



*Improving Life Through Science and Technology
Lubbock-Pecos-Halfway*

Helm Research Farm

Summary Report

2018

Technical Report 19-3

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

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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 projects include weed and insect control, plant breeding and yield trials for several commodities 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, moderately to moderately slowly 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.



Cotton Irrigation Timing using Subsurface Drip Irrigation (SDI) (Field 2)

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

Objective: Determine cotton lint yield and water productivity of three irrigation timing treatments using subsurface drip irrigation (SDI) at low irrigation capacity.

Methodology: This ongoing field study was conducted in a 12-acre area irrigated by SDI with a 30-inch dripline spacing and focused on preplant and early season irrigation timing with limited irrigation capacity. The treatments were T1 – minimal irrigation for cotton plant establishment, no irrigation during the vegetative period, 0.15 in./day rate during the reproductive and maturation periods; T2 – irrigation at 0.15 in./day rate during preplant, no irrigation during the vegetative period, 0.15 in./day rate during the reproductive and maturation periods; and T3 – minimal irrigation for plant establishment, 0.15 in./day rate during the vegetative, reproductive and maturation periods. A fourth treatment (Check) provided sufficient irrigation for plant establishment with no additional seasonal irrigation. Cotton yields, fiber quality (lint loan value) and water productivity (IWUE) were determined.

Results: Total irrigation quantities for the three respective treatments were 11.70, 13.98 and 13.38 inches with corresponding lint yields of 1665, 1600, and 1830 lb/acre. Due to significantly less seasonal rainfall in 2018 than 2017, irrigation water productivity (IWUE) was less in 2018 than 2017 with T1 (lowest total irrigation) having the numerically highest IWUE in both years. Preplant irrigation above that needed for germination (T2) resulted in similar yield and lower loan value than the similar treatment with preplant at lower amounts (T1) while using 2.3 in. additional irrigation. However, eliminating irrigation during the vegetative period in “dry” 2018 reduced lint yield by 230 lb/acre (T1 vs T3).

This year’s results support the concept of limiting preplant irrigation, even with low irrigation capacity, to conserve irrigation water.

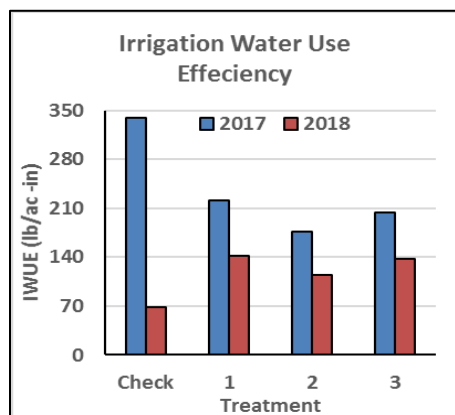


Figure 1: Irrigation water use efficiency (IWUE) from irrigation timing treatments at the Helm Research Farm, Halfway, Tx., 2017-2018.

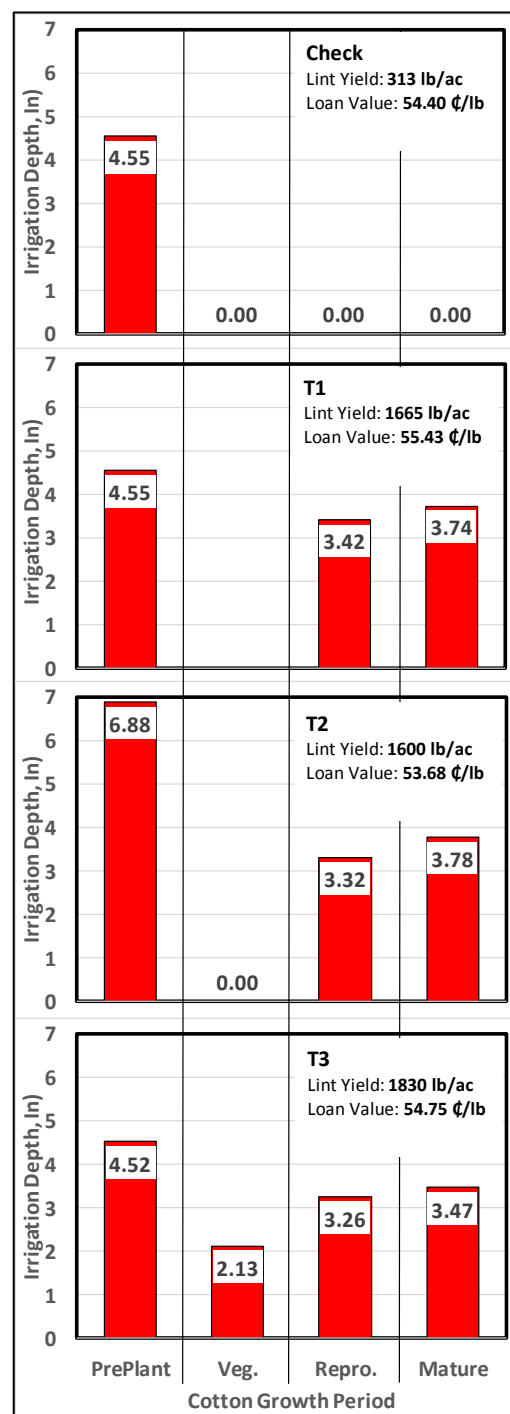


Figure 2: Irrigation amounts by growth period from irrigation timing treatments at the Helm Research Farm, Halfway, 2018.

Cotton Response to Preplant and Early Season Irrigation Amounts with SDI (Field 3)

James Bordovsky, Joe Mustian, Scott Jordan and Heath Johnson

Objective: Determine cotton lint yield, water productivity, and fiber quality of preplant and early season irrigation treatments using SDI.

Methodology: This study quantified differences in water productivity of SDI cotton during irrigation periods having the highest evaporation losses in the Texas South Plains. In this 16-acre test area, cotton was irrigated using 60-inch spaced SDI laterals, with each lateral irrigating two 30-inch crop rows. Treatment factors included preplant irrigation quantity and early season (vegetative period) irrigation capacity resulting in seven irrigation treatments, including a “preplant only” check (Table 1).



Figure 1. Harvesting subsurface drip irrigated treatments from irrigation timing experiments at the Helm Research Farm, Halfway, TX, 2018.

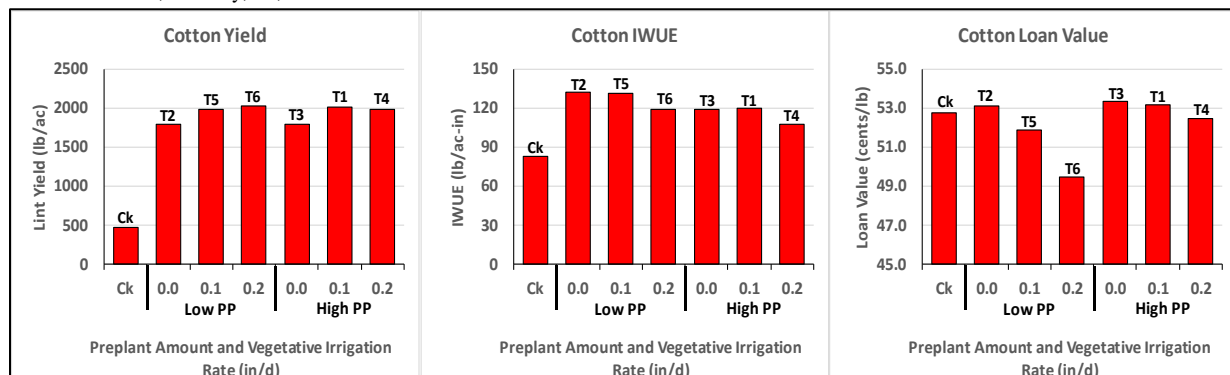
seasonal rainfall compared to 2017. Also, unlike previous years, at the 0.2 in./d vegetative period irrigation rate, the “low” (T6) vs. “high” (T4) preplant amount resulted in significantly reduced fiber quality (cotton lint loan value, Fig. 2) at \$0.495/lb. vs \$0.525/lb., respectively. This year’s results continue to support the concept that limited preplant and early season irrigation can increase irrigation productivity without proportional decreases in cotton yield

Results: Total annual irrigation ranged from 13.5 to 18.4 inches (Table 1) and lint yields ranged from 1790 to 2020 lb./ac (Fig. 2) within the six irrigated treatments. Unlike previous years and due to below average rainfall from May through July (3.3” vs. 7.4”), treatments not irrigated during the vegetative period (T2 & T3) resulted in up to 11% lower yields than those with irrigation. Irrigation water use efficiencies (IWUE) were generally greater in treatments having “low” versus “high” preplant irrigation, however, respective IWUE treatments were less in 2018 than those in 2017, this being attributed to decreases in

Table 1. Irrigation treatments, planned and actual irrigation amounts, during preplant, vegetative, reproduction and maturation periods, using SDI at Helm Research Farm, 2018

Treat. No.	Proposed Irr. Rate (in./day)			Actual Irrigation Amount (in.)			
	Preplant	Veg. Period	Repro. & Mat. Periods	Preplant	Veg. Period	Repro. & Mat. Periods	Total Irr. (in)
Check	0.1	0	0	5.6	0	0	5.6
T2	0.1	0	0.2	5.5	0	8.1	13.5
T5	0.1	0.1	0.2	5.5	1.8	7.8	15.1
T6	0.1	0.2	0.2	5.5	3.5	8	17
T3	0.2	0	0.2	7	0	8.1	15.1
T1	0.2	0.1	0.2	7	2.1	7.7	16.7
T4	0.2	0.2	0.2	6.9	4	7.5	18.4

Figure 2. Cotton lint yield, irrigation water use efficiency, and lint loan value for the seven irrigation timing treatments at the Helm Research Farm, Halfway, Tx, 2018.



The Effect of Crop Rotation, Irrigation Rate, and Tillage on Verticillium Wilt (Field 5)

Terry Wheeler, Cecil Haralson, Zachary Hilliard, and Robert Ballesteros

Methodology: The Helm circle includes a winter wheat/summer fallow/cotton rotation; a sorghum/cotton rotation; and continuous cotton with and without a cover crop. There are three irrigation rates, a base rate (1.0B) and 50% above (1.5B) and below (0.5B) the base rate. The two tillage systems are conventional tillage with beds and LEPA irrigation every other furrow, and flat ground/minimum tillage with splatter irrigation. Verticillium wilt incidence was measured on 27 August across all treatments, and defoliation due primarily to Verticillium was measured on only the 1.5B irrigation rate on 19 September. There was considerable defoliation in the other irrigation treatments, but it was difficult to differentiate between defoliation caused by water stress and the disease, so the other irrigation rate measurements were not used.



Figure 1. Splatter irrigation applicator used in reduced (flat planted) tillage treatments during seasonal irrigations at the Helms Research Farm, Halfway, Tx., 2018.

Results: Wilt Incidence: Verticillium wilt incidence increased as irrigation rate increased (Table 1). At the 1.0B irrigation rate, the flat ground/minimum tillage system had less Verticillium wilt than the bed/conventional tillage system for the continuous cotton/no cover, wheat/fallow/cotton, and sorghum/cotton systems. At the high irrigation rate (1.5B), tillage system did not affect the incidence of Verticillium wilt.

Table 1. Effect of tillage system and irrigation rate on incidence of Verticillium wilt in continuous cotton (CC), wheat/fallow/cotton (W/F/C) and Sorghum/Cotton (S/C) rotations.

Irr	CC-no cover		CC-cover		W/F/C		S/C	
	Bed	Flat	Bed	Flat	Bed	Flat	Bed	Flat
0.5B	2.8 cZ ^a	5.1 cZ	9.5 bZ	8.4 cZ	8.3 bZ	1.5 cZ	3.6 bZ	8.8 cZ
1.0B	37.9 bZ	22.8 bY	16.7 bZ	23.5 bZ	56.5 aZ	16.7 bY	52.9 aZ	34.2 bY
1.5B	59.9 aZ	62.1 aZ	48.5 aZ	53.6 aZ	61.8 aZ	67.2 aZ	56.0 aZ	49.5 aZ

^aThe comparison between irrigation rate (within a tillage system and cropping system) was based on a, b, c where the means followed by the same letter would not be significantly different at $P=0.05$. The comparison between tillage systems (but within the same irrigation rate and cropping system) consisted of Z or Y, where the means followed by the same letter would not be significantly different at $P=0.05$.

Defoliation: In the continuous cotton/no cover, Verticillium wilt caused more defoliation in the beds/conventional tillage compared with the flat ground/minimum tillage (Fig. 2). However, with the wheat/fallow/cotton system and the sorghum/cotton system, there was more defoliation associated with the flat ground/minimum tillage systems than the beds/conventional tillage system.

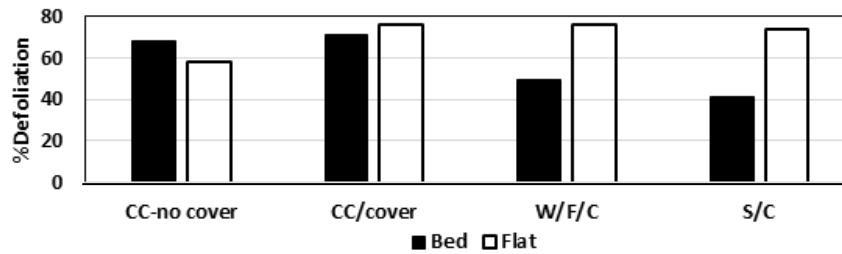


Figure 2. Effect of tillage system (Bed/conventional tillage versus flat ground/minimum tillage) and cropping system (CC=continuous cotton, W/F/C = wheat/fallow/cotton, S/C = sorghum/cotton) on defoliation caused by Verticillium wilt, in the high irrigation rate. * indicates differences in tillage systems were significant at $P=0.05$

Yield: For the two continuous cotton systems, the two tillage systems yielded similarly at the 1.0 and 1.5B irrigation rates (Table 2). Verticillium wilt differences that were seen in these systems did not affect yield in any measurable way. However, in the wheat/fallow/cotton system, at 1.0B, the higher wilt incidence in the beds compared with flat ground, translated into lower yields for the beds compared to flat ground tillage systems. While at 1.5B, defoliation caused by Verticillium, which was worse in the flat ground, translated to lower yields in the flat ground compared to the beds. The sorghum/cotton rotation system produced similar trends at 1.0B and 1.5B irrigation rates were seen as with the wheat/fallow/cotton system (Table 2).

Table 2. Effect of irrigation rate (I), tillage system (Bed versus flat ground), and cropping system (CC=continuous cotton, W/F=wheat/fallow, S=sorghum) on cotton lint yield.

I	CC/Cover		CC/no cover		W/F/Cotton		S/Cotton	
	Bed	Flat	Bed	Flat	Bed	Flat	Bed	Flat
0.5	689 bZ ^a	587 bZ	643 bY	748 bZ	962 cY	1,102 bZ	598 cY	803 bZ
1.0	989 aZ	829 aZ	1,355 aZ	1,340 aZ	1,241 bY	1,477 aZ	1,041 bY	1,219 aZ
1.5	939 aZ	922 aZ	1,375 aZ	1,406 aZ	1,352 aZ	1,197 bY	1,324 aZ	1,182 aY

^aThe comparison between irrigation rate (within a tillage system and cropping system) was based on a, b, c where the means followed by the same letter would not be significantly different at $P=0.05$. The comparison between tillage systems (but within the same irrigation rate and cropping system) consisted of Z or Y, where the means followed by the same letter would not be significantly different at $P=0.05$.

Conclusion: Verticillium wilt can be worse under wetter/cooler soil conditions, which can be caused by higher irrigation rates and flat ground/reduced tillage compared with beds and conventional tillage. In the cropping systems where Verticillium wilt is more likely to be a problem (wedges B, C, E, F), management practices that result in cooler/wetter soil conditions lose more yield to Verticillium wilt. In the wedges where Verticillium wilt appears to be less of a problem (wedges A and D), irrigation rate is the primary driving factor for yield, and tillage systems had minimal impact.

Effects of Crop Rotation, Tillage, and Irrigation on Soil Organic Carbon and Aggregate Distribution (Field 5aef)

Katie Lewis, Dustin Kelley, Joseph Burke, and James Bordovsky

Objective: Evaluate the cumulative effects of crop rotation, tillage, and irrigation level on soil organic carbon and aggregate formation.

Methodology: Soil samples were collected at depth (0-6, 6-12 inches) in January 2018 from cropping systems (continuous cotton, sorghum following cotton, and cotton following sorghum) under reduced and conventional tillage and irrigation levels of 1.5*base irrigation (BI) and 0.5*BI. Soil samples were dried at 105°C for 72 hours. An aliquot (100 g) of each sample was separated into size fractions, including large macroaggregates (4 mm - 2 mm), small macroaggregates (2 mm - 0.25 mm), microaggregates (0.25 mm - 0.053 mm), and silt and clay (<0.053 mm). After sieving fraction weights were recorded and used to calculate aggregate mean weight diameter (MWD). Finally, an aliquot of soil was combusted to determine soil organic C (SOC).

Results: Mean weight diameter is used to express aggregate stability and measures macro-aggregate stability as affected by soil management practices. Within the 0-6" soil depth, MWD was generally greater under conventional tillage except in continuous cotton at 1.5*BI (Fig. 1a & b). Aggregate MWD did not consistently respond to irrigation. At the 6-12" depth, differences in MWD between reduced and conventional tillage were generally greater than the 0-6" depth (Fig. 1b). Soil organic C (SOC) was generally greatest in reduced tillage at the 6-12" depth, but fluctuate between treatments in the 0-6" depth (Fig. 2a, b). This is likely due to increased organic material under reduced tillage compared to conventional tillage.

