



Improving Life Through Science and Technology

Lubbock-Pecos-Halfway

Helm Research Farm

Summary Report

2014

Technical Report
15-3

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 sole 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 irrigation (SDI). Other research projects include weed and insect control, plant breeding and yield trials for several commodities and production systems projects. 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 five wells, 320 to 340 feet deep, pumping at rates of 150 to 250 gallons per minute each.



Cotton Response to Irrigation Level using SDI in Every Row (Field 2).

James Bordovsky, Joe Mustian, Casey Hardin, K.C. Amerson

Objective: Determine cotton lint yield at three irrigation levels using 30-inch SDI spaced laterals.



Methodology: A subsurface drip irrigation system was modified in 2013 allowing field scale experiments where uniform stand establishment was critical to the test. The 12-acre area contained ten plots, with plots being 16 rows wide and 1300 ft long, and SDI laterals placed in every row 30 inches apart and 12 inches below the level soil surface. Drip emitters are spaced every 24-inches and have manufactured flow rates of 0.18 gallon per hour at 15 psi pressure. The irrigation system modifications occurred in 2013 with the initial experiments planted in 2014. The experiments conducted in this area required

irrigations at three levels with the base irrigation quantity (1.0BI) at approximately 60% ET. Other seasonal levels were 50% and 150% of 1.0BI, or 0.5BI and 1.5BI, respectively. Cotton was grown and tests harvested. Non-test areas were harvested with commercial harvesting equipment and yields and fiber quality from the different irrigation levels determined. Those results are contained herein.

Results: Although there was little rain during the winter and spring of 2013-2014, cotton stand establishment was timely and uniform with minimum preplant irrigation (see appendix). Rain during the growing season was above average resulting in fairly low irrigation amounts of 2.7, 5.1 and 7.3 inches for 0.5BI, 1.0BI, and 1.5BI treatments respectively. Cotton yields were high ranging from 800 to 2400 lb/acre and seasonal irrigation water use efficiency ranged from 220 to 320 lb/ac-inch (Figure 1). Fiber quality data is contained in Table 1. This information will add to the existing irrigation cotton response data base that supports management recommendations.

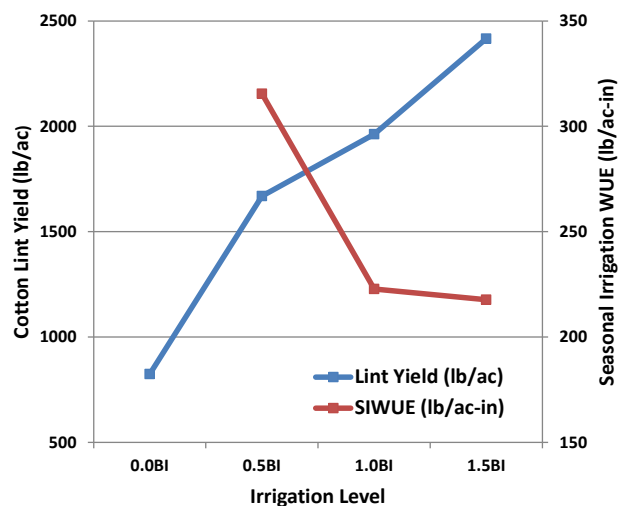


Figure 1. Cotton lint yield and seasonal irrigation water use efficiency resulting from three irrigation levels using SDI at the Helms Research Farm, 2014.

Table 1. Fiber quality parameters resulting from irrigation quantity treatments using SDI with 30-inch lateral spacing, 2014.

Irr.											
Treat.	Mic	Length	Unif.	Streng.	Elon.	Rd	+b	CGrd	Leaf	Loan	
0.0BI	3.4	1.01	78.8	31.9	8.5	74.7	7.7	41-1	3	0.4655	
0.5BI	5.0	1.07	82.2	31.2	10.2	75.4	8.0	41-1	4	0.4970	
1.0BI	4.1	1.09	82.3	30.9	9.5	76.1	8.5	31-2	3	0.5580	
1.5BI	3.9	1.08	81.9	30.3	9.5	75.3	8.7	31-4	3	0.5570	

Bayer Cotton Agronomic Performance Trial (Field 2)

Wayne Keeling, Justin Spradley, Joel Webb and Martha Zwonitzer

Objective: Compare yield, fiber quality, and gross revenue as a function of nine Bayer Crop Science varieties and irrigation levels.

Methodology: Irrigations were at base (M), 1.5x base (H), and 0.5x base (L) levels. See appendix for additional agronomic details.

Results: Four commercial FiberMax, two Stoneville and two experimental varieties were compared under three irrigation levels. When averaged across irrigation level, differences were determined between varieties. When averaged across varieties, highest yield were produced under base irrigation. Yields were reduced at high irrigation level compared to base irrigation. Cotton lint value was reduced in dryland and low irrigation levels. Gross revenues were affected by both variety and irrigation level (Table 1).

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

Variety	Irrigation Level			Dry (0.0)	Average
	Low (3.0)	Base (4.4)	High (6.0)		
	lbs/A				
FM1320GL	1240	1710	1844	727	1380 BC
FM2322GL	1349	1712	1702	771	1383 BC
FM2011GT	1360	1791	1750	901	1450 AB
FM2334GLT	1278	1561	1395	755	1247 D
BX1538GLT	1464	1959	1753	777	1488 A
BX1539GLT	1431	1590	1500	788	1327 CD
FM1830GLT	1246	1726	1617	639	1307 CD
ST4747GLB2	1439	1864	1747	938	1797 A
ST4946GLB2	1486	1833	1650	810	1444 AB
Average	1366 C	1750 A	1661 B	789 D	--
	cents/lb				
FM1320GL	55.99	57.18	57.98	55.04	56.54 D
FM2322GL	57.44	57.86	58.13	57.43	57.71 AB
FM2011GT	56.33	57.49	57.85	56.73	57.10 BCD
FM2334GLT	57.71	57.99	57.90	58.29	57.97 A
BX1538GLT	57.84	57.79	58.38	57.89	57.97 A
BX1539GLT	57.78	57.86	56.90	55.45	56.70 CD
FM1830GLT	57.76	58.11	57.50	57.41	57.70 ABC
ST4747GLB2	57.55	57.56	57.66	57.31	57.52 ABC
ST4946GLB2	57.44	57.89	58.31	56.23	57.46 ABC
Average	57.31 BC	57.75 AB	57.84 A	56.86 C	--
	\$/A				
FM1320GL	694	978	1069	400	785 BC
FM2322GL	775	991	989	443	799 BC
FM2011GT	767	1030	1014	511	830 AB
FM2334GLT	738	905	808	440	723 D
BX1538GLT	847	1132	1023	450	863 A
BX1539GLT	827	920	855	437	760 D
FM1830GLT	720	1003	931	367	755 CD
ST4747GLB2	828	1073	1008	538	862 A
ST4946GLB2	854	1062	960	456	833 AB
Average	783 C	1011 A	962 B	449 D	--

Cotton Response to Pre-plant and Early Season Irrigation Amounts with SDI (Field 3).

James Bordovsky, Joe Mustian, Casey Hardin, K.C. Amerson

Objective: Determine cotton lint yield and water use efficiency of pre-plant and early season irrigation treatments using SDI.

Methodology: The proposed study quantifies differences in water productivity of SDI cotton during the irrigation periods having the highest environmental demand on the South Plains. The treatment factors include pre-plant irrigation quantity and early growing season irrigation capacity resulting in six treatments plus "pre-plant only" check (Table 1). In 2014, crop rows were planted directly above SDI 60" wide drip laterals due to dry winter and spring and inability to adequately wet seedbeds with pre-plant irrigation. Due to poor plant stands caused by heavy rains and blowing sand in late May, cotton was replanted on 10 June.

Table 1. Planned irrigation amounts and capacities during specific cotton growth periods for SDI timing experiments at the Helm Research Farm.

Treat. No.	Irrigation Capacity (in/day)			Probable Irrigation Amts. (in)				
	Reproduc			Pre-plant	Reproduc			Total
	Vegetative Period	tive Period	Maturation Period	Irr. Amt. (in)	Vegetative Period	tive Period	Maturation Period	
T0	0.0	0.0	1.0	2.0	0.0	0.0	0.0	2.0
T2	0.0	0.2	0.2	2.0	0.0	4.0	6.0	12.0
T5	0.1	0.2	0.2	2.0	3.0	4.0	6.0	15.0
T6	0.2	0.2	0.2	2.0	6.0	4.0	6.0	18.0
T3	0.0	0.2	0.2	4.0	0.0	4.0	6.0	14.0
T1	0.1	0.2	0.2	4.0	3.0	4.0	6.0	17.0
T4	0.2	0.2	0.2	4.0	6.0	4.0	6.0	20.0



Results: Due to poor plant stands caused by heavy rains and blowing sand in late May, cotton was replanted on 2 June. The late crop and additional seasonal rains eliminated the need for irrigation during the vegetative period and reduced planned irrigations the rest of the year. Treatments T2 and T5 were irrigated identically with 2.3 inches of total seasonal rain as were T1 and T4 with only 2.9 inches of irrigation during the growing season. There were no yield differences resulting from the 2014 irrigation treatments (Figure 1). However, differences in water use efficiencies were significant indicating water

saving opportunities in years with above average rain. This study will be continued.

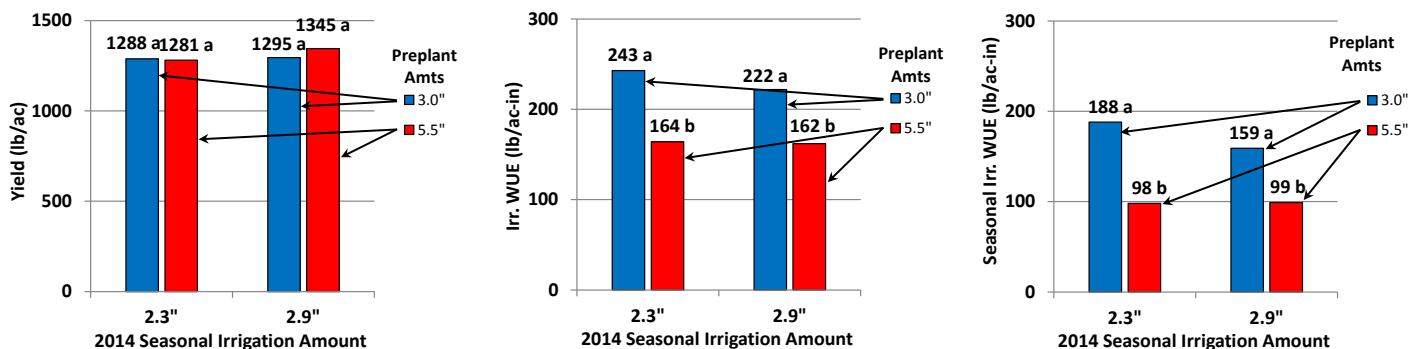


Figure 1. Cotton lint yield, irrigation water use efficiency, and seasonal irrigation water use efficiency from two pre-plant and two seasonal irrigation amounts in SDI delivered irrigation timing experiments at the Helms Research Farm, 2014.

Cotton Response to Tillage, Irrigation Level and Crop Rotation (Field 5a-b-d-f)

James Bordovsky, Wayne Keeling, Casey Hardin, K.C. Amerson, and Martha Zwonitzer

Objective: A field experiment was conducted to determine yield and in-season water productivity of cotton at three irrigation levels under conventional and reduced tillage in rotation sequences of continuous cotton, wheat (terminated)-cotton and cotton following grain sorghum.

Methodology: Cotton was grown under two tillage systems—conventional and reduced. Under reduced tillage, the field was tilled to incorporate preseason herbicide applications. The base irrigation level (2.5” of seasonal irrigation in 2014) met approximately 60% of crop water needs using ET scheduling. The other water levels were $\pm 50\%$ of the base amount (1.4” and 3.6”). All cotton was planted in areas of continuous cotton or in rotation with grain sorghum or a terminated wheat cover crop, and replanted on June 4 due to weather events. Crop responses were evaluated by harvesting 4 rows x 60° pivot arc and determining turnout and fiber data from sub-samples from each treatment. Seasonal irrigation treatments were replicated three times. The crop sequence areas (pivot wedges) were not replicated; therefore, only general comparisons can be made regarding tillage system effects.

Results: Cotton yields and seasonal irrigation water use efficiencies (WUE) from the three rotation sequences, two tillage systems, and three irrigation levels are in Figures 1 and 2. Generally, lint yields were lower for cotton produced under reduced tillage than those produced under conventional tillage. Cotton planted following a terminated wheat cover crop showed the greatest response to increased irrigation level. Overall, the 1.5 base level irrigation showed the highest yields except in the case of the S-C rotation under conventional tillage. These field tests provide management options that help maintain short-term grower productivity while providing valuable information to improve future water value.

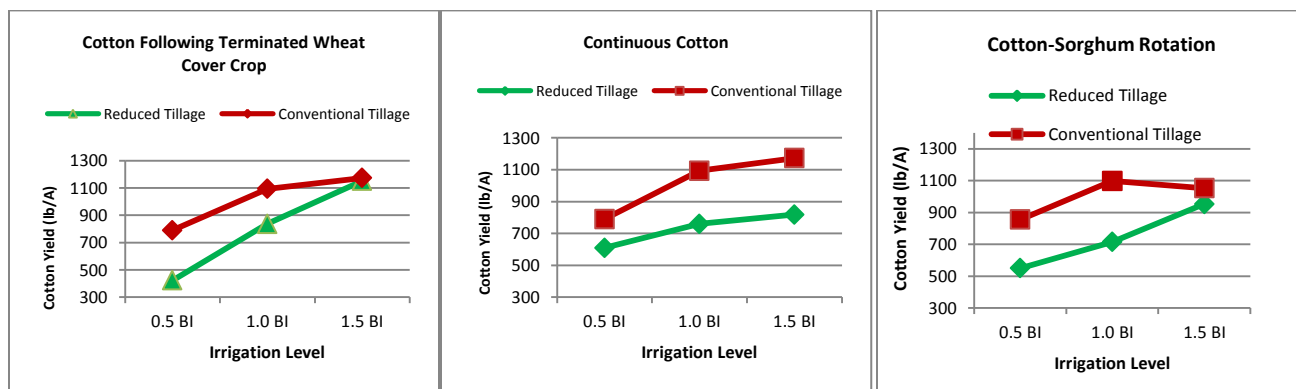


Figure 1. Cotton lint yield for three cropping sequences) at three irrigation levels and under two tillage systems at the Helm Research Farm, 2014.

