The Texas High Plains Initiative for Strategic and Innovative Irrigation Management and Conservation

Final Report for USDA-NRCS Conservation Innovation Grant
Contract #69-3A75-11-184

Principal Participants:

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Danny Krienke, NPGCD Director - Ochiltree County Cooperator (2010-2014)
Harold Grall, NPGCD Director - Moore County Cooperator (2010-2014)
Phil Haaland, Past NPGCD Director - Hartley County Cooperator (2010-2014)
Brian Bezner, Past NPGCD Director - Dallam County Cooperator (2011-2014)
James Born - Ochiltree County Cooperator (2011)
Brent Clark - Hartley County Cooperator (2012-2014)
David Ford - Hartley County Cooperator (2012-2014)
Frische Brothers - Moore County Cooperator (2012-2013)
Hartley Feeders - Hartley County Cooperator (2011-2014)
Chad Hicks - Hartley County Cooperator (2011-2012)
Tommy Laubhan - Lipscomb County Cooperator (2012-2014)
Joe Reinart - Sherman County Cooperator (2011-2014)
Richard Schad - Hansford County Cooperator (2012-2014)
Steve Shields - Hutchinson County Cooperator (2011)

Southern High Plains:

Arthur Farms - Crosby County
Blake Davis - Lamb County
Noah Estrada - Castro County
Barry Evans - Swisher County
Jerry Don Glover - Parmer County
Randy McGee - Lubbock County
Bob Meyer - Deaf Smith County
Glen Schur - Hale County
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Barrett Mooney, HydroBio ARS
Karlyle Haaland, PivoTrac®
North Plains Groundwater Conservation District's Board of Directors

Financial Support Provided By:

North Plains Groundwater Conservation District
High Plains Underground Water Conservation District #1
Netafilm USA
USDA-NRCS Conservation Innovation Grant
TWDB Agricultural Water Conservation Grant

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Definition of Terms

AgriPartner was a 10 year (1998-2007) demonstration project conducted by Texas A&M AgriLife Extension.

Application Rate is the amount of water a center pivot system applied during a single revolution, units: inches per revolution.

Capacitance is the ability of a body to store an electrical charge.

Electrical Conductivity is the degree to which a specified material conducts electricity.

Electromagnetic is the ability to produce magnetism developed by a current of electricity.

Field Capacity is the amount of water a soil type can hold after excess water has drained.

Fixed Costs is the costs that do not change with a change in production. These costs are incurred regardless of whether or not a crop was grown. These include land rent charges and investment costs for irrigation equipment.

Gross Income is the total revenue received per acre from the sale of production.

Gross Margin is the total revenue less variable costs.

Harvest is the point where the grain is removed from the plant.

LEPA is low energy precise application used in center pivots.

Net Gain represents the "200-12" field's net profit is higher than the Control field's net profit.

Net Loss represents the "200-12" field's net profit is less than the Control field's net profit.

Net Returns is the gross margin less fixed costs.

Pre Plant is the time before planting of the crop.

Root Zone is the area occupied by the crop's roots.

Strip Till is a minimum tillage system that combines the drying and warming benefits of conventional tillage with the soil protecting advantages of no-till by disturbing only the portion of the soil that is to contain the seed row.

Tassel is the last stage in the vegetation growth of a corn plant.

Time Running Wet is the amount of time a center pivot system is applying water.

Variable Costs are the cash expenses for production inputs including interest on operating loans.

Variable Rate Irrigation is the process of changing the application rate to supply water at rates relative to the needs of individual areas within the fields.

4 Leaf is the sixth stage in the vegetation growth of a corn plant. The collar of the 4^{th} leaf is visible.

Executive Summary

South Plains

There were nine producers and 14 demonstration sites located in Castro, Crosby, Deaf Smith, Floyd, Hale, Lamb, Lubbock, Parmer, and Swisher Counties participating in the project. Collectively, the producers produced eight different crops with multiple cropping systems including cotton and corn monoculture systems, as well as multi-crop systems. The project collected production data and provided information to aid in producer management decisions. The crops were monitored for irrigation water, crop water demand, yields, input costs, and overall producer profitability.

Major Accomplishments and Findings

Irrigation Systems: A comparison of pivot and subsurface drip irrigation systems indicates that crops grown with the drip irrigation systems produced higher crop yields and yield per inch of applied water resulting in higher profitability. An evaluation of a LEPA equipped pivot compared the sprinkler heads in the bubble and spray modes. The LEPA bubble mode was found to generate higher crop yields and profits per inch of applied irrigation compared to the LEPA spray mode.

Economic Evaluations: Cost and return budgets were prepared for each site each year of the project. The budgets provided information on cost of production and profitability which was used to analyze various production practices and irrigation systems from an economic prospective.

Sustainability: Several sites in the project were evaluated using the Fieldprint Calculator to assess sustainability. The Fieldprint Calculator is a tool designed by Field to Market, the Keystone Alliance for Sustainable Agriculture, which can aid in measuring metrics related to sustainable crop production and identifying sustainable production practices. Results show that subsurface drip sites had a more sustainable profile compared to pivot sites under the same management systems.

Field Level Testing of Capacitance Probes: Producers involved in the project tested the effectiveness of new technologies for irrigation system management and for sensing soil moisture levels and crop stress. These technologies delivered real time information on soil moisture levels to producers that could be used in making irrigation scheduling decisions. The experience of producers using these technologies has provided unbiased evaluations to aid other producers in making decisions regarding adoption of these technologies.

Irrigation Management Tools: Several irrigation management tools are available through the TAWC Solutions website. The Resource Allocation Analyzer can assist producers in evaluating crop production alternatives based on profit maximizing criteria relative to a specified level of water availability. The Irrigation Scheduling Tool uses evapotranspiration estimates and crop water-use coefficients to assist producers in irrigation scheduling decisions. These web tools may be accessed at www.tawcsolutions.org.

Project Outreach: Meetings, field days, and field tours were held each year of the project to disseminate results from the project and provide information from researchers and industry experts regarding irrigation and crop management. In 2012, three "barn" meetings were held in the early summer to provide producers information on the technologies and tools available to assist producers in irrigation management. Field walks were held during the 2013 and 2014 growing seasons at selected sites to demonstrate how water management decisions can be made using information from the technologies installed in the fields in addition to assessing crop conditions. A series of five weekly short courses were also held during 2014 to educate producers on cotton irrigation management. The field walks and short-course sessions were taught by the crop consultants working in the project.

Northern Panhandle

In 2009, the North Plains Groundwater Conservation District (NPGCD) began planning the "200-12" Reduced Irrigation on Corn Demonstration Project ("200-12" Project). The "200-12" Project is a five year on-farm, field scale project that demonstrates how water conservation technologies and irrigation management practices can reduce groundwater use and still ensure that agricultural producers remain financially viable with limited and/or diminishing groundwater resources. The "200-12" Project is spