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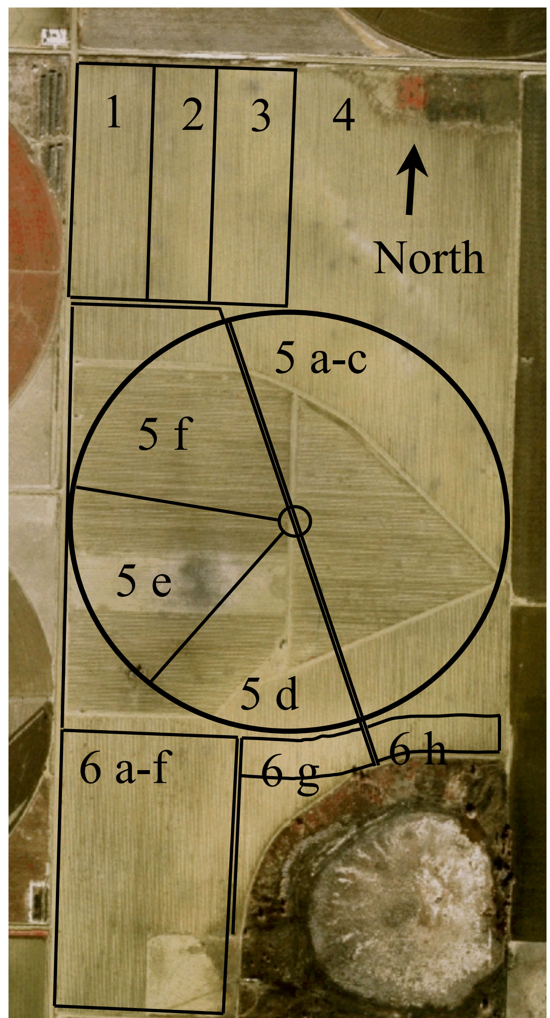
Helms Research Farm

Texas A&M University System
Texas Agricultural Research and Extension Center
Lubbock/Halfway

Background and General Description

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

Current projects at the Helms Research Farm involve production options and economics of subsurface drip irrigation (SDI) and site-specific farming. Other research projects will include weed and insect control, plant breeding and yield trials for several commodities and production systems projects.



Helm Farm, 1998

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. Water wells in the area produce 300 to 500 gpm from pumping depths of 320 to 340 feet deep.

New installations at the Helms farm include 2 water wells, 1 130-acre center pivot, 9900 ft of underground water line, and 86 acres of subsurface drip irrigation. An additional water well and pipeline are planned in 2002.

Helms Committee

Helms Committee members make recommendations regarding the development and general research direction to Dr. Jaroy Moore, Resident Director, TAES, Lubbock.

Members include:
Calvin Trostle, Agronomist-Grain Crops, TAEX
Doug Nesmith, Farm Research Manager, TAES
Gary Peterson, Sorghum Breeder, TAES
Jim Bordovsky, Irrigation Engineer, TAES
John Gannaway, Cotton Breeder, TAES
Wayne Keeling, Agronomist-Weed Pests, TAES
Wenwei Xu, Corn Breeder, TAES, TTU

Corn Breeding (Field 1)
Wenwei Xu

Objective: The objectives are to select drought tolerant corn germplasm adapted to the Texas High Plains and to determine the economic and agronomic feasibility of growing drought tolerant corn as a production and rotation crop for the region.

Methodology: Each year we plant about 10,000 small plots in this field. Breeding populations are evaluated under full-irrigation and drought-stressed conditions. The timing, intensity, and duration of drought stress and uniform soil moisture across the field are important factors for field evaluation of drought tolerance. With the low rainfall and high temperatures in the West Texas, we can create different soil moisture regimes by controlling irrigation. The subsurface drip irrigation systems at this 12-acre field as well as another 7-acre field in Lubbock provide our corn-breeding program excellent field facilities for drought research. The drip tapes are buried 12 inches below soil surface in a 40-inch spacing. Corn is planted on top of each tape. Each drip irrigation field has 10 controllers for accurate control of water to create up to 10 different soil-water conditions. We routinely create three water treatments within a field: well-watered, pre-tassel drought stress and post-tassel drought stress. The plants under well-watered treatment are well watered throughout the growing season in order to evaluate yield potential and agronomic performance. Under the drought treatments, however, irrigation is withheld for a period of time to impose the drought stress at a specific growth stage. The best performing populations are selected for the next breeding cycle. In addition, we evaluated the commercial food corn hybrids for the yield performance and adaptation for the Texas High Plains.