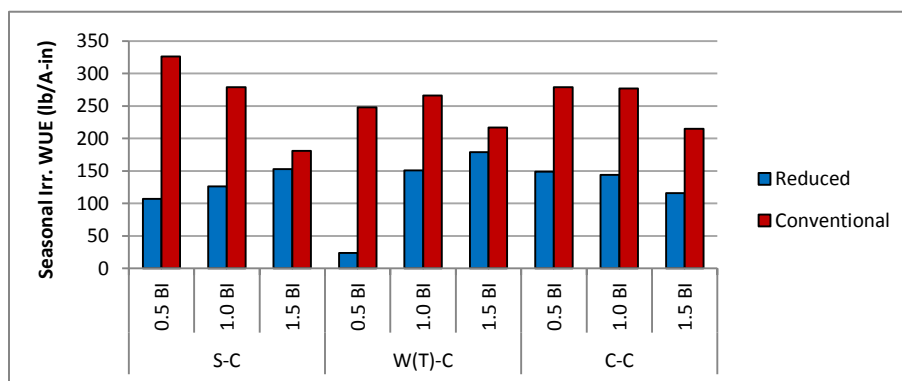


Figure 2. Seasonal irrigation water use efficiencies of cotton under two tillage management systems, three cropping sequences at three irrigation levels at the Helm Research Farm, 2014.

Evaluation of Zero-Early Cotton Irrigation Strategy (Field 5d)

James Bordovsky and Joe Mustian

Objective: Compare cotton lint yield and water productivity of a recently develop "Zero-Early" cotton irrigation strategy compared to the traditional limited irrigation strategy.



Methodology: Recently completed small plot field experiments showed treatments with reduced irrigation in early cotton growth stages (through mid-July) used 20 percent less total seasonal irrigation with minor yield loss compared to the traditional strategy of applying irrigations when the crop is small and water use demands of the plant are low, hoping to store water in the profile. A large scale field evaluation compared these strategies under two tillage systems at three irrigation levels. The "zero-early" treatments were irrigated at 26% of the traditional treatments from crop establishment until 8 Aug (see appendix).

Results: Cotton was planted in terminated wheat cover under both tillage systems. The tilled system was cultivated and furrow diked as needed during the growing season, the reduced till system was not. Irrigation amounts during the growing season were small due to timely rains. Only a 0.75 inch irrigation reduction occurred due to the zero-early strategy. Cotton yields were numerically higher in all "zero early" vs. the traditional treatments except for the 1.5BI level in the reduced tilled area (Fig. 1). Although differences in seasonal irrigations were small between strategies, seasonal irrigation water use efficiencies were significantly higher in the "zero early" treatments in both tilled and reduce tillage systems (Fig. 2). This result continues to validate the results of earlier experiments. Additional tests will result in grower recommendations that improve water productivity in this water short area.

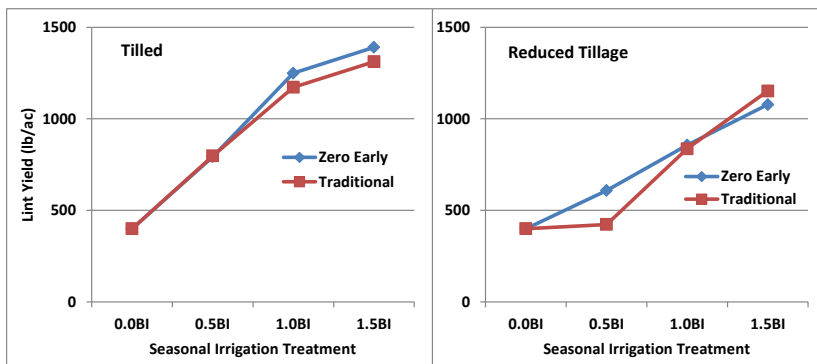


Figure 1. Cotton lint yield of two cotton tillage systems and three irrigation levels at the Helms Research Farm, 2014.

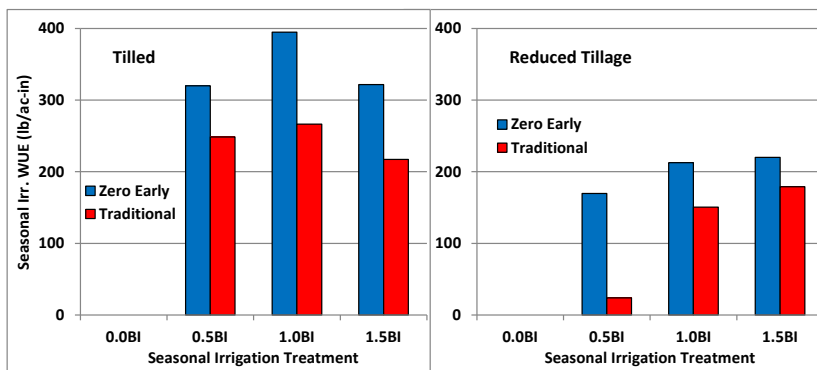


Figure 2. Seasonal irrigation water use efficiencies of two cotton tillage systems and three irrigation levels at the Helms Research Farm, 2014.

Grain Sorghum Performance at Multiple Irrigation Levels (Field 5e).

James Bordovsky, Wayne Keeling, K.C. Amerson, Casey Hardin.

Objective: A field experiment was conducted to determine yield of grain sorghum at three irrigation levels.

Methodology: Grain sorghum was planted using DeKalb 4945 hybrid in 2014. The **Base** irrigation level (3.3" of seasonal irrigation) along with rain met approximately 60% of crop water needs using ET scheduling. The other water levels were $\pm 50\%$ of the **Base** amount (**Low** – 1.8" and **High** – 4.8"). The test area had been in cotton in 2013. Other agronomic information is included in the appendix.



Figure 1. Irrigated grain sorghum at the Helms Research Farm.

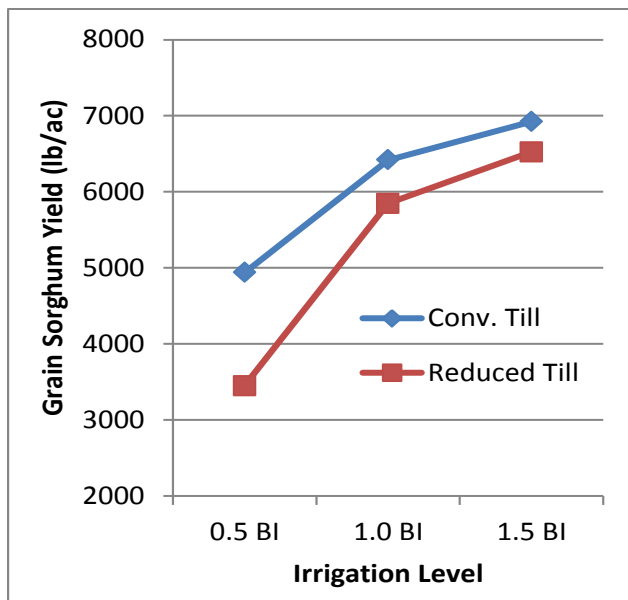


Figure 2. Grain sorghum yield resulting from tillage and irrigation level treatments at the Helms Research Farm, 2014.

Results: 2014 was the first year of experiments that included tillage as a treatment factor. Rainfall for the summer of 2014 was high at approximately 16 inches with favorable distribution for sorghum. Yields of grain sorghum were consistently higher in the conventional treatment at all irrigation levels than was the reduced till. This could be attributed to higher rainfall runoff from reduced till treatments (no furrow dikes) than from the conventional treatments (furrow diked). Being the first year of this rotation, there was virtually no crop residue in the reduced till treatments to lessen soil surface evaporation or runoff compare to conventional treatments. Future yield results will likely differ from these over the course of the experiment.

Yield and Water Productivity of SDI Cotton Having Traditional Versus Wide Crop Row Spacing (Field 6cde).

James P. Bordovsky, Joe Mustian, K.C. Amerson, and Casey Hardin

Objective: Compare germination, yield, and water productivity resulting from SDI system/plant position strategies.

Methodology: Cotton seed germination has been a major issue when irrigating with SDI in some soils, particularly in years with little rain during the planting period. A strategy of planting 60" crop rows directly over drip laterals to insure germination was compared to the traditional method of planting two 30" crops equidistant and 15" from 60" spaced drip laterals. Cotton was irrigated in a 24-acre field with treatments replicated in 60 ft x 1600 ft plots. Planting occurred on 17 May 2013 and replanted due to



Figure 1. SDI cotton planted on 30" rows in a traditional planting manner, 2013.

weather related issues on 4 June 2014. The irrigation volume and timing was the same for both treatments in a given year (see appendix for 2014 details).



Figure 2. SDI cotton planted in a 60" skip row pattern with crop rows directly above drip laterals, 2013.

Results: Pre- and at-plant irrigation totaled 8.0" in 2013 and 9.0" in 2014 in treated areas. In 2013, soil moisture at planting in the traditional seed zones was somewhat less than optimal at planting, however rain events on 3 and 6 June provided sufficient water to achieve acceptable plant stands (Figs. 1&2). In 2014, all areas were sufficiently wet to achieve germination by the time of replant.

Yield, water productivity, and lint loan values for 2013 and 2014 are shown in Figure 3. The traditional planting resulted in significantly higher lint yield and water use efficiency using the same volume of water as the skip row strategy in both years. However, seed costs were lower and lint values were significantly higher in the skip row compared to the traditional planting. Skip row planting may be an acceptable strategy in years with questionable germination due to lack of planting moisture when irrigating with SDI.

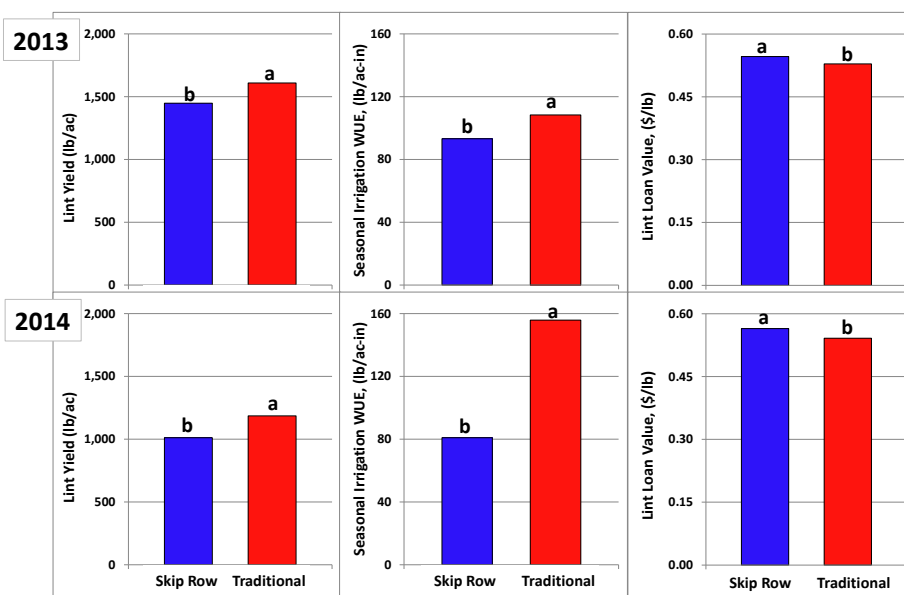


Figure 3. Cotton lint yield, water use efficiency, and cotton lint loan value of cotton planted in a 60" skip row verse a traditional 30" pattern irrigated by SDI on 60" lateral spacing at the Helms Research Farm, 2013-2014.

Evaluation of Seeding Rates on Cotton Row Spacings of 60 Inches Irrigated by SDI (Field 6h).

James Bordovsky, Joe Mustian, Casey Hardin, and K.C. Amerson

Objective: Determine cotton lint yield and water use efficiency at three seeding rates irrigated by 60-inch SDI spaced laterals with cotton planted over laterals to improve germination.

Methodology: To ensure germination during dry periods using subsurface drip systems, the strategy of planting 60" crop rows directly over drip laterals has been evaluated. In addition to better germination, one advantage over traditional alternate furrow SDI is the reduction in seed expense. The disadvantage is reductions in yield if timely rain eventually establishes a stand in the traditional system. It is hypothesized that higher plant populations in a skip-row SDI system could compensate for a portion of this yield loss. This experiment evaluated planting rates of 28, 33 and 38 thousand seed per acre in a test area irrigated by 60-inch lateral spaced SDI. Details are given in the appendix.

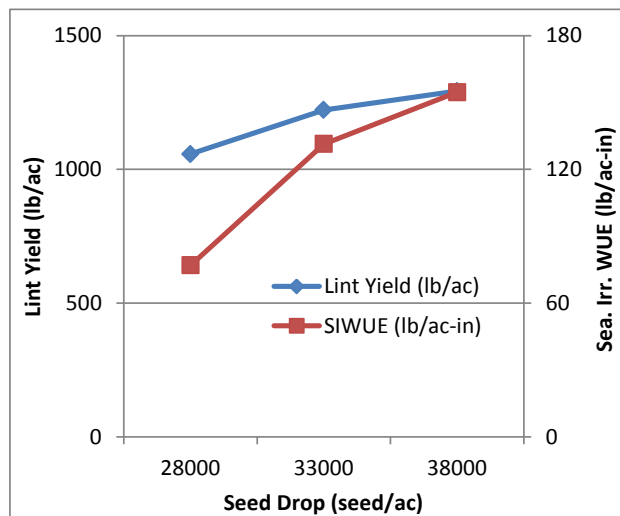


Figure 1. Cotton lint yield and seasonal irrigation water use efficiency resulting from three seeding rates with rows 60 inches apart using SDI under each row, Helms Research Farm, 2014.

