an ongoing crop rotation-tillage-irrigation study conducted on a 125-acre area irrigated by LEPA. Grain sorghum was planted in a two-year rotation with cotton. Two tillage systems, conventional tillage (even center pivot spans) and reduced tillage (odd pivot spans) were used. In addition, each pivot span was divided into three sections with each section delivering one of three irrigation levels. The irrigation levels were designated as base irrigation rate (1.0 BI); 50% of base irrigation (0.5 BI); and 150% of base irrigation (1.5 BI). Irrigation amounts, crop varieties, field operations, pesticides, and nutrient applications are provided in the appendix.

Figure 1: Grain sorghum harvest from treatment areas following cotton using conventional and reduced tillage systems at three irrigation levels at the Helms Farm, 2014 – 2019)

Results: Average grain sorghum yields from 2014 through 2019 are given in Figure 2. Non-irrigated yields were lower in 2019 (292 lb/ac) compared to previous years (4200, 3800, 1270, 555 lb/ac in 2015, 2016, 2017, and 2018, respectively). With one exception over the past years, grain yields have increased with increased irrigation. Over the last three-year period, reduced tillage treatments have consistently resulted in higher grain sorghum yields at the 0.5 BI and 1.0 BI irrigation levels than those in the conventional tillage treatments.

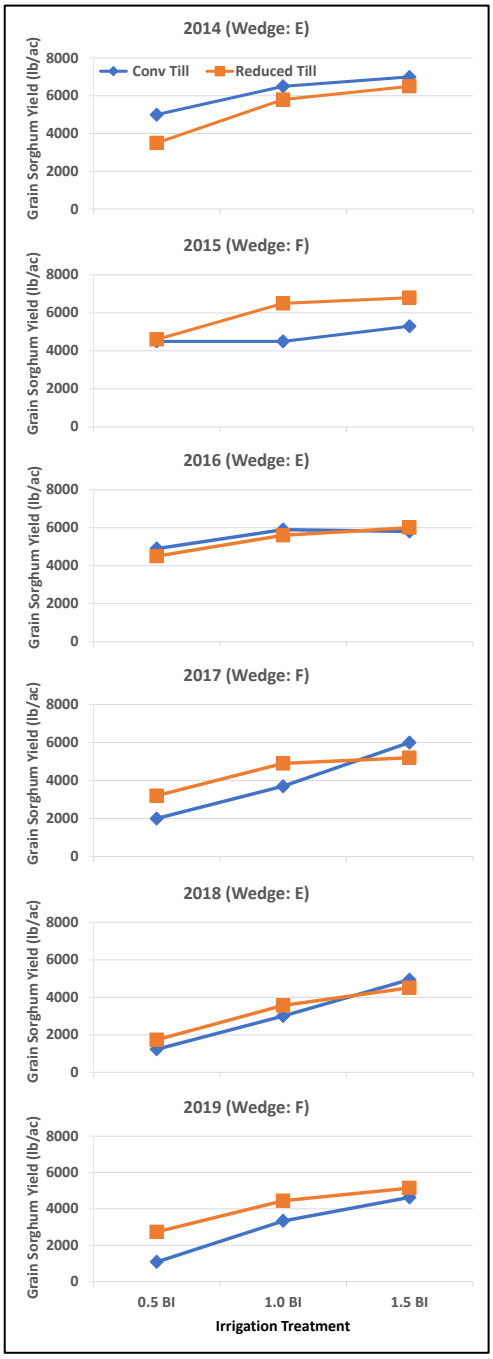


Figure 2: Grain sorghum yields from treatment areas following cotton using conventional and reduced tillage systems at three irrigation levels at the Helms Farm, 2014 – 2019.

The Effect That Verticillium Wilt Has on Yield and Gross Returns of Cotton (Field 5a-e)

Terry Wheeler, Jim Bordovsky, Donna McCallister, Will Keeling, Cecil Haralson, Zach Hilliard, and Robert Ballesteros

Methodology: The Helm Farm circle is divided into 6 wedges (A-F). Since 2014, wedge A has been in continuous cotton without a cover crop; wedge B and C are in a cotton/winter wheat/summer fallow rotation; wedge D is in continuous cotton with a wheat cover crop; and wedges E and F are in a cotton/sorghum rotation. There are three irrigation rates, where 1.0B is the base rate, and 0.5B and 1.5B are 50% below or above the 1.0B rate. Each of these irrigation rates cover approximately 20 rows under each span of the pivot from the 3rd through the 8th span. Since 2014, there are two tillage treatments, a conventional tillage treatment with beds and LEPA irrigation every other furrow, and a minimum tillage treatment on flat ground with splatter irrigation. This circle is infested with *Verticillium dahliae* which is a fungus that causes Verticillium wilt. The cropping system does not have impact on Verticillium wilt, because the circle has had this disease since 2007 and previous cropping systems and soil properties associated with different wedges have more impact on the disease than the current cropping systems. The analysis will be presented in terms of the land areas with the most Verticillium wilt, to the land areas with the least Verticillium wilt.

Results: The land area with the most Verticillium wilt and highest density of *V. dahliae* spores is the sorghum/cotton rotation (wedges E and F, average of 19% wilt). The next most "diseased" area is where the cotton/winter wheat/summer fallow (wedges B and C, average of 15% wilt) is. This is followed by the continuous cotton wedge without a cover crop (wedge A, average of 13% wilt), and finally the continuous cotton wedge with a cover crop (wedge D, average of 10% wilt).

The most obvious impact on yield was that the continuous cotton with no cover (wedge A) had much lower yields than the rest of the circle (Fig. 1A). This is an area that just has lower yield potential due to its slope and probably some soil properties specific to that part of the circle. With the sorghum/cotton rotation area, the yield went from highest to lowest at the 1.0B, 1.5B, and 0.5B irrigation rates, and for the 1.0 and 1.5 rates, yield was higher for the minimum tillage system than for the conventional tillage system (Fig. 1A). Those irrigation rates will have the most Verticillium wilt. However, looking at the gross margin for that area, the minimum tillage system had a large advantage over the conventional tillage system (Fig. 1B), and the gross margin was best for 1.0B, followed by 0.5B, and lowest for the 1.5B irrigation rate (for both tillage systems). With the wheat/fallow/cotton area, yield was against the highest for the 1.0B irrigation rate. The gross margin was highest for the lowest irrigation rate (0.5) for both tillage systems, followed by the 1.0B, and lowest for the 1.5B irrigation rates. Again, the minimum tillage system was more profitable than the conventional tillage system. With the low yielding A wedge, all irrigation rates and both tillage systems had negative gross margins. With the continuous cotton system/cover crop that had the least amount of wilt, yields were highest and similar between the 1.0B and 1.5B irrigation rates, and similar between tillage systems. Gross margins were also similar between tillage systems and highest for the 1.0B irrigation rate. In areas with the most Verticillium wilt, reducing irrigation rate and using minimum tillage resulted in the best gross margin.

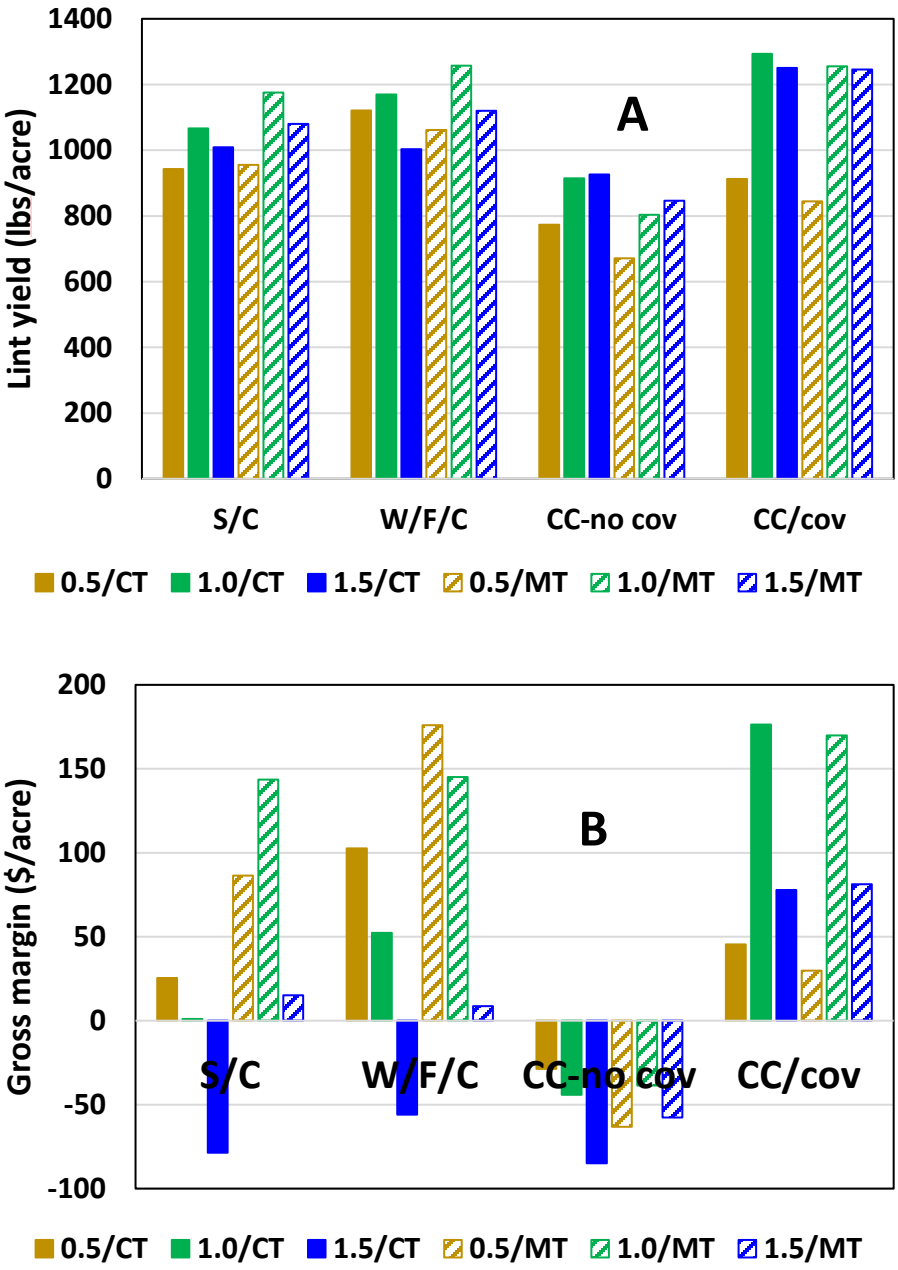


Figure 1. The affect of irrigation rate (0.5, 1.0, 1.5) and tillage system (CT = conventional tillage, MT = minimum tillage) on lint yield (A) and gross margin (B).

Performance of Deltapine Varieties as Affected by Irrigation Levels at Halfway, TX, 2019.

Katie Lewis, Dustin Kelley, Ira Yates, Debrah Dobitz, and Amee Bumguardner

Methodology:

Plot Size: 4 Rows x 35 feet, 4 replications

Planting Date: May 16, Replanted May 30

Varieties:		
	DP2012B3XF	DP2020B3XF
	DP2022B3XF	DP2044B3XF
	18R628NRB3XF	DP1908B3XF
	DP1909XF	DP1948B3XF
	DP1820B3XF	DP1822XF
	DP1845B3XF	DP1646B2XF

Herbicides:

Trifluralin 4EC 1 qt/ac - 3/5/2019
Medal EC 1.3 pt/ac - 5/22/2019
Solera 48 oz/ac, Induce 1% - 5/31/2019
Engenia 12.8 oz/ac, Showdown 48 oz/ac,
Smoke & Justified 3oz/ac - 6/24/2019
Acephate 3 oz/ac - 6/25/2019
Medal EC 1.3 pt/ac - 7/1/2019
Showdown 36 oz/ac, Liberty 42 oz/ac - 7/23/2019
Mepiquat 8 oz/ac - 7/24/2019
Diuron 1.5 pt/ac - 7/30/2019
Mepiquat 16 oz/ac - 8/14/2019
Mepiquat 18 oz/ac - 8/26/2019

Fertilizer: 107-63-0 (irrigated); 33-28-0 (dryland)

Irrigation: LEPA

	Dry	Low	Base	High
Pre-plant	2.9”	2.9"	2.9"	2.9"
In-season	0.8”	3.9"	7.4"	10.8"
Total	3.7”	6.8"	10.2"	13.6"

Harvest Date: November 18

Results: Twelve Deltapine varieties were compared under three irrigation levels and dryland (preplant irrigation only) conditions. Averaged across varieties, yields increased from dryland to the high irrigation level (Table 1). Averaged across the four water regimes, DP 1646 B2XF, DP 1822 XF, DP 1845 B3XF, and DP 2044 B3XF produced over 1,100 lb lint/acre. Marginal differences were determined for loan value averaged across varieties. Generally, the low irrigation level had a greater loan value (Table 2).