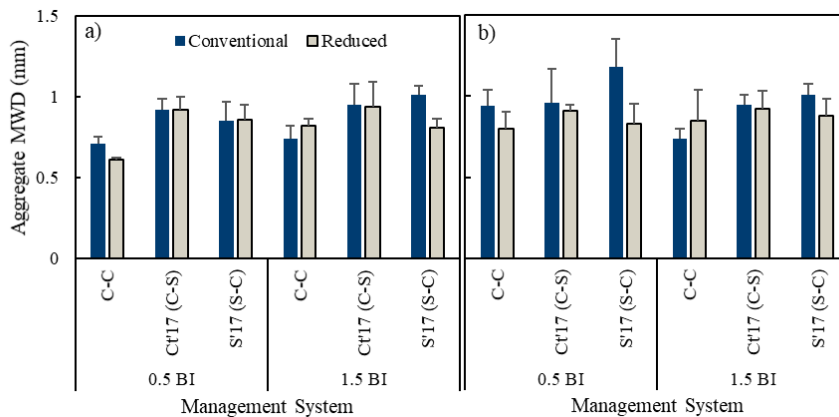


Figure 1. Mean weight diameter (MWD) of soil aggregates as affected by crop rotation [continuous cotton (C-C), cotton following sorghum (C'17, S-C), and sorghum following cotton (S'17, C-S)], irrigation level (1.5BI and 0.5BI), and tillage (reduced and conventional) at soil depths of 0-6" (a) and 6-12" (b).

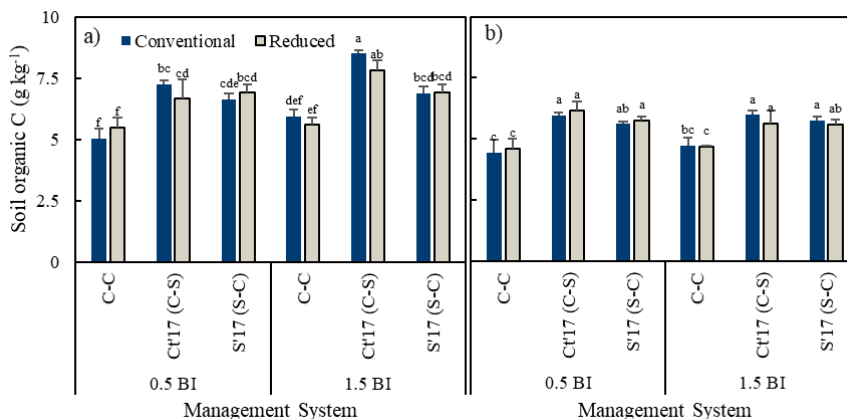


Figure 2. Soil organic C (SOC) as affected by crop rotation [continuous cotton (C-C), cotton following sorghum (C'17, S-C), and sorghum following cotton (S'17, C-S)], irrigation level (1.5BI and 0.5BI), and tillage (reduced and conventional) at soil depths of 0-6" (a) and 6-12" (b). Letters indicate significant differences between treatment at depth ($P < 0.0001$).

Cotton Response to Irrigation Level, Continuous Cotton (Field 5a)

James Bordovsky, Casey Hardin, Joe Mustian, and Scott Jordan

Objective: Determine yield and water use efficiency of continuous cotton at three irrigation levels under conventional 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, conventionally tilled 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.

Results: Rainfall for 2018 totaled 10.6 inches and combined preplant and seasonal irrigations in the three respective irrigation treatments were 9.0, 13.2, and 16.4 inches. As expected, cotton lint yields increased from the 0.5 BI to the 1.0 BI treatments (690 lb/ac to 990 lb/ac) but were reduced by 5% when additional irrigation was added in the 1.5 BI treatment (Figure 2). This may be partially due to the effects of verticillium wilt in this non-rotated pivot wedge. Seasonal irrigation water use efficiency (SIWUE), which is the yield response per unit of irrigation above “preplant only” yield (0.0BI), was near 80 lb/ac-in. in both 0.5 BI and 1.0 BI treatments, but well below values in other pivot irrigated and SDI experiments. The 1.5 BI treatment decreased SIWUE and reduced fiber quality and loan values compared to those in the 0.5 BI and 1.0 BI treatments. This pattern has been seen in each of the previous three years. Compared to cotton in rotation with wheat or sorghum, or cotton planted into terminated wheat cover (the next three reports), yields in continuous, conventionally tilled cotton were low.



Figure 1: Cotton harvest in conventionally tilled plots, Helm Research Farm, 2018.

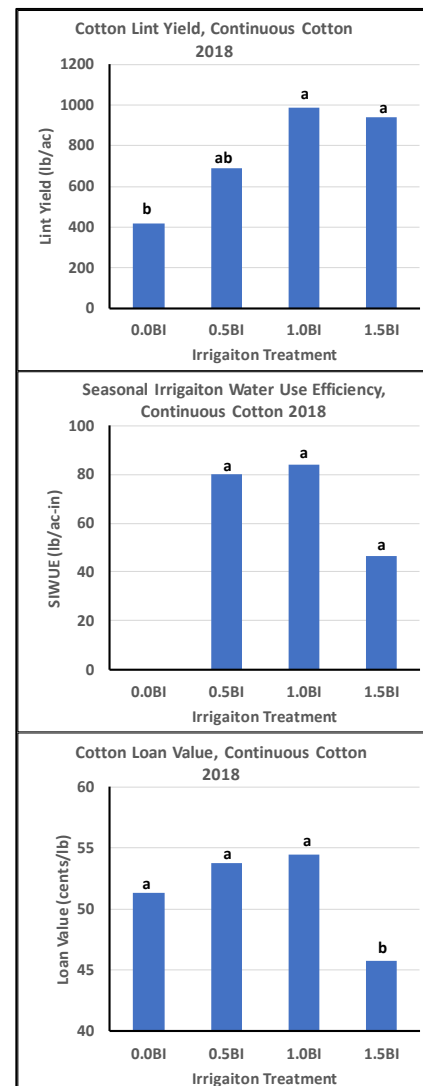


Figure 2: Lint yield, seasonal irrigation water use efficiency (SIWUE), and cotton lint loan value of continuous cotton using conventional tillage, Helm Research Farm, 2018.

Cotton / Wheat Grain Rotation Response to Tillage and Irrigation Levels (Field 5b)

James Bordovsky, Casey Hardin, Joe Mustian, and Scott Jordan

Objective: Determine lint yield 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 2018) was planted following wheat harvest for grain and summer fallow period (in 2017). Two tillage systems, conventional tillage (spans 4, 6, and 8) and reduced tillage (spans 3, 5, and 7), were used. In addition, each pivot span was divided into three sections, with each section delivering different irrigation amounts. The three 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 for 2018 are listed in the appendix.

Results: Annual rainfall was below the long-term average in 2018 at 10.6 inches compare to 18.7 inches. Combined preplant and seasonal irrigation amounts for the three irrigation treatments were 9.3, 14.3, and 17.8 inches respectively. Under reduced tillage, the 0.5 BI and 1.0 BI irrigation treatments resulted in 14.4% and 19% higher respective lint yields and 54.7% and 44.8% higher respective seasonal irrigation water use efficiencies (SIWUE) than corresponding conventionally tilled treatments (Figure 1). Irrigation above the 1.0BI level increased yield among conventional treatments, but reduced yields in corresponding no-till treatments. Irrigation at 1.5 BI consistently reduced SIWUE and lint loan values compared to lower irrigation amounts, regardless of tillage method. Profile water storage from the previous fallow period positively affected crop responses, particularly at the lower irrigation levels.

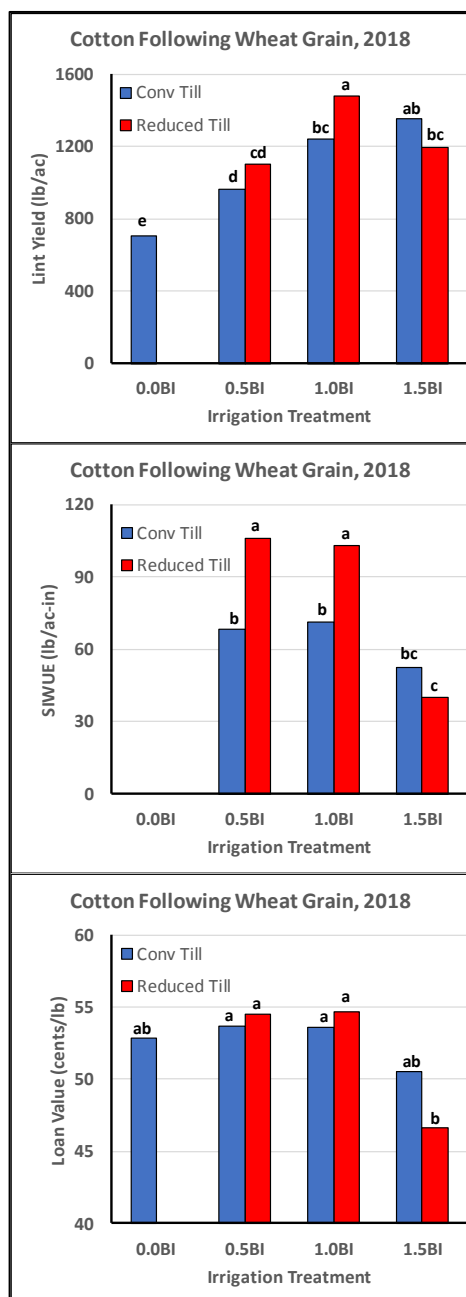


Figure 1. Cotton lint yield, seasonal irrigation water use efficiency, and cotton lint loan value from irrigation levels in two tillage systems at Helms Research Farm, 2018.



Figure 2. Cotton planting into harvested wheat in tillage x crop rotation x irrigation level experiments at the Helms Research Farm, 2018.

Cotton Planted into Terminated Wheat Response to Tillage and Irrigation Levels (Field 5d)

James Bordovsky, Casey Hardin, Joe Mustian, and Scott Jordan

Objective: Determine yield 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 test results are part of a comprehensive crop rotation-tillage-irrigation study being conducted at the Helm Research Farm. In this 22-acre test area, cotton has been planted into terminated wheat for the past several years. Two tillage systems, conventional tillage (in spans 4, 6, and 8) and reduced tillage (in spans 3, 5, and 7) were used. Each pivot span was divided into three sections, with each section providing different irrigation amounts. 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). Irrigations on the western half of this wedge were delayed until July 9th versus a more traditional start on the eastern half of the wedge (June 26th). Irrigation amounts, field operations, varieties, pesticides and nutrient applications for 2018 are listed in the appendix.

Results: Annual rainfall in 2018 was 43% below the long-term average at 10.6 inches. Within an irrigation level for a given seasonal irrigation start date, there were no significant differences due to tillage treatments in yield, seasonal irrigation water use efficiency (SIWUE), or loan price (Figure 1). Regardless of irrigation start dates, irrigation above 0.5 BI significantly increased yield. Within treatments having the traditional irrigation start date, irrigation above 1.0 BI did not increase cotton yield. However, in treatments with the late irrigation start under the reduced tillage, increasing irrigation above the 1.0 BI to the 1.5 BI level increased yield by 12.6%. The highest SIWUE was at the 1.0 BI level regardless of when irrigation was initiated. Delaying seasonal irrigation resulted in approximately the same or increased yields with less total irrigation compared to corresponding traditional irrigation start treatments resulting in higher SIWUE's. This is attributed to reducing irrigation evaporation losses by delaying seasonal irrigation.

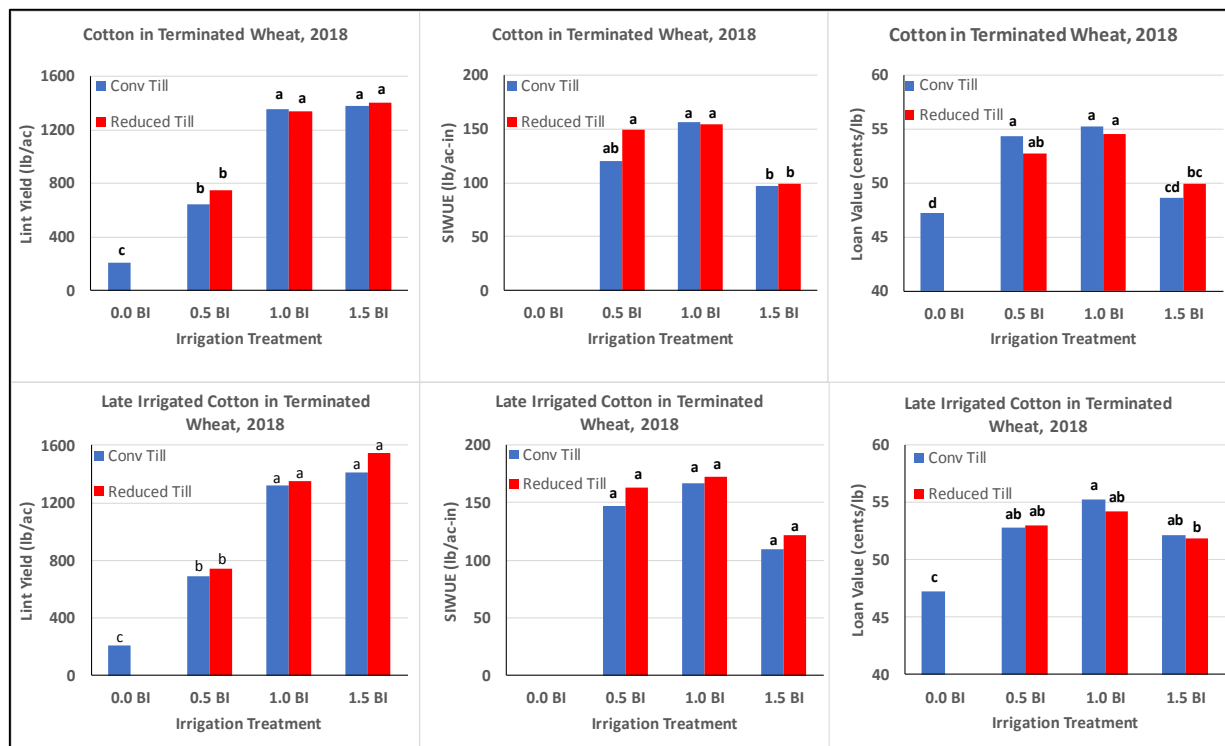


Figure 1. Cotton lint yield, seasonal irrigation water use efficiency (SIWUE), and lint loan values from treatments having two irrigation start dates, two tillage methods, and three levels of irrigation at the Helm Research Farm, 2018.

Grain Sorghum / Cotton Rotation Response to Tillage and Irrigation Levels (Field 5e)

James Bordovsky, Casey Harden, Joe Mustian, and Scott Jordan

Objective: Determine yield and water productivity of grain sorghum following cotton in two-year rotation with cotton 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 the LEPA method. Grain sorghum was planted in a two-year rotation with cotton. Two tillage systems, conventional tillage (even pivot spans) and reduced tillage (odd spans) were evaluated. Each span was divided into three sections delivering three levels of irrigation. Irrigation treatments 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). The base irrigation level provided approximately 50% ET_{crop} of grain sorghum. Irrigation amounts, crop hybrids, 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 Helm Farm, 2014-2018.

Results: Average grain sorghum yields for 2014 through 2018 are given in Figure 2. Non-irrigated grain sorghum yields in the conventional tillage areas were lower in 2018 (555 lb/ac) compared to previous years (4200, 3800, and 1270 lb/ac in 2015, 2016, and 2017 respectively). With one exception, over the past years, grain yields have increased with increased irrigation. The highest seasonal irrigation water use efficiency (SIWUE) has consistently been at the 1.0 BI level (data not displayed). The effects of tillage treatments have been inconsistent over the five-year period. In 2014 and 2016, reduced tillage treatments result in lower grain yields than conventional treatments in Wedge E. However, in 2018, this trend reversed with results following yield trends seen in 2015 and 2017 (Wedge F), possibly indicating a gradual improvement in water holding capacity in the no till treatment areas of this wedge. Tillage effects may become more apparent with time.

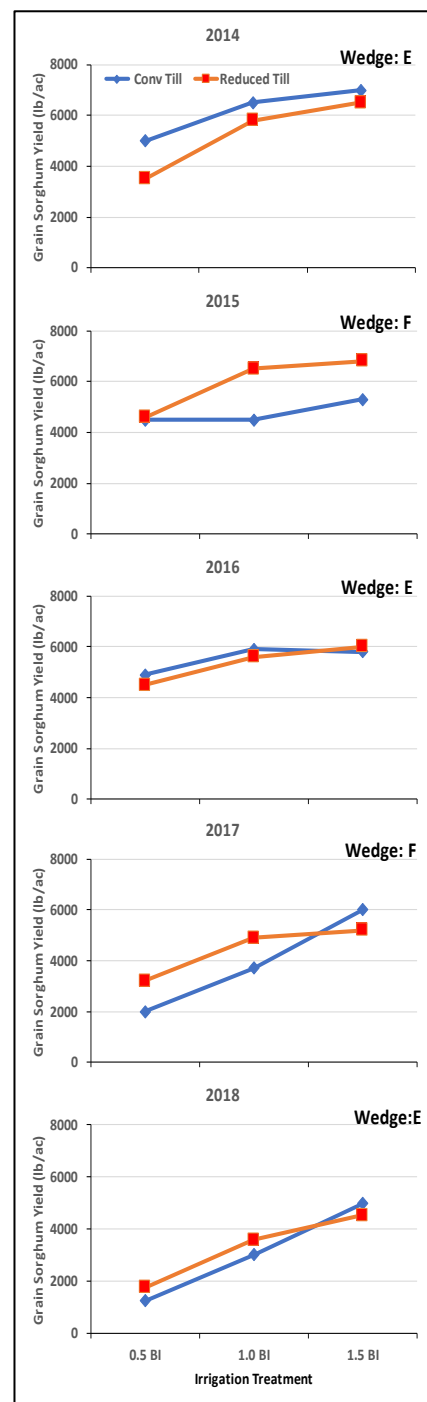


Figure 2. Grain sorghum yields from treatment areas following cotton using conventional and reduced tillage systems at three irrigation levels at the Helm Farm, 2014-2018.