Results: Drought tolerant germplasm has been developed. Four testcrosses made with inbred S1 and YQ-1 performed well in comparison to the commercial check hybrids. We plan to release S1 and YQ-1 lines in 2002. Testcrosses of several advanced breeding lines also yielded well under well-irrigated and drought conditions. New sources of drought tolerance and corn earworm resistance have been identified from exotic germplasm. Drought tolerant hybrids produced significantly higher yields under severe drought condition. Among the 47 commercial food corn hybrids, Asgrow RX776W, Zimmerman E8272, and Pioneer hybrid 32T17 may be the best choice for the Texas High Plans. When irrigation was reduced from 80% evapotranspiration (ET) (17.5 acre-inch irrigation plus rain) to 60% ET (12.8 acre-inch irrigation plus rain), the yield was reduced by 4.4 bu/a for every inch of water. However, yield loss rises dramatically from 60% ET to 50% ET (9.1 acre-inch irrigation plus rain), a 7.8 bu/a yield loss per every inch of irrigation.

Expectations: Breeding is a continuous process. We will continue to use this field facility to screen drought tolerance, insect resistance and yield potential. New germplasm will be released. In contrast to the Corn Belt states, there is limited industrial breeding effort in the Texas corn producers. Therefore, the germplasm developed from our breeding program can be particularly useful for the Texas. This field will also be the site for the feasibility study of drip irrigation in corn production and for the development of drought tolerance corn management.

Drip Irrigation Management (Field 2)

James P. Bordovsky, Doug Nesmith, Joe Mustian, Dana Porter, Eduardo Segarra, Randy Boman

Objective: The objective is to evaluate production inputs and resulting lint yields of two cotton management scenarios – high input for maximum yield versus normal input for sustainable yield.

Methodology: Cotton was planted in a field where a ten-zone SDI system was installed. Irrigations were applied in alternate furrows of 30-inch rows with each zone 1300 ft by 16 rows wide and independently controlled and metered. Two levels of drip irrigated cotton management were compared. The first was a *High-Input*, high-yield management scenario with the production goal of 3.5 bales per acre and no restriction on input levels. The second management scenario will provide more *Normal* levels of inputs with annual yield goals of 2.5 bales per acre

Results: The 2001 cotton crop was planted late due to wet weather and other priorities. Irrigations were applied daily with *Normal* treatments receiving 60% of the base irrigation amount (estimated evaporative demand) and *High Input* treatments watered at 110% of base irrigation. In season nitrogen fertilizer was applied as a ratio of irrigation quantity. As expected, following a very dry growing season, yields were significantly higher and cotton fibers significantly longer from *High Input* treatments compared to the *Normal* treatments. Table 1 summarizes cotton lint yield and fiber quality data.

Table 1. Irrigation quantity, lint yield, and fiber quality data resulting from two levels of management using SDI irrigation at TAES, Halfway, 2001.

Treatment	Seasonal Irr. (in.)	Yield (lb./ac.)	Mic	Length (in.)	Strength (gr/tx)
Normal	8.51	687	4.5	1.005	28.55
High Input	13.83	1014	4.1	1.045	28.28

Expectations: Comparison of the treatment inputs and yields will be made to help growers determine optimum water management and return on investment using SDI.

Figure 1. Field of cotton irrigated by SDI, managed at 2 levels of input. Multiple cotton varieties were irrigated by SDI, which was installed in 2001.