Table 1. Effect of cotton variety and irrigation on lint yield (lbs/ac).

	Lint Yield (lb/ac)				
Varieties	**Dry**	**Low**	**Base**	**High**	**Average**
18R628NRB3XF	721	850	1227	1397	**1049**
DP1646B2XF	762	902	1295	1490	**1112**
DP1820B3XF	690	843	1210	1481	**1056**
DP1822XF	741	936	1225	1612	**1129**
DP1845B3XF	770	883	1281	1570	**1126**
DP1908B3XF	678	762	1084	1352	**969**
DP1909XF	724	806	1087	1493	**1028**
DP1948B3XF	669	976	1195	1517	**1089**
DP2012B3XF	702	876	1266	1516	**1090**
DP2020B3XF	728	803	1208	1495	**1058**
DP2022B3XF	664	806	1156	1588	**1054**
DP2044B3XF	738	872	1223	1594	**1107**
Average	**716**	**860**	**1205**	**1509**	**1072**

Table 2. Effect of cotton variety and irrigation on loan value (cents/lb).

	Loan Value (cents/lb)				
Varieties	**Dry**	**Low**	**Base**	**High**	**Average**
18R628NRB3XF	52.40	53.85	53.00	50.20	**52.36**
DP1646B2XF	53.70	54.00	54.10	53.90	**53.93**
DP1820B3XF	53.90	54.30	53.95	54.30	**54.11**
DP1822XF	53.95	54.25	53.95	54.35	**54.13**
DP1845B3XF	54.25	54.15	54.25	54.30	**54.24**
DP1908B3XF	53.80	54.10	54.10	54.25	**54.06**
DP1909XF	53.65	54.10	53.85	54.25	**53.96**
DP1948B3XF	54.30	54.20	54.30	54.30	**54.28**
DP2012B3XF	52.80	54.10	53.85	54.30	**53.76**
DP2020B3XF	53.70	54.10	54.10	54.15	**54.01**
DP2022B3XF	52.55	53.45	52.55	53.80	**53.09**
DP2044B3XF	54.30	54.30	54.20	50.60	**53.35**
Average	**53.61**	**54.08**	**53.85**	**53.56**	**53.77**

Performance of Americot Varieties as Affected by Low-Energy Precision Application (LEPA) Irrigation Levels at Halfway, TX, 2019.

Wayne Keeling, Justin Spradley, Ray White, and Brice DeLong

Methodology:

Plot Size: 4 rows by 35 feet, 4 replications

Planting Date: May 30

Varieties: DP 1646 B2XF
NG 2982 B3XF
NG 3930 B3XF
NG 3956 B3XF
NG 4098 B3XF
NG 4777 B2XF
NG 4936 B3XF
NG 5711 B3XF

Herbicides:			
	Trifluralin	1 qt/A	3/5/19
	Medal	1.3 pt/A	5/16/19
	Engenia	12.8 oz/A	6/24/19
	Warrant	1.3 pt/A	7/1/19
	Glyphosate	32 oz/A	7/12/19
	Diuron (hooded sprayer)	1.5 pt/A	7/29/19

Fertilizer: 140-60-0

Irrigation in-season:

	Low	Base	High
Preplant	3.4”	3.4”	3.4”
In Season	3.4”	6.9”	10.3”
Total	6.8”	10.3”	13.7”

Harvest Date: November 14

Results: Seven NexGen varieties and a competitive check were compared under three levels of center-pivot LEPA irrigation. The trial was planted in May but due to hail damage was replanted May 30. When varieties were averaged within irrigation levels, yields increased from 669 lbs/A to 1335 lbs/A with increased irrigation. When averaged across irrigation levels, the highest yielding group included NG 4777 B3XF, NG 4098 B3XF, NG 3930 B3XF, and DP 1646 B2XF. Loan values were similar for the base and high irrigation levels and higher than the low irrigation treatment. When averaged across irrigation levels, highest loan values were achieved with NG 4098 B3XF, NG 4936 B3XF, and DP 1646 B2XF. Gross revenues ($/A) increased with higher irrigation inputs. When averaged across irrigation levels, highest gross revenues were achieved with NG 4777 B2XF, NG 4098 B3XF. Yields, loan values, and gross returns are summarized in Table 1.

Table 1. Effect of variety and irrigation level on cotton lint yield (lbs/A), loan value (¢/lb), and gross revenue ($/A).

	In-season Irrigation Levels (inches)			
Variety	**Low (3.4)**	**Base (10.3)**	**High (13.7)**	**Average**
	---------- lbs/A----------			
DP 1646 B2XF	730	1280	1443	**1151 A**
NG 2982 B3XF	684	1137	1187	**1003 BC**
NG 3930 B3XF	648	1254	1449	**1117 A**
NG 3956 B3XF	611	1114	1314	**1013 BC**
NG 4098 B3XF	711	1234	1307	**1084 AB**
NG 4777 B2XF	658	1191	1498	**1116 A**
NG 4936 B3XF	721	1079	1264	**1021 BC**
NG 5711 B3XF	592	1063	1220	**958 C**
Average	**669 C**	**1169 B**	**1335 A**	**--**
	---------- ¢/lb----------			
DP 1646 B2XF	56.15	56.43	56.45	**56.34 A**
NG 2982 B3XF	51.35	54.55	50.65	**52.18 E**
NG 3930 B3XF	53.98	55.68	56.48	**55.38 B**
NG 3956 B3XF	52.00	54.48	55.90	**54.13 C**
NG 4098 B3XF	55.80	56.48	56.48	**56.25 A**
NG 4777 B2XF	49.98	53.50	56.03	**53.17 D**
NG 4936 B3XF	56.25	56.40	56.63	**56.43 A**
NG 5711 B3XF	53.80	56.35	56.20	**55.45 B**
Average	**53.66 B**	**55.48 A**	**55.60 A**	**--**
	---------- $/A----------			
DP 1646 B2XF	410	722	815	**649 A**
NG 2982 B3XF	351	620	601	**524 D**
NG 3930 B3XF	350	698	818	**622 AB**
NG 3956 B3XF	318	607	734	**553 CD**
NG 4098 B3XF	397	697	738	**611 AB**
NG 4777 B2XF	329	637	839	**602 AB**
NG 4936 B3XF	406	609	716	**577 BC**
NG 5711 B3XF	319	599	686	**535 CD**
Average	**360 C**	**649 B**	**743 A**	**--**

Performance of FiberMax and Stoneville Varieties as Affected by Low-Energy Precision Application (LEPA) Irrigation Levels at Halfway, TX, 2019.

Wayne Keeling, Justin Spradley, Ray White, and Brice DeLong

Methodology:

Plot Size: 4 rows by 35 feet, 3 replications

Planting Date: May 15

Varieties:

BX 2002 GL (FM 2202 GL)	FM 1911 GLT
BX 2005 GLT	FM 2398 GLT
BX 2037 GLT	FM 2498 GLT
FM 1621 GL	FM 2574 GLT
FM 1830 GLT	ST 5600 B2XF
FM 1888 GL	ST 5707 B2XF

Herbicides:

Trifluralin	1 qt/A	3/5/19
Medal	1.3 pt/A	5/16/19
Warrant	1.3 pt/A	7/1/19
Glyphosate	32 oz/A	7/12/19
Medal	1.3 pt/A	7/29/19
Glyphosate	32 oz/A	8/1/19

Fertilizer: 140-60-0

Irrigation in-season:

	Low	Base	High
Preplant	3.4”	3.4”	3.4”
In Season	3.4”	6.9”	10.3”
Total	6.8”	10.3”	13.7”

Harvest Date: November 14

Results: Twelve entries, including nine commercial varieties, seven FiberMax and two Stoneville, along with three experimental varieties were compared under three levels of center-pivot irrigation. When averaged across varieties, lint yields ranged from 750 lbs/A to 1303 lbs/A as irrigation level increased. When averaged across irrigation levels, the highest yields were produced with FM 2498 GLT, FM 2398 GLT, and FM 1621 GLT. Variety or irrigation level did not affect loan values. Gross revenue ($/A) was highest with FM 1621 GL, FM 2398 GLT, FM 2498 GLT, and FM 2202 GL, which is a new variety for 2020. Effects of varieties and irrigation levels in cotton lint yield, fiber quality, and gross revenues are summarized in (Table 1).

Table 1. Effect of variety and irrigation level on cotton lint yield (lbs./A), loan value (¢/lb.), and gross revenue ($/A).

	Irrigation Levels (inches)			
Variety	**Low (3.4)**	**Base (6.9)**	**High (10.3)**	**Average**
	---------- lbs/A----------			
BX 2005 GLT	795	1170	1413	**1126 BCD**
BX 2037 GLT	780	1119	1205	**1035 E**
FM 1621 GL	816	1304	1387	**1169 ABC**
FM 1830 GLT	733	1169	1185	**1029 E**
FM 1888 GL	754	1152	1340	**1082 CDE**
FM 1911 GLT	680	1178	1393	**1084 CDE**
FM 2202 GL	796	1202	1372	**1123 BCD**
FM 2398 GLT	799	1225	1492	**1172 AB**
FM 2498 GLT	786	1305	1595	**1229 A**
FM 2574 GLT	726	1176	1337	**1080 DE**
ST 5600 B2XF	644	885	877	**802 G**
ST 5707 B2XF	696	1066	1040	**934 F**
Average	**750 B**	**1163 A**	**1303 A**	**--**
	----------¢/lb----------			
BX 2005 GLT	50.33	52.95	51.15	**51.48 A**
BX 2037 GLT	52.02	53.97	50.20	**52.06 A**
FM 1621 GL	49.83	53.02	52.68	**51.84 A**
FM 1830 GLT	52.47	54.20	49.75	**52.14 A**
FM 1888 GL	51.03	52.57	52.85	**52.15 A**
FM 1911 GLT	52.23	53.18	51.07	**52.16 A**
FM 2202 GL	52.65	52.85	52.93	**52.81 A**
FM 2398 GLT	52.38	52.85	53.77	**53.00 A**
FM 2498 GLT	51.42	52.55	53.90	**52.62 A**
FM 2574 GLT	52.12	53.97	52.33	**52.81 A**
ST 5600 B2XF	51.40	53.33	50.38	**51.71 A**
ST 5707 B2XF	49.85	53.80	47.32	**50.32 A**
Average	**51.48 A**	**53.27 A**	**51.53 A**	**--**
	----------$/A----------			
BX 2005 GLT	401	620	722	**581 BCDE**
BX 2037 GLT	406	604	609	**540 DE**
FM 1621 GL	408	692	730	**610 ABC**
FM 1830 GLT	385	634	595	**538 E**
FM 1888 GL	384	605	708	**566 CDE**
FM 1911 GLT	356	627	714	**566 CDE**
FM 2202 GL	419	635	728	**594 ABCD**
FM 2398 GLT	419	647	802	**623 AB**
FM 2498 GLT	404	686	860	**650 A**
FM 2574 GLT	378	635	706	**573 BCDE**
ST 5600 B2XF	331	472	442	**415 G**
ST 5707 B2XF	347	573	499	**473 G**
Average	**387 B**	**619 A**	**676 A**	**--**

Performance of PhytoGen Varieties as Affected by Irrigation Levels at Halfway, TX, 2019.

