Texas A&M AgriLife Research

Improving Life Through Science and Technology

Lubbock-Pecos-Halfway

Helm Research Farm

Summary Report

2016

Technical Report
17-3

Texas AgriLife Research / Craig Nessler, Director
The Texas A&M University System / College Station, Texas

Table of Contents

Texas AgriLife Research - Texas AgriLife Extension
Lubbock / Halfway
Research Participants

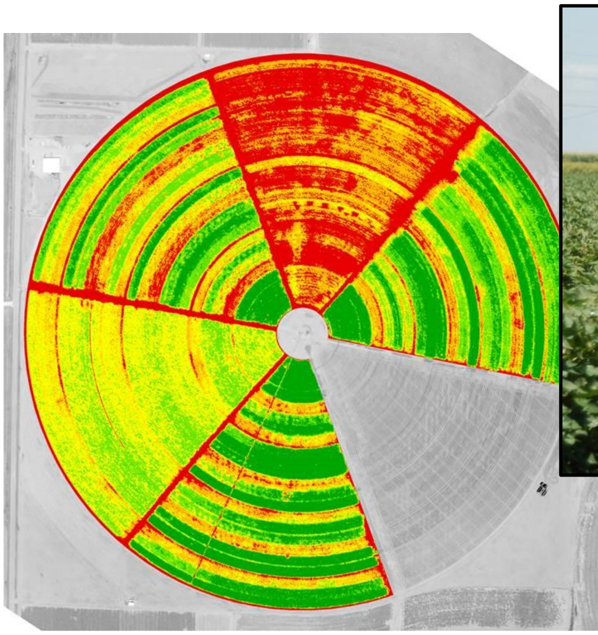
Name	**Specialty**	**Association**	**E-mail Address**
Jaroy Moore	Resident Director	AgriLife Research	j-moore@tamu.edu
James Bordovsky	Ag. Engineering-Irrigation	AgriLife Research	j-bordovsky@tamu.edu
Stanley Carroll	Cotton Entomology	AgriLife Research	scarroll@ag.tamu.edu
S.D. Coyle	Cotton Entomology	AgriLife Research	sean.coyle@ag.tamu.edu
Casey Hardin	Research Assistant	AgriLife Research-Halfway	cwhardin@ag.tamu.edu
James Grant	Plant Pathology	AgriLife Research	james.grant@ag.tamu.edu
Abdul Hakeem	Cotton Entomology	AgriLife Research	abdul.hakeem@ag.tamu.edu
Cecil Haralson	Plant Pathology	AgriLife Research	cecil.haralson@ag.tamu.edu
Scott Jordan	Ag. Engineering-Irrigation	AgriLife Research	scott.jordan@ag.tamu.edu
Wayne Keeling	Agronomy-Weed Science	AgriLife Research	w-keeling@tamu.edu
Katelyn Kesheimer	Integrated Pest Management	AgriLife Extension	katelyn.kesheimer@ag.tamu.edu
Katie Lewis	Soil Chemistry and Fertility	AgriLife Research	katie.lewis@ag.tamu.edu
Joe Mustian	Ag. Engineering-Irrigation	AgriLife Research-Halfway	jmustian@tamu.edu
Megha Parajulee	Cotton Entomology	AgriLife Research	mparajul@ag.tamu.edu
Russ Perkins		Bayer CropScience	russ.perkins@bayer.com
Dana Porter	Ag. Engineering-Irrigation	AgriLife Extension	dporter@ag.tamu.edu
Pat Porter	Entomology	AgriLife Extension	pat.porter@ag.tamu.edu
Blayne Reed	Integrated Pest Management	AgriLife Extension	blayne.reed@ag.tamu.edu
Craig Sandoski		Gowan Company	csandoski@gowanco.com
Justin Spradley	Agronomy Extension-	Asst. AgriLife Research	jlspradley@ag.tamu.edu
Terry Wheeler	Plant Pathology	AgriLife Research	twheeler@ag.tamu.edu
Ray White	Soil Chemistry and Fertility	AgriLife Research	ray.white@ag.tamu.edu

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.



Grain Sorghum Irrigation Timing Using Subsurface Drip Irrigation (SDI) (Field 2).
James Bordovsky, Joe Mustian, Scott Jordan and Casey Hardin

Objective: Determine late planted grain sorghum yield, water use efficiency, and relative water value of three irrigation timing treatments using subsurface drip irrigation.

Figure 1. Installation of subsurface drip irrigation for experiments at the Helm Research Farm, Halfway, TX.

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). 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 the early 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 (dryland) was also included. Grain sorghum was planted to replace hail and wind damaged cotton and test areas harvested with commercial harvesting equipment. Yields and water productivity from the different treatments were determined.

Results: On June 21, following hail and wind events that destroyed the first two cotton plantings, grain sorghum (DKS 3707) was planted at 32,500 seeds/acre. Although seasonal rainfall was near normal, rain from mid-May through mid-June was above average at 5.16 inches which eliminated the need for irrigation during the early vegetative period of T3. This resulted in T1 and T3 being irrigated identically. Figure 2 shows early and late season soil water by treatment. Although T2 treatment received more pre-plant irrigation, the volumetric soil water content at the end of the season was lower than the T1 and T3 treatments without resulting in significant increases in sorghum yield (Figs. 2 and 3). This year's result shows little value in early irrigation.

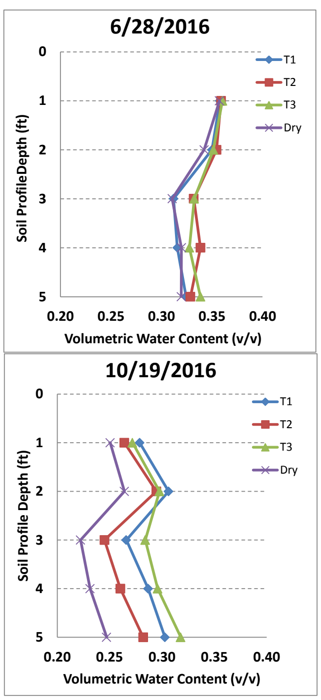


Figure 2. Profile soil water of three irrigation treatments at planting and near harvest at the Helm Research Farm, Halfway, TX.

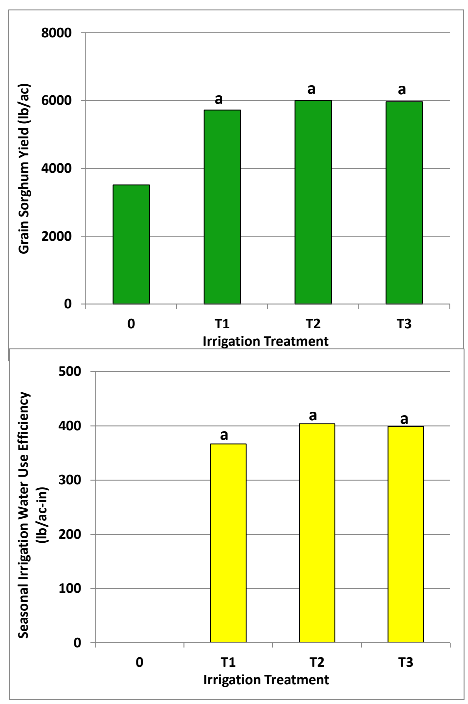


Figure 3. Grain sorghum yield and seasonal irrigation water use efficiency from irrigation treatments at the Helm Research Farm, Halfway, TX.

Grain Sorghum Response to Pre-plant and Early Season Irrigation Amounts with SDI (Field 3).
James Bordovsky, Joe Mustian, Scott Jordan and Casey Hardin

Objective: Determine late season grain sorghum yield and water use efficiency of pre-plant and early season irrigation treatments using SDI.

Methodology: This study attempts to quantify differences in water productivity of SDI grain sorghum during irrigation periods having the highest evaporation losses in the Texas South Plains. Treatment factors included pre-plant 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. Due to issues caused by heavy rains, hail and blowing sand, cotton was terminated and replanted with grain sorghum on 22 June.

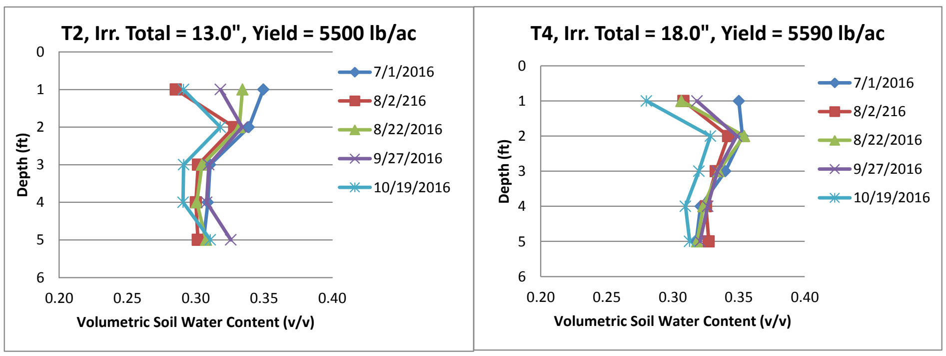


Figure 1. Profile water content of irrigation treatments having the lowest and highest irrigation amounts in experiments at Texas A&M AgriLife Research, Helm Farm, 2016.

Results: Total irrigation for the year, including pre-plant, ranged from 13.0 to 18.0 inches for the six treatments (Table 1). In terms of irrigation effect on soil water, profile water changes over the growing season indicated less water availability at depths of greater than 2 feet in treatment T2, with the lowest total irrigation, compared to T4, with the highest irrigation (Figure 1). However, grain yields from the six irrigated treatments were not significantly different ($p<0.05$) ranging from 5400 to 5680 lb/ac at 13% moisture content. Seasonal irrigation water use efficiency increased by an average of 29% from 228 to 294 lb/ac-in when comparing T4 at 18 inches to T2 at 13inches of irrigation, respectively. The lack of yield differences are partially due to early season rainfall and the somewhat late sorghum planting date as well as high early season evaporative demand. These results support the concept that, even with SDI, irrigating early in the growing season, attempting to store water for later use with limited irrigation capacity, reduces the overall irrigation water value.

Table 1. Irrigation treatments; planned and actual irrigation application rates; grain yield; and seasonal irrigation water use efficiency at Texas A&M AgriLife Research Helm Farm, 2016.

		Proposed Irrigation Rate (in/day)			Acutal Irrigation Amount (ac-in/ac)					
Treat. No.	Irrigation Treat. Description	Pre-plant	Vegetative Period	Reproductive and Maturation Periods	Pre-plant	Vegetative Period	Reproductive and Maturation Periods	Total	Grain Yield (lb/ac)	Sea. Irr. WUE (lb/ac-in)
T0	Light PP + 0.0" Seasonal	0.1	0.0	0.0	2.9	0	0	2.9	2667	
T2	Light PP + 0.0"/d Veg. Period	0.1	0.0	0.2	3.3	0	9.7	13.0	5504 a	294 a
T5	Light PP + 0.1"/d Veg. Period	0.1	0.1	0.2	3.9	1.9	9.4	15.2	5676 a	267 a
T6	Light PP + 0.2"/d Veg.Period	0.1	0.2	0.2	3.4	3.2	9.7	16.3	5559 a	225 a
T3	Heavy PP + 0.0"/d Veg. Period	0.2	0.0	0.2	5.3	0	9.6	14.9	5403 a	285 a
T1	Heavy PP + 0.1'/d Veg. Period	0.2	0.1	0.2	5.7	1.8	9.7	17.2	5476 a	243 a
T4	Heavy PP + 0.2"/d Veg. Period	0.2	0.2	0.2	5.2	3.1	9.7	18.0	5589 a	228 a

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

Verticillium wilt of Cotton as Affected by Crop Rotation, Tillage, Irrigation Rate, and Replanting (Field 5abdf).
Terry Wheeler, James Grant, and Cecil Haralson.

The weather in July and early August was not conducive for the development of Verticillium wilt. However, starting in mid-August, cool and wet conditions continued for approximately 4 wks. There was a typical incidence of Verticillium wilt by the 25th of August, and severe defoliation by late September. Crop rotation did not affect the severity of Verticillium wilt, however, irrigation rate as usual did, with higher irrigation resulting in more Verticillium wilt (Fig. 1). Various parts of the circle were replanted in late June, and that also had an impact on Verticillium wilt severity. In general, Verticillium wilt was more severe in original planted cotton than in replanted cotton (Fig. 1).

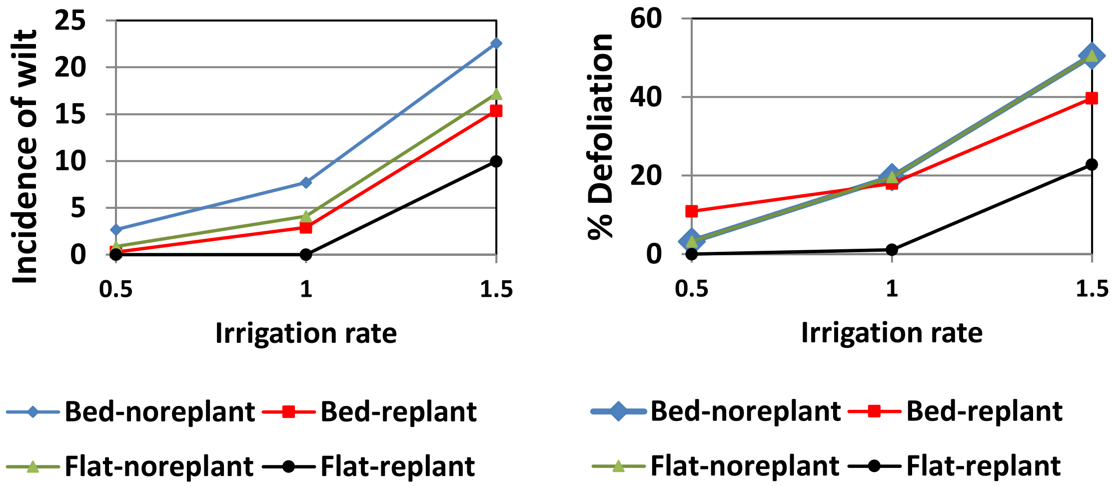


Figure 1. The effect of tillage (conventional tillage treatment included beds, while minimum tillage treatments were on flat ground), and whether or not the cotton was replanted on Verticillium wilt incidence and defoliation.

The relationship between Verticillium wilt severity (defoliation) and yield was somewhat different between each cropping system, tillage system, and whether it was replanted. In the wheat/cotton rotation, the original planted cotton with beds lost a similar amount of yield to wilt as the original planted cotton on flat ground, and the replanted cotton with beds (Fig. 2). However, overall, the minimum tillage system on flat ground made higher yields than the cotton in conventional tillage using beds. The amount that cotton yield was reduced per 1% defoliation ranged from 11 to 12 lbs/acre.

In the cotton/sorghum rotation, yields were reduced by 8 to 10 lbs/acre per 1% defoliation in the conventional tilled (beds) cotton, both for original and replanted areas. However, the cotton on flat ground did not show a loss in yield due to Verticillium wilt defoliation (Fig. 3).

In the continuous cotton with or without a wheat cover, there was no relationship between Verticillium wilt or defoliation and yield loss. These two systems had less wilt by 25 Aug (2% and 7%, respectively) than did the cotton/wheat (12%) or cotton/sorghum rotations (14%). The continuous cotton system with no cover was completely replanted. Defoliation averaged 12, 23, 29, and 30% for the continuous cotton system without and with cover, cotton/wheat, and cotton/sorghum rotations, respectively.

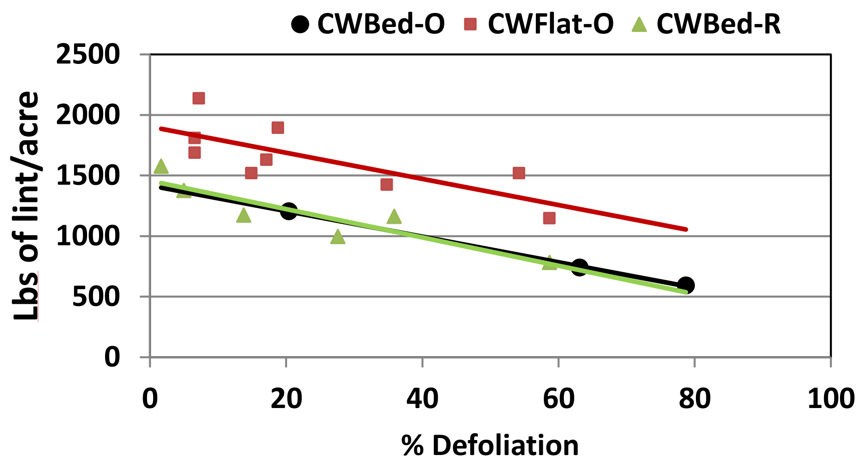


Figure 2. Relationship between cotton lint yield and defoliation due to Verticillium wilt in the cotton that was rotated with wheat. The tillage systems were conventional with beds (Bed) and minimal tillage on flat ground (Flat). Some of the cotton in beds were replanted (R), and some was the original planting (O). All the cotton planted on flat ground was original planting.

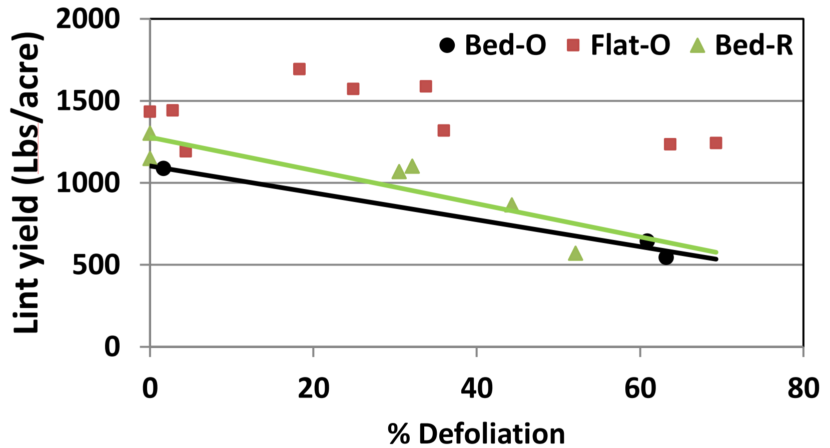


Figure 3. Relationship between cotton line yield and defoliation due to Verticillium wilt in the cotton that was rotated with sorghum. The tillage systems were conventional with beds (Bed) and minimal tillage on flat ground (Flat). Some of the cotton in beds were replanted (R), and some was the original planting (O). All the cotton planted on flat ground was original planting.

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

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

Methodology: The goal of MDI (Dragonline™) is to reduce irrigation evaporation losses. The idea of replacing center pivot sprinkler nozzles with drip lines is not new. However, what is new is the advancement in the way the drip line is connected to center pivots and drip line emitter technology e.g., pressure compensated emitters. 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 (Fig. 2). Specific irrigation and other production details are available in the appendix.

Figure 1. Mobile Drip Irrigation applicators on the center pivot used in field experiments at Texas A&M AgriLife Research, Helm Farm, 2016.

