TEXAS A&M AGRILIFE RESEARCH

Improving Life Through Science and Technology

Lubbock-Pecos-Halfway

Helm Research Farm

Summary Report

2017

Technical Report
18-3

Texas AgriLife Research / Craig Nessler, 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

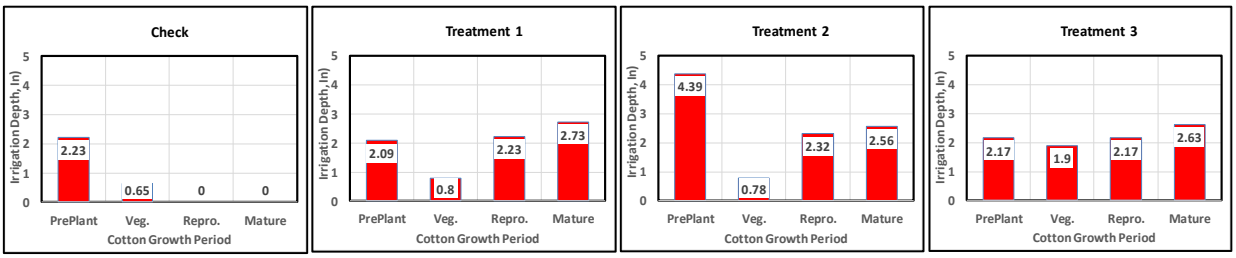
Objective: Determine cotton lint yield, water use efficiency and relative water value of three irrigation timing treatments using subsurface drip irrigation.

Figure 1. Harvesting subsurface drip irrigated treatments from irrigation timing experiments at the Helm Research Farm, Halfway, TX, 2017.

Methodology: The primary research question relates to efficiency of soil profile irrigation storage when subsurface drip irrigation (SDI) is applied early in the growing season at times when irrigation capacity is greater than crop evapotranspiration (ET) rate. This field study was irrigated with SDI having 30-in. dripline spacing and focused on three irrigation timing treatments replicated in a RCB design. Treatments were: T1 - minimal irrigation for plant establishment, no irrigation during vegetative period, 0.15 in/day rate during reproductive and maturation periods; T2 - irrigation at 0.15 in/day rate during preplant for up to 30 days, no irrigation during vegetative period, 0.15 in/day rate during reproductive and maturation periods; and T3 - minimal irrigation for plant establishment, 0.15 in/day rate during vegetative, reproductive, and maturation periods. A treatment having sufficient irrigation for plant establishment with no further seasonal irrigation (check) was also included. Cotton was grown and test plots were harvested with commercial harvesting equipment. Cotton yields, fiber quality, and water productivity from the different treatments were determined.

Results: Heavy rainfall in August and the latter half of September (see detail rain in appendix) and relatively low seasonal temperatures resulted in very respectable lint yields with poor fiber quality and below normal loan values. Seasonal irrigation quantities were 7.85, 10.26, and 8.87 inches with corresponding lint yields of 1740, 1800, and 1810 lb lint/acre for respective treatments (Fig. 2). Limiting preplant irrigation versus more traditional preplant irrigation amounts (T1 vs. T2) resulted in a 4% reduction in yield which was offset by 3.6% higher loan price while using 2.4 inches less irrigation. This year's results continue to support the concept of limiting preplant irrigations to conserve irrigation water.

Figure 2. Irrigation amounts by period, total irrigation, cotton lint yield, and lint loan values from three irrigation sequences at the Helm Research Farm, Halfway, TX, 2017.



	Check	Treatment 1	Treatment 2	Treatment 3
Irr. Amt.	2.88 in.	7.85 in.	10.26 in.	8.87 in.
Yield	977 lb/ac	1740 lb/ac	1800 lb/ac	1810 lb/ac
Loan	$0.442 /lb	$0.524 /lb	$0.506 /lb	$0.514 /lb

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 and water productivity of preplant and early season irrigation treatments using SDI.

Methodology: This study quantifies differences in water productivity of SDI cotton during irrigation periods having the highest evaporation losses in the Texas South Plains. Treatment factors included preplant irrigation quantity and early season irrigation capacity resulting in six treatments in addition to a "pre-plant only" check (Table 1). SDI laterals were spaced 60 in. apart with each irrigating 2 30-in. crop rows.

Results: Rain was higher and air temperatures were lower than seasonal averages in 2017. Hail on 3 July partially damaged most plants, but the crop recovered. Due to an irrigation controller programming error during the vegetative period, irrigations of Treatments T2 and T3 were nearly identical to treatments T5 and T4, respectively. High preplant irrigation treatments (T1, T3, and T4) had numerically higher yields than the low preplant irrigation treatments (T2, T5, T6) by 11, 9, and 8%, respectively. However, these treatment pairs used 37, 31, and 31% more irrigation (Table 1). Additional irrigation during the vegetative period (T2 & T5 vs. T6, and T1 & T3 vs. T4) did not increase yield (Table 1) but did reduce water productivity and cotton lint loan values (Table 2). This year's results continue to support the concept of limiting preplant and early season irrigation to conserve irrigation water in this water short area.

Table 1. Irrigation treatments, planned and actual irrigation amounts, cotton lint yields, and total irrigation water productivity of low and high preplant irrigation amounts using SDI at the Texas A&M AgriLife Research Center, Halfway, Tx, 2017.

		Proposed Irr. Rate (in./d)			Actual Irrigation Amount (in.)				Yield	IWUE
Preplant Irrigation	Treat. No.	Preplant	Veg. Period	Repo. & Mat. Periods	Preplant	Veg. Period	Repo. & Mat. Periods	Total Irr (in)	(lb/ac)	(lb/ac-in)
Low	T0	0.1	0.0	0.0	2.2	0.8	0.0	2.9	864 c*	299.6 a
	T2	0.1	0.0	0.2	3.0	1.3	4.0	8.3	1558 ab	188.0 b
	T5	0.1	0.1	0.2	2.7	1.4	3.7	7.9	1481 b	188.4 b
	T6	0.1	0.2	0.2	2.7	3.1	3.6	9.4	1525 ab	163.1 c
High	T3	0.2	0.0	0.2	5.6	1.3	3.9	10.9	1696 a	155.8 cd
	T1	0.2	0.1	0.2	5.6	1.3	3.8	10.8	1669 a	154.9 cd
	T4	0.2	0.2	0.2	5.5	3.4	3.4	12.3	1666 a	135.3 d

*Yield and IWUE means in a column followed by the same letter are not significantly different ($p<0.05$, Tukey)

Table 2. Cotton lint fiber quality characteristics and loan values of irrigation treatments using SDI at the Texas A&M AgriLife Research Center, Halfway, Tx, 2017.

Preplant Irrigation	Treat. No.	Mic	Length	Uniformity	Strength	Loan ($/lb)
Low	T0	2.98 ab*	1.15 a	80.0 a	28.8 a	0.500 ac
	T2	3.03 ab	1.18 a	80.2 a	29.2 a	0.518 ab
	T5	2.98 ab	1.18 a	80.9 a	29.0 a	0.518 ab
	T6	2.88 b	1.17 a	80.4 a	28.9 a	0.502 bc
High	T3	3.08 a	1.18 a	80.7 a	29.8 a	0.524 ab
	T1	3.12 a	1.19 a	80.7 a	29.7 a	0.532 a
	T4	2.94 ab	1.18 a	80.5 a	29.4 a	0.491 c

*Means in a column followed by the same letter are not significantly different ($p<0.05$, Tukey)

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 2017 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 following cotton in the rotation at 1.5*BI (Fig. 1a). The lower irrigation level consistently resulted in smaller MWD. This is most likely due to less biomass produced both above- and below-ground and reduced microbial activity. At the 6-12" depth, differences in MWD between reduced and conventional tillage were not as great at this deeper soil depth (Fig. 1b). Soil organic C (SOC) was greater in the cotton-sorghum rotation at both depths regardless of irrigation level and tillage (Fig. 2a, b). This is likely due to increased organic material additions in the cotton-sorghum rotation compared to continuous cotton system.

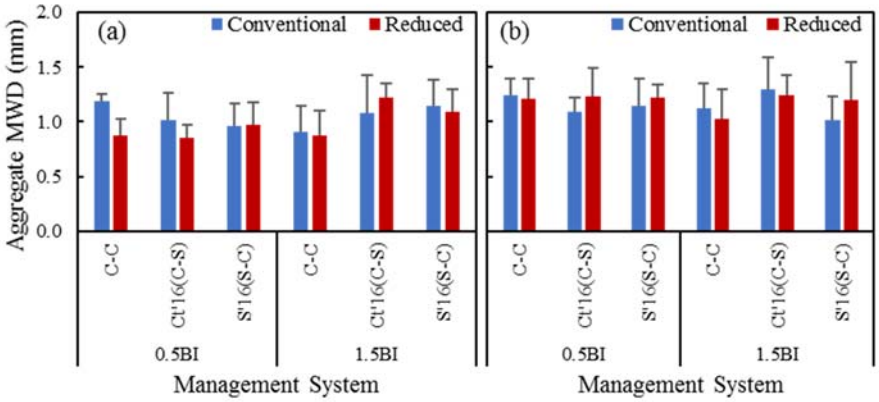


Figure 1. Mean weight diameter (MWD) of soil aggregates as affected by crop rotation [continuous cotton (C-C), cotton following sorghum (C'15, S-C), and sorghum following cotton (S'15, C-S], irrigation level (1.5BI and 0.5BI), and tillage (reduced and conventional) at soil depths of 0-6" (a) and 6-12" (b).

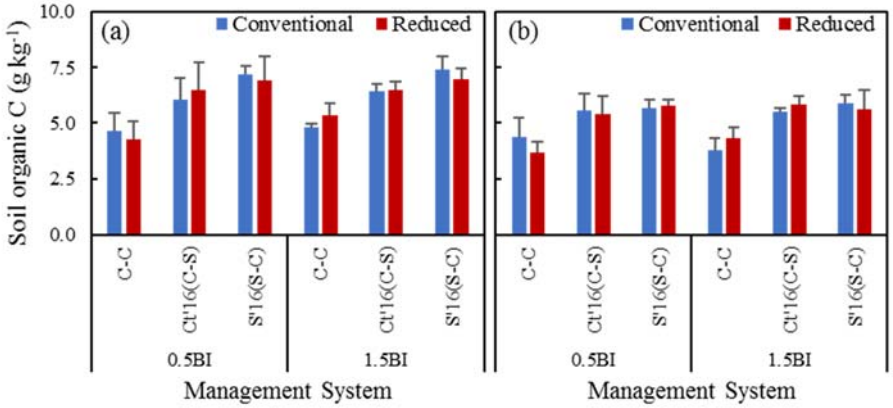


Figure 2. Soil organic C (SOC) as affected by crop rotation [continuous cotton (C-C), cotton following sorghum (C'15, S-C), and sorghum following cotton (S'15, C-S], irrigation level (1.5BI and 0.5BI), and tillage (reduced and conventional) at soil depths of 0-6" (a) and 6-12" (b).

Affect of Cropping System, Irrigation Rate, and Tillage on Verticillium Wilt (Field 5)
Terry Wheeler, James Grant, and Zachary Hilliard

Objective: Determine the influence of cropping system (continuous cotton with or without a cover, sorghum/cotton, and wheat/summer fallow/cotton), irrigation rate (base and +/- 50% of base rate), and tillage (conventional tillage on beds with LEPA irrigation every other furrow, versus flat ground reduced tillage with splatter irrigation) on Verticillium wilt incidence, defoliation, and spore counts in the soil.

Methodology: Soil in plots for all these treatments (a total of 108 plots) were sampled during the winter and assayed for a type of spore (microsclerotia) of *Verticillium dahliae* (which causes the infection in the spring of cotton). Cotton plots were rated for incidence of Verticillium wilt on August 22, and for defoliation on September 22. Only the base (1.0B) and 50% above base (1.5B) were rated for defoliation, because the low irrigation rate (0.5B) appeared to have defoliation due to water stress and not due to the disease.

Results: The spores (microsclerotia) of *V. dahliae* responsible for long-term survival and initial infection in the spring, were highest in the wedges with the longest history of continuous cotton (Table 1). The microsclerotia density was also highest at the 1.5B irrigation rate (Table 2) Within the 1.5B rate, the fungal density was higher for conventional tillage than for reduced tillage. At the 1.0B and 0.5B irrigation rates, microsclerotia densities were similar.

Table 1. Affect of cropping system on microsclerotia (MS) and Verticillium wilt in 2017.

Wedge	Cropping systems[1] (years)			MS/ cc soil	Wilt (%)
	01-09	10-13	14-17		
A	CCC	CS	CCC	14.7 b	7.0 c
B	SCC	SCC	WFC	9.8 c	
C	SCC	SCC	WFC	9.2 c	12.6 b
D	SCC	SCC	CCC	5.6 c	8.8 bc
E	CCC	CCC	SC	22.1 a	21.8 a
F	CCC	CS	SC	13.5 b	

[1]Years include 2001-2009 (01-09), 2010-2013 (10-13), and 2014-2017 (14-17). CCC is continuous cotton; SCC is 1 year of sorghum and 2 years of cotton; WFC is winter wheat and summer fallow rotated with cotton; and SC is a sorghum/cotton rotation.

Table 2. Affect of irrigation rate (IR) and tillage[1] on microsclerotia density (MS), Verticillium wilt and defoliation in 2017.

IR	MS/cc soil		Wilt incidence		% Defoliation	
	Conv	Red	Conv	Red	Conv	Red
0.5	5.8 b z	7.1 b z	1.7 b[2] z	2.7 c z	------	-----
1.0	8.1 b z	9.6 b z	4.8 b y	10.2 b z	13.3 b z	12.0 b z
1.5	28.1 a z	16.3 a y	31.0 a z	24.6 a y	47.1 a z	39.0 a y

[1]Conventional tillage (Conv) included beds, normal tillage operations, and LEPA irrigation every other furrow. Reduced tillage (Red) included flat ground, minimum tillage, and Splatter irrigation.
[2]Comparisons between irrigation rates, within a tillage treatment followed by different letters (a or b) indicate treatments were significantly different (P=0.10). Comparisons within an irrigation rate and between tillage treatments followed by a different letter (z or y) were significantly different (P=0.10).

Wilt incidence was highest in wedge E, followed by wedge C, then D and A on 22 August (Table 1). The 1.5B irrigation rate had much higher incidences of wilt than the 1.0B and 0.5B rates (Table 2). Verticillium wilt was also higher in reduced tillage than conventional tillage in the 1.0B rate, but Verticillium wilt was lower in reduced tillage compared to conventional tillage at the 1.5B rate when analyzed over all four cotton wedges (Table 2).

Defoliation was much higher at the 1.5B rate than the 1.0B rate (0.5B rate was not measured). Tillage affects were not seen at 1.0B rate, but defoliation was lower at the reduced tillage and 1.5B rate, than with conventional tillage at the 1.5B rate (Table 2). Defoliation was negatively related to yield in wedge C (more reduction in reduced tillage), D (more reduction in reduced tillage), and E (more reduction in reduced tillage) (Figure 1).

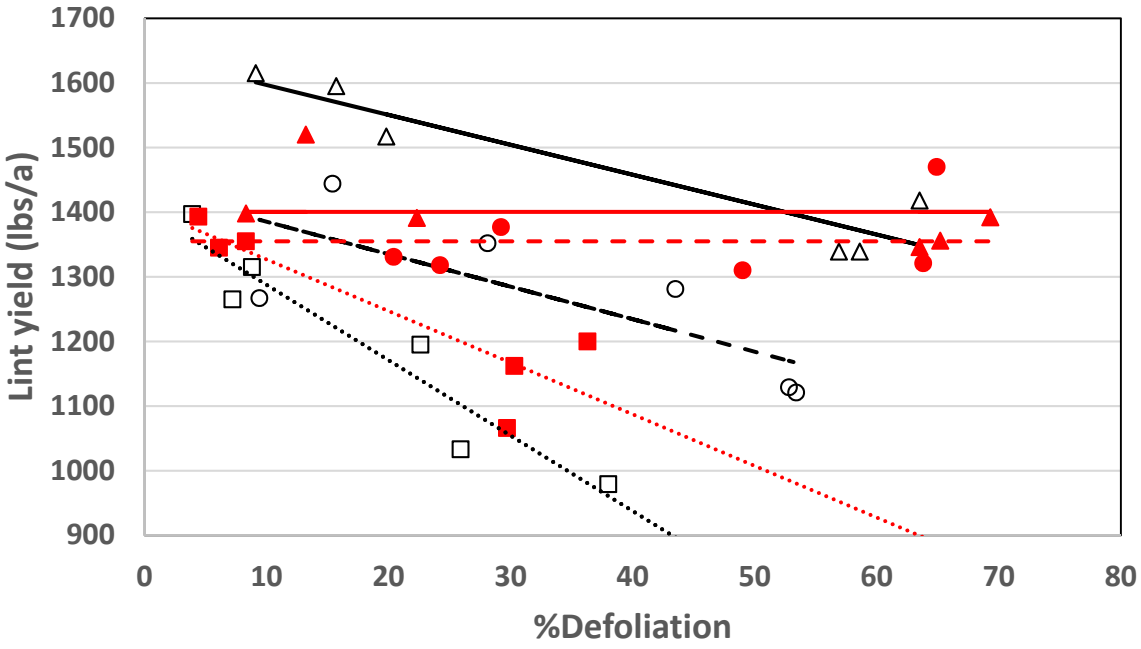


Figure 1. Wedge C = □ for reduce tillage (RT) and ■ for conventional tillage (CT); Wedge D = △ for RT and ▲ for CT; Wedge E = ○ for RT and ● for CT.

Comparison of LEPA and Mobile Drip Irrigation (MDI) Application Methods (Field 5).
James Bordovsky, Joe Mustian, and Scott Jordan

Objective: Compare yield and water productivity response of cotton and grain sorghum in cropping systems irrigated by LEPA and Mobile Drip Irrigation (MDI) application methods.

Methodology: The goal of MDI (Dragonline™) is to reduce irrigation losses when irrigating with a pivot. The idea of replacing center pivot sprinkler nozzles with drip lines is not new. However, the advancement in drip line connectivity to pivots and in drip line emitter technology e.g., pressure compensated emitters, is new. A field experiment was conducted comparing LEPA to MDI on one span of the Helm Pivot. Six 8-row span sections were equipped with either LEPA or MDI applicators, and irrigations applied in cotton and grain sorghum crops growing in defined crop rotation sequences. Specific irrigation and other production details are available in the appendix.