An Evaluation of Low Mammalian Toxicity Insecticide Applied Through Drip Irrigation (Field 2)

Scott Armstrong[1], Jim Bordovsky[2] and Leonardo Camelo[1]
[1]Texas Tech University and [2]Texas A&M University

Objectives: To evaluate the efficacy of newer, safer insecticide chemistry delivered through drip irrigation for Lygus control compared to a conventional insecticide and a control.

Methods: New insecticide chemistry along with an increase in drip irrigation acreage in Texas will allow for the evaluation of new techniques for Hemipterous insect control. A New insecticide by the trade name imidacloprid, also know as Admire®, has an extremely low mammalian toxicity and is labeled and registered for cotton insect control. This product was evaluated through drip irrigation along with a standard treatment of Orthene®, and no control (check). The imidachloprid was injected in to the drip system at the recommenced rate two days prior to artificially infesting with Lygus. On the day of infestation (July 19), ten lygus were enclosed in nylon mesh bags on ninth node, first position squares and left for 24 hours. The treatments were replicated four times, with ten enclosures of Lygus per treatment. Following the infestation period, the Lygus were observed to be dead or alive and each boll was tagged so that it could be harvested at a later date. A laboratory evaluation was used as well as the field enclosure study that required ten ninth node, first position squares be removed from the field an taken to laboratory where it was infested under enclosure and the surface area damage by Lygus feeding was estimated using a subjective damage rating system developed by the author. Damage was assessed at 24 and 96 hr after treatment.

Fig. 1. Cotton anther with carola and carpal walls removed showing damage from Lygus feeding.

Table 1. Percent mortality, and surface area damage to ninth node, first position, cotton anthers.

Treatment	Mean % Mortal.	Estimated surface area damage to anther 24 hr post infestation	96 hr post infestation	Seed cotton (g)
Control	0 %	21.0 a	39.5 a	4.1 a
Admire 16 oz/A	20 %	12.8 a	17.5 b	5.1 a
Orthene 3 oz/A	100 %	0.0 b	0.30 b	4.1 a

Summary: The conventional insecticide orthene® provided 100% mortality followed by admire® with no mortality in the control. Damage estimates increased from 24 hr to 96 hr and only slightly for the orthene®. Seed cotton was highest for the admire treatment. The ninth position, first-node may not be a realistic cotton fruit to evaluate. An earlier position would probably result in better assessment of feeding by Lygus.

Drip Irrigation Design and Management (Field 3)
James P. Bordovsky, Joe Mustian, Doug Nesmith, Dana Porter, Eduardo Segarra

Objective: The objective is to evaluate SDI designs in terms of spatial water application and yield uniformity.

Methodology: The available soil water, emitter flow rates, and cotton lint yields caused by the water distributions of three installed SDI designs having planned field flow variations of 0.71, 0.85, and 0.94 over 1300-ft. lengths will be evaluated. Drip tape having three different diameters 0.65, 0.875, and 0.990 inches was installed in 8-row plots (1300 feet long) in the spring of 2000. An additional experimental factor is irrigation quantity with separate plots capable of being irrigated at two levels of evaporative demand. Each of the six treatments was replicated in four blocks.

Results: A summary of cotton lint yield and uniformity statistics resulting from two irrigation levels and drip irrigation designs is given in Table 1. The drip design with the highest flow variation (0.94) resulted in the highest yields and best uniformity parameters, however, reductions in flow variations did not greatly reduce yield in 2001.

Expectations: This SDI installation will provide a direct, replicated comparison of cotton yields resulting from drip systems with three preplanned water distribution uniformities. Future work will allow comparisons of actual emitter flow rates to manufacturers theoretical flow rates. These data will give SDI designers and users a relationship between standard uniformity coefficients and actual cotton lint yields and provide a basis for more cost effective initial designs and management of SDI systems as pumping capacities decline.

Table 1. Cotton lint yield and uniformity statistics resulting from subsurface drip irritation at two levels of irrigation with three tape designs, TAES, Helms,2001.