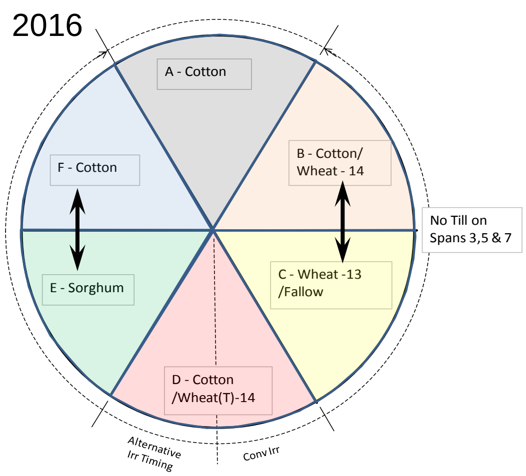


Figure 2. Crops and rotation sequences of various pivot wedges in field experiments at Texas A&M AgriLife Research, Helm Farm, 2016.

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. One-year findings indicate MDI plots resulted in slightly greater numerical cotton yields than those irrigated by the LEPA method (Fig. 3). MDI had significantly greater yield than LEPA ($p<0.05$) in cotton treatments planted in terminated wheat (pivot wedge D, conventional irrigation). There were no significant differences in cotton fiber quality among methods in any of the cropping systems. Sorghum yields (wedge E) were not significantly different between the two application methods, 5055 and 5010 lb/ac for LEPA and MDI, respectively. From this initial evaluation and field observations, MDI's advantage over LEPA will likely occur on sloping fields with heavy soil texture where larger LEPA applications could result in runoff. These evaluations will continue.

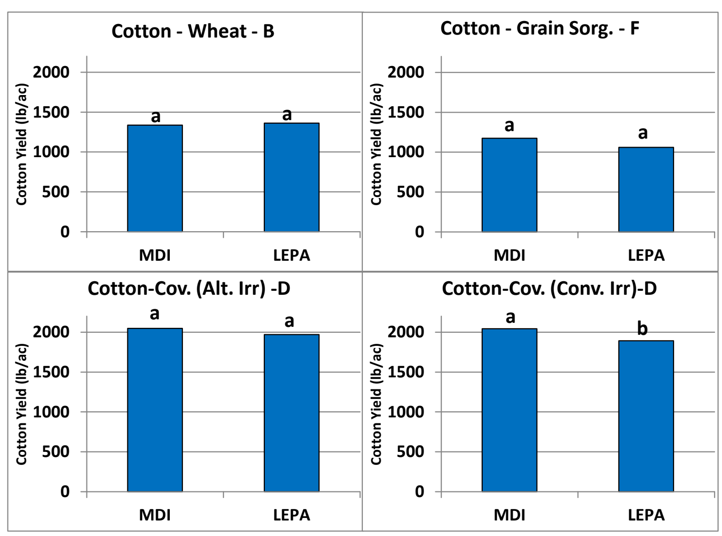


Figure 3. Cotton yield responses to MDI and LEPA irrigation methods in various crop sequences in field experiments at Texas A&M AgriLife Research, Helm Farm, 2016.

Continuous Cotton Response to Tillage and Irrigation Level (Field 5a)

James Bordovsky, Wayne Keeling, Terry Wheeler, Katie Lewis, Casey Hardin and Joe Mustian

Objective: Determine yield and water productivity of continuous cotton at three irrigation 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 wedge, cotton has been grown since 2014. In 2016, due to adverse weather, the area was replanted with the exception of three 8-row strips in conventionally tilled treatments, in each of the three irrigation levels. Cotton yield from these strips were used for comparison to replanted cotton. Due to the late planting, seasonal irrigation application occurred only as the pivot passed over the area at 100% speed moving from/to adjacent wedges. Seasonal irrigation totals were 0.8, 1.7 and 2.4 ac-in/ac in irrigation treatments designate as 0.5BI, 1.0BI, and 1.5BI, respectively. Tillage practices, cotton varieties, pesticides, and nutrient applications are listed in the appendix.

Figure 1. First cotton planting (May 13, 2016) in the no till treatment area of tillage-irrigation experiments, Texas A&M AgriLife Research, Helm Farm 2016.

Results: No- or reduced-tillage in a continuous cotton cropping system is difficult to maintain in the Southern High Plains due to the lack of sufficient residue to protect young cotton plants when inevitable high winds and blowing sand occurs. Tillage greatly reduces the wind-blown sand damage on cotton. Although the original cotton plantings were severely damaged on June 15, these non-replant areas produced higher average yields, 1049 lb/ac, than areas that were replanted, 875 lb/ac (Fig. 2). Yields of both original and late planted cotton were unexpectedly high due to favorable late season weather. Lint loan values of the early planting, particularly from the lowest irrigation treatment area, were much higher than those of the replant, $0.57 vs. $0.50, respectively (Fig. 3).

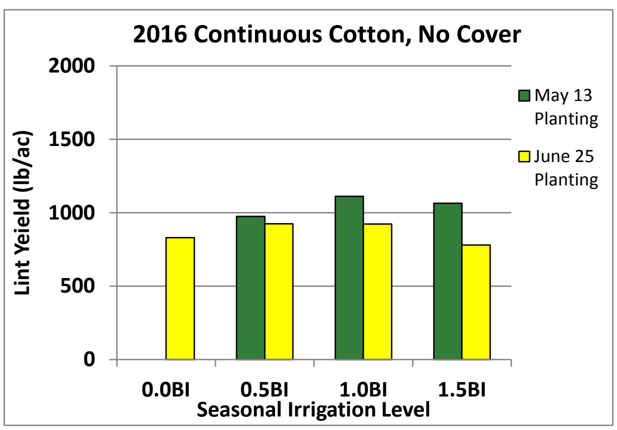


Figure 2. Cotton lint yield from areas of continuous cotton with an original planting date of May 13 and a replant date of June 25 in tillage-irrigation experiments, Texas A&M AgriLife Research, Helm Farm 2016.

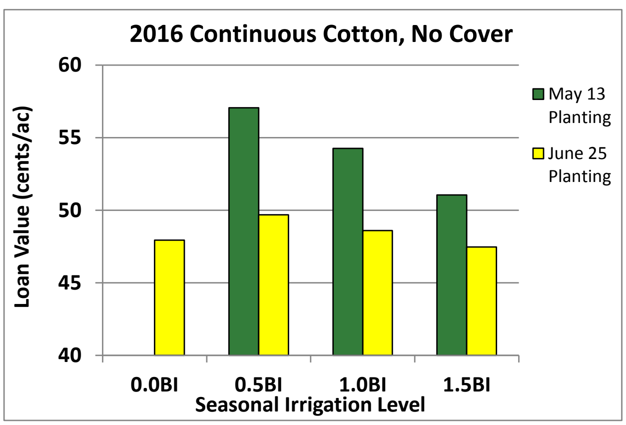


Figure 3. Cotton lint loan values from areas of continuous cotton with an original planting date of May 13 and a replant date of June 25 in tillage-irrigation experiments, Texas A&M AgriLife Research, Helm Farm 2016.

Cotton Response to Tillage and Irrigation Levels in a Cotton-Wheat Rotation (Field 5b)

James Bordovsky, Wayne Keeling, Terry Wheeler, Katie Lewis, Casey Hardin and Joe Mustian

Objective: Determine yield and water productivity of cotton in a cotton-wheat rotation 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 into wheat stubble in 2014 and again in 2016 within a 2-year cotton-wheat rotation sequence. Two tillage systems, conventional tillage (in pivot spans 4, 6, and 8) and reduced tillage, or no-till, (in 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 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 meets approximately 60% ET of cotton in years of average rainfall. Specific irrigations, tillage operations, cotton varieties, pesticides, and nutrient applications for 2016 are listed in the appendix.

Results: Heavy rain and cool weather followed planting and a high wind event on June 15 resulted in damaged cotton plants and poor stands in all areas. Following the "wind event", portions of each conventional tilled treatment replicate were replanted on June 22. Cotton yields were progressively reduced by irrigation above the 0.5 BI level except in the "reduced tilled" treatment where yields averaged 1890 lb/ac at 1.0BI. Loan values and seasonal irrigation water use efficiencies were significantly reduced ($p<0.05$) by irrigations above 0.5BI regardless of planting date or tillage treatment. Reduced tillage significantly increased yields, loan values and seasonal water use efficiencies over conventional tillage (Fig. 2). The initial planting generally resulted in the same or better yield, loan value, and water productivity as the late planted cotton treatments.

Figure 1. Cotton planted into wheat stubble in no-till test area on May 12; resulting cotton stand on June 14; and cotton (conventional till area) following "wind event" on June 15 at Texas A&M AgriLife Research, Helm Farm, 2016.

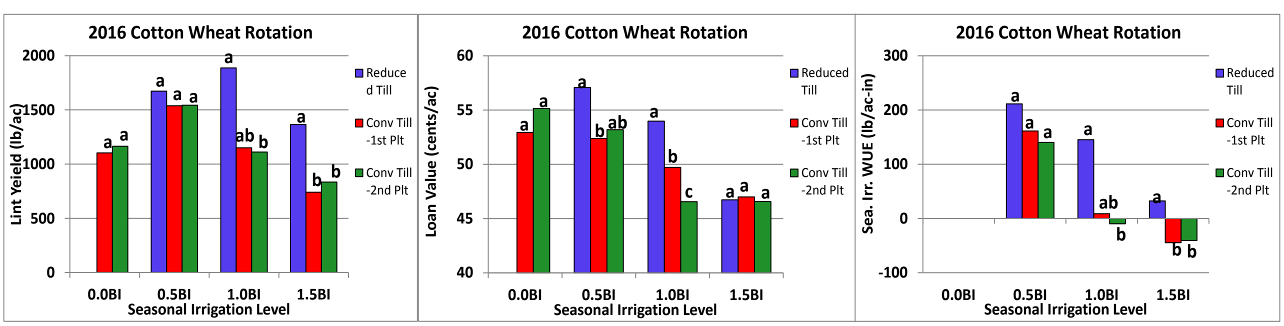


Figure 2. Cotton lint yield, lint loan value, and seasonal irrigation water use efficiency of cotton planted on two dates in a cotton-wheat rotation system at three irrigation levels in tilled and reduced-tilled treatments at Texas A&M AgriLife Research, Helm Farm, 2016.

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

James Bordovsky, Wayne Keeling, Terry Wheeler, Katie Lewis, 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.

Figure 1. Cotton planted into terminated wheat in a no-till test plot on May 13 and cotton stand on June 14 at Texas A&M AgriLife Research, Helm Farm, 2016.

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 into terminated wheat from 2014 through 2016. Two tillage systems, conventional tillage (in pivot spans 4, 6, and 8) and reduced tillage (in 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 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 meets approximately 60% ET of cotton in years of average rainfall. Specific irrigations, tillage operations, cotton varieties, pesticides, and nutrient applications for 2016 are listed in the appendix.

Results: Heavy rain and cool weather followed planting and a high wind event on June 15 resulted in damaged cotton plants and poor stands in all areas, particularly those not protected by cover crops. Cotton yields were significantly reduced ($p<0.05$) by irrigation above and below the 1.0 BI level. Loan values at 1.5BI were \$0.07/lb less than the average loan value of the other irrigation treatments. Water use efficiency was highest at the 0.5BI irrigation level at approximately 200 lb/ac-in, decreasing significantly when going from 1.0BI to 1.5BI. In 2016, the only tillage in the "conventional till" treatments was furrow diking following stand establishment; "reduced till" treatments were not tilled. There were no differences due to tillage affects except at the 1.5BI irrigation level where the reduced tillage system significantly increase yield by over 100 lb/ac (Fig. 2). Although yields were good, results indicate that irrigation management with limited water resources in "damaged cotton" years is important.

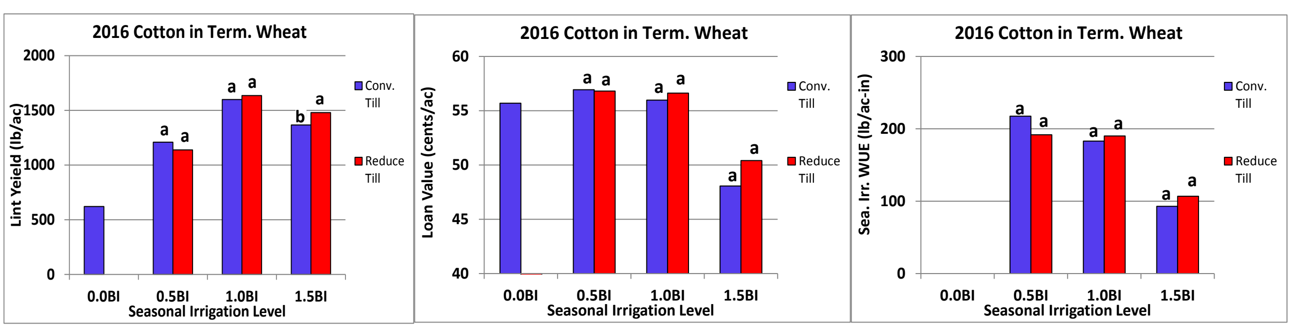


Figure 2. Cotton lint yield, lint loan value, and seasonal irrigation water use efficiency of cotton planted into terminated wheat in tilled and no-tilled areas irrigated at three levels at Texas A&M AgriLife Research, Helm Farm, 2016. Means separations are within an irrigation level.

Comparison of Multi-sensor Capacitance and TDR Soil Water Measurement Methods (Field 5)

Scott Jordan, James Bordovsky, Joe Mustian, and Dana Porter

Objective: Compare commercially available soil water sensors and evaluate their potential for irrigation management decisions in areas having limited irrigation capacity.

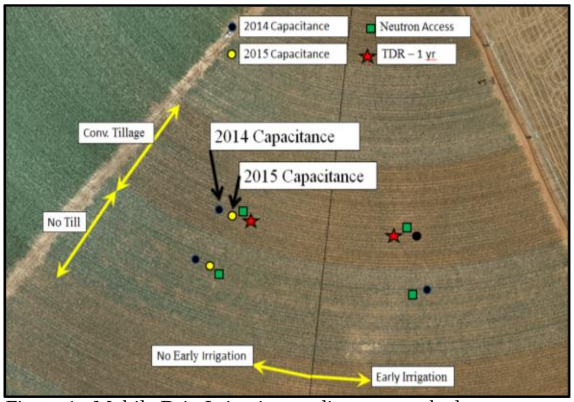


Figure 1. Mobile Drip Irrigation applicators attached to a center pivot used in field experiments at Texas AgriLife Research, Helm Farm, 2016.

Methodology: Sensors can provide a timely representation of soil water content within the soil profile, yet 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 two sets of "permanent" capacitance sensors (AquaSpy SoilPro 1200 PC: P100A) were installed in the northwest treatment area of an ongoing irrigation study. One capacitance sensor was installed in this area in 2014 and the second in 2015. 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 6 hours or less from June 20 through September 30, 2016. Daily irrigation, rainfall and estimated evapotranspiration were also measured.

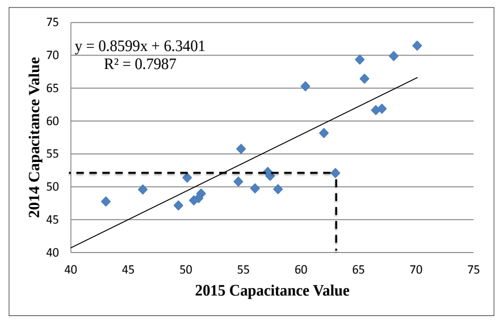


Figure 2. Soil moisture measurements of the 2015 capacitance sensor compared to the 2014 capacitance sensor in field experiments at Texas A&M AgriLife Research, Helm Farm, 2016.

Results: The 2016 seasonal irrigation and rainfall amounts were 8.4 and 7.8 inches, respectively. The average cotton lint yield in the treatment area was 1430 pounds per acre. A comparison of soil water measurements from 2014 and 2015 capacitance sensors installed in this treatment is in Fig. 2. The 2014 verses 2015 capacitance sensors resulted in different measurements under similar conditions. For example, on September 6 at the 24" depth, the 2014 sensor measurement was 52.0 while that of the 2015 sensor was 20% higher at 63.0. Fig. 3 shows capacitance sensor data, which was normalized to that of the TDR sensors, at depths of 12", 24" and 36". Both TDR and capacitance sensors showed responses to irrigation and rainfall events; however significant differences between sensor types did occur. For example, the rainfall event on August 9 can be seen at all depths for the capacitance sensor, while the TDR sensors only show a response at depths of 12" and 36". Even in common soil and crop environments, measurements among identical as well as different sensor types often occurs due to sensor placement, non-uniform soil texture and/or differences in sensor manufacturing. These initial results show potential for sensor based, deficit cotton irrigation management in the Texas South Plains.

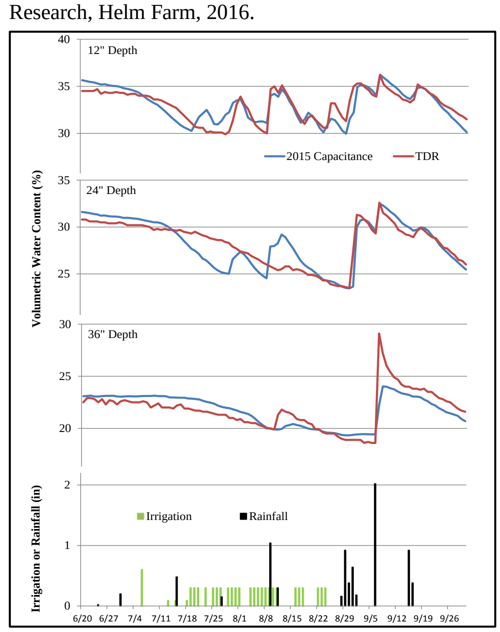


Figure 3. Volumetric soil water content over time from TDR and capacitance sensors in field experiments at Texas A&M AgriLife Research, Helm Farm, 2016.

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

James Bordovsky, Wayne Keeling, Terry Wheeler, Katie Lewis, Casey Hardin and Joe Mustian

Objective: Determine yield and water productivity of grain sorghum following cotton in a two year rotation with cotton irrigated at three levels under

Figure 1. Grain sorghum planting and sorghum emergence in reduce - till treatment areas in field experiments at the Texas A&M AgriLife Research, Helm Farm, 2016.

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 quantities (or 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 typically meets 60% ET of grain sorghum in years of average rainfall. Irrigation amounts, sorghum hybrids, pesticides, and nutrient applications for 2016 are listed in the appendix.

Results: Average grain sorghum yields for 2014, 2015, and 2016 are in Fig. 2. Non-irrigated yields in the conventionally tilled areas were high at 4200 lb/ac in 2015 and 3800 lb/ac in 2016. Yields may have been impacted by infestations of sugar cane aphid which were sprayed twice in 2015 and once in 2016. Tillage effects within this rotation may become more evident with time.