Cotton / Sorghum Rotation Response to Tillage and Irrigation Levels (Field 5f)

James Bordovsky, Casey Hardin, Joe Mustian, and Scott Jordan

Objective: Determine yield 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 on 125 acres irrigated by LEPA. In this 22-acre test area, cotton was planted following grain sorghum in a two-year rotation. Two tillage systems, conventional tillage (pivot spans 4, 6, and 8) and reduced tillage (spans 3, 5, and 7), were used. Field operations for each tillage method are in the appendix. In addition, each pivot span was divided into three sections with each section delivering one of three irrigation levels to the soil surface below. The irrigation levels were designate as base irrigation rate (1.0BI); 50% of base rate (0.5BI); and 150% of base rate (1.5BI). The pivot irrigation capacity at 1.0BI met approximately 60% ET_{crop} of cotton.

Results: Cotton yields were less in 2018 than in 2017 with larger yield reductions at the 0.5 BI irrigation level (Figure 1). This was partially attributed to less rainfall and higher air temperatures in 2018. Seasonal irrigations increased from 1.5, 3.5, and 5.0 inches in 2017 to 3.3, 7.8, and 11.3 inches in 2018 in the three respective irrigation treatments. Higher irrigations in 2018 with no proportional increase in yield resulted in season irrigation water use efficiency (SIWUE) being reduced from 2017 to 2018 in complementary treatments. In both years at the 0.5 BI and 1.0 BI levels, cotton yields were higher in reduced than in the conventionally tilled areas. Fiber quality, as reflected in the lint loan value, of the 1.5 BI treatments were less than those of the 0.5 BI and 1.0 BI levels treatments, and conventional compared to reduced tillage reduced loan values by 6.3% and 9.1% at 1.0 BI and 1.5 BI levels, respectively (data not shown).

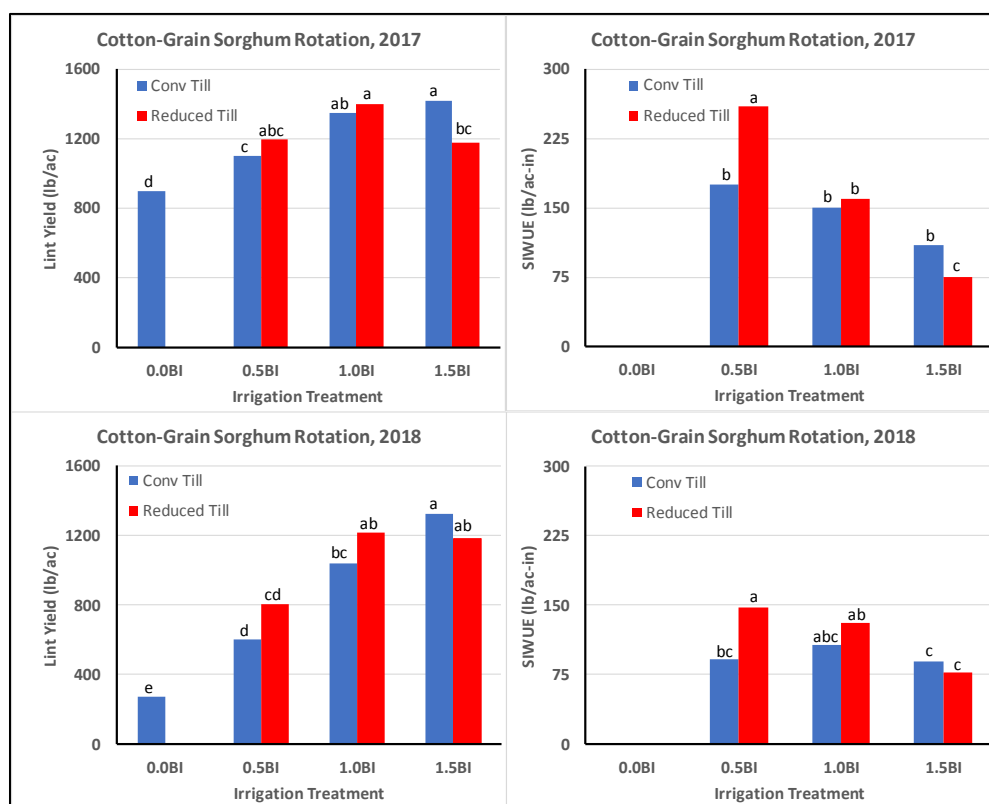


Figure 1: Lint yield and seasonal irrigation water use efficiency of irrigated cotton treatments following grain sorghum using conventional and reduced tillage systems at three irrigation levels at Texas A&M AgriLife Research, Helm Farm, 2017-2018.

Comparison of Multi-sensor Capacitance and TDR Soil Moisture Sensors (Field 5)

Scott Jordan, James Bordovsky, and Dana Porter

Objective: Compare commercially available soil moisture sensors and evaluate their potential for irrigation management decisions in deficit irrigation areas.

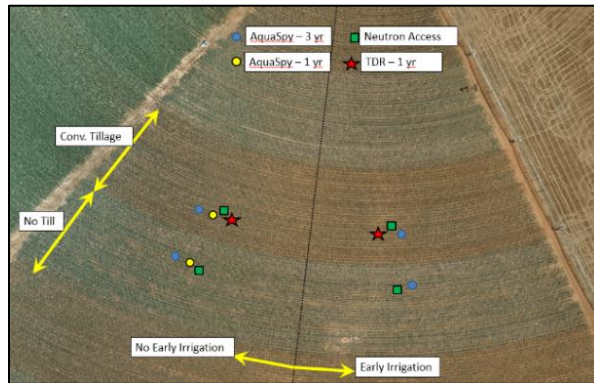


Figure 1. Soil moisture sensor installation locations within water management treatments at Texas A&M AgriLife Research, Halfway, TX, 2018.

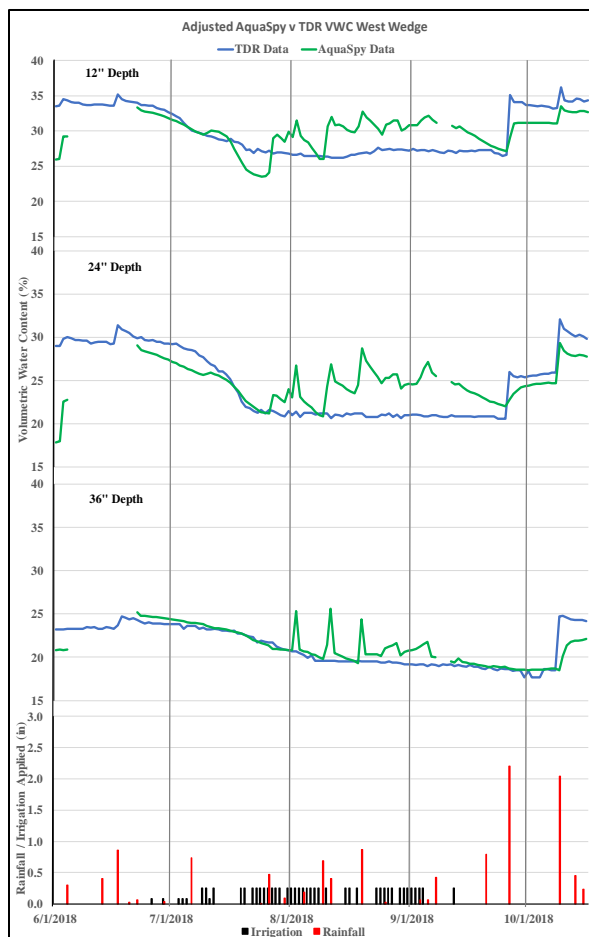


Figure 2. Soil moisture content over time from TDR and capacitance sensors in field experiments at Texas A&M AgriLife Research, Halfway, TX, 2018.

Methodology: Soil moisture sensors can provide up-to-date representation of the soil moisture content within the soil, however their use for irrigation scheduling in low irrigation capacity environments is limited. A set of Time Domain Reflectometry (TDR) sensors (Model #: ACC-TDR-315L) and a set of “permanent” capacitance sensors (AquaSpy Soil Pro 1200 PC:P100A) were installed in the northwest area of an ongoing irrigation study. The TDR sensors were positioned below individual cotton crop rows, while the capacitance sensors were located 7.5 inches from the row in non-traffic furrows. Capacitance and TDR soil water measurements were recorded at intervals of 2 hours from June 1 through October 16, 2018. Daily irrigation and rainfall were also measured.

Results: The 2018 seasonal irrigation and rainfall amounts were 10.3 and 8.7 inches, respectively for this treatment area. The average cotton lint yield in the treatment area was 1324 pounds per acre. Figure 2 shows capacitance sensor data, which were normalized to that of the TDR sensors, and TDR sensor data, at depths of 12”, 24”, 36”. Due to a communication error with the data logger between June 6 and June 21 and again between September 8 and September 10, no data were recorded during these periods. While both sensors monitored soil moisture, there were significant differences in the responses between sensor types to irrigation and rainfall events. For example, the capacitance sensor was more responsive to irrigations through the growing season, while the TDR sensor showed a greater response to the large rainfalls at the end of the growing season. At the 12” depth, the TDR sensor showed a more gradual decline in soil moisture around July 15, where the capacitance sensor showed a sharper decline in soil moisture during the same time. Even in common soil crop environments, differences in soil moisture readings can occur due to sensors placement, non-uniform soil texture and/or differences in sensor manufacturing. These results show the possibility for using sensor based management practices in deficit cotton irrigation areas in the Texas South Plains.

Effect of Nitrogen Fertility on Cotton Crop Response to Simulated Cotton Fleahopper Damage (Field 6g)

M.N. Parajulee, A. Hakeem, Katie Lewis, S.C. Carroll, 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 May 25, 2018. The experiment was laid out in a split-split-plot randomized block design with five nitrogen fertility rate treatments applied for 16 years as main plots (16-row plots), split into two 8-row sub-plots: 1) nitrogen applied annually as previous years, and 2) nitrogen not applied since 2016, and two artificial cotton square injury treatments mimicking acute cotton fleahopper infestation as sub-sub-plots with four replications (total 80 experimental units). Within each of the five main-plot treatments that included pre-bloom side-dress applications of augmented N fertilizer rates of 0, 50, 100, 150, and 200 lb N/acre for 16 years, sub-plot treatments included N augmentation using a soil applicator injection rig on July 3, 2018 as in previous years versus no N augmentation. 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 40 sub-plots on June 22, 2018. Within each sub-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.

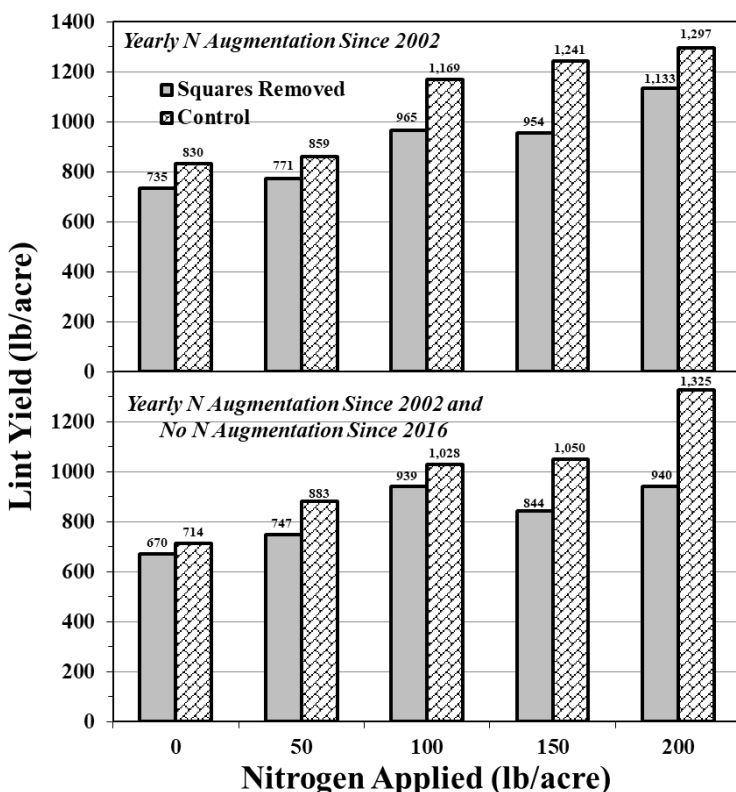


Fig. 1. Lint yield following 100% square removal 3-week into squaring as affected by continuous long-term augmentation of varying N rates versus N withdrawal for two years after 16-year augmentation.

Results: Considerably higher residual soil nitrogen was recorded from plots that received the two highest N rates in preceding 16 years. Withdrawing of N following 16 years of continuous augmentation resulted in lower leaf N and slightly lower lint in all N rate treatments (Fig. 1). However, lint yield was similar across all five N treatments in 2017 when N augmentation was ceased and the crop only experienced the long-term residual N. Removal of 100% squares 3-week into squaring did not significantly impact lint yield at lower N levels, but the yield was reduced by 20-30% at the two highest N levels; greater impact of square removal was observed on N-withdrawn plots compared to that in continuous N augmented plots. Only a slight reduction in yield without N augmentation for two years after 16 years of N augmentation indicates the presence of enough residual N in the soil.

Performance of Americot Varieties as Affected by Low-Energy Precision Application (LEPA) Irrigation Levels at Halfway, TX, 2018.

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

MATERIALS AND METHODS:

Plot Size:	4 rows by 30 feet, 4 replications			
Planting Date:	May 18			
Varieties:	NG 3729B2XF	NG 3780B2XF		
	NG 3930B3XF	NG 3956B3XF		
	NG 4777B2XF	NG 5711B3XF		
	DP 1646B2XF			
Herbicides:	Trifluralin 1 qt/A – March 6			
	Medal 1.3 pt/A + Helmquat 2 pt/A – May 18			
	Glyphosate 32 oz/A – June 11			
	Medal 1.3 pt/A – June 14			
	Glyphosate 32 oz/A – June 19			
	Glyphosate 32 oz/A – July 10			
	Diuron 1.5 pt/A – July 13			
Fertilizer:	136-31-0			
Irrigation in-season:	LEPA			
		Low	Base	High
	Preplant	7.8"	7.8"	7.8"
	In Season	4.7"	9.4"	14.1"
	Total	12.5"	17.2"	21.9"
Harvest Date:	November 21			

RESULTS AND DISCUSSION:

Six NexGen varieties, including three Bollgard III XtendFlex entries, and a competitive commercial variety were compared under three irrigation levels. Highest yields were produced with the base irrigation level and declined with additional irrigation (Table 1). When averaged across irrigation levels, highest yields were produced with NG 3930B3XF and NG 3956B3XF. Loan values declined with increasing irrigation (Table 2). Highest loan values were produced with DP 1646B2XF. When averaged across irrigation levels, highest gross revenues were produced with NG 3930B3XF and NG 3956B3XF (Table 3).

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

Variety	In-season Irrigation Levels			Average
	Low (4.7)	Base (9.4)	High (14.1)	
	----- lbs/A -----			
NG 3729B2XF	886	1214	1035	1045 C
NG 3780B2XF	939	1351	1302	1197 B
NG 3930B3XF	1089	1907	1634	1543 A
NG 3956B3XF	1015	1793	1782	1530 A
NG 4777B2XF	1066	1681	1201	1316 B
NG 5711B3XF	1117	1068	755	980 C
DP 1646B2XF	813	1181	1030	1008 C
Average	989 C	1456 A	1248 B	--

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

Variety	In-season Irrigation Levels			Average
	Low (4.7)	Base (9.4)	High (14.1)	
	----- cents/lb -----			
NG 3729B2XF	56.43	50.88	46.03	51.11 E
NG 3780B2XF	54.58	53.33	50.60	52.83 BC
NG 3930B3XF	54.53	53.50	48.63	52.22 CD
NG 3956B3XF	52.90	53.83	50.00	52.24 CD
NG 4777B2XF	54.65	54.88	50.13	53.22 B
NG 5711B3XF	53.85	51.15	50.53	51.84 DE
DP 1646B2XF	55.25	54.38	52.88	54.17 A
Average	54.60 A	53.13 B	49.83 C	--

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

Variety	In-season Irrigation Levels			Average
	Low (4.7)	Base (9.4)	High (14.1)	
	----- \$/A -----			
NG 3729B2XF	500	618	476	531 C
NG 3780B2XF	513	719	659	630 B
NG 3930B3XF	594	1020	794	803 A
NG 3956B3XF	536	968	891	798 A
NG 4777B2XF	582	923	602	702 B
NG 5711B3XF	600	544	384	509 C
DP 1646B2XF	449	642	545	545 C
Average	539 C	776 B	622 A	--

Performance of FiberMax and Stoneville Varieties as Affected by Irrigation Levels at Halfway, TX, 2018.