Wayne Keeling, Justin Spradley, and Ray White, Brice Delong

Methodology:

Plot Size: 4 rows by 32 feet, 4 replications

Planting Date: May 15

Varieties:

DP 1646 B2XF	PHY 350 W3FE
FM 1911 GLT	PHY 480 W3FE
NG 4777 B2XF	PX 2B14 W3FE
PHY 210 W3FE	PX 2C14 W3FE
PHY 250 W3FE	PX 3B07 W3FE (PHY 400 W3FE)
PHY 300 W3FE	PX 3C06 W3FE
PHY 320 W3FE	PX 3D32 W3FE
PHY 340 W3FE	PX 3D43 W3FE

Herbicides:

Trifluralin	1 qt/A	3/5/19
Medal	1.3 pt/A	5/16/19
Warrant	1.3 pt/A	7/1/19
Glyphosate	32 oz/A	7/12/19
Medal	1.3 pt/A	7/29/19
Glyphosate	32 oz/A	8/1/19

Fertilizer: 140-60-0

Irrigation in-season:

	Low	Base	High
Preplant	3.4”	3.4”	3.4”
In Season	3.4”	6.9”	10.3”
Total	6.8”	10.3”	13.7”

Harvest Date: October 28

Results: Thirteen commercial and experimental PhytoGen varieties and three commercial standards were compared under three levels of LEPA irrigation. When averaged across varieties, yields ranged from 672 to 1145 lbs lint/A as irrigation increased. When averaged across irrigation levels, highest yields were produced with PHY 320 W3FE, PHY 350 W3FE, and three experimentals (Table 1). Loan values were similar for the base and high irrigation levels. Varieties that produced the highest loan values included PHY 210 W3FE, PHY 250 W3FE, PHY 320 W3FE, PHY 350 W3FE, one experimental, FM 1911 GLT, and DP 1646 B2XF (Table 2). When averaged across varieties, gross revenues ($/A) were related to yield levels and were higher with increased irrigation. When averaged across irrigation levels, highest gross revenues were produced with highest yield varieties (Table 3).

Table 1. Effect of variety and irrigation level on cotton lint yield (lbs./A).

	In-season Irrigation Levels (inches)			
Variety	**Low (5.1)**	**Base (7.7)**	**High (10.2)**	**Average**
	---------- lbs/A----------			
DP 1646 B2XF	537	878	1234	**883 EFGH**
FM 1911 GLT	621	1026	1223	**957 CDEF**
NG 4777 B2XF	684	1313	1144	**1047 ABC**
PHY 210 W3FE	692	1078	1256	**1009 ABCD**
PHY 250 W3FE	666	998	1192	**952 CDEF**
PHY 300 W3FE	682	1020	1100	**934 DEFG**
PHY 320 W3FE	702	1046	1232	**994 ABCD**
PHY 340 W3FE	562	976	1007	**848 GH**
PHY 350 W3FE	787	1182	1240	**1070 AB**
PHY 480 W3FE	667	938	817	**808 H**
PX 2B14 W3FE	579	1081	1245	**968 BCDEF**
PX 2C14 W3FE	688	1247	1136	**1024 ABCD**
PHY 400 W3FE	648	905	1046	**866 FGH**
PX 3C06 W3FE	830	1256	1142	**1076 A**
PX 3D32 W3FE	680	1117	1140	**979 ABCDE**
PX 3D43 W3FE	723	1204	1172	**1033 ABCD**
Average	**672 C**	**1079 B**	**1145 A**	**--**

Table 2. Effect of variety and irrigation level on loan value (¢/lb).

	In-season Irrigation Levels (inches)			
Variety	**Low (5.1)**	**Base (7.7)**	**High (10.2)**	**Average**
	----------¢/lb----------			
DP 1646 B2XF	53.60	55.48	56.83	**55.30 A**
FM 1911 GLT	49.83	53.78	56.78	**53.46 ABCD**
NG 4777 B2XF	48.65	53.60	56.13	**52.79 BCDE**
PHY 210 W3FE	50.15	52.95	56.28	**53.13 ABCD**
PHY 250 W3FE	51.83	54.20	53.25	**53.09 ABCDE**
PHY 300 W3FE	50.58	51.18	50.48	**50.74 EF**
PHY 320 W3FE	52.93	54.65	53.23	**53.60 ABC**
PHY 340 W3FE	50.63	53.65	53.13	**52.47 CDE**
PHY 350 W3FE	53.55	54.38	52.10	**53.34 ABCD**
PHY 480 W3FE	51.60	53.40	43.83	**49.61 F**
PX 2B14 W3FE	52.90	56.20	55.83	**54.98 AB**
PX 2C14 W3FE	51.05	53.33	52.08	**52.15 CDE**
PHY 400 W3FE	51.43	53.83	52.38	**52.54 CDE**
PX 3C06 W3FE	49.20	54.98	52.78	**52.32 CDE**
PX 3D32 W3FE	51.75	53.20	51.65	**52.20 CDE**
PX 3D43 W3FE	47.50	52.93	53.15	**51.19 DEF**
Average	**51.07 B**	**53.86 A**	**53.12 A**	**--**

Table 3. Effect of variety and irrigation level on gross revenue ($/A).

	In-season Irrigation Levels (inches)			
Variety	**Low (5.1)**	**Base (7.7)**	**High (10.2)**	**Average**
	----------$/A----------			
DP 1646 B2XF	295	521	604	**473 ABCD**
FM 1911 GLT	276	509	772	**519 AB**
NG 4777 B2XF	307	699	633	**546 A**
PHY 210 W3FE	364	580	658	**534 A**
PHY 250 W3FE	353	571	676	**533 A**
PHY 300 W3FE	327	523	476	**442 BCD**
PHY 320 W3FE	372	613	653	**546 A**
PHY 340 W3FE	260	501	518	**426 CD**
PHY 350 W3FE	392	634	630	**552 A**
PHY 480 W3FE	341	531	318	**397 D**
PX 2B14 W3FE	308	634	679	**540 A**
PX 2C14 W3FE	367	677	602	**549 A**
PHY 400 W3FE	324	497	618	**479 ABCD**
PX 3C06 W3FE	389	687	505	**527 A**
PX 3D32 W3FE	334	584	605	**508ABC**
PX 3D43 W3FE	329	619	645	**531 A**
Average	**333 C**	**586 B**	**599 A**	**--**

Effect Of Nitrogen Fertility On Cotton Crop Response To Simulated Cotton Fleahopper Damage

M.N. Parajulee, A. Hakeem, D. P. Dhakal, Katie Lewis, and J.P. Bordovsky

Objective: The objective was to evaluate the effect of artificial injury to cotton squares mimicking acute cotton fleahopper damage under variable nitrogen application rates on cotton fiber yield and quality.

Methodology: A high-yielding cotton cultivar, NG3406 B2XF, was planted at a targeted rate of 54,000 seeds/acre on June 4, 2019. The experiment was laid out in a split-plot randomized block design with five nitrogen fertility rate treatments (0, 50, 100, 150, and 200 lb N/acre) applied for 17 years as main plots (16-row plots) and two artificial cotton square injury treatments mimicking acute cotton fleahopper infestation as sub-plots with four replications (total 40 experimental units). Within each of the five main-plot treatments included pre-bloom side-dress applications of N augmentation using a soil applicator injection rig on July 19, 2019. Pre-treatment soil samples (consisting of three 0 to 12 and 12 to 24-inch depth soil cores each) were collected from each of the 20 main-plots on June 26, 2019. Ten leaves per plot were collected three times (5 August, 29 August, and 29 September) for leaf dry weight and nitrogen analysis. Within each main-plot, two 8-ft. sections of uniform cotton were flagged in the middle two rows, each receiving hand removal of 100% cotton squares three weeks into squaring or control (no square removal). Five plants were removed to determine biomass. Treatment plots were harvested for lint yield and fiber analysis.

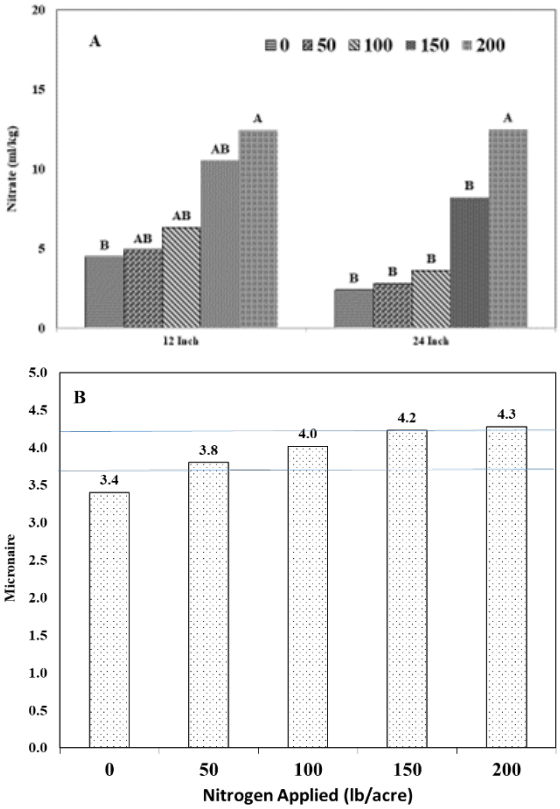


Fig. 1. A) Residual nitrogen recorded from prior year N applied plots at 0-12 and 12-24-inch depths, B) Lint micronaire values affected by variable N augmentation rates.

Results: Significantly higher soil residual nitrogen was recorded from plots that received 200 lb/acre N in preceding 16 years than control plots at 0-12 inch. At 12-24-inch depth, residual N at 200 lb/acre treatment was significantly higher than for remaining N applied treatments (Fig. 1A). The lint quality, measured in terms of micronaire values, was compromised at both zero and 200 lb/A N treatments. While micronaire was barely within the premium range at 150 lb/A, there was a clear trend that the micronaire values increased with N applied rates and the N augmentation >150 lb/A appeared to increase the micronaire value from premium range to a discount territory (Fig. 1B). It is not entirely clear why a low N (zero N augmentation) resulted in lower micronaire. At higher N rates, it is plausible that the carbohydrate supply to maturing bolls increased that resulted in increased micronaire. Simulated square removal did not result in significant change in micronaire values.

Appendix

2019 Rain and Irrigation Amounts At Helms Research Farm, Halfway, TX

Helms Irrigation Amounts (in)