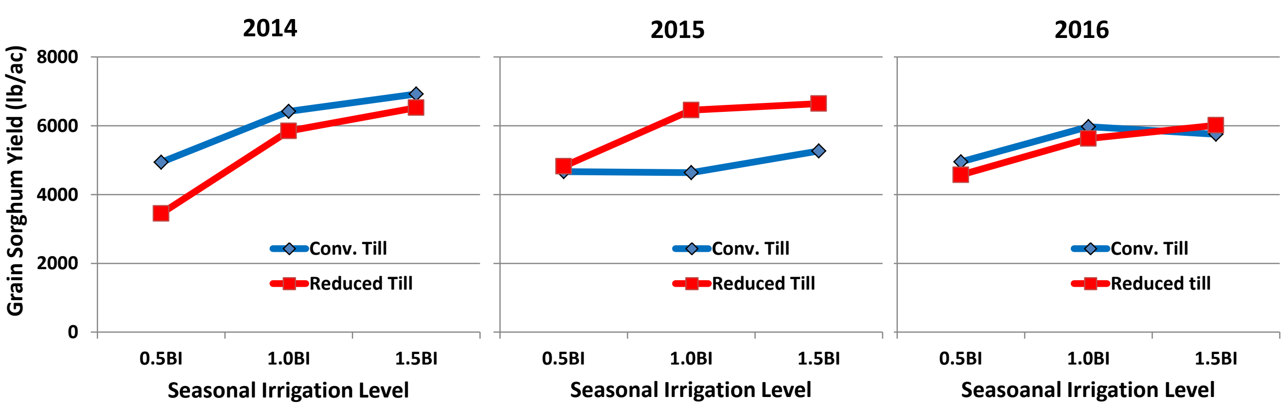


Figure 2. Grain sorghum yield from treatment areas following cotton using conventional and reduced tillage systems at three irrigation levels at Texas A&M AgriLife Research, Helm Farm, 2014-2016.

Effects of Crop Rotation, Tillage, and Irrigation on Soil Organic Matter (Field 5abcd).

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

Objective: Evaluate the cumulative effects of crop rotation, tillage, and irrigation level on soil organic matter (SOM).

Methodology: Soil samples were collected at the 0-6" depth in July 2016 from wedges A-D under reduced (RT) and conventional tillage (CT), and irrigation levels of 1.5*base irrigation (BI) and 0.5*BI. Soil samples were air dried for 15 days. Samples were analyzed for SOM by the combustion method to determine SOM (LOI) by igniting samples in a muffle furnace at 400°C for 16 hours. After ignition, weights were recorded and subtracted from oven-dry weights to determine SOM lost during combustion (LOI%).

Results: Soil organic matter influences nutrient cycling, infiltration and water retention, structure and aggregation of soil, and cation exchange capacity, but is highly sensitive to management. Tillage breaks soil aggregates exposing SOM, which can be degraded by soil microbes or lost through erosion. Within the 0-6" soil depth, SOM matter was not significantly different between irrigation level or tillage (Figure 1). Other studies on the Texas High Plains suggest improvements in SOM levels can take decades to achieve because of limited biomass production from cotton and extreme climatic conditions which decompose organic matter rapidly.

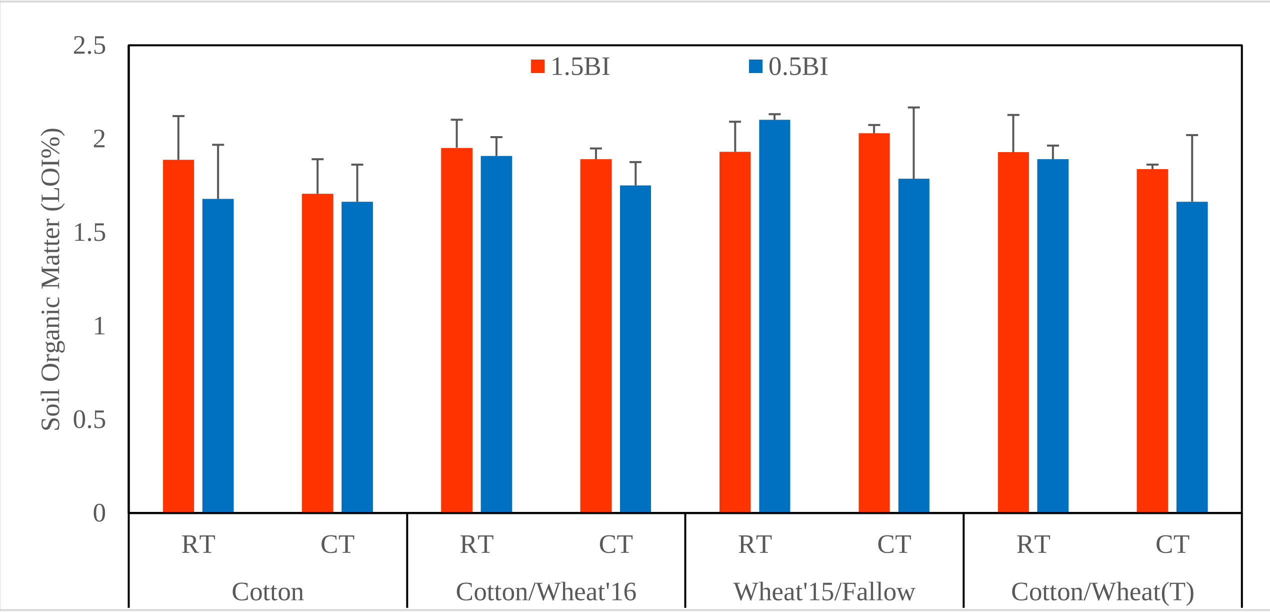


Figure 1. Soil organic matter (SOM) levels as affected by crop rotation, irrigation level (1.5BI and 0.5BI), and tillage (RT, reduced tillage; CT, conventional tillage) at soil depths of 0-6".

Cotton Response to Tillage and Irrigation Levels in Two-Year Cotton-Grain Sorghum Rotation (Field 5f)

James Bordovsky, Wayne Keeling, Terry Wheeler, Katie Lewis, Casey Hardin and Joe Mustian

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

Figures 1 and 2. Cotton in a reduce - till treatment area planted on May 12 (left) and being irrigated in July (right) in field experiments at the Texas A&M AgriLife Research, Helm Farm, 2016.

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 wedge, cotton was planted into grain sorghum stubble in 2014 and again in 2016 in a 2-year cotton-sorghum rotation sequence. Two tillage systems, conventional tillage (in pivot spans 4, 6, and 8) and reduced tillage (in 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 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 meets approximately 60% ET of cotton in years of average rainfall. Specific irrigations, tillage operations, cotton varieties, pesticides, and nutrient applications for 2016 are listed in the appendix.

Results: Heavy rain and cold temperatures followed planting and a high wind event on June 15 resulted in damaged cotton plants and poor stands within all test areas. Following the "wind event", portions of each conventional tilled treatment replicate were replanted on June 24. Similar to the results in the cotton-wheat rotation wedge, cotton yields were reduced by irrigation above the 0.5BI level with the exception of the "reduced tilled" treatment where yields averaged 1672 lb/ac at 1.0BI. Loan values and seasonal irrigation water use efficiencies were significantly reduced ($p<0.05$) by irrigations above 0.5BI regardless of planting date or tillage treatment. Within irrigation levels, reduced tillage generally increased yields, loan values and seasonal water use efficiencies over conventional tillage, often by significant amounts (Fig. 3). The initial plantings tended to have the same or better yield, loan value, and water productivity as the late planted cotton treatments.

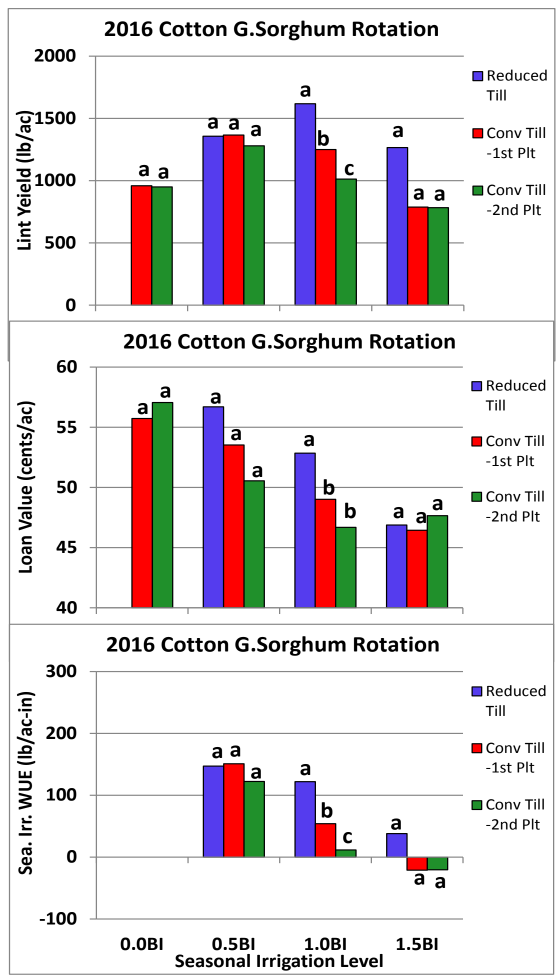


Figure 3. Cotton lint yield, lint loan value, and seasonal irrigation water use efficiency of cotton planted on two dates in a cotton-grain sorghum rotation system at three irrigation levels in tilled and reduced-tilled treatments at Texas A&M AgriLife Research, Helm Farm, 2016.

Company Sponsored Field Trial of Experimental Aphid Material on Sugarcane Aphid Populations in Texas High Plains Grain Sorghum (Field 6)
Blayne Reed

Objective: Independently evaluate efficacy of experimental company compound on Texas High Plains sugarcane aphid populations on grain sorghum against known control level factors for viability of novel mode of action control, potential recommended rate starting points, and realistically investigate need to farther pursue compound advancement in labeling process.

Methodology: An existing field of replanted DK 37-07 sorghum behind failed cotton was utilized once sugarcane aphids reached ET naturally. Plots consisting of 6 rows wide by 44 feet long were lain out with alleys cut for a 4 treatment CRBD with 4 replications. The aphid population was allowed to 'build' across plots for 4 days until plot populations were considered evenly distributed via pretreatment count on 2 September. Plots were then treated via CO2 backpack sprayer set at 15.5 GPA later on the 2 September date. Only the first two rows of each plot were treated or counted to prevent treatment drift. The treatments were: 1) UTC; 2) Experimental low rate + MSO @ 0.5% V/V; 3) Experimental high rate + MSO @ 0.5% V/V; and 4) Sivanto @ 5 oz./ac. + MSO @ 0.5% V/V. Per leaf aphid counts of the 3rd leaf below flag from 5 randomly selected plants per plot were conducted at Pre, 3 DAT, 7 DAT, 19 DAT, and 28 DAT. At the 28DAT and harvest date, plot wide sugarcane aphid damage ratings of 0-10 were taken. Harvest was conducted on 18 November by hand harvesting 10 row feet from each plot. Harvested samples were threshed utilizing a Haldrup sorghum thresher and all grain yield and quality data were recorded. All aphid populations, damage ratings, and grain yield data were compared utilizing ANOVA and LSD.

Results: At 3 DAT the standard Sivanto treatment had separated from the untreated check and both experimental rate treatments despite a numeric downward trend in SCA populations for the experimental treatments. This trend continued through the 7 DAT and 19 DAT counts with both experimental rates showing some numeric and some significant promise in SCA control, but not matching Sivanto fully. By the 28 DAT counts, SCA had begun to rebound and only Sivanto remained significantly better than the UTC. The 0-10 damage ratings from 28 DAT shows benefit to all treatments over the UTC and the harvest rating shows a superior benefit to Sivanto, but significant benefit to the Experimental high rate. Numeric advantages only significant at a P=0.0752 level also hint a beneficial response to both the Sivanto and high rate treatment. Due to the novel MOA of the experimental and a significant showing of the higher rate, the company is moving forward with the product for additional rate refinement and possible labeling.

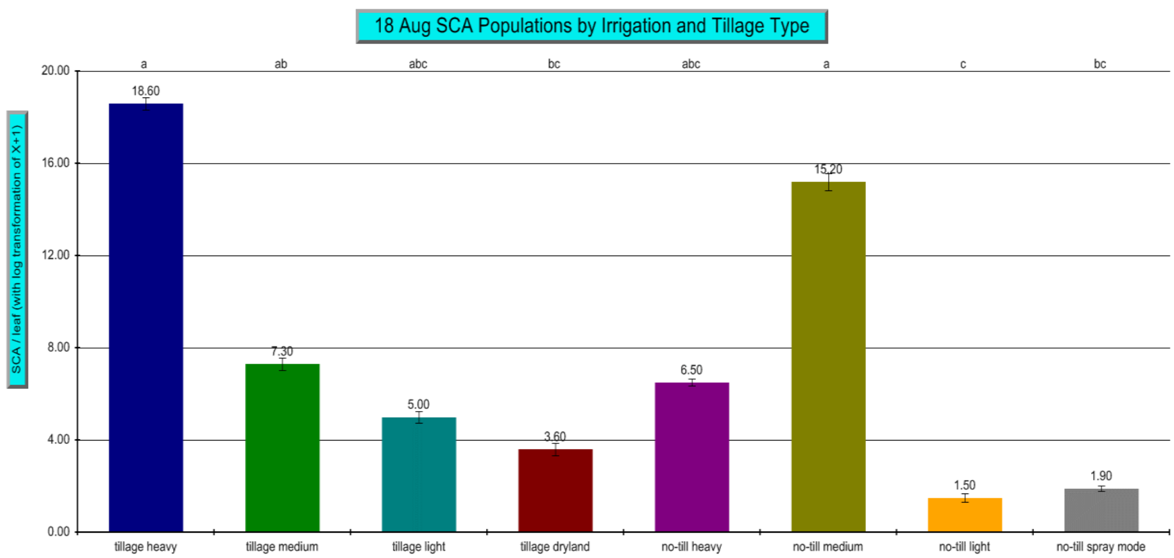
	Pre-Treatment	3 DAT	7 DAT	19 DAT	28 DAT	28 DAT 0-10 damage rating	Harvest 0-10 damage rating	% moisture	Bu. Wt.	LBS. Grain/ac
UTC	207.7 a	134.7 a	66.1 a	52.2 a	58.0 a	5.88 a	7.69 a	13.74 a	58.4 a	3486.9 a
Expierimental Low Rate + MSO @ 0.5% V/V	208.6 a	48.9 a	15.6 b	19.4 ab	66.0 a	3.25 b	6.75 a	13.97 a	59.5 a	3895.0 a
Experimental High Rate + MSO @ 0.5% V/V	153.2 a	55.3 a	17.8 ab	9.9 bc	60.1 a	2.75 b	4.94 b	14.51 a	59.6 a	4310.8 a
Sivanto @ 5 oz./ac + MSO @ 0.5% V/V	169.3 a	11.0 b	4.8 b	4.3 c	23.7 b	2.88 b	2.69 c	13.92 a	59.6 a	4336.9 a
	LSD @ 0.05 = 146 P=0.7755 NS	LSD @ 0.05 = 23-89.2 P=0.0045	LSD @ 0.05 = 15.6-48.94 P=0.0154	LSD@ 0.05 = 11.04-35.93 P=0.0073	LSD @ 0.05 = 27.1-35.1 P=0.0446	LSD @ 0.05 = 1.813 P=0.0111	LSD @ 0.05 = 1.597 P=0.0003	LSD @ 0.05 = 0.7 P=0.1409 NS	LSD @ 0.05 = 1.898 P=0.4769	LSD @0.05 = 715.6 P=0.0752 NS

Sugarcane Aphid Population Distribution of Grain Sorghum by Irrigation Amount and Tillage Type (Field 5e)
Blayne Reed, Pat Porter, Katelyn Kesheimer, Jim Bordovsky

Objective: Observe natural sugarcane aphid infestations on an existing sorghum trial with varying irrigation amounts and tillage types to determine any preferences by the aphid, clarify aphid behaviors and give clues to any potential management benefits to producers.

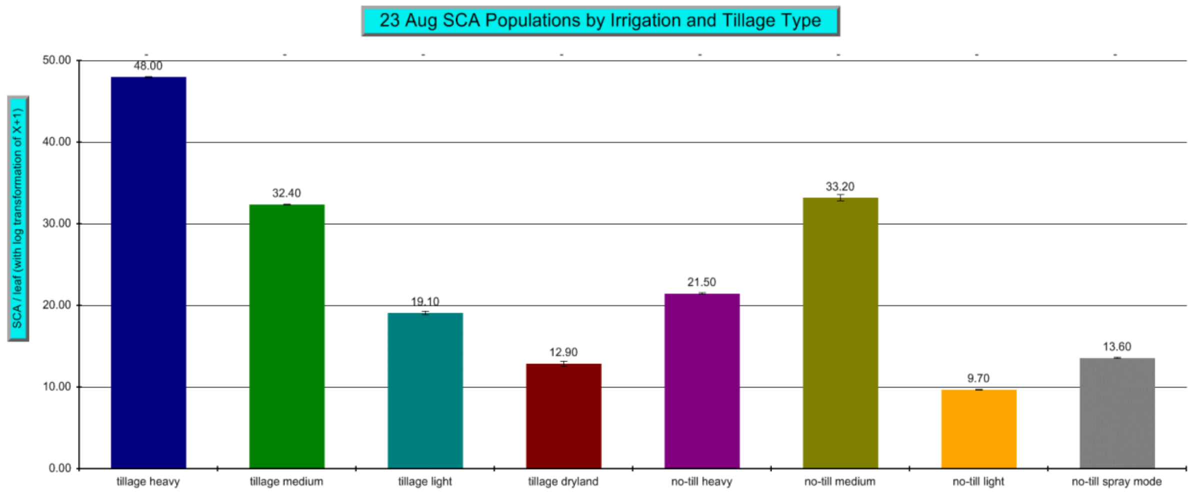
Methodology: The Plains Pest Management field scouting program detected an economic population of sugarcane aphids building in the large plot trial with 3 replications conducted by Jim Bordovsky. On 18 and 23 August, 5 plants per plot were randomly selected from deep within each plot. From each plant, the lowest green leaf and the second leaf below flag were counted for sugarcane aphids per leaf. All upper and lower leaves counted were analyzed separately and jointly as SCA per leaf utilizing ANOVA and LSD at ***P*=0.1**. Following the 23 August counts, the trial was successfully treated for the economic population of sugarcane aphids.

Results: On 18 August the heavy irrigated / tilled treatment and medium irrigated / no-till had significantly more aphids than the light irrigated / no-till, spray mode irrigated / no-till, and the dryland / tilled treatments **(*P*=0.08)**.



That the medium irrigated / no-till treatment separated from the three 'drier' treatments and was statistically not different from the heavy irrigated / tilled treatment was a surprising result. Any heavy irrigated treatment separating alone would not have been a surprise.

A similar numeric trend continued with the 23 August count, but there were no significant differences and all plots held economic populations of SCA.



Additional study is suggested from these preliminary results for confirmation before implications or producer management strategies could be amended based upon irrigation or tillage type. If confirmed, implications could be profound and possibly unique among sorghum pests.

Impact of Surfactant Type on Sugarcane Aphid Product Efficacy and Other Possible Treatment Options (Field 6)

Blayne Reed, Russ Perkins and Craig Sandoski

Objective: Determine if surfactant type has any impact or improvement of Sivanto efficacy for sugarcane aphid control in sorghum compared to known performances and untreated check plus access performance of unlabeled aphid product Strafer and producer inquisition treatment against known performance and untreated check treatments.