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

MATERIALS AND METHODS:

Plot Size:	4 rows by 30 feet, 3 replications				
Planting Date:	May 17				
Varieties:	FM 1621GL (BX 1921GL) FM 2398GLTP (BX 1971GLTP) BX 1972GLTP FM 1320GL FM 1830GLT FM 1888GL FM 1911GLT FM 2322GL FM 2498GLT FM 2574GLT ST 4946GLB2 ST 5471GLTP				
Herbicides:	Trifluralin 1 qt/A – March 7 Medal 1.3 pt/A + Helmquat 2 pt/A – May 17 Clethodim 12 oz/A – May 29 Glyphosate 32 oz/A – June 7 Medal 1.3 pt/A – June 14 Glyphosate 32 oz/A – June 19 Glyphosate 32 oz/A – July 10 Diuron 1.5 pt/A – July 13				
Fertilizer:	136-31-0				
Irrigation in-season:	LEPA				
		Dry	Low	Base	High
	Preplant	4.2"	7.8"	7.8"	7.8"
	In Season	<u>2.9"</u>	<u>4.7"</u>	<u>9.4"</u>	<u>14.1"</u>
	Total	7.1"	12.5"	17.2"	21.9"
Harvest Date:	November 5				

RESULTS AND DISCUSSION:

Ten FiberMax and two Stoneville varieties were compared under three irrigation levels and dryland (preplant irrigation only) conditions. When averaged across varieties, yields increased from the low to base levels, but were similar at the base and high levels (Table 1). When averaged across irrigation levels, the highest yielding group included FM 1621GL, FM 1911GLT, FM 2498GLT, FM 2574GLT, and FM 2398GLTP. Loan value declined at the high irrigation level and ranged from 53.15 cents/lb to 55.69 cents/lb across varieties (Table 2). Highest gross revenues (\$/A) were produced with FM 1621GL, FM 1830GLT, FM 1888GL, FM 1911GLT, FM 2498GLT, and FM 2574GLT (Table 3).

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

Variety	In-season Irrigation Levels				Average
	Dry (2.9)	Low (4.7)	Base (9.4)	High (14.1)	
	----- lbs/A -----				
FM 1621GL	1171	1107	1569	1880	1431 ABCD
FM 2398GLTP	1009	1288	1788	1633	1429 BCD
BX 1972GLTP	1057	1121	1475	1415	1267 E
FM 1320GL	726	1144	1693	1854	1354 CDE
FM 1830GLT	917	1231	1904	1949	1500 ABC
FM 1888GL	769	1139	1825	2221	1488 ABC
FM 1911GLT	1057	1275	2017	2009	1589 A
FM 2322GL	840	1335	1621	1647	1361 CDE
FM 2498GLT	890	1294	2009	2107	1575 AB
FM 2574GLT	882	1293	2166	1846	1546 AB
ST 4946GLB2	1064	1269	1656	1766	1438 ABCD
ST 5471GLTP	1029	1157	1387	1727	1325 DE
Average	951 C	1221 B	1759 A	1838 A	--

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

Variety	In-season Irrigation Levels				Average
	Dry (2.9)	Low (4.7)	Base (9.4)	High (14.1)	
	----- cents/lb -----				
FM 1621GL	55.72	56.10	55.52	54.78	55.52 AB
FM 2398GLTP	55.73	54.98	55.60	54.82	55.28 AB
BX 1972GLTP	56.10	55.20	53.95	53.58	54.70 AB
FM 1320GL	54.52	53.67	56.08	54.43	54.67 AB
FM 1830GLT	55.45	56.25	56.47	54.20	55.59 A
FM 1888GL	55.40	55.53	55.60	56.23	55.69 A
FM 1911GLT	55.85	55.77	55.50	55.10	55.55 AB
FM 2322GL	55.33	56.25	56.15	55.48	55.80 A
FM 2498GLT	52.15	55.27	56.02	55.92	54.83 AB
FM 2574GLT	56.38	54.60	56.45	52.67	55.02 AB
ST 4946GLB2	54.52	55.92	53.45	53.17	54.26 BC
ST 5471GLTP	53.48	54.60	52.55	52.00	53.15 C
Average	55.05 AB	55.34 A	55.28 A	54.37 B	--

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

Variety	In-season Irrigation Levels				Average
	Dry (2.9)	Low (4.7)	Base (9.4)	High (14.1)	
	----- \$/A -----				
FM 1621GL	652	621	871	1031	793 ABCDE
FM 2398GLTP	562	709	994	890	788 BCDE
BX 1972GLTP	593	618	798	765	693 F
FM 1320GL	396	618	949	1010	743 DEF
FM 1830GLT	510	693	1075	1054	833 ABCD
FM 1888GL	426	634	1016	1249	831 ABCD
FM 1911GLT	591	711	1120	1106	881 A
FM 2322GL	466	751	910	913	760 CDEF
FM 2498GLT	469	715	1126	1180	872 AB
FM 2574GLT	497	708	1223	972	849 ABC
ST 4946GLB2	580	710	880	940	777 CDEF
ST 5471GLTP	552	633	729	905	704 EF
Average	525 C	677 B	974 A	1001 A	--

Performance of PhytoGen Varieties as Affected by Irrigation Levels at Halfway, TX, 2018.
Wayne Keeling, Justin Spradley, Ray White, and Brice DeLong

MATERIALS AND METHODS:

Plot Size:	4 rows by 30 feet, 4 replications				
Planting Date:	May 17				
Varieties:	DP 1646B2XF	FM 1911GLT			
	NG 4545GLT	PHY 250W3FE			
	PHY 300W3FE	PHY 320W3FE			
	PHY 340W3FE	PHY 350W3FE			
	PHY 430W3FE	PHY 440W3FE			
	PHY 480W3FE	PHY 490W3FE			
	PHY 210W3FE (PX2A31W3FE)				
	PHY 39W3FE (PX2BX4W3FE)				
	PX3B07W3FE				
Herbicides:	Trifluralin 1 qt/A – March 7				
	Medal 1.3 pt/A + Helmquat 2 pt/A – May 17				
	Clethodim 12 oz/A – May 29				
	Glyphosate 32 oz/A – June 7				
	Medal 1.3 pt/A – June 14				
	Glyphosate 32 oz/A – June 19				
	Glyphosate 32 oz/A – July 10				
	Diuron 1.5 pt/A – July 13				
Fertilizer:	136-31-0				
Irrigation in-season:	LEPA				
		Dry	Low	Base	High
	Preplant	4.2”	7.8”	7.8”	7.8”
	In Season	<u>2.9”</u>	<u>4.7”</u>	<u>9.4”</u>	<u>14.1”</u>
	Total	7.1”	12.5”	17.2”	21.9”
Harvest Date:	November 5				

RESULTS AND DISCUSSION:

Twelve PhytoGen W3FE (Enlist) varieties and three competitive standards were compared under dryland and three levels of center-pivot irrigation. When averaged across varieties, yields increased with increasing irrigation, averaging 1503 lbs/A at the high irrigation level (Table 1). When averaged across irrigation levels, the highest yielding group included PHY 250W3FE, PHY 320W3FE, PHY 350W3FE, PHY430W3FE, and PHY 39W3FE. Loan values were similar for the low and base irrigation levels, and lowest at the high irrigation level (Table 2). Highest loan values were produced by DP 1646B2XF. Gross revenues (yield x loan value) were highest with PHY 250W3FE, PHY 320W3FE, PHY 350W3FE, and PHY 210W3FE.

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

Variety	In-season Irrigation Levels				Average
	Dry (2.9)	Low (4.7)	Base (9.4)	High (14.1)	
	----- lbs/A -----				
DP 1646B2XF	287	783	1213	1230	878 F
FM 1911GLT	498	745	1472	1655	1092 ABCD
NG 4545B2XF	407	772	1068	1399	911 F
PHY 250W3FE	512	941	1583	1734	1192 A
PHY 300W3FE	460	904	1341	1492	1049 BCD
PHY 320W3FE	410	1007	1448	1639	1125 ABC
PHY 340W3FE	372	871	1160	1343	936 EF
PHY 350W3FE	502	982	1448	1616	1136 AB
PHY 430W3FE	531	916	1455	1450	1088 ABCD
PHY 440W3FE	453	1099	1226	1299	1019 CDE
PHY 480W3FE	532	1048	1233	1274	1021 CDE
PHY 490W3FE	379	915	1354	1453	1025 CDE
PHY 210W3FE	422	764	1346	1812	1085 BCD
PHY 39W3FE	438	819	1557	1651	1116 ABCD
PX3B07W3FE	387	1021	1186	1502	1024 CDE
Average	439 D	906 C	1339 B	1503 A	--

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

Variety	In-season Irrigation Levels				Average
	Dry (2.9)	Low (4.7)	Base (9.4)	High (14.1)	
	----- cents/lb -----				
DP 1646B2XF	52.73	53.86	55.36	53.03	53.74 A
FM 1911GLT	51.74	53.20	53.55	49.85	52.08 B
NG 4545B2XF	48.86	52.80	53.31	52.83	51.95 BC
PHY 250W3FE	51.38	53.28	53.40	50.80	52.21 B
PHY 300W3FE	47.43	51.45	53.19	50.49	50.63 DEF
PHY 320W3FE	49.41	53.44	53.30	48.59	51.18 BCD
PHY 340W3FE	49.69	52.34	52.30	47.44	50.44 DEF
PHY 350W3FE	48.18	53.08	54.43	52.65	52.08 B
PHY 430W3FE	45.74	48.63	47.79	45.76	46.97 G
PHY 440W3FE	51.08	54.15	49.71	43.03	49.49 F
PHY 480W3FE	50.13	53.16	48.90	46.99	49.79 EF
PHY 490W3FE	50.70	52.20	54.56	49.31	51.69 BCD
PHY 210W3FE	49.86	53.31	53.98	51.98	52.28 B
PHY 39W3FE	50.54	53.45	53.36	45.88	50.80 CDE
PX3B07W3FE	48.95	52.79	50.13	47.43	49.82 EF
Average	49.76 B	52.74 A	52.48 A	49.07 C	--

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

Variety	In-season Irrigation Levels				Average
	Dry (2.9)	Low (4.7)	Base (9.4)	High (14.1)	
	-----\$/A-----				
DP 1646B2XF	152	420	672	652	473 GH
FM 1911GLT	257	396	787	825	566 ABCD
NG 4545B2XF	201	408	570	739	479 GH
PHY 250W3FE	264	502	846	883	623 A
PHY 300W3FE	218	467	713	759	539 CDEF
PHY 320W3FE	203	538	771	799	577 ABC
PHY 340W3FE	186	456	607	638	471 H
PHY 350W3FE	243	521	788	850	600 AB
PHY 430W3FE	243	446	697	664	512 DEFGH
PHY 440W3FE	231	595	610	560	499 FGH
PHY 480W3FE	269	557	603	600	507 EFGH
PHY 490W3FE	193	477	739	715	531 CDEFG
PHY 210W3FE	211	407	727	941	571 ABC
PHY 39W3FE	222	439	829	756	561 BCDE
PX3B07W3FE	190	538	594	717	509 DEFGH
Average	219 D	478 C	703 B	740 A	--

Performance of PhytoGen Varieties as Affected by PGR Treatments at Halfway, TX, 2018.
Wayne Keeling, Justin Spradley, Ray White, and Brice DeLong

MATERIALS AND METHODS:

Plot Size:	4 rows by 30 feet, 4 replications	
Planting Date:	May 14	
Varieties:	FM 1911GLT	PHY 210W3FE
	PHY 250W3FE	PHY 300W3FE
	PHY 340W3FE	PHY 39W3FE
	PHY 480W3FE	PHY 490W3FE
	PX3A83W3FE	PX3A99W3FE
Treatments:	Untreated:	no mepiquat
	Basic:	4 oz/A two weeks prior to bloom 8 oz/A at early bloom
	Aggressive:	8 oz/A 2 weeks prior to bloom 16 oz/A at early bloom 8 oz/A at peak bloom
Fertilizer:	136-31-0	
Irrigation in-season:	LEPA	
		High
	Preplant	7.8"
	In Season	<u>14.1"</u>
	Total	21.9"
Harvest Date:	November 2	

RESULTS AND DISCUSSION:

Nine PhytoGen W3FE (Enlist) varieties and a competitive standard were grown under full irrigation with 14.1 acre/inches applied in-season. Plant growth regulator treatments (mepiquat chloride) were untreated, basic (4 oz + 8 oz), and aggressive (8 oz + 16 oz + 8 oz). End-of-season plant heights varied among varieties with a trend toward shorter plants with increasing mepiquat chloride rates, but untreated plants did not exceed 32" tall with any variety (Table 1). Lint yields varied from 1227 to 1439 lbs/A across varieties but were not affected by plant growth regulator treatments (Table 2). Loan values and gross revenues varied among varieties but were not affected by treatments. These results indicate that without excessive rainfall and with effective irrigation and nutrient management, optimum plant size and profitable yields and fiber quality can be produced without plant growth regulator inputs. Less determinant varieties may require plant growth regulators under different growing conditions and irrigation management.

Table 1. Effect of variety and PGR treatment on height (in).

Variety	PGR Treatments			Average
	Untreated	Basic	Aggressive	
	-----inches-----			
FM 1911GLT	22	20	21	21 E
PHY 210W3FE	24	24	21	23 D
PHY 250W3FE	23	23	21	22 DE
PHY 300W3FE	28	27	26	27 AB
PHY 340W3FE	28	27	24	27 BC
PHY 39W3FE	24	23	22	23 D
PHY 480W3FE	30	26	24	27 BC
PHY 490W3FE	32	28	26	29 A
PX3A82W3FE	29	23	25	25 C
PX3A99W3FE	28	27	26	27 B
Average	27 A	25 A	24 A	--

Table 2. Effect of variety and PGR treatment on cotton lint yield (lbs/A).

Variety	PGR Treatments			Average
	Untreated	Basic	Aggressive	
	-----lbs/A-----			
FM 1911GLT	1357	1229	1246	1277 CD
PHY 210W3FE	1476	1470	1430	1459 A
PHY 250W3FE	1401	1316	1435	1384 ABC
PHY 300W3FE	1386	1443	1505	1445 A
PHY 340W3FE	1347	1324	1200	1290 VCD
PHY 39W3FE	1396	1378	1451	1408 AB
PHY 480W3FE	1246	1234	1202	1227 D
PHY 490W3FE	1421	1333	1336	1363 ABC
PX3A82W3FE	1472	1291	1556	1439 A
PX3A99W3FE	1401	1456	1393	1417 A
Average	1390 A	1347 A	1375 A	--

Table 3. Effect of variety and PGR treatment on loan value (cents/lb).

Variety	PGR Treatments			Average
	Untreated	Basic	Aggressive	
	-----cents/lb-----			
FM 1911GLT	54.06	53.78	54.95	54.26 A
PHY 210W3FE	53.50	54.56	53.41	53.83 AB
PHY 250W3FE	52.83	53.00	54.21	53.35 AB
PHY 300W3FE	51.60	52.43	53.04	52.35 BCD
PHY 340W3FE	53.05	52.04	50.28	51.79 CDE
PHY 39W3FE	50.33	52.05	49.53	50.63 E
PHY 480W3FE	49.68	51.93	51.05	50.88 DE
PHY 490W3FE	51.90	53.03	53.58	52.83 ABC
PX3A82W3FE	51.43	50.76	52.83	51.67 CDE
PX3A99W3FE	54.64	54.51	53.13	54.09 A
Average	52.30 A	52.81 A	52.60 A	--

Table 4. Effect of variety and PGR treatment on revenue (\$/A).