Figure 1. Mobile Drip Irrigation applicators on a commercial center pivot irrigating cotton.

Results: Cotton was harvested using a modified commercial 4-row cotton stripper from all treatment replicates with sub-samples taken to determine gin turnout and cotton fiber quality. Over a two-year evaluation and out of ten replicated comparisons, only when cotton treatments were planted in conventionally irrigated, terminated wheat in 2016 (Table 1) did MDI produced significantly higher yield than LEPA. There were no significant differences in cotton fiber quality among methods in any of the cropping systems. Sorghum yields were not significantly affected by application method with 5055 and 5010 lb/ac in 2016 and 3097 and 3334 lb/ac in 2017 for LEPA and MDI, respectively. From these evaluations and field observations, MDI's advantage over LEPA may only occur on sloping fields with heavy soil texture where LEPA applications could result in runoff.

Table1. Cotton lint and grain yield, seasonal irrigation water use efficiency, and cotton loan value for cropping sequences with water delivered by LEPA and Mobile Drip Irrigation applicators at Texas A&M AgriLife Research Helm Farm, 2016-2017.

				Yield (grain or lint, lb/ac)		SIWUE (lb/ac-in)		Lint Loan Value (cents/lb)	
Year	Crop	Cropping Sequence	Irrigation Strategy	LEPA*	MDI	LEPA	MDI	LEPA	MDI
2016	Cotton	Continuous Cotton in Terminated Wheat	Late Start	1970 a	2048 a	176 a	186 a	52.4 a	52.6 a
			Regular Start	1892 b	2043 a	151 b	169 a	51.6 a	52.6 a
		Cotton / Grain Sorghun 2 year Rotaton	Regular Start	1060 a	1174 a	12 a	27 a	46.9 a	46.6 a
		Cotton / Wheat (Harvested) 2 year Rotaton	Regular Start	1362 a	1338 a	32 a	29 a	47.0 a	46.8 a
	Grain Sorghum	Grain Sorghun / Cotton 2 year Rotaton	Regular Start	5055 a	5010 a	155 a	150 a		
2017	Cotton	Continuous Cotton	Regular Start	917 a	1027 a	77 a	108 a	46.4 a	46.7 a
		Continuous Cotton in Terminated Wheat	Regular Start	1219 a	1175 a	182 a	168 a	47.8 a	48.5 a
		Cotton / Grain Sorghun 2 year Rotaton	Regular Start	1262 a	1209 a	98 a	83 a	47.4 a	46.5 a
		Cotton / Wheat (Harvested) 2 year Rotaton	Regular Start	1333 a	1259 a	100 a	79 a	49.2 a	46.6 a
	Grain Sorghum	Grain Sorghun / Cotton 2 year Rotaton	Regular Start	3097 a	3334 a	503 a	568 a		

* Values between irrigation applicators for Yield, SIWUE, or Loan Values within a cropping sequence followed by the same letter are not significantly different, $p<0.05$)

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

Objective: Determine yield and water productivity of continuous cotton at three irrigation levels under conventional 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, continuous, conventionally tilled cotton has been grown since 2014. Each pivot span was divided into three sections with each section delivering one of three irrigation quantities (or 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 in years of average rainfall. Irrigation amounts, cotton varieties, pesticides, and nutrient applications are listed in the appendix.

Results: Annual rainfall exceed 26 inches in 2017 with high rainfall in August and September and severe hail on 3 July. This past year makes the third consecutive year with adverse weather and above average rainfall. Although the cotton crop was not replanted, it was injured and developed slowly resulting in below average production. Total seasonal irrigations were approximately 1.3, 3.5 and 4.8 inches in the three respective irrigation treatment areas of each pivot span. Within a narrow range, cotton yields numerically increased with increased irrigation (Figure 1), however, larger irrigations reduced fiber quality and lint loan values (Figure 2). This same pattern was seen in each of the previous 2 years. Compared to cotton in rotation with wheat or grain sorghum, or planted into terminated wheat cover (next three reports), yields in conventionally tilled, continuous cotton were low to very low.

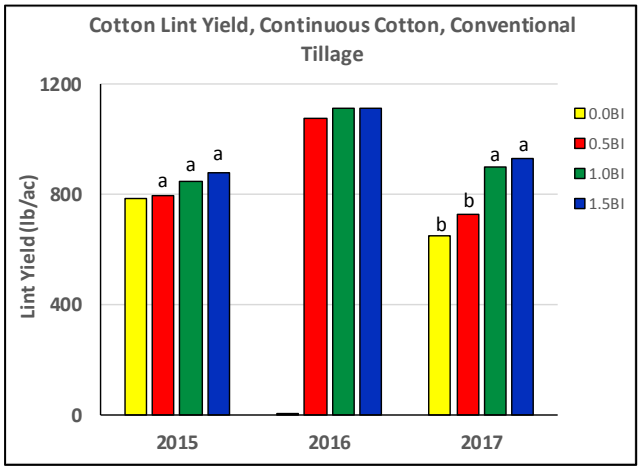


Figure 1. Cotton lint yield from areas of continuous cotton using conventional tillage systems at three irrigation levels, Helm Farm 2015-2017.

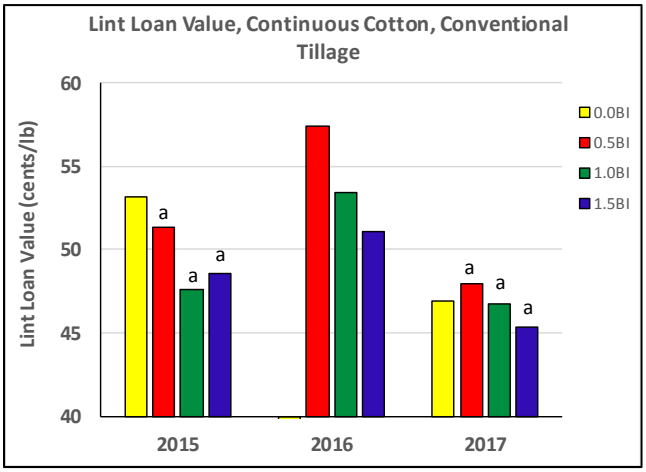


Figure 2. Lint loan values from cotton grown in areas of continuous cotton using conventional tillage systems at three irrigation levels, Helm Farm 2015-2017.

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

Objective: Determine 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 being conducted on 125 acres irrigated by LEPA. In this 22-acre test area, cotton has been planted (2017) following wheat harvested for grain and summer fallow period (2016). Two tillage systems, conventional (pivot spans 4, 6, and 8) and reduced tillage (spans 3, 5, and 7), were used. Specific 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 quantities 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 in years of average rainfall.

Results: Rain was higher and air temperatures were lower than seasonal averages in 2017. Hail on 3 July partially damaged most plants, but the crop recovered. Unlike the 2016 weather damaged crop, there were no significant differences in lint yield, water productivity, or cotton loan value between conventional and reduced tillage within individual irrigation levels (Figure 1). Irrigation treatments at the 1.0BI level resulted in the highest yield. Irrigation at the 1.5BI level reduced yield, water productivity, and cotton fiber quality as determined by the loan value compared to treatments having less seasonal irrigation.

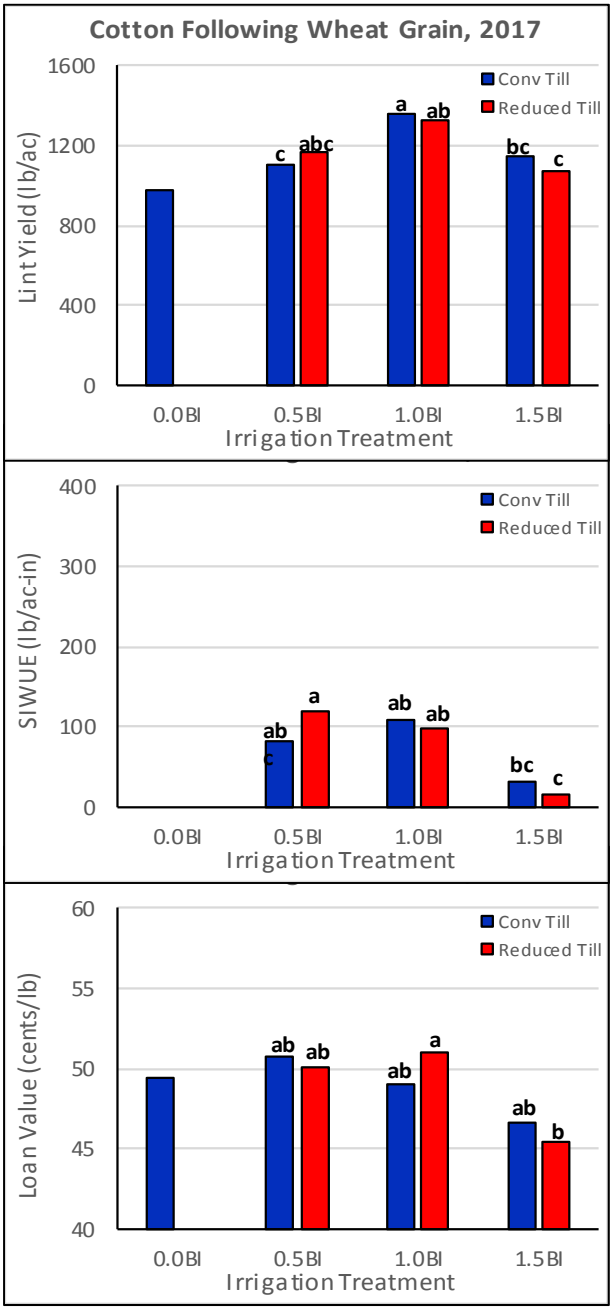


Figure 1. Cotton lint yield, seasonal irrigation water productivity and lint loan values from irrigation level by tillage experiments at Texas A&M AgriLife Research, Helm Farm, Halfway, Tx, 2017.

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

Objective: Determine yield and water productivity of cotton planted into terminated wheat with cotton irrigated at three levels under conventional and reduced tillage systems and with seasonal irrigations at both traditional and late start times.

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 for the past several years, cotton was planted into terminated wheat. Two tillage systems, conventional tillage (in pivot spans 4, 6, and 8) and reduced tillage (in 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 quantities (or 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). Also, seasonal irrigations on the west half of this wedge were delayed until 18 July verse an earlier, more traditional, irrigation start on the east (30 June) to document effects on seasonal irrigation timing. Irrigation amounts, varieties, pesticides, and nutrient applications for 2017 are listed in the appendix.

Results: Within an irrigation level for a given seasonal irrigation start date, there were no significant differences due to tillage treatments in yield, water productivity (SIWUE), or loan price, although yields and SIWUE were numerically higher for reduced versus conventionally tilled treatments. On both irrigation start dates, irrigation above the 0.5BI level significantly increase yield, however, irrigation above the 1.0BI level tended to have no positive effect on cotton yield. Increased irrigation tended to reduce water productivity, in some cases significantly ($p<.05$), also reducing lint loan values. Unlike in previous years and in all cases, 2017 yields were lower in respective plots where seasonal irrigations were delayed. However, water productivity was similar or much higher in these same treatments.

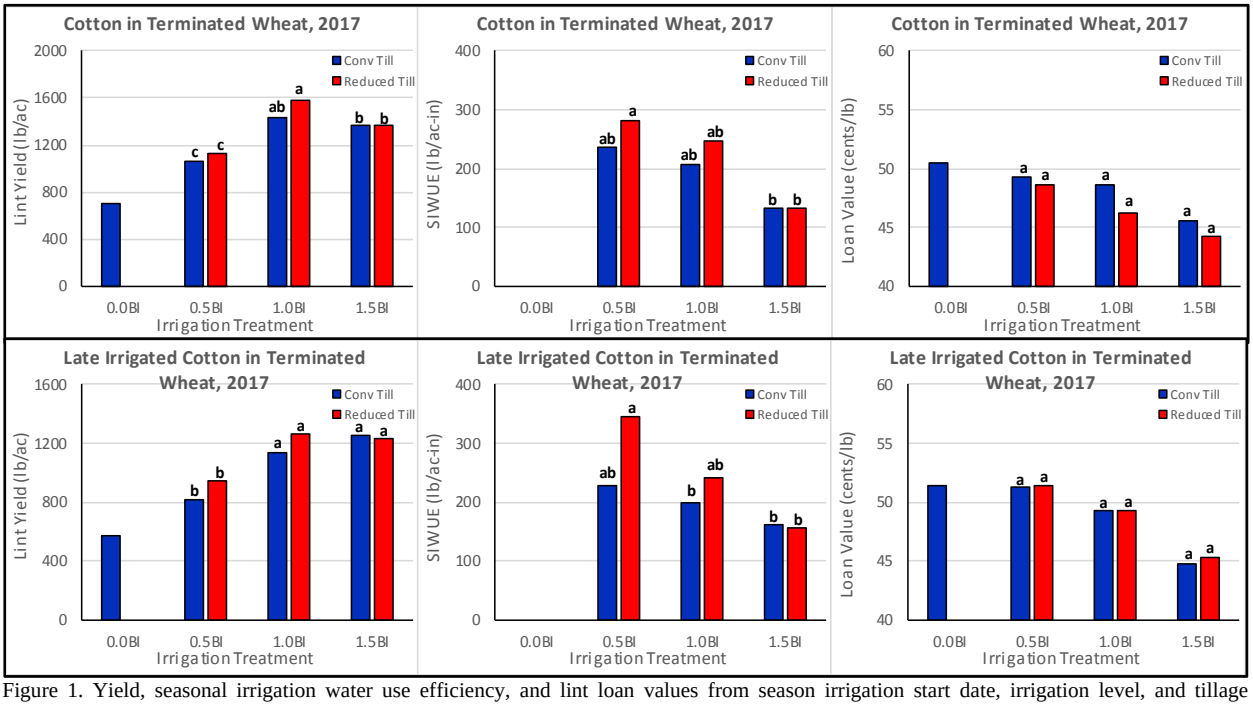


Figure 1. Yield, seasonal irrigation water use efficiency, and lint loan values from season irrigation start date, irrigation level, and tillage treatments at Texas A&M AgriLife Research Helm Farm, Halfway, Tx, 2017.

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

Objective: Determine yield and water productivity of cotton following grain sorghum in a two year rotation 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 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 or 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: Rain was higher and air temperatures were lower than seasonal averages in 2017. Hail on 3 July partially damaged most plants, but the crop recovered. Total seasonal irrigations were approximately 1.5, 3.5 and 5.0 inches in the three respective irrigation treatment areas of each pivot span. Cotton yields did not increase with irrigation beyond the 1.0BI level (Figure 1). Water productivity (SIWUE) at the 0.5BI level under reduced tillage was significantly higher than other treatments (Figure 2) with productivity trending lower with increased irrigation. Cotton yields were numerically lower in the conventional versus the reduced tilled plots but were significantly higher ($p<0.05$) at the 1.5BI irrigation level. Fiber quality, as reflected in the lint loan price, showed no significant difference due to tillage or irrigation treatments (data not shown).

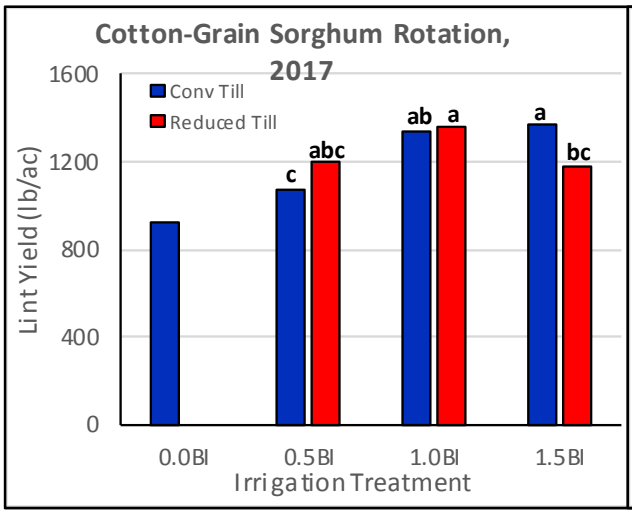


Figure 1. Lint yields of cotton treatments following grain sorghum using conventional and reduced tillage systems at three irrigation levels at the Texas A&M AgriLife Research Helm Farm, Halfway, Tx., 2017.

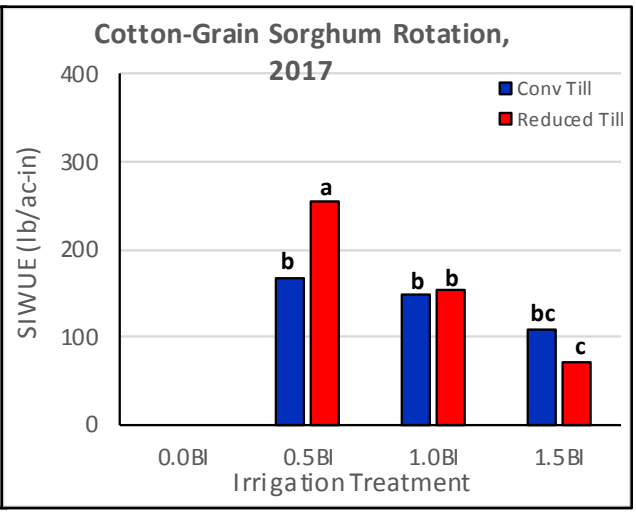


Figure 2. Seasonal irrigation water use efficiency of irrigated cotton treatments following grain sorghum using conventional and reduced tillage systems at three irrigation levels at the Texas A&M AgriLife Research Helm Farm, Halfway, Tx., 2017.

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

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 a comprehensive crop rotation-tillage-irrigation study being conducted on 125 acres irrigated by LEPA. In this 22-acre test area, grain sorghum was planted following cotton 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. In addition, each pivot span was divided into three sections with each pivot section delivering one of three irrigation levels to the soil surface below. The irrigation levels were designate as the 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 50% ET_{crop} of grain sorghum. Irrigation amounts, sorghum hybrid, pesticides, and nutrient applications for 2016 are listed in the appendix.

Results: Average grain sorghum yields for 2014, 2015, 2016, and 2017 are in Figure 1. Non-irrigated yields in the conventionally tilled areas were high at 4200, 3800, and 1269 lb/ac in 2015, 2016, and 2017, respectively. Yields have been impacted by infestations of sugar cane aphid which were sprayed twice in 2015 and once in 2016. Yields have increased with increased irrigation and a consistent pattern of optimum seasonal irrigation productivity occurring at the 1.0BI irrigation level (data not shown). The effects of tillage treatments have been inconsistent over the four-year test period. The reduced till sorghum tended to have higher yields than sorghum within conventional treatments when planted in Wedge F (2015, 2017) where the conventional tillage tended to have the higher yields when planted in Wedge E (2014, 2016). Tillage effects within this rotation may become more evident with time.