Methodology: An existing field of replanted DK 37-07 sorghum behind failed cotton was utilized once sugarcane aphids reached ET naturally. Plots consisting of 6 rows wide by 48 feet long were lain out with alleys cut for a 7 treatment CRBD with 4 replications. The aphid population was allowed to 'build' across plots for 4 days until plot populations were considered evenly distributed via pretreatment count on 2 September. Plots were then treated via CO2 backpack sprayer set at 15.5 GPA later on the 2 September date. Only the first two rows of each plot were treated or counted to prevent treatment drift. The treatments were: 1) UTC; 2) Sivanto @ 5 oz./ac. + NIS @ 1% V/V; 3) Sivanto @ 5 oz./ac. + MSO @ 1% V/V; 4) Sivanto @ 5 oz./ac. + COC @ 1% V/V; 5) Transform @ 1 oz./ac. + NIS @ 1% V/V; 6) Strafer @ 3 oz./ac. + NIS @ 1 % V/V; and 7) Sivanto @ 5 oz./ac. + Lorsban @ 12 oz./ac. + NIS @ 1% V/V. Per leaf aphid counts of the 3rd leaf below flag from 5 randomly selected plants per plot were conducted at Pre, 7DAT, 19DAT, and 28DAT. At the 28DAT and harvest date, plot wide sugarcane aphid damage ratings of 0-10 were taken. Harvest was conducted on 18 November by hand harvesting 10 row feet from each plot. Harvested samples were threshed utilizing a Haldrup sorghum thresher and all grain yield and quality data were recorded. All aphid populations, damage ratings, and grain yield data were compared utilizing ANOVA and LSD.

Results: At the 28 DAT count, the Sivanto / MSO treatment had fewer aphids than the NIS treatment. If surfactants are a factor to improve upon SCA efficacy, then it is a small factor with a small advantage to MSO. The Strafer treatment held no advantage over the Transform treatment offering no need to seek a sorghum label. The Sivanto + Lorsban treatment was among the best performers, but it is suspected that the treatment was aided by beneficials returning to the plots from untreated areas of the field.

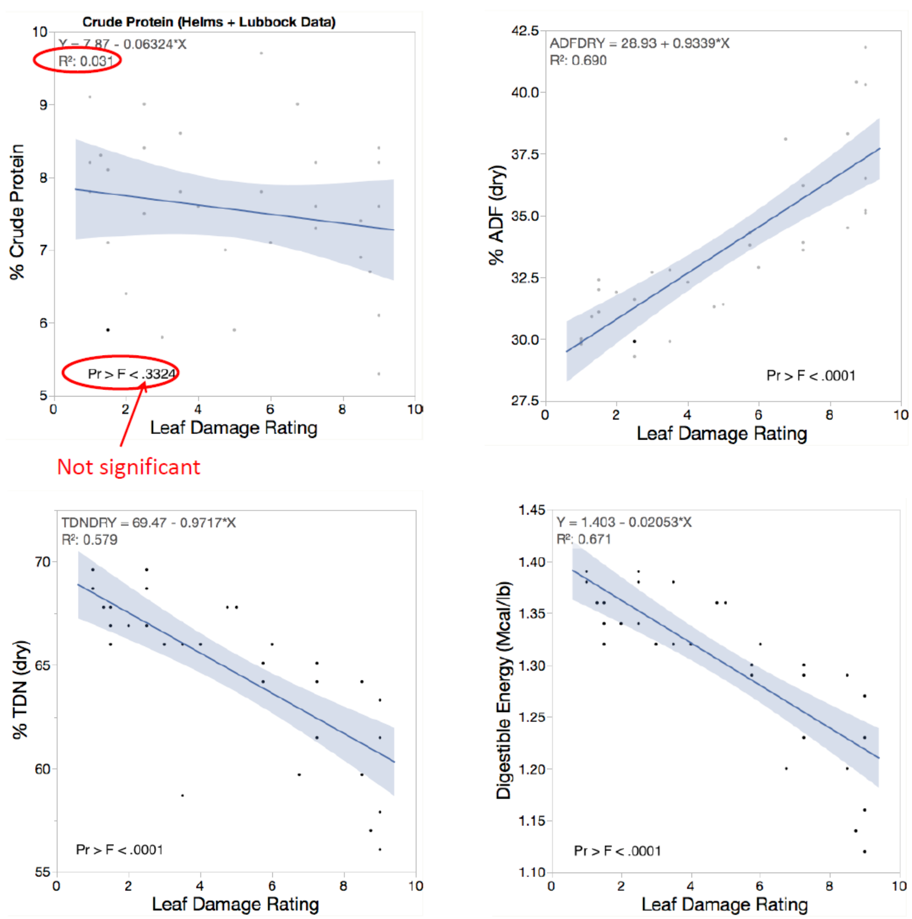
	Pre-Treatment	7 DAT	19 DAT	28 DAT	28 DAT 0-10 damage rating	Harvest 0-10 damage rating	% moisture	Bu. Wt.	LBS. Grain/ac
UTC	113.0 a	24.8 a	35.7 a	77.7 a	6.75 a	6.44 a	13.55 a	59.2 a	3877.2 a
Sivanto @ 5 oz./ac. + NIS @ 1% V/V	105.1 a	2.9 c	5.0 b	23.7 cd	4.25 b	5.00 bc	13.63 a	59.7 a	4337.0 a
Sivanto @ 5 oz./ac. + MSO @ 1% V/V	79.7 a	2.1 c	1.8 b	9.5 e	4.00 b	4.00 c	13.38 a	59.1 a	4628.4 a
Sivanto @ 5 oz./ac. + COC @ 1% V/V	117.8 a	3.8 bc	2.5 b	15.1 de	3.75 b	4.13 c	13.63 a	60.0 a	4210.2 a
Transform @ 1 oz./ac. + NIS @1% V/V	77.1 a	7.9 b	25.6 a	42.0 b	4.25 b	7.69 a	13.75 a	59.1 a	3722.5 a
Strafer @ 3 oz./ac. + NIS @ 1% V/V	119.2 a	7.6 b	16.4 a	38.8 bc	4.00 b	6.56 ab	13.68 a	60.1 a	4098.9 a
Sivanto @ 5 oz./ac. + Lorsban @ 12 oz./ac. + NIS @ 1% V/V	96.4 a	3.2 bc	2.2 b	11.2 e	2.75 b	3.75 c	13.63 a	59.7 a	4941.8 a
	LSD @ 0.05 = 59.7t P=0.5328 NS	LSD @ 0.05 = 13.61t P=0.0002	LSD@ 0.05 = 20.8t P=0.0001	LSD @ 0.05 = 31.2t P=0.0001	LSD @ 0.05 = 1.956 P=0.0199	LSD @ 0.05 = 1.742 P=0.0007	LSD @ 0.05 = 1.155 P=0.3632 NS	LSD @ 0.05 = 0.518 P=0.8322 NS	LSD @0.05 = 853.7 P=0.0966 NS

Preliminary Efforts to Determine the Impact of Sugarcane Aphid Damage to Sorghum-Type Hay for Cattle Feed (Field 6 and AgriLife Center Lubbock)
Pat Porter, Blayne Reed, Katelyn Kesheimer, Sorghum Checkoff

Objective: To provide an initial observation of any potential economic sugarcane aphid damage to sorghum-type hay crops utilized for cattle feed by evaluating sorghum Stover, commonly utilized locally as hay by area cattlemen, left from area sorghum trials with known sugarcane aphid damage ratings taken before grain harvest.

Methodology: Sugarcane aphid trials utilized for study were Blayne Reed's trials from Helms Farm at Halfway, Texas and Dr. Pat Porter's trial at the Lubbock Station. All trials were rated on a 0-10 sugarcane aphid damage rating scale just before grain harvest. 3 to 4 stalks were machete harvested by hand from plots with the known damage ratings, bagged, and taken to the ServiTech Lab in Amarillo, Texas and tested for a basic feed analysis. Results from both locations were combined and analyzed for a correlation between sugarcane aphid damage ratings and the various feed quality factors including protein content, acid detergent fiber, total digestible nutrients, and digestible energy.

Results: Although it showed a general downward trend, crude protein was not impacted significantly by SCA damage. All other factors were significantly impacted by SCA leaf damage in a negative way regarding hay quality. These negative impacts moved very good quality Stover hay to a bare minimum feed quality level. This preliminary study indicates that much of the SCA thresholds for grain sorghum should be transferable to hay and silage sorghums and that much more in-depth study is needed.



Performance of FiberMax and Stoneville Varieties as Affected by Irrigation Levels (Texas A&M AgriLife Research, Halfway)

Wayne Keeling, Justin Spradley and Ray White

Methodology: Plot Size: 4 rows by 40 feet, 3 replications. Planting Date: May 10. Herbicides: Trifluralin 1 qt/A – March 3, Glyphosate 32 oz/A – May 4, Caparol 3 pt/A – May 11, Glyphosate 32 oz/A + Warrant 3 pt/A – July 10, Glyphosate 32 oz/A + Diuron 1.5 pt/A – August 1. Fertilizer: 100-0-0. Irrigation at low, medium and high levels: Preplant = 4.2", 4.2", 4.2"; Seasonal = 3.2", 6.45", 9.7"; Total = 7.4", 10.65", 13.9". Harvest Date: Nov. 10.

Results: Seven FiberMax and two Stoneville varieties were evaluated under three irrigation levels at Halfway in 2016. Due to timely rainfall, high yields were produced across the irrigations, with in-season irrigation inputs ranging from 3.2 to 9.7 acre inches applied. Optimum yields and gross revenues were produced with the base irrigation treatments (6.45" applied in-season). The high irrigation treatments produced a similar yield to the base treatment and reduced fiber quality (lower micronaire). Highest loan values were produced with the low irrigation treatment. When averaged across irrigation levels, the highest yields and gross revenues were produced with FM 1888 GL and FM 2322 GL.

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

	Irrigation Levels				
Variety	**Dry (0.0)**	**Low (3.2)**	**Base (6.45)**	**High (9.7)**	**Average**
		------------------ lbs/A------------------			
FM 1830 GLT	1186	1379	1670	1567	**1451 BC**
FM 1888 GL	1289	1449	1947	1942	**1657 A**
FM 1900 GLT	1080	1375	1581	1637	**1418 CD**
FM 1911 GLT	1026	1317	1741	1541	**1406 CD**
FM 2007 GLT	1071	1326	1665	1529	**1398 CD**
FM 2322 GL	1288	1554	1789	1956	**1647 A**
FM 9250 GL	1134	1360	1680	1708	**1471 BC**
ST 4747 GLB2	867	1391	1866	1998	**1531 B**
ST 4946 GLB2	1020	1244	1562	1581	**1352 D**
Average	**1107 C**	**1377 B**	**1722 A**	**1718 A**	-
		------------------cents/lb-----------------			
FM 1830 GLT	55.8	55.9	51.7	49.4	**53.2 ABC**
FM 1888 GL	55.2	55.2	55.2	51.8	**54.4 A**
FM 1900 GLT	52.5	54.2	54.4	47.4	**52.1 BCD**
FM 1911 GLT	55.4	56.6	51.3	51.6	**53.7 AB**
FM 2007 GLT	55.0	55.7	51.2	49.0	**52.7 ABC**
FM 2322 GL	54.6	57.2	53.9	51.3	**54.3 A**
FM 9250 GL	52.6	55.4	49.9	47.6	**51.4 C**
ST 4747 GLB2	51.1	55.0	53.4	48.0	**51.9 BC**
ST 4946 GLB2	55.1	54.7	51.7	48.8	**52.6 ABC**
Average	**54.1 B**	**55.5 A**	**52.5 C**	**49.4 D**	-
		--------------------$/A--------------------			
FM 1830 GLT	662	771	866	773	**768 BC**
FM 1888 GL	711	801	1075	1009	**899 A**
FM 1900 GLT	566	745	860	777	**737 BCD**
FM 1911 GLT	569	745	898	794	**751 BCD**
FM 2007 GLT	589	739	852	749	**733 CD**
FM 2322 GL	705	889	963	1003	**890 A**
FM 9250 GL	596	753	836	814	**750 BCD**
ST 4747 GLB2	442	765	1000	959	**791 B**
ST 4946 GLB2	562	681	809	764	**704 D**
Average	**600 C**	**765 B**	**907 A**	**849 A**	-

Effect of Nitrogen Fertilizer on Cotton Fleahopper Samage Potential and Crop Response to Injury (Texas A&M AgriLife Research, Halfway)

M.N. Parajulee, A. Hakeem, S.D. Coyle, S.C. Carroll, and 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 1900GLT, was planted at a targeted rate of 54,000 seeds/acre on May 27, 2016. 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 July 14. Pre-treatment soil samples (consisting of three soil cores; 0 to 24-inch depth), were collected from each of the 25 experiment plots on July 1. Three 3-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. Two weeks into cotton squaring (July 17), the most critical phenological stage of cotton for cotton fleahopper management in the Texas High Plains, three cotton fleahopper augmentation treatments (5 cotton fleahopper nymphs per plant, manual removal of 100% squares pre-flower, and no fleahopper augmentation as control) were deployed in these designated row sections to simulate an acute infestation of fleahoppers. With 20% field survivorship, this density is equivalent to 3-4 times current cotton fleahopper threshold (25-30 fleahoppers per 100 plants) for the High Plains.

Results: Cotton fleahoppers induced ~20% square drop across all N plots. Varying rates of N augmentation resulted in phenotypic expression of N deficiency in cotton across treatment plots, more pronouncedly between zero N plots and N augmented plots, which were reflected on temporal chlorophyll and leaf N contents of the fifth leaf (Fig. 1).

All N augmented plots had higher lint yields than on zero N plots, but the crop response to variation in N level was not well defined (Fig. 2). Combined over all N treatments, the acute infestation of fleahoppers rendered the lint yield reduction from 1,209 lb/acre in the control to 976 lb/acre in fleahopper plots. Lint yield was not significantly affected by ~20% fleahopper-induced square loss at zero N and the two highest N plots, either via pruning of undesirable fruit load (zero N) or compensation (high N). On the other hand, lint yield was lower in fleahopper augmented 50 and 100 lb/acre plots compared to that in control plots, suggesting that the plant response to cotton fleahopper injury is greatly influenced by the availably of N fertility. Manual removal of 100% squares pre-flower did not impact the lint yield.

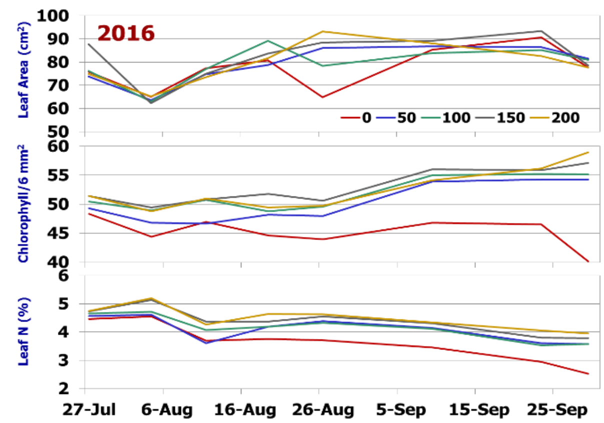


Fig. 1. Temporal dynamics of leaf area, chlorophyll concentration, and leaf N content on 5th mainstem leaf as influenced by varying N rates, 2016.

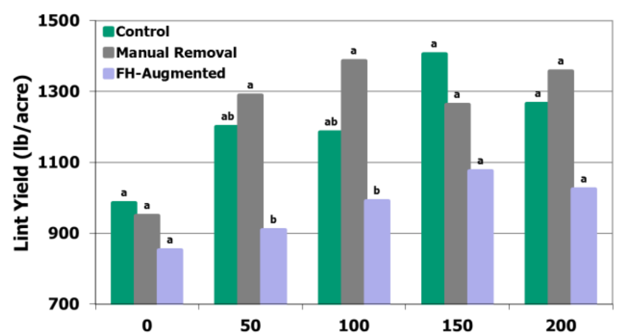


Fig. 1. Effect of N rates on lint yield following a single acute infestation of cotton fleahopper versus uninfested control and manual removal of 100% squares prior to the initiation of flowering, 2016.

APPENDIX

2016 Rain and Irrigation Amounts At Helm Research Farm, Halfway, TX

Rainfall (inches)

Helms Irrigation Amounts (inches) D= driip irrigation, L = LEPA irrigation, S = spray irrigation, F= furrow water

Date Mo	Da	Yr	Rainfall Half @ Building	Rainfall Helms @ Well 1	Field 2 Inseason Irr. G.Sorg. Zone 1 T1	Zone 2 T3	Zone 3 T2	Zone 4 T3	Zone 5 T2	Zone 6 T1	Zone 7 T3	Zone 8 T1	Zone 9 T2	Zone 10 Dry	system
1	5	2016	0.05	0.05											
1	6	2016	0.01	0.01											
1	9	2016		0.03											
2	22	2016	0.10												
2	23	2016	0.04												
2		2016													
3	8	2016	0.49	0.13											
3	17	2016													
3	28	2016			0.05	0.05	0.04	0.05	0.04	0.05	0.05	0.05	0.04	0.03	D
3	29	2016			0.03	0.05	0.02	0.05	0.02	0.03	0.05	0.03	0.02	0.00	D
3	30	2016			0.07	0.04	0.06	0.04	0.06	0.07	0.04	0.07	0.06	0.08	D
4	4	2016													
4	5	2016													
4	7	2016													
4	8	2016													
4	9	2016													
4	10	2016	0.20	0.01											
4	11	2016													
4	12	2016													
4	13	2016	0.33	0.35	0.00	0.00	0.16	0.00	0.16	0.00	0.00	0.00	0.16	0.00	D
4	14	2016					0.17		0.17				0.17		D
4	15	2016					0.17		0.17				0.17		D
4	16	2016													
4	17	2016													
4	18	2016					0.17		0.17				0.17		D
4	19	2016	0.26	0.29			0.00		0.00				0.00		D
4	20	2016					0.16		0.16				0.16		D
4	21	2016					0.15		0.15				0.15		D
4	22	2016													
4	23	2016													
4	24	2016													
4	25	2016					0.17		0.17				0.17		D
4	26	2016					0.17		0.17				0.17		D
4	27	2016			0.10	0.12	0.14	0.12	0.14	0.10	0.12	0.10	0.14	0.15	D
4	28	2016			0.15	0.15	0.17	0.15	0.17	0.15	0.15	0.15	0.17	0.16	D
4	29	2016	0.49	0.29	0.19	0.16	0.16	0.16	0.16	0.19	0.16	0.19	0.16	0.00	D
4	30	2016			0.14	0.16	0.16	0.16	0.16	0.14	0.16	0.14	0.16	0.33	D
5	1	2016			0.13	0.16	0.14	0.16	0.14	0.13	0.16	0.13	0.14	0.17	D
5	2	2016			0.13	0.16	0.16	0.16	0.16	0.13	0.16	0.13	0.16	0.17	D
5	3	2016			0.19	0.16	0.17	0.16	0.17	0.19	0.16	0.19	0.17	0.17	D
5	4	2016			0.16	0.16	0.14	0.16	0.14	0.16	0.16	0.16	0.14	0.17	D
5	5	2016			0.20	0.19	0.20	0.19	0.20	0.20	0.19	0.20	0.20	0.17	D