Variety	Untreated	PGR Treatments		Average
		Basic	Aggressive	
		-----\$/A-----		
FM 1911GLT	732	661	685	693 CD
PHY 210W3FE	788	802	762	784 A
PHY 250W3FE	740	697	779	739 ABC
PHY 300W3FE	718	755	798	757 ABC
PHY 340W3FE	715	689	604	669 DE
PHY 39W3FE	703	718	721	714 BCD
PHY 480W3FE	620	641	613	625 E
PHY 490W3FE	738	705	716	720 ABCD
PX3A82W3FE	754	659	820	744 ABC
PX3A99W3FE	766	794	738	766 AB
Average	727 A	712 A	724 A	--

Appendix

2018 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											
Mo	Da	Year	Halfway @ Building	Hiems @ Well 1	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	Fallow	Fallow	Fallow	Cotton	Cotton	Cotton	Fallow	Fallow	Cotton	Cotton	Cotton	
2	17	2018	0.80	0.74																													
2	19	2018																															
2	20	2018																															
2	21	2018																															
2	22	2018																															
2	23	2018																															
3	18	2018	0.07	0.06																													
3	21	2018						0.03	0.03	0.04	0.04	0.04	0.04	0.03		0.02	0.02	0.02	0.02	0.03	0.02	0.02											
3	22	2018																															
3	25	2018	0.08																														
3	26	2018						0.08	0.07	0.04	0.11	0.10	0.10	0.11		0.05	0.09	0.08	0.07	0.07	0.07	0.05						0.08	0.03	0.04	0.03	0.02	
3	27	2018	0.13	0.23																									0.03	0.07	0.00	0.03	0.08
3	29	2018																															
4	6	2018																															
4	7	2018																															
4	8	2018																															
4	9	2018																															
4	10	2018																															
4	11	2018						0.13	0.15					0.16		0.06	0.19	0.19	0.11										0.30	0.09	0.17	0.17	0.18
4	12	2018						0.13	0.15					0.16		0.21	0.19	0.19	0.19									0.27	0.30	0.23	0.17	0.18	
4	13	2018	0.05					0.14	0.06					0.16		0.19	0.19	0.20	0.18									0.28	0.26	0.23	0.17	0.18	
4	14	2018						0.13	0.20					0.16		0.19	0.19	0.19	0.18									0.28	0.27	0.23	0.17	0.18	
4	15	2018						0.14	0.20					0.16		0.19	0.19	0.19	0.18									0.27	0.27	0.23	0.18	0.18	
4	16	2018						0.14	0.15					0.16		0.21	0.19	0.19	0.19									0.28	0.32	0.24	0.17	0.18	
4	17	2018						0.13	0.15					0.16		0.17	0.19	0.19	0.19									0.28	0.22	0.24	0.17	0.18	
4	18	2018						0.14	0.15					0.16		0.18	0.19	0.19	0.19									0.28	0.25	0.24	0.17	0.18	
4	19	2018						0.16	0.15					0.14		0.23	0.19	0.19	0.19									0.28	0.31	0.24	0.17	0.18	
4	20	2018	0.20	0.32				0.16	0.15					0.14		0.24	0.19	0.19	0.19									0.28	0.32	0.24	0.17	0.18	
4	21	2018						0.15	0.15					0.14		0.19	0.19	0.19	0.19									0.28	0.25	0.23	0.17	0.18	
4	22	2018						0.16	0.15					0.15		0.19	0.20	0.19	0.19									0.27	0.26	0.24	0.18	0.18	
4	23	2018						0.15	0.15					0.14		0.19	0.19	0.19	0.19									0.27	0.26	0.24	0.17	0.18	
4	24	2018						0.16	0.15					0.14		0.19	0.19	0.22	0.19									0.28	0.25	0.24	0.17	0.18	
4	25	2018						0.16	0.15					0.13		0.16	0.19	0.16	0.16									0.28	0.25	0.24	0.17	0.18	
4	26	2018						0.13	0.14	0.14	0.15	0.15	0.15	0.15		0.20	0.19	0.18	0.17	0.19	0.18	0.20					0.27	0.27	0.24	0.16	0.16		
4	27	2018						0.14	0.14	0.14	0.15	0.15	0.15	0.14	0.15	0.20	0.19	0.18	0.17	0.20	0.18	0.20					0.27	0.29	0.24	0.16	0.16		
4	28	2018						0.13	0.13	0.13	0.14	0.15	0.15	0.14	0.15	0.17	0.19	0.19	0.18	0.17	0.18	0.18					0.26	0.26	0.24	0.16	0.16		
4	29	2018	0.11	0.21				0.13	0.13	0.14	0.14	0.15	0.14	0.14	0.15	0.17	0.18	0.18	0.17	0.17	0.18	0.18					0.27	0.25	0.24	0.16	0.17		
4	30	2018						0.13	0.13	0.10	0.14	0.14	0.15	0.14	0.15	0.15	0.19	0.18	0.17	0.16	0.18	0.20					0.19	0.30	0.18	0.24	0.24		
5	1	2018						0.13	0.12	0.15	0.10	0.13	0.16	0.15	0.14	0.15	0.19	0.18	0.17	0.16	0.17	0.20					0.18	0.21	0.26	0.24	0.24	0.24	
5	2	2018						0.14	0.17	0.12	0.13	0.15	0.16	0.14	0.15	0.09	0.19	0.00	0.09	0.20	0.18	0.20					0.18	0.23	0.27	0.25	0.26	0.26	
5	3	2018						0.14	0.08	0.15	0.15	0.14	0.15	0.14	0.15	0.00	0.19	0.00	0.00	0.16	0.20	0.20					0.18	0.18	0.28	0.24	0.25	0.24	
5	4	2018						0.15	0.29	0.19	0.18	0.13	0.12	0.12	0.12	0.08	0.19	0.09	0.12	0.25	0.20	0.20					0.18	0.26	0.32	0.23	0.24	0.24	
5	5	2018						0.15	0.11	0.16	0.18	0.13	0.12	0.12	0.12	0.08	0.18	0.09	0.06	0.15	0.19	0.19					0.17	0.20	0.24	0.23	0.23	0.23	

2018 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																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
			Halfway @ Building	Helms @ Well 1	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	Crop:					Crop:					Crop:																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
Mo	Da	Year			Cotton										Cotton										Fallow					Cotton					Fallow					Cotton					Fallow					Cotton																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
5	6	2018			0.15	0.11	0.17	0.18	0.12	0.12	0.12	0.12	0.12	0.12	0.08	0.18	0.09	0.06	0.14	0.19	0.19																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									</

2018 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																				
Mo	Da	Year	Halfway @ Building	Helms @ Well 1	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	Crop:																				
																						Cotton							Cotton							Cotton						
6	18	2018																				Fallow	Fallow	Fallow	Cotton	Cotton	Cotton	Fallow	Fallow	Fallow	Cotton	Cotton	Cotton									
6	19	2018																																								
6	20	2018	0.03	0.03																																						
6	21	2018																																								
6	22	2018	0.06	0.06																																						
6	23	2018																																								
6	24	2018																																								
6	25	2018																																								
6	26	2018						0.14				0.14				0.10				0.18	0.00	0.02																				
6	27	2018					0.14	0.14			0.13					0.10				0.17	0.07	0.20																				
6	28	2018					0.14	0.14			0.13					0.10				0.21	0.13	0.20																				
6	29	2018	0.04	0.04			0.14	0.14			0.13					0.10				0.19	0.15	0.22																				
6	30	2018					0.14				0.13					0.10				0.19	0.10	0.27																				
7	1	2018					0.14	0.14			0.13					0.10				0.19	0.05	0.11																				
7	2	2018					0.14	0.13			0.14					0.10				0.19	0.08	0.20																				
7	3	2018					0.14	0.13			0.12					0.10				0.19	0.16	0.32																				
7	4	2018					0.14	0.13			0.13					0.10				0.19	0.06	0.07																				
7	5	2018					0.13	0.13			0.13					0.06				0.19	0.07	0.20																				
7	6	2018	0.58	0.74			0.12	0.13			0.13					0.15				0.21	0.15	0.21																				
7	7	2018					0.13	0.13			0.13					0.10				0.26	0.10	0.27																				
7	8	2018					0.13	0.13			0.13					0.10				0.24	0.10	0.25																				
7	9	2018					0.13				0.13					0.04				0.05	0.05	0.05																				
7	10	2018					0.13	0.13			0.13					0.10				0.19	0.13	0.19																				
7	11	2018					0.16	0.14			0.13					0.10				0.19	0.10	0.20																				
7	12	2018					0.28	0.26	0.29	0.26	0.15	0.15	0.14	0.21	0.26					0.19																						
7	13	2018					0.14	0.14	0.14	0.14	0.13	0.00	0.12	0.13	0.12					0.36	0.26	0.11																				
7	14	2018					0.14	0.14	0.14	0.14	0.14	0.22	0.13	0.13	0.12					0.19	0.10	0.24																				
7	15	2018					0.14	0.14	0.14	0.14	0.00	0.07	0.13	0.13	0.12					0.19	0.02	0.16																				
7	16	2018					0.13	0.13	0.13	0.13	0.07	0.00	0.13	0.13	0.12					0.18	0.37	0.35	0.18	0.18	0.35																	
7	17	2018					0.13	0.13	0.13	0.09	0.25	0.25	0.13	0.13	0.12					0.18	0.18	0.13	0.10	0.18	0.10																	
7	18	2018					0.13	0.13	0.13	0.11	0.30	0.32	0.13	0.13	0.12					0.18	0.18	0.16	0.16	0.18	0.17																	
7	19	2018					0.13	0.13	0.13	0.12	0.12	0.12	0.13	0.13	0.12					0.18	0.18	0.16	0.17	0.35	0.29																	
7	20	2018					0.13	0.13	0.13	0.21	0.14	0.13	0.13	0.13	0.12					0.18	0.18	0.22	0.22	0.18	0.23																	
7	21	2018					0.13	0.13	0.13	0.13	0.25	0.21	0.13	0.13	0.12					0.18	0.18	0.21	0.20	0.18	0.24																	
7	22	2018					0.13	0.13	0.13	0.13	0.05	0.08	0.13	0.13	0.12					0.18	0.18	0.16	0.18	0.18	0.15																	
7	23	2018					0.00	0.00	0.00	0.00	0.08	0.14	0.13	0.13	0.13					0.02																						
7	24	2018	0.01	0.01			0.22	0.23	0.13	0.05	0.13	0.13	0.12	0.13	0.12					0.26	0.27	0.13	0.13	0.27	0.13																	
7	25	2018					0.18	0.13	0.22	0.21	0.12	0.14	0.13	0.13	0.12					0.18	0.18	0.19	0.18	0.18	0.30																	
7	26	2018	0.34	0.47			0.13	0.13	0.13	0.13	0.13	0.13	0.14	0.13	0.23					0.18	0.18	0.41	0.18	0.18	0.18																	
7	27	2018					0.13	0.13	0.13	0.16	0.13	0.15	0.13	0.13	0.12					0.18	0.18	0.19	0.20	0.18	0.20																	
7	28	2018					0.13	0.13	0.13	0.18	0.20	0.14	0.13	0.13	0.12					0.18	0.18	0.25	0.23	0.18	0.26																	
7	29	2018					0.13	0.13	0.13	0.09	0.06	0.14	0.13	0.13	0.12					0.18	0.18	0.12	0.13	0.18	0.12																	
7	30	2018	0.09	0.09			0.13	0.13	0.13	0.10	0.13	0.14	0.13	0.13	0.12					0.18	0.18	0.16	0.16	0.18	0.17																	

2018 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								
Mo	Da	Year	Halfway @ Building	Helms @ Weir 1	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	
					Crop:										Crop:							Crop:								
					Cotton										Cotton							Cotton								
8	7	31	2018		0.13	0.12	0.12	0.10	0.13	0.14	0.13	0.13	0.12		0.18	0.18	0.16	0.16	0.17	0.16			Fallow	Fallow	Fallow	Cotton	Cotton	Fallow	Cotton	Cotton
8	1	2018			0.12	0.12	0.13	0.11	0.13	0.14	0.13	0.13	0.12		0.06	0.17	0.16	0.08	0.03	0.11					0.14	0.14	0.12	0.19	0.08	
8	2	2018			0.05	0.07	0.08	0.12	0.13	0.14	0.13	0.13	0.12		0.08	0.13	0.12	0.03	0.09	0.02					0.13	0.13	0.12	0.19	0.07	
8	3	2018			0.13	0.13	0.13	0.21	0.15	0.13	0.13	0.13	0.12		0.18	0.18	0.21	0.21	0.18	0.20					0.14	0.13	0.11	0.20	0.07	
8	4	2018		0.19	0.13	0.12	0.13	0.13	0.19	0.22	0.13	0.13	0.12		0.18	0.18	0.18	0.17	0.18	0.20					0.14	0.13	0.11	0.29	0.07	
8	5	2018			0.12	0.12	0.12	0.08		0.07	0.13	0.13	0.12		0.17	0.17	0.10	0.12	0.17	0.09					0.12	0.13	0.11	0.05	0.07	
8	6	2018			0.14	0.13	0.13	0.07	0.13	0.14	0.13	0.13	0.12		0.18	0.18	0.15	0.13	0.18	0.10					0.13	0.14	0.12	0.19	0.08	
8	7	2018			1.28	0.18	0.12	0.14	0.12	0.14	0.13	0.13	0.12		0.17	0.17	0.18	0.18	0.17	0.19					0.14	0.14	0.11	0.19	0.07	
8	8	2018						0.09	0.13	0.14	0.13	0.13	0.12		0.05	0.04	0.09	0.08	0.02	0.11					0.14	0.14	0.12	0.19	0.08	
8	9	2018	0.32	0.69		0.06	0.13	0.12	0.13	0.14	0.13	0.13	0.12		0.17	0.17	0.17	0.17	0.17	0.18					0.18	0.16	0.12	0.19	0.08	
8	10	2018																												
8	11	2018	0.30	0.40																										
8	12	2018																												
8	13	2018			0.14	0.14	0.14	0.11	0.05	0.10	0.13	0.13	0.12		0.18	0.18	0.14	0.15	0.18	0.15					0.22	0.17	0.14	0.09	0.08	
8	14	2018			0.14	0.14	0.14	0.09	0.14	0.14	0.13	0.13	0.13		0.18	0.18	0.16	0.17	0.18	0.17					0.17	0.16	0.14	0.19	0.07	
8	15	2018			0.21	0.37	0.26	0.41	0.14	0.14	0.13	0.22	0.29		0.18	0.18	0.18	0.18	0.19	0.19					0.22	0.16	0.14	0.12	0.08	
8	16	2018			0.14	0.13	0.16		0.05	0.13	0.13	0.13	0.12		0.18	0.18	0.19	0.19	0.18	0.20					0.12	0.11	0.10	0.15	0.05	
8	17	2018																							0.11	0.11	0.09	0.15	0.05	
8	18	2018	0.58		0.00	0.14	0.14	0.17	0.34	0.14	0.13	0.13	0.12		0.18	0.18	0.25	0.24	0.18	0.28					0.12	0.11	0.08	0.12	0.05	
8	19	2018	0.58	0.87		0.13	0.12	0.12	0.03	0.11		0.09	0.13	0.13		0.17	0.17	0.12	0.12	0.17	0.13				0.10	0.12	0.10	0.05	0.06	
8	20	2018																												
8	21	2018																												
8	22	2018			0.12	0.12	0.12	0.17	0.23	0.15	0.13	0.13	0.13		0.17	0.17	0.23	0.21	0.16	0.26					0.12	0.12	0.10	0.18	0.06	
8	23	2018			0.14	0.14	0.14	0.13	0.12	0.14	0.13	0.13	0.12		0.04	0.19	0.18	0.08	0.01	0.11					0.16	0.12	0.10	0.13	0.06	
8	24	2018			0.12	0.12	0.12	0.22	0.13	0.15	0.13	0.13	0.12		0.17	0.17	0.23	0.14	0.16	0.11					0.12	0.12	0.09	0.19	0.06	
8	25	2018	0.04	0.03	0.12	0.11	0.12	0.13	0.12	0.15	0.13	0.13	0.13		0.16	0.16	0.16	0.17	0.16	0.17					0.12	0.12	0.10	0.18	0.06	
8	26	2018			0.12	0.11	0.12	0.06	0.12	0.15	0.13	0.13	0.13		0.16	0.16	0.14	0.13	0.16	0.13					0.11	0.11	0.09	0.18	0.06	
8	27	2018			0.10	0.09	0.10	0.15	0.12	0.14	0.13	0.13	0.13		0.14	0.14	0.14	0.16	0.13	0.15					0.11	0.11	0.09	0.17	0.06	
8	28	2018			0.11	0.11	0.12	0.10	0.11	0.14	0.13	0.13	0.13		0.16	0.15	0.15	0.15	0.16	0.15					0.12	0.12	0.09	0.17	0.06	
8	29	2018			0.12	0.12	0.12	0.13	0.12	0.15	0.13	0.13	0.13		0.16	0.16	0.16	0.17	0.16	0.17					0.11	0.11	0.09	0.17	0.06	
8	30	2018			0.13	0.24	0.24	0.09	0.12	0.13	0.13	0.13	0.13		0.18	0.18	0.15	0.22	0.24	0.15					0.13	0.13	0.11	0.17	0.07	
8	31	2018			0.13	0.12	0.13	0.17	0.13	0.15	0.13	0.13	0.13		0.18	0.18	0.20	0.20	0.17	0.21					0.13	0.13	0.11	0.21		
9	1	2018			0.13	0.12	0.13	0.14	0.22	0.15	0.13	0.13	0.13		0.18	0.18	0.22	0.21	0.17	0.24					0.13	0.13	0.11	0.22		
9	2	2018			0.13	0.12	0.13	0.13	0.04	0.15	0.13	0.13	0.13		0.18	0.18	0.14	0.15	0.18	0.13					0.13	0.13	0.11	0.14		
9	3	2018	0.06	0.06	0.13	0.12	0.13	0.13	0.13	0.18	0.15	0.13	0.13		0.18	0.18	0.20	0.20	0.17	0.21					0.12	0.11	0.13	0.18	0.18	
9	4	2018			0.09	0.09	0.09	0.09	0.16	0.22	0.01	0.00	0.00		0.10	0.00	0.09	0.10	0.10	0.03					0.11	0.11	0.14	0.18	0.18	
9	5	2018	0.32	0.06	0.09	0.09	0.09	0.18	0.09	0.10	0.15	0.09	0.09		0.10	0.10	0.10	0.05	0.00	0.10					0.10	0.10	0.06	0.09	0.09	
9	6	2018			0.20	0.21	0.20	0.01	0.09	0.09	0.03	0.24	0.20		0.10	0.10	0.09	0.18	0.14	0.06					0.10	0.10				
9	7	2018	0.28	0.42												0.04	0.00	0.00	0.08	0.09										
9	8	2018																												
9	9	2018			0.14	0.00	0.14								0.10	0.04	0.09	0.10	0.13	0.00										
9	10	2018			0.17	0.09	0.10	0.09	0.09	0.08					0.10	0.10	0.09	0.10	0.09	0.10	0.10				0.19	0.19	0.13	0.06	0.18	
9	11	2018			0.09	0.09	0.08	0.09	0.09	0.08	0.09	0.19	0.18		0.10	0.17	0.09	0.10	0.11	0.20					0.10	0.10	0.06	0.02	0.09	