Date			Rainfall (in)		Field 2 Irrigation (Drip)										Field 3 Irrigation (Drip)							Field 6 Irrigation (Drip)							
					Zones (Treatment)										Zones							Zones							
					1 (T1)	2 (T3)	3 (T2)	4 (T3)	5 (T2)	6 (T1)	7 (T3)	8 (T1)	9 (T2)	10 (Dry)	1	2	3	4	5	6	7	A	B	C	D	E	F	G	H
Mo	Da	Year	Halfway @ Buildling	Helms @ Well 1	Crop:										Crop:							Crop:							
					Cotton										Cotton							Fallow	Fallow	Fallow	Cotton	Cotton	Fallow	Cotton	Cotton
1	18	2019	0.01																										
2	22	2019	0.02																										
2	23	2019	0.20	0.22																									
3	9	2019	0.07	0.07																									
3	11	2019	0.02																										
3	12	2019	1.00																										
3	13	2019	0.13	1.15																									
3	22	2019	0.04																										
4	5	2019	0.06	0.08																									
4	8	2019				0.01	0.01	0.01	0.01		0.01	0.01	0.01		0.00	0.01	0.00	0.00	0.00	0.00					0.06	0.03	0.02	0.33	0.23
4	10	2019			0.17	0.19	0.19	0.17	0.19	0.25	0.25	0.25	0.24	0.25	0.08	0.08	0.08	0.14	0.14	0.14	0.10								
4	11	2019																							0.08	0.15	0.15	0.06	0.05
4	13	2019	0.11	0.15																									
4	18	2019					0.15		0.15				0.14		0.20		0.19	0.20							0.21	0.26	0.26	0.15	0.14
4	19	2019					0.16		0.15				0.14		0.17		0.19	0.20							0.21	0.25	0.26	0.15	0.14
4	20	2019					0.15		0.15				0.14		0.22		0.19	0.20							0.21	0.29	0.27	0.15	0.14
4	21	2019					0.15		0.15				0.14		0.27		0.25	0.32											
4	22	2019	0.10				0.15		0.15				0.14		0.12		0.14								0.42	0.54	0.53	0.30	0.28
4	23	2019	0.84	0.92			0.15		0.15				0.14		0.27		0.20	0.25							0.21	0.33	0.37	0.15	0.14
4	24	2019					0.15		0.15				0.14		0.11		0.20	0.14							0.21	0.22	0.16	0.12	0.14
4	25	2019			0.11	0.11	0.12	0.13	0.11	0.12	0.12	0.12	0.14	0.12	0.23	0.09	0.19	0.22	0.15	0.17	0.20				0.10	0.19	0.29	0.16	0.12
4	26	2019	0.06	0.07	0.10	0.10	0.11	0.13	0.05	0.12	0.11	0.12	0.14	0.05	0.14	0.20	0.19	0.13	0.15	0.13	0.20				0.14	0.08	0.18	0.13	0.12
4	27	2019			0.13	0.16	0.15	0.13	0.26	0.31	0.26	0.15	0.14	0.25	0.19	0.19	0.19	0.24	0.35	0.16	0.35								
4	29	2019			0.27	0.27	0.30	0.27	0.24	0.16	0.18	0.30	0.27	0.30	0.34	0.39	0.38	0.20	0.23	0.41	0.22								
4	30	2019	0.08	0.14	0.13	0.15	0.15	0.13	0.17	0.15	0.12	0.14	0.14	0.15	0.20	0.20	0.20	0.20	0.18	0.20	0.20				0.11	0.11	0.11	0.02	0.07
5	1	2019	0.01		0.13	0.15	0.15	0.13	0.10	0.16	0.15	0.15	0.14	0.15	0.20	0.20	0.20	0.18	0.19	0.20	0.17				0.12	0.11	0.11	0.11	0.12
5	2	2019	0.01		0.14	0.16	0.14	0.14	0.15	0.16	0.15	0.14	0.15	0.14	0.19	0.20	0.19	0.22	0.20	0.20	0.22				0.12	0.11	0.11	0.14	0.12
5	3	2019	0.04		0.14	0.16	0.14	0.14	0.16	0.14	0.14	0.14	0.15	0.14	0.19	0.20	0.19	0.21	0.20	0.20	0.20				0.12	0.11	0.11	0.10	0.12
5	4	2019	0.01		0.14	0.16	0.14	0.14	0.07	0.14	0.14	0.14	0.15	0.14	0.19	0.20	0.17	0.16	0.20	0.20	0.17				0.12	0.11	0.11	0.10	0.12
5	5	2019	0.02	0.02																									
5	6	2019			0.29	0.32	0.29	0.29	0.32	0.28	0.27	0.27	0.29	0.29	0.38	0.41	0.39	0.41	0.39	0.31	0.40				0.23	0.22	0.22	0.26	0.24
5	7	2019	0.23	0.26	0.14	0.16	0.14	0.14	0.17	0.13	0.14	0.14	0.15	0.13	0.19	0.20	0.20	0.21	0.19	0.19	0.19				0.11	0.10	0.10	0.10	0.12
5	9	2019	0.54	0.40																									
5	10	2019	0.38	0.30																									
5	11	2019	0.01																										
5	16	2019			0.14	0.16	0.14	0.13	0.23	0.27	0.14	0.14	0.15	0.14	0.18	0.20	0.18	0.20	0.28	0.20	0.29								
5	17	2019			0.14	0.15	0.14	0.11		0.01	0.13	0.14	0.14	0.14	0.18	0.20	0.15	0.14	0.11	0.20	0.07								
5	20	2019	0.01																										
5	23	2019	0.02																										
5	24	2019	0.09	0.22																									
5	25	2019	3.46	3.52																									
5	30	2019	0.02																										
5	31	2019	0.02																										
6	3	2019	0.29	0.74																									
6	5	2019	1.07	1.26																									
6	14	2019	0.01	0.15																									

2019 Rain and Irrigation Amounts At Helms Research Farm, Halfway, TX

Helms Irrigation Amounts (in)

Date			Rainfall (in)		Field 2 Irrigation (Drip)										Field 3 Irrigation (Drip)							Field 6 Irrigation (Drip)							
					Zones (Treatment)										Zones							Zones							
					1 (T1)	2 (T3)	3 (T2)	4 (T3)	5 (T2)	6 (T1)	7 (T3)	8 (T1)	9 (T2)	10 (Dry)	1	2	3	4	5	6	7	A	B	C	D	E	F	G	H
Mo	Da	Year	Halfway @ Buildling	Helms @ Well 1	Crop:										Crop:							Crop:							
					Cotton										Cotton							Fallow	Fallow	Fallow	Cotton	Cotton	Fallow	Cotton	Cotton
6	15	2019	0.28	0.01																									
6	17	2019	0.97																										
6	18	2019	0.17	0.92																									
7	2	2019	0.22	0.18																									
7	6	2019	0.23																										
7	7	2019	1.56	1.74																									
7	31	2019																						0.08	0.12	0.04	0.10		
8	1	2019			0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03		0.01	0.02	0.01	0.01	0.02	0.01									
8	2	2019				0.82		0.75			0.77							0.79											
8	6	2019			0.72					0.79		0.73			0.77														
8	7	2019														0.78	0.76		0.77										
8	8	2019					0.79		0.77				0.74							0.79										
8	9	2019				0.74		0.68			0.68							0.77						0.29	0.25	0.27	0.17		
8	12	2019																						0.88	0.86	0.83	0.40	0.41	
8	13	2019			0.75					0.78		0.82			0.80														
8	14	2019																	0.77					0.34	0.17	0.25	0.12	0.13	
8	15	2019					0.74		0.73				0.74							0.78				0.28	0.20	0.27	0.11	0.11	
8	16	2019				0.79		0.84			0.84							0.75						0.29	0.27	0.27	0.11	0.11	
8	19	2019																							0.16	0.03			
8	20	2019													0.80									0.29	0.34	0.28	0.12	0.13	
8	21	2019														0.79	0.78							0.29	0.28	0.27	0.11	0.11	
8	22	2019					0.75		0.73				0.71					0.78		0.83							0.90		
8	23	2019																						0.30	0.45	0.31	0.12	0.13	
8	24	2019	0.06																										
8	27	2019													0.75									0.29	0.24	0.28	0.12	0.13	
8	28	2019	0.04														0.79		0.80					0.29	0.29	0.27	0.11	0.11	
8	29	2019																		0.80				0.29	0.27	0.28	0.12	0.12	
8	30	2019				0.74		0.68			0.69							0.77						0.28	0.25	0.27	0.10	0.10	
9	5	2019																		0.83				0.30	0.29	0.28	0.12	0.13	
9	6	2019																0.81						0.29	0.29	0.28	0.12	0.13	
9	9	2019	0.42	0.55																									
9	12	2019	0.64	1.72																									
9	13	2019	0.16																										
9	19	2019	0.10																										
9	20	2019	0.02																										
9	21	2019	0.44																										
9	28	2019	0.43	0.54																									
9	29	2019		0.37																									
9	30	2019	0.02																										
Pre & At Plant			3.99	3.78	2.19	2.42	3.40	2.21	3.29	2.40	2.30	2.32	3.34	2.40	4.24	2.98	4.27	4.15	2.94	2.92	2.98				2.74	3.24	3.38	2.54	2.42
Seasonal			10.75	11.92	1.50	3.12	2.32	2.96	2.26	1.60	3.01	1.57	2.21		3.14	1.59	2.35	4.69	2.36	4.03					4.79	4.75	4.49	2.97	1.84
Totals			14.74	15.70	3.69	5.54	5.71	5.18	5.55	4.00	5.31	3.89	5.55	2.40	7.38	4.56	6.61	8.84	5.30	6.95	2.98				7.53	7.98	7.87	5.51	4.26

2019 Rain and Irrigation Amounts At Helms Research Farm, Halfway, TX

Helms Irrigation Amounts (in) L = LEPA Irrigation S = Spray Irrigation

Date			Rainfall (in)		Field: 5 Wedge: A [Crop: Cotton]					Field: 5 Wedge: B [Crop: Wheat]					Field: 5 Wedge: C [Crop: Cotton]					Field: 5 Wedge: D (East) [Crop: Cotton]					Field: 5 Wedge: D (West) [Crop: Cotton]					Field: 5 Wedge: E [Crop: Cotton]					Field: 5 Wedge: F [Crop: Sorghum]				
					Irrigation Level					Irrigation Level					Irrigation Level					Irrigation Level					Irrigation Level					Irrigation Level					Irrigation Level				
					Span 2	Span 3 - Span 8				Span 2	Span 3 - Span 8				Span 2	Span 3 - Span 8				Span 2	Span 3 - Span 8				Span 2	Span 3 - Span 8				Span 2	Span 3 - Span 8				Span 2	Span 3 - Span 8			
Mo	Da	Year	Halfway @ Buildling	Helms @ Well 1	Base	Base	Base - 50%	Base + 50%	System	Base	Base	Base - 50%	Base + 50%	System	Base	Base	Base - 50%	Base + 50%	System	Base	Base	Base - 50%	Base + 50%	System	Base	Base	Base - 50%	Base + 50%	System	Base	Base	Base - 50%	Base + 50%	System	Base	Base	Base - 50%	Base + 50%	System
1	18	2019	0.01	0.00																																		
2	22	2019	0.02	0.00																																		
2	23	2019	0.20	0.22																																		
3	9	2019	0.07	0.07																																		
3	11	2019	0.02	0.00																																		
3	12	2019	1.00	0.00																																		
3	13	2019	0.13	1.15																																		
3	22	2019	0.04	0.00																																		
4	5	2019	0.06	0.08																																		
4	9	2019													1.00	1.00	1.00	1.00	S																			
4	10	2019																		1.00	1.00	1.00	1.00	S	1.00	1.00	1.00	1.00	S									
4	13	2019	0.11	0.15																																		
4	15	2019																												1.00	1.00	1.00	1.00	S					
4	16	2019																																	1.00	1.00	1.00	1.00	S
4	17	2019			1.00	1.00	1.00	1.00	S																													
4	18	2019								1.00	1.00	1.00	1.00	S																								
4	19	2019													0.50	0.50	0.50	0.50	S	0.50	0.50	0.50	0.50	S	0.50	0.50	0.50	0.50	S									
4	20	2019																												0.50	0.50	0.50	0.50	S	0.50	0.50	0.50	0.50	S
4	21	2019			0.50	0.50	0.50	0.50	S	0.50	0.50	0.50	0.50	S																								
4	22	2019	0.10	0.00											0.50	0.50	0.50	0.50	S	0.50	0.50	0.50	0.50	S	0.50	0.50	0.50	0.50	S	0.50	0.50	0.50	0.50	S					
4	23	2019	0.84	0.92	0.50	0.50	0.50	0.50	S	0.50	0.50	0.50	0.50	S																					0.50	0.50	0.50	0.50	S
4	24	2019													0.35	0.35	0.35	0.35	S	0.35	0.35	0.35	0.35	S	0.35	0.35	0.35	0.35	S	0.35	0.35	0.35	0.35	S					
4	25	2019			0.35	0.35	0.35	0.35	S	0.35	0.35	0.35	0.35	S																					0.35	0.35	0.35	0.35	S
4	26	2019	0.06	0.07																																		
4	30	2019	0.08	0.14																																		
5	5	2019	0.02	0.02																																		
5	7	2019	0.23	0.26																																		
5	9	2019	0.54	0.40																																		
5	10	2019	0.38	0.30																																		
5	11	2019	0.01	0.00																																		
5	20	2019	0.01	0.00											0.50	0.50	0.50	0.50	S	0.50	0.50	0.50	0.50	S	0.50	0.50	0.50	0.50	S									
5	23	2019	0.02	0.00																																		
5	24	2019	0.09	0.22																																		
5	25	2019	3.46	3.52																																		
5	30	2019	0.02	0.00																																		
5	31	2019	0.02	0.00																																		
6	3	2019	0.29	0.74																																		
6	5	2019	1.07	1.26																																		
6	14	2019	0.01	0.15																																		
6	15	2019	0.28	0.01																																		
6	17	2019	0.97	0.00																																		
6	18	2019	0.17	0.92																																		
7	2	2019	0.22	0.18																										0.50	0.50	0.50	0.50	S	0.50	0.50	0.50	0.50	S
7	3	2019			0.50	0.50	0.50	0.50	S	0.30	0.30	0.30	0.30	S	.																								
7	6	2019	0.23	0.00																																		
7	7	2019	1.56	1.74																																		
7	23	2019													0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.05	0.08		0.08	L	0.17	0.25		0.25	L					
7	24	2019			0.17	0.25		0.25	L	0.05	0.08		0.08	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.05	0.08		0.08	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L
7	25	2019			0.17	0.25		0.25	L	0.05	0.08		0.08	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.05		0.08	0.08	L						0.17	0.25		0.25	L
7	26	2019			0.17		0.25	0.25	L																					0.17		0.25	0.25	L	0.17		0.25	0.25	L
7	30	2019													0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.05	0.08		0.08	L	0.17	0.25		0.25	L					
7	31	2019			0.17	0.25		0.25	L	0.05	0.08		0.08	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.05	0.08		0.08	L						0.17	0.25		0.25	L
8	1	2019			0.17	0.25		0.25	L	0.05	0.08		0.08	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.05		0.08	0.08	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L