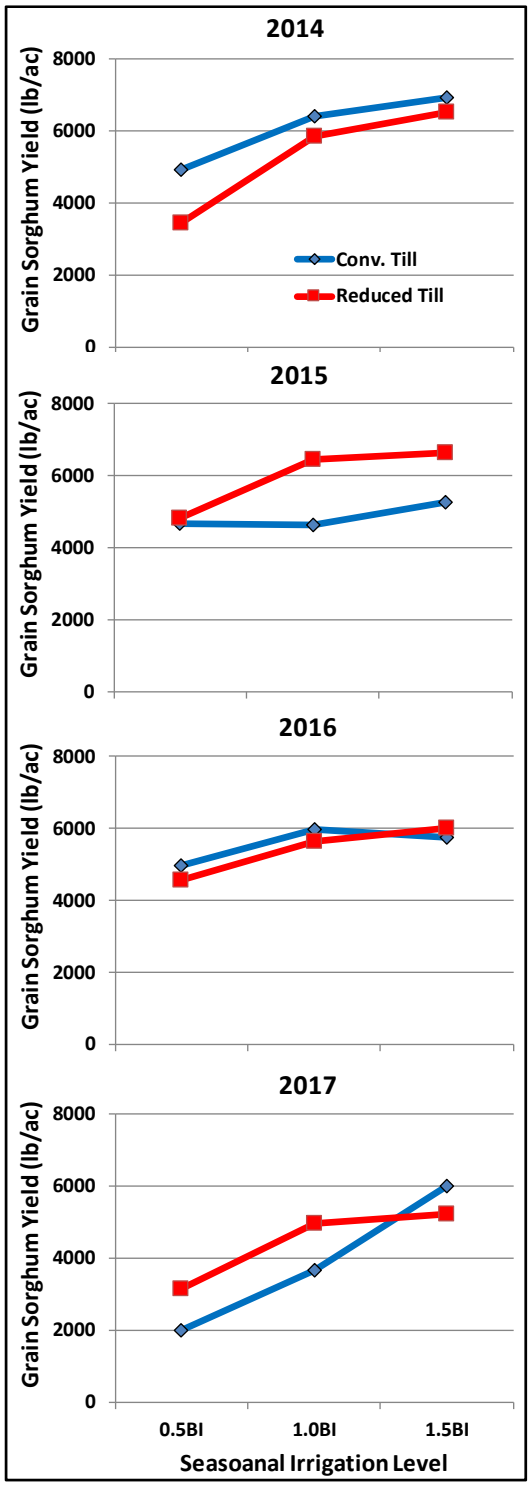


Figure 1. Grain sorghum yield from treatment areas following cotton using conventional and reduced tillage systems at three irrigation levels at Texas A&M AgriLife Research, Helm Farm, 2014-2017.

Strategies for Plant Growth Regulators in Early and Mid-Late Maturing Cotton Varieties
Seth Byrd, Robert Wright, and John Wanjura

Objective: Determine response of late and early maturing cotton varieties to various application schedules of plant growth regulators.

Methodology: Two cotton varieties, the early maturing FiberMax 1830 GLT (FM 1830) and the mid to late maturing Deltapine 1646 B2XF (DP 1646) were planted in plots consisting of 4, 30 inch rows measuring 358 feet in length on May 12 at a rate of 50,000 seeds per acre. Irrigation, applied through drip tape located under every other row middle, totaled 9.1 inches from planting until the end of the season, and an additional 15.97 inches of rainfall was received during the same period. A non-treated check (treatment 1) and three schedules of plant growth regulator (PGR) applications were evaluated, including; 2) multiple applications of low rates (4 oz acre^{-1} at matchhead square (MHSQ), early bloom (EB), and 2 weeks after early bloom (EB+2 wk.) followed by 8 oz acre^{-1} at 4 weeks after early bloom (EB+4 wk.); 3) two applications of a moderate rate of 12 oz acre^{-1} at EB and EB+4 wk.; and 4) one high application of 24 oz acre^{-1} at EB+4 wk. A generic mepiquat chloride product was used for all PGR treatments. Four replications of each variety by PGR treatment combination were included. Plant height was measured throughout the season, and prior to the application of harvest aids plant height, total nodes, and percent of open bolls were quantified. Entire plots were stripped and weighed in the field. A 20 lb. subsample of seedcotton was taken from each plot for ginning. Fiber samples were sent to the Texas Tech Fiber and Biopolymer Research Institute for grading and HVI classing.

Results: Variations in plant height were present throughout the flowering stage (Table 1), although by the end of the bloom stage there was no difference in height between the low (2) and moderate (3) PGR treatments and both resulted in shorter plants than the non-treated (1) and the late high rate (4) application. Plant heights in treatments 2 and 3 were 3 to 5 inches shorter by the end of the bloom period than plants in treatments 1 and 4. However, there were greater differences in plant height due to the differences in varieties than the different PGR treatments. By the end of the season trends in plant height mirrored those observed during the flowering stage, with shorter plants resulting from PGR treatment 2 and 3, while plant height in the non-treated was no different than the one high application (Table 2). This same trend was present for total nodes, but there was no difference in percent open, turnout, or lint yield due to PGR application schedule. The variety FM 1830 resulted in shorter plants with fewer total nodes and a greater percent of open bolls at the end of the season. While there was no difference in turnout due to variety, FM 1830 did result in a 223 lbs. acre^{-1} increase in lint yield, a 0.3 increase in micronaire, and a 2.5 cents per pound increase in loan value. There was no effect of PGR regime on turnout, lint yield, or any of the fiber quality parameters evaluated through HVI classing.

Table 1. Variety and PGR treatment effects on plant height measured throughout the season.

	MHSQ[1]	EB	EB+2 wk.	EB+4 wk.	EB+6 wk.
Variety					
DP 1646 B2XF	15.6 a	20.0 a	27.4 a	31.5 a	34.3 a
FM 1830 GLT	14.1 b	17.0 b	22.1 b	27.1 b	28.3 b
pLSD	*0.7*	*1.2*	*2.1*	*2.2*	*1.9*
PGR Treatment					
1. Non-Treated	14.6	19.1 a	26.0 a	31.0 a	33.5 a
2. Four/Low	14.9	17.5 b	24.2 b	27.9 b	28.0 b
3. Two/Moderate	14.7	18.8 a	23.9 b	27.7 b	30.4 b
4. One/High	15.1	18.6 a	24.9 ab	30.7 ab	33.4 a
pLSD	*NS*	*0.9*	*1.5*	*3.1*	*2.7*

Table 2. Variety and PGR treatment effects on end of season growth, maturity, turnout, and yield.

	Height (in)	Total Nodes	Percent Open	Micronaire	Loan Value (cents per pound)
Variety					
DP 1646 B2XF	34.1 a	22.5 a	42.1 b	3.1	52.4 b
FM 1830 GLT	26.3 b	20.7 b	62.3 a	3.4	54.9 a
pLSD	*1.5*	*0.6*	*7.4*	*0.1*	*0.7*
PGR Treatment					
1. Non-Treated	33.2 a	22.6 a	47.3	3.2	53.8
2. Four/Light	27.5 b	20.6 b	53.5	3.2	53.4
3. Two/Moderate	27.8 b	21.0 b	54.5	3.2	53.6
4. One/High	32.4 a	22.1 a	53.4	3.3	53.8
pLSD	*2.1*	*0.8*	*NS*	*NS*	*NS*

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

M.N. Parajulee, A. Hakeem, 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, FiberMax® 1900GTL, was planted at a targeted rate of 52,000 seeds/acre on May 4, 2017. 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 (Na), and 2) nitrogen not applied (Nna) during 2017, and two artificial cotton square injury treatments mimicking acute cotton fleahopper infestation as sub-sub-plots with four replications. The five main-plot treatments included pre-bloom side-dress applications of augmented N fertilizer rates of 0, 50, 100, 150, and 200 lb N/acre using a soil applicator injection rig on July 3, 2017. Pre-treatment soil samples (consisting of three 0 to 12 and 12 to 24-inch depth soil cores each), were collected from each of the 20 main plots on July 20, 2017. 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.

Results: Considerably higher residual soil nitrogen was recorded from plots that received the two highest N rates in preceding 16 years (Fig. 1). Not applying N following 16 years of continuous augmentation of N resulted in lower leaf N in all N rate treatments. 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. Lint yield in N augmented treatments increased with higher N rates, but it maximized at 100 N lb/A and then declined. It was unclear why the yield was significantly reduced at 150 lb/acre treatment. Numerically higher lint yield was observed in the 100 and 150 lb/acre nitrogen treatments, however, no significant differences in lint yield were observed between Na and Nna.

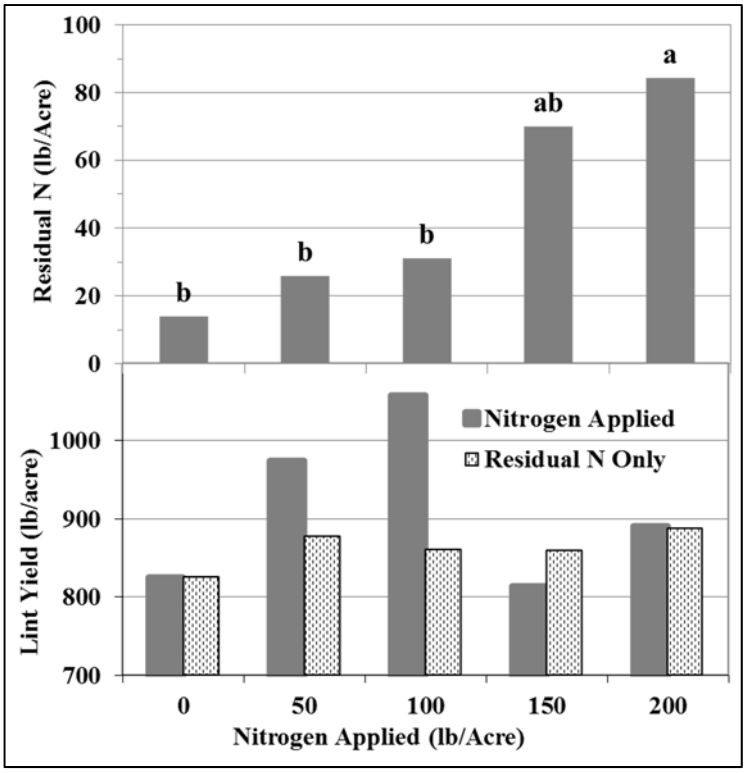


Fig. 1. Residual N (top) after the 16-year augmentation of five N rates and lint yield (bottom) on N_a vs. N_{na}.

High residual soil nitrogen has resulted in higher leaf nitrogen levels, yet at the same time, higher residual soil nitrogen reduced lint yield as plants grow longer, producing more bolls which shed later due to physiological stress. This year we have not observed reduced lint yields from plots in which N was not applied, which indicates the presence of enough residual nitrogen in the soil.

Comparison of Multi-sensor Capacitance and TDR Soil Water Measurement Methods (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.

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 or less from July 1 through September 30, 2017. Daily irrigation and rainfall where also measured.

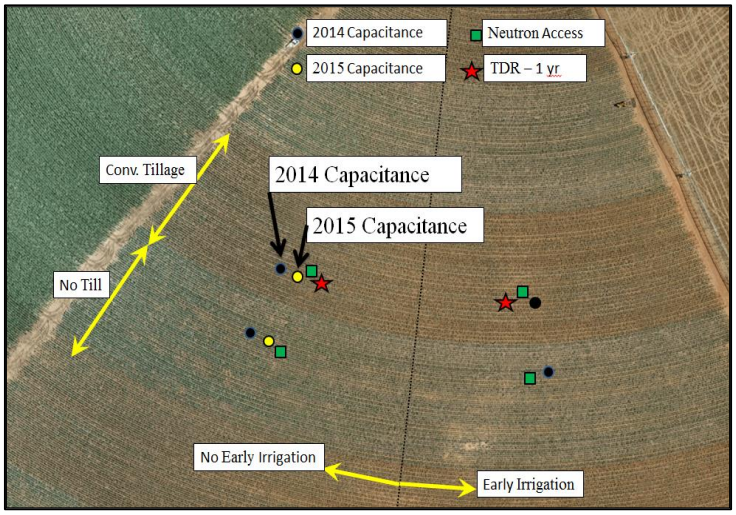


Figure 1. Soil moisture sensor installation locations within water management treatments at Texas A&M AgriLife Research, Halfway, TX, 2017.

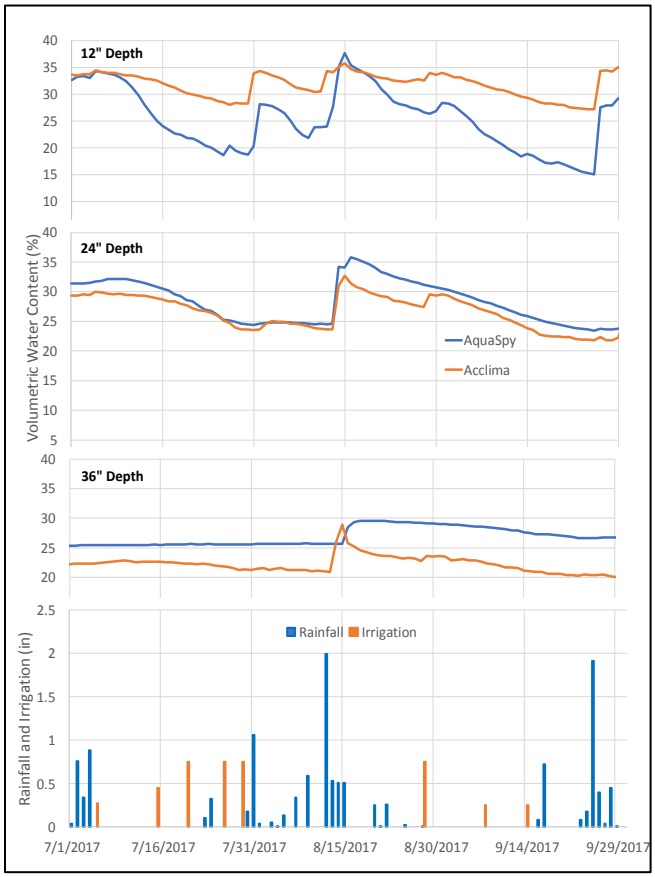


Figure 2. Soil moisture content over time from TDR and capacitance sensors in field experiments at Texas A&M AgriLife Research, Halfway, TX, 2017.

Results: The 2017 seasonal irrigation and rainfall amounts were 6.9 and 16.1 inches, respectively. The cotton lint yield in the treatment area was 1284 pounds per acre. Figure 2 contains capacitance sensor data normalized to that of the TDR sensor data, and TDR and capacitance data at depths of 12", 24", 36". Both TDR and capacitance sensors showed responses to irrigation and rainfall events. However, differences between the sensors types occurred. For example, at the 12" depth, the TDR sensor (Acclima) responded immediately to the August 9 rainfall, while the capacitance sensor (Aquaspy) response was later, more gradual and of higher magnitude. Differences in soil water readings 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.

Impact of Leaf Pubescence Levels on Fiber Quality of Stripper-Harvested Cotton
Seth Byrd, John Wanjura, Gaylon Morgan, and Robert Wright (Field 6bc)

Objective: Evaluate response of fiber quality of stripper-harvested cotton across smooth and hairy leaf cotton varieties.

Methodology: Four cotton varieties, two hairy leaf and two smooth leaf, were planted on May 12 at 50,000 seeds per acre. The two hairy leaf varieties consisted of Deltapine 1522 B2XF (DP 1522) and PhytoGen 333 WRF (PHY 333), while the two smooth leaf varieties included FiberMax 1830 GLT (FM 1830) and NexGen 3522 B2XF (NG 3522). According to seed company resources, DP 1522 is classified as semi-smooth, PHY 333 as hairy, while FM 1830 and NG 3522 are classified as smooth leaf types. Actual leaf and bract pubescence levels were determined by sampling both bracts and uppermost fully expanded leaves and determining the amount of hairs, or trichomes, per cm^{-2}. After plots were harvested and ginned, lint samples were sent to the Texas Tech University Fiber and Biopolymer Research Institute for HVI fiber quality determination. Results will focus on fiber quality parameters linked leaf hairiness characteristics, primarily leaf and color grade.

Results: Trichome counts from bracts and leaves followed the same pattern as the variety classifications, with DP 1522 and PHY 333 producing greater trichomes per cm^{-2} than FM 1830 and NG 3522. While these differences were reflected in leaf grade values, as FM 1830 and NG 3522 resulted in lower leaf grades than DP 1522 and PHY 333. However, no fiber quality discounts resulted due to leaf grade as across all varieties leaf grades did not exceed 4. Regardless of variety, either a 31 or 32 color grade was produced, again not resulting in a fiber quality discount.

Performance of Bayer and Stoneville Varieties as Affected by Low-energy Precision Application (LEPA) Irrigation Levels at Halfway, TX, 2017

Wayne Keeling – Professor, Justin Spradley and Ray White – Research Assistant and Graduate Research Assistant

MATERIALS AND METHODS:

Plot Size:	4 rows by 40 feet, 3 replications
Planting Date:	May 17
Varieties:	BX 1833GLT, BX 1834GLT, BX 1835GLT, FM 1320GL, FM 1830GLT, FM 1888GL, FM 1911GLT, FM 2322GL, FM 2498GLT, FM 2574GLT, ST 4949GLT, ST 5517GLTP
Herbicides:	Trifluralin 32 oz/A – March 7 Cotoran 32 oz/A – May 17 Glyphosate 32 oz/A – May 26 Glyphosate 32 oz/A – June 16 Medal EC or S-metolachlor 1.3 pt/A – June 20 Warrant 3 pt/A – July 26 Clethodim 16 oz/A – August 21
Fertilizer:	97-0-0-16S
Irrigation in-season:	LEPA

	Low	Base	High
Preplant	0.5”	0.5”	0.5”
In Season	2.8”	5.6”	8.4”
Total	3.3”	6.1”	8.9”

Harvest Date:	November 14

RESULTS AND DISCUSSION:

Twelve experimental and commercial Stoneville and FiberMax varieties were evaluated under three irrigation levels. When averaged across irrigation levels yields ranged from 840 to 947 lbs lint/A as irrigation level increased (Table 1). When averaged across irrigation levels, yields ranged from 757 to 1091 lbs lint/A. Loan values were similar across irrigation levels but ranged between 47.28 to 53.48 c/lb for the different varieties. Gross revenues were highest at the high irrigation level and were highest with FM 2498 GLT. Both FM 2498 GLT and FM 2574 GLT are new FiberMax varieties for 2018.