Date Mo	Da	Yr	Field 3 Inseason Irr. Drip G.Sorg Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	system	Field 5 - A span 2 Pivot Cotton	Field 5 - A spans 3-8 Pivot Cotton Base	Base-50%	Base+50%	system	Field 5 - B span 2 Pivot Cotton	Field 5 - B spans 3-8 Pivot Cotton Base	Base-50%	Base+50%	system	Field 5 - C span 2 Pivot Wheat	Field 5 - C spans 3-8 Pivot Wheat Base	Base-50%	Base+50%	system
1	5	2016																							
1	6	2016																							
1	9	2016																							
2	22	2016																							
2	23	2016																							
2		2016																							
3	8	2016																							
3	17	2016																			1.00	1.00	1.00	1.00	
3	28	2016																							
3	29	2016																							
3	30	2016																							
4	4	2016																			0.75	0.75	0.75	0.75	
4	5	2016																			0.50	0.50	0.50	0.50	
4	7	2016																							
4	8	2016																							
4	9	2016																							
4	10	2016																							
4	11	2016																							
4	12	2016																			0.75	0.75	0.75	0.75	S
4	13	2016	0.02	0.02	0.02	0.02	0.02	0.02		D															
4	14	2016	0.04	0.04	0.04	0.04	0.04	0.04		D	0.75	0.75	0.75	0.75	S										
4	15	2016	0.17	0.17	0.17	0.17	0.17	0.17		D						0.75	0.75	0.75	0.75	S					
4	16	2016	0.19	0.19	0.19	0.19	0.19	0.19		D											0.75	0.75	0.75	0.75	S
4	17	2016	0.19	0.19	0.19	0.19	0.19	0.19		D															
4	18	2016	0.19	0.19	0.19	0.19	0.19	0.19		D															
4	19	2016	0.09	0.09	0.09	0.09	0.09	0.09		D															
4	20	2016	0.18	0.18	0.18	0.18	0.18	0.18		D															
4	21	2016	0.20	0.20	0.20	0.20	0.20	0.20		D	0.50	0.50	0.50	0.50	L										
4	22	2016														0.50	0.50	0.50	0.50	L	0.50	0.50	0.50	0.50	L
4	23	2016	0.02	0.02	0.02	0.02	0.02	0.02		D															
4	24	2016	0.03	0.03	0.03	0.03	0.03	0.03		D															
4	25	2016	0.20	0.20	0.20	0.20	0.20	0.20		D	0.30	0.30	0.30	0.30	L										
4	26	2016	0.19	0.19	0.19	0.19	0.19	0.19		D						0.30	0.30	0.30	0.30	L	0.50	0.50	0.50	0.50	L
4	27	2016	0.24	0.24	0.24	0.24	0.24	0.24	0.13	D															
4	28	2016	0.19	0.19	0.19	0.19	0.19	0.19	0.10	D	0.30	0.30	0.30	0.30	L						0.50	0.50	0.50	0.50	L
4	29	2016	0.25	0.25	0.25	0.25	0.25	0.25	0.10	D						0.30	0.30	0.30	0.30	L					
4	30	2016	0.25	0.25	0.25	0.25	0.25	0.25	0.10	D															
5	1	2016	0.21	0.21	0.21	0.21	0.21	0.21	0.10	D															
5	2	2016	0.19	0.19	0.19	0.19	0.19	0.19	0.10	D	0.30	0.30	0.30	0.30	L										
5	3	2016	0.21	0.21	0.21	0.21	0.21	0.21	0.10	D						0.30	0.30	0.30	0.30	L	0.50	0.50	0.50	0.50	L
5	4	2016	0.18	0.18	0.18	0.18	0.18	0.18	0.10	D	0.30	0.30	0.30	0.30	L										
5	5	2016	0.20	0.20	0.20	0.20	0.20	0.20	0.10	D						0.30	0.30	0.30	0.30	L	0.50	0.50	0.50	0.50	L

2016 Rain and Irrigation Amounts At Helm Research Farm, Halfway, TX

Rainfall (inches)

Helms Irrigation Amounts (inches) D= driip irrigation, L = LEPA irrigation, S = spray irrigation, F= furrow water

Date Mo	Da	Yr	Rainfall: Half @ Building	Rainfall: Helms @ Well 1	Field 2 Inseason Irr. G.Sorg. Zones 1 T1	2 T3	3 T2	4 T3	5 T2	6 T1	7 T3	8 T1	9 T2	10 Dry	system	Field 3 Inseason Irr. Drip G.Sorg Zones 1	2	3	4	5	6	7	syste
5	6	2016			0.17	0.12	0.16	0.12	0.16	0.17	0.12	0.17	0.16	0.17	D	0.19	0.19	0.19	0.19	0.19	0.19	0.10	D
5	7	2016			0.12	0.16	0.15	0.16	0.15	0.12	0.16	0.12	0.15	0.17	D	0.18	0.18	0.18	0.18	0.18	0.18	0.10	D
5	8	2016			0.13	0.17	0.15	0.17	0.15	0.13	0.17	0.13	0.15	0.17	D	0.19	0.19	0.19	0.19	0.19	0.19	0.10	D
5	9	2016			0.15	0.14	0.13	0.14	0.13	0.15	0.14	0.15	0.13	0.17	D	0.17	0.17	0.17	0.17	0.17	0.17	0.10	D
5	10	2016			0.16	0.17	0.18	0.17	0.18	0.16	0.17	0.16	0.18	0.14	D								
5	11	2016			0.17	0.17	0.15	0.17	0.15	0.17	0.17	0.17	0.15	0.14	D								
5	12	2016																					
5	13	2016																					
5	14	2016	1.20	0.95																			
5	15	2016																					
5	16	2016																					
5	17	2016																					
5	18	2016	0.46	0.52																			
5	19	2016	0.56	0.51																			
5	20	2016																					
5	21	2016																					
5	22	2016																					
5	23	2016																					
5	24	2016			0.10	0.14	0.10	0.14	0.10	0.10	0.14	0.10	0.10	0.17	D							0.30	D
5	25	2016			0.16	0.16	0.05	0.16	0.05	0.16	0.16	0.16	0.05	0.17	D							0.30	D
5	26	2016			0.16	0.16	0.13	0.16	0.13	0.16	0.16	0.16	0.13	0.17	D							0.30	D
5	27	2016			0.21	0.17	0.14	0.17	0.14	0.21	0.17	0.21	0.14	0.17	D							0.30	D
5	28	2016			0.10	0.17	0.10	0.17	0.10	0.10	0.17	0.10	0.10	0.17	D							0.32	D
5	29	2016	0.81	0.66																			
5	30	2016																					
5	31	2016																					
6	1	2016	0.85	1.13																			
6	2	2016																					
6	3	2016																					
6	4	2016																					
6	5	2016																					
6	6	2016																					
6	7	2016																					
6	8	2016																					
6	9	2016																					
6	10	2016																					
6	11	2016	0.42	1.26																			
6	12	2016																					
6	13	2016																					
6	14	2016																					
6	15	2016	0.15	0.79																			
6	16	2016																					
6	17	2016																					

Mo	Da	Yr	Field 5 - A span 2 Pivot Cotton	Field 5 - A spans 3-8 Pivot Cotton Base	Base-50%	Base+50%	system	Field 5 - B span 2 Pivot Cotton	Field 5 - B spans 3-8 Pivot Cotton Base	Base-50%	Base+50%	system	Field 5 - C span 2 Pivot Wheat	Field 5 - C spans 3-8 Pivot Wheat Base	Base-50%	Base+50%	system
5	6	2016															
5	7	2016															
5	8	2016															
5	9	2016	0.25	0.25	0.25	0.25	L										
5	10	2016						0.25	0.25	0.25	0.25	L	0.50	0.50	0.50	0.50	L
5	11	2016															
5	12	2016															
5	13	2016															
5	14	2016															
5	15	2016															
5	16	2016															
5	17	2016															
5	18	2016															
5	19	2016															
5	20	2016															
5	21	2016															
5	22	2016															
5	23	2016	0.20	0.20	0.20	0.20	S										
5	24	2016						0.20	0.20	0.20	0.20	S					
5	25	2016	0.20	0.20	0.20	0.20	S										
5	26	2016						0.20	0.20	0.20	0.20	S					
5	27	2016															
5	28	2016															
5	29	2016															
5	30	2016															
5	31	2016															
6	1	2016															
6	2	2016															
6	3	2016															
6	4	2016															
6	5	2016															
6	6	2016															
6	7	2016															
6	8	2016															
6	9	2016															
6	10	2016															
6	11	2016															
6	12	2016															
6	13	2016															
6	14	2016															
6	15	2016															
6	16	2016															
6	17	2016															

2016 Rain and Irrigation Amounts At Helm Research Farm, Halfway, TX

Helms Irrigation Amounts (inches) D= driip irrigation, L = LEPA irrigation, S = spray irrigation, F= furrow water

Date Mo	Da	Yr	Rainfall (inches) Half @ Building	Rainfall (inches) Helms @ Well 1	Field 2 Inseason Irr. G.Sorg. Zones 1 T1	2 T3	3 T2	4 T3	5 T2	6 T1	7 T3	8 T1	9 T2	10 Dry	system	Field 3 Inseason Irr. Drip G.Sorg Zones 1	2	3	4	5	6	7	syste	Field 5 - A span 2 Pivot Cotton	Field 5 - A spans 3-8 Pivot Cotton Base	Base-50%	Base+50%	system	Field 5 - B span 2 Pivot Cotton	Field 5 - B spans 3-8 Pivot Cotton Base	Base-50%	Base+50%	system	Field 5 - C span 2 Pivot Wheat	Field 5 - C spans 3-8 Pivot Wheat Base	Base-50%	Base+50%	system
6	18	2016																																				
6	19	2016																																				
6	20	2016																																				
6	21	2016																																				
6	22	2016			0.42	0.39	0.37	0.39	0.37	0.42	0.39	0.42	0.37	0.42		0.30	0.30	0.30	0.30	0.30	0.30		D															
6	23	2016			0.28	0.30	0.23	0.30	0.23	0.28	0.30	0.28	0.23	0.31		0.22	0.22	0.22	0.22	0.22	0.22		D	0.30	0.30	0.30	0.30	S	0.3	0.3	0.3	0.3	S					
6	24	2016	0.02	0.02	0.30	0.29	0.39	0.29	0.39	0.30	0.29	0.30	0.39	0.31		0.27	0.27	0.27	0.27	0.27	0.27		D															
6	25	2016			0.25	0.20	0.18	0.20	0.18	0.25	0.20	0.25	0.18	0.29		0.20	0.20	0.20	0.20	0.20	0.20		D															
6	26	2016														0.08	0.08	0.08	0.08	0.08	0.08		D															
6	27	2016																																				
6	28	2016																																				
6	29	2016																																				
6	30	2016	0.47	0.20																																		
7	1	2016	0.01																																			
7	2	2016	0.02																																			
7	3	2016																																				
7	4	2016																																				
7	5	2016					1.05								D	0.23							D															
7	6	2016														0.42			0.31	0.58	0.30		D															
7	7	2016																	0.70	0.04	0.73		D															
7	8	2016	0.04																0.25		0.26		D	0.60	0.60	0.60	0.60	S	0.6	0.6	0.6	0.6	S					
7	9	2016																																				
7	10	2016																																				
7	11	2016																																				
7	12	2016					0.88								D																							
7	13	2016					0.16								D																							
7	14	2016																																				
7	15	2016	0.76	0.48												0.43			0.22	0.45	0.22		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
7	16	2016																	0.76		0.79		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
7	17	2016														0.18			0.22	0.19	0.23		D															
7	18	2016																																				
7	19	2016			0.27	0.32									D	0.58			0.59	0.61	0.61		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
7	20	2016			0.49	0.51									D	0.45			0.45	0.46	0.47		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
7	21	2016			0.18	0.18	0.22	0.86							D	0.36	0.86	0.78	0.36	0.37	0.37		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
7	22	2016					1.13	0.33	1.06	1.12	0.29	0.28	0.28		D		0.46	0.49					D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
7	23	2016									0.80	0.80	0.78		D	0.40			0.40				D															
7	24	2016														0.87			0.87				D															
7	25	2016														0.02			0.02	0.67	0.69		D															
7	26	2016			0.48	0.51									D	0.15	0.13	0.13	0.15	0.63	0.66		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
7	27	2016	0.10	0.15	0.29	0.30	1.10	1.10	0.09	0.09	0.05	0.11	0.07		D		0.73	0.74		0.09	0.09		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
7	28	2016			0.25	0.24			0.90	0.91	0.31	0.30	0.30		D		0.28	0.27		0.03	0.03	0.06	D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
7	29	2016				0.02			0.11	0.11	0.69	0.64	0.68		D		0.24	0.23					D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
7	30	2016														0.04			0.04		0.01		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					

2016 Rain and Irrigation Amounts At Helm Research Farm, Halfway, TX

Rainfall (inches)

Helms Irrigation Amounts (inches) D= driip irrigation, L = LEPA irrigation, S = spray irrigation, F= furrow water

Date Mo	Da	Yr	Half @ Building	Helms @ Well 1	Field 2 Inseason Irr. G.Sorg. Zones 1 T1	2 T3	3 T2	4 T3	5 T2	6 T1	7 T3	8 T1	9 T2	10 Dry	system	Field 3 Inseason Irr. Drip G.Sorg Zones 1	2	3	4	5	6	7	syste	Field 5 - A span 2 Pivot Cotton	Field 5 - A spans 3-8 Pivot Cotton Base	Base-50%	Base+50%	system	Field 5 - B span 2 Pivot Cotton	Field 5 - B spans 3-8 Pivot Cotton Base	Base-50%	Base+50%	system	Field 5 - C span 2 Pivot Wheat	Field 5 - C spans 3-8 Pivot Wheat Base	Base-50%	Base+50%	system
7	31	2016														0.77			0.77	0.02	0.02		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
8	1	2016																		0.68	0.70		D															
8	2	2016			0.42	0.44									D	0.66	0.08	0.08	0.66	0.62	0.56		D															
8	3	2016			0.43	0.46	1.03	1.04							D		0.93	0.92					D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
8	4	2016			0.19	0.14			1.03	1.05	0.31	0.31	0.30		D		0.24	0.24					D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
8	5	2016			0.05						0.69	0.67	0.67		D		0.11	0.11					D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
8	6	2016														0.47	0.03	0.03	0.48		0.08		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
8	7	2016														0.76			0.88				D	0.09	0.06	0.03	0.09	L										
8	8	2016														0.70			0.59				D						0.3	0.2	0.10	0.30	L					
8	9	2016	1.10	1.04	0.52	0.56									D					0.74	0.76		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
8	10	2016			0.38	0.40	0.86	0.87	0.01	0.02					D		0.76	0.76		0.76	0.78		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
8	11	2016	0.29	0.30	0.06	0.07	0.04	0.05	1.03	1.08					D		0.71	0.71		0.18	0.18		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
8	12	2016					0.14	0.14		0.09	1.02	0.97	0.99		D		0.34	0.34		0.14	0.15		D															
8	13	2016														0.50			0.50				D															
8	14	2016																																				
8	15	2016														0.89			0.89	0.71	0.73		D	0.09	0.06	0.03	0.09	L										
8	16	2016			0.59	0.46									D		0.11	0.10		0.59	0.62		D						0.3	0.2	0.10	0.30	L					
8	17	2016			0.19	0.36	1.00	1.00							D		0.73	0.73		0.04	0.04		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
8	18	2016			0.30	0.22			1.06	1.01	0.36	0.35	0.35		D		0.37	0.37					D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
8	19	2016					0.05	0.05			0.66	0.66	0.65		D		0.18	0.18					D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
8	20	2016														0.50			0.50				D															
8	21	2016														0.76			0.76				D															
8	22	2016														0.14			0.14	0.71	0.73		D															
8	23	2016			0.45	0.47									D		0.13	0.13		0.62	0.65		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
8	24	2016			0.41	0.43	0.97	0.97							D		0.75	0.75		0.02	0.02		D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
8	25	2016			0.19	0.20	0.11	0.11	1.05	1.09	0.38	0.39	0.39		D		0.38	0.38					D	0.09	0.06	0.03	0.09	L	0.3	0.2	0.10	0.30	L					
8	26	2016									0.69	0.70	0.68		D	0.61			0.61				D															
8	27	2016														0.70			0.69	0.04	0.04		D															
8	28	2016	0.19	0.16																0.66	0.68		D															
8	29	2016	0.80	0.92													0.19	0.19		0.64	0.67		D															
8	30	2016	0.68	0.38													0.94	0.94					D															
8	31	2016	0.40	0.64																																		
9	1	2016	0.15	0.18																																		
9	8	2016	1.80	2.02																																		
9	15	2016	0.93	0.92																																		
9	16	2016	0.40	0.38																																		
10	13	2016	0.38	0.39																																		
Pre & At Plant			1.97	1.16	4.42	4.47	5.49	4.47	5.49	4.42	4.47	4.42	5.49	4.70		5.39	5.39	5.39	5.39	5.39	5.39	2.85		3.40	3.40	3.40	3.40	#	3.40	3.40	3.40	3.40		6.75	6.75	6.75	6.75	
Seasonal			12.99	14.00	6.12	6.28	8.75	6.53	6.35	6.57	6.25	6.18	6.13	0.00		11.57	9.66	9.59	12.79	11.28	12.86	0.06		3.03	2.22	1.41	3.03	#	8.70	6.00	3.30	8.70		0.00	0.00	0.00	0.00	
TOTALS			14.96	15.16	10.54	10.75	14.24	11.00	11.84	10.99	10.72	10.60	11.62	4.70		16.96	15.05	14.98	18.18	16.67	18.25	2.90		6.43	5.62	4.81	6.43	#	12.10	9.40	6.70	12.10		6.75	6.75	6.75	6.75	

2016 Rain and Irrigation Amounts At Helm Research Farm, Halfway, TX

Rainfall (inches)

Helms Irrigation Amounts (inches) D= driip irrigation, L = LEPA irrigation, S = spray irrigation, F= furrow water