Irrigation Quantity (% of Base Irrigation)	Tape Diameter (in.)	Estimated Flow Variation	Yield (lb./ac.)	CU[1]	SD	Yield Variation
60	0.650	0.71	1011	84	228	1.39
	0.875	0.94	1035	92	106	0.45
	0.990	0.85	975	92	106	0.45
100	0.630	0.71	1285	77	222	1.02
	0.875	0.94	1334	75	133	0.51
	0.990	0.85	1300	75	207	1.09

CU[1] = Christiansen's uniformity coefficient, S.D. = standard deviation, Yield Variation = ((max. yield - min. yield) / min. yield)

Figure 1. Cotton irrigated by SDI using three drip tape designs and irrigated at two levels. The filter station and drip valve controls are located in the building on the right, TAES, Helms Farm, July 2001.

Optimizing Plant Productivity Using Site-Specific Crop Management (Field 5a-c)
Stephen Machado, Oregon State University (formerly from T.A.E.S., Lubbock), Robert Lascano, Tom Archer, Eduardo Segarra

Objectives: The objective is to describe the interactive biological effects of site-specific water, nutrient, weed, arthropod, and disease management on crop growth and production in an irrigated corn system. The goal is to reduce variability in yield across management units but to have a management system that maximizes the economic profitability of each management unity, and collectively maximizes economic return for the field.

Methodology: In late May 2001, short-season drought tolerant corn hybrid Pioneer 3223 was planted on a half-circle on Helms Farm in Halfway, Texas. Nitrogen was applied at three rates (110, 185, and 240 lbs N ac^{-1}) on entire passes on the half-circle. These nitrogen rates were applied based on depth to caliche and soil texture within each irrigation span for a total of three spans in the experiment. One rate of irrigation was applied to the experiment, expecting variations in the soil texture, depth to caliche, and CEC to lead to spatial variability in soil water and plant growth responses. In season data collection occurred within 12 m^2 of each DGPS location (see Figure 1) set the previous year. Data collection consisted of bimonthly soil moisture readings, canopy reflectance measurements, and plant growth measurements. The cornfield was harvested using a John Deere Greenstar Yield Monitoring combine.

Results: Samples collected in 2001 are still being processed and other data collected has not been completely analyzed. However, the goal of analysis will be to take 2000 and 2001 data and created a prescription for field management. Parameters for defining crop management zones will be set forth based on previous experiments, and implemented on a new field location in 2002.

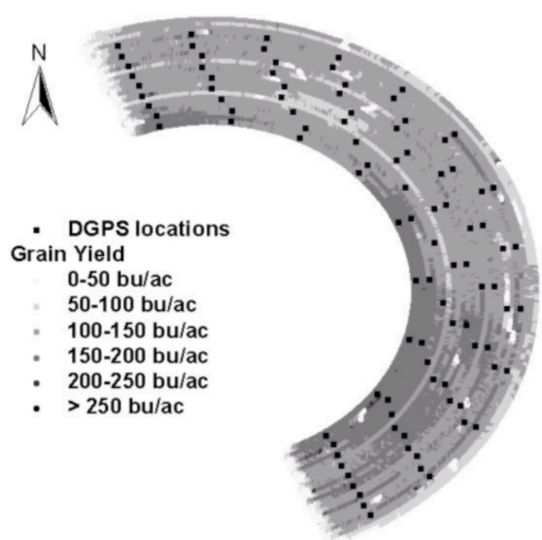


Figure 1. Grain yield (bu ac^{-1}) collected with the John Deere GreenStar Yield Mapping Combine.

Variable Rate Irrigation System Development and Evaluation (Field 5d)
James P. Bordovsky, Steve Jackson, Joe Mustian, Robert Lascano, Eduardo Segarra

Objective: The objective was to modify a center pivot irrigation system to provide variable quantities of water in a pre-programmed manner as the system circles a field and to evaluate the systems performance mechanically and in terms of crop response.