2019 Rain and Irrigation Amounts At Helms Research Farm, Halfway, TX

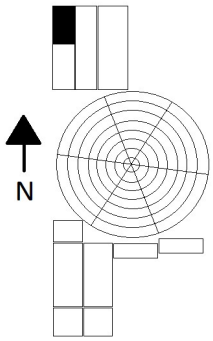
Helms Irrigation Amounts (in) L = LEPA Irrigation S = Spray Irrigation

Date			Rainfall (in)		Field: 5 Wedge: A [Crop: Cotton]					Field: 5 Wedge: B [Crop: Wheat]					Field: 5 Wedge: C [Crop: Cotton]					Field: 5 Wedge: D (East) [Crop: Cotton]					Field: 5 Wedge: D (West) [Crop: Cotton]					Field: 5 Wedge: E [Crop: Cotton]					Field: 5 Wedge: F [Crop: Sorghum]				
					Irrigation Level					Irrigation Level					Irrigation Level					Irrigation Level					Irrigation Level					Irrigation Level					Irrigation Level				
					Span 2	Span 3 - Span 8				Span 2	Span 3 - Span 8				Span 2	Span 3 - Span 8				Span 2	Span 3 - Span 8				Span 2	Span 3 - Span 8				Span 2	Span 3 - Span 8				Span 2	Span 3 - Span 8			
Mo	Da	Year	Halfway @ Buildling	Helms @ Well 1	Base	Base	Base - 50%	Base + 50%	System	Base	Base	Base - 50%	Base + 50%	System	Base	Base	Base - 50%	Base + 50%	System	Base	Base	Base - 50%	Base + 50%	System	Base	Base	Base - 50%	Base + 50%	System	Base	Base	Base - 50%	Base + 50%	System	Base	Base	Base - 50%	Base + 50%	System
8	2	2019			0.17		0.25	0.25	L	0.05		0.08	0.08	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L						0.17		0.25	0.25	L	0.17		0.25	0.25	L
8	3	2019			0.17	0.25		0.25	L	0.05	0.08		0.08	L	0.17	0.25		0.25	L						0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	4	2019			0.17	0.25		0.25	L	0.05	0.08		0.08	L						0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	5	2019													0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L										
8	6	2019			0.17		0.25	0.25	L	0.05		0.08	0.08	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L
8	7	2019			0.17	0.25		0.25	L	0.05	0.08		0.08	L	0.17	0.25		0.25	L											0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	8	2019			0.17	0.25		0.25	L	0.05	0.08		0.08	L						0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	9	2019													0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L					
8	10	2019			0.17	0.25	0.25	0.25	L	0.06		0.09	0.09	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L						0.17		0.25	0.25	L
8	11	2019			0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17	0.25		0.25	L											0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	12	2019			0.17	0.25		0.25	L	0.06	0.09		0.09	L						0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	13	2019			0.17		0.25	0.25	L						0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L
8	14	2019								0.06		0.09	0.09	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	15	2019			0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	16	2019			0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L					
8	17	2019			0.17		0.25	0.25	L	0.06		0.09	0.09	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L						0.17		0.25	0.25	L
8	18	2019				0.25		0.25	L	0.06	0.09		0.09	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	19	2019			0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17		0.25	0.25	L											0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	20	2019			0.17		0.25	0.25	L	0.06		0.09	0.09	L						0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L
8	21	2019			0.17	0.25		0.25	L						0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	22	2019			0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	23	2019								0.06	0.09		0.09	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L										
8	24	2019	0.06	0.00																									0.17		0.25	0.25	L	0.17		0.25	0.25	L
8	25	2019			0.17		0.25	0.25	L	0.06		0.09	0.09	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	26	2019			0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L					
8	27	2019			0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L						0.17	0.25		0.25	L
8	28	2019	0.04	0.00	0.17		0.25	0.25	L	0.06		0.09	0.09	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L
8	29	2019			0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17	0.25		0.25	L											0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	30	2018			0.17	0.25		0.25	L	0.06	0.09		0.09	L						0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L
8	31	2019			0.17		0.25	0.25	L	0.06		0.09	0.09	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L
9	1	2019			0.17	0.25		0.25	L						0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L
9	2	2019								0.06	0.09		0.09	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L
9	3	2019			0.17	0.25		0.25	L																													
9	4	2019								0.06	0.09		0.09	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L					
9	5	2019			0.17		0.25	0.25	L	0.06		0.09	0.09	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L						0.17		0.25	0.25	L
9	6	2019			0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17			0.25	L											0.17	0.25		0.25	L	0.17	0.25		0.25	L
9	7	2019			0.17			0.25	L											0.17			0.25	L	0.17			0.25	L	0.17			0.25	L	0.17			0.25	L
9	9	2019	0.42	0.55																																		
9	11	2019																																		0.34	0.50		0.50	L
9	12	2019	0.64	1.72																																0.17			0.25	L
9	13	2019	0.16	0.00																																				
9	19	2019	0.10	0.00																																				
9	20	2019	0.02	0.00																																				
9	21	2019	0.44	0.00																																				
9	24	2019																																		0.51	0.75		0.75	L
9	27	2019																																		0.34	0.50		0.50	L
9	28	2019	0.43	0.54																																				
9	29	2019	0.00	0.37																																				
9	30	2019	0.02																																					
Pre & At Plant			7.50	7.52	2.35	2.35	2.35	2.35		2.35	2.35	2.35	2.35		2.85	2.85	2.85	2.85		2.85	2.85	2.85	2.85		2.85	2.85	2.85	2.85		2.35	2.35	2.35	2.35		2.35	2.35	2.35	2.35	
Seasonal			7.17	8.18	6.28	6.50	3.25	9.25		2.18	2.29	1.18	3.17		5.95	5.75	2.75	8.75		5.95	5.75	2.75	8.75		5.23	5.07	2.41	7.73		6.45	6.25	3.25	9.25		7.81	8.00	3.25	11.25	
Totals			14.67	15.70	8.63	8.85	5.60	11.60		4.53	4.64	3.53	5.52		8.80	8.60	5.60	11.60		8.80	8.60	5.60	11.60		8.08	7.92	5.26	10.58		8.80	8.60	5.60	11.60		10.16	10.35	5.60	13.60	

Operations Summary

Year	2019
Farm	Helm
Field ID	Field 1 North
Exp. Design	Corn
Soil Type	Pullman Clay Loam

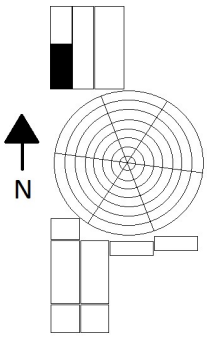
Field Operations	Date	Activity
Tillage	1/16/2019	Disk
	1/16/2019	Disk(Angle)
	3/5/2019	List
	5/14/2019	Bed Conditioners
	5/27/2019	Rotary Hoe
	6/3/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/12/2019	Cultivate
Fertility	4/8/2019	Liquid 32-0-0 27.5gal/ac
	4/8/2019	Liquid 10-40-0 20gal/ac
Planting / Harvest		
Herbicide /	3/20/2019	Panther 2oz/ac
Growth Regulator	5/1/2019	Showdown 48oz/ac, Dynamic 1%
	5/3/2019	Acuron 2.5qt/ac
	6/10/2019	Beacon 4oz/ac, Crop Oil 1%
	6/25/2019	Medal EC 1.3pt/ac
	9/11/2019	Showdown 64oz/ac, Dynamic 1%
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting		
Seasonal		
Rainfall		
PrePlant & Planting	1/1 - 5/17	3.78in.
Seasonal	5/18 - 9/30	11.92in.



Operations Summary

Year	2019
Farm	Helm
Field ID	Field 1 South
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

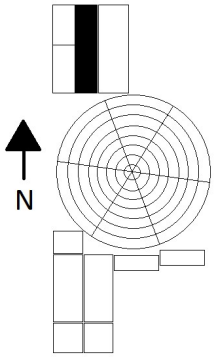
Field Operations	Date	Activity
Tillage	10/3/2018	Disk
	3/21/2019	Stalk Puller
	5/22/2019	Bed Packer
	5/27/2019	Rotary Hoe
	6/3/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/21/219	Rotary Hoe
	6/26/2019	Cultivate and Dike
Fertility		
Planting / Harvest	11/27/2019	Planted Grit Wheat 45lbs/ac (Cover)
	5/3/2019	Planted NexGin 3406B2XF 46,000seed/ac
	5/22/2019	Planted NexGin 3500XF 46,000seed/ac (Replant)
	10/28/2019	Harvested all test
Herbicide /	3/18/2019	Clash 8oz/ac, Induce 1%
Growth Regulator	3/21/2019	Panther 2oz/ac
	4/4/2019	Showdown 48oz/ac, Dyne-Amic 1%
	5/1/2019	Showdown 48oz/ac, Dyne-Amic 1%
	5/3/2019	Medal EC 1.3pt/ac
	6/20/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 1.3pt/ac
	7/18/2019	Mepiquat 8oz/ac
	7/24/2019	Medal EC 1.3pt/ac
	7/30/2019	Mepiquat 16oz/ac
	8/6/2019	Mepiquat 16oz/ac
Insecticide	6/7/2019	Acephate 3oz/ac
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dynamic 1%
	10/16/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting		
Seasonal		
Rainfall		
PrePlant & Planting	1/1 - 5/22	3.78in.
Seasonal	5/23 - 9/30	11.92in.



Operations Summary

Year	2019
Farm	Helm
Field ID	Field 2
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

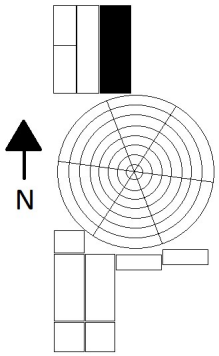
Field Operations	Date	Activity
Tillage	12/6/2018	Shred
	1/8/2019	Stalk Puller X 2
	1/15/2019	Cultivate and Dike
	4/3/2019	Rotary Hoe
	4/18/2019	Bed Packer
	5/13/2019	Rotary Hoe
	5/14/2019	Bed Packer
	5/27/2019	Rotary Hoe
	5/28/2019	Bed Conditioner
	5/29/2019	Bed Packer
	6/3/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/19/2019	Rotary Hoe
	6/27/2019	Rotary Hoe
Fertility	4/5/2019	Liquid 32-0-0 9gal/ac (no application to east 16 rows)
	4/5/2019	Liquid 10-34-0 9gal/ac (no application to east 16 rows)
Planting / Harvest	5/14/2019	Planted Fibermax 2498 GTL 46,000seed/ac
	5/29/2019	Planted NexGin 3780 B2XF 44,000seed/ac (Replant)
	11/4/2019	Harvested all test
Herbicide / Growth Regulator	3/20/2019	Panther 2oz/ac
	4/9/2019	Showdown 48oz/ac, Dyne-Amic 1%
	5/1/2019	Showdown 48oz/ac, Dyne-Amic 1%
	5/3/2019	Medal EC 1.33pt/ac
	6/28/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 3oz/ac
	7/31/2019	Diuron 1.5pt/ac
	8/16/2019	Mepiquat 12oz/ac
Insecticide	6/17/2019	Acephate 3oz/ac
	6/27/2019	Acephate 3oz/ac
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dynamic 1%
	10/16/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/29	Trt. 1 = 2.30in., Trt. 2 = 3.34in., Trt. 3 = 2.31in., Dry = 2.40in.
Seasonal	5/30 - 8/30	1 = 1.50in., 2 = 3.12in., 3 = 2.32in., 4 = 2.96in., 5 = 2.26in., 6 = 1.60in., 7 = 3.01in., 8 = 1.57in.
		9 = 2.21in., 10 = 0.00in.
Rainfall		
PrePlant & Planting	1/1 - 5/29	7.52in.
Seasonal	5/30 - 9/30	8.18in.