Date			Half @ Building	Helms @ Well 1	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				Pivot	Pivot				Pivot	Pivot				Drip	Drip	Drip	Drip	Drip	Drip	Drip	Drip	
					Cotton	Cotton				Cotton	Cotton				G.Sorg.	G.Sorg.				Cot	Cot				G.Sorg.	G.Sorg.	G.Sorg.	G.Sorg.	G.Sorg.	Fallow	Cot	Cot	
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									syste
1	5	2016	0.05	0.05																													
1	6	2016	0.01	0.01																													
1	9	2016		0.03																													
2	22	2016	0.10																														
2	23	2016	0.04																														
2		2016																															
3	8	2016	0.49	0.13																													
3	17	2016																															
3	28	2016																															
3	29	2016																															
3	30	2016																													0.23			D
4	4	2016																								0.12	0.13	0.12	0.02	0.12	0.38			D
4	5	2016																								0.12	0.13	0.12	0.23	0.17	0.36			D
4	7	2016																								0.12	0.13	0.12	0.12	0.13	0.36			D
4	8	2016																								0.12	0.13	0.12	0.12	0.18	0.42			D
4	9	2016																								0.12	0.13	0.12	0.12	0.05	0.29			D
4	10	2016	0.20	0.01																						0.12	0.13	0.12	0.12	0.13	0.36			D
4	11	2016																								0.12	0.13	0.12	0.09	0.06	0.36			D
4	12	2016																								0.12	0.13	0.12	0.10	0.12	0.36			D
4	13	2016	0.33	0.35	0.75	0.75	0.75	0.75	S	0.75	0.75	0.75	0.75	S	0.75	0.75	0.75	0.75	S							0.12	0.13	0.12	0.14	0.12	0.36			D
4	14	2016																			0.75	0.75	0.75	0.75	S	0.12	0.13	0.11	0.09	0.10	0.35			D
4	15	2016																								0.12	0.13	0.11	0.13	0.12	0.35			D
4	16	2016																																
4	17	2016																																
4	18	2016																								0.12	0.13	0.11	0.11	0.12	0.35			D
4	19	2016	0.26	0.29																						0.12	0.13	0.11	0.13	0.12		0.21	0.22	D
4	20	2016																			0.50	0.50	0.50	0.50	L				0.04	0.12		0.16		D
4	21	2016																								0.11	0.11	0.10	0.10	0.08		0.21	0.26	D
4	22	2016																																
4	23	2016			0.50	0.50	0.50	0.50	L	0.50	0.50	0.50	0.50	L	0.50	0.50	0.50	0.50	L							0.11	0.11	0.10	0.12	0.16		0.20	0.22	D
4	24	2016																												0.05				D
4	25	2016																			0.30	0.30	0.30	0.30	L					0.08				D
4	26	2016																								0.18	0.18	0.23	0.18	0.18		0.52	0.53	D
4	27	2016			0.30	0.30	0.30	0.30	L	0.30	0.30	0.30	0.30	L	0.30	0.30	0.30	0.30	L	0.30	0.30	0.30	0.30	L	0.18	0.19	0.18	0.18	0.17		0.53	0.52	D
4	28	2016																								0.20	0.21	0.10	0.26	0.00		0.21	0.17	D
4	29	2016	0.49	0.29	0.30	0.30	0.30	0.30	L	0.30	0.30	0.30	0.30	L	0.30	0.30	0.30	0.30	L							0.32	0.34	0.30	0.29	0.31		0.21	0.19	D
4	30	2016																								0.32	0.37	0.29	0.35	0.55		0.18	0.20	D
5	1	2016																								0.29	0.29	0.28	0.26	0.00		0.16	0.18	D
5	2	2016																			0.30	0.30	0.30	0.30	L	0.29	0.22	0.18	0.24	0.28		0.17	0.18	D
5	3	2016			0.30	0.30	0.30	0.30	L	0.30	0.30	0.30	0.30	L												0.32	0.31	0.22	0.32	0.32		0.18	0.19	D
5	4	2016													0.30	0.30	0.30	0.30	L	0.30	0.30	0.30	0.30	L	0.32	0.33	0.32	0.25	0.32		0.18	0.20	D
5	5	2016																								0.32	0.29	0.28	0.32	0.32		0.18	0.19	D

2016 Rain and Irrigation Amounts At Helm Research Farm, Halfway, TX

Rainfall (inches)

Helms Irrigation Amounts (inches) D= driip irrigation, L = LEPA irrigation, S = spray irrigation, F= furrow water

Date			Half @ Building	Helms @ Well 1	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				Pivot	Pivot				Pivot	Pivot				Drip	Drip	Drip	Drip	Drip	Drip	Drip	Drip	
					Cotton	Cotton				Cotton	Cotton				G.Sorg.	G.Sorg.				Cot	Cot				G.Sorg.	G.Sorg.	G.Sorg.	G.Sorg.	G.Sorg.	Fallow	Cot	Cot	
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									syste
5	6	2016			0.30	0.30	0.30	0.30	L	0.30	0.30	0.30	0.30	L	0.30	0.30	0.30	0.30	L						0.32	0.42	0.49	0.42	0.32		0.18	0.19	D
5	7	2016																															
5	8	2016																							0.32	0.32	0.22	0.23	0.32		0.18	0.19	D
5	9	2016																		0.25	0.25	0.25	0.25	L	0.63	0.56	0.51	0.61	0.63		0.36	0.39	D
5	10	2016			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						0.32	0.27	0.26	0.32	0.32		0.18	0.19	D
5	11	2016																							0.06	0.70	0.66	0.12	0.05		0.08	0.05	D
5	12	2016																							0.06	0.73	0.69	0.14	0.05		0.08	0.05	D
5	13	2016																							0.15	0.09	0.08	0.10	0.07		0.20	0.13	D
5	14	2016	1.20	0.95																													
5	15	2016																															
5	16	2016																															
5	17	2016																															
5	18	2016	0.46	0.52																													
5	19	2016	0.56	0.51																													
5	20	2016																															
5	21	2016																															
5	22	2016																															
5	23	2016																		0.20	0.20	0.20	0.20	S									
5	24	2016																										0.08	0.20		0.15	0.16	D
5	25	2016			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	0.19	0.19	0.05	0.15	0.19				D
5	26	2016																							0.19	0.19	0.15	0.18	0.21				D
5	27	2016																							0.19	0.19	0.19	0.18	0.17				D
5	28	2016																							0.19	0.19	0.32	0.22	0.19				D
5	29	2016	0.81	0.66																					0.19	0.19	0.19	0.19	0.19				D
5	30	2016																															
5	31	2016																															
6	1	2016	0.85	1.13																													
6	2	2016																															
6	3	2016																															
6	4	2016																															
6	5	2016																															
6	6	2016																															
6	7	2016																															
6	8	2016																															
6	9	2016																															
6	10	2016			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														
6	11	2016	0.42	1.26											0.30	0.30	0.30	0.30	S														
6	12	2016																															
6	13	2016																															
6	14	2016																															
6	15	2016	0.15	0.79																													
6	16	2016																															
6	17	2016																															

2016 Rain and Irrigation Amounts At Helm Research Farm, Halfway, TX

Rainfall (inches)

Helms Irrigation Amounts (inches) D= driip irrigation, L = LEPA irrigation, S = spray irrigation, F= furrow water

Date			Half @ Building	Helms @ Well 1	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				Pivot	Pivot				Pivot	Pivot				Drip	Drip	Drip	Drip	Drip	Drip	Drip	Drip	
					Cotton	Cotton				Cotton	Cotton				G.Sorg.	G.Sorg.				Cot	Cot				G.Sorg.	G.Sorg.	G.Sorg.	G.Sorg.	G.Sorg.	Fallow	Cot	Cot	
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									syste
6	18	2016																															
6	19	2016																															
6	20	2016																															
6	21	2016																															
6	22	2016																															
6	23	2016																															
6	24	2016	0.02	0.02											0.30	0.30	0.30	0.30	S	0.30	0.30	0.30	0.30	S									
6	25	2016																															
6	26	2016																															
6	27	2016																															
6	28	2016																															
6	29	2016																															
6	30	2016	0.47	0.20																													
7	1	2016	0.01																														
7	2	2016	0.02																														
7	3	2016																															
7	4	2016																															
7	5	2016																															
7	6	2016			0.60	0.60	0.60	0.60	S	0.60	0.60	0.60	0.60	S																			
7	7	2016																		0.60	0.60	0.60	0.60	S									
7	8	2016	0.04																														
7	9	2016													0.60	0.60	0.60	0.60	S														
7	10	2016																															
7	11	2016																															
7	12	2016																															
7	13	2016			0.20	0.1333	0.07	0.20	L	0.09	0.06	0.03	0.09	L											0.08	0.25	0.08		0.11		0.26	1.00	D
7	14	2016													0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.08	0.25	0.20		0.10		0.18	0.18	D
7	15	2016	0.76	0.48	0.30	0.2	0.10	0.30	L	0.09	0.06	0.03	0.09	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L									
7	16	2016																															
7	17	2016																															
7	18	2016			0.30	0.2	0.10	0.30	L	0.09	0.06	0.03	0.09	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.00	0.00	0.09		0.10		0.10	0.00	D
7	19	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L											0.08	0.23	0.15		0.09		0.17	0.17	D
7	20	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L						0.30	0.2	0.10	0.30	L	0.17	0.50	0.33		0.24		0.35	0.35	D
7	21	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.08	0.23	0.00		0.04		0.17	0.17	D
7	22	2016													0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.09	0.28	0.17		0.11		0.18	0.19	D
7	23	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L						0.09	0.26	0.31		0.11		0.18	0.19	D
7	24	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L											0.09	0.26	0.05		0.11		0.18	0.19	D
7	25	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L											0.09	0.27	0.18		0.11		0.18	0.19	D
7	26	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.09	0.26	0.20		0.11		0.18	0.19	D
7	27	2016	0.10	0.15											0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.09	0.26	0.21		0.11		0.18	0.18	D
7	28	2016													0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.14	0.24	0.06		0.07		0.15	0.17	D
7	29	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.00	0.00	0.15		0.11		0.18	0.02	D
7	30	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.09	0.26	0.19		0.12		0.18	0.19	D

2016 Rain and Irrigation Amounts At Helm Research Farm, Halfway, TX

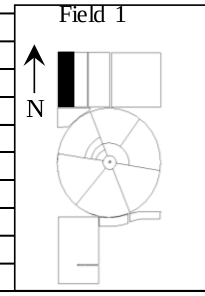
Rainfall (inches)

Helms Irrigation Amounts (inches) D= driip irrigation, L = LEPA irrigation, S = spray irrigation, F= furrow water

Date Mo	Da	Yr	Half @ Building	Helms @ Well 1	Field 5 - D East span 2 Pivot Cotton	Field 5 - D East spans 3-8 Pivot Cotton Base	Base-50%	Base+50%	system	Field 5 - D West span 2 Pivot Cotton	Field 5 - D West spans 3-8 Pivot Cotton Base	Base-50%	Base+50%	system	Field 5 - E span 2 Pivot G.Sorg.	Field 5 - E spans 3-8 Pivot G.Sorg. Base	Base-50%	Base+50%	system	Field 5 - F span 2 Pivot Cot	Field 5 - F spans 3-8 Pivot Cot Base	Base-50%	Base+50%	system	Field 6 - A Drip G.Sorg.	Field 6 - B Drip G.Sorg.	Field 6 - C Drip G.Sorg.	Field 6 - D Drip G.Sorg.	Field 6 - E Drip G.Sorg.	Field 6 F Drip Fallow	Field 6 - G Drip Cot	Field 6 - H Drip Cot	syste
7	31	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.09	0.26	0.05		0.11		0.18	0.19	D
8	1	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L						0.09	0.22	0.11		0.11		0.17	0.18	D
8	2	2016																							0.08	0.29	0.17		0.11		0.18	0.18	D
8	3	2016																		0.30	0.2	0.10	0.30	L	0.08	0.25	0.19		0.11		0.17	0.18	D
8	4	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.09	0.26	0.19		0.10		0.18	0.18	D
8	5	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.09	0.25	0.19		0.10		0.19	0.17	D
8	6	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.09	0.25	0.17		0.11		0.17	0.18	D
8	7	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.08	0.26	0.17		0.11		0.17	0.18	D
8	8	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.09	0.25	0.17		0.11		0.17	0.18	D
8	9	2016	1.10	1.04	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.08	0.26	0.17		0.11		0.17	0.18	D
8	10	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.08	0.25	0.15		0.10		0.17	0.17	D
8	11	2016	0.29	0.30	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L						0.09	0.30	0.18		0.03		0.18	0.18	D
8	12	2016																							0.09	0.25	0.19		0.11		0.20	0.18	D
8	13	2016																							0.09	0.25	0.19		0.12		0.20	0.18	D
8	14	2016																							0.09	0.26	0.19		0.13		0.20	0.19	D
8	15	2016																		0.30	0.2	0.10	0.30	L	0.09	0.25	0.00		0.08		0.20	0.18	D
8	16	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.08	0.23	0.17		0.11		0.18	0.18	D
8	17	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.09	0.27	0.19		0.10		0.18	0.18	D
8	18	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.09	0.25	0.15		0.11		0.18	0.19	D
8	19	2016																							0.09	0.26	0.18		0.11		0.18	0.18	D
8	20	2016																							0.09	0.26	0.18		0.11		0.18	0.18	D
8	21	2016																							0.09	0.26	0.18		0.11		0.18	0.19	D
8	22	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.09	0.26	0.14		0.11		0.18	0.19	D
8	23	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L						0.09	0.25	0.17		0.11		0.18	0.19	D
8	24	2016			0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.30	0.2	0.10	0.30	L	0.09	0.26	0.14		0.11		0.18	0.19	D
8	25	2016																		0.30	0.2	0.10	0.30	L	0.09	0.26	0.20		0.11		0.18	0.19	D
8	26	2016																							0.09	0.26	0.32		0.18		0.18	0.19	D
8	27	2016																							0.09	0.26	0.18		0.07		0.18	0.19	D
8	28	2016	0.19	0.16																					0.09	0.26	0.02		0.08		0.18	0.19	D
8	29	2016	0.80	0.92																					0.09	0.26	0.26		0.11		0.18	0.19	D
8	30	2016	0.68	0.38																					0.09	0.26	0.24		0.19		0.18	0.19	D
8	31	2016	0.40	0.64																													
9	1	2016	0.15	0.18																													
9	8	2016	1.80	2.02																													
9	15	2016	0.93	0.92																													
9	16	2016	0.40	0.38																													
10	13	2016	0.38	0.39																													
Pre & At Plant			1.97	1.16	3.30	3.30	3.30	3.30	#	3.30	3.30	3.30	3.30		3.60	3.60	3.60	3.60		3.50	3.50	3.50	3.50	#	7.29	8.62	7.90	7.35	7.36	4.52	4.72	4.61	
Seasonal			12.99	14.00	8.90	6.13	3.37	8.90		8.37	5.78	3.19	8.37		8.70	6.00	3.30	8.70		8.70	6.00	3.30	8.70		3.98	11.53	7.58	0.00	5.02	0.00	8.42	9.04	
TOTALS			14.96	15.16	12.20	9.43	6.67	12.20		11.67	9.08	6.49	11.67		12.30	9.60	6.90	12.30		12.20	9.50	6.80	12.20		11.27	20.15	15.48	7.35	12.39	4.52	13.14	13.65	

Operations Summary

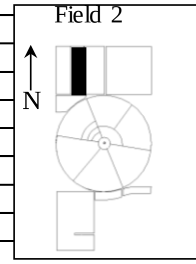
Year	2016
Farm	Helm
Field ID	Field 1
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage	10/29/2015	Shred F.1 North
	12/7/2015	Shred F.1 South
	12/7/2015	Disk F.1 North
	12/10/2015	List F.1 North
	2/1/2016	Disk F. 2 South tw ice
	2/3/2016	Cultivate F.1 South
	3/14/2016	List F.1 South
	4/13/2016	Bed Conditioner F. 1 South
	5/23/2016	Rotary Hoe F. 1 South
	6/4/2016	Rotary Hoe F. 1 South
	6/13/2016	Rotary Hoe F. 1 South
	6/16/2016	Rotary Hoe F. 1 South
	7/8/2016	Cultivate and Dike F. 1 North
	10/3/2016	Shred F. 1 South
	10/4/2016	Disk F. 1 South three times
	11/28/2016	Shred F. 1 North
Fertility	4/13/2016	50 gal/ac, liquid 32-0-0, F. 1 South
	4/13/2016	9.2 gal/ac, liquid 10-34-0, F. 1 South
	6/15/2016	50 gal/ac, liquid 32-0-0, F. 1 South
Planting	12/10/2015	VNS 45 lbs/ac (cover crop) F. 1 North
	5/23/2016	FiberMax (mixed varieties) at 52,000 seed/ac F. 1 North
	6/21/2016	DKS 3707 at 32,500 seed/ac (replant) F. 1 North
	10/4/2016	VNS 45 lbs/ac (cover crop) F. 1 South
Herbicide/	3/16/2016	Salvo 1 pt/ac F. 1 North
Grow th Regulator	4/4/2016	Makaze 32 oz/ac, Maximizer 2% F. 1 North
	4/20/2016	Makaze 32 oz/ac, Maximizer 2% F. 1 North
	5/5/2016	Acuron 2.5 qt/ac, Makaze 32 oz/ac F. 1 South
	5/23/2016	Caporal 3 pt/ac F. 1 North
	6/7/2016	Makaze 32 oz/ac F. 1 North
	6/10/2016	Warrant 3 pt/ac F. 1 North
	6/13/2016	Select Max 12oz/ac F. 1 North
	6/17/2016	Accent D 1oz/ac F. 1 South
	6/21/2016	Milo Pro 1.2 qt/ac F. 1 North
	7/12/2016	AIM EC 1 oz/ac, Crop Oil 1% F. 1 North
	7/18/2016	Medal 1 pt/ac, Atrazine 1pt/ac F. 1 North
	10/24/2016	Makaze 32 oz/ac F. 1 North
Insecticide	6/7/2016	Acephate 3.2 oz/ac F. 1 North
	8/24/2016	Sivanto 5 oz/ac, Crop Oil 1% F. 1 North
Harvest aid		
Irrigation Amt.		
PrePlant & Planting		
Seasonal		
Rainfall		
PrePlant & Planting		
Seasonal		

Operations Summary

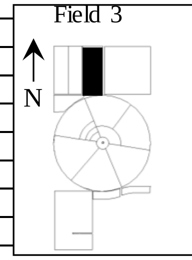
Year	2016
Farm	Helm
Field ID	Field 2
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage	12/19/2015	Shred
	2/3/2016	Cultivate
	3/4/2016	Cultivate
	3/15/2016	List
	5/2/2016	Planter (used to consolidate beds)
	5/22/2016	Rotary Hoe
	5/31/2016	Rotary Hoe
	6/4/2016	Rotary Hoe
	6/13/2016	Rotary Hoe
	6/16/2016	Rotary Hoe
	7/11/2016	Cultivate and Dike
Fertility	4/8/2016	19.7 gal/ac, liquid 32-0-0, zones 1-9
	4/8/2016	15 gal/ac, liquid 32-0-0, dryland 16 rows
	4/8/2016	7.4 gal/ac, liquid 10-34-0, zones 1-9
	8/3,4,5/16	15gal/ac, liquid 32-0-0 zones 1-9 (injected into drip lines)
Planting	5/10/2016	NexGen 1511B2RF at 52,000 seed/ac
	5/24/2016	FiberMax 2484B2F at 52,000 seed/ac (replant)
	6/21/2016	DKS 3707 at 32,500 seed/ac (replant)
Herbicide/	3/4/2016	Trifluralin 1qt/ac
Growth Regulator	5/11/2016	Caporal 3pt/ac
	6/6/2016	Makaze 32 oz/ac
	6/10/2016	Warrant 3 pt/ac
	6/21/2016	Milo Pro 1.2 qt/ac
	7/18/2016	Medal 1pt/ac, Atrazine 1pt/ac
	10/24/2016	Makaze 32 oz/ac
Insecticide	6/6/2016	Acephate 3.2 oz/ac
	8/24/2016	Sivanto 5 oz/ac, Crop Oil 1%
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	3-28 to 6-25	Trt.1 4.42in.; Trt. 2 5.49in.; Trt.3 4.47in.; Dry 4.70in.
Seasonal	7-5 to 8-26	1 = 6.12in.; 2 = 6.26in.; 3 = 8.75in.; 4 = 6.53in.; 5 = 6.35in.; 6 = 6.57in.; 7 = 6.25in.; 8 = 6.18in
		9 = 6.13in.; 10 = 0.00in.
Rainfall		
PrePlant & Planting	1-5 to 6-25	7.00in.
Seasonal	6-26 to 10-13	8.16in.