Results: Although there was little rain during the winter and spring of 2013-2014, cotton stand establishment was timely. However, heavy rain and blowing sand in late May and early June reduced populations and slowed plant growth. Rain during the growing season was above average resulting in low seasonal irrigation amounts of 3 inches. Due to the environmental effects, cotton yields were low ranged from only 1050 to 1250 lb/acre with seasonal irrigation water use efficiency ranging from 70 to 155 lb/ac-inch (Figure 1). Both lint yield and SIWUE increased significantly ($p < 0.05$) with increased population. There were no significant differences in fiber quality parameters resulting from the three population treatments (Table 1). Additional evaluations will be made.

Table 1. Fiber quality parameters resulting from three planting rates on 60-inch row spacing with SDI lateral under each crop row, Helm Research Farm, 2014.

Seeding Rate (seed drop/ac)	Mic	Length	Unif.	Streng.	Elon.	Rd	+b	Leaf	Loan
28000	3.2	1.1	81.9	31.4	8.9	76.6	8.2	3.3	0.532
33000	3.3	1.1	82.0	31.7	8.7	78.2	8.6	3.0	0.538
38000	3.3	1.1	82.1	31.9	8.7	78.1	8.5	3.7	0.535

Influence of Crop Rotation, Irrigation Rate, and Variety on Profitability from 2007 - 2013.

T. A. Wheeler, J. P. Bordovsky, J. W. Keeling, and J. E. Woodward.

Methodology: The Helms field circle was part of a long-term experiment to look at the effects of crop rotation, variety, and irrigation rate on Verticillium wilt management. Cotton yields, loan value of lint, seeding rate, sorghum yield, irrigation water pumped, and fertilizer applied were recorded from 2007 – 2013. Rotation consisted of: 1) continuous cotton (CCC); 2) two years cotton and one year sorghum rotations (CSC); 3) every other year with a cotton sorghum rotation (SCSC). The last rotation system was only in place from 2010 – 2013, and only with a tolerant variety to Verticillium wilt. Irrigation rate consisted of a base rate (1.0B) that maintained about 80% of the water the crop required (evapotranspiration, ET) in 2007 – 2009; and 60% ET in 2010 – 2013, when pumping capacity was sufficient. There was also a rate 50% below the base rate (0.5B) and 50% above the base rate (1.5B). Varieties changed over the years, but there was a variety that was somewhat tolerant to Verticillium wilt and a variety that was susceptible to Verticillium wilt. The returns above total specified expenses was calculated based on the inputs and outputs listed above, and using recommended values for other farm expenses in the budget sheets by the Texas AgriLife Extension Service(<http://agrilifecdn.tamu.edu>). A \$0.60/lb lint price was used with adjustments based on the loan value. The data from 2011 was not used in the analysis.

Results: The tolerant variety was more profitable than the susceptible variety at the 1.5B and 1.0B irrigation rates, but was less profitable than the susceptible variety at the 0.5B rates (Fig. 1). As irrigation rate increased so did the advantage of tolerant compared to susceptible variety.

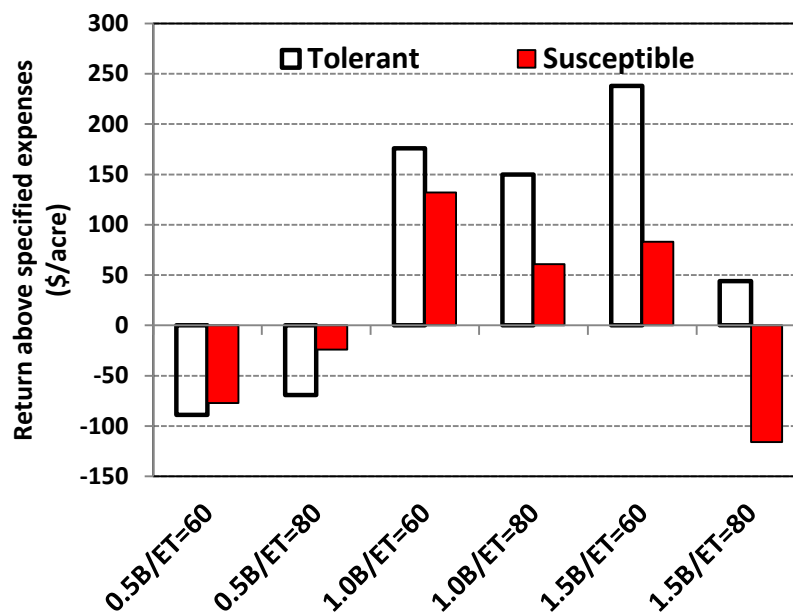


Figure 1. Effect of irrigation rate (1.0B = base rate, 0.5B = 50% below base; 1.5B = 50% above base rate), and Verticillium wilt tolerant and susceptible varieties on profitability. The base irrigation rate targeted an evapotranspiration rate (ET) of 60% in 2010 – 2013 and 80% in 2007-2009.

When planting a *Verticillium* wilt susceptible variety, the continuous cotton system lost more money than the 2 year cotton/1 year sorghum system at all irrigation rates (Fig. 2A).

The profit margin of the rotation system compared to continuous cotton, increased under wetter conditions (higher irrigation rate or ET=80). When planting a *Verticillium* wilt tolerant variety, the two crop rotation systems were more profitable than the continuous cotton at all irrigation rates (Fig. 2B). The 1 year cotton/1 year sorghum rotation was the most profitable at the 0.5B irrigation rate (Fig. 2B). At the base irrigation rate and 60%ET, all three systems performed similarly, but at 80% ET, the crop rotation system was better than continuous cotton. At the 1.5B irrigation rate, the rotated systems were better than continuous cotton (Fig. 2B).

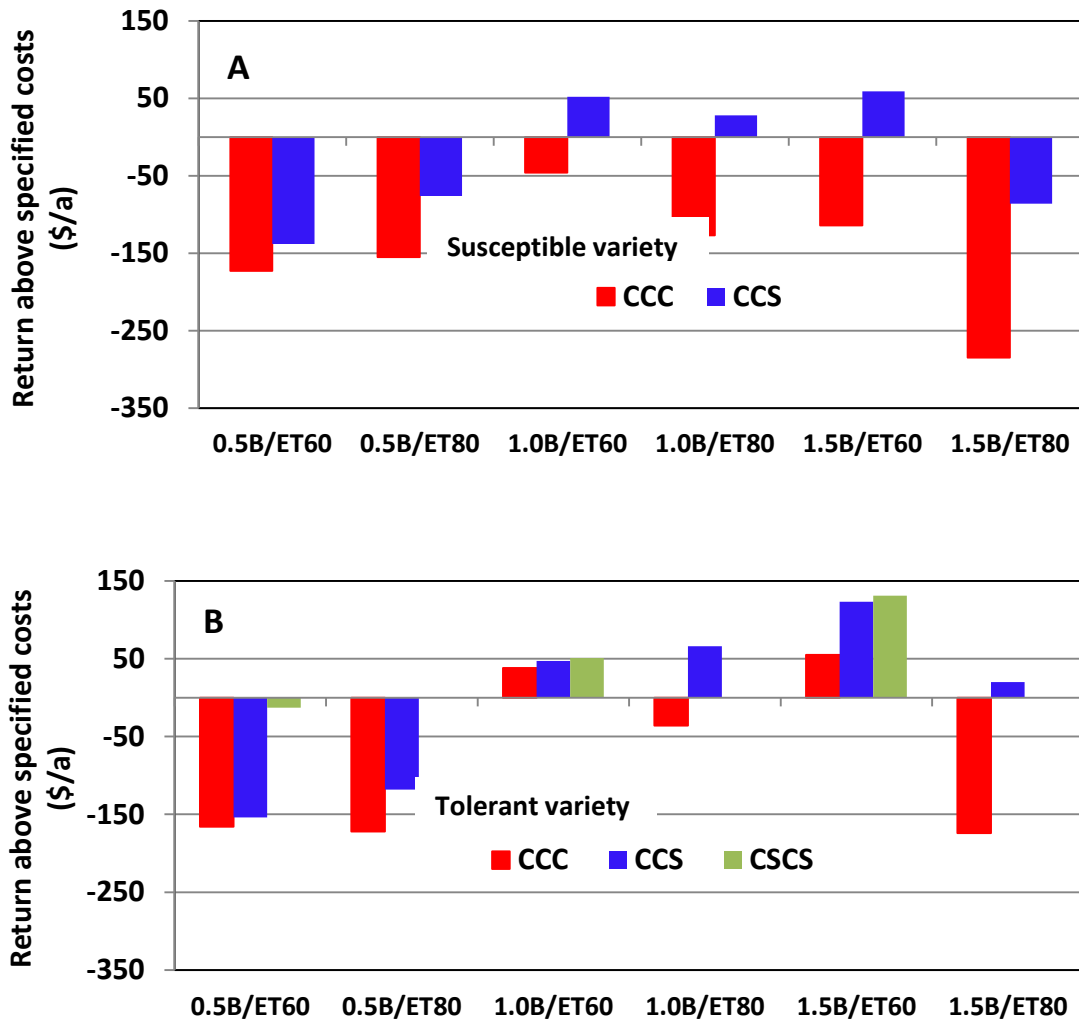


Figure 2. Effect of crop rotation and irrigation rate on the returns above total specified costs (\$/acre) for varieties susceptible (A) and tolerant (B) to *Verticillium* wilt. The cropping systems compared were continuous cotton (CCC), 2 yr cotton and 1 yr sorghum (CCS), and 1 yr cotton/1 yr sorghum (CSCS). Irrigation rate consisted of a base rate (1.0B), 50% below the base rate (0.5B) and 50% above the base rate (1.5B). The base rate targeted an evapotranspiration rate (ET) of 80% in 2007-2009 and 60% in 2010 – 2013.

The Effect of Crop Rotation, Irrigation Rate, Irrigation Timing, and Tillage on Verticillium wilt in 2014.

T. A. Wheeler, J. P. Bordovsky, J. W. Keeling, and J. E. Woodward

Objective: Measure Verticillium wilt under multiple growing conditions.

Methodology: Verticillium wilt was measured on all the following treatments:

Crop rotation (wedges A, B, F): Wedge B, crop rotation (2 year cotton/1 year sorghum – in place since 2001); and wedges A and F, which had been in continuous cotton from 2001 – 2009, and then rotated every other year with sorghum since 2010.

Irrigation rate (wedges A, B, F): base irrigation rate (1.0B) targeted 60% of the evapotranspiration rate of cotton, when pumping capacity was sufficient; 0.5B was 50% less than 1.0B; 1.5B was 50% higher than 1.0B.

Irrigation timing (wedge D): An alternative irrigation treatment delayed irrigation until the plants began to flower. This was compared to an earlier (regular) initiation of irrigation.

Tillage (wedges A, B, F): Every other span of all wedges either had beds and conventional tillage, where irrigation was applied to furrow diked areas (every other row), or water was applied to flat ground on every other furrow and no tillage.

Results:

Crop rotation: Verticillium wilt was higher (26%) on the wedges that had been in long-term cotton prior to 2010 and then rotated every other year with sorghum (wedges A and F), than on the wedge that had been in a long-term cotton/cotton/sorghum rotation (15%).

Irrigation rate affected wilt incidence with an average wilt incidence of 8%, 19%, and 34% for the 0.5B, 1.0B, and 1.5B rates respectively.

Irrigation timing: The delayed irrigation treatment in wedge D had significantly less wilt (8.5%) on 14 August than the normally timed irrigation treatment (12.5%). Similarly, wilt averaged 7 and 10% for the delayed and normally timed irrigation treatments on 27 August.

Tillage treatments: There was more wilt on the bedded rows (23% wilt incidence) than on the flat rows (15%).

The effects of the long-term (2001 – 2009) continuous cotton are still being seen, even though wedges A and F have been rotated every other year with sorghum since 2010. They still have more Verticillium wilt than in wedge B which has been in a long-term rotation since 2001. Irrigation rate performed typically with higher irrigation rate resulting in more Verticillium wilt. The delay in starting irrigation until flowering does show a slight reduction in Verticillium wilt relative to normal irrigation initiation, without hurting yield. The cotton on beds had higher Verticillium wilt than cotton on flat ground, which was unexpected. Generally the beds would be expected to have a higher temperature than no-till flat ground, which should lead to lower Verticillium wilt. However, in this case, the lack of furrow dikes resulted in poorer water infiltration on flat ground and was less conducive (drier) for Verticillium wilt.

Effect of Nitrogen Fertilizer on Cotton Fleahopper Damage Potential and Crop Response to Injury

M.N. Parajulee, A. Hakeem, R. Norman, S.C. Carroll, J.P. Bordovsky

Objective: The objective was to evaluate the effect of nitrogen fertilizer application rates on cotton fleahopper damage potential and cotton's response to fleahopper injury.

Methodology: A high-yielding FiberMax® cultivar, FM 9063B2F, was planted at a targeted rate of 54,000 seeds/acre on May 19, 2014. The experiment was a split-plot randomized block design with five nitrogen fertility rate treatments as main plot, two insect augmentation treatments as sub-plots, and five replications. The five main-plot treatments included pre-bloom side-dress applications of augmented nitrogen fertilizer rates of 0, 50, 100, 150, and 200 lbs N/acre using a soil applicator injection rig on 23 July. Pre-treatment soil samples (consisting of three 0 to 24-inch depth soil cores; each subdivided into 0 to 12-inch and 12 to 24-inch sections and bagged according to depth), were collected from each of the 25 experiment plots on July 10, 2014. Two 10-ft. sections of uniform cotton were flagged in the middle two rows of each 16-row main-plot that served as two insect treatment sub-plots. The sub-plot treatments included two cotton fleahopper augmentation levels (5 nymphs per plant vs. no fleahoppers augmented as control) applied to each of the five nitrogen rates two weeks into cotton squaring to simulate an acute infestation of cotton fleahoppers. Crop growth and fruiting patterns were monitored during the crop season and the treatment plots were harvested for lint yield and fiber analysis.