2018 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									
Mo	Da	Year	Halfway @ Building	Helms @ Well 1	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		
					Crop:										Crop:							Crop:									
					Cotton										Cotton							Cotton									
9	12	2018			0.09	0.09	0.11	0.09	0.09	0.13	0.18	0.18	0.17		0.10	0.09	0.09	0.03				Fallow	Fallow	Fallow	Cotton	Cotton	Fallow	Cotton	Cotton		
9	13	2018			0.09	0.09	0.09	0.09	0.09	0.10	0.09	0.09	0.08												0.10	0.10	0.06	0.12	0.09		
9	14	2018																							0.10	0.10	0.07	0.07	0.09		
9	15	2018																													
9	16	2018																													
9	18	2018																													
9	20	2018	0.75	0.79																											
9	23	2018																													
9	24	2018																													
9	25	2018																													
9	26	2018	2.20	2.20																											
9	27	2018																													
9	28	2018																													
Pre & At Plant			1.70	1.90	4.46	4.51	6.88	4.54	6.90	4.59	4.48	4.49	6.90	4.56	7.00	5.47	6.97	6.96	5.51	5.48	5.60	0.00	0.00	0.00	0.00	9.79	9.87	9.86	11.26	11.42	
Seasonal			8.14	8.71	7.42	9.07	7.34	9.04	7.33	7.37	9.11	7.34	7.26	0.00	9.92	8.32	8.33	11.58	9.74	11.70	0.00	0.00	0.00	0.00	8.51	7.82	6.51	9.76	3.16		
TOTALS			9.84	10.61	11.88	13.58	14.21	13.58	14.23	11.96	13.59	11.83	14.16	4.56	16.92	13.79	15.30	18.54	15.25	17.18	5.60	0.00	0.00	0.00	0.00	18.30	17.69	16.36	21.01	14.57	

2018 Rain and Irrigation Amounts At Helm Research Farm, Halfway, TX

Helm's Irrigation Amounts (in) L = LEPA Irrigation S = Spray Irrigation

Date		Rainfall (in)		Field: 5 Wedge: A (Crop: Cotton)			Field: 5 Wedge: B (Crop: Cotton)			Field: 5 Wedge: C (Crop: Wheat)			Field: 5 Wedge: D (West) (Crop: Cotton)			Field: 5 Wedge: E (Crop: Sorghum)			Field: 5 Wedge: F (Crop: Cotton)		
				Span 2	Span 3 - Span 8	Base - Base + 50%	Span 2	Span 3 - Span 8	Base - Base + 50%	Span 2	Span 3 - Span 8	Base - Base + 50%	Span 2	Span 3 - Span 8	Base - Base + 50%	Span 2	Span 3 - Span 8	Base - Base + 50%	Span 2	Span 3 - Span 8	Base - Base + 50%
2	17	2018																			
2	19	2018	0.80																		
2	20	2018																			
2	21	2018																			
2	22	2018																			
2	23	2018																			
3	18	2018	0.07																		
3	21	2018																			
3	22	2018																			
3	25	2018	0.08																		
3	26	2018																			
3	27	2018	0.13																		
3	29	2018																			
4	6	2018																			
4	7	2018																			
4	8	2018																			
4	9	2018																			
4	10	2018																			
4	11	2018																			
4	12	2018																			
4	13	2018	0.05																		
4	14	2018																			
4	15	2018																			
4	16	2018																			
4	17	2018																			
4	18	2018																			
4	19	2018																			
4	20	2018	0.20																		
4	21	2018																			
4	22	2018																			
4	23	2018																			
4	24	2018																			
4	25	2018																			
4	26	2018																			
4	27	2018																			
4	28	2018																			
4	29	2018	0.11																		
4	30	2018																			
5	1	2018																			
5	2	2018																			
5	3	2018																			
5	4	2018																			
5	5	2018																			
5	6	2018																			

2018 Rain and Irrigation Amounts At Helm 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: Cotton)				Field: 5 Wedge: C (Crop: Wheat)				Field: 5 Wedge: D (East) (Crop: Cotton)				Field: 5 Wedge: D (West) (Crop: Cotton)				Field: 5 Wedge: E (Crop: Sorghum)				Field: 5 Wedge: F (Crop: Cotton)			
					Irrigation Level		Irrigation Level		Irrigation Level		Irrigation Level		Irrigation Level		Irrigation Level		Irrigation Level		Irrigation Level		Irrigation Level		Irrigation Level		Irrigation Level		Irrigation Level		Irrigation Level		Irrigation Level	
Mo	Da	Year	Hallway @ Building	Helms @ Well 1	Span 2	Base	Span 3	Base	Span 8	Base	Span 3	Base	Span 8	Base	Span 2	Base	Span 3	Base	Span 8	Base	Span 2	Base	Span 3	Base	Span 8	Base	Span 2	Base	Span 3	Base	Span 8	Base
5	7	2018																														
5	8	2018																														
5	9	2018																														
5	10	2018																														
5	11	2018																														
5	12	2018																														
5	13	2018																														
5	14	2018																														
5	15	2018		0.13	0.05																											
5	16	2018																														
5	17	2018																														
5	18	2018																														
5	19	2018																														
5	20	2018		0.13	0.29																											
5	21	2018																														
5	22	2018																														
5	23	2018																														
5	24	2018																														
5	25	2018																														
5	26	2018																														
5	27	2018																														
5	28	2018																														
5	29	2018																														
5	30	2018																														
5	31	2018																														
6	1	2018																														
6	2	2018																														
6	3	2018																														
6	4	2018		0.28	0.30																											
6	5	2018																														
6	6	2018																														
6	7	2018																														
6	8	2018																														
6	9	2018																														
6	10	2018																														
6	11	2018																														
6	12	2018																														
6	13	2018		0.39	0.40																											
6	14	2018																														
6	15	2018																														
6	16	2018																														
6	17	2018		0.75	0.86																											
6	18	2018																														
6	19	2018																														

2018 Rain and Irrigation Amounts At Helm 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: Cotton)			Field: 5 Wedge: C (Crop: Wheat)			Field: 5 Wedge: D (East) (Crop: Cotton)			Field: 5 Wedge: D (West) (Crop: Cotton)			Field: 5 Wedge: E (Crop: Sorghum)			Field: 5 Wedge: F (Crop: Cotton)		
				Span 2	Base	Span 3 - Span 8 Base - Base + 50%	Span 2	Base	Span 3 - Span 8 Base - Base + 50%	Span 2	Base	Span 3 - Span 8 Base - Base + 50%	Span 2	Base	Span 3 - Span 8 Base - Base + 50%	Span 2	Base	Span 3 - Span 8 Base - Base + 50%	Span 2	Base	Span 3 - Span 8 Base - Base + 50%	Span 2	Base	Span 3 - Span 8 Base - Base + 50%
Mo	Da	Year	Building																					
6	20	2018	0.03																					
6	21	2018																						
6	22	2018	0.06																					
6	23	2018																						
6	24	2018																						
6	25	2018																						
6	26	2018																						
6	27	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
6	28	2018																						
6	29	2018	0.04	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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	1	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	2	2018																						
7	3	2018																						
7	4	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	5	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	6	2018	0.58	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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	7	2018																						
7	8	2018																						
7	9	2018																						
7	10	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	11	2018		0.22	0.33	0.33 L	0.05	0.08	0.08 L	0.05	0.08	0.08 L	0.05	0.08	0.08 L	0.05	0.08	0.08 L	0.22	0.33	0.33 L	0.22	0.33	0.33 L
7	12	2018					0.17	0.25	0.25 L	0.10	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L	0.25	0.25	0.25 L	0.25	0.25	0.25 L
7	13	2018		0.17	0.25	0.25 L	0.17	0.25	0.25 L	0.05	0.08	0.08 L												
7	14	2018																						
7	15	2018																						
7	16	2018																						
7	17	2018																						
7	18	2018																						
7	19	2018																						
7	20	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	21	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	22	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	23	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	24	2018	0.01	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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	25	2018					0.17	0.25	0.25 L	0.05	0.08	0.08 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	26	2018	0.34	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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	27	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	28	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	29	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	30	2018	0.09	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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
7	31	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
8	1	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L
8	2	2018		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	0.05	0.08	0.08 L	0.17	0.25	0.25 L	0.17	0.25	0.25 L

2018 Rain and Irrigation Amounts At Helm Research Farm, Halfway, TX

Helm's Irrigation Amounts (in) L = LEPA Irrigation S = Spray Irrigation

Date			Rainfall (in)		Field: 5 Wedge: A (Crop: Cotton)				Field: 5 Wedge: B (Crop: Cotton)				Field: 5 Wedge: C (Crop: Wheat)				Field: 5 Wedge: D (East) (Crop: Cotton)				Field: 5 Wedge: E (Crop: Sorghum)				Field: 5 Wedge: F (Crop: Cotton)			
					Irrigation Level		Span 2		Span 3 - Span 8		Irrigation Level		Span 2		Span 3 - Span 8		Irrigation Level		Span 2		Span 3 - Span 8		Irrigation Level		Span 2		Span 3 - Span 8	
Mo	Da	Year	Halfway @ Building	Hains @ Well 1	Base	Base + 50%	Base - 50%	Base	Base + 50%	Base - 50%	Base	Base + 50%	Base - 50%	Base	Base + 50%	Base - 50%	Base	Base + 50%	Base - 50%	Base	Base + 50%	Base - 50%	Base	Base + 50%	Base - 50%	Base	Base + 50%	Base - 50%
8	3	2018			0.17	0.25	0.25	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
8	4	2018						0.05	0.08																			
8	5	2018			0.17	0.25	0.25	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
8	6	2018			0.17	0.25	0.25	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
8	7	2018			0.17	0.25	0.25	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
8	8	2018			0.17	0.25	0.25	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
8	9	2018	0.32	0.69	0.17	0.25	0.25	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
8	10	2018			0.17	0.25	0.25	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
8	11	2018	0.30	0.40	0.17	0.25	0.25	0.05	0.08																			
8	12	2018																										
8	13	2018																										
8	14	2018																										
8	15	2018																										
8	16	2018																										
8	17	2018																										
8	18	2018	0.58																									
8	19	2018	0.58	0.87																								
8	20	2018																										
8	21	2018																										
8	22	2018																										
8	23	2018																										
8	24	2018																										
8	25	2018	0.04	0.03	0.10	0.15	0.15	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
8	26	2018			0.10	0.15	0.15	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
8	27	2018			0.10	0.15	0.15	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
8	28	2018			0.10	0.15	0.15	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
8	29	2018																										
8	30	2018			0.10	0.15	0.15	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
8	31	2018			0.10	0.15	0.15	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
9	1	2018			0.10	0.15	0.15	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
9	2	2018			0.10	0.15	0.15	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
9	3	2018	0.06		0.10	0.15	0.15	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
9	4	2018			0.10	0.15	0.15	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
9	5	2018	0.32	0.06																								
9	6	2018																										
9	7	2018	0.28	0.42																								
9	8	2018																										
9	9	2018																										
9	10	2018			0.10	0.15	0.15	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
9	11	2018																										
9	12	2018																										
9	13	2018			0.10	0.15	0.15	0.05	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
9	14	2018																										
9	15	2018																										

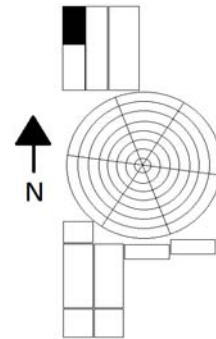
2018 Rain and Irrigation Amounts At Helm Research Farm, Halfway, TX

Date		Rainfall (in)		Field: 5 Wedge: A (Crop: Cotton)			Field: 5 Wedge: B (Crop: Cotton)			Field: 5 Wedge: C (Crop: Wheat)			Field: 5 Wedge: D (East) (Crop: Cotton)			Field: 5 Wedge: D (West) (Crop: Cotton)			Field: 5 Wedge: E (Crop: Sorghum)			Field: 5 Wedge: F (Crop: Cotton)		
				Irrigation Level			Irrigation Level			Irrigation Level			Irrigation Level			Irrigation Level			Irrigation Level			Irrigation Level		
Mo	Da	Year	Halfway @ Building	Helm @ Well 1	Span 2	Span 3 - Span 8	Base - 50%	Base	Base + 50%	Span 2	Span 3 - Span 8	Base - 50%	Base	Base + 50%	Span 2	Span 3 - Span 8	Base - 50%	Base	Base + 50%	Span 2	Span 3 - Span 8	Base - 50%	Base	Base + 50%
9	16	2018																						
9	18	2018																						
9	20	2018																						
9	23	2018																						
9	24	2018																						
9	25	2018																						
9	26	2018																						
9	27	2018																						
9	28	2018																						
Pre & At Plant			1.70	1.90	6.01	6.01	6.01	6.01	6.31	6.31	6.31	6.31	6.81	6.81	6.81	6.81	6.81	6.81	6.81	6.81	6.81	6.01	6.01	6.01
Seasonal			8.14	8.71	7.03	7.18	2.95	10.38	7.80	7.98	3.00	11.48	2.35	2.55	0.96	3.67	7.70	7.83	3.25	11.33	8.72	8.83	3.75	12.83
TOTALS			9.84	10.61	13.04	13.19	8.96	16.39	14.11	14.29	9.31	17.79	7.55	7.75	6.16	8.87	14.51	14.64	10.06	18.14	12.58	12.69	7.61	16.69
																					13.71	13.84	9.26	17.34

Operations Summary

Year	2018
Farm	Helm
Field ID	Field 1 North
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

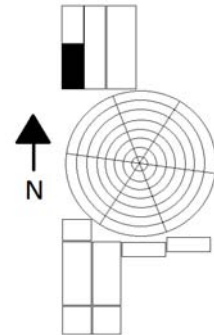
Field Operations	Date	Activity
Tillage	10/16/2017	Shred
	10/17/2017	Disk X 2
	10/17/2017	List
	5/17/2018	Stalk Puller
	5/17/2018	Row Packer
Fertility		
Planting / Harvest	10/18/2017	Planted VNS Wheat 45lbs/ac
	5/29/2018	Planted Cropland 3226 B2XF 48,000seed/ac
	11/2/2018	Harvested all test
Herbicide / Growth Regulator	3/20/2018	Dicamba 8oz/ac, Inuce 1%
	4/6/2018	Showdown 32oz/ac, Dyne-Amic 2%
	4/27/2018	Showdown 36oz/ac, Dyne-Amic 2%
	5/21/2018	Medal EC 1.3pt/ac
	6/12/2018	Showdown 36oz/ac, Dyne-Amic 1%
	7/2/2018	Select Max 12oz/ac, Induce 1%
	7/9/2018	Mepiquat 7oz/ac
	7/20/2018	Diuron 1.5pt/ac
	7/24/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
	7/24/2018	Mepiquat 12oz/ac
	8/8/2018	Mepiquat 16oz/ac
Insecticide		
Harvest aid	10/1/2018	Setup 6SL 32oz/ac, ETX 1.25oz/ac, Dynamic 1%
	10/22/2018	Solera 32oz/ac, Preference 0.5%
Irrigation Amt.		
PrePlant & Planting		
Seasonal		
Rainfall		
PrePlant & Planting		
Seasonal		



Operations Summary

Year	2018
Farm	Helm
Field ID	Field 1 South
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

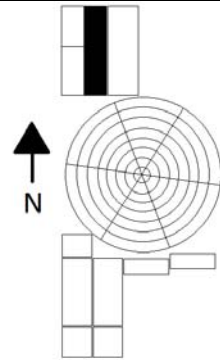
Field Operations	Date	Activity
Tillage	12/5/2017	Shred
	12/6/2017	Disk
	1/9/2018	Disk
	2/22/2018	Cultivate
	2/27/2018	List
	6/1/2018	Cultivate
	6/13/2018	Cultivate
Fertility	3/26/2018	Liquid 32-0-0 33gal/ac
	6/8/2018	Liquid 32-0-0 33gal/ac
Planting / Harvest	5/11/2018	Planted Mixed Plots
	10/14/2018	Harvested all test
Herbicide / Growth Regulator	5/11/2018	Acuron 2.5qt/ac, Helmquat 2pt/ac, Induce 1%
	6/13/2018	Prowl 1.5pt/ac
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting		
Seasonal		
Rainfall		
PrePlant & Planting		
Seasonal		



Operations Summary

Year	2018
Farm	Helm
Field ID	Field 2
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

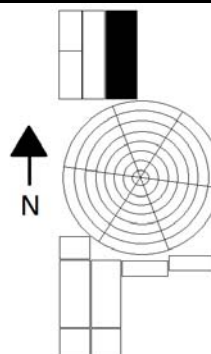
Field Operations	Date	Activity
Tillage	12/13/2017	Shred
	1/9/2018	Disk
	2/22/2018	Cultivate
	3/12/2018	Cultivate
	4/9/2018	Seed Bed Packer
	4/30/2018	Rotary Hoe
	6/5/2018	Cultivate
	7/9/2018	Cultivate and Dike
Fertility	3/27/2018	Liquid 32-0-0 17gal/ac
	3/28/2018	Liquid 10-34-0 4.2gal/ac
	7/12/2018	Liquid 32-0-0 20lbs/ac (applied through drip irrigation)
Planting / Harvest	5/15/2018	Planted FiberMax 2484 B2RF 48,000seed/ac
	11/5/2018	Harvested all test
Herbicide / Growth Regulator	3/12/2018	Trifluralin 4EC 1qt/ac
	5/14/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	5/30/2018	Showdown 36oz/ac, Dyne-Amic 2%
	6/5/2018	Medal EC 1.3pt/ac, Showdown 36oz/ac, Dyne-Amic 1%
	6/21/2018	Showdown 32oz/ac, Dyne-Amic 1%
	7/9/2018	Mepiquat 8oz/ac
	7/19/2018	Diuron 1.5pt/ac
Insecticide	5/31/2018	Acephate 3.2oz/ac
Harvest aid	10/21/2018	Setup 6SL 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/22/2018	Solera 32oz/ac, Preference 0.5%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/31	Trt. 1 = 4.55in., Trt. 2 = 6.88in., Trt. 3 = 4.52in., Dry = 4.56in.
Seasonal	6/1 - 9/26	1 = 7.42in., 2 = 9.07in., 3 = 7.34in., 4 = 9.04in., 5 = 7.33in., 6 = 7.37in., 7 = 9.11in., 8 = 7.34in., 9 = 7.26in., 10 = 0.00in.
Rainfall		
PrePlant & Planting	1/1 - 5/31	1.90in.
Seasonal	6/1 - 9/26	8.71in.