Operations Summary

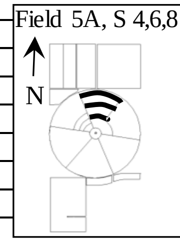
Year	2016
Farm	Helm
Field ID	Field 3
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage	12/9/2015	Shred
	2/3/2016	Cultivate
	3/4/2016	Cultivate
	5/2/2016	Planter (used to consolidate beds)
	5/22/2016	Rotary Hoe
	5/31/2016	Rotary Hoe
	6/4/2016	Rotary Hoe
	6/13/2016	Rotary Hoe
	6/16/2016	Rotary Hoe
	6/20/2016	Cultivate
	7/19/2016	Cultivate and Dike
Fertility	4/8/2016	17 gal/ac, liquid 32-0-0
	4/11/2016	7.7 gal/ac, liquid 10-34-0
	8/1,2/16	15gal/ac, liquid 32-0-0 zones 1-6 (injected into drip lines)
Planting	5/11/2016	NexGen 1511B2RF at 52,000 seed/ac
	6/22/2016	DKS 3707 at 34,500 seed/ac (replant)
Herbicide/ Growth Regulator	3/4/2016	Trifluralin 1qt/ac
	5/11/2016	Caporal 3pt/ac
	6/6/2016	Makaze 32 oz/ac
	6/10/2016	Warrant 3 pt/ac
	6/23/2016	Milo Pro 1.2 qt/ac
	7/19/2016	Medal 1pt/ac, Atrazine 1pt/ac
	10/24/2016	Makaze 32 oz/ac
Insecticide	6/6/2016	Acephate 3.2 oz/ac
	8/24/2016	Sivanto 5oz/ac, Crop Oil 1%
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	4-13 to 6-26	Zones 1,3,4 = 5.39in.; Zones 2,5,6 = 3.31in.; Border = 2.85in.
Seasonal	7-5 to 8-30	1 = 11.57in.; 2 = 9.66in.; 3 = 9.59in.; 4 = 12.79in.; 5 = 11.28in.; 6 = 12.86in.; 7 = 0.06in.
Rainfall		
PrePlant & Planting	1-5 to 6-26	7.00in.
Seasonal	6-27 to 10-13	8.16in.

Operations Summary

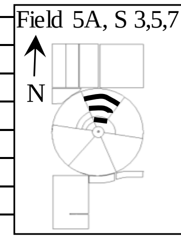
Year	2016
Farm	Helm
Field ID	Field 5a Span 2,4,6,8
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage	12/11/2015	Shred
	2/9/2016	Chisel
	2/10/2016	Cultivate
	2/22/2016	Chisel
	3/8/2016	Cultivate
	3/16/2016	List
	4/12/2016	Dike and Bed Conditioner
	5/23/2016	Rotary Hoe
	5/31/2016	Rotary Hoe
Fertility	4/1/2016	29.95 gal/ac, liquid 32-0-0
	4/4/2016	7.9 gal/ac, liquid 12-0-0-26, medium w atter application
	4/4/2016	8 gal/ac, liquid 10-34-0, liquid 12-0-0-26, medium w ater application
	4/5/2016	8 gal/ac, liquid 10-34-0, liquid 12-0-0-26, high w ater application
Planting	5/12/2016	FiberMax 2484 B2F at 54,000 seed/ac
	6/22/2016	FiberMax 1320GL at 43,000 seed/ac (replant)
Herbicide/	3/8/2016	Trifluralin 1pt/ac
Grow th Regulator	3/16/2016	Salvo 1pt/ac
	5/12/2016	Caporal 3pt/ac
	6/6/2016	Makaze 32 oz/ac
	6/10/2016	Warrant 3 pt/ac
	6/24/2016	Makaze 32 oz/ac, Maximizer 2%
	7/1/2016	Liberty 32oz/ac
	7/7/2016	Warrant 3 pt/ac
	8/2/2016	Diuron 1.5 pt/ac, Makaze 32 oz/ac
Insecticide	6/6/2016	Acephate 3.2 oz/ac
Harvest aid	11/11/2016	ETX 1.25oz/ac, Boll Buster 1 qt/ac, Maximizer 1%
Irrigation Amt.		
PrePlant & Planting	4-12 to 6-24	Span2 3.40in.
	4-12 to 6-24	Base 3.40in; Base-50% 3.40in; Base+50% 3.40in; Dry 3.40in. In span 4,6,8
Seasonal	7-6 to 8-25	Span2 3.03in.
	7-6 to 8-25	Base 2.22in; Base-50% 1.41in; Base+50% 3.03in; Dry 0.00in. In span 4,6,8
Rainfall		
PrePlant & Planting	1-5 to 6-26	7.00in.
Seasonal	6-27 to 10-13	8.16in.

Operations Summary

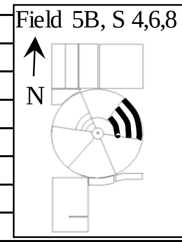
Year	2016
Farm	Helm
Field ID	Field 5a Spans 3,5,7
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage	5/31/2016	Rotary Hoe
	6/4/2016	Rotary Hoe
	6/14/2016	Rotary Hoe
	7/18/2016	Cultivate and Dike
Fertility	4/6/2015	29.95 gal/ac, liquid 32-0-0
	4/4/2016	7.9 gal/ac, liquid 12-0-0-26, medium w atter application
	4/4/2016	8 gal/ac, liquid 10-34-0, liquid 12-0-0-26, medium w ater application
	4/5/2016	8 gal/ac, liquid 10-34-0, liquid 12-0-0-26, high w ater application
Planting	5/12/2016	FiberMax 2484 B2F at 54,000 seed/ac
	6/22/2016	FiberMax 1320GL at 43,000 seed/ac (replant)
Herbicide/ Grow th Regulator	4/8/2016	Stealth 3 pt/ac
	5/12/2016	Caporal 3pt/ac
	6/6/2016	Makaze 32 oz/ac
	6/10/2016	Warrant 3 pt/ac
	6/24/2016	Makaze 32 oz/ac, Maximizer 2%
	6/28/2016	Makaze 48 oz/ac, Maximizer 2%
	7/1/2016	Liberty 32 oz/ac
	7/7/2016	Warrant 3 pt/ac
	8/2/2016	Diuron 1.5 pt/ac, Makaze 32 oz/ac
Insecticide	6/6/2016	Acephate 3.2 oz/ac
Harvest aid	11/11/2016	ETX 1.25oz/ac, Boll Buster 1 qt/ac, Maximizer 1%
Irrigation Amt.		
PrePlant & Planting	4-12 to 6-24	Base 3.40in; Base-50% 3.40in; Base+50% 3.40in
Seasonal	7-6 to 8-25	Base 2.22in; Base-50% 1.41in; Base+50% 3.03in
Rainfall		
PrePlant & Planting	1-5 to 6-26	7.00in.
Seasonal	6-27 to 10-13	8.16in.

Operations Summary

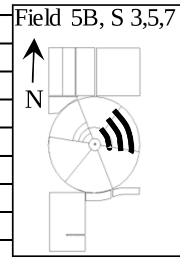
Year	2016
Farm	Helm
Field ID	Field 5b Span 2, 4, 6, 8
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage	2/2/2016	Disk
	2/3/2016	Disk
	2/9/2016	Chisel
	2/10/2016	Cultivate
	2/22/2016	Chisel
	3/8/2016	Cultivate
	3/16/2016	List
	4/12/2016	Dike and Bed Conditioner
	5/23/2016	Rotary Hoe
	5/31/2016	Rotary Hoe
	6/4/2016	Rotary Hoe
	6/14/2016	Rotary Hoe
	6/17/2016	Rotary Hoe
	7/15/2016	Cultivate and Dike
Fertility	4/1/2016	29.95 gal/ac, liquid 32-0-0
	4/7/2016	13 gal/ac, liquid 12-0-0-26, low w ater application
	4/7/2016	13 gal/ac, liquid 10-34-0, liquid12-0-0-26, medium w ater application
	4/7/2016	13 gal/ac, liquid 10-34-0, liquid12-0-0-26, high w ater application
Planting	5/12/2016	FiberMax 2484B2F at 54,000 seed/ac
	6/22/2016	FiberMax 1320GL at 43,000 seed/ac (replant)
	12/14/2016	Dumas 70 lb/ac (yield)
Herbicide/ Grow th Regulator	3/8/2016	Trifuralin 1qt/ac
	3/16/2016	Salvo 1 pt/ac
	5/12/2016	Caporal 3pt/ac
	5/13/2016	Makaze 48 oz/ac, Maximizer 2%
	6/6/2016	Makaze 32 oz/ac
	6/10/2016	Warrant 3pt/ac
	6/24/2016	Makaze 32 oz/ac, Maximizer 2%
	7/7/2016	Warrant 3pt/ac
	8/2/2016	Diuron 1.5 pt/ac, Makaze 32 oz/ac
	8/5/2016	Pentia 12 oz/ac
Insecticide	6/6/2016	Acephate 3.2 oz/ac
Harvest aid	10/24/2016	ETX 1.25 oz/ac, Boll Buster 1 qt/ac, Maximizer 1%
	11/1/2016	Bone Dry 1.3 pt/ac, Activator 90 1%
Irrigation Amt.		
PrePlant & Planting	4-12 to 6-24	Span2 3.40in.
	4-12 to 6-24	Base 3.40in; Base-50% 3.40in; Base+50% 3.40in; Dry 3.40in. In span 4,6,8
Seasonal	7-6 to 8-25	Span2 8.70in.
	7-6 to 8-25	Base 6.00in; Base-50% 3.3in; Base+50% 8.70in; Dry 0.00 in span 4,6,8
Rainfall		
PrePlant & Planting	1-5 to 6-26	7.00in.
Seasonal	6-27 to 10-13	8.16in.

Operations Summary

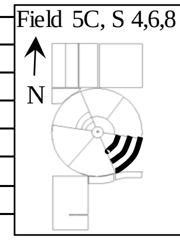
Year	2016
Farm	Helm
Field ID	Field 5b (Span 3,5,7)
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage		
Fertility	4/1/2016	29.95 gal/ac, liquid 32-0-0
	4/7/2016	13 gal/ac, liquid 12-0-0-26, low w ater application
	4/7/2016	13 gal/ac, liquid 10-34-0, liquid12-0-0-26, medium w ater application
	4/7/2016	13 gal/ac, liquid 10-34-0, liquid12-0-0-26, high w ater application
Planting	5/12/2016	FiberMax 2484B2F at 54,000 seed/ac
	6/22/2016	FiberMax 1320GL at 43,000 seed/ac (replant)
	12/14/2016	Dumas 70 lb/ac (yield)
Herbicide/	2/26/2016	Makaze 32 oz/ac, Maximizer 1%
Grow th Regulator	4/8/2016	Stealth 3 pt/ac
	5/12/2016	Caporal 3pt/ac
	5/13/2016	Makaze 48 oz/ac, Maximizer 2%
	6/6/2016	Makaze 32 oz/ac
	6/10/2016	Warrant 3pt/ac
	6/24/2016	Makaze 32 oz/ac, Maximizer 2%
	6/28/2016	Makaze 48 oz/ac, Maximizer 2%
	7/72016	Warrant 3pt/ac
	8/2/2016	Diuron 1.5 pt/ac, Makaze 32 oz/ac
	8/5/2016	Pentia 12 oz/ac
Insecticide	6/6/2016	Acephate 3.2 oz/ac
Harvest aid	10/24/2016	ETX 1.25 oz/ac, Boll Buster 1 qt/ac, Maximizer 1%
	11/1/2016	Bone Dry 1.3 pt/ac, Activator 90 1%
Irrigation Amt.		
PrePlant & Planting	4-12 to 6-24	Base 3.40in; Base-50% 3.40in; Base+50% 3.40in
Seasonal	7-6 to 8-25	Base 6.00in; Base-50% 3.30in; Base+50% 8.70in
Rainfall		
PrePlant & Planting	1-5 to 6-26	7.00in.
Seasonal	6-27 to 10-13	8.16in.

Operations Summary

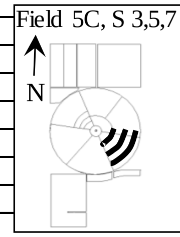
Year	2016
Farm	Helm
Field ID	Field 5c Spans 2,4,6,8
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage	10/5/2016	Disk
Fertility	3/16/2016	30 lbs/ac, liquid 32-0-0
Planting	11/24/2015	TAM 111 at 70 lbs/ac (yield)
Herbicide/	3/16/2016	Sword 14 oz/ac
Growth Regulator	7/8/2016	Diuron 1qt/ac, Bone Dry 1qt/ac
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	3-17 to 5-10	6.75in.
Seasonal		
Rainfall		
PrePlant & Planting	1-5 to 5-10	1.16in.
Seasonal	5-11 to 10-13	14.00in.

Operations Summary

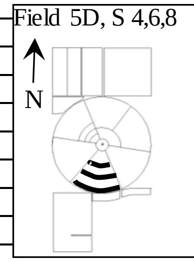
Year	2016
Farm	Helm
Field ID	Field 5c (Span 3,5,7)
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage		
Fertility	3/16/2016	30 lbs/ac, liquid 32-0-0
Planting	11/24/2015	TAM 111 at 70 lbs/ac (yield)
Herbicide/	3/16/2016	Sw ord 14 oz/ac
Grow th Regulator	7/8/2016	Diuron 1qt/ac, Bone Dry 1qt/ac
	10/11/2016	Makaze 32 oz/ac, Maximizer 2%
Insecticide		
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	3-17 to 5-10	6.75in.
Seasonal		
Rainfall		
PrePlant & Planting	1-5 to 5-10	1.16in.
Seasonal	5-11 to 10-13	14.00in.

Operations Summary

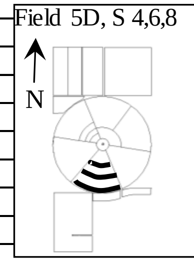
Year	2016
Farm	Helm
Field ID	Field 5d (Span 2, 4, 6, 8) East Half
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage	6/28/2016	Cultivate and Dike
Fertility	4/1/2016	29.95 gal/ac, liquid 32-0-0
	4/6/2016	8 gal/ac, liquid 10-34-0, liquid 12-0-0-26, medium w ater application
	4/6/2016	7.8 gal/ac, liquid 12-0-0-26, low w ater application
	4/6/2016	8 gal/ac, liquid 10-34-0, liquid 12-0-0-26, high w ater application
	7/25/2016	10.8 gal/ac, liquid 32-0-0, high w ater application
Planting	11/23/2015	VNS at 70 lbs/ac (cover)
	5/13/2016	FiberMax 2484B2F at 54,000 seed/ac
	12/9/2016	VNS at 70 lbs/ac (cover)
Herbicide/	3/17/2016	Salvo 1 pt/ac
Grow th Regulator	4/4/2016	Makaze 32 oz/ac, Maximizer 2%
	4/8/2016	Stealth 3 pt/ac
	4/20/2016	Makaze 32 oz/ac, Maximizer 2%
	5/13/2016	Caporal 3pt/ac
	6/6/2016	Makaze 32 oz/ac
	6/10/2016	Warrant 3 pt/ac
	7/6/2016	Warrant 3 pt/ac
	8/2/2016	Diuron 1.5 pt/ac, Makaze 32 oz/ac
	8/5/2016	Pentia 12 oz/ac
Insecticide	6/6/2016	Acephate 3.2 oz/ac
Harvest aid	10/24/2016	ETX 1.25 oz/ac, Boll Buster 1 qt/ac, Maximizer 1%
	11/1/2016	Bone Dry 1.3 pt/ac, Activator 90 1%
Irrigation Amt.		
PrePlant & Planting	4-12 to 6-24	Span2 3.30in.
	4-12 to 6-24	Base 3.30in; Base-50% 3.30in; Base+50% 3.30in; Dry 3.30in. In span 4,6,8
Seasonal	7-6 to 8-25	Span2 8.37in.
	7-6 to 8-25	Base 6.13in; Base-50% 3.37in; Base+50% 9.90in; Dry 0.00in. In span 4,6,8
Rainfall		
PrePlant & Planting	1-5 to 6-26	7.00in.
Seasonal	6-27 to 10-13	8.16in.

Operations Summary

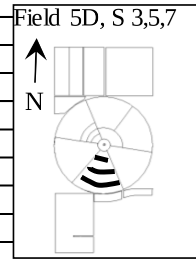
Year	2016
Farm	Helm
Field ID	Field 5d (Span 2, 4, 6, 8) West Half
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage	6/28/2016	Cultivate and Dike
Fertility	4/1/2016	29.95 gal/ac, liquid 32-0-0
	4/6/2016	8 gal/ac, liquid 10-34-0, liquid 12-0-0-26, medium w ater application
	4/6/2016	7.8 gal/ac, liquid 12-0-0-26, low w ater application
	4/6/2016	8 gal/ac, liquid 10-34-0, liquid 12-0-0-26, high w ater application
	7/25/2016	10.8 gal/ac, liquid 32-0-0, high w ater application
Planting	11/23/2015	VNS at 70 lbs/ac (cover)
	5/13/2016	FiberMax 2484B2F at 54,000 seed/ac
	12/9/2016	VNS at 70 lbs/ac (cover)
Herbicide/	3/17/2016	Salvo 1 pt/ac
Grow th Regulator	4/4/2016	Makaze 32 oz/ac, Maximizer 2%
	4/8/2016	Stealth 3 pt/ac
	4/20/2016	Makaze 32 oz/ac, Maximizer 2%
	5/13/2016	Caporal 3pt/ac
	6/6/2016	Makaze 32 oz/ac
	6/10/2016	Warrant 3 pt/ac
	7/6/2016	Warrant 3 pt/ac
	8/2/2016	Diuron 1.5 pt/ac, Makaze 32 oz/ac
	8/5/2016	Pentia 12 oz/ac
Insecticide	6/6/2016	Acephate 3.2 oz/ac
Harvest aid	10/24/2016	ETX 1.25 oz/ac, Boll Buster 1 qt/ac, Maximizer 1%
	11/1/2016	Bone Dry 1.3 pt/ac, Activator 90 1%
Irrigation Amt.		
PrePlant & Planting	4-12 to 6-24	Span2 3.30in.
	4-12 to 6-24	Base 3.30in; Base-50% 3.30in; Base+50% 3.30in; Dry 3.30in. In span 4,6,8
Seasonal	7-6 to 8-25	Span2 8.37in.
	7-6 to 8-25	Base 5.78in; Base-50% 3.19in; Base+50% 8.37in; Dry 0.00in. In span 4,6,8
Rainfall		
PrePlant & Planting	1-5 to 6-26	7.00in.
Seasonal	6-27 to 10-13	8.16in.