Results: Plant growth response varied significantly to variable rates of N (Fig. 1). Leaf size was slightly smaller in zero and 50 lb N plots, but the leaf chlorophyll in zero N plots was much lower than that for other plots throughout the growing season. The leaf chlorophyll content in zero N plots declined precipitously beginning in late August, when plants began allocating much of their resources to boll maturation, whereas this phenomenon did not occur in plots that received ≥ 50 lb N/acre. Percentage leaf nitrogen declined as season progressed, especially when plants began diverting its energy to fruit maturation. However, the leaf nitrogen content in zero N plots began to decline soon after cotton began flowering.

The lint yields in 50 and 100 lb N plots were significantly lower (Fig. 2) in fleahopper augmented plots (25% square loss) compared to that in control plots, suggesting that the plant response to cotton fleahopper injury is greatly influenced by nitrogen fertility.

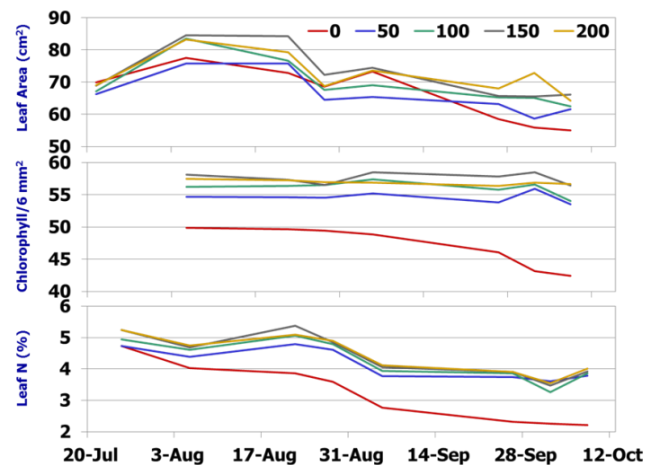


Fig. 1. Temporal dynamics of leaf growth (leaf area), chlorophyll, and % leaf nitrogen content measured on fifth mainstem leaf as influenced by the variable rates of augmented nitrogen (lb N/acre), 2014.

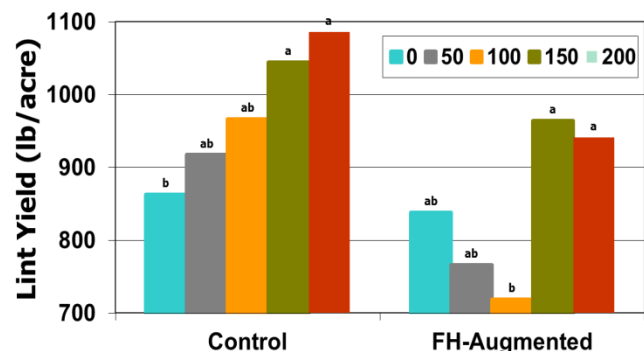


Fig. 2. Effect of nitrogen augmentation rates on lint yield following a single acute infestation of cotton fleahopper versus unfested control, 2014.

APPENDIX

2014 Rain and Irrigation Amooounts at Helm Research Farm, Halfway

			Rainfall (inches)																												
Date			Halfway @ Building	Helms @ Well 1	Field 2					Field 3						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			Field 5 - D East span 2				
					Drip					Drip							Pivot				Pivot	Pivot				Pivot	Pivot			Pivot	
					Cotton					n							n				Cotton	Cotton				Wheat	Wheat			Cotton	
										Prewater Irr.			Inseason Irr.																		
Mo	Da	Yr			Trt.1	Trt. 2	Trt. 3	Dry	system	Zones 1,3,4	Zones 2,5,6	Border	Zones 1,4,5, 6	Zones 2,3	Border	system	Base	Base- 50%	Base +50%	system		Base	Base- 50%	Base+ 50%	system		Base	Base- 50%	Base +50%	system	
12	12	2013																								0.75	0.75	0.75	0.75	S	
12	13	2013	0.01	0.01																						0.75	0.75	0.75	0.75		
12	14	2013																								0.75	0.75	0.75	0.75	S	
12	15	2013																												0.75	
12	20	2013	0.02	0.02																											
12	21	2013	0.09	0.09																											
2	2	2014	0.03	0.03																											
2	4	2014	0.05	0.05																											
3	3	2014	0.07	0.07																											
3	8	2014	0.01	0.01																											
3	9	2014																													
3	10	2014			0.54	0.56	0.52	0.14	D			0.79																			
3	26	2014	0.17	0.17																											
4	6	2014	0.05	0.05																											
4	8	2014																													
4	9	2014																													
4	10	2014																													
4	11	2014																													
4	12	2014																													
4	13	2014																													
4	14	2014								0.17						D															
4	15	2014								0.20						D															
4	16	2014								0.20						D															
4	17	2014								0.16						D										0.25	0.25	0.25	0.25	S	0.25
4	18	2014								0.16						D										0.25	0.25	0.25	0.25	S	0.25
4	19	2014	0.04	0.07						0.19						D															
4	20	2014								0.19						D															
4	21	2014								0.22						D															
4	22	2014								0.20						D	0.40	0.40	0.40		0.40	0.40	0.40	0.40	L						
4	23	2014								0.21						D	0.40	0.40	0.40		0.40	0.40	0.40	0.40	L						
4	24	2014								0.22						D	0.40	0.40	0.40		0.40	0.40	0.40	0.40	L						
4	25	2014								0.27						D	0.40	0.40	0.40		0.40	0.40	0.40	0.40	L						
4	26	2014								0.22						D	0.40	0.40	0.40		0.40	0.40	0.40	0.40	L						
4	27	2014								0.23						D	0.40	0.40	0.40		0.40	0.40	0.40	0.40	L						

2014 Rain and Irrigation Amooounts at Helm Research Farm, Halfway

			Rainfall (inches)																																									
Date			Halfway @ Building		Helms @ Well 1		Field 2										Field 3				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				Field 5 - D East span 2							
Mo	Da	Yr				Drip				system	Zones 1,3,4	Zones 2,5,6	Border	Zones 1,4,5, 6	Zones 2,3	Border	system	Base	Base- 50%	Base +50%	system		Base	Base- 50%	Base+ 50%	system		Base	Base- 50%	Base +50%	system		Base	Base- 50%	Base +50%	system								
																																						Pivot n	Pivot n	Cotton	Cotton	Pivot Wheat	Pivot Wheat	Pivot Cotton
4	28	2014				0.24	0.25	0.25	0.28	D	0.19	0.21					D	0.40	0.40	0.40		0.40	0.40	0.40	0.40	L		0.40	0.40	0.40	0.40	L	0.40											
4	29	2014				0.24	0.26	0.26	0.28	D	0.22	0.22					D											0.40	0.40	0.40	0.40	L	0.40											
4	30	2014				0.24	0.22	0.22	0.28	D	0.19	0.20					D	0.30	0.30	0.30		0.30	0.30	0.30	0.30	L																		
5	1	2014				0.24	0.27	0.27	0.27	D	0.22	0.23					D											0.40	0.40	0.40	0.40	L	0.40											
5	2	2014				0.33	0.32	0.35	0.35	D	0.28	0.28					D											0.40	0.40	0.40	0.40	L	0.40											
5	3	2014				0.18	0.21	0.19	0.27	D	0.18	0.18					D											0.40	0.40	0.40	0.40	L	0.40											
5	4	2014				0.19	0.21	0.20	0.28	D	0.17	0.17					D																											
5	5	2014				0.24	0.26	0.26	0.28	D	0.21	0.22					D											0.40	0.40	0.40	0.40	L	0.40											
5	6	2014				0.03	0.15	0.03		D	0.23	0.23					D											0.40	0.40	0.40	0.40	L												
5	7	2014				0.17				D	0.17	0.26	0.81				D																											
5	8	2014									0.04	0.30	0.76				D																											
5	9	2014																																										
5	10	2014																0.60	0.60	0.60		0.60	0.60	0.60	0.60	S																		
5	11	2014																										0.60	0.60	0.60	0.60	S												
5	12	2014																															0.60											
5	13	2014																																										
5	14	2014																																										
5	15	2014																																										
5	16	2014																																										
5	17	2014																0.40	0.40	0.40		0.40	0.40	0.40	0.40	S																		
5	18	2014																										0.40	0.40	0.40	0.40	S	0.40											
5	19	2014									0.11	0.11	0.16				D																											
5	20	2014									0.13	0.09	0.09				D																											
5	21	2014									0.08	0.12	0.12				D											0.30	0.30	0.30	0.30	S	0.30											
5	22	2014	0.14	0.12							0.09	0.08	0.12				D	0.30	0.30	0.30		0.30	0.30	0.30	0.30	S																		
5	23	2014	1.31	1.35																																								
5	24	2014	0.77	0.88																																								
5	25	2014	0.74	0.84																																								
5	26	2014	0.69	0.78																																								
5	27	2014																																										
6	5	2014																																										
6	6	2014	0.55	0.59																																								
6	7	2014	1.22	1.30																																								
6	8	2014	0.02	0.01																																								

2014 Rain and Irrigation Amooounts at Helm Research Farm, Halfway

			Rainfall (inches)																													
Date			Halfway @ Building	Helms @ Well 1	Field 2					Field 3							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				Field 5 - D East span 2
Mo	Da	Yr			Trt.1	Trt. 2	Trt. 3	Dry	system	Zones 1,3,4	Zones 2,5,6	Border	Zones 1,4,5, 6	Zones 2,3	Border	system	Base	Base- 50%	Base +50%	system	Base	Base- 50%	Base+ 50%	system	Base	Base- 50%	Base +50%	system	Base	Base- 50%	Base +50%	system
					Drip					Drip							Pivot				Pivot	Pivot					Pivot	Pivot				Pivot
					Cotton					n							n				Cotton	Cotton					Wheat	Wheat				Cotton
										Prewater Irr.			Inseason Irr.																			
6	9	2014	0.64	0.67																												
6	10	2014																														
6	11	2014																														
6	12	2014																														
6	13	2014	0.24	0.34																												
6	14	2014																														
6	15	2014																														
6	16	2014																														
6	17	2014																														
6	18	2014																														
6	19	2014	0.56	0.73																												
6	20	2014																														
6	21	2014																														
6	22	2014																														
6	23	2014																														
6	24	2014	0.40	0.56																												
6	25	2014																														
6	26	2014																														
6	27	2014																														
6	28	2014																														
6	29	2014																														
6	30	2014																														
7	1	2014	0.56	0.81																												
7	2	2014	0.60	0.59																												
7	3	2014																														
7	13	2014																														
7	14	2014	0.89	0.83																												
7	15	2014																														
7	16	2014	0.32	0.44																												
7	17	2014	0.93	0.69																												
7	18	2014																														
7	19	2014																														
7	20	2014																														
7	21	2014																														
7	22	2014																														
7	23	2014			0.46	0.84	1.22		D																							
7	24	2014			0.06	0.09	0.25		D																							
7	25	2014			0.11	0.12	0.12		D																							

2014 Rain and Irrigation Amooounts at Helm Research Farm, Halfway

			Rainfall (inches)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
Date			Halfway @ Building		Helms @ Well 1						Field 3						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		Field 5 - D East span 2																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
Mo	Da	Yr					Trt. 1		Trt. 2		Trt. 3		Dry		system	Zones 1,3,4		Zones 2,5,6		Border		Zones 1,4,5, 6		Zones 2,3		Border		system	Base		Base- 50%		Base+ 50%		system			Base		Base- 50%		Base+ 50%		system																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
7	26	2014							0.08	0.09				D																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

2014 Rain and Irrigation Amooounts at Helm Research Farm, Halfway

			Rainfall (inches)																												
Date			Halfway @ Building	Helms @ Well 1	Field 2					Field 3						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				Field 5 - D East span 2		
					Drip					Drip							Pivot				Pivot	Pivot				Pivot	Pivot				Pivot
					Cotton					n							n				Cotton	Cotton				Wheat	Wheat				Cotton
										Prewater Irr.			Inseason Irr.																		
Mo	Da	Yr			Trt.1	Trt. 2	Trt. 3	Dry	system	Zones 1,3,4	Zones 2,5,6	Border	Zones 1,4,5, 6	Zones 2,3	Border	system	Base	Base- 50%	Base +50%	system		Base	Base- 50%	Base+ 50%	system		Base	Base- 50%	Base +50%	system	
9	2	2014			0.26	0.53	0.76		D								0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20
9	3	2014											0.21	0.23	0.11	D	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20
9	4	2014											0.17	0.15	0.03	D															
9	5	2014	1.52	1.62																											
9	6	2014																													
9	9	2014																													
9	11	2014	0.19	0.15																											
9	12	2014	0.12	0.14																											
9	13	2014																													
9	14	2014	0.01	0.01																											
9	15	2014																													
9	16	2014																													
9	18	2014	3.20	3.40																											
9	19	2014	0.33	0.30																											
9	20	2014	0.10	0.08																											
9	25	2014	0.05	0.03																											
9	27	2014																													
9	28	2014																													
10	10	2014	0.06	0.13																											
10	12	2014	0.05	0.05																											
10	13	2014	0.06	0.05																											
10	22	2014	0.18	0.30																											
Pre & At Plant			4.19	4.54	2.64	2.71	2.55	2.43		5.35	2.90	2.85					4.40	4.40	3.60		4.40	4.40	4.40	4.40		3.70	3.70	3.70	3.70		3.30
Seasonal			14.11	16.00	2.68	5.10	7.31	0.00					2.84	2.27	1.44		2.50	1.40	3.60		2.50	2.50	1.40	3.60		1.20	1.20	0.60	1.80		2.90
TOTALS			18.30	20.54	5.32	7.81	9.86	2.43					Totals for Zones				6.90	5.80	7.20		6.90	6.90	5.80	8.00		4.90	4.90	4.30	5.50		6.20