Methodology: The variable-rate system design required water to be supplied from the pivot lateral through pressure regulators and solenoid valves to each of three manifolds comprising the manifold unit. There are three manifold units per 160-ft pivot span. Hoses are used to direct water from the manifolds to the modified LEPA applicator. Nozzle sizes for each applicator provide flow rates of 1x, 2x, and 3x, which, in various combinations, will provide 6 discrete irrigation amounts ranging from 20 to 120% of a base irrigation rate. Manifold units, hoses, and LEPA applicators were installed on Spans 6, 7, and 8 of the Helms pivot. A controller actuated valves supplying water to manifolds at preplanned locations within the field with changes occurring at 3^{o} intervals around the 360^{o} pivot. Mechanical evaluations were made. A field experiment where cotton was irrigated in both VR and uniform fashion was also conducted in 2001. Management zones were established based on slope along the furrow and soil texture. Cotton growth characteristics and lint yield were obtained.

Figure 1. Evaluation of the hydraulic performance of a VR irrigation system, TAES, Helms Farm, 2001.

Figure 2. Remote terminal unit activating valves on Spans 7 and 8 of the VR irrigation system, TAES, Helms Farm, 2001

Results: The mechanical evaluation of the VR irrigation system resulted in modifications in valves and the LEPA applicator. The modifications resulted in very high correlations of actual to desired water volumes. Discrete water applications were made in areas as small as 0.1 acre. Cotton response data is currently being evaluated.

Expectations: Potential improvements in total water resource efficiency as affected by water holding capacities of soils, rainfall runoff, or other water related parameters will be evaluated with this water delivery system. Span 5 will be modified for VR application in 2002.

Replicated Transgenic Cotton Variety Demonstration Under LEPA Irrigation (Field 5e)
Randy Boman, Mark Kelley, Mark Stelter, Alan Helm

Objective: The objective is to determine differences in cotton yield and net value of selected cotton varieties grown under LEPA irrigation in large field plots.

Methodology:

Varieties:	FiberMax 989RR, FiberMax 989BG/RR, Paymaster 2280BG/RR, Paymaster 2326BG/RR, Paymaster 2326RR, Paymaster 2200RR, Paymaster 2266 RR
Experimental design:	Randomized complete block with 4 replications
Seeding rate:	15 lb seed/acre in 30-inch row spacing (John Deere Max Emerge II vacuum planter)
Plot size:	8 rows by variable length due to pivot pie (690-1320 feet long)
Irrigation and Rain:	9.41 inches seasonal irrigation by LEPA, 7.46 inches rainfall (Apr-Sept)
Other:	Normal cultural practices were followed, pests controlled at standard thresholds
Economics:	Ginning costs were based on $1.55 per cwt. of bur cotton and $100 per ton for seed value. Ginning cost does not include bagging, ties, and checkoff. Systems costs were determined by variety per acre using manufacturer's suggested retail prices for seed, and appropriate technology fees for Bollgard and/or Roundup Ready based on the 15 lb/acre seeding rate.

Results and Discussion:

Lint turnout ranged from 23.4% to 26.5%. Lint yields varied from a low of 1143 lb/acre (Paymaster 2266RR) to a high of 1391 lb/acre (FiberMax 989RR). Lint loan values were generally high all across the varieties. After adding lint and seed value, total value for varieties ranged from a low of $735.14 (Paymaster 2200RR) to a high of $889.86 (FiberMax 989 BG/RR). When subtracting ginning and systems costs, the net value among varieties ranged from $628.30 (Paymaster 2326 BG/RR) to $768.78 (FiberMax 989RR), a difference of $140.48. These data indicate that substantial differences can be obtained in terms of net value/acre due to variety selection. It should be noted that no inclement weather was encountered in this trial prior to harvest. High intensity rainfall and/or high wind events were not experienced to potentially cause pre-harvest losses with the open boll picker-type varieties (FiberMax 989RR and FiberMax 989BG/RR). Producers should take note that the harvest period optimum encountered in 2001 is not considered "normal" for most years in the Texas High Plains. Additional multi-site and multi-year applied research is needed to evaluate varieties across a series of environments.