Operations Summary

Year	2018
Farm	Helm
Field ID	Field 3
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

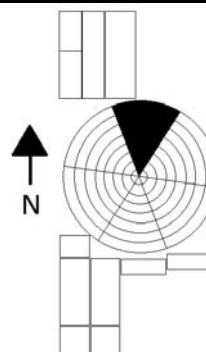
Field Operations	Date	Activity
Tillage	12/13/2017	Shred
	1/9/2018	Disk
	2/22/2018	Cultivate
	3/12/2018	Cultivate
	3/13/2018	List
	4/10/2018	Seed Bed Packer
	4/30/2018	Rotary Hoe
	6/6/2018	Cultivate
	7/20/2018	Cultivate and Dike
Fertility	3/27/2018	Liquid 10-34-0 8.4gal/ac
	3/28/2018	Liquid 32-0-0 16.5gal/ac
	4/4/2018	Liquid Zinc 0.35lbs/ac
	7/13/2018	Liquid 32-0-0 20lbs/ac (applied through drip irrigation)
	7/16/2018	Liquid 32-0-0 20lbs/ac (applied through drip irrigation)
Planting / Harvest	5/16/2018	Planted FiberMax 2484 B2RF 48,000seed/ac
	11/5/2018	Harvested all test
Herbicide / Growth Regulator	3/12/2018	Trifluralin 4EC 1qt/ac
	5/16/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	5/30/2018	Showdown 36oz/ac, Dyne-Amic 2%
	6/5/2018	Medal EC 1.3pt/ac, Showdown 36oz/ac, Dyne-Amic 1%
	6/21/2018	Showdown 32oz/ac, Dyne-Amic 1%
	7/9/2018	Mepiquat 8oz/ac
	7/20/2018	Diuron 1.5pt/ac
Insecticide	5/31/2018	Acephate 3.2oz/ac
Harvest aid	10/21/2018	Setup 6SL 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/22/2018	Solera 32oz/ac, Preference 0.5%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/31	Zones 1,3,4 = 6.98in., Zones 2,5,6 = 5.48in.
Seasonal	6/1 - 9/26	1 = 9.92in., 2 = 8.32in., 3 = 8.33in., 4 = 11.58in., 5 = 9.74in., 6 = 11.70in., Border = 0.00in.
Rainfall		
PrePlant & Planting	1/1 - 5/31	1.90in.
Seasonal	6/1 - 9/26	8.71in.



Operations Summary

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

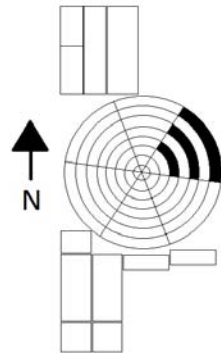
Field Operations	Date	Activity
Tillage	12/12/2017	Shred
	1/22/2018	Disk
	1/23/2018	Chisel
	1/29/2018	Cultivate
	3/5/2018	Chisel
	3/9/2018	Cultivate
	3/9/2018	List
	3/27/2018	Rip Soft Middles
	4/5/2018	Dike and Bed Conditioners
	5/7/2018	Dike and Bed Conditioners
	5/24/2018	Rotary Hoe X 2
	6/6/2018	Rotary Hoe
	6/14/2018	Cultivate and Dike
	7/16/2018	Cultivate and Dike
Fertility	3/28/2018	Liquid 32-0-0 20gal/ac (Low Water Only)
	3/29/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	3/29/2018	Liquid 32-0-0 10gal/ac (Medium Water Only)
	4/2/2018	Liquid 10-34-0 4gal/ac (High Water Only)
	4/3/2018	Liquid 10-34-0 2gal/ac (Medium Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (High Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (Medium Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac(High Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac (Medium Water Only)
Planting / Harvest	5/18/2018	Planted NexGin 3500 XF 48,000seed/ac
	11/9/2018	Harvested all test
Herbicide / Growth Regulator	3/9/2018	Trifluralin 4EC 1qt/ac
	5/18/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	6/5/2018	Showdown 32oz/ac, Dyne-Amic 1%
	6/14/2018	Medal EC 1.3pt/ac
	6/20/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
	7/9/2018	Mepiquat 8oz/ac
	7/18/2018	Diuron 1.5pt/ac
	7/24/2018	Mepiquat 12oz/ac
	8/8/2018	Mepiqueat 16oz/ac
	9/17/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
Insecticide	6/5/2018	Acephate 3.2oz/ac
Harvest aid	10/1/2018	Setup 6SL 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/22/2018	Solera 32oz/ac, Preference 0.5%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/31	Base = 6.01in., Base-50% = 6.01in., Base+50% = 6.01in.
Seasonal	6/1 - 9/26	Base = 7.18in., Base-50% = 2.95in., Base+50% = 10.38in.
Rainfall		
PrePlant & Planting	1/1 - 6/2	1.90in.
Seasonal	6/3 - 9/26	8.71in.



Operations Summary

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

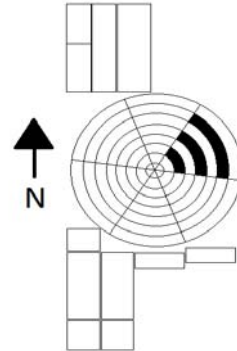
Field Operations	Date	Activity
Tillage	1/3/2018	Shred
	1/23/2018	Disk
	1/23/2018	Chisel
	1/24/2018	Disk
	1/29/2018	Cultivate
	3/2/2018	Chisel
	3/9/2018	Cultivate
	3/12/2018	List
	3/26/2018	Rip Soft Middles
	4/5/2018	Dike and Bed Conditioners
	5/7/2018	Dike and Bed Conditioners
	5/27/2018	Rotary Hoe
	6/12/2018	Cultivate and Dike
	7/17/2018	Cultivate and Dike
Fertility	3/28/2018	Liquid 32-0-0 20gal/ac (Low Water Only)
	3/29/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	3/29/2018	Liquid 32-0-0 10gal/ac (Medium Water Only)
	4/2/2018	Liquid 10-34-0 4gal/ac (High Water Only)
	4/2/2018	Liquid 10-34-0 4gal/ac (High Water Only)
	4/2/2018	Liquid 12-0-0-26 2gal/ac (High Water Only)
	4/3/2018	Liquid 10-34-0 2gal/ac (High Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (High Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (Medium Water Only)
	7/16/2018	32-0-0 20gal/ac (High Water Only)
	7/16/2018	32-0-0 20gal/ac (Medium Water Only)
Planting / Harvest	5/17/2018	Planted NexGin 3500 XF 48,000seed/ac
	11/6/2018	Harvested all test
Herbicide / Growth Regulator	3/9/2018	Trifluralin 4EC 1qt/ac
	5/17/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	6/5/2018	Showdown 32oz/ac, Dyne-Amic 1%
	6/14/2018	Medal EC 1.3pt/ac
	6/20/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
	7/9/2018	Mepiquat 8oz/ac
	7/18/2018	Diuron 1.5pt/ac
	7/24/2018	Mepiquat 12oz/ac
	8/8/2018	Mepiquat 16oz/ac
	9/17/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
Insecticide	6/5/2018	Acephate 3.2oz/ac
Harvest aid	10/1/2018	Setup 6SL 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/22/2018	Solera 32oz/ac, Preference 0.5%
Irrigation Amt.		
PrePlant & Planting	1/1 - 6/2	Base = 6.31in., Base-50% = 6.31in., Base+50% = 6.31in.
Seasonal	6/3 - 9/26	Base = 7.80in., Base-50% = 3.00in., Base+50% = 11.48in.
Rainfall		
PrePlant & Planting	1/1 - 6/2	1.90in.
Seasonal	6/3 - 9/26	8.71in.



Operations Summary

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

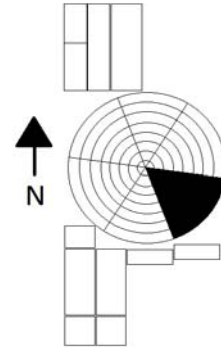
Field Operations	Date	Activity
Tillage		
Fertility	3/28/2018	Liquid 32-0-0 20gal/ac (Low Water Only)
	3/29/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	3/29/2018	Liquid 32-0-0 10gal/ac (Medium Water Only)
	4/2/2018	Liquid 10-34-0 4gal/ac (High Water Only)
	4/2/2018	Liquid 10-34-0 4gal/ac (High Water Only)
	4/2/2018	Liquid 12-0-0-26 2gal/ac (High Water Only)
	4/3/2018	Liquid 10-34-0 2gal/ac (High Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (High Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (Medium Water Only)
	7/16/2018	32-0-0 20gal/ac (High Water Only)
Planting / Harvest	5/17/2018	Planted NexGin 3500 XF 48,000seed/ac
	11/6/2018	Harvested all test
Herbicide / Growth Regulator	3/20/2018	Dicamba 12oz/ac, Showdown 32oz/ac, Induce 1%
	5/17/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	6/5/2018	Showdown 32oz/ac, Dyne-Amic 1%
	6/14/2018	Medal EC 1.3pt/ac
	6/20/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
	7/9/2018	Mepiquat 8oz/ac
	7/18/2018	Diuron 1.5pt/ac
	7/24/2018	Mepiquat 12oz/ac
	8/8/2018	Mepiquat 16oz/ac
	9/17/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
Insecticide	6/5/2018	Acephate 3.2oz/ac
Harvest aid	10/1/2018	Setup 6SL 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/22/2018	Solera 32oz/ac, Preference 0.5%
Irrigation Amt.		
PrePlant & Planting	1/1 - 6/2	Base = 6.31in., Base-50% = 6.31in., Base+50% = 6.31in.
Seasonal	6/3 - 9/26	Base = 7.80in., Base-50% = 3.00in., Base+50% = 11.48in.
Rainfall		
PrePlant & Planting	1/1 - 6/2	1.90in.
Seasonal	6/3 - 9/26	8.71in.



Operations Summary

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

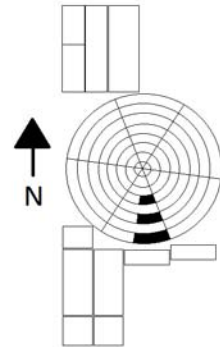
Field Operations	Date	Activity
Tillage	12/8/2017	Shred
Fertility		
Planting / Harvest	12/8/2017	Planted UnderWood Wheat 70lbs/ac (Yield)
	6/8/2018	Harvested all test
Herbicide / Growth Regulator	3/20/2018	Dicamba 8oz/ac, Induce 1%
	6/14/2018	Medal EC 1.3pt/ac
	7/6/2018	Clash 16oz/ac, Showdown 32oz/ac, Diuron 1qt/ac
	8/9/2018	Clash 16oz/ac, Showdown 32oz/ac, Induce 1%
	10/23/2018	Solera 32oz/ac, Preference 0.5% (Spans 3, 5, 7 Only)
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	11/1 - 12/31	Base = 0.00in., Base-50% = 0.00in., Base+50% = 0.00in.
Seasonal	1/1 - 6/8	Base = 5.20in., Base-50% = 5.20in., Base+50% = 5.20in.
Rainfall		
PrePlant & Planting	11/1 - 12/31	
Seasonal	1/1 - 6/8	2.2in



Operations Summary

Year	2018
Farm	Helm
Field ID	Field 5D East (Even Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

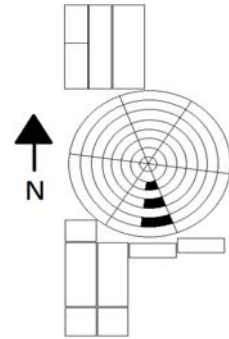
Field Operations	Date	Activity
Tillage	12/8/2017	Shred
	4/19/2018	Stalk Puller
	7/2/2018	Cultivate and Dike
	7/18/2018	Cultivate and Dike
Fertility	3/28/2018	Liquid 32-0-0 20gal/ac (Low Water Only)
	3/29/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	3/29/2018	Liquid 32-0-0 10gal/ac (Medium Water Only)
	4/2/2018	Liquid 10-34-0 4gal/ac (High Water Only)
	4/3/2018	Liquid 10-34-0 2gal/ac (Medium Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (High Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (Medium Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac (High Water Only)
Planting / Harvest	12/8/2017	Planted UnderWood Wheat 70lbs/ac (Cover)
	5/15/2018	NexGin 3500 XF 48,000seed/ac
	11/11/2018	Harvested all test
Herbicide / Growth Regulator	3/20/2018	Dicamba 8oz/ac, Induce 1%
	4/5/2018	Panther 2oz/ac
	4/16/2018	Showdown 36oz/ac, Dyne-Amic 2%
	4/27/2018	Showdown 36oz/ac, Dyne-Amic 2%
	5/15/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	5/31/2018	Showdown 32oz/ac, Dyne-Amic 1%
	6/14/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	6/20/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
	7/10/2018	Mepiquat 8oz/ac
	7/18/2018	Diuron 1.5pt/ac
	7/24/2018	Mepiquat 12oz/ac
	8/8/2018	Mepiquat 16oz/ac
Insecticide	5/31/2018	Acephate 3.2oz/ac
Harvest aid	10/1/2018	Setup 6SL 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/22/2018	Solera 32oz/ac, Preference 0.5%
Irrigation Amt.		
PrePlant & Planting	1/1 - 6/2	Base = 6.81in., Base-50% = 6.81in., Base+50% = 6.81in.
Seasonal	6/3 - 9/26	Base = 7.83in., Base-50% = 3.25in., Base+50% = 11.33in.
Rainfall		
PrePlant & Planting	1/1 - 6/2	1.90in.
Seasonal	6/3 - 9/26	8.71in.



Operations Summary

Year	2018
Farm	Helm
Field ID	Field 5D East (Odd Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

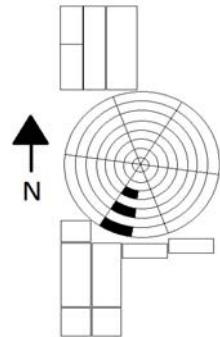
Field Operations	Date	Activity
Tillage		
Fertility	3/28/2018	Liquid 32-0-0 20gal/ac (Low Water Only)
	3/29/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	3/29/2018	Liquid 32-0-0 10gal/ac (Medium Water Only)
	4/2/2018	Liquid 10-34-0 4gal/ac (High Water Only)
	4/3/2018	Liquid 10-34-0 2gal/ac (Medium Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (High Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (Medium Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac (Medium Water Only)
Planting / Harvest	12/8/2017	Planted UnderWood Wheat 70lbs/ac (Cover)
	5/15/2018	Planted NexGin 3500 XF 48,000seed/ac
	11/11/2018	Harvested all test
Herbicide / Growth Regulator	3/20/2018	Dicamba 8oz/ac, Induce 1%
	4/5/2018	Panther 2oz/ac
	4/16/2018	Showdown 36oz/ac, Dyne-Amic 2%
	4/27/2018	Showdown 36oz/ac, Dyne-Amic 2%
	5/15/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	5/31/2018	Showdown 32oz/ac, Dyne-Amic 1%
	6/14/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	6/20/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
	7/10/2018	Mepiquat 8oz/ac
	7/18/2018	Diuron 1.5pt/ac
	7/24/2018	Mepiquat 12oz/ac
	8/8/2018	Mepiquat 16oz/ac
Insecticide	5/31/2018	Acephate 3.2oz/ac
Harvest aid	10/1/2018	Setup 6SL 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/22/2018	Solera 32oz/ac, Preference 0.5%
Irrigation Amt.		
PrePlant & Planting	1/1 to 6/2	Base = 6.81in., Base-50% = 6.81in., Base+50% = 6.81in.
Seasonal	6/3 to 9/26	Base = 7.83in., Base-50% = 3.25in., Base+50% = 11.33in.
Rainfall		
PrePlant & Planting	1/1 - 6/2	1.90in.
Seasonal	6/3 - 9/26	8.71in.