2014 Rain and Irrigation Amooounts at Helm Research Farm, Halfway

Rainfall (inches)

D= driip irrigation, L = LEI D= driip irrigation, L = LEPA irrigation, S = spray irrigation, F= furrow water

Date			Halfway @ Building	Helms @ Well 1	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,B,C, E	Field 6 F	Field 6 G	Field 6 H	
					Pivot				Pivot	Pivot				Pivot	Pivot				Pivot	Pivot				Drip	Drip	Drip	Drip	
					Cotton				Cotton	Cotton				Sorg	Sorg				Cotton	Cotton				Cotton	Cotton	Cotton	Cotton	
Mo	Da	Yr			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	
12	12	2013																										
12	13	2013	0.01	0.01	0.75	0.75	0.75	S	0.75	0.75	0.75	0.75	S															
12	14	2013																										
12	15	2013			0.75	0.75	0.75	S	0.75	0.75	0.75	0.75	S															
12	20	2013	0.02	0.02																								
12	21	2013	0.09	0.09																								
2	2	2014	0.03	0.03																								
2	4	2014	0.05	0.05																								
3	3	2014	0.07	0.07																								
3	8	2014	0.01	0.01																								
3	9	2014																										
3	10	2014																										
3	26	2014	0.17	0.17																								
4	6	2014	0.05	0.05																								
4	8	2014																										
4	9	2014																						0.24	0.24	0.14	0.16	D
4	10	2014																						0.24	0.24	0.13	0.16	D
4	11	2014																						0.33	0.33	0.13	0.12	D
4	12	2014																						0.27	0.27	0.13	0.14	D
4	13	2014																						0.26	0.26	0.13	0.14	D
4	14	2014																						0.15	0.15	0.13	0.05	D
4	15	2014																						0.29	0.29	0.13	0.14	D
4	16	2014																						0.28	0.28	0.13	0.14	D
4	17	2014			0.25	0.25	0.25	S	0.25	0.25	0.25	0.25	S											0.25	0.25	0.13	0.14	D
4	18	2014			0.25	0.25	0.25	S	0.25	0.25	0.25	0.25	S											0.39	0.39	0.13	0.14	D
4	19	2014	0.04	0.07																				0.21	0.21	0.13	0.14	D
4	20	2014																						0.22	0.22	0.13	0.14	D
4	21	2014																0.40	0.40	0.40	0.40	L	0.26	0.26	0.13	0.14	D	
4	22	2014																						0.24	0.24	0.13	0.14	D
4	23	2014																0.40	0.40	0.40	0.40	L	0.25	0.25	0.13	0.14	D	
4	24	2014																0.40	0.40	0.40	0.40	L	0.26	0.26	0.13	0.14	D	
4	25	2014																0.40	0.40	0.40	0.40	L	0.32	0.32	0.13	0.14	D	
4	26	2014																0.40	0.40	0.40	0.40	L	0.26	0.26	0.13	0.14	D	
4	27	2014																0.40	0.40	0.40	0.40	L	0.27	0.27	0.12	0.14	D	

2014 Rain and Irrigation Amooounts at Helm Research Farm, Halfway

Rainfall (inches)

D= driip irrigation, L = LEI D= driip irrigation, L = LEPA irrigation, S = spray irrigation, F= furrow water

Date			Halfway @ Building	Helms @ Well 1	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,B,C, E	Field 6 F	Field 6 G	Field 6 H	
					Pivot				Pivot	Pivot				Pivot	Pivot				Pivot	Pivot				Drip	Drip	Drip	Drip	
					Cotton				Cotton	Cotton				Sorg	Sorg				Cotton	Cotton				Cotton	Cotton	Cotton	Cotton	
Mo	Da	Yr			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	
4	28	2014																L	0.40	0.40	0.40	0.40	L	0.24	0.24	0.13	0.14	D
4	29	2014			0.40	0.40	0.40	L	0.40	0.40	0.40	0.40	L	0.40	0.40	0.40	0.40	L					L	0.28	0.28	0.13	0.14	D
4	30	2014																L	0.30	0.30	0.30	0.30	L	0.26	0.26	0.13	0.14	D
5	1	2014			0.40	0.40	0.40	L	0.40	0.40	0.40	0.40	L	0.40	0.40	0.40	0.40	L					L	0.29	0.29	0.13	0.14	D
5	2	2014			0.40	0.40	0.40	L	0.40	0.40	0.40	0.40	L	0.40	0.40	0.40	0.40	L					L	0.37	0.37	0.13	0.14	D
5	3	2014			0.40	0.40	0.40	L	0.40	0.40	0.40	0.40	L	0.40	0.40	0.40	0.40	L					L	0.22	0.22	0.13	0.14	D
5	4	2014																L					L	0.22	0.22	0.13	0.14	D
5	5	2014			0.40	0.40	0.40	L	0.40	0.40	0.40	0.40	L	0.40	0.40	0.40	0.40	L					L	0.28	0.28	0.13	0.14	D
5	6	2014												0.40	0.40	0.40	0.40	L					L	0.30	0.30	0.13	0.14	D
5	7	2014												0.40	0.40	0.40	0.40	L					L	0.22	0.22	0.12	0.14	D
5	8	2014																L	0.60	0.60	0.60	0.60	S	0.21	0.21	0.07	0.14	D
5	9	2014																L					S	0.26	0.26	0.77	0.60	D
5	10	2014																L					S	0.13	0.13	0.42	0.51	D
5	11	2014																L					S	0.14	0.14	0.43	0.51	D
5	12	2014			0.60	0.60	0.60	S	0.60	0.60	0.60	0.60	S					L					S	0.16	0.16	0.55	0.53	D
5	13	2014																L					S	0.15	0.15	0.55	0.46	D
5	14	2014																L					S	0.16	0.16	0.55	0.57	D
5	15	2014																L					S	0.15	0.15	0.55	0.51	D
5	16	2014																L	0.40	0.40	0.40	0.40	S	0.10	0.10	0.15	0.14	D
5	17	2014																L					S	0.12	0.12	0.15	0.14	D
5	18	2014			0.40	0.40	0.40	S	0.40	0.40	0.40	0.40	S					L					S	0.12	0.12	0.16	0.14	D
5	19	2014																L					S	0.10	0.10	0.14	0.26	D
5	20	2014																L					S	0.11	0.11	0.14	0.01	D
5	21	2014			0.30	0.30	0.30	S	0.30	0.30	0.30	0.30	S					L					S	0.11	0.11	0.13	0.14	D
5	22	2014	0.14	0.12														L	0.30	0.30	0.30	0.30	S	0.10	0.10	0.02	0.14	D
5	23	2014	1.31	1.35														L					S					
5	24	2014	0.77	0.88														L					S					
5	25	2014	0.74	0.84														L					S					
5	26	2014	0.69	0.78														L					S					
5	27	2014																L					S					
6	5	2014																L					S					
6	6	2014	0.55	0.59														L					S					
6	7	2014	1.22	1.30														L					S					
6	8	2014	0.02	0.01														L					S					

2014 Rain and Irrigation Amooounts at Helm Research Farm, Halfway

Rainfall (inches)

D= driip irrigation, L = LEI D= driip irrigation, L = LEPA irrigation, S = spray irrigation, F= furrow water

Date			Halfway @ Building	Helms @ Well 1	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,B,C, E	Field 6 F	Field 6 G	Field 6 H
Mo	Da	Yr			Pivot				Pivot	Pivot				Pivot	Pivot				Pivot	Pivot				Drip	Drip	Drip	Drip
					Cotton				Cotton	Cotton				Sorg	Sorg				Cotton	Cotton				Cotton	Cotton	Cotton	Cotton
					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
6	9	2014	0.64	0.67																							
6	10	2014																									
6	11	2014																									
6	12	2014																									
6	13	2014	0.24	0.34																							
6	14	2014																									
6	15	2014																									
6	16	2014																									
6	17	2014																									
6	18	2014																									
6	19	2014	0.56	0.73																							
6	20	2014																									
6	21	2014																									
6	22	2014																									
6	23	2014																									
6	24	2014	0.40	0.56																							
6	25	2014																									
6	26	2014																									
6	27	2014																									
6	28	2014																									
6	29	2014																									
6	30	2014																									
7	1	2014	0.56	0.81																							
7	2	2014	0.60	0.59																							
7	3	2014																									
7	13	2014																									
7	14	2014	0.89	0.83																							
7	15	2014																									
7	16	2014	0.32	0.44																							
7	17	2014	0.93	0.69																							
7	18	2014																									
7	19	2014																									
7	20	2014																									
7	21	2014																									
7	22	2014																									
7	23	2014																									
7	24	2014																									
7	25	2014																									

2014 Rain and Irrigation Amooounts at Helm Research Farm, Halfway

Rainfall (inches)

D= driip irrigation, L = LEI D= driip irrigation, L = LEPA irrigation, S = spray irrigation, F= furrow water

Date			Halfway @ Building	Helms @ Well 1	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,B,C, E		Field 6 F	Field 6 G	Field 6 H	
					Pivot				Pivot	Pivot				Pivot	Pivot				Pivot	Pivot					Drip	Drip	Drip	Drip		
					Cotton				Cotton	Cotton				Sorg	Sorg				Cotton	Cotton					Cotton	Cotton	Cotton	Cotton		
Mo	Da	Yr			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	26	2014																												
7	27	2014																												
7	28	2014																												
7	29	2014			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	0.30	0.30	0.30	0.30	S							
7	30	2014																												
7	31	2014																						0.10					D	
8	1	2014			0.25	0.13	0.38	L						0.25	0.25	0.13	0.38	L	0.25	0.25	0.13	0.38	L							
8	2	2014																												
8	3	2014			0.25	0.13	0.38	L						0.25	0.25	0.13	0.38	L	0.25	0.25	0.13	0.38	L							
8	4	2014																						0.07					D	
8	5	2014																									0.36	0.44	D	
8	6	2014			0.25	0.13	0.38	L						0.25	0.25	0.13	0.38	L	0.25	0.25	0.13	0.38	L	0.11	0.11	0.15	0.14	D		
8	7	2014			0.25	0.13	0.38	L	0.25	0.25	0.13	0.38	L	0.25	0.25	0.13	0.38	L	0.25	0.25	0.13	0.38	L	0.12	0.12	0.15	0.14	D		
8	8	2014																						0.14	0.12	0.15	0.14	D		
8	9	2014																						0.13	0.12	0.15	0.14	D		
8	10	2014																						0.13	0.12	0.15	0.14	D		
8	11	2014	1.15	2.12																										
8	12	2014																												
8	13	2014																												
8	14	2014																												
8	15	2014			0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L						0.09	0.03	0.14	0.15	D		
8	16	2014																						0.12	0.12	0.15	0.14	D		
8	17	2014																						0.12	0.12	0.15	0.15	D		
8	18	2014																						0.12	0.11	0.13	0.14	D		
8	19	2014			0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.11	0.11	0.13	0.14	D		
8	20	2014			0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.15	0.12	0.13	0.14	D		
8	21	2014			0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.40	0.40	0.20	0.60	L						0.12	0.12	0.14	0.14	D		
8	22	2014																												
8	23	2014																												
8	24	2014																												
8	25	2014												0.20	0.20	0.10	0.30	L						0.13	0.12	0.14	0.14	D		
8	26	2014	0.16	0.06																				0.15	0.14	0.13	0.15	D		
8	27	2014			0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.08	0.09	0.14	0.14	D		
8	28	2014			0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.12	0.12	0.14	0.14	D		
8	29	2014																												
8	30	2014																												
8	31	2014																												
9	1	2014																												

2014 Rain and Irrigation Amooounts at Helm Research Farm, Halfway

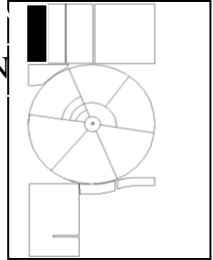
Rainfall (inches)

D= driip irrigation, L = LEI D= driip irrigation, L = LEPA irrigation, S = spray irrigation, F= furrow water

Date			Halfway @ Building	Helms @ Well 1	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,B,C, E	Field 6 F	Field 6 G	Field 6 H
Mo	Da	Yr			Base	Base- 50%	Base+ 50%	system		Base	Base- 50%	Base+ 50%	system		Base	Base- 50%	Base+ 50%	system		Base	Base- 50%	Base+ 50%	system				
					Pivot				Pivot	Pivot				Pivot	Pivot				Pivot	Pivot				Drip	Drip	Drip	Drip
					Cotton				Cotton	Cotton				Sorg	Sorg				Cotton	Cotton				Cotton	Cotton	Cotton	Cotton
9	2	2014			0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.15	0.17	0.14	0.15
9	3	2014			0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.20	0.20	0.10	0.30	L	0.08	0.14	0.14	0.14
9	4	2014																									
9	5	2014	1.52	1.62																							
9	6	2014																									
9	9	2014																									
9	11	2014	0.19	0.15																							
9	12	2014	0.12	0.14																							
9	13	2014																									
9	14	2014	0.01	0.01																							
9	15	2014																									
9	16	2014																									
9	18	2014	3.20	3.40																							
9	19	2014	0.33	0.30																							
9	20	2014	0.10	0.08																							
9	25	2014	0.05	0.03																							
9	27	2014																									
9	28	2014																									
10	10	2014	0.06	0.13																							
10	12	2014	0.05	0.05																							
10	13	2014	0.06	0.05																							
10	22	2014	0.18	0.30																							
Pre & At Plant			4.19	4.54	3.30	3.30	3.30	#	3.30	3.30	3.30	3.30		2.80	2.80	2.80	2.80		4.40	4.40	4.40	4.40	#	9.79		8.54	8.79
Seasonal			14.11	16.00	2.90	1.60	4.20		2.15	2.15	1.23	3.08		3.30	3.30	1.80	4.80		2.50	2.50	1.40	3.60		2.34		2.91	3.00
TOTALS			18.30	20.54	6.20	4.90	7.50		5.45	5.45	4.53	6.38		6.10	6.10	4.60	7.60		6.90	6.90	5.80	8.00		12.13		11.45	11.79