Operations Summary

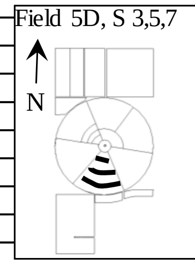
Year	2016
Farm	Helm
Field ID	Field 5d (Span 3, 5, 7) East Half
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage		
Fertility	4/1/2016	29.95 gal/ac, liquid 32-0-0
	4/6/2016	8 gal/ac, liquid 10-34-0, liquid 12-0-0-26, medium w ater application
	4/6/2016	7.8 gal/ac, liquid 12-0-0-26, low w ater application
	4/6/2016	8 gal/ac, liquid 10-34-0, liquid 12-0-0-26, high w ater application
	7/25/2016	10.8 gal/ac, liquid 32-0-0, high w ater application
Planting	11/23/2015	VNS at 70 lbs/ac (cover)
	5/13/2016	FiberMax 2484B2F at 54,000 seed/ac
	12/9/2016	VNS at 70 lbs/ac (cover)
Herbicide/	3/17/2016	Salvo 1 pt/ac
Grow th Regulator	4/4/2016	Makaze 32 oz/ac, Maximizer 2%
	4/8/2016	Stealth 3 pt/ac
	4/20/2016	Makaze 32 oz/ac, Maximizer 2%
	5/13/2016	Caporal 3pt/ac
	6/6/2016	Makaze 32 oz/ac
	6/10/2016	Warrant 3 pt/ac
	7/6/2016	Warrant 3 pt/ac
	8/2/2016	Diuron 1.5 pt/ac, Makaze 32 oz/ac
	8/5/2016	Pentia 12 oz/ac
Insecticide	6/6/2016	Acephate 3.2 oz/ac
Harvest aid	10/24/2016	ETX 1.25 oz/ac, Boll Buster 1 qt/ac, Maximizer 1%
	11/1/2016	Bone Dry 1.3 pt/ac, Activator 90 1%
Irrigation Amt.		
PrePlant & Planting	4-12 to 6-24	Base 3.30in; Base-50% 3.30in; Base+50% 3.30in
Seasonal	7-6 to 8-25	Base 6.13in; Base-50% 3.37in; Base+50% 8.9in
Rainfall		
PrePlant & Planting	1-5 to 6-26	7.00in.
Seasonal	6-27 to 10-13	8.16in.

Operations Summary

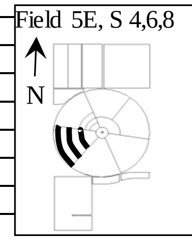
Year	2016
Farm	Helm
Field ID	Field 5d (Span 3, 5, 7) West Half
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Fertility	4/1/2016	29.95 gal/ac, liquid 32-0-0
	4/6/2016	8 gal/ac, liquid 10-34-0, liquid 12-0-0-26, medium w ater application
	4/6/2016	7.8 gal/ac, liquid 12-0-0-26, low w ater application
	4/6/2016	8 gal/ac, liquid 10-34-0, liquid 12-0-0-26, high w ater application
	7/25/2016	10.8 gal/ac, liquid 32-0-0, high w ater application
Planting	11/23/2015	VNS at 70 lbs/ac (cover)
	5/13/2016	FiberMax 2484B2F at 54,000 seed/ac
	12/9/2016	VNS at 70 lbs/ac (cover)
Herbicide/	3/17/2016	Salvo 1 pt/ac
Grow th Regulator	4/4/2016	Makaze 32 oz/ac, Maximizer 2%
	4/8/2016	Stealth 3 pt/ac
	4/20/2016	Makaze 32 oz/ac, Maximizer 2%
	5/13/2016	Caporal 3pt/ac
	6/6/2016	Makaze 32 oz/ac
	6/10/2016	Warrant 3 pt/ac
	7/6/2016	Warrant 3 pt/ac
	8/2/2016	Diuron 1.5 pt/ac, Makaze 32 oz/ac
	8/5/2016	Pentia 12 oz/ac
Insecticide	6/6/2016	Acephate 3.2 oz/ac
Harvest aid	10/24/2016	ETX 1.25 oz/ac, Boll Buster 1 qt/ac, Maximizer 1%
	11/1/2016	Bone Dry 1.3 pt/ac, Activator 90 1%
Irrigation Amt.		
PrePlant & Planting	4-12 to 6-24	Base 3.30in; Base-50% 3.30in; Base+50% 3.30in
Seasonal	7-6 to 8-25	Base 5.78in; Base-50% 3.19in; Base+50% 8.37in
Rainfall		
PrePlant & Planting	1-5 to 6-26	7.00in.
Seasonal	6-27 to 10-13	8.16in.

Operations Summary

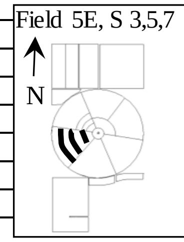
Year	2016
Farm	Helm
Field ID	Field 5e (Span 2,4,6,8)
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage	12/11/2016	Shred
	2/8/2016	Chisel
	2/11/2016	Cultivate
	2/19/2016	Chisel
	3/16/2016	List
	4/12/2016	Dike and Bed Conditioner
	5/23/2016	Rotary Hoe
	5/31/2016	Rotary Hoe
	6/4/2016	Rotary Hoe
	6/14/2016	Rotary Hoe
	6/28/2016	Cultivate and Dike
Fertility	4/1/2016	29.95 gal/ac, liquid 32-0-0
	7/13/2016	10.8 gal/ac, liquid 32-0-0, medium w ater application
	7/13/2016	21.7 gal/ac, liquid 32-0-0, high w ater application
	7/13/2016	21.7 gal/ac, liquid 32-0-0, Span 2 and Overhang
Planting	6/6/2016	DKS 49-45 at 35,00, 52,000 and 70,000 at seed/ac
Herbicide/	3/3/2016	Milo Pro 1.5 qt/ac
Grow th Regulator	3/16/2016	Salvo 1pt/ac
	5/25/2016	Makaze 48 oz/ac, Maximizer 2%
	6/7/2016	Milo Pro 1qt/ac, Warrant 3pt/ac, Makaze 32 oz/ac
	7/7/2016	Medal 1pt/ac, Atrazine 1pt/ac
	10/5/2016	Makaze 32 oz/ac
Insecticide	8/24/2016	Sivanto 5 oz/ac, Crop Oil 1%
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	4-12 to 6-24	Span2 3.60in.
	4-12 to 6-24	Base 3.60in; Base-50% 3.60in; Base+50% 3.60in; Dry 3.60in. In span 4,6,8
Seasonal	7-6 to 8-25	Span2 8.70in.
	7-6 to 8-25	Base 6.00in; Base-50% 3.33in; Base+50% 8.7in; Dry 0.00in. In span 4,6,8
Rainfall		
PrePlant & Planting	1-5 to 6-26	7.00in.
Seasonal	6-27 to 10-13	8.16in.

Operations Summary

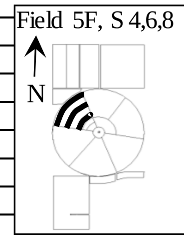
Year	2016
Farm	Helm
Field ID	Field 5e (Span 3,5,7)
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage	6/17/2016	Rotary Hoe
Fertility	4/1/2016	29.95 gal/ac, liquid 32-0-0
	7/13/2016	10.8 gal/ac, liquid 32-0-0, medium w ater application
	7/13/2016	21.7 gal/ac, liquid 32-0-0, high w ater application
	7/13/2016	21.7 gal/ac, liquid 32-0-0, Span 2 and Overhang
Planting	6/6/2016	DKS 49-45 at 35,00, 52,000 and 70,000 at seed/ac
Herbicide/	3/3/2016	Milo Pro 1.5 qt/ac
Grow th Regulator	3/16/2016	Salvo 1pt/ac
	5/25/2016	Makaze 48 oz/ac, Maximizer 2%
	6/7/2016	Milo Pro 1qt/ac, Warrant 3pt/ac, Makaze 32 oz/ac
	7/7/2016	Medal 1pt/ac, Atrazine 1pt/ac
	10/5/2016	Makaze 32 oz/ac
Insecticide	8/24/2016	Sivanto 5 oz/ac, Crop Oil 1%
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	4-12 to 6-24	Base 3.60in; Base-50% 3.60in; Base+50% 3.60in
Seasonal	7-6 to 8-25	Base 6.00in; Base-50% 3.33in; Base+50% 8.70in
Rainfall		
PrePlant & Planting	1-5 to 6-26	7.00in.
Seasonal	6-27 to 10-13	8.16in.

Operations Summary

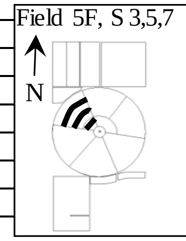
Year	2016
Farm	Helm
Field ID	Field 5f (Span 2,4,6,8)
Exp. Design	Sorghum
Soil Type	



Field Operations	Date	Activity
Tillage	12/11/2015	Shred
	2/2/2016	Disk
	2/3/2016	Disk
	2/8/2016	Chisel
	2/11/2016	Cultivate
	2/22/2016	Chisel
	3/8/2016	Cultivate
	3/15/2016	List
	4/12/2016	Dike and Bed Conditioner
	5/23/2016	Rotary Hoe
	5/31/2016	Rotary Hoe
	6/4/2016	Rotary Hoe
	6/14/2016	Rotary Hoe
	6/17/2016	Rotary Hoe
	7/18/2016	Cultivate and Dike
Fertility	4/1/2016	29.95 gal/ac, liquid 32-0-0
	4/4/2016	7.9 gal/ac, liquid 12-0-0-26, low w ater application
	4/4/2016	8 gal/ac, liquid 12-0-0-26, medium w ater application
	4/5/2016	8 gal/ac, liquid 12-0-0-26, high w ater application
	7/25/2016	10.8 gal/ac, liquid 32-0-0, high w ater application
Planting	5/16/2016	FiberMax 2484B2F at 54,000 seed/ac
	6/22/2016	FiberMax 1320GL at 43,000 seed/ac (replant)
Herbicide/	3/8/2016	Trifluralin 1qt/ac
Grow th Regulator	3/16/2016	Salvo 1 pt/ac
	5/10/2016	Makaze 32 oz/ac, Maximizer 2%
	5/12/2016	Caporal 5pt/ac
	6/6/2016	Makaze 32 oz/ac
	6/10/2016	Warrant 3 pt/ac
	6/24/2016	Makaze 32 oz/ac, Maximizer 2%
	7/6/2016	Warrant 3 pt/ac
	8/2/2016	Diuron 1.5 pt/ac, Makaze 32 oz/ac
	8/5/2016	Pentia 12 oz/ac
Insecticide	6/6/2016	Acephate 3.2 oz/ac
Harvest aid	10/24/2016	ETX 1.25 oz/ac, Boll Buster 1qt/ac, Maximizer 1%
	11/1/2016	Bone Dry 1.3 pt/ac, Activator 90 1%
Irrigation Amt.		
PrePlant & Planting	4-12 to 6-24	Span2 3.50in.
	4-12 to 6-24	Base 3.50in; Base-50% 3.50in; Base+50% 3.50in; Dry 3.50in. In span 4,6,8
Seasonal	7-6 to 8-25	Span2 8.70in.
	7-6 to 8-25	Base 6.00in; Base-50% 3.30in; Base+50% 8.7in; Dry 0.00in. In span 4,6,8
Rainfall		
PrePlant & Planting	1-5 to 6-26	7.00in.
Seasonal	6-27 to 10-13	8.16in.

Operations Summary

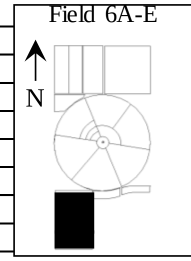
Year	2016
Farm	Helm
Field ID	Field 5f (Spans 3,5,7)
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage		
Fertility	4/1/2016	107 lbs N/ac, liquid 32-0-0, low water application
	4/4/2016	7.9 gal/ac, liquid 12-0-0-26, low water application
	4/4/2016	8 gal/ac, liquid 12-0-0-26, medium water application
	4/5/2016	8 gal/ac, liquid 12-0-0-26, high water application
	7/25/2016	10.8 gal/ac, liquid 32-0-0, high water application
Planting	5/16/2016	FiberMax 2484B2F at 54,000 seed/ac
	6/22/2016	FiberMax 1320GL at 43,000 seed/ac (replant)
Herbicide/	4/8/2016	Stealth 3pt/ac
Growth Regulator	5/10/2016	Makaze 32 oz/ac, Maximizer 2%
	5/12/2016	Caporal 5pt/ac
	6/6/2016	Makaze 32 oz/ac
	6/10/2016	Warrant 3 pt/ac
	6/24/2016	Makaze 32 oz/ac, Maximizer 2%
	6/28/2016	Makaze 48 oz/ac, Maximizer 2%
	7/6/2016	Warrant 3 pt/ac
	8/2/2016	Diuron 1.5 pt/ac, Makaze 32 oz/ac
	8/5/2016	Pentia 12 oz/ac
Insecticide	6/6/2016	Acephate 3.2 oz/ac
Harvest aid	10/24/2016	ETX 1.25 oz/ac, Boll Buster 1qt/ac, Maximizer 1%
	11/1/2016	Bone Dry 1.3 pt/ac, Activator 90 1%
Irrigation Amt.		
PrePlant & Planting	4-12 to 6-24	Base 3.50in; Base-50% 3.50in; Base+50% 3.50in
Seasonal	7-6 to 8-25	Base 6.00in; Base-50% 3.33in; Base+50% 8.70in
Rainfall		
PrePlant & Planting	1-5 to 6-26	7.00in.
Seasonal	6-27 to 10-13	8.16in.

Operations Summary

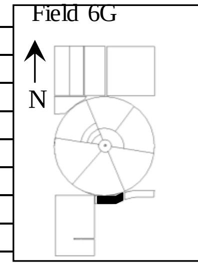
Year	2016
Farm	Helm
Field ID	Field 6 - Zone A-E
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage	12/10/2015	Shred
	2/5/2016	Cultivate
	2/12/2016	Disk
	3/7/2016	Cultivate
	3/10/2016	List
	4/13/2016	Bed Conditioner
	4/29/2016	Planter (used to consolidate beds)
	5/22/2016	Rotary Hoe
	6/1/2015	Rotary Hoe
	6/4/2016	Rotary Hoe
	6/13/2016	Rotary Hoe
	6/16/2016	Rotary Hoe
	7/13/2016	Cultivate and Dike
Fertility	4/11/2016	19.4 gal/ac, liquid 32-0-0, zone A
	4/11/2016	37.3 gal/ac, liquid 32-0-0, zone B
	4/12/2016	29.1 gal/ac, liquid 32-0-0, zone C
	4/12/2016	29.1 gal/ac, liquid 32-0-0, zone E
	4/12/2016	7.3 gal/ac, liquid 32-0-0, zone D
Planting	5/24/2016	NexGen 3500XF and NexGin 3406B2XF at 52,000 seed/ac
	6/21/2016	DKS 3707 at 34,500 seed/ac (replant)
Herbicide/	3/7/2016	Trifluralin 1 qt/ac
Growth Regulator	5/10/2016	Makaze 32 oz/ac, Maximizer 2%
	5/25/2016	Caporal 3 pt/ac
	6/7/2016	Makaze 32 oz/ac
	6/10/2016	Warrant 3 pt/ac
	6/23/2016	Milo Pro 1.2 qt/ac
	7/13/2016	AIM EC 1 oz/ac
	7/19/2016	Medal 1 pt/ac, Atrazine 1 pt/ac
	10/24/2016	Makaze 32 oz/ac
Insecticide	6/7/2016	Acephate 3.2 oz/ac
	8/24/2016	Sivanto 5 oz/ac, Crop Oil 1%
Harvest aid		
Irrigation Amt.		
PrePlant & Planting	3-30 to 5-29	Avg. for Zones A-E 7.70in.
Seasonal	7-13 to 8-30	ZoneA 3.98in; ZoneB 11.53in; ZoneC 7.58in; ZoneD 0.00in; ZoneE 5.02in.
Rainfall		
PrePlant & Planting	1-5 to 5-29	3.80in.
Seasonal	5-30 to 10-13	11.36in.

Operations Summary

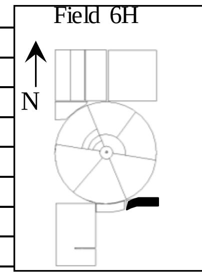
Year	2016
Farm	Helm
Field ID	Field 6 - Zone G
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage	12/9/2015	Shred
	2/5/2016	Cultivate
	2/11/2016	Disk
	3/4/2016	Cultivate
	3/11/2016	List
	4/14/2016	Bed Conditioner
	5/2/2016	Planter (used to consolidate beds)
	5/22/2016	Rotary Hoe
	5/31/2016	Rotary Hoe
	6/4/2016	Rotary Hoe
	6/13/2016	Rotary Hoe
	6/16/2016	Rotary Hoe
	6/28/2016	Cultivate
Fertility		
Planting	5/16/2016	FiberMax 1900GLT at 52,000 seed/ac
	6/23/2016	FiberMax 1900GLT at 52,000 seed/ac (replant)
Herbicide/ Growth Regulator	3/4/2016	Trifluralin 1qt/ac
	5/23/2016	Caporal 3 pt/ac
	6/10/2016	Warrant 3 pt/ac
	7/7/2016	Warrant 3 pt/ac
	8/5/2016	Pentia 12 oz/ac
Insecticide		
Harvest aid	10/24/2016	ETX 1.25 oz/ac, Boll Buster 1qt/ac, Maximizer 1%
	11/1/2016	Bone Dry 1.3 pt/ac, Activator 90 1%
Irrigation Amt.		
PrePlant & Planting	4-19 to 5-24	4.72in.
Seasonal	7-13 to 8-30	8.42in.
Rainfall		
PrePlant & Planting	1-5 to 5-24	3.14in.
Seasonal	5-25 to 10-13	12.02in.

Operations Summary

Year	2016
Farm	Helm
Field ID	Field 6 - Zone H
Exp. Design	
Soil Type	



Field Operations	Date	Activity
Tillage	12/9/2016	Shred
	2/5/2016	Cultivate
	2/11/2016	Disk
	3/7/2016	Cultivator
	3/11/2016	List
	4/14/2016	Bed Conditioner
	5/2/2016	Planter (used to consolidate beds)
	5/22/2016	Rotary Hoe
	5/31/2016	Rotary Hoe
	6/4/2016	Rotary Hoe
	6/13/2016	Rotary Hoe
	6/16/2016	Rotary Hoe
	6/28/2016	Cultivate
Fertility	4/2/2015	36.8 gal/ac, liquid 32-0-0
Planting	5/23/2016	DeltaPine 1219B2F at 52,000 seed/ac
Herbicide/ Growth Regulator	5/23/2016	Caporal 3 pt/ac
	6/10/2016	Warrant 3 pt/ac
	7/7/2016	Warrant 3 pt/ac
	8/5/2016	Pentia 12 oz/ac
Insecticide		
Harvest aid	10/24/2016	ETX 1.25 oz/ac, Boll Buster 1qt/ac, Maximizer 1%
	11/1/2016	Bone Dry 1.3 pt/ac, Activator 90 1%
Irrigation Amt.		
PrePlant & Planting	4-19 to 5-24	4.61in.
Seasonal	7-13 to 8-30	9.04in.
Rainfall		
PrePlant & Planting	1-5 to 5-24	3.14in.
Seasonal	5-25 to 10-13	12.02in.