Operations Summary

Year	2018
Farm	Helm
Field ID	Field 5D West (Even Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

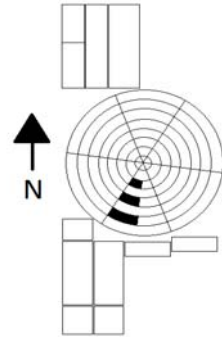
Field Operations	Date	Activity
Tillage	12/8/2017	Shred
	4/19/2018	Stalk Puller
	7/2/2018	Cultivate and Dike
	7/18/2018	Cultivate and Dike
Fertility	3/28/2018	Liquid 32-0-0 20gal/ac (Low Water Only)
	3/29/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	3/29/2018	Liquid 32-0-0 10gal/ac (Medium Water Only)
	4/2/2018	Liquid 10-34-0 4gal/ac (High Water Only)
	4/3/2018	Liquid 10-34-0 2gal/ac (Medium Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (High Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (Medium Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac (Medium Water Only)
Planting / Harvest	12/8/2017	Planted UnderWood Wheat 70lbs/ac (Cover)
	5/15/2018	Planted NexGin 3500 XF 48,000seed/ac
	11/11/2018	Harvested all test
Herbicide / Growth Regulator	3/20/2018	Dicamba 8oz/ac, Induce 1%
	4/5/2018	Panther 2oz/ac
	4/16/2018	Showdown 36oz/ac, Dyne-Amic 2%
	4/27/2018	Showdown 36oz/ac, Dyne-Amic 2%
	5/15/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	5/31/2018	Showdown 32oz/ac, Dyne-Amic 1%
	6/14/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	6/20/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
	7/10/2018	Mepiquat 8oz/ac
	7/18/2018	Diuron 1.5pt/ac
	7/24/2018	Mepiquat 12oz/ac
	8/8/2018	Mepiquat 16oz/ac
Insecticide	5/31/2018	Acephate 3.2oz/ac
Harvest aid	10/1/2018	Setup 6SL 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/22/2018	Solera 32oz/ac, Preference 0.5%
Irrigation Amt.		
PrePlant & Planting	1/1 - 6/2	Base = 6.81in., Base-50% = 6.81in., Base+50% = 6.81in.
Seasonal	6/3 - 9/26	Base = 7.15in., Base-50% = 3.08in., Base+50% = 10.31in.
Rainfall		
PrePlant & Planting	1/1 - 6/2	1.90in.
Seasonal	6/3 - 9/26	8.71in.



Operations Summary

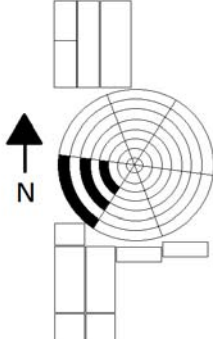
Year	2018
Farm	Helm
Field ID	Field 5D West (Odd Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

Field Operations	Date	Activity
Tillage		
Fertility	3/28/2018	Liquid 32-0-0 20gal/ac (Low Water Only)
	3/29/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	3/29/2018	Liquid 32-0-0 10gal/ac (Medium Water Only)
	4/2/2018	Liquid 10-34-0 4gal/ac (High Water Only)
	4/3/2018	Liquid 10-34-0 2gal/ac (Medium Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (High Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (Medium Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac (Medium Water Only)
Planting / Harvest	12/8/2017	Planted UnderWood Wheat 70lbs/ac (Cover)
	5/15/2018	Planted NexGin 3500 XF 48,000seed/ac
	11/11/2018	Harvested all test
Herbicide / Growth Regulator	3/20/2018	Dicamba 8oz/ac, Induce 1%
	4/5/2018	Panther 2oz/ac
	4/16/2018	Showdown 36oz/ac, Dyne-Amic 2%
	4/27/2018	Showdown 36oz/ac, Dyne-Amic 2%
	5/15/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	5/31/2018	Showdown 32oz/ac, Dyne-Amic 1%
	6/14/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	6/20/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
	7/10/2018	Mepiquat 8oz/ac
	7/18/2018	Diuron 1.5pt/ac
	7/24/2018	Mepiquat 12oz/ac
	8/8/2018	Mepiquat 16oz/ac
Insecticide	5/31/2018	Acephate 3.2oz/ac
Harvest aid	10/1/2018	Setup 6SL 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/22/2018	Solera 32oz/ac, Preference 0.5%
Irrigation Amt.		
PrePlant & Planting	1/1 - 6/2	Base = 6.81in., Base-50% = 6.81in., Base+50% = 6.81in.
Seasonal	6/3 - 9/26	Base = 7.15in., Base-50% = 3.08in., Base+50% = 10.31in.
Rainfall		
PrePlant & Planting	1/1 - 6/2	1.90in.
Seasonal	6/3 - 9/26	8.71in.



Operations Summary

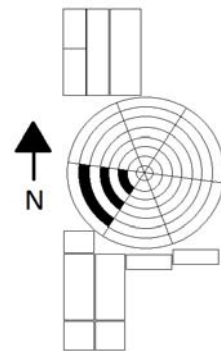
Year	2018
Farm	Helm
Field ID	Field 5E (Even Spans)
Exp. Design	Grain Sorghum
Soil Type	Pullman Clay Loam

Field Operations	Date	Activity	
Tillage	12/12/2017	Shred	
	1/18/2018	Disk	
	1/19/2018	Chisel	
	1/24/2018	Disk	
	1/30/2018	Cultivate	
	3/1/2018	Chisel	
	3/12/2018	List	
	3/22/2018	Rip Soft Middles	
	4/4/2018	Dike and Bed Conditioners	
	5/8/2018	Dike and Bed Conditioners	
	6/19/2018	Rotary Hoe	
	7/18/2018	Cultivate and Dike	
Fertility	3/28/2018	Liquid 32-0-0 20gal/ac (Low Water Only)	
	3/29/2018	Liquid 32-0-0 20gal/ac (High Water Only)	
	3/29/2018	Liquid 32-0-0 10gal/ac (Medium Water Only)	
	4/2/2018	Liquid 10-34-0 4gal/ac (High Water Only)	
	4/3/2018	Liquid 10-34-0 2gal/ac (Medium Water Only)	
	4/3/2018	Liquid Zinc 10gal/ac (High Water Only)	
	4/3/2018	Liquid Zinc 10gal/ac (Medium Water Only)	
	7/16/2018	Liquid 32-0-0 20gal/ac (High Water Only)	
	7/16/2018	Liquid 32-0-0 20gal/ac (Medium Water Only)	
Planting / Harvest	6/14/2018	Planted Frontier F-305C 40,000seed/ac, 55,000seed/ac, 70,000seed/ac	
	11/27/2018	Harvested outside spans	
	11/28/2018	Harvested inside spans	
Herbicide / Growth Regulator	6/11/2018	Showdown 64oz/ac, Firezone 2%	
	7/18/2018	Diuron 1.5pt/ac	
	8/4/2018	Blackhawk 2oz/ac	
	8/29/2018	Blackhawk 2oz/ac, Induce 0.25%	
Insecticide			
Harvest aid	10/23/2018	Showdown 64oz/ac, Dyne-Amic 1%	
Irrigation Amt.			
PrePlant & Planting	1/1 - 6/2	Base = 3.86in., Base-50% = 3.86in., Base+50% = 3.86in.	
Seasonal	6/3 - 9/26	Base = 8.83in., Base-50% = 3.75in., Base+50% = 12.83in.	
Rainfall			
PrePlant & Planting	1/1 - 6/2	1.90in.	
Seasonal	6/3 - 9/26	8.71in.	

Operations Summary

Year	2018
Farm	Helm
Field ID	Field 5E (Odd Spans)
Exp. Design	Grain Sorghum
Soil Type	Pullman Clay Loam

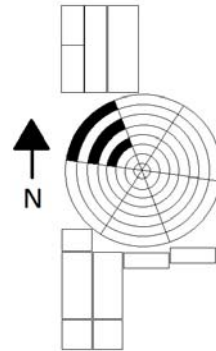
Field Operations	Date	Activity
Tillage		
Fertility	3/28/2018	Liquid 32-0-0 20gal/ac (Low Water Only)
	3/29/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	3/29/2018	Liquid 32-0-0 10gal/ac (Medium Water Only)
	4/2/2018	Liquid 10-34-0 4gal/ac (High Water Only)
	4/3/2018	Liquid 10-34-0 2gal/ac (Medium Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (High Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (Medium Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac (Medium Water Only)
Planting / Harvest	6/14/2018	Planted Frontier F-305C 40,000seed/ac, 55,000seed/ac, 70,000seed/ac
	11/27/2018	Harvested outside spans
	11/28/2018	Harvested inside spans
Herbicide / Growth Regulator	3/20/2018	Dicamba 12oz/ac, Showdown 32oz/ac, Induce 1%
	6/11/2018	Showdown 64oz/ac, Firezone 2%
	7/18/2018	Diuron 1.5pt/ac
	8/4/2018	Blackhawk 2oz/ac
	8/29/2018	Blackhawk 2oz/ac, Induce 0.25%
Insecticide		
Harvest aid	10/23/2018	Showdown 64oz/ac, Dyne-Amic 1%
Irrigation Amt.		
PrePlant & Planting	1/1 - 6/2	Base = 3.86in., Base-50% = 3.86in., Base+50% = 3.86in.
Seasonal	6/3 - 9/26	Base = 8.83in., Base-50% = 3.75in., Base+50% = 12.83in.
Rainfall		
PrePlant & Planting	1/1 - 6/2	1.90in.
Seasonal	6/3 - 9/26	8.71in.



Operations Summary

Year	2018
Farm	Helm
Field ID	Field 5F (Even Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

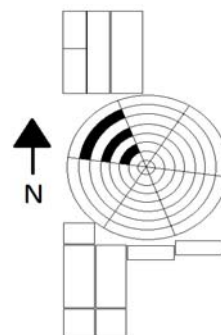
Field Operations	Date	Activity
Tillage	12/12/2017	Shred
	1/19/2018	Disk
	1/22/2018	Chisel
	1/24/2018	Disk
	1/30/2018	Cultivate
	3/1/2018	Chisel
	3/9/2018	Cultivate
	3/12/2018	List
	3/23/2018	Rip Soft Middles
	4/4/2018	Dike and Bed Conditioners
	5/8/2018	Dike and Bed Conditioners
	6/14/2018	Cultivate and Dike
	7/17/2018	Cultivate and Dike
Fertility	3/28/2018	Liquid 32-0-0 20gal/ac (Low Water Only)
	3/29/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	3/29/2018	Liquid 32-0-0 10gal/ac (Medium Water Only)
	4/2/2018	Liquid 10-34-0 4gal/ac (High Water Only)
	4/3/2018	Liquid 10-34-0 2gal/ac (Medium Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (High Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (Medium Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac (Medium Water Only)
Planting / Harvest	5/20/2018	Planted NexGin 3500 XF 48,000seed/ac
	11/9/2018	Harvested all test
Herbicide / Growth Regulator	3/9/2018	Trifluralin 4EC 1qt/ac
	5/20/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	6/5/2018	Showdown 32oz/ac, Dyne-Amic 1%
	6/14/2018	Medal EC 1.3pt/ac
	6/20/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
	7/9/2018	Mepiquat 8oz/ac
	7/18/2018	Diuron 1.5pt/ac
	7/24/2018	Mepiquat 12oz/ac
	8/8/2018	Mepiquat 16oz/ac
	9/17/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
Insecticide	6/5/2018	Acephate 3.2oz/ac
Harvest aid	10/1/2018	Setup 6SL 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/22/2018	Solera 32oz/ac, Preference 0.5%
Irrigation Amt.		
PrePlant & Planting	1/1 - 6/2	Base = 6.01in., Base-50% = 6.01in., Base+50% = 6.01in.
Seasonal	6/3 - 9/26	Base = 7.83in., Base-50% = 3.25in., Base+50% = 11.33in.
Rainfall		
PrePlant & Planting	1/1 - 6/2	1.90in.
Seasonal	6/3 - 9/26	8.71in.



Operations Summary

Year	2018
Farm	Helm
Field ID	Field 5F (Odd Spans)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

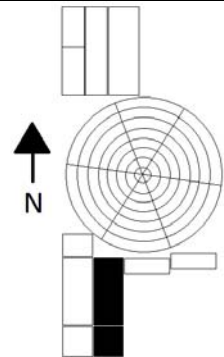
Field Operations	Date	Activity
Tillage		
Fertility	3/28/2018	Liquid 32-0-0 20gal/ac (Low Water Only)
	3/29/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	3/29/2018	Liquid 32-0-0 10gal/ac (Medium Water Only)
	4/2/2018	Liquid 10-34-0 4gal/ac (High Water Only)
	4/3/2018	Liquid 10-34-0 2gal/ac (Medium Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (High Water Only)
	4/3/2018	Liquid Zinc 10gal/ac (Medium Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac (High Water Only)
	7/16/2018	Liquid 32-0-0 20gal/ac (Medium Water Only)
Planting / Harvest	5/20/2018	Planted NexGin 3500 XF 48,000seed/ac
	11/9/2018	Harvested all test
Herbicide / Growth Regulator	3/20/2018	Dicamba 12oz/ac, Showdown 32oz/ac, Induce 1%
	5/20/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	6/5/2018	Showdown 32oz/ac, Dyne-Amic 1%
	6/14/2018	Medal EC 1.3pt/ac
	6/20/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
	7/9/2018	Mepiquat 8oz/ac
	7/10/2018	Showdown 32oz/ac, Dyne-Amic 1%
	7/18/2018	Diuron 1.5pt/ac
	7/24/2018	Mepiquat 12oz/ac
	8/8/2018	Mepiquat 16oz/ac
Insecticide	9/17/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
	6/5/2018	Acephate 3.2oz/ac
Harvest aid	10/1/2018	Setup 6SL 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/22/2018	Solera 32oz/ac, Preference 0.5%
Irrigation Amt.		
PrePlant & Planting	1/1 - 6/2	Base = 6.01in., Base-50% = 6.01in., Base+50% = 6.01in.
Seasonal	6/3 - 9/26	Base = 7.83in., Base-50% = 3.25in., Base+50% = 11.33in.
Rainfall		
PrePlant & Planting	1/1 - 6/2	1.90in.
Seasonal	6/3 - 9/26	8.71in.



Operations Summary

Year	2018
Farm	Helm
Field ID	Field 6 - Zones D - F
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

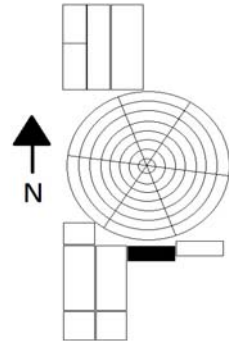
Field Operations	Date	Activity
Tillage	12/14/2017	Shred
	1/5/2018	Disk
	1/8/2018	Disk
	2/23/2018	Cultivate
	3/13/2018	Cultivate
	3/14/2018	List
	4/13/2018	Seed Bed Packer
	4/30/2018	Rotary Hoe
	5/27/2018	Rotary Hoe
	6/7/2018	Cultivate
Fertility	3/26/2018	Liquid 32-0-0 30gal/ac (Zones D-E Only)
	7/10/2018	Liquid 32-0-0 54 lbs/ac (applied through drip irrigation; Zones D-E Only)
	7/11/2018	Liquid 32-0-0 54 lbs/ac (applied through drip irrigation; Zones D-E Only)
Planting / Harvest	5/16/2018	Planted NexGin 4689 B2XF 48,000seed/ac
	11/3/2018	Harvested zone D
	11/4/2018	Harvested zone E
Herbicide / Growth Regulator	3/20/2018	Dicamba 8oz/ac, Induce 1% (Zone E Only)
	5/16/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Induce 1%
	5/31/2018	Showdown, 36oz/ac, Dyne-Amic 2%
	6/7/2018	Medal EC 1.3pt/ac, Showdown 36oz/ac, Dyne-Amic 1%
	7/9/2018	Mepiquat 8oz/ac
	7/10/2018	Engenia 12.8oz/ac, Showdown 48oz/ac, Justified 3oz/ac, Smoke 1qt/100gal
	7/20/2018	Diuron 1.5pt/ac
	7/24/2018	Mepiquat 12oz/ac
	8/8/2018	Mepiquat 16oz/ac
Insecticide	5/31/2018	Acephate 3.2oz/ac
Harvest aid	10/1/2018	Setup 6SL 32oz/ac, ETX 1.25oz/ac, Dyne-Amic 1%
	10/23/2018	Solera 32oz/ac, Preference 0.5%
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/31	Zone D =9.79in., Zone E = 9.87in., Zone F = 9.86in.
Seasonal	6/1 - 9/26	Zone D =8.51in., Zone E = 7.82in., Zone F = 6.51in.
Rainfall		
PrePlant & Planting	1/1 - 5/31	1.90in.
Seasonal	6/1 - 9/26	8.71in.



Operations Summary

Year	2018
Farm	Helm
Field ID	Field 6 - Zone G
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

Field Operations	Date	Activity
Tillage	12/14/2017	Shred
	1/3/2018	Disk
	1/9/2018	Disk
	2/23/2018	Cultivate
	3/13/2018	Cultivate
	3/19/2018	List
	4/13/2018	Seed Bed Packer
	6/26/2018	Disk
Fertility		
Planting / Harvest	5/29/2018	Planted Regulated Plots 46,000seed/ac
	6/26/2018	No harvest, test was terminated
Herbicide / Growth Regulator	3/12/2018	Trifluralin 4EC 1qt/ac
	5/21/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Showdown 48oz/ac, Firezone 1pt/ac
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/31	Zone H = 11.42in.
Seasonal	6/1 - 9/26	Zone H = 3.16in.
Rainfall		
PrePlant & Planting	1/1 - 5/31	1.90in.
Seasonal	6/1 - 9/26	8.71in.



Operations Summary

Year	2018
Farm	Helm
Field ID	Field 6 - Zone H
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

Field Operations	Date	Activity
Tillage	12/14/2017	Shred
	1/3/2018	Disk
	1/9/2018	Disk
	2/23/2018	Cultivate
	3/13/2018	Cultivate
	3/19/2018	List
	4/13/2018	Seed Bed Packer
	6/26/2018	Disk
Fertility		
Planting / Harvest	5/29/2018	Planted Regulated Plots 46,000seed/ac
	6/26/2018	No harvest, test was terminated
Herbicide / Growth Regulator	3/12/2018	Trifluralin 4EC 1qt/ac
	5/21/2018	Medal EC 1.3pt/ac, Helmquat 2pt/ac, Showdown 48oz/ac, Firezone 1pt/ac
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1 - 5/31	Zone H = 11.42in.
Seasonal	6/1 - 9/26	Zone H = 3.16in.
Rainfall		
PrePlant & Planting	1/1 - 5/31	1.90in.
Seasonal	6/1 - 9/26	8.71in.