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

Variety	In-season Irrigation Levels			Average
	Low (3.3)	Base (6.1)	High (8.9)	
	---------- lbs/A----------			
BX1833GLT	910	914	996	**940 B**
BX1834GLT	826	967	993	**929 BC**
BX1835GLT	840	854	932	**875 BCD**
FM1320GL	857	899	921	**892 BC**
FM1830GLT	872	905	1003	**926 BC**
FM1888GL	853	847	949	**883 BCD**
FM1911GLT	746	860	939	**849 CDE**
FM2322GL	830	733	811	**791 EF**
FM2498GLT	1050	1094	1101	**1082 A**
FM2574GLT	838	802	1006	**882 BCD**
ST4949GLT	677	644	816	**712 F**
ST5517GLTP	778	754	892	**808 DE**
Average	**840 B**	**856 B**	**947 A**	**--**
	----------cents/lb----------			
BX1833GLT	53.63	52.67	53.53	**53.28 A**
BX1834GLT	51.80	52.67	52.97	**52.48 ABC**
BX1835GLT	48.00	48.13	50.17	**48.77 F**
FM1320GL	50.97	52.07	51.80	**51.61 BCD**
FM1830GLT	53.93	52.73	54.00	**53.56 A**
FM1888GL	52.00	52.07	50.63	**51.57 CD**
FM1911GLT	47.97	49.83	51.77	**49.86 EF**
FM2322GL	48.67	50.53	51.90	**50.37 DE**
FM2498GLT	53.60	53.70	53.17	**53.49 A**
FM2574GLT	53.77	53.10	52.60	**53.16 AB**
ST4949GLT	51.40	42.53	46.93	**46.96 G**
ST5517GLTP	51.70	49.30	52.80	**51.27 CDE**
Average	**51.45 A**	**50.78 A**	**51.86 A**	**--**
	----------$/A----------			
BX1833GLT	488	481	534	**501 B**
BX1834GLT	427	509	526	**488 B**
BX1835GLT	404	411	467	**427 CDE**
FM1320GL	437	469	477	**461 BCD**
FM1830GLT	470	477	542	**497 B**
FM1888GL	443	442	482	**456 BCD**
FM1911GLT	357	429	487	**424 CDE**
FM2322GL	405	370	421	**399 E**
FM2498GLT	563	588	585	**579 A**
FM2574GLT	450	426	531	**469 BC**
ST4949GLT	350	275	383	**336 F**
ST5517GLTP	400	372	473	**415 DE**
Average	**433 B**	**437 B**	**492 A**	**--**

Performance of PhytoGen Varieties as Affected by Irrigation Levels at Halfway, TX, 2017

Wayne Keeling – Professor, Justin Spradley and Ray White – Research Assistant and Graduate Research Assistant

MATERIALS AND METHODS:

Plot Size:	4 rows by 30 feet, 4 replications
Planting Date:	May 17
Varieties:	PHY 243 WRF, PHY 250 W3FE, PHY 300 W3FE, PHY 312 WRF, PHY 330 W3FE, PHY 340 W3FE, PHY 450 W3FE, PHY 490 W3FE, PX2A23W3FE, PX2A27W3FE, PX2A28W3FE, PX2A31W3FE, PX2A36W3FE, PX2AX2W3FE, PX2AX3W3FE, PX2AX4W3FE, PX3A82W3FE, PX3A96W3FE, PX3A99W3FE, DP 1646 B2XF, FM 1911 GLT, NG 3406 B2XF
Herbicides:	Trifluralin 32 oz/A – March 7 Cotoran 32 oz/A – May 17 Glyphosate 32 oz/A – May 26 Glyphosate 32 oz/A – June 16 Medal EC or S-metolachlor 1.3 pt/A – June 20 Warrant 3 pt/A – July 26 Clethodim 16 oz/A – August 21
Fertilizer:	97-0-0-16S
Irrigation in-season:	LEPA

	Low	Base	High
Preplant	0.5”	0.5”	0.5”
In Season	2.8”	5.6”	8.4”
Total	3.3”	6.1”	8.9”

Harvest Date:	November 14

RESULTS AND DISCUSSION:

Nineteen commercial and experimental PhytoGen varieties and three other commercial standards were compared under three levels of center-pivot irrigation. Due to above-average rainfall, below average heat unit accumulation, and a significant hail received in early July, yields were lower than average. When averaged across varieties, yields increased from 761 lbs to 922 lbs/A with increased irrigation (Table 1). When averaged across irrigation levels, yields ranged from 716 lbs to 1015 lbs/A. Loan values across irrigation levels ranged from 47.97 to 51.59 cents/lb with no clear trends (Table 2). Gross revenue increased with increased irrigation and ranged from $364 to $526 per acre (Table 3). This trial included several new PhytoGen varieties for 2018.

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

Variety	In-season Irrigation Levels			Average
	Low (3.3)	Base (6.1)	High (8.9)	
	---------- lbs/A----------			
PHY 243 WRF	796	901	925	**873 A-F**
PHY 250 W3FE	706	880	990	**858 B-F**
PHY 300 W3FE	746	729	873	**782 FG**
PHY 312 WRF	670	793	968	**810 EFG**
PHY 330 W3FE	750	666	932	**782 FG**
PHY 340 W3FE	716	661	915	**763 GH**
PHY 450 W3FE	749	782	862	**797 EFG**
PHY 490 W3FE	736	779	843	**786 FG**
PX2A23W3FE	825	913	901	**879 A-E**
PX2A27W3FE	693	839	897	**809 EFG**
PX2A28W3FE	823	868	959	**883 A-E**
PX2A31W3FE	842	1013	1017	**957 A**
PX2A36W3FE	774	1006	942	**907 A-D**
PX2AX2W3FE	874	988	975	**945 ABC**
PX2AX3W3FE	797	837	973	**869 A-F**
PX2AX4W3FE	811	814	949	**857 B-F**
PX3A82W3FE	822	788	961	**857 C-F**
PX3A96W3FE	848	928	1074	**950 AB**
PX3A99W3FE	750	826	944	**840 D-F**
DP 1646 B2XF	650	542	748	**646 I**
FM 1911 GLT	617	660	787	**687 HI**
NG 3406 B2XF	756	671	847	**757 GH**
Average	**761 C**	**813 B**	**922 A**	**--**

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

Variety	In-season Irrigation Levels			Average
	Low (3.3)	Base (6.1)	High (8.9)	
	----------cents/lb----------			
PHY 243 WRF	49.54	49.84	48.33	**49.23 HI**
PHY 250 W3FE	50.24	51.13	52.19	**51.18 B-G**
PHY 300 W3FE	49.65	47.51	51.88	**49.67 GHI**
PHY 312 WRF	49.25	51.05	52.46	**50.92 B-G**
PHY 330 W3FE	50.03	48.25	51.14	**49.80 E-H**
PHY 340 W3FE	49.93	47.95	52.00	**49.95 E-H**
PHY 450 W3FE	50.75	48.84	50.79	**50.12 D-H**
PHY 490 W3FE	51.73	49.24	50.35	**50.43 C-H**
PX2A23W3FE	50.18	51.20	52.34	**51.23 B-F**
PX2A27W3FE	50.50	50.86	52.59	**51.31 A-E**
PX2A28W3FE	51.35	50.23	50.40	**50.65 C-H**
PX2A31W3FE	51.36	52.71	51.43	**51.83 ABC**
PX2A36W3FE	49.93	49.60	52.49	**50.67 C-H**
PX2AX2W3FE	50.11	51.23	51.80	**51.04 B-G**
PX2AX3W3FE	50.80	48.81	51.58	**50.39 C-H**
PX2AX4W3FE	51.26	52.00	51.41	**51.55 A-D**
PX3A82W3FE	50.99	49.00	50.39	**50.12 D-I**
PX3A96W3FE	51.10	50.95	53.21	**51.75 ABC**
PX3A99W3FE	52.98	51.23	52.85	**52.35 AB**
DP 1646 B2XF	53.26	51.73	53.53	**52.83 A**
FM 1911 GLT	47.73	48.75	50.83	**49.1 I**
NG 3406 B2XF	50.60	47.29	51.19	**49.69 F-I**
Average	**50.60 B**	**49.97 C**	**51.60 A**	**--**

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

Variety	In-season Irrigation Levels			Average
	Low (3.3)	Base (6.1)	High (8.9)	
	----------$/A----------			
PHY 243 WRF	395	449	447	**430 D-I**
PHY 250 W3FE	355	449	518	**440 C-H**
PHY 300 W3FE	370	348	454	**390 HIJ**
PHY 312 WRF	332	406	507	**415 D-I**
PHY 330 W3FE	376	320	477	**391 G-J**
PHY 340 W3FE	360	317	477	**384 IJK**
PHY 450 W3FE	381	384	439	**401 E-I**
PHY 490 W3FE	380	384	425	**396 F-I**
PX2A23W3FE	414	468	471	**450 A-E**
PX2A27W3FE	350	426	472	**416 D-I**
PX2A28W3FE	421	436	483	**446 A-F**
PX2A31W3FE	433	535	521	**496 A**
PX2A36W3FE	388	499	495	**460 A-D**
PX2AX2W3FE	439	507	504	**483 ABC**
PX2AX3W3FE	405	409	502	**438 C-H**
PX2AX4W3FE	416	423	488	**442 B-G**
PX3A82W3FE	419	387	482	**429 D-I**
PX3A96W3FE	434	475	573	**493 AB**
PX3A99W3FE	397	426	499	**441 C-H**
DP 1646 B2XF	346	284	400	**343 JK**
FM 1911 GLT	294	322	400	**338 K**
NG 3406 B2XF	382	319	435	**378 IJK**
Average	**386 C**	**408 B**	**476 A**	**--**

Performance of Americot Varieties as Affected by Low-energy Precision Application (LEPA) Irrigation Levels at Halfway, TX, 2017

Wayne Keeling – Professor, Justin Spradley and Ray White – Research Assistant and Graduate Research Assistant

MATERIALS AND METHODS:

Plot Size:	4 rows by 30 feet, 4 replications
Planting Date:	Low – 6/2/2017 High – 5/25/2017
Varieties:	NG 4545 B2XF, NG 5007 B2XF NG 4689 B2XF, NG 3406 B2XF NG 3517 B2XF, NG 3699 B2XF NG 4601 B2XF, AMX 1711 B3XF AMX 5140 XF, AMX 6992 XF AMX 6180 B2XF, AMX 6431 B2XF
Herbicides:	Trifluralin 1 qt/A – March 7 Clethodim 12 oz/A – April 21 Cotoran 1 qt/A – May 17 Paraquat 1 qt/A – May 17 Engenia 12.8 oz/A – June 14 Glyphosate 32 oz/A – June 14 Medal EC or S-metolachlor 1.3 pt/A – June 20 Engenia 12.8 oz/A – July 19 Glyphosate 32 oz/A – July 19 Warrant 3 pt/A – July 26
Fertilizer:	61-0-0-10S
Irrigation in-season:	LEPA

	Low	High
Preplant	2.9”	2.9”
In Season	1.4”	4.2”
Total	4.3”	7.1”

Harvest Date:	November 15

RESULTS AND DISCUSSION:

Twelve commercial and experimental varieties from Americot were evaluated under two irrigation levels on a field rotated with corn. Under the low irrigation treatment, yieldS ranged from 571-1040 lbs/A (Table 1). Under the high irrigation treatment, yields ranged from 784 to 1456 lbs/A. When averaged across irrigation levels, highest yields were produced with NG 3517 B2XF and NG 3699 B2XF. Loan values were lower for the higher irrigation treatments due to lower micronaire readings. Highest net returns resulted with NG 3517 B2XF, NG 3699 B2XF, and one experimental lines. This test area received significant hail damage on July 3 but recovered surprisingly well.

Table 1. Effect of cultivar under low and high irrigation level on cotton lint yield (lbs/A), loan value (cents/lb), and revenue ($/A).

Variety	Irrigation Levels		Average
	Low	High	
	---------- lbs/A----------		
AMX1711B3XF	571	784	**678 H**
AMX5140XF	913	1019	**966 FG**
AMX6180B2XF	937	1140	**1039 B-E**
AMX6431B2XF	930	1229	**1080 BC**
AMX6992XF	828	1033	**930 D-G**
NG 3406 B2XF	936	1141	**1039 BCD**
NG 3517 B2XF	1040	1456	**1248 A**
NG 3699 B2XF	923	1428	**1176 AB**
NG 4545 B2XF	883	1086	**985 D-G**
NG 4601 B2XF	816	1032	**924 EFG**
NG 4689 B2XF	931	1206	**1069 C-F**
NG 5007 B2XF	709	987	**848 G**
Average	**868 B**	**1128 A**	**--**
	----------cents/lb----------		
AMX1711B3XF	50.10	48.88	**49.49**
AMX5140XF	54.88	48.23	**51.55**
AMX6180B2XF	52.63	47.10	**49.86**
AMX6431B2XF	55.83	53.75	**54.79**
AMX6992XF	51.28	49.33	**50.30**
NG 3406 B2XF	55.23	48.10	**51.66**
NG 3517 B2XF	55.08	52.25	**53.66**
NG 3699 B2XF	54.38	49.40	**51.89**
NG 4545 B2XF	55.88	54.63	**55.25**
NG 4601 B2XF	51.50	49.90	**50.70**
NG 4689 B2XF	56.13	47.15	**51.64**
NG 5007 B2XF	52.78	47.85	**50.31**
Average	**53.80**	**49.71**	**ns**
	----------$/A----------		
AMX1711B3XF	243	366	**305 F**
AMX5140XF	448	434	**441 DE**
AMX6180B2XF	467	550	**509 CDE**
AMX6431B2XF	512	633	**573 ABC**
AMX6992XF	436	506	**471 DE**
NG 3406 B2XF	546	526	**536 BCD**
NG 3517 B2XF	535	747	**641 A**
NG 3699 B2XF	537	705	**621 AB**
NG 4545 B2XF	500	528	**514 CD**
NG 4601 B2XF	360	534	**447 DE**
NG 4689 B2XF	501	514	**507 CDE**
NG 5007 B2XF	395	423	**409 E**
Average	**457 A**	**539 A**	**--**

Appendix

2017 Rain and Irrigation Amounts At Texas A&M AgriLife Helm Research Farm, Halfway, TX

Date			Rainfall (inches)		Field 2 Irrigation (in)											Field 3 Irrigation (in)								Field 5 - A span 2	Field 5 - A spans 3-8				Field 5 - B span 2	Field 5 - B spans 3-8				Field 5 - C span 2	Field 5 - C spans 3-8			
					Cotton											Cotton								Pivot Cotton					Pivot Wheat - Fallow					Pivot Cotton				
					Zones											Zones																							
Mo	Da	Yr	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	system	1	2	3	4	5	6	7	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system
1	1	2017	0.25	0.39																																		
1	15	2017	1.42	1.40																																		
2	14	2017	0.58	0.55																																		
3	16	2017																										0.75	0.75	0.75	0.75	L					
3	20	2017																										0.75	0.75	0.75	0.75	L					
3	27	2017																										0.75	0.75	0.75	0.75	L					
3	29	2017	1.05	1.68																																		
4	12	2017	0.75	0.58																																		
4	13	2017																																				
4	14	2017																																				
4	15	2017																																				
4	16	2017	0.13	0.04																																		
4	17	2017			0.10	0.13	0.12	0.16	0.14	0.16	0.12	0.14	0.16	0.15	D																							
4	18	2017					0.05								D	0.09	0.12	0.12	0.10	0.12	0.10	0.13																	
4	19	2017					0.44		0.44				0.23		D	0.10			0.07																				
4	20	2017					0.17		0.15				0.30	0.02	D	0.16		0.37	0.18																				
4	21	2017					0.18		0.18				0.21		D	0.27		0.23	0.22																				
4	22	2017					0.18		0.18				0.19		D	0.23		0.24	0.23																				
4	23	2017					0.19		0.18				0.19		D	0.22		0.23	0.22																				
4	24	2017					0.18		0.18				0.18		D	0.22		0.23	0.22										0.35	0.35	0.35	0.35	L	0.25	0.25	0.25	0.25	L
4	25	2017					0.18		0.18				0.19		D	0.33		0.23	0.24					0.25	0.25	0.25	0.25	L										
4	26	2017	0.62	0.49			0.18		0.18				0.19		D	0.08		0.23	0.21										0.35	0.35	0.35	0.35	L					
4	27	2017					0.18		0.18				0.19		D	0.30		0.23	0.22															0.25	0.25	0.25	0.25	L
4	28	2017					0.18		0.18				0.18		D	0.23		0.23	0.27																				
4	29	2017	1.20	1.29			0.18		0.18				0.18		D	0.23		0.23	0.27																				
4	30	2017					0.18		0.18				0.19		D	0.24		0.24	0.29																				
5	1	2017																																				
5	2	2017																																				
5	3	2017																																				
5	4	2017																																				
5	5	2017																																				
5	6	2017																																				
5	7	2017																																				
5	8	2017																																				
5	9	2017	1.22	0.18																																		
5	10	2017			0.14	0.14	0.16	0.16	0.15	0.16	0.40	0.17	0.16	0.16	D									0.25	0.25	0.25	0.25	L	0.35	0.35	0.35	0.35	L					
5	11	2017			0.12	0.14	0.16	0.16	0.16	0.16	0.20	0.16	0.16	0.16	D	0.12	0.12	0.12	0.12	0.12	0.11	0.10	D											0.25	0.25	0.25	0.25	L
5	12	2017			0.12	0.14	0.16	0.16	0.02	0.10	0.16	0.16	0.16	0.16	D	0.12	0.12	0.12	0.12	0.12	0.14	0.11	D	0.25	0.25	0.25	0.25	L	0.35	0.35	0.35	0.35	L	0.25	0.25	0.25	0.25	L
5	13	2017			0.12	0.14	0.16	0.16	0.12	0.15	0.15	0.16	0.16	0.16	D	0.12	0.12	0.12	0.12	0.12	0.04	0.07	D	0.25	0.25	0.25	0.25	L	0.35	0.35	0.35	0.35	L					
5	14	2017			0.13	0.14	0.16	0.16	0.12	0.15	0.16	0.17	0.16	0.16	D	0.24	0.25	0.24	0.24	0.23	0.21	0.18	D																
5	15	2017			0.12	0.14	0.15	0.15	0.10	0.15	0.15	0.15	0.15	0.15	D	0.24	0.23	0.23	0.21	0.20	0.17	0.18	D																
5	16	2017			0.12	0.14	0.15	0.13	0.11	0.15	0.16	0.15	0.15	0.15	D	0.24	0.23	0.23	0.21	0.21	0.30	0.18	D																
5	17	2017			0.12	0.14	0.15	0.18	0.25	0.22	0.16	0.16	0.15	0.15	D	0.24	0.23	0.23	0.30	0.29	0.24	0.18	D																
5	18	2017			0.17	0.14	0.15	0.15	0.15	0.10	0.16	0.16	0.16	0.15	D	0.23	0.23	0.22	0.24	0.16	0.12	0.00	D	0.40	0.40	0.40	0.40	S											
5	19	2017			0.17	0.14	0.15	0.15	0.22	0.24	0.09	0.15	0.16	0.16	D	0.23	0.11	0.12	0.23	0.31	0.24	0.18	D																