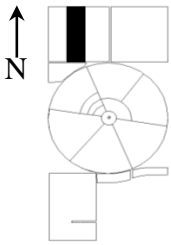
Operations Summary

Year	2014
Farm	Helm
Field ID	Field 1 Corn Hybrids for Drought Tolerance Xu
Exp. Design	5 zones, 24 rows x 1300' plots, 40" row width
Soil Type	

Field Operations	Date	Activity	<div>Field 1</div> 
Tillage	12/3/2013	Shred F.1 North	
	1/21/2014	Disk F.1 North 2 times	
	3/6/2014	Field Cultivate F.1 North & F.1 South	
	3/6/2014	List F.1 North & F.1 South	
	5/30/2014	Rotary Hoe F.1 North & F.1 South	
	6/9/2014	Rotary Hoe F.1 North	
	6/11/2014	Cultivate F.1 South	
	12/8/2014	Shred F.1 North	
Fertility	3/6/2014	200-80-0 Dry F.1 South	
	3/6/2014	80-20-0 Dry F.1 North	
	6/5/2014	93.7 lbs of N applied thru colter rig F.1S	
Planting	5/9/2014	Corn plots F.1 South	
	6/3/2014	NexGin 1511 B2RF at 56,000 seed/ac F.1N	
Herbicide/Growth Regulator	5/14/2014	Atrazine 1qt/ac Warrant 3pt/ac Roundup 60oz/ac F.1 South	
	6/16/2014	Fusilade 12oz/ac F.1 North	
	7/7/2014	Cropsmart 40oz/ac Warrant 3pt/ac F.1 North	
	7/28/2014	Makaze 32oz/ac Warrant 3pt/ac Pentia 10oz/ac F.1 North	
Insecticide			
Harvest aid	10/27/2014	Boll Buster 1qt/ac ET 1.25oz/ac F.1 North	
	11/3/2014	Helmquat 3SL 1qt/ac F.1 North	
Irrigation Amt.			
PrePlant & Planting			
Seasonal			
Rainfall			
PrePlant & Planting			
Seasonal			

Operations Summary

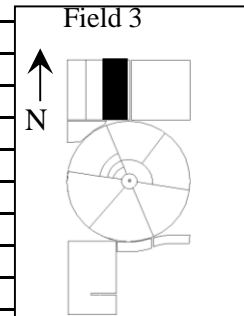
Year	2014	
Farm	Helm	
Field ID	Field 2	
Exp. Design	Cotton	Keeling
Soil Type		

Field Operations	Date	Activity	<div>Field 2</div> 
Tillage	2/24/2014	Rolling Cultivator	
	2/27/2014	List with bed rollers	
	2/28/2014	Cultivate and Dike	
	4/4/2014	Cultivate and Dike	
	6/20/2014	Rotary Hoe	
	6/25/2014	Rotary Hoe	
	7/3/2014	Rotary Hoe	
	12/9/2014	Shred	
Fertility	4/3/2014	37 lbs of N/ac + 13 lbs of P/ac applied Thru Colter rig at 50/50 mix Low water	
	4/3/2014	86 lbs of N/ac + 31 lbs of P/ac applied Thru Colter rig at 50/50 mix High water	
	7/25,29/2014	Trt. 1= 18lbs of N/ac; Trt. 2&3 = 28 lbs of N/ac (32-0-0) (Injected into drip Lines)	
Planting	5/7/2014	Phytogen/Nexgen at 56,000 seed/ac mixed plots	
Herbicide/Growth Regulator	2/24/2014	Trifluralin HF 2pt/ac	
	5/8/2014	Caporal 3pt/ac Round up 32oz/ac	
	6/10/2014	Cropsmart 32oz/ac	
	7/7/2014	Cropsmart 32oz/ac Warrant 3pt/ac	
	7/28/2014	Makaze 32oz/ac Warrant 3pt/ac	
Insecticide			
Harvest aid	10/29/2014	Boll Buster 1qt/ac ET 1.25oz.ac	
Irrigation Amt.			
PrePlant & Planting	3/10 to 5/7	Trt. 1 2.64 in; Trt. 2 2.71 in; Trt. 3 2.55 in.	
Seasonal	7/24 to 9/3	Trt. 1 2.68 in.; Trt. 2 5.11 in; Trt. 3 7.31 in.	
Rainfall			
PrePlant & Planting	1/1 to 5/7	0.45 in.	
Seasonal	5/7 to 9/18	19.03 in.	

Operations Summary

Year	2014
Farm	Helm
Field ID	Field 3
Exp. Design	Cotton
Soil Type	

Field Operations	Date	Activity
Tillage	12/2/2013	Shredder
	12/10/2013	Stalk Puller
	12/13/2013	Chisel
	2/19/2014	Disk
	2/21/2014	Field Cultivate
	2/27/2014	List
	5/30/2014	Rotary Hoe
	6/9/2014	Rotary Hoe
	6/20/2014	Rotary Hoe
	6/30/2014	Cultivate
	7/5/2014	Rotary Hoe
	7/25/2014	Cultivate
Fertility	4/2/2014	85 lbs of N + 30 lbs of P applied thru colter rig (50/50 mix)
	7/30/2014	8.8 lbs of N/ac (32-0-0) (injected into drip lines)
Planting	5/9/2014	Nexgen 1511 B2RF at 65,000 seed/ac Skip row on tape
	6/2/2014	Nexgen 1511 B2RF at 56,000 seed/ac replant
Herbicide/Growth Regulator	2/19/2014	Trifluralin HF 2pt/ac
	5/14/2014	Caporal 3pt/ac Round Up 32oz/ac
	7/7/2014	Cropsmart 32oz/ac Warrant 3pt/ac
	7/28/2014	Makaze 32oz/ac Warrant 3pt/ac
Insecticide		
Harvest aid	10/24/2014	Boll Buster 1qt/ac ET 1.25oz/ac
	10/31/2014	Helmquat 3SL 1qt/ac
Irrigation Amt.		
PrePlant & Planting Seasonal	3/10 to 5/23	Zones 1,3,4 5.35 in.; Zones 2,5,6 2.90 in.; Border 2.85 in.
	7/30 to 9/4	Zones 1,3,4 2.84 in.; Zones 2,5,6 2.27 in.; Border 1.44 in.
Rainfall		
PrePlant & Planting Seasonal	1/1 to 5/7	0.45 in.
	5/7 to 9/18	19.03 in.

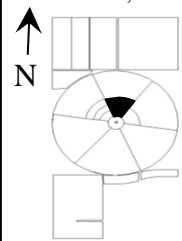


Operations Summary

Year	2014
Farm	Helm
Field ID	Field 5a Span 2
Exp. Design	Cotton
Soil Type	

Field Operations	Date	Activity
Tillage	1/13/2014	Chisel
	2/19/2014	Disk
	2/21/2014	Lister (Roller & Bed Conditioners)
	4/4/2014	Cultivate and Dike
	6/9/2014	Rotary Hoe
	6/20/2014	Rotary Hoe
	6/25/2014	Rotary Hoe
	7/5/2014	Rotary Hoe
	7/24/2014	Cultivate & Dike
Fertility	2/17/2014	30-30-0 Dry
	3/28/2014	71 lbs of N/ac + 25 lbs of P/ac Applied thru colter rig
Planting	5/14/2014	FM 2334 GLT at 54,000 seed/ac
	6/4/2014	FM 2011 GT at 52,000 seed/ac replant
Herbicide/Growth Regulator	2/18/2014	Trifluralin HF 2pt/ac
	5/14/2014	Caporal 3pt/ac Roundup 32oz/ac
	6/27/2014	Cropsmart 32oz/ac Warrant 3pt/ac
	7/3/2014	Cropsmart 44oz/ac
	7/25/2014	Makaze 32oz/ac Warrant 3pt/ac
Insecticide		
Harvest aid	10/23/2014	Boll Buster 1qt/ac ET 1.25oz/ac
	10/31/2014	Helmquat 3SL 1qt/ac
Irrigation Amt.		
PrePlant & Planting Seasonal	4/22 to 5/22	4.40 in.
	7/31 to 9/3	2.50 in.
Rainfall		
PrePlant & Planting Seasonal	1/1 to 5/7	0.45 in.
	5/7 to 9/18	19.03 in.

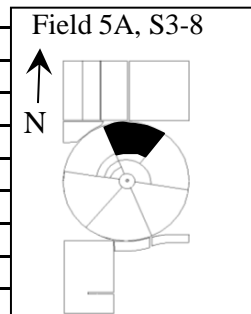
Field 5A, S 2



Operations Summary

Year	2014
Farm	Helm
Field ID	Field 5a Spans 3-8
Exp. Design	Cotton
Soil Type	

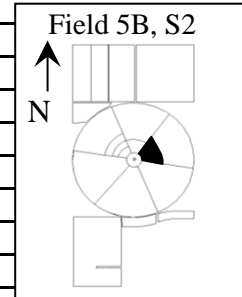
Field Operations	Date	Activity
Tillage	1/13/2014	Chisel
	2/19/2014	Disk
	2/21/2014	Lister (Roller & Bed Conditioners) Even Spans
	4/4/2014	Cultivate & Dike Even Spans
	6/9/2014	Rotary Hoe
	6/20/2014	Rotary Hoe
	6/25/2014	Rotary Hoe
	7/5/2014	Rotary Hoe
	7/24/2014	Cultivate & Dike Even Spans
Fertility	2/17/2014	30-30-0 Dry
	3/27/2014	19 lbs of N/ac Applied thru colter rig (Low Water)
	3/28/2014	71 lbs of N/ac + 25 lbs of P/ac Applied thru colter rig @ (overhang)
	4/1/2014	58 lbs of N/ac + 21 lbs of P/ac Applied thru colter rig (Med & High Water)
	7/22/2014	34 lbs of N/ac Applied thru colter rig (High Water)
Planting	5/14/2014	FM 2334 GLT at 54,000 seed/ac
	6/4/2014	FM 2011 GT at 52,000 seed/ac replant
Herbicide/Growth Regulator	2/18/2014	Trifluralin HF 2pt/ac
	5/14/2014	Caporal 3pt/ac Roundup 32oz/ac
	6/27/2014	Cropsmart 32oz/ac Warrant 3pt/ac
	7/3/2014	Cropsmart 44oz
	7/25/2014	Makaze 32oz/ac Warrant 3pt/ac
Insecticide		
Harvest aid	10/23/2014	Boll Buster 1qt/ac ET 1.25oz/ac
	10/31/2014	Helmquat 3SL 1qt/ac
Irrigation Amt.		
PrePlant & Planting Seasonal	4/22 to 5/7	Base 4.40 in.; Base -50% 4.40 in.; Base +50% 4.40 in.
	7/31 to 9/3	Base 2.50 in.; Base -50% 1.40 in.; Base +50% 3.60 in.
Rainfall		
PrePlant & Planting Seasonal	1/1 to 5/7	0.45 in.
	5/7 to 9/18	19.03 in.



Operations Summary

Year	2014
Farm	Helm
Field ID	Field 5b Span 2
Exp. Design	Cotton
Soil Type	

Field Operations	Date	Activity
Tillage	1/14/2014	Chisel
	2/19/2014	Disk
	2/21/2014	Lister (Roller & Bed Conditioners)
	4/4/2014	Cultivate and Dike
	6/9/2014	Rotary Hoe
	6/20/2014	Rotary Hoe
	6/25/2014	Rotary Hoe
	7/5/2014	Rotary Hoe
	7/24/2014	Cultivate & Dike
Fertility	2/17/2014	30-30-0 Dry
	3/28/2014	71 lbs of N/ac + 25 lbs of P/ac Applied thru colter rig
Planting	5/14/2014	FM 2334 GLT at 54,000 seed/ac
	6/4/2014	FM 2011 GT at 52,000 seed/ac replant
Herbicide/Growth Regulator	2/18/2014	Trifluralin HF 2pt/ac
	5/14/2014	Caporal 3pt/ac Roundup 32oz/ac
	6/27/2014	CropSmart 32oz/ac Warrant 3pt/ac
	7/3/2014	CropSmart 44oz/ac
	7/25/2014	Makaze 32oz/ac Warrant 3pt/ac
Insecticide		
Harvest aid	10/23/2014	Boll Buster 1qt/ac ET 1.25oz/ac
	10/31/2014	Helmquat 3SL 1qt/ac
Irrigation Amt.		
PrePlant & Planting Seasonal	4/22 to 5/22	4.40 in.
	7/31 to 9/3	2.50 in.
Rainfall		
PrePlant & Planting Seasonal	1/1 to 5/7	0.45 in
	5/7 to 9/18	19.03 in.