Operations Summary

Year	2019
Farm	Helm
Field ID	Field 3
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

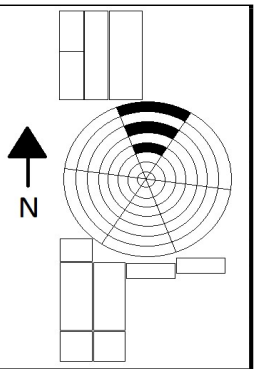
Field Operations	Date	Activity
Tillage	1/9/2019	Stalk Puller X 2
	4/3/2019	Rotary Hoe
	4/18/2019	Bed Packer
	5/13/2019	Rotary Hoe
	5/14/2019	Bed Packer
	5/27/2019	Rotary Hoe
	5/28/2019	Bed Conditioner
	5/29/2019	Bed Packer
	6/3/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/19/2019	Rotary Hoe
	6/27/2019	Cultivate and Dike
Fertility	4/5/2019	Liquid 32-0-0 9gal/ac (no application on first and last 8 rows)
	4/5/2019	Liquid 10-34-0 9gal/ac (no application on first and last 8 rows)
Planting / Harvest	5/14/2019	Planted Fibermax 2498 GTL 46,000seed/ac
	5/29/2019	Planted NexGin 3780 B2XF 44,000seed/ac (Replant)
	11/4/2019	Harvested all test
Herbicide /	3/20/2019	Panther 2oz/ac
Growth Regulator	4/9/2019	Showdown 48oz/ac, Dyne-Amic 1%
	5/1/2019	Showdown 48oz/ac, Dyne-Amic 1%
	5/3/2019	Medal EC 1.33pt/ac
	6/28/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 3oz/ac
	7/31/2019	Diuron 1.5pt/ac
	8/16/2019	Mepiquat 12oz/ac
Insecticide		
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dynamic 1%
	10/16/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/29	Zones 1, 3, 4 = 4.22in., Zones 2, 5, 6 = 2.95in.
Seasonal	5/30 - 9/30	1 = 3.14in., 2 = 1.59in., 3 = 2.35in., 4 = 4.69in., 5 = 2.36in., 6 = 4.03in., Border = 0.00in.
Rainfall		
PrePlant & Planting	1/1 - 5/29	7.52in.
Seasonal	5/30 - 9/30	8.18in.



Operations Summary

Year	2019
Farm	Helm
Field ID	Field 5A (Even Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

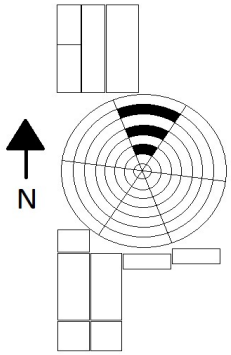
Field Operations	Date	Activity
Tillage	11/26/2018	Shred
	1/22/2019	Disk
	1/24/2019	Disk
	1/29/2019	Chisel
	3/18/2019	Cultivate
	3/19/2019	List
	4/3/2019	Dike and Bed Conditioner
	4/18/2019	Bed Conditioner
	5/15/2019	Rotary Hoe
	5/28/2019	Rotary Hoe
	5/31/2019	Dike and Bed Conditioner
	6/4/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/19/2019	Rotary Hoe
	6/26/2019	Cultivate and Dike
	7/19/2019	Cultivate and Dike
Fertility	3/29/2019	Liquid 32-0-0 8.3gal/ac (Dryland)
	3/29/2019	Liquid 32-0-0 20gal/ac (Low Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (High Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (Medium Water)
	4/1/2019	Liquid 10-34-0 6gal/ac (High Water)
	4/1/2019	Liquid 12-0-0-26 4gal/ac (High Water)
	4/2/2019	Liquid 10-34-0 6gal/ac (Medium Water)
	7/17/2019	Liquid 32-0-0 20.8gal/ac (High Water)
	7/18/2019	Liquid 32-0--0 10.3gal/ac (Medium Water)
Planting / Harvest	5/16/2019	Planted NexGin 3500XF 46,000seed/ac
	5/31/2019	Planted NexGin 3500XF 44,000seed/ac (Replant)
	11/3/2019	Harvested all test
Herbicide / Growth Regulator	3/18/2019	Trifuralin 1qt/ac
	5/22/2019	Medal EC 1.3pt/ac
	6/28/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 1.3pt/ac
	7/18/2019	Mepiquat 8oz/ac
	7/30/2019	Diuron 1.5pt/ac
	8/16/2019	Mepiquat 16oz/ac (High Water)
	8/28/2019	Mepiquat 16oz/ac (High Water)
Insecticide	6/28/2019	Acephate 3oz/ac
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/17/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/30	Base = 2.35in., Base - 50% = 2.35in., Base + 50% = 2.35in.
Seasonal	5/31 - 9/30	Base = 6.50in., Base - 50% = 3.25in., Base + 50% = 9.25in.
Rainfall		
PrePlant & Planting	1/1 - 5/30	7.52in.
Seasonal	5/31 - 9/30	8.18in.



Operations Summary

Year	2019
Farm	Helm
Field ID	Field 5A (Odd Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

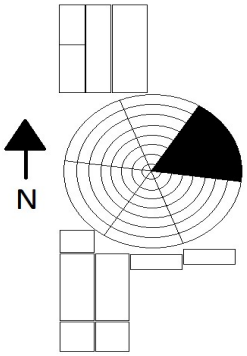
Field Operations	Date	Activity
Tillage	11/26/2018	Shred
	11/28/2019	Stalk Puller (Including Overhang)
	11/30/2019	List (Including Overhang)
	3/27/2019	Stalk Puller (Including Overhang)
	5/28/2019	Rotary Hoe
	5/31/2019	Dike and Bed Conditioner
	6/4/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/19/2019	Rotary Hoe
	6/26/2019	Cultivate and Dike
	7/19/2019	Cultivate and Dike
Fertility	3/29/2019	Liquid 32-0-0 8.3gal/ac (Dryland)
	3/29/2019	Liquid 32-0-0 20gal/ac (Low Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (High Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (Medium Water)
	4/1/2019	Liquid 10-34-0 6gal/ac (High Water)
	4/1/2019	Liquid 12-0-0-26 4gal/ac (High Water)
	4/2/2019	Liquid 10-34-0 6gal/ac (Medium Water)
	7/17/2019	Liquid 32-0-0 20.8gal/ac (High Water)
	7/18/2019	Liquid 32-0--0 10.3gal/ac (Medium Water)
Planting / Harvest	11/30/2019	Planted Grit 45lb/ac (Wheat Cover Including Overhang)
	5/16/2019	Planted NexGin 3500XF 46,000seed/ac
	5/31/2019	Planted NexGin 3500XF 44,000seed/ac (Replant)
	11/3/2019	Harvested all test
Herbicide / Growth Regulator	3/18/2019	Clash 8oz/ac
	4/4/2019	Panther 2oz/ac, Showdown 48oz/ac, Dyne-Amic 1%
	5/22/2019	Medal EC 1.3pt/ac
	6/28/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 1.3pt/ac
	7/18/2019	Mepiquat 8oz/ac
	7/30/2019	Diuron 1.5pt/ac
	8/16/2019	Mepiquat 16oz/ac (High Water)
	8/28/2019	Mepiquat 16oz/ac (High Water)
Insecticide	6/28/2019	Acephate 3oz/ac
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/17/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/30	Base = 2.35in., Base - 50% = 2.35in., Base + 50% = 2.35in.
Seasonal	5/31 - 9/30	Base = 6.50in., Base - 50% = 3.25in., Base + 50% = 9.25in.
Rainfall		
PrePlant & Planting	1/1 - 5/30	7.52in.
Seasonal	5/31 - 9/30	8.18in.



Operations Summary

Year	2018
Farm	Helm
Field ID	Field 5B (All Spans)
Exp. Design	Wheat
Soil Type	Pullman Clay Loam

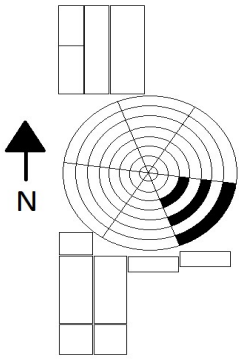
Field Operations	Date	Activity
Tillage	11/20/2018	Shred
Fertility		
Planting / Harvest	11/20/2019	Planted Grit 70lb/ac
	6/21/2019	Harvested all test
Herbicide /	3/18/2019	Clash 8oz/ac
Growth Regulator	7/3/2019	Clash 12oz/ac, Charger Basic 1.3pt/ac, Showdown 48oz/ac
	7/30/2019	Clash 16oz/ac, Diuron 1qt/ac, Showdown 48oz/ac
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting		
Seasonal	1/1 - 5/30	Base = 2.35in., Base - 50% = 2.35in., Base + 50% = 2.35in.
	5/31 - 9/30	Base = 2.29in., Base - 50% = 1.18in., Base + 50% = 3.17in.
Rainfall		
PrePlant & Planting	1/1 - 5/30	7.52in.
Seasonal	5/31 - 9/30	8.18in.



Operations Summary

Year	2019
Farm	Helm
Field ID	Field 5C (Even Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

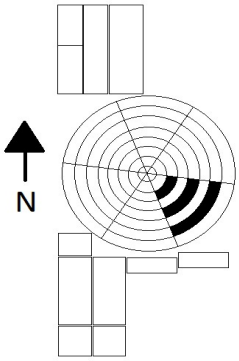
Field Operations	Date	Activity
Tillage	10/3/2018	Disk
	1/31/2019	Chisel
	3/18/2019	Cultivate
	3/19/2019	List
	4/17/2019	Bed Conditioner
	5/15/2019	Rotary Hoe
	5/28/2019	Rotary Hoe
	5/30/2019	Dike and Bed Conditioner
	6/4/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/19/2019	Rotary Hoe
	6/25/2019	Cultivate and Dike
	7/18/2019	Cultivate and Dike
Fertility	3/29/2019	Liquid 32-0-0 8.3gal/ac (Dryland)
	3/29/2019	Liquid 32-0-0 20gal/ac (Low Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (High Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (Medium Water)
	4/1/2019	Liquid 10-34-0 6gal/ac (High Water)
	4/1/2019	Liquid 12-0-0-26 4gal/ac (High Water)
	4/2/2019	Liquid 10-34-0 6gal/ac (Medium Water)
	7/17/2019	Liquid 32-0-0 20.8gal/ac (High Water)
	7/18/2019	Liquid 32-0--0 10.3gal/ac (Medium Water)
Planting / Harvest	5/15/2019	Planted NexGin 3500XF 46,000seed/ac
	5/30/2019	Planted NexGin 3500XF 44,000seed/ac (Replant)
	11/1/2019	Harvested all test
Herbicide /	3/18/2019	Trifuralin 1qt/ac
Growth Regulator	5/16/2019	Medal EC 1.3pt/ac
	6/27/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 1.3pt/ac
	7/18/2019	Mepiquat 8oz/ac
	7/29/2019	Diuron 1.5pt/ac
	8/16/2019	Mepiquat 16oz/ac (High Water)
	8/28/2019	Mepiquat 16oz/ac (High Water)
Insecticide	6/28/2019	Acephate 3oz/ac
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/17/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/30	Base = 2.85in., Base - 50% = 2.85in., Base + 50% = 2.85in.
Seasonal	5/31 - 9/30	Base = 5.75in., Base - 50% = 2.75in., Base + 50% = 8.75in.
Rainfall		
PrePlant & Planting	1/1 - 5/30	7.52in.
Seasonal	5/31 - 9/30	8.18in.



Operations Summary

Year	2019
Farm	Helm
Field ID	Field 5C (Odd Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

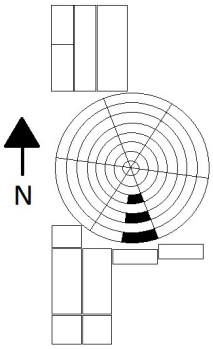
Field Operations	Date	Activity
Tillage	5/28/2019	Rotary Hoe
	6/4/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/19/2019	Rotary Hoe
Fertility	3/29/2019	Liquid 32-0-0 8.3gal/ac (Dryland)
	3/29/2019	Liquid 32-0-0 20gal/ac (Low Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (High Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (Medium Water)
	4/1/2019	Liquid 10-34-0 6gal/ac (High Water)
	4/1/2019	Liquid 12-0-0-26 4gal/ac (High Water)
	4/2/2019	Liquid 10-34-0 6gal/ac (Medium Water)
	7/17/2019	Liquid 32-0-0 20.8gal/ac (High Water)
	7/18/2019	Liquid 32-0--0 10.3gal/ac (Medium Water)
Planting / Harvest	5/15/2019	Planted NexGin 3500XF 46,000seed/ac
	5/30/2019	Planted NexGin 3500XF 44,000seed/ac (Replant)
	11/1/2019	Harvested all test
Herbicide /	3/20/2019	Clash 8oz/ac, Showdown 48oz/ac, Induce 1%
Growth Regulator	3/20/2019	Panther 2oz/ac
	5/16/2019	Medal EC 1.3pt/ac
	6/27/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 1.3pt/ac
	7/18/2019	Mepiquat 8oz/ac
	7/29/2019	Diuron 1.5pt/ac
	8/16/2019	Mepiquat 16oz/ac (High Water)
	8/28/2019	Mepiquat 16oz/ac (High Water)
Insecticide	6/28/2019	Acephate 3oz/ac
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/17/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/30	Base = 2.85in., Base - 50% = 2.85in., Base + 50% = 2.85in.
Seasonal	5/31 - 9/30	Base = 5.75in., Base - 50% = 2.75in., Base + 50% = 8.75in.
Rainfall		
PrePlant & Planting	1/1 - 5/30	7.52in.
Seasonal	5/31 - 9/30	8.18in.