2017 Rain and Irrigation Amounts At Texas A&M AgriLife Helm Research Farm, Halfway, TX

Date			Rainfall (inches)		Field 2 Irrigation (in)											Field 3 Irrigation (in)								Field 5 - A span 2	Field 5 - A spans 3-8				Field 5 - B span 2	Field 5 - B spans 3-8				Field 5 - C span 2	Field 5 - C spans 3-8			
					Cotton											Cotton								Pivot					Pivot					Pivot				
					Zones											Zones								Cotton					Wheat - Fallow					Cotton				
Mo	Da	Yr	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	system	1	2	3	4	5	6	7	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system
5	20	2017			0.17	0.14	0.15	0.15	0.15	0.18	0.09	0.15	0.15	0.15	D	0.23	0.23	0.23	0.23	0.24	0.25	0.18	D															
5	21	2017			0.42	0.38	0.15	0.19	0.36	0.03	0.09	0.15	0.15	0.15	D	0.22	0.23	0.22	0.04	0.12	0.30	0.17	D											0.30	0.30	0.30	0.30	S
5	22	2017																																				
5	23	2017	0.15	0.24												0.24	0.25	0.24	0.32	0.14	0.09	0.14	D															
5	24	2017														0.24	0.25	0.24	0.23	0.17	0.17	0.17	D															
5	25	2017			0.17	0.14	0.15	0.03			0.09	0.16	0.16	0.16	D	0.24	0.24	0.24	0.16	0.17	0.25	0.18	D	0.25	0.25	0.25	0.25	S										
5	26	2017			0.17	0.14	0.15	0.16	0.15	0.16	0.09	0.16	0.15	0.16	D	0.24	0.24	0.24	0.24	0.24	0.22	0.14	D	0.25	0.25	0.25	0.25	S						0.25	0.25	0.25	0.25	S
5	27	2017			0.17	0.14	0.15	0.16	0.15	0.16	0.09	0.16	0.16	0.16	D	0.24	0.24	0.24	0.24	0.24	0.22	0.15	D											0.25	0.25	0.25	0.25	S
5	28	2017			0.17	0.14	0.16	0.16	0.15	0.15	0.09	0.16	0.16	0.17	D	0.24	0.24	0.24	0.24	0.24	0.23	0.15	D															
5	29	2017			0.18	0.15	0.16	0.17	0.16	0.16	0.09	0.17	0.16	0.16	D	0.24	0.24	0.23	0.24	0.24	0.23	0.15	D															
5	30	2017																																				
5	31	2017																																				
6	1	2017																																				
6	2	2017	1.00	0.75																																		
6	3	2017																																				
6	4	2017																																				
6	5	2017																																				
6	6	2017																																				
6	7	2017																																				
6	8	2017	0.60	0.94																																		
6	9	2017																																				
6	10	2017																																				
6	11	2017																																				
6	12	2017	0.02	0.02																																		
6	13	2017																																				
6	14	2017																																				
6	15	2017	0.04	0.04																																		
6	16	2017																																				
6	17	2017																																				
6	18	2017																																				
6	19	2017																																				
6	20	2017																																				
6	21	2017	0.40	0.14																																		
6	22	2017																																				
6	23	2017																																				
6	24	2017																						0.50	0.50	0.50	0.50	S										
6	25	2017	1.22	1.41																																		
6	26	2017																																				
6	27	2017																																				
6	28	2017																																				
6	29	2017																																				
6	30	2017																																			0.25	0.25		0.25	L
7	1	2017																						0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17	0.25		0.25	L

2017 Rain and Irrigation Amounts At Texas A&M AgriLife Helm Research Farm, Halfway, TX

Date			Rainfall (inches)		Field 2 Irrigation (in)											Field 3 Irrigation (in)								Field 5 - A span 2	Field 5 - A spans 3-8				Field 5 - B span 2	Field 5 - B spans 3-8				Field 5 - C span 2	Field 5 - C spans 3-8			
					Cotton											Cotton								Pivot Cotton					Pivot Wheat - Fallow					Pivot Cotton				
					Zones											Zones																							
Mo	Da	Yr	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	system	1	2	3	4	5	6	7	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system
7	2	2017	0.80	0.82																																	
7	3	2017																					0.17	0.25		0.25	L	0.06	0.09		0.09	L					
7	4	2017	0.85	0.75																																	
7	5	2017																																			
7	6	2017																																			
7	7	2017																																			
7	8	2017																																			
7	9	2017																																			
7	10	2017			0.13	0.17	0.17	0.26	0.18	0.13	0.15	0.15	0.15																					0.17		0.25	0.25	L
7	11	2017														0.38	0.39	0.38	0.30	0.44	0.25	0.18	D	0.17		0.25	0.25	L										
7	12	2017				0.13	0.14				0.15				D				0.31		0.25		D															
7	13	2017				0.14	0.14				0.15				D				0.19		0.09		D															
7	14	2017				0.14	0.14				0.15				D				0.31		0.21		D												0.17	0.25		0.25	L
7	15	2017				0.13	0.14				0.15				D				0.22		0.13		D	0.17	0.25		0.25	L						0.17	0.25		0.25	L
7	16	2017				0.14	0.15				0.15				D				0.37		0.45		D	0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17		0.25	0.25	L
7	17	2017				0.14	0.14				0.15				D				0.19		0.21		D	0.17		0.25	0.25	L	0.06	0.09		0.09	L					
7	18	2017				0.13	0.14				0.15				D				0.19		0.20		D											0.17	0.25		0.25	L
7	19	2017				0.14	0.14				0.15				D				0.19		0.21		D	0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17	0.25		0.25	L
7	20	2017				0.13	0.13				0.15				D				0.19		0.17		D	0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17		0.25	0.25	L
7	21	2017			0.23	0.23	0.14	0.15	0.15	0.15	0.15	0.16	0.15		D	0.30	0.40	0.35	0.12		0.03		D	0.17		0.25	0.25	L	0.06		0.09	0.09	L					
7	22	2017				0.03	0.14	0.15	0.14	0.14	0.15	0.15	0.15		D	0.07	0.16	0.25	0.18	0.19	0.14		D															
7	23	2017			0.12	0.14	0.14	0.15	0.14	0.14	0.15	0.15	0.15		D	0.19	0.38	0.30	0.19	0.17	0.06		D															
7	24	2017			0.12	0.14	0.14	0.15	0.15	0.15	0.14	0.16	0.15		D	0.13	0.25	0.31	0.00	0.00	0.00		D															
7	25	2017			0.12	0.14	0.11	0.15	0.15	0.15	0.15	0.16	0.15		D	0.19	0.14	0.11	0.19	0.20	0.17		D												0.17	0.25		0.25	L
7	26	2017			0.15	0.14	0.14	0.15	0.15	0.15	0.15	0.16	0.15		D	0.19	0.00	0.00	0.19	0.20	0.21		D	0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17	0.25	0.25	0.25	L
7	27	2017			0.16	0.14	0.14	0.15	0.15	0.15	0.15	0.16	0.15		D	0.04	0.00	0.00	0.00	0.00	0.03		D	0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17			0.25	L
7	28	2017			0.18	0.13	0.14	0.15	0.15	0.15	0.15	0.16	0.15		D	0.20	0.21	0.12	0.15	0.20	0.23		D	0.17		0.25	0.25	L	0.06		0.09	0.09	L	0.17	0.25		0.25	L
7	29	2017			0.20	0.15	0.14	0.15	0.15	0.15	0.15	0.15	0.17		D	0.24	0.18	0.19	0.15	0.20	0.23		D	0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17	0.25		0.25	L
7	30	2017				0.12	0.14	0.15	0.15	0.15	0.15	0.16	0.12		D	0.12	0.08	0.12	0.15	0.20	0.21		D	0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17		0.25	0.25	L
7	31	2017	1.23	1.78																																	
8	1	2017			0.12	0.14	0.12	0.15	0.14	0.13	0.15	0.15	0.12		D																							
8	2	2017			0.11	0.13	0.16	0.14	0.14	0.17	0.14	0.15	0.17		D																							
8	3	2017	0.08	0.07	0.09	0.12	0.12	0.11	0.12	0.13	0.12	0.13	0.13		D					0.16			D															
8	4	2017			0.00	0.00	0.11	0.15	0.15	0.15	0.15	0.16	0.15		D																							
8	5	2017	0.17	0.11	0.21	0.14	0.14	0.15	0.15	0.15	0.15	0.16	0.15		D																							
8	6	2017			0.04	0.14	0.14	0.15	0.15	0.15	0.15	0.15	0.15		D																							
8	7	2017	0.48	0.29	0.26	0.13	0.14	0.15	0.15	0.15	0.15	0.16	0.15		D					0.12	0.12		D															
8	8	2017																																			
8	9	2017	0.58	0.79																																	
8	10	2017			0.13	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.15		D																							
8	11	2017																																			

2017 Rain and Irrigation Amounts At Texas A&M AgriLife Helm Research Farm, Halfway, TX

Date			Rainfall (inches)		Field 2 Irrigation (in)											Field 3 Irrigation (in)								Field 5 - A span 2	Field 5 - A spans 3-8				Field 5 - B span 2	Field 5 - B spans 3-8				Field 5 - C span 2	Field 5 - C spans 3-8			
					Cotton											Cotton								Pivot						Pivot					Pivot				
					Zones											Zones								Cotton						Wheat - Fallow					Cotton				
Mo	Da	Yr	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	system	1	2	3	4	5	6	7	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system
8	12	2017																																				
8	13	2017																																				
8	14	2017	2.73	2.64																																		
8	15	2017	0.49	0.75																																		
8	16	2017																																				
8	17	2017																																				
8	18	2017																																				
8	19	2017																																				
8	20	2017	0.31	0.09																																		
8	21	2017			0.05	0.09	0.10	0.05	0.10	0.10	0.05	0.10	0.10		D	0.09	0.10	0.09	0.09	0.10	0.10		D																
8	22	2017	0.25	0.36	0.21	0.09	0.10	0.10	0.09	0.10	0.11	0.10	0.10		D	0.09	0.10	0.09	0.09	0.09	0.10		D																
8	23	2017			0.21	0.21	0.10	0.10	0.10	0.10	0.10	0.10	0.10		D	0.09	0.10	0.09	0.09	0.09	0.10		D																
8	24	2017			0.23	0.21	0.10	0.14	0.10	0.10	0.14	0.10	0.10		D	0.09	0.10	0.09	0.09	0.09	0.10		D																
8	25	2017			0.06	0.09	0.10	0.06	0.09	0.10	0.06	0.10	0.10		D	0.09	0.09	0.09	0.09	0.09	0.10		D												0.17	0.20		0.20	L
8	26	2017														0.09	0.09	0.09	0.09	0.09	0.09		D	0.17	0.25		0.25	L										
8	27	2017			0.19	0.18	0.20	0.20	0.19	0.20	0.20	0.20	0.20		D	0.10	0.10	0.10	0.10	0.10	0.10		D																
8	28	2017	0.11	0.40	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10		D	0.09	0.10	0.09	0.09	0.10	0.10		D												0.20	0.30		0.30	L
8	29	2017			0.15	0.09	0.10	0.16	0.10	0.10	0.16	0.10	0.10		D	0.09	0.09	0.09	0.09	0.10	0.10		D	0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17		0.25	0.25	L
8	30	2017			0.04	0.09	0.10	0.04	0.10	0.10	0.04	0.10	0.10		D	0.09	0.10	0.09	0.09	0.10	0.10		D	0.17		0.25	0.25	L										
8	31	2017			0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10		D	0.09	0.10	0.09	0.09	0.10	0.10		D																
9	1	2017			0.13	0.09	0.10	0.14	0.10	0.10	0.14	0.10	0.10		D	0.10	0.10	0.09	0.09	0.09	0.10		D																
9	2	2017														0.09	0.09	0.09	0.09	0.09	0.09		D																
9	3	2017			0.16	0.18	0.20	0.16	0.19	0.20	0.16	0.20	0.20		D	0.10	0.10	0.10	0.10	0.10	0.10		D																
9	4	2017			0.10	0.09	0.10	0.10	0.09	0.10	0.10	0.10	0.10		D	0.10	0.10	0.09	0.09	0.09	0.10		D																
9	5	2017			0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10		D	0.10	0.10	0.09	0.09	0.09	0.10		D																
9	6	2017			0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10		D	0.10	0.10	0.09	0.09	0.09	0.10		D																
9	7	2017			0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10		D	0.05	0.10	0.10		0.05			D												0.17	0.25		0.25	L
9	8	2017			0.11			0.13			0.13				D									0.17	0.25		0.25	L										
9	9	2017			0.14	0.15	0.16	0.14	0.16	0.16	0.15	0.17	0.16		D																								
9	10	2017			0.14	0.15	0.16	0.14	0.16	0.17	0.16	0.17	0.17		D																								
9	11	2017			0.14	0.15	0.16	0.14	0.16	0.17	0.15	0.17	0.17		D																								
9	12	2017														0.49	0.47	0.30	0.08	0.47	0.08		D																
9	13	2017																0.17	0.17		0.17		D																
9	14	2017																	0.22		0.23		D												0.17	0.25		0.25	L
9	15	2017																						0.17	0.25		0.25	L										
9	16	2017																																				
9	17	2017	0.73	0.72																																		
Pre & At Plant			7.37	6.84	2.88	2.76	5.21	2.74	5.05	2.58	2.54	2.84	5.24	2.84		6.60	3.90	6.58	6.47	3.68	3.63	2.75		1.90	1.90	1.90	1.90		4.00	4.00	4.00	4.00		1.80	1.80	1.80	1.80	
Seasonal			12.09	12.87	4.89	6.01	6.15	5.19	4.99	5.11	6.50	5.27	5.12	0.00		4.17	4.38	4.30	5.85	4.19	5.72	0.18		3.67	4.00	1.75	5.25		0.78	0.99	0.18	1.17		3.95	4.00	2.00	5.50	
TOTALS			19.46	19.71	7.77	8.77	11.36	7.93	10.04	7.69	9.04	8.11	10.36	2.84		10.77	8.28	10.87	12.32	7.87	9.35	2.93		5.57	5.90	3.65	7.15		4.78	4.99	4.18	5.17		5.75	5.80	3.80	7.30	

2017 Rain and Irrigation Amounts At Texas A&M AgriLife Research Farm, Halfway, TX

Date			Rainfall (inches)		Field 5 - D East span 2	Field 5 - D East spans 3-8				Field 5 - D West span 2	Field 5 - D West spans 3-8				Field 5 - E span 2	Field 5 - E spans 3-8				Field 5 - F span 2	Field 5 - F spans 3-8				Field 6 - A	Field 6 - B	Field 6 - C	Field 6 - D	Field 6 - E	Field 6 - F	Field 6 - G	Field 6 - H	
					Pivot					Pivot					Pivot					Pivot					Drip	Drip	Drip	Drip	Drip	Drip	Drip	Drip	
					Cotton					Cotton					Cotton					Sorghum					Cotton	Cotton	Cotton	Cotton	Cotton	Fallow	Cotton	Cotton	
Mo	Da	Yr	Halfway @ Building	Helms @ Well 1		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system									system
1	1	2017	0.25	0.39																													
1	15	2017	1.42	1.40																													
2	14	2017	0.58	0.55																													
3	16	2017																															
3	20	2017																															
3	27	2017																															
3	29	2017	1.05	1.68																													
4	12	2017	0.75	0.58																													
4	13	2017																															
4	14	2017																															
4	15	2017																															
4	16	2017	0.13	0.04																													
4	17	2017																															
4	18	2017																								0.04	0.03	0.07	0.13	0.03	0.28	0.23	0.12	D
4	19	2017																								0.13	0.13	0.10	0.05	0.11	0.11	0.14	0.14	D
4	20	2017																								0.13	0.13	0.09	0.07	0.12	0.11	0.13	0.14	D
4	21	2017																								0.14	0.13	0.17	0.18	0.13	0.11	0.14	0.14	D
4	22	2017																								0.13	0.13	0.13	0.13	0.13	0.10	0.13	0.14	D
4	23	2017																								0.14	0.14	0.13	0.14	0.14	0.13	0.13	0.15	D
4	24	2017																								0.18	0.21	0.22	0.22	0.21	0.18	0.32	0.32	D
4	25	2017			0.25	0.25	0.25	0.25	L	0.25	0.25	0.25	0.25	L	0.25	0.25	0.25	0.25	L						0.27	0.24	0.32	0.41	0.35	0.22	0.29	0.30	D
4	26	2017	0.62	0.49																						0.24	0.24	0.15	0.06	0.16	0.22	0.29	0.30	D
4	27	2017			0.25	0.25	0.25	0.25	L	0.25	0.25	0.25	0.25	L												0.24	0.24	0.35	0.36	0.25	0.22	0.29	0.30	D
4	28	2017													0.25	0.25	0.25	0.25	L						0.32	0.30	0.25	0.31	0.36		0.20	0.22	D
4	29	2017	1.20	1.29																						0.32	0.30	0.26	0.30	0.36		0.20	0.21	D
4	30	2017																								0.30	0.30	0.25	0.31	0.36		0.20	0.20	D
5	1	2017																															
5	2	2017																															
5	3	2017																															
5	4	2017																															
5	5	2017																															
5	6	2017																															
5	7	2017																															
5	8	2017																															
5	9	2017	1.22	0.18																													
5	10	2017																													1.00	0.24	D
5	11	2017			0.25	0.25	0.25	0.25	L	0.25	0.25	0.25	0.25	L	0.25	0.25	0.25	0.25	L															
5	12	2017			0.25	0.25	0.25	0.25	L	0.25	0.25	0.25	0.25	L											0.16	0.20	0.37	0.30	0.15		0.34	1.13	D
5	13	2017													0.25	0.25	0.25	0.25	L						0.24	0.17	0.14	0.15	0.17		0.14	0.14	D
5	14	2017																							0.24	0.17	0.13	0.15	0.15		0.14	0.14	D
5	15	2017																							0.10	0.23	0.26	0.26	0.25		0.09	0.05	D
5	16	2017																							0.27	0.27	0.26	0.27	0.25		0.17	0.13	D
5	17	2017																							0.28	0.27	0.26	0.27	0.34		0.18	0.24	D
5	18	2017																							0.30	0.26	0.26	0.27	0.28		0.21	0.17	D
5	19	2017			0.40	0.40	0.40	0.40	S	0.40	0.40	0.40	0.40	S	0.40	0.40	0.40	0.40	S						0.37	0.27	0.26	0.26	0.27		0.21	0.24	D