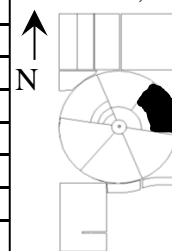


Operations Summary

Year	2014
Farm	Helm
Field ID	Field 5b Spans 3-8
Exp. Design	Cotton
Soil Type	

Field Operations	Date	Activity
Tillage	1/14/2014	Chisel
	2/19/2014	Disk
	2/21/2014	Lister (Roller & Bed Conditioners) Even Spans
	4/4/2014	Cultivate & Dike Even Spans
	6/9/2014	Rotary Hoe
	6/20/2014	Rotary Hoe
	6/25/2014	Rotary Hoe
	7/5/2014	Rotary Hoe
	7/24/2014	Cultivate & Dike Even Spans
Fertility	2/17/2014	30-30-0
	3/27/2014	19 lbs of N/ac Applied thru colter rig (Low Water)
	3/28/2014	71 lbs of N/ac + 25 lbs of P/ac Applied thru coulter rig (overhang)
	4/1/2014	58 lbs of N/ac + 21 lbs of P/ac Applied thru coulter rig (Med & High Water)
	7/22/2014	34 lbs of N/ac Applied thru colter rig (High Water)
Planting	5/14/2014	FM 2334 GLT at 54,000 seed/ac
	6/4/2014	FM 2011 GT at 52,000 seed/ac replant
Herbicide/Growth Regulator	2/18/2014	Trifluralin HF 2pt/ac
	5/14/2014	Caporal 3pt/ac Roundup 32oz/ac
	6/27/2014	Cropsmart 32 oz/ac Warrant 3pt/ac
	7/3/2014	Cropsmart 44oz/ac
	7/25/2014	Makaze 32oz/ac Warrant 3pt/ac
Insecticide		
Harvest aid	10/23/2014	Boll Buster 1qt/ac ET 1.25oz/ac
	10/31/2014	Helmquat 3SL 1qt/ac
Irrigation Amt.		
PrePlant & Planting Seasonal	4/22 to 5/22	Base = 4.40 in.; Base -50% = 4.40 in.; Base +50% = 4.40 in.
	7/31 to 9/3	Base = 2.50 in.; Base -50% = 1.40 in.; Base +50% = 3.60 in.
Rainfall		
PrePlant & Planting Seasonal	1/1 to 5/7	0.45 in.
	5/7 to 9/18	19.03 in.

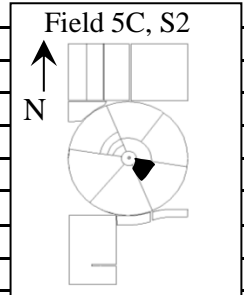
Field 5B, S3-8



Operations Summary

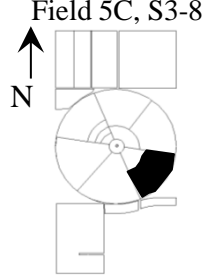
Year	2014
Farm	Helm
Field ID	Field 5c (Span 2)
Exp. Design	Wheat
Soil Type	

Field Operations	Date	Activity
Tillage	11/20/2013	Shred
	12/3/2013	Field Cultivate
	3/11/2014	Track Fill
	4/21/2014	Track Fill
	9/4/2014	Strip Till
	9/5/2014	Strip Till
Fertility	12/2/2013	30-30-0 Dry
Planting	12/11/2013	Greer Wheat at 70lbs/ac
Herbicide/Growth Regulator	6/18/2014	Cropsmart 64oz/ac
	7/22/2014	Cropsmart 32oz/ac Dicamba DMA Salt 8oz/ac
	8/25/2014	Helmquat 3SL 1qt/ac
	10/7/2014	Roundup Power Max 32oz/ac
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting Seasonal	12/12 to 4/13	1.50 in.
	4/17 to 5/21	4.20 in.
Rainfall		
PrePlant & Planting Seasonal	12/13 to 1/1	0.12 in.
	1/1 to 5/26	4.42 in.



Operations Summary

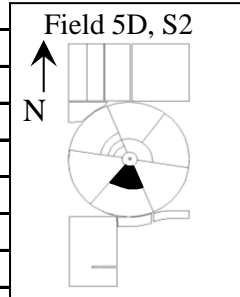
Year	2014
Farm	Helm
Field ID	Field 5c Spans 3-8
Exp. Design	Wheat
Soil Type	

Field Operations	Date	Activity	<div>Field 5C, S3-8</div> 
Tillage	11/20/2013	Shred	
	12/3/2013	Field Cultivate	
	3/11/2014	Track Fill	
	4/21/2014	Track Fill	
	9/4/2014	Strip Till Even Spans	
	9/5/2014	Strip Till Odd Spans	
Fertility	12/2/2013	30-30-0 Dry	
Planting	12/11/2013	Greer Wheat at 70lbs/ac	
Herbicide/Growth Regulator	6/18/2014	Cropsmart 64oz/ac	
	7/22/2014	Cropsmart 32oz/ac Dicamba DMA Salt 8oz/ac	
	8/25/2014	Helmquat 3SL 1qt/ac	
	10/7/2014	Roundup PowerMax 32oz/ac	
Insecticide			
Harvest aid			
Irrigation Amt.			
PrePlant & Planting Seasonal	12/12 to 4/13	1.50 in.	
	4/17 to 5/21	4.20 in.	
Rainfall			
PrePlant & Planting Seasonal	12/13 to 1/1	0.12 in.	
	1/1 to 5/26	4.42 in.	

Operations Summary

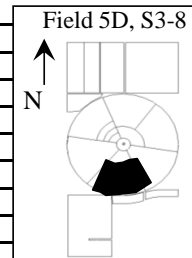
Year	2014
Farm	Helm
Field ID	Field 5d East Span 2
Exp. Design	Cotton
Soil Type	

Field Operations	Date	Activity
Tillage	11/21/2013	Shred
	12/4/2013	Field Cultivate
	7/8/2014	Cultivate
	7/23/2014	Cultivate
Fertility	12/2/2013	30-30-0 Dry
	3/28/2014	71 lbs of N/ac + 25 lbs of P/ac Applied thru colter rig
Planting	12/12/2013	VNS Wheat at 65lbs/ac Cover
	5/15/2014	FM 2334 GLT at 54,000 seed/ac
Herbicide/Growth Regulator	5/2/2014	Roundup 32oz/ac
	5/8/2014	Helmquat 3SL 2.5oz/ac
	5/16/2014	Caporal 3pt/ac Prowl H2O 1qt/ac
	6/11/2014	Cropsmart 32oz/ac
	6/26/2014	Cropsmart 32oz/ac Warrant 3pt/ac
	7/3/2014	Cropsmart 48oz/ac
	7/25/2014	Makaze 32oz/ac Warrant 3pt/ac
Insecticide		
Harvest aid	10/24/2014	Boll Buster 1qt/ac ET 1.25oz/ac
	10/31/2014	Helmquat 3SL 1qt/ac
Irrigation Amt.		
PrePlant & Planting	4/29 to 5/21	3.30 in.
Seasonal	7/29 to 9/3	2.90 in.
Rainfall		
PrePlant & Planting	1/1 to 5/7	0.45 in.
Seasonal	5/7 to 9/18	19.03 in.



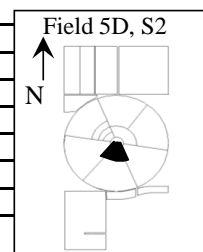
Operations Summary

Year	2014	
Farm	Helm	
Field ID	Field 5d East Span 3-8	
Exp. Design	Cotton	
Soil Type		
Field Operations	Date	Activity
Tillage	11/21/2013	Shred
	12/4/2014	Field Cultivate
	5/29/2014	Rotary Hoe Span 8
	6/9/2014	Rotary Hoe Span 8
	6/20/2014	Rotary Hoe Span 8
	7/8/2014	Cultivate Span 6,8
	7/23/2014	Cultivate and Dike Span 6,8
Fertility	12/2/2013	30-30-0 Dry
	3/27/2014	19 lbs of N/ac Applied thru coulter rig (Low Water)
	3/28/2014	71 lbs of N/ac + 25 lbs of P/ac Applied thru colter rig (Overhang)
	4/1/2014	58 lbs of N/ac + 21 lbs of P/ac Applied thru colter rig (Med & High Water)
Planting	12/12/2013	VNS Wheat at 65lbs/ac cover
	5/15/2014	FM 2334 GLT at 54,000 seed/ac
	6/27/2014	FM 2011 GT at 56,000 seed/ac replant Overhang
Herbicide/Growth Regulator	5/2/2014	Roundup 32oz/ac
	5/8/2014	Helmquat 3SL 2.5oz/ac
	5/16/2014	Caporal 3pt/ac Prowl H2O 1qt/ac
	6/11/2014	Cropsmart 32oz/ac
	6/26/2014	Cropsmart 32oz/ac Warrant 3pt/ac
	7/3/2014	Cropsmart 48oz/ac
	7/25/2014	Makaze 32oz/ac Warrant 3pt/ac
Insecticide		
Harvest aid	10/24/2014	Boll Buster 1qt/ac ET 1.25oz/ac
	10/31/2014	Helmquat 3SL 1qt/ac
Irrigation Amt.		
PrePlant & Planting	4/29 to 5/21	3.30 in.
Seasonal	7/29 to 9/3	Base = 2.90 in.; Base -50% = 1.60 in.; Base +50% = 4.20 in.
Rainfall		
PrePlant & Planting	1/1 to 5/7	0.45 in.
Seasonal	5/7 to 9/18	19.03 in.



Operations Summary

Year	2014	
Farm	Helm	
Field ID	Field 5d West Span 2	
Exp. Design	Cotton	
Soil Type		
Field Operations	Date	Activity
Tillage	11/21/2013	Shred
	12/4/2013	Field Cultivate
	7/8/2014	Cultivate
	7/23/2014	Cultivate
Fertility	12/2/2013	30-30-0 Dry
	3/28/2014	71 lbs of N/ac + 25 lbs of P/ac Applied thru coulters rig
Planting	12/12/2013	VNS Wheat at 65lbs/ac Cover
	5/15/2014	FM 2334 GLT at 54,000 seed/ac
Herbicide/Growth Regulator	5/2/2014	Roundup 32oz/ac
	5/8/2014	Helmquat 3SL 2.5oz/ac
	5/16/2014	Caporal 3pt/ac Prowl H2O 1qt/ac
	6/11/2014	CropSmart 32oz/ac
	6/26/2014	CropSmart 32oz/ac Warrant 3pt/ac
	7/3/2014	CropSmart 48oz/ac
	7/25/2014	Makaze 32oz/ac Warrant 3pt/ac
Insecticide		
Harvest aid	10/24/2014	Boll Buster 1qt/ac ET 1.25oz/ac
	10/31/2014	Helmquat 3SL 1qt/ac
Irrigation Amt.		
PrePlant & Planting	4/29 to 5/21	3.30 in.
Seasonal	7/29 to 9/3	2.15 in.
Rainfall		
PrePlant & Planting	1/1 to 5/7	0.45 in.
Seasonal	5/7 to 9/18	19.03 in.

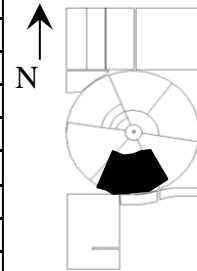


Operations Summary

Year	2014
Farm	Helm
Field ID	Field 5d West Spans 3-8
Exp. Design	Cotton
Soil Type	

Field Operations	Date	Activity
Tillage	11/21/2013	Shred
	12/4/2014	Field Cultivate
	5/29/2014	Rotary Hoe Span 8
	6/9/2014	Rotary Hoe Span 8
	6/20/2014	Rotary Hoe Span 8
	7/8/2014	Cultivate Span 4,6,8
	7/23/2014	Cultivate and Dike Span 4,6,8
Fertility	12/2/2013	30-30-0 Dry
	3/27/2014	19 lbs of N/ac Applied thru coulter rig (Low Water)
	3/28/2014	71 lbs of N/ac + 25 lbs of P/ac Applied thru coulter rig (Overhang)
	4/1/2014	58 lbs of N/ac + 21 lbs of P/ac Applied thru coulter rig (Med & High Water)
Planting	12/12/2013	VNS Wheat at 65lbs/ac cover
	5/15/2014	FM 2334 GLT at 54,000 seed/ac
	6/27/2014	FM 2011 GT at 56,000 seed/ac replant Overhang
Herbicide/Growth Regulator	5/2/2014	Roundup 32oz/ac
	5/8/2014	Helmquat 3SL 2.5oz/ac
	5/16/2014	Caporal 3pt/ac Prowl H2O 1qt/ac
	6/11/2014	Cropsmart 32oz/ac
	6/26/2014	Cropsmart 32oz/ac Warrant 3pt/ac
	7/3/2014	Cropsmart 48oz/ac
	7/25/2014	Makaze 32oz/ac Warrant 3pt/ac
Insecticide		
Harvest aid	10/24/2014	Boll Buster 1qt/ac ET 1.25oz/ac
	10/31/2014	Helmquat 3SL 1qt/ac
Irrigation Amt.		
PrePlant & Planting Seasonal	4/29 to 5/21	3.30 in.
	7/29 to 9/3	Base = 2.15 in; Base -50% = 1.23 in; Base +50% = 3.08 in.
Rainfall		
PrePlant & Planting Seasonal	1/1 to 5/7	0.45 in.
	5/7 to 9/18	19.03 in.

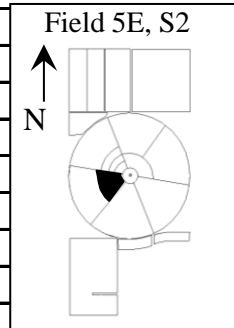
Field 5D, S3-8



Operations Summary

Year	2014
Farm	Helm
Field ID	Field 5e (Span 2)
Exp. Design	Milo
Soil Type	

Field Operations	Date	Activity
Tillage	11/30/2013	Shred
	12/17/2013	Chisel
	12/19/2013	Disk
	2/20/2014	Field Cultivate
	2/21/2014	List
	4/4/2014	Cultivate and Dike
	5/30/2014	Rotary Hoe
	6/11/2014	Rotary Hoe
	6/21/2014	Rotary Hoe
	7/5/2014	Rotary Hoe
	7/10/2014	Cultivate
	7/23/2014	Cultivate and Dike
Fertility	2/17/2014	30-30-0 Dry
	3/28/2014	71 lbs of N/ac + 25 lbs of P/ac Applied thru coulter rig
Planting	6/16/2014	DKS 49-45 at 40,000 55,000 and 70,000 seed/ac
Herbicide/Growth Regulator	3/7/2014	Milo Pro 1qt/ac
	6/3/2014	Glystar 64oz/ac
	6/16/2014	Milo Pro 1qt/ac Warrant 3pt/ac
	7/24/2014	Warrant 5.5pt/ac
	10/17/2014	Roundup 1qt/ac
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting Seasonal	4/29 to 5/7	2.80 in.
	7/29 to 9/3	3.30 in.
Rainfall		
PrePlant & Planting Seasonal	1/1 to 5/7	0.45 in.
	5/7 to 9/18	19.03 in.