Operations Summary

Year	2019
Farm	Helm
Field ID	Field 5D East (Even Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

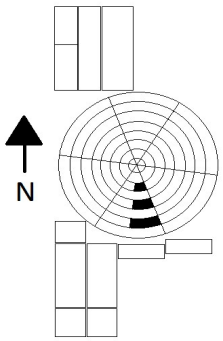
Field Operations	Date	Activity
Tillage	11/26/2018	Shred
	3/28/2019	Stalk Puller
	5/28/2019	Rotary Hoe
	6/4/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/19/2019	Rotary Hoe
	6/25/2019	Cultivate and Dike
	7/18/2019	Cultivate and Dike
Fertility	3/29/2019	Liquid 32-0-0 8.3gal/ac (Dryland)
	3/29/2019	Liquid 32-0-0 20gal/ac (Low Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (High Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (Medium Water)
	4/1/2019	Liquid 10-34-0 6gal/ac (High Water)
	4/1/2019	Liquid 12-0-0-26 4gal/ac (High Water)
	4/2/2019	Liquid 10-34-0 6gal/ac (Medium Water)
	7/17/2019	Liquid 32-0-0 20.8gal/ac (High Water)
	7/18/2019	Liquid 32-0--0 10.3gal/ac (Medium Water)
Planting / Harvest	11/26/2018	Planted Grit 45lb/ac (Wheat Cover)
	5/15/2019	Planted NexGin 3500 XF 46,000seed/ac
	5/30/2019	Planted NexGin 3500 XF 44,000seed/ac (Replant)
	11/2/2019	Harvested all test
Herbicide /	3/18/2019	Clash 8oz/ac
Growth Regulator	4/4/2019	Panther 2oz/ac, Showdown 48oz/ac, Dyne-Amic 1%
	5/16/2019	Medal EC 1.3pt/ac
	6/27/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 1.3pt/ac
	7/18/2019	Mepiquat 8oz/ac
	7/29/2019	Diuron 1.5pt/ac
	8/16/2019	Mepiquat 16oz/ac (High Water)
	8/28/2019	Mepiquat 16oz/ac (High Water)
Insecticide	6/28/2019	Acephate 3oz/ac
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/17/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/30	Base = 2.85in., Base - 50% = 2.85in., Base + 50% = 2.85in.
Seasonal	5/31 - 9/30	Base = 5.75in., Base - 50% = 2.75in., Base + 50% = 8.75in.
Rainfall		
PrePlant & Planting	1/1 - 5/30	7.52in.
Seasonal	5/31 - 9/30	8.18in.



Operations Summary

Year	2019
Farm	Helm
Field ID	Field 5D East (Odd Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

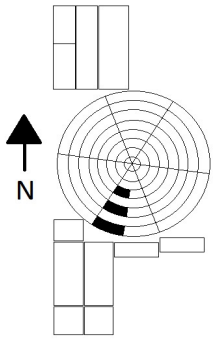
Field Operations	Date	Activity
Tillage	5/28/2019	Rotary Hoe
	6/4/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/19/2019	Rotary Hoe
Fertility	3/29/2019	Liquid 32-0-0 8.3gal/ac (Dryland)
	3/29/2019	Liquid 32-0-0 20gal/ac (Low Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (High Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (Medium Water)
	4/1/2019	Liquid 10-34-0 6gal/ac (High Water)
	4/1/2019	Liquid 12-0-0-26 4gal/ac (High Water)
	4/2/2019	Liquid 10-34-0 6gal/ac (Medium Water)
	7/17/2019	Liquid 32-0-0 20.8gal/ac (High Water)
	7/18/2019	Liquid 32-0--0 10.3gal/ac (Medium Water)
Planting / Harvest	11/26/2018	Planted Grit 45lb/ac (Wheat Cover)
	5/15/2019	Planted NexGin 3500 XF 46,000seed/ac
	5/30/2019	Planted NexGin 3500 XF 44,000seed/ac (Replant)
	11/2/2019	Harvested all test
Herbicide /	3/18/2019	Clash 8oz/ac
Growth Regulator	4/4/2019	Panther 2oz/ac, Showdown 48oz/ac, Dyne-Amic 1%
	5/16/2019	Medal EC 1.3pt/ac
	6/27/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 1.3pt/ac
	7/18/2019	Mepiquat 8oz/ac
	7/29/2019	Diuron 1.5pt/ac
	8/16/2019	Mepiquat 16oz/ac (High Water)
	8/28/2019	Mepiquat 16oz/ac (High Water)
Insecticide	6/28/2019	Acephate 3oz/ac
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/17/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/30	Base = 2.85in., Base - 50% = 2.85in., Base + 50% = 2.85in.
Seasonal	5/31 - 9/30	Base = 5.75in., Base - 50% = 2.75in., Base + 50% = 8.75in.
Rainfall		
PrePlant & Planting	1/1 - 5/30	7.52in.
Seasonal	5/31 - 9/30	8.18in.



Operations Summary

Year	2019
Farm	Helm
Field ID	Field 5D West (Even Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

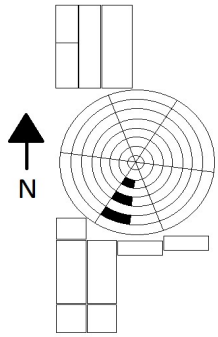
Field Operations	Date	Activity
Tillage	11/26/2018	Shred
	3/28/2019	Stalk Puller
	5/28/2019	Rotary Hoe
	6/4/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/19/2019	Rotary Hoe
	6/25/2019	Cultivate and Dike
	7/18/2019	Cultivate and Dike
Fertility	3/29/2019	Liquid 32-0-0 8.3gal/ac (Dryland)
	3/29/2019	Liquid 32-0-0 20gal/ac (Low Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (High Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (Medium Water)
	4/1/2019	Liquid 10-34-0 6gal/ac (High Water)
	4/1/2019	Liquid 12-0-0-26 4gal/ac (High Water)
	4/2/2019	Liquid 10-34-0 6gal/ac (Medium Water)
	7/17/2019	Liquid 32-0-0 20.8gal/ac (High Water)
	7/18/2019	Liquid 32-0--0 10.3gal/ac (Medium Water)
Planting / Harvest	11/26/2018	Planted Grit 45lb/ac (Wheat Cover)
	5/15/2019	Planted NexGin 3500 XF 46,000seed/ac
	5/30/2019	Planted NexGin 3500 XF 44,000seed/ac (Replant)
	11/2/2019	Harvested all test
Herbicide /	3/18/2019	Clash 8oz/ac
Growth Regulator	4/4/2019	Panther 2oz/ac, Showdown 48oz/ac, Dyne-Amic 1%
	5/16/2019	Medal EC 1.3pt/ac
	6/27/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 1.3pt/ac
	7/18/2019	Mepiquat 8oz/ac
	7/29/2019	Diuron 1.5pt/ac
	8/16/2019	Mepiquat 16oz/ac (High Water)
	8/28/2019	Mepiquat 16oz/ac (High Water)
Insecticide	6/28/2019	Acephate 3oz/ac
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/17/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/30	Base = 2.85in., Base - 50% = 2.85in., Base + 50% = 2.85in.
Seasonal	5/31 - 9/30	Base = 5.07in., Base - 50% = 2.41in., Base + 50% = 7.73in.
Rainfall		
PrePlant & Planting	1/1 - 5/30	7.52in.
Seasonal	5/31 - 9/30	8.18in.



Operations Summary

Year	2019
Farm	Helm
Field ID	Field 5D West (Odd Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

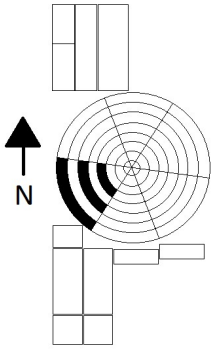
Field Operations	Date	Activity
Tillage	5/28/2019	Rotary Hoe
	6/4/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/19/2019	Rotary Hoe
Fertility	3/29/2019	Liquid 32-0-0 8.3gal/ac (Dryland)
	3/29/2019	Liquid 32-0-0 20gal/ac (Low Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (High Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (Medium Water)
	4/1/2019	Liquid 10-34-0 6gal/ac (High Water)
	4/1/2019	Liquid 12-0-0-26 4gal/ac (High Water)
	4/2/2019	Liquid 10-34-0 6gal/ac (Medium Water)
	7/17/2019	Liquid 32-0-0 20.8gal/ac (High Water)
	7/18/2019	Liquid 32-0--0 10.3gal/ac (Medium Water)
Planting / Harvest	11/26/2018	Planted Grit 45lb/ac (Wheat Cover)
	5/15/2019	Planted NexGin 3500 XF 46,000seed/ac
	5/30/2019	Planted NexGin 3500 XF 44,000seed/ac (Replant)
	11/2/2019	Harvested all test
Herbicide /	3/18/2019	Clash 8oz/ac
Growth Regulator	4/4/2019	Panther 2oz/ac, Showdown 48oz/ac, Dyne-Amic 1%
	5/16/2019	Medal EC 1.3pt/ac
	6/27/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 1.3pt/ac
	7/18/2019	Mepiquat 8oz/ac
	7/29/2019	Diuron 1.5pt/ac
	8/16/2019	Mepiquat 16oz/ac (High Water)
	8/28/2019	Mepiquat 16oz/ac (High Water)
Insecticide	6/28/2019	Acephate 3oz/ac
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/17/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/30	Base = 2.85in., Base - 50% = 2.85in., Base + 50% = 2.85in.
Seasonal	5/31 - 9/30	Base = 5.07in., Base - 50% = 2.41in., Base + 50% = 7.73in.
Rainfall		
PrePlant & Planting	1/1 - 5/30	7.52in.
Seasonal	5/31 - 9/30	8.18in.



Operations Summary

Year	2019
Farm	Helm
Field ID	Field 5E (Even Spans)
Exp. Design	Grain Sorghum
Soil Type	Pullman Clay Loam

Field Operations	Date	Activity
Tillage	1/22/2019	Disk
	1/28/2019	Chisel
	3/18/2019	Cultivate
	3/19/2019	List
	3/20/2019	Rip Soft Middles
	4/4/2019	Dike and Bed Conditioner
	4/17/2019	Bed Conditioner
	5/15/2019	Rotary Hoe
	5/28/2019	Rotary Hoe
	5/31/2019	Dike and Bed Conditioner
	6/4/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/19/2019	Rotary Hoe
	6/25/2019	Cultivate and Dike
	7/18/2019	Cultivate and Dike.
Fertility	3/29/2019	Liquid 32-0-0 8.3gal/ac (Dryland)
	3/29/2019	Liquid 32-0-0 20gal/ac (Low Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (High Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (Medium Water)
	4/1/2019	Liquid 10-34-0 6gal/ac (High Water)
	4/1/2019	Liquid 12-0-0-26 4gal/ac (High Water)
	4/2/2019	Liquid 10-34-0 6gal/ac (Medium Water)
	7/17/2019	Liquid 32-0-0 20.8gal/ac (High Water)
	7/18/2019	Liquid 32-0--0 10.3gal/ac (Medium Water)
Planting / Harvest	5/17/2019	Planted NexGin 3500 XF 46,000/ac
	5/31/2019	Planted NexGin 3500 XF 44,000/ac (Replant)
	11/2/2019	Harvested all test
Herbicide / Growth Regulator	3/18/2019	Trifuralin 1qt/ac
	5/22/2019	Medal EC 1.3pt/ac, Showdown 32oz/ac
	6/27/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 1.3pt/ac
	7/18/2019	Mepiquat 8oz/ac
	7/29/2019	Diuron 1.5pt/ac
	8/16/2019	Mepiquat 16oz/ac (High Water)
	8/28/2019	Mepiquat 16oz/ac (High Water)
Insecticide	6/28/2019	Acephate 3oz/ac
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/17/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/31	Base = 2.35in., Base - 50% = 2.35in., Base + 50% = 2.35in.
Seasonal	6/1 - 9/30	Base = 6.25in., Base - 50% = 3.25in., Base + 50% = 9.25in.
Rainfall		
PrePlant & Planting	1/1 - 5/31	7.52in.
Seasonal	6/1 - 9/30	8.18in.