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Date			Rainfall (inches)			Field 5 - D East span 2	Field 5 - D East spans 3-8				Field 5 - D West span 2	Field 5 - D West spans 3-8				Field 5 - E span 2	Field 5 - E spans 3-8				Field 5 - F span 2	Field 5 - F spans 3-8				Field 6 - A	Field 6 - B	Field 6 - C	Field 6 - D	Field 6 - E	Field 6 - F	Field 6 - G	Field 6 - H	
						Pivot					Pivot					Pivot					Pivot					Drip	Drip	Drip	Drip	Drip	Drip	Drip	Drip	
						Cotton					Cotton					Cotton					Sorghum					Cotton	Cotton	Cotton	Cotton	Cotton	Fallow	Cotton	Cotton	
Mo	Da	Yr	Halfway @ Building	Helms @ Well 1			Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system										system
5	20	2017																			0.40	0.40	0.40	0.40	S	0.29	0.27	0.26	0.26	0.28		0.17	0.18	D
5	21	2017				0.30	0.30	0.30	0.30	S	0.30	0.30	0.30	0.30	S	0.30	0.30	0.30	0.30	S						0.23	0.27	0.26	0.26	0.28		0.10	0.09	D
5	22	2017																			0.40	0.40	0.40	0.40	S									
5	23	2017	0.15	0.24																														
5	24	2017														0.30	0.30	0.30	0.30	S	0.30	0.30	0.30	0.30	S									
5	25	2017																			0.30	0.30	0.30	0.30	S									
5	26	2017				0.25	0.25	0.25	0.25	S	0.25	0.25	0.25	0.25	S																			
5	27	2017				0.25	0.25	0.25	0.25	S	0.25	0.25	0.25	0.25	S	0.25	0.25	0.25	0.25	S														
5	28	2017																																
5	29	2017																																
5	30	2017																																
5	31	2017																																
6	1	2017																			0.50	0.50	0.50	0.50	S									
6	2	2017	1.00	0.75																														
6	3	2017																																
6	4	2017																																
6	5	2017																																
6	6	2017																																
6	7	2017																																
6	8	2017	0.60	0.94																														
6	9	2017																																
6	10	2017																																
6	11	2017																																
6	12	2017	0.02	0.02																														
6	13	2017																																
6	14	2017																																
6	15	2017	0.04	0.04																														
6	16	2017																																
6	17	2017																																
6	18	2017																																
6	19	2017																																
6	20	2017																																
6	21	2017	0.40	0.14																														
6	22	2017				0.50	0.50	0.50	0.50	S	0.50	0.50	0.50	0.50	S																			
6	23	2017														0.50	0.50	0.50	0.50	S	0.50	0.50	0.50	0.50	S									
6	24	2017																																
6	25	2017	1.22	1.41																														
6	26	2017																																
6	27	2017																																
6	28	2017																																
6	29	2017																																
6	30	2017				0.25	0.25		0.25	L	0.06	0.09		0.09	L	0.17	0.25		0.25	L														
7	1	2017				0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17	0.25				0.17	0.25		0.25	L									

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Date			Rainfall (inches)			Field 5 - D East span 2	Field 5 - D East spans 3-8				Field 5 - D West span 2	Field 5 - D West spans 3-8				Field 5 - E span 2	Field 5 - E spans 3-8				Field 5 - F span 2	Field 5 - F spans 3-8				Field 6 - A	Field 6 - B	Field 6 - C	Field 6 - D	Field 6 - E	Field 6 F	Field 6 - G	Field 6 - H	
						Pivot					Pivot					Pivot					Pivot					Drip	Drip	Drip	Drip	Drip	Drip	Drip	Drip	
						Cotton					Cotton					Cotton					Sorghum					Cotton	Cotton	Cotton	Cotton	Cotton	Fallow	Cotton	Cotton	
Mo	Da	Yr	Halfway @ Building	Helms @ Well 1			Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system										system
7	2	2017	0.80	0.82																														
7	3	2017														0.17			0.25	L	0.17	0.25		0.25	L									
7	4	2017	0.85	0.75																														
7	5	2017																																
7	6	2017																																
7	7	2017																																
7	8	2017																																
7	9	2017																																
7	10	2017				0.17		0.25	0.25	L	0.06		0.09	0.09	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L									
7	11	2017																									0.31	0.32	0.15	0.17	0.18		0.18	0.10	D
7	12	2017																									0.12	0.63	0.14	0.14	0.12		0.10	0.05	D
7	13	2017																									0.00	0.03	0.48	0.48	0.18		0.00	0.09	D
7	14	2017				0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.02	0.15	0.18	0.19	0.39		0.09	0.09	D
7	15	2017				0.17	0.25		0.25	L	0.06	0.09		0.09	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.20	0.18	0.18	0.18	0.18		0.09	0.09	D
7	16	2017				0.17		0.25	0.25	L	0.06			0.09	L											0.20	0.19	0.19	0.19	0.18		0.09	0.10	D
7	17	2017									0.12			0.18	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17	0.18	0.18	0.19	0.18		0.09	0.09	D
7	18	2017				0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.18	0.18	0.19	0.18		0.09	0.09	D
7	19	2017				0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L		0.25				0.17	0.18	0.18	0.19	0.18		0.09	0.11	D
7	20	2017				0.17		0.25	0.25	L	0.17		0.25	0.25	L						0.17			0.25	L	0.11	0.11	0.18	0.18	0.18		0.09	0.29	D
7	21	2017														0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.45	0.33	0.27	0.27	0.28		0.17	0.17	D
7	22	2017																								0.07	0.20	0.26	0.27	0.27		0.09	0.08	D
7	23	2017																								0.36	0.28	0.27	0.26	0.29		0.26	0.19	D
7	24	2017																								0.21	0.27	0.26	0.27	0.28		0.09	0.17	D
7	25	2017				0.17	0.25		0.25	L	0.17	0.25		0.25	L											0.29	0.26	0.24	0.24	0.27		0.19	0.17	D
7	26	2017				0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.29	0.28	0.26	0.26	0.27		0.18	0.17	D
7	27	2017				0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.31	0.27	0.26	0.26	0.27		0.21	0.17	D
7	28	2017				0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L									
7	29	2017				0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L									
7	30	2017				0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L									
7	31	2017	1.23	1.78												0.17		0.25	0.25	L														
8	1	2017																																
8	2	2017																																
8	3	2017	0.08	0.07																														
8	4	2017																									0.10	0.08	0.18	0.18	0.18	0.00	0.10	0.11	D
8	5	2017	0.17	0.11																							0.24	0.18	0.17	0.17	0.17	0.00	0.08	0.08	D
8	6	2017																									0.08	0.18	0.16	0.16	0.16	0.00	0.08	0.08	D
8	7	2017	0.48	0.29																							0.19	0.18	0.18	0.18	0.17	0.00	0.09	0.09	D
8	8	2017																																
8	9	2017	0.58	0.79																														
8	10	2017																																
8	11	2017																																

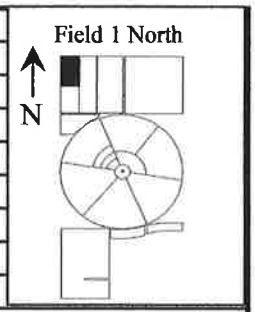
2017 Rain and Irrigation Amounts At Texas A&M AgriLife Research Farm, Halfway, TX

Date			Rainfall (inches)		Field 5 - D East span 2	Field 5 - D East spans 3-8				Field 5 - D West span 2	Field 5 - D West spans 3-8				Field 5 - E span 2	Field 5 - E spans 3-8				Field 5 - F span 2	Field 5 - F spans 3-8				Field 6 - A	Field 6 - B	Field 6 - C	Field 6 - D	Field 6 - E	Field 6 F	Field 6 - G	Field 6 - H	
					Pivot					Pivot					Pivot					Pivot					Drip	Drip	Drip	Drip	Drip	Drip	Drip	Drip	
					Cotton					Cotton					Cotton					Sorghum					Cotton	Cotton	Cotton	Cotton	Cotton	Fallow	Cotton	Cotton	
Mo	Da	Yr	Halfway @ Building	Helms @ Well 1		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system		Base	Base-50%	Base+50%	system									system
8	12	2017																															
8	13	2017																															
8	14	2017	2.73	2.64																													
8	15	2017	0.49	0.75																													
8	16	2017																															
8	17	2017																															
8	18	2017																															
8	19	2017																															
8	20	2017	0.31	0.09																													
8	21	2017																								0.27	0.10	0.09	0.06	0.03		0.00	0.06	D
8	22	2017	0.25	0.36																						0.09	0.09	0.09	0.06	0.09		0.00	0.06	D
8	23	2017																								0.14	0.10	0.09	0.06	0.04		0.00	0.06	D
8	24	2017																								0.11	0.10	0.09	0.07	0.13		0.05	0.11	D
8	25	2017			0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.09	0.10	0.09	0.07	0.09		0.05	0.08	D
8	26	2017																								0.09	0.09	0.09	0.06	0.06			0.09	D
8	27	2017																								0.10	0.10	0.09	0.07	0.05		0.05	0.10	D
8	28	2017	0.11	0.40	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.09	0.10	0.09	0.06	0.08		0.05	0.11	D
8	29	2017			0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.17		0.25	0.25	L	0.09	0.10	0.09	0.06	0.17		0.10	0.15	D
8	30	2017																								0.09	0.10	0.09	0.06	0.01			0.06	D
8	31	2017																								0.09	0.10	0.09	0.06	0.16		0.06	0.11	D
9	1	2017																								0.09	0.10	0.09	0.06	0.09		0.09	0.15	D
9	2	2017																								0.10	0.09	0.09	0.07	0.06		0.04	0.08	D
9	3	2017																								0.09	0.10	0.09	0.06	0.06		0.04	0.08	D
9	4	2017																								0.09	0.10	0.09	0.06	0.13		0.02	0.11	D
9	5	2017																								0.09	0.10	0.09	0.06	0.08		0.05	0.11	D
9	6	2017																								0.09	0.10	0.09	0.06	0.06		0.05	0.11	D
9	7	2017			0.17	0.25		0.25	L	0.17	0.25		0.25	L	0.17	0.25		0.25	L						0.09	0.10	0.09	0.06	0.14		0.05	0.11	D
9	8	2017																		0.40	0.60		0.60	L	0.00	0.00	0.00	0.00	0.01		0.05	0.05	D
9	9	2017																															
9	10	2017																															
9	11	2017																															
9	12	2017																								0.10	0.10	0.09	0.07					D
9	13	2017																								0.09	0.10	0.09	0.07					D
9	14	2017			0.17	0.25		0.25	L	0.17	0.25		0.25	L												0.10	0.09	0.08	0.08	0.08			0.17	D
9	15	2017													0.17	0.25		0.25	L	0.40	0.60		0.60	L	0.11	0.09	0.08	0.08	0.08				D
9	16	2017																								0.11	0.09	0.09	0.08	0.08				D
9	17	2017	0.73	0.72																						0.11	0.09	0.09	0.08	0.08				D
Pre & At Plant			7.37	6.84	2.20	2.20	2.20	2.20		2.20	2.20	2.20	2.20		2.25	2.25	2.25	2.25		1.40	1.40	1.40	1.40		5.05	4.90	4.94	5.12	5.12	1.69	5.44	5.44	
Seasonal			12.09	12.87	3.92	4.00	2.00	5.50		3.31	3.36	1.59	4.72		4.00	4.00	2.00	5.50		4.69	5.20	2.25	6.45		6.62	6.95	6.69	6.24	6.42	0.00	3.20	4.51	
TOTALS			19.46	19.71	6.12	6.20	4.20	7.70		5.51	5.56	3.79	6.92		6.25	6.25	4.25	7.75		6.09	6.60	3.65	7.85		11.67	11.86	11.63	11.36	11.54	1.69	8.64	9.95	

Operations Summary

Year	2017
Farm	Helm
Field ID	Field 1 North
Exp. Design	Corn
Soil Type	Pullman Clay Loam

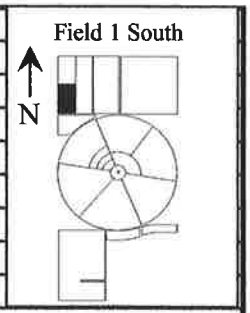
Field Operations	Date	Activity
Tillage	11/28/2016	Shred
	1/10/2016	Disk 2 times
	1/12/2016	Disk
	3/3/2017	List
	5/2/2017	Rotary Hoe
	6/1/2017	Cultivate
Fertility	3/16/2017	Liquid 32-0-0 35gal/ac
Planting/Harvest	4/28/2017	Planted Mixed Plots
	5/3/2017	Planted Dekalb (East 20 rows) 30,000seed/ac
	10/10/2017	Harvested all test
Herbicide/ Growth Regulator	3/27/2017	Atrazine 1qt/ac
	4/28/2017	Acuron 2.5qt/ac
	6/14/2017	Rifle 8oz/ac, Diuron 1qt/ac, Activator 90 1%
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting		
Seasonal		
Rainfall		
PrePlant & Planting		
Seasonal		



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 1 South
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

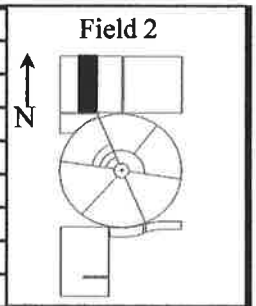
Field Operations	Date	Activity
Tillage	10/3/2016	Shred
	10/4/2016	Disk 3 times
	7/19/2017	Cultivate and Dike
Fertility		
Planting/Harvest	10/4/2016	Planted VNS 45lb/ac (Cover)
	5/11/2017	PlantedNexGen 3406 B2XF 52,000seed/ac
	11/7/2017	Harvested all test
Herbicide/	3/10/2017	Rifle 8oz/ac, Roundup 32oz/ac
Growth Regulator	4/3/2017	Panther 2oz/ac
	6/2/2017	Medal EC 1.3pt/ac
	6/7/2017	Engenia 12.8oz/ac, Makaze 32oz/ac, Choice Trio 1qt/100gal, Reign 1qt/100gal
	6/22/2017	Medal EC 1.3pt/ac, Pentia 4oz/ac
	7/6/2017	Pentia 8oz/ac, Makaze 32oz/ac, Maximizer 1%
	7/20/2017	Mepiquat 8oz/ac
	8/4/2017	Mepiquat 8oz/ac
	10/19/2017	Ethephon 6 32oz/ac, AIM EC 1oz/ac, Dynamic 5oz/ac
Insecticide	5/30/2017	Acephate 90 3.2oz/ac
	6/5/2017	Acephate 90 3.2oz/ac
Harvest aid	11/3/2017	Helmquat 3SL 32oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting		
Seasonal		
Rainfall		
PrePlant & Planting		
Seasonal		



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 2
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

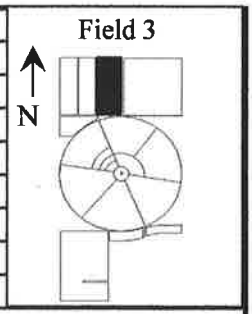
Field Operations	Date	Activity
Tillage	2/2/2017	Disk
	2/3/2017	Disk
	2/22/2017	Cultivate
	3/8/2017	Cultivate
	3/13/2017	Cultivate
	3/14/2017	List
	5/2/2017	Rotary Hoe
	6/5/2017	Rotary Hoe
	6/10/2017	Rotary Hoe
	6/22/2017	Cultivate and Dike
Fertility	3/24/2017	Liquid 32-0-0 20gal/ac
	7/7, 7/10-17	Liquid 32-0-0 57lbs/ac (applied through drip irrigation)
Planting/Harvest	5/11/2017	Planted FiberMax 2484 B2RF 50,000seed/ac
	11/9/2017	Harvested all test
Herbicide/	3/8/2017	Trifluralin1qt/ac applied 2 times
Growth Regulator	5/5/2017	Medal EC 1.3pt/ac, Bone Dry 2pt/ac, Activator 90 1%
	5/26/2017	Makaze 32oz/ac, Maximizer 1%
	6/2/2017	Medal EC 1.3pt/ac
	6/15/2017	Makaze 32oz/ac, Maximizer 1%
	6/22/2017	Medal EC 1.3pt/ac
	7/6/2017	Makaze 32oz/ac, Maximizer 1%
	7/26/2017	Diuron 1.5pt/ac
	8/17/2017	Mepiquat 12oz/ac
	10/19/2017	Ethephon 6 32oz/ac, AIM EC 1oz/ac, Dynamic 5oz/ac
Insecticide	6/5/2017	Acephate 90 3.2oz/ac
	6/15/2017	Acephate 90 3.2oz/ac
Harvest aid	11/3/2017	Helmquat 3SL 32oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Trt. 1 = 2.76in., Trt. 2 = 5.16in., Trt. 3 = 2.68in., Dry = 2.84in.
Seasonal	6/1-10/6	1 = 4.89in., 2 = 6.01in., 3 = 6.15in., 4 = 5.19in., 5 = 4.99in., 6 = 5.11in., 7 = 6.50in., 8 = 5.27in.,
		9 = 5.12in., 10 = 0.00in.
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 3
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