Narrow Row Cotton Evaluation (Field 5f)

James Bordovsky, Doug Nesmith, Stacey Ontai, Randy Boman, John Gannaway, Wayne Keeling

Objective: The objective of this experiment was to evaluate cotton yield and water use efficiency as affected by row spacing and cotton variety using ultra narrow row (UNR) cotton management.

Figure 1. Planting cotton into terminated wheat at TAES, Helms Farm, 2001.

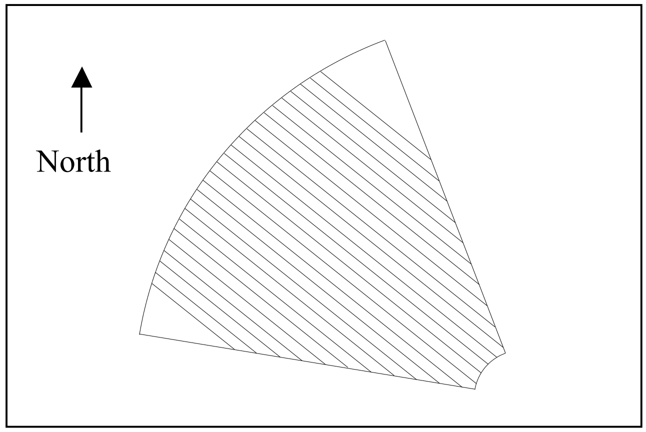


Figure 2. Plot layout of UNR cotton irrigation experiment in a 20-acre area under the Helms pivot. All plots were irrigated with LEPA applicators spaced 5 ft apart and traveling perpendicular to the planted row direction.

Methodology: Cotton was flat planted using a narrow row planter on a 20-acre area into terminated wheat. Cotton drill spacings were 7.5, 15, and 30 inches and varieties planted were Paymaster 2326RR and Paymaster 2156RR. Treatments were replicated four times with plot size of 40 ft by a minimum of 300 ft. Figure 1 shows the general field layout of the experiment. All treatments were irrigated identically with irrigation quantities higher than normal due to the high narrow row plant populations. Seasonal irrigation totaled 15 inches. Plots were both hand and machine harvested.

Results: Table 1 contains hand harvested lint yield based on row configuration and cotton variety. The first year's data show small differences in the yield due to row spacings within the PM2156RR variety. There was a reduction in yield of the 30-inch spacing treatment compared to more closely spaced plants within the PM2326RR variety. Large varietial differences occurred in 2001.

Table 1. Row spacing effect on cotton lint yield (lb./acre) of two varieties at TAES, Helms Farm, 2001.

Variety	Row Spacing		
	7.5 inches	15 inches	30 inches
PM 2156RR	1578	1496	1528
PM 2326RR	1194	1200	1015

Expectations: UNR cotton production may give producers an additional efficient water management alternative to LEPA in fields with excess slope or poor infiltration.

New Subsurface Drip Irrigation Installation (Field 6)
James P. Bordovsky, Doug Nesmith, Joe Mustian, Wayne Keeling

Objective: The objective was to install subsurface drip irrigation in a 46-acre area.

Methodology: Installation on the 46-acre, eight zone drip system was begun in April of 2002 and completed in June. SDI was installed on 60-inch spacing. Soybeans were planted in July, but the massive soil disturbance caused by the new SDI installation and very light rainfall following the installation resulted in poor plant stands.

Expectations: This subsurface drip irrigated field will provide an area to investigate crop response to varieties, plant populations, weed management options, conservation tillage, ultra-narrow plantings, fertility management, etc. using SDI as the water delivery tool.

Figure 1. Plowing drip tape into alternate 30-inch furrows, TAES, Helms, 2001.

Figure 2. Installing water lines to different SDI zones, TAES, Helms, 2001.

Figure 3. Zone lines going to SDI filter station, TAES, Helms, 2001.

Figure 4. SDI filter station, TAES, Helms, 2001.