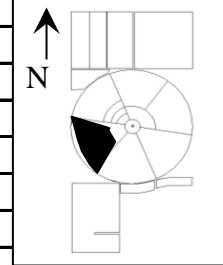


Operations Summary

Year	2014
Farm	Helm
Field ID	Field 5e (Spans 3-8)
Exp. Design	Milo
Soil Type	

Field Operations	Date	Activity
Tillage	11/30/2013	Shred
	12/17/2013	Chisel
	12/19/2013	Disk
	2/20/2014	Field Cultivate
	2/21/2014	List Span 4,6,8
	4/4/2014	Cultivate & Dike Span 4,6,8
	5/30/2014	Rotary Hoe
	6/11/2014	Rotary Hoe
	6/21/2014	Rotary Hoe
	7/5/2014	Rotary Hoe
	7/10/2014	Cultivate Spans 4,6,8
	7/23/2014	Cultivate and Dike Span 4,6,8
Fertility	2/17/2014	30-30-0 Dry
	3/27/2014	19 lbs of N/ac Applied thru coulter rig (Low Water)
	3/28/2014	71 lbs of N/ac + 25 lbs of P/ac Applied thru coulter rig (Overhang)
	4/1/2014	58 lbs of N/ac + 21 lbs of P/ac Applied thru coulter rig (Med & High Water)
	7/22/2014	68 lbs of N/ac Applied thru coulter rig (High Water)
Planting	6/16/2014	DKS 49-45 at 40,000 55,000 and 70,000 seed/ac
Herbicide/Growth Regulator	3/7/2014	Milo Pro 1qt/ac
	6/3/2014	Glystar 64oz/ac
	6/16/2014	Milo Pro 1qt/ac Warrant 3pt/ac
	7/24/2014	Warrant 5.5pt/ac
	10/17/2014	Roundup 1qt/ac
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting Seasonal	4/29 to 5/7	2.80 in.
	7/29 to 9/3	Base = 3.30 in.; Base -50% = 1.80 in.; Base +50% = 4.80 in.
Rainfall		
PrePlant & Planting Seasonal	1/1 to 5/7	0.45 in.
	5/7 to 9/18	19.03 in.

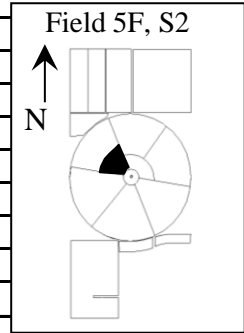
Field 5E, S3-8



Operations Summary

Year	2014
Farm	Helm
Field ID	Field 5f (Span 2)
Exp. Design	Cotton
Soil Type	

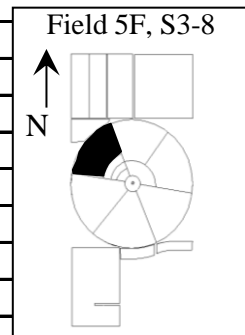
Field Operations	Date	Activity
Tillage	11/20/2013	Shred
	12/18/2013	Chisel
	2/19/2014	Disk
	2/20/2014	Field Cultivate
	2/21/2014	List
	4/4/2014	Dike
	5/30/2014	Rotary Hoe
	6/9/2014	Rotary Hoe
	6/20/2014	Rotary Hoe
	7/3/2014	Rotary Hoe
	7/10/2014	Cultivate
	7/24/2014	Cultivate and Dike
Fertility	2/17/2014	30-30-0 Dry
	3/28/2014	71 lbs of N/ac + 25 lbs of P/ac Applied thru coulter rig
Planting	5/14/2014	FM 2334 GLT at 54,000 seed/ac
	6/4/2014	FM 2011 GT at 52,000 seed/ac replant
Herbicide/Growth Regulator	2/18/2014	Trifluralin HF 2pt/ac
	5/14/2014	Caporal 3pt/ac Glystar 32oz/ac
	6/5/2014	ET 2oz/ac Glystar 64oz/ac
	6/27/2014	CropSmart 32oz/ac Warrant 3pt/ac
	7/25/2014	CropSmart 32oz/ac Warrant 3pt/ac
Insecticide		
Harvest aid	10/23/2014	Boll Buster 1qt/ac ET 1.25oz/ac
	10/31/2014	Helmquat 3SL 1qt/ac
Irrigation Amt.		
PrePlant & Planting	4/21 to 5/22	4.40 in.
Seasonal	7/29 to 9/3	2.50 in.
Rainfall		
PrePlant & Planting	1/1 to 5/7	0.45 in.
Seasonal	5/7 to 9/18	19.03 in.



Operations Summary

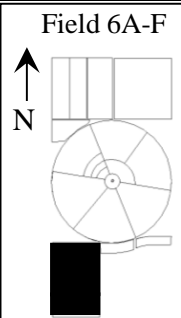
Year	2014
Farm	Helm
Field ID	Field 5f (Spans 3-8)
Exp. Design	Cotton
Soil Type	

Field Operations	Date	Activity
Tillage	11/20/2013	Shred
	12/18/2013	Chisel
	2/19/2014	Disk
	2/20/2014	Field Cultivate
	2/21/2014	List Span 4,6,8
	4/4/2014	Dike Span 4,6,8
	5/30/2014	Rotary Hoe
	6/9/2014	Rotary Hoe
	6/20/2014	Rotary Hoe
	7/3/2014	Rotary Hoe
	7/10/2014	Cultivate Span 4,6,8
	7/24/2014	Cultivate and Dike Span 4,6,8
Fertility	2/17/2014	30-30-0 Dry
	3/27/2014	19 lbs of N/ac Applied thru coulter rig (Low Water)
	3/28/2014	71 lbs of N/ac + 25 lbs of P/ac Applied thru coulter rig (Overhang)
	4/1/2014	58 lbs of N/ac + 21 lbs of P/ac Applied thru coulter rig (Med & High Water)
	7/22/2014	34 lbs of N/ac Applied thru coulter rig (High Water)
Planting	5/14/2014	FM 2334 GLT at 54,000 seed/ac
	6/4/2014	FM 2011 GT at 52,000 seed/ac
Herbicide/Growth Regulator	2/18/2014	Trifluralin HF 2pt/ac
	5/14/2014	Caporal 3pt/ac Glystar 32oz/ac
	6/5/2014	ET 2oz/ac Glystar 64oz/ac
	6/27/2014	Cropsmart 32oz/ac Warrant 3pt/ac
	7/25/2014	Cropsmart 32oz/ac Warrant 3pt/ac
Insecticide		
Harvest aid	10/23/2014	Boll Buster 1qt/ac ET 1.25oz/ac
	10/31/2014	Helmquat 3SL 1qt/ac
Irrigation Amt.		
PrePlant & Planting Seasonal	4/21 to 5/22	4.40 in.
	7/29 to 9/3	Base = 2.50 in.; Base -50% = 1.40 in.; Base +50% = 3.60 in.
Rainfall		
PrePlant & Planting Seasonal	1/1 to 5/7	0.45 in.
	5/7 to 9/18	19.03 in.



Operations Summary

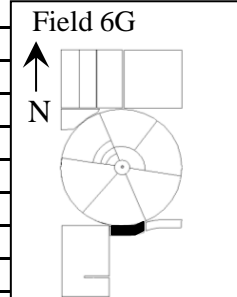
Year	2014
Farm	Helm
Field ID	Field 6 - Zone A-F
Exp. Design	Cotton
Soil Type	

Field Operations	Date	Activity	<div>Field 6A-F</div> 
Tillage	12/3/2013	Shred	
	12/11/2013	Stalk Puller	
	12/16/2013	Chisel	
	2/12/2014	Field Cultivator	
	2/21/2014	Field Cultivator	
	2/25/2014	List	
	4/30/2014	Bed Conditioners	
	5/30/2014	Rotary Hoe	
	6/9/2014	Rotary Hoe	
	6/20/2014	Rotary Hoe	
	7/5/2014	Rotary Hoe	
	7/23/2014	Cultivate 60" Rows	
	7/25/2014	Cultivate 30" Rows	
Fertility	4/4/2014	67 lbs of N/ac + 24 lbs of P/ac Applied thru coulter rig (2:1 ratio of 32-0-0/10-34-0)	
	8/1 to 8/5	Zones A-E 35 lbs of N/ac (32-0-0)(injected into drip lines)	
Planting	5/8/2014	Nexgen 1511 B2RF at 56,000 seed/ac 30" Rows F.6 C-F	
	5/8/2014	Nexgen 1511 B2RF at 63,000 seed/ac 60" Rows F.6 C-F	
	5/21/2014	Plots Mixed Varieties Dow Test F.6 A,B	
	5/21/2014	Phytogen 367 WRF at 56,000 seed/ac F.6 A,B Dow Test Border	
	6/3/2014	Nexgen 1511 B2RF at 56,000 seed/ac Replant F.6 C-F	
	6/27	FM 2011 GT at 56,000 seed/ac replant F.6 F	
Herbicide/Growth Regulator	2/21/2014	Trifluralin HF 2pt/ac	
	5/9/2014	Caparol 3 pt/ac Glystar 32oz/ac F.6 C-F	
	5/22/2014	Caparol 3 pt/ac Glystar 32oz/ac F.6 A,B Test Border	
	6/4/2014	ET 2oz/ac Glystar 32oz/ac F.6 C-F	
	6/23/2014	Cropsmart 32 oz F.6 A,B	
	7/7/2014	Cropsmart 44oz/ac Warrant 3pt/ac F.6 A-F	
	7/28	Cropsmart 44oz/ac Warrant 3pt/ac F.6 A-F	
Insecticide			
Harvest aid	10/27/2014	Boll Buster 1qt/ac ET 1.25oz/ac	
	11/3/2014	Helmquat 3SL 1qt/ac	
Irrigation Amt.			
PrePlant & Planting	4/9-5/22	9.79 in.	
Seasonal	7/31 to 9/4	Zones A-E = 2.34 in.; Zone F = 2.10 in.	
Rainfall			
PrePlant & Planting	1/1 to 5/7	0.45 in.	
Seasonal	5/7 to 9/18	19.03 in.	

Operations Summary


Year	2014	
Farm	Helm	
Field ID	Field 6 - Zone G	
Exp. Design	Cotton Drip Irrigated Nitrogen Level Effects on Insects	Parajulee
Soil Type		

Field Operations	Date	Activity
Tillage	12/2/2013	Shred
	12/10/2013	Stalk Puller
	12/13/2013	Chisel
	2/19/2014	Field Cultivator
	2/26/2014	List
	5/28/2014	Rotary Hoe
	6/9/2014	Rotary Hoe
	6/20/2014	Rotary Hoe
	6/30/2014	Cultivate
	7/5/2014	Rotary Hoe
	7/28/2014	Cultivate
Fertility	7/23/2014	32-0-0 liquid (applied thru coulter rig at mixed rates)
Planting	5/19/2014	FM 9063 B2F at 60,000 seed/ac
	6/16	FM 9063 B2F at 54,000 seed/ac replant
Herbicide/Growth Regulator	2/19/2014	Trifluralin HF 2pt/ac
	5/20/2014	Caparol 3 pt/ac Glystar
	6/27/2014	Cropsmart 32oz/ac Warrant 3pt/ac
	7/7/2014	Cropsmart 40oz/ac
	7/28/2014	Cropsmart 32oz/ac Warrant 3pt/ac
Insecticide		
Harvest aid	10/23/2014	Boll Buster 1qt/ac ET 1.25oz/ac
	11/3/2014	Helmquat 3SL 1qt/ac
Irrigation Amt.		
PrePlant & Planting Seasonal	4/9 to 5/22	8.54 in.
	7/31 to 9/4	2.91 in.
Rainfall		
PrePlant & Planting Seasonal	1/1 to 5/7	0.45 in.
	5/7 to 9/18	19.03 in.



Operations Summary

Year	2014
Farm	Helm
Field ID	Field 6 - Zone H
Exp. Design	Cotton Drip Irrigated
Soil Type	

Field Operations	Date	Activity	
Tillage	12/2/2013	Shred	<div>Field 6H</div> <div></div>
	12/10/2013	Stalk Puller	
	12/13/2013	Chisel	
	2/19/2014	Field Cultivate	
	2/27/2014	List	
	5/29/2014	Rotary Hoe	
	6/9/2014	Rotary Hoe	
	6/21/2014	Rotary Hoe	
	6/30/2014	Cultivate	
Fertility	4/3/2014	47 lbs of N/ac + 17 lbs of P/ac Applied thru colter rig (50/50 mix)	
Planting	5/19/2014	Nexgen 1511 B2RF at 56,000/65,000,76,000 seed/ac	
Herbicide/Growth Regulator	2/19/2014	Trifluralin HF 2pt/ac	
	5/20/2014	Caparol 3 pt/ac Glystar 32oz/ac	
	6/10/2014	Cropsmart 32oz/ac	
	6/17/2014	Gramoxin 2oz/ac Glystar 32oz/ac	
	6/27/2014	Cropsmart 32oz/ac Warrant 3pt/ac	
	7/7/2014	Cropsmart 40oz/ac	
	7/28/2014	Cropsmart 32oz/ac Warrant 3pt/ac	
Insecticide			
Harvest aid	10/23/2014	Boll Buster 1qt/ac ET 1.25oz/ac	
	11/3/2014	Helmquat 3SL 1qt/ac	
Irrigation Amt.			
PrePlant & Planting Seasonal	4/9 to 5/22	8.79 in.	
	7/31 to 9/4	3.00 in.	
Rainfall			
PrePlant & Planting Seasonal	1/1 to 5/7	0.45 in.	
	5/7 to 9/18	19.03 in.	