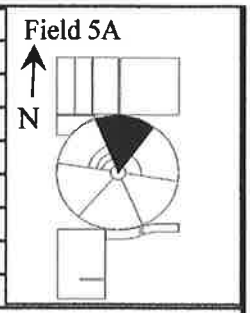
Field Operations	Date	Activity
Tillage	2/2/2017	Disk
	2/3/2017	Disk
	2/22/2017	Cultivate
	3/9/2017	Cultivate
	3/13/2017	Cultivate
	3/14/2017	List
	5/2/2017	Rotary Hoe
	6/5/2017	Rotary Hoe
	6/10/2017	Rotary Hoe
	6/22/2017	Cultivate and Dike
Fertility	3/24/2017	Liquid 32-0-0, 10-34-0 and 12-0-0-26 27 gal/ac (Excluding 8 rows on each end)
	7/11, 7/17	Liquid 32-0-0 57lbs/ac (applied through drip irrigation)
Planting/Harvest	5/11/2017	Planted FiberMax 2484 B2RF 50,000seed/ac
	11/9/2017	Harvested all test
Herbicide/	5/5/2017	Medal EC 1.3pt/ac, Bone Dry 2pt/ac, Activator 90 1%
Growth Regulator	5/26/2017	Makaze 32oz/ac, Maximizer 1%
	5/30/2017	Acephate 90 3.2oz/ac
	6/2/2017	Medal EC 1.3pt/ac
	6/15/2017	Makaze 32oz/ac, Maximizer 1%
	6/22/2017	Medal EC 1.3pt/ac
	7/6/2017	Makaze 32oz/ac, Maximizer 1%
	7/26/2017	Diuron 1.5pt/ac
	8/17/2017	Mepiquat 12oz/ac
	10/19/2017	Ethephon 6 32oz/ac, AIM EC 1oz/ac, Dynamic 5oz/ac
Insecticide	6/5/2017	Acephate 90 3.2oz/ac
	6/15/2017	Acephate 90 3.2oz/ac
Harvest aid	11/3/2017	Helmquat 3SL 32oz/ac, Induce 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Zones 1, 3, 4 = 6.55in., Zones 2, 5, 6 = 3.75in., Border = 2.75in.
Seasonal	6/1-10/6	1 = 4.17in., 2 = 4.38in., 3 = 4.30in., 4 = 5.85in., 6 = 5.72in., 7 = 0.18In.
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 5a
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

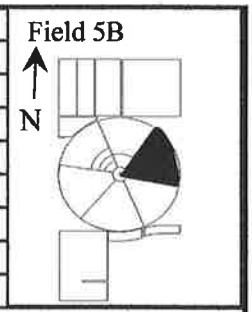
Field Operations	Date	Activity
Tillage	1/11/2017	Shred
	2/7/2017	Disk
	2/8/2017	Disk
	2/9/2017	Chisel
	2/10/2017	Cultivate
	3/10/2017	Cultivate and List
	3/21/2017	Rip Soft Middles
	4/7/2017	Dike
	5/2/2017	Rotary Hoe
	5/30/2017	Rotary Hoe
	6/5/2017	Rotary Hoe
	6/10/2017	Rotary Hoe
	6/13/2017	Cultivate and Dike
	6/16/2017	Cultivate and Dike
Fertility	3/21/2017	Liquid 32-0-0 20gal/ac
	3/22/2017	Liquid 32-0-0, 10-34-0, 12-0-0-26 20 gal/ac
Planting/Harvest	5/15/2017	Planted NexGen 3500XF 50,000seed/ac
	11/7/2017	Harvested spans 3-8
	11/8/2018	Harvested span 2
Herbicide/	3/9/2017	Trifuralin 1qt/ac
Growth Regulator	4/16/2017	Caporal 3pt/ac,Gramoxone 2pt/ac, Activator 90 0.50%
	6/7/2017	Engenia 12.8oz/ac, Makaze 32oz/ac, Choice Trio 1qt/100gal, Reign 1qt/100gal
	6/15/2017	Makaze 32oz/ac, Maximizer 1%
	6/20/2017	Medal EC 1.3pt/ac
	7/20/2017	Mepiquat 8oz/ac, applied to High and Medium water
	7/27/2017	Diuron 1.5pt/ac
	8/4/2017	Mepiquat 16oz/ac, applied to High and Mediuam water
	8/22/2017	Potenza 20oz/ac
	10/19/2017	Ethephon 6 32oz/ac, AIM EC 1oz/ac, Dynamic 5oz/ac
Insecticide	6/6/2017	Acephate 90 3.2oz/ac
	6/15/2017	Acephate 90 3.2oz/ac
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Span 2 1.90in.
	1/1-5/31	Base 1.90in., Base-50% 1.90in., Base+50% 1.90in.
Seasonal	6/1-10/6	Span 2 4.00in.
	6/1-10/6	Base 4.00 in., Base-50% 1.75 in., Base+50% 5.25in.
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 5b
Exp. Design	Wheat
Soil Type	Pullman Clay Loam

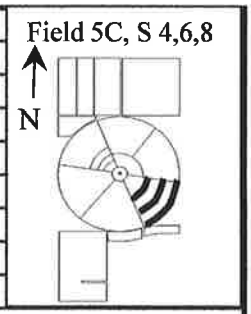
Field Operations	Date	Activity
Tillage		
Fertility	3/16/2017	Liquid 32-0-0 26gal/ac (applied using pivot)
	3/20/2017	Liquid 32-0-0 26gal/ac (applied using pivot)
Planting/Harvest	12/14/2016	Planted Dumas 70lb/ac (yield)
	6/12/2017	Harvested all spans
Herbicide/	3/10/2017	Rifle 6oz/ac
Growth Regulator	7/7/2017	Rifle 8oz/ac, Makaze 32oz/ac, Diuron 1qt/ac
	8/21/2017	Rifle 16oz/ac, Makaze 32oz/ac, Activator 90 1%
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Span 2 4.00in.
	1/1-5/31	Base 4.00in., Base-50% 4.00In., Base+50% 4.00in.
Seasonal	6/1-10/6	Span 2 0.99in.
	6/1-10/6	Base 0.99 in., Base-50% 0.18 in., Base+50% 1.17 in.
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 5c Spans 2,4,6,8
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

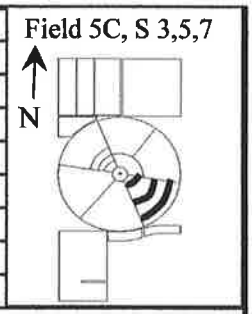
Field Operations	Date	Activity
Tillage	10/5/2016	Disk
	1/12/2017	Disk
	2/8/2017	Chisel
	2/10/2017	Cultivate
	3/10/2017	Cultivate
	3/10/2017	List
	3/15/2017	Rip Soft Middles
	4/6/2017	Dike
	5/2/2017	Rotary Hoe
	6/5/2017	Rotary Hoe
	6/10/2017	Rotary Hoe
	6/14/2017	Cultivate and Dike
	6/16/2017	Cultivate and Dike
Fertility	3/21/2017	Liquid 32-0-0 20gal/ac
	3/22/2017	Liquid 32-0-0, 10-34-0, 12-0-0-26 20gal/ac
	3/23/2017	Liquid 32-0-0, 12-0-0-26 20gal/ac
Planting/Harvest	5/17/2017	Planted NexGen 3500XF 50,000seed/ac
	11/7/2017	Harvested spans 3-8
	11/8/2017	Harvestd span 2
Herbicide/	3/9/2017	Trifuralin 1qt/ac
Growth Regulator	4/16/2017	Caparol 3pt/ac, Gramoxone 2pt/ac, Activator 90 0.50%
	6/14/2017	Makaze 32oz/ac, Maximizer 1%
	6/20/2017	Medal EC 1.3pt/ac
	7/6/2017	Engenia 12.8oz/ac, Makaze 32oz/ac, Choice Trio 1qt/100gal, Reign 1qt/100gal
	7/20/2017	Mepiquat 8oz/ac, applied to High and Medium water
	7/24/2017	Diuron 1.5pt/ac
	8/4/2017	Mepiquat 16oz/ac, applied to High and Medium water
	8/22/2017	Potenza 20oz/ac
	10/19/2017	Ethephon 6 32oz/ac, AIM EC 1oz/ac, Dynamic 5oz/ac
Insecticide	6/6/2017	Acephate 90 3.2oz/ac
	6/14/2017	Acephate 90 3.2oz/ac
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Span 2 1.80in.
	1/1-5/31	Base 1.80in., Base-50% 1.80in., Base+50% 1.80in. (Spans 4, 6, 8)
Seasonal	6/1-10/6	Span 2 4.00 in.
	6/1-10/6	Base 4.00 in., Base-50% 2.00 in., Base+50% 5.5 in. (Spans 4, 6, 8)
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 5c (Span 3,5,7)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

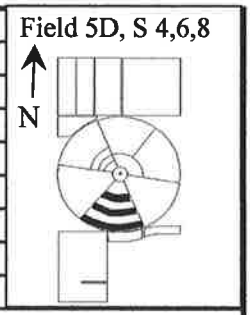
Field Operations	Date	Activity
Tillage		
Fertility	3/21/2017	Liquid 32-0-0 20gal/ac
	3/22/2017	Liquid 32-0-0, 10-34-0, 12-0-0-26 20gal/ac
	3/23/2017	Liquid 32-0-0, 12-0-0-26 20gal/ac
Planting/Harvest	5/17/2017	Planted NexGen 3500XF 50,000seed/ac
	11/8/2017	Harvestd spans 3-8
Herbicide/	3/10/2017	Rifle 12oz/ac, Roundup 32oz/ac
Growth Regulator	4/3/2017	Panther 2oz/ac
	4/16/2017	Caparol 3pt/ac, Gramoxone 2pt/ac, Activator 90 0.50%
	6/14/2017	Makaze 32oz/ac, Maximizer 1%
	6/20/2017	Medal EC 1.3pt/ac
	7/6/2017	Engenia 12.8oz/ac, Makaze 32oz/ac, Choice Trio 1qt/100gal, Reign 1qt/100gal
	7/20/2017	Mepiquat 8oz/ac
	7/24/2017	Diuron 1.5pt/ac
	8/4/2017	Mepiquat 16/oz/ac
	8/22/2017	Potenza 20oz/ac
	10/19/2017	Ethephon 6 32oz/ac, AIM EC 1oz/ac, Dynamic 5oz/ac
Insecticide	6/6/2017	Acephate 90 3.2oz/ac
	6/14/2017	Acephate 90 3.2oz/ac
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Span 2 1.80in.
	1/1-5/31	Base 1.80in., Base-50% 1.80in., Base+50% 1.80in. (Spans 4, 6, 8)
Seasonal	6/1-10/6	Span 2 4.00 in.
	6/1-10/6	Base 4.00 in., Base-50% 2.00 in., Base+50% 5.5 in. (Spans 4, 6, 8)
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 5d East (Span 2, 4, 6, 8)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

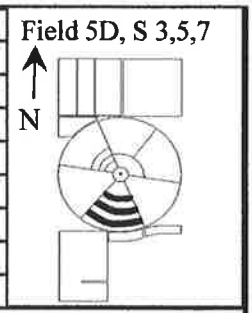
Field Operations	Date	Activity
Tillage	4/7/2017	Shred
	4/10/2017	Stalk Puller
	6/14/2017	Cultivate and Dike
	6/20/2017	Cultivate and Dike
Fertility	3/21/2017	Liquid 32-0-0 20gal/ac
	3/22/2017	Liquid 32-0-0, 10-34-0, 12-0-0-26 20gal/ac
	3/22/2017	Liquid 32-0-0, 12-0-0-26 20gal/ac
	3/23/2017	Liquid 32-0-0. 12-0-0-26 20gal/ac
Planting/Harvest	12/9/2016	Planted VNS 70 lbs/ac (Cover)
	5/17/2017	Planted NexGen 3500XF 50,000seed/ac
	11/6/2017	Harvested spans 3-8
	11/8/2017	Harvested span 2
Herbicide/	3/10/2017	Rifle 8oz/ac
Growth Regulator	4/3/2017	Panther 2oz/ac
	4/16/2017	Caparol 3pt/ac, Gramoxone 2pt/ac, Activator 90 0.50%
	4/17/2017	Makaze 48oz/ac
	6/14/2017	Makaze 32oz/ac, Maximizer 1%
	6/20/2017	Medal EC 1.3pt/ac
	7/6/2017	Engenia 12.8oz/ac, Makaze 32oz/ac, Choice Trio 1qt/100gal, Reign 1qt/100gal
	7/20/2017	Mepiquat 8oz/ac, applied to High and Medium water
	7/25/2017	Diuron 1.5pt/ac
	8/4/2017	Mepiquat 16/oz/ac, applied to High and Medium water
	8/22/2017	Potenza 20oz/ac
	10/19/2017	Ethephon 6 32oz/ac, AIM EC 1oz/ac, Dynamic 5oz/ac
Insecticide	6/6/2017	Acephate 90 3.2oz/ac
	6/14/2017	Acephate 90 3.2oz/ac
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Span 2 2.20in.
	1/1-5/31	Base 2.20in., Base-50% 2.20in., Base+50% 2.20in. (Spans 4, 6, 8)
Seasonal	6/1-10/6	Span 2 4.00 in.
	6/1-10/6	Base 4.00in., Base-50% 2.00 in., Base+50% 5.50 in. (Spans 4, 6, 8)
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 5d East (Span 3, 5, 7)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

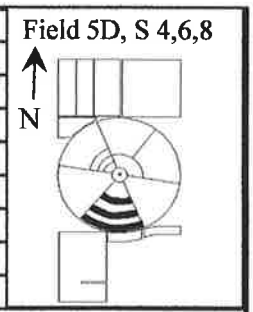
Field Operations	Date	Activity
Tillage		
Fertility	3/21/2017	Liquid 32-0-0 20gal/ac
	3/22/2017	Liquid 32-0-0, 10-34-0, 12-0-0-26 20gal/ac
	3/23/2017	Liquid 32-0-0, 12-0-0-26 20gal/ac
Planting/Harvest	12/9/2016	Planted VNS 70 lbs/ac (Cover)
	5/17/2017	Planted NexGen 3500XF 50,000seed/ac
	11/6/2017	Harvested spans 3-8
Herbicide/	3/10/2017	Rifle 8oz/ac
Growth Regulator	4/3/2017	Panther 2oz/ac
	4/16/2017	Caparol 3pt/ac, Gramoxone 2pt/ac, Activator 90 0.50%
	4/17/2017	Makaze 48oz/ac
	6/14/2017	Makaze 32oz/ac, Maximizer 1%
	6/20/2017	Medal EC 1.3pt/ac
	7/6/2017	Engenia 12.8oz/ac, Makaze 32oz/ac, Choice Trio 1qt/100gal, Reign 1qt/100gal
	7/20/2017	Mepiquat 8oz/ac, applied to High and Medium water
	7/25/2017	Diuron 1.5pt/ac
	8/4/2017	Mepiquat 16/oz/ac, applied to High and Medium water
	8/22/2017	Potenza 20oz/ac
	10/19/2017	Ethephon 6 32oz/ac, AIM EC 1oz/ac, Dynamic 5oz/ac
Insecticide	6/6/2017	Acephate 90 3.2 oz/ac
	6/14/2017	Acephate 90 3.2 oz/ac
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Span 2 2.20in.
	1/1-5/31	Base 2.20in., Base-50% 2.20in., Base+50% 2.20in. (Spans 4, 6, 8)
Seasonal	6/1-10/6	Span 2 4.00 in.
	6/1-10/6	Base 4.00in., Base-50% 2.00 in., Base+50% 5.50 in. (Spans 4, 6, 8)
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 5d West (Span 2, 4, 6, 8)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

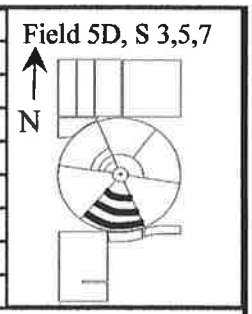
Field Operations	Date	Activity
Tillage	4/7/2017	Shred
	4/10/2017	Stalk Puller
	6/14/2017	Cultivate and Dike
	6/20/2017	Cultivate and Dike
Fertility	3/21/2017	Liquid 32-0-0 20gal/ac
	3/22/2017	Liquid 32-0-0, 10-34-0, 12-0-0-26 20gal/ac
	3/23/2017	Liquid 32-0-0, 12-0-0-26 20gal/ac
Planting/Harvest	12/9/2016	Planted VNS 70 lbs/ac (Cover)
	5/17/2017	Planted NexGen 3500XF 50,000seed/ac
	11/6/2017	Harvested spans 3-8
	11/8/2017	Harvested span 2
Herbicide/	3/10/2017	Rifle 8oz/ac
Growth Regulator	4/3/2017	Panther 2oz/ac
	4/16/2017	Caparol 3pt/ac, Gramoxone 2pt/ac, Activator 90 0.50%
	4/17/2017	Makaze 48oz/ac
	6/14/2017	Makaze 32oz/ac, Maximizer 1%
	6/20/2017	Medal EC 1.3pt/ac
	7/6/2017	Engenia 12.8oz/ac, Makaze 32oz/ac, Choice Trio 1qt/100gal, Reign 1qt/100gal
	7/20/2017	Mepiquat 8oz/ac, applied to High and Medium water
	7/25/2017	Diuron 1.5pt/ac
	8/4/2017	Mepiquat 16/oz/ac, applied to High and Medium water
	8/22/2017	Potenza 20oz/ac
	10/19/2017	Ethephon 6 32oz/ac, AIM EC 1oz/ac, Dynamic 5oz/ac
Insecticide	6/6/2017	Acephate 90 3.2oz/ac
	6/14/2017	Acephate 90 3.2oz/ac
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Span 2 2.20in.
	1/1-5/31	Base 2.20in., Base-50% 2.20in., Base+50% 2.20in. (Spans 4, 6, 8)
Seasonal	6/1-10/6	Span 2 3.36 in.
	6/1-10/6	Base 3.36 in., Base-50% 1.59 in., Base+50% 4.72 in. (Spans 4, 6, 8)
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 5d West (Span 3, 5, 7)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