Operations Summary

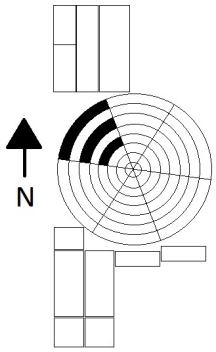
Year	2019
Farm	Helm
Field ID	Field 5E (Odd Spans)
Exp. Design	Grain Sorghum
Soil Type	Pullman Clay Loam

Field Operations	Date	Activity
Tillage		
Fertility	3/29/2019	Liquid 32-0-0 8.3gal/ac (Dryland)
	3/29/2019	Liquid 32-0-0 20gal/ac (Low Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (High Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (Medium Water)
	4/1/2019	Liquid 10-34-0 6gal/ac (High Water)
	4/1/2019	Liquid 12-0-0-26 4gal/ac (High Water)
	4/2/2019	Liquid 10-34-0 6gal/ac (Medium Water)
	7/17/2019	Liquid 32-0-0 20.8gal/ac (High Water)
	7/18/2019	Liquid 32-0--0 10.3gal/ac (Medium Water)
Planting / Harvest	5/17/2019	Planted NexGin 3500 XF 46,000/ac
	5/31/2019	Planted NexGin 3500 XF 44,000/ac (Replant)
	11/2/2019	Harvested all test
Herbicide /	3/20/2019	Clash 8oz/ac, Showdown 48oz/ac, Induce 1%
Growth Regulator	3/20/2019	Panther 2oz/ac
	5/22/2019	Medal EC 1.3pt/ac, Showdown 32oz/ac
	6/27/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 1.3pt/ac
	7/18/2019	Mepiquat 8oz/ac
	7/29/2019	Diuron 1.5pt/ac
	8/16/2019	Mepiquat 16oz/ac (High Water)
	8/28/2019	Mepiquat 16oz/ac (High Water)
Insecticide	6/28/2019	Acephate 3oz/ac
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/17/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/31	Base = 2.35in., Base - 50% = 2.35in., Base + 50% = 2.35in.
Seasonal	6/1 - 9/30	Base = 6.25in., Base - 50% = 3.25in., Base + 50% = 9.25in.
Rainfall		
PrePlant & Planting	1/1 - 5/31	7.52in.
Seasonal	6/1 - 9/30	8.18in.

Operations Summary

Year	2019
Farm	Helm
Field ID	Field 5F (Even Spans)
Exp. Design	Sorghum
Soil Type	Pullman Clay Loam

Field Operations	Date	Activity
Tillage	1/22/2019	Disk
	1/29/2019	Chisel
	2/28/2019	List
	3/1/2019	Rip Soft Middles
	4/3/2019	Dike and Bed Conditioner
	4/4/2019	Dike and Bed Conditioner
	4/18/2019	Bed Conditioner
	5/15/2019	Rotary Hoe
	5/28/2019	Rotary Hoe
	6/4/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/11/2019	Cultivate and Dike
	6/20/2019	Rotary Hoe
	7/12/2019	Cultivate and Dike
	7/19/2019	Cultivate and Dike
Fertility	3/29/2019	Liquid 32-0-0 8.3gal/ac (Dryland)
	3/29/2019	Liquid 32-0-0 20gal/ac (Low Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (High Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (Medium Water)
	4/1/2019	Liquid 10-34-0 6gal/ac (High Water)
	4/1/2019	Liquid 12-0-0-26 4gal/ac (High Water)
	4/2/2019	Liquid 10-34-0 6gal/ac (Medium Water)
	7/17/2019	Liquid 32-0-0 20.8gal/ac (High Water)
	7/18/2019	Liquid 32-0--0 10.3gal/ac (Medium Water)
Planting / Harvest	6/17/2019	Planted Frontier Hybrid F-305C 40,000, 50,000, 70,000seed/ac
	10/15/2019	Harvested all test
Herbicide / Growth Regulator	5/1/2019	Atrazine 1pt/ac, Showdown 48oz/ac
	6/17/2019	Solera 48oz/ac, Medal EC 1.3pt/ac, Induce 1%
	7/23/2019	Clash 16oz/ac, Medal 1.3pt/ac
Insecticide	8/22/2019	Sivanto 8oz/ac
Harvest aid	10/8/2019	Showdown 64oz/ac, Dyne-Amic 1%
Irrigation Amt.		
PrePlant & Planting	1/1 - 6/17	Base = 2.35in., Base - 50% = 2.35in., Base + 50% = 2.35in.
Seasonal	6/18 - 9/30	Base = 8.00in., Base - 50% = 3.25in., Base + 50% = 11.25in.
Rainfall		
PrePlant & Planting	1/1 - 6/17	9.68in.
Seasonal	6/18 - 9/30	6.02in.



Operations Summary

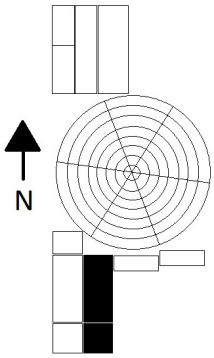
Year	2019
Farm	Helm
Field ID	Field 5F (Odd Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

Field Operations	Date	Activity
Tillage		
Fertility	3/29/2019	Liquid 32-0-0 8.3gal/ac (Dryland)
	3/29/2019	Liquid 32-0-0 20gal/ac (Low Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (High Water)
	3/29/2019	Liquid 32-0-0 14 gal/ac (Medium Water)
	4/1/2019	Liquid 10-34-0 6gal/ac (High Water)
	4/1/2019	Liquid 12-0-0-26 4gal/ac (High Water)
	4/2/2019	Liquid 10-34-0 6gal/ac (Medium Water)
	7/17/2019	Liquid 32-0-0 20.8gal/ac (High Water)
	7/18/2019	Liquid 32-0--0 10.3gal/ac (Medium Water)
Planting / Harvest	6/17/2019	Planted Frontier Hybrid F-305C 40,000, 50,000, 70,000seed/ac
	10/15/2019	Harvested all test
Herbicide /	3/20/2019	Clash 12oz/ac, Showdown 48oz/ac, Induce 1%
Growth Regulator	5/1/2019	Atrazine 1pt/ac, Showdown 48oz/ac
	6/17/2019	Solera 48oz/ac, Medal EC 1.3pt/ac, Induce 1%
	7/23/2019	Clash 16oz/ac, Medal 1.3pt/ac
Insecticide	8/22/2019	Sivanto 8oz/ac
Harvest aid	10/8/2019	Showdown 64oz/ac, Dyne-Amic 1%
Irrigation Amt.		
PrePlant & Planting	1/1 - 6/17	Base = 2.35in., Base - 50% = 2.35in., Base + 50% = 2.35in.
Seasonal	6/18 - 9/30	Base = 8.00in., Base - 50% = 3.25in., Base + 50% = 11.25in.
Rainfall		
PrePlant & Planting	1/1 - 6/17	9.68in.
Seasonal	6/18 - 9/30	6.02in.

Operations Summary

Year	2019
Farm	Helm
Field ID	Field 6 - Zones D - F
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

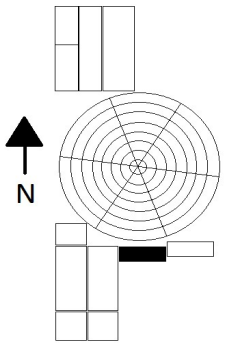
Field Operations	Date	Activity
Tillage	12/6/2018	Shred
	1/14/2019	Stalk Puller X 2
	1/17/2019	Disk
	1/18/2019	Disk(Angle)
	4/2/2019	Cultivate
	4/8/2019	List
	4/18/2019	Bed Packer
	5/6/2019	Bed Packer
	5/13/2019	Rotary Hoe
	5/23/2019	Bed Packer
	5/27/2019	Rotary Hoe
	6/3/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/19/2019	Rotary Hoe
	6/27/2019	Cultivate and Dike (South Side)
	7/12/2019	Cultivate and Dike (North Side)
Fertility	4/10/2019	Liquid 32-0-0 34gal/ac
	4/10/2019	Liquid 12-0-0-26 2gal/ac
	4/10/2019	Liquid 10-34-0 12gal/ac
Planting / Harvest	5/6/2019	Planted NexGin 3406 B2XF 46,000seed/ac
	5/23/2019	Planted NexGin 3500 XF 46,000seed/ac (Replant North Side of Water Way)
	5/31/2019	Planted NexGin 3500 XF 44,000seed/ac (Replant South Side of Water Way)
	6/10/2019	Planted NexGin 3500 XF 46,000seed/ac (Replant North Side of Water Way)
	11/1/2019	Harvested all crop
Herbicide /	5/3/2019	Medal EC 1.3pt/ac
Growth Regulator	6/20/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	6/28/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 3oz/ac
	8/1/2019	Diuron 1.5pt/ac
	8/16/2019	Mepiquat 12oz/ac
Insecticide	6/17/2019	Acephate 3oz/ac
	6/27/2019	Acephate 3oz/ac
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dynamic 1%
	10/17/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1 - 6/10	Zone D = 2.74in., Zone E = 3.24., Zone F = 3.38in.
Seasonal	6/11 - 9/30	Zone D = 4.79in., Zone E 4.75in., Zone F = 4.49in.
Rainfall		
PrePlant & Planting	1/1 - 6/10	9.52in.
Seasonal	6/11 - 9/30	6.18in.



Operations Summary

Year	2019
Farm	Helm
Field ID	Field 6 - Zone G
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

Field Operations	Date	Activity
Tillage	12/4/2018	Shred
	1/11/2019	Stalk Puler X 2
	1/18/2019	Disk
	4/5/2019	List
	4/19/2019	Bed Packer
	5/2/2019	Bed Packer
	5/13/2019	Rotary Hoe
	5/27/2019	Rotary Hoe
	5/29/2019	Bed Conditioner
	6/3/2019	Rotary Hoe
	6/7/2019	Rotary Hoe
	6/19/2019	Rotary Hoe
	6/26/2019	Cultivate and Dike
Fertility		
Planting / Harvest	5/2/2019	Planted NeGin 3406 B2XF 46,000seed/ac
	5/29/2019	Planted NeGin 3406 B2XF 44,000seed/ac (Replant)
	10/28/2019	Harvested all test
Herbicide /	3/5/2019	Trifuralin 1qt/ac
Growth Regulator	5/1/2019	Showdown 48oz/ac, Dyne-Amic 1%
	5/2/2019	Medal EC 1.3pt/ac
	6/10/2019	Solera 32oz/ac, Induce 1%
	6/28/2019	Engenia 12.8oz/ac, Showdown 48oz/ac, Smoke 1qt/100gal, Justified 3oz/ac
	7/1/2019	Medal EC 3oz/ac
	7/30/2019	Medal EC 1.3pt/ac
Insecticide	6/17/2019	Acephate 3oz/ac
	6/27/2019	Acephate 3oz/ac
Harvest aid	10/8/2019	Setup 32oz/ac, ETX 1.25oz/ac, Dynamic 1%
	10/16/2019	Solera 24oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/29	Zone G = 2.54in.
Seasonal	5/30 - 9/30	Zone G = 2.97in.
Rainfall		
PrePlant & Planting	1/1 - 5/29	7.52in.
Seasonal	5/30 - 9/30	8.18in.



Operations Summary

Year	2019
Farm	Helm
Field ID	Field 6 - Zone H
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

Field Operations	Date	Activity
Tillage	4/4/2019	Shred
Fertility		
Planting / Harvest	5/14/2019	Planted Delta Pine 46,000seed/ac (Regulated Plots)
Herbicide /	3/20/2019	Clash 8oz/ac, Showdown 48oz/ac, Induce 1%
Growth Regulator	3/21/2019	Panther 2oz/ac
	5/1/2019	Showdown 48oz/ac, Dyne-Amic 1%
	5/3/2019	Medal EC 1.3pt/ac
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/14	Zone H = 2.42in.
Seasonal	5/15 - 9/30	Zone H = 1.84in.
Rainfall		
PrePlant & Planting	1/1 - 5/14	3.78in.
Seasonal	5/15 - 9/30	11.92in.