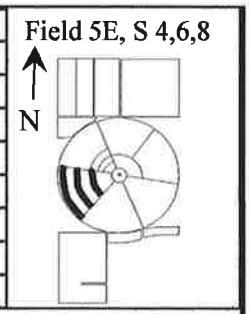
Field Operations	Date	Activity
Fertility	3/21/2017	Liquid 32-0-0 20gal/ac
	3/22/2017	Liquid 32-0-0, 10-34-0, 12-0-0-26 20gal/ac
	3/23/2017	Liquid 32-0-0, 12-0-0-26 20gal/ac
Planting/Harvest	12/9/2016	Planted VNS 70 lbs/ac (Cover)
	5/17/2017	Planted NexGen 3500XF 50,000seed/ac
	11/6/2017	Harvested spans 3-8
Herbicide/	3/10/2017	Rifle 8oz/ac
Growth Regulator	4/3/2017	Panther 2oz/ac
	4/16/2017	Caparol 3pt/ac, Gramoxone 2pt/ac, Activator 90 0.50%
	4/17/2017	Makaze 48oz/ac
	6/14/2017	Makaze 32oz/ac, Maximizer 1%
	6/20/2017	Medal EC 1.3pt/ac
	7/6/2017	Engenia 12.8oz/ac, Makaze 32oz/ac, Choice Trio 1qt/100gal, Reign 1qt/100gal
	7/20/2017	Mepiquat 8oz/ac, applied to High and Medium water
	7/25/2017	Diuron 1.5pt/ac
	8/4/2017	Mepiquat 16/oz/ac, applied to High and Medium water
	8/22/2017	Potenza 20oz/ac
	10/19/2017	Ethephon 6 32oz/ac, AIM EC 1oz/ac, Dynamic 5oz/ac
Insecticide	6/6/2017	Acephate 90 3.2oz/ac
	6/14/2017	Acephate 90 3.2oz/ac
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Span 2 2.20in.
	1/1-5/31	Base 2.20in., Base-50% 2.20in., Base+50% 2.20in. (Spans 4, 6, 8)
Seasonal	6/1-10/6	Span 2 3.36 in.
	6/1-10/6	Base 3.36 in., Base-50% 1.59 in., Base+50% 4.72 in. (Spans 4, 6, 8)
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 5e (Span 2,4,6,8)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

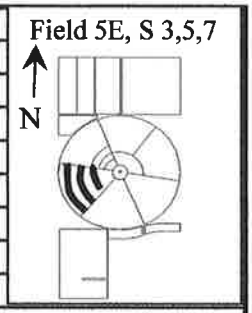
Field Operations	Date	Activity
Tillage	1/24/2017	Shred
	2/7/2017	Disk
	2/8/2017	Disk
	2/10/2017	Chisel
	2/21/2017	Cultivate
	3/10/2017	Cultivate
	3/10/2017	List
	3/15/2017	Rip Soft Middles
	4/6/2017	Dike
	5/2/2017	Rotary Hoe
	6/5/2017	Rotary Hoe
	6/10/2017	Rotary Hoe
	6/14/2017	Cultivate and Dike
	6/19/2017	Cultivate and Dike
Fertility	3/21/2017	Liquid 32-0-0 20gal/ac
	3/22/2017	Liquid 32-0-0, 10-34-0, 12-0-0-26 20gal/ac
	3/23/2017	Liquid 32-0-0, 12-0-0-26 20gal/ac
Planting/Harvest	5/16/2017	PlantedNexGen 3500XF 50,000seed/ac
	11/7/2017	Harvested spans 3-8
	11/8/2017	Harvested span 2
Herbicide/	3/9/2017	Trifuralin 1qt/ac
Growth Regulator	4/16/2017	Caparol 3pt/ac, Gramoxone 2pt/ac, Activator 90 0.50%
	4/17/2017	Makaze 48oz/ac
	6/14/2017	Makaze 32oz/ac, Maximizer 1%
	6/20/2017	Medal EC 1.3pt/ac
	7/6/2017	Engenia 12.8oz/ac, Makaze 32oz/ac, Choice Trio 1qt/100gal, Reign 1qt/100gal
	7/20/2017	Mepiquat 8oz/ac, applied to High and Medium water
	7/25/2017	Diuron 1.5pt/ac
	8/4/2017	Mepiquat 16oz/ac, applied to High and Medium water
	8/22/2017	Potenza 20oz/ac
	10/19/2017	Ethephon 6 32oz/ac, AIM EC 1oz/ac, Dynamic 5oz/ac
Insecticide	6/6/2017	Acephate 90 3.2oz/ac
	6/14/2017	Acephate 90 3.2oz/ac
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Span 2 2.25in.
	1/1-5/31	Base 2.25in., Base-50% 2.25in., Base+50% 2.25in. (Spans 4, 6, 8)
Seasonal	6/1-10/6	Span 4.00 in.
	6/1-10/6	Base 4.00 in., Base-50% 2.00 in., Base+50% 5.50 in. (Spans 4, 6, 8)
Rainfall		
PrePlant & Planting	1/1-5/31	6.84In.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 5e (Span 3,5,7)
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

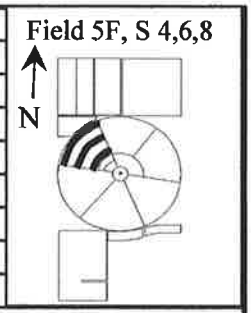
Field Operations	Date	Activity
Tillage		
Fertility	3/21/2017	Liquid 32-0-0 20gal/ac
	3/22/2017	Liquid 32-0-0, 10-34-0, 12-0-0-26 20gal/ac
	3/23/2017	Liquid 32-0-0, 12-0-0-26 20gal/ac
Planting/Harvest	5/16/2017	Planted NexGen 3500XF 50,000seed/ac
	11/7/2017	Harvested spans 3-8
Herbicide/	3/10/2017	Rifle 12oz/ac, Roundup 32oz/ac
Growth Regulator	4/3/2017	Panther 2oz/ac
	4/16/2017	Caparol 3pt/ac, Gramoxone 2pt/ac, Activator 90 0.50%
	4/17/2017	Makaze 48oz/ac
	6/14/2017	Makaze 32oz/ac, Maximizer 1%
	6/20/2017	Medal EC 1.3pt/ac
	7/6/2017	Engenia 12.8oz/ac, Makaze 32oz/ac, Choice Trio 1qt/100gal, Reign 1qt/100gal
	7/20/2017	Mepiquat 8oz/ac, applied to High and Medium water
	7/25/2017	Diuron 1.5pt/ac
	8/4/2017	Mepiquat 16oz/ac, applied to High and Medium water
	8/22/2017	Potenza 20oz/ac
	10/19/2017	Ethephon 6 32oz/ac, AIM EC 1oz/ac, Dynamic 5oz/ac
Insecticide	6/6/2017	Acephate 90 3.2oz/ac
	6/14/2017	Acephate 90 3.2oz/ac
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Span 2 2.25in.
	1/1-5/31	Base 2.25in., Base-50% 2.25in., Base+50% 2.25in. (Spans 4, 6, 8)
Seasonal	6/1-10/6	Span 4.00 in.
	6/1-10/6	Base 4.00 in., Base-50% 2.00 in., Base+50% 5.50 in. (Spans 4, 6, 8)
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 5f (Span 2,4,6,8)
Exp. Design	Grain Sorghum
Soil Type	Pullman Clay Loam

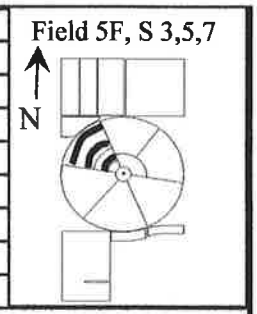
Field Operations	Date	Activity
Tillage	1/24/2017	Shred
	2/7/2017	Disk
	2/8/2017	Disk
	2/10/2017	Chisel
	2/21/2017	Cultivate
	3/3/2017	List
	3/6/2017	Rip Soft Middles
	4/7/2017	Dike
	5/2/2017	Rotary Hoe
	6/5/2017	Rotary Hoe
	6/10/2017	Rotary Hoe
	6/13/2017	Cultivate and Dike
	6/19/2017	Cultivate and Dike
Fertility	3/20/2017	Liquid 32-0-0 20gal/ac
Planting/Harvest	5/31/2017	Planted DynaGrow M60GB31 40,000, 55,000 and 70,000seed/ac
	10/24/2017	Harvested all test
Herbicide/	3/27/2017	Atrazine 1qt/ac
Growth Regulator	5/19/2017	Bone Dry 2pt/ac, Activator 90 0.50%
	6/1/2017	Milo Pro 1qt/ac, Medal EC 1.3 pt/ac,
	6/20/2017	Medal EC 1.3pt/ac
	7/14/2017	Rifle 8oz/ac, Diuron 1qt/ac
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Span 2 1.40in.
	1/1-5/31	Base 1.40in., Base-50% 1.40in., Base+50% 1.40in. (Spans 4, 6, 8)
Seasonal	6/1-10/6	Span 5.2 in.
	6/1-10/6	Base 5.2 in., Base-50% 2.25 in., Base+50% 6.45 in. (Spans 4, 6, 8)
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 5f (Spans 3,5,7)
Exp. Design	Grain Sorghum
Soil Type	Pullman Clay Loam

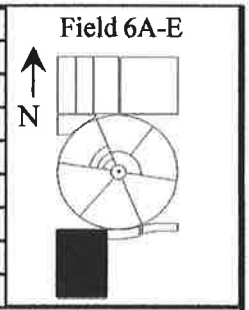
Field Operations	Date	Activity
Tillage	5/2/2017	Rotary Hoe
Fertility	3/20/2017	Liquid 32-0-0 20gal/ac
Planting/Harvest	5/31/2017	Planted DynaGrow M60GB31 40,000, 55,000 and 70,000seed/ac
	10/24/2017	Harvested all test
Herbicide/	3/10/2017	Rifle 12 oz/ac, Roundup 32oz/ac
Growth Regulator	3/27/2017	Atrazine 1qt/ac
	5/19/2017	Bone Dry 2 pt/ac, Activator 90 0.50%
	6/1/2017	Milo Pro 1 qt/ac, Medal EC 1.3pt/ac,
	6/20/2017	Medal EC 1.3pt/ac
	7/14/2017	Rifle 8oz/ac, Diuron 1qt/ac
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Span 2 1.40in.
	1/1-5/31	Base 1.40in., Base-50% 1.40in., Base+50% 1.40in. (Spans 4, 6, 8)
Seasonal	6/1-10/6	Span 5.2 in.
	6/1-10/6	Base 5.2 in., Base-50% 2.25 in., Base+50% 6.45 In. (Spans 4, 6, 8)
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 6 - Zone A-E
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

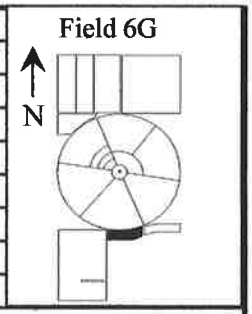
Field Operations	Date	Activity
Tillage	2/6/2017	Disk
	2/9/2017	Disk
	2/23/2017	Cultivate
	3/9/2017	Cultivate
	3/14/2017	Cultivate
	3/15/2017	List
	5/2/2017	Rotary Hoe
	6/5/2017	Rotary Hoe
	6/10/2017	Rotary Hoe
	6/21/2017	Cultivate and Dike
Fertility	3/27/2017	Liquid 32-0-0, 10-34-0, 12-0-0-24 22.6gal/ac
	7/12-7/17	Liquid 32-0-0 57lbs/ac (applied throug drip irrigation)
Planting/Harvest	5/12/2017	Planted DeltaPine 1646, FiberMax 1830, NexGen 3522, PhytoGen 333, DeltaPine 1522 48,000 and
		50,000seed/ac
	11/13/2017	Harvested all test
Herbicide/	3/8/2017	Trifuralin 1qt/ac
Growth Regulator	5/5/2017	Medal EC 1.3pt/ac, Bone Dry 2pt/ac, Activator 90 1%
	6/2/2017	Medal EC 1.3pt/ac
	6/22/2017	Medal EC 1.3pt/ac
	7/7/2017	Makaze 32oz/ac, Maximizer 1%
	7/26/2017	Diuron 1.5pt/ac
	8/4/2017	Mepiquat 20oz/ac (Zones B-E)
	8/22/2017	Potenza 20oz/ac (Zones B-E)
	10/19/2017	Ethephon 6 32oz/ac, AIM EC 1oz/ac, Dynamic 5oz/ac
Insecticide	6/6/2017	Acephate 90 3.2oz/ac
	6/14/2017	Acephate 90 3.2oz/ac
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	Avg. for Zones A-E 5.026in.
Seasonal	6/1-10/6	Zone A 6.62in., Zone B 6.95in., Zone C 6.69., Zone D 6.24in., Zone E 6.42in.
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 6 - Zone G
Exp. Design	Cotton
Soil Type	Pulmman Clay Loam

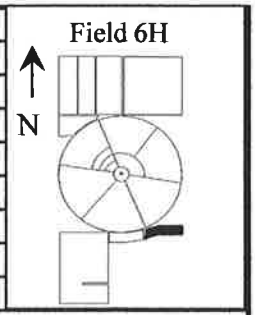
Field Operations	Date	Activity
Tillage	1/10/2017	Shred
	1/10/2017	Disk
	2/23/2017	Cultivate
	3/8/2017	Cultivate
	3/14/2017	Cultivate
	3/20/2017	List
	4/7/2017	Rotary Hoe
	5/2/2017	Rotary Hoe
	6/5/2017	Rotary Hoe
	6/10/2017	Rotary Hoe
	6/22/2017	Cultivate and Dike
Fertility		
Planting/Harvest	5/4/2017	Planted FiberMax 1900GTL 52,000seed/ac
	11/6/2017	Harvested all test
Herbicide/	3/7/2017	Trifuralin 1qt/ac
Growth Regulator	5/5/2017	Medal EC 1.3pt/ac, Bone Dry 2pt/ac, Activator 90 1%
	5/26/2017	Makaze 32oz/ac, Maximizer 1%
	6/2/2017	Medal EC 1.3pt/ac
	6/22/2017	Medal EC 1.3pt/ac
	7/7/2017	Makaze 32oz/ac, Maximizer 1%
	7/26/2017	Diuron 1.5pt/ac
Insecticide	6/8/2017	Acephate 90 3.2oz/ac
Harvest aid	10/22/2017	Helmquat 3SL 32oz/ac, Activator 90 0.50%
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	5.44in.
Seasonal	6/1-10/6	3.20in.
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 6 - Zone H
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

Field Operations	Date	Activity
Tillage	1/10/2017	Shred
	1/10/2017	Disk
	2/23/2017	Cultivate
	3/9/2017	Cultivate
	3/14/2017	Cultivate
	3/20/2017	List
	4/7/2017	Rotary Hoe
	5/2/2017	Rotary Hoe
	6/5/2017	Rotary Hoe
	6/10/2017	Rotary Hoe
	6/22/2017	Cultivate and Dike
Fertility	3/27/2017	Liquid 32-0-0, 10-34-0, 12-0-0-24 7.5gal/ac
Planting/Harvest	5/11/2017	Planted NexGen 3406B2XF 52,000seed/ac
	11/6/2017	Harvested all test
Herbicide/	3/9/2017	Trifuralin 1qt/ac
Growth Regulator	5/5/2017	Medal EC 1.3pt/ac, Bone Dry 2pt/ac, Activator 90 1%
	5/26/2017	Makaze 32oz/ac, Maximizer 1%
	6/2/2017	Medal EC 1.3pt/ac
	6/6/2017	Engenia 12.8oz/ac, Choice Trio 1qt/100gal, Reign 1qt/100gal
	6/22/2017	Medal EC 1.3pt/ac
	7/7/2017	Makaze 32 oz/ac, Maximizer 1%
	7/20/2017	Mepiquat 8oz/ac
	7/26/2017	Diuron 1.5pt/ac
	8/3/2017	Mepiquat 16oz/ac
Insecticide	5/26/2017	Acephate 90 3.2oz/ac
	6/5/2017	Acephate 90 3.2oz/ac
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	1/1-5/31	5.44in.
Seasonal	6/1-10/6	4.51in.
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.



Operations Summary

Year	2017
Farm	Helm
Field ID	Field 10
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

Field Operations	Date	Activity
Tillage	1/10/2017	Shred
	1/10/2017	Disk
	2/22/2017	Cultivate
	3/8/2017	Cultivate
	3/20/2017	List
	4/7/2017	Rotary Hoe
	5/2/2017	Rotary Hoe
	6/5/2017	Rotary Hoe
	6/10/2017	Rotary Hoe
	6/22/2017	Cultivate and Dike
Fertility	3/24/2017	Liquid 32-0-0 20gal/ac
Planting/Harvest	5/11/2017	Planted NexGen 3406B2XF 52,000 seed/ac
	11/6/2017	Harvested all test
Herbicide/	3/7/2017	Trifuralin 1 qt/ac
Growth Regulator	5/5/2017	Medal EC 1.3pt/ac, Bone Dry 2pt/ac, Activator 90 1%
	6/2/2017	Medal EC 1.3 pt/ac
	6/6/2017	Engenia 12.8oz/ac, Choice Trio 1qt/100gal, Reign 1qt/100gal
	6/22/2017	Medal EC 1.3pt/ac
	7/7/2017	Makaze 32oz/ac, Maximizer 1%
	7/20/2017	Mepiquat 8oz/ac
	7/26/2017	Diuron 1.5pt/ac
Insecticide	5/30/2017	Acephate 90 3.2oz/ac
	6/5/2017	Acephate 90 3.2oz/ac
	6/14/2017	Acephate 90 3.2oz/ac
Harvest aid	10/22/2017	Helmquat 3SL 32oz/ac, Activator 90 0.50%
Irrigation Amt.		
PrePlant & Planting		
Seasonal		
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.

Operations Summary

Year	2017
Farm	Helm
Field ID	Dryland
Exp. Design	Cotton
Soil Type	Pullman Clay Loam

Field Operations	Date	Activity
Tillage	11/28/2016	Shred
	11/28/206	Disk
	12/2/2016	List and Bed Conditioner
	6/28/2017	Rotary Hoe
	7/18/2017	Cultivate and Dike
Fertility		
Planting/Harvest	12/6/2016	Planted VNS 45lbs/ac (Cover)
	6/6/2017	Planted NexGen 3406B2XF 44,000seed/ac
	11/27/2017	Harvested half of field (Half of field was not harvestable)
Herbicide/	4/18/2017	Makaze 48oz/ac
Growth Regulator	6/6/2017	Engenia 12.8oz/ac, Choice Trio 1qt/100gal, Reign 1qt/100gal
	6/8/2017	Engenia 32oz/ac, Maximizer 1%
	6/20/2017	Medal EC 1.3pt/ac
	7/19/2017	Engenia 32oz/ac, Choice 1qt/100gal, Maximizer 1%
	7/27/2017	Warrant 3pt/ac
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting		
Seasonal		
Rainfall		
PrePlant & Planting	1/1-5/31	6.84in.
Seasonal	6/1-10/6	16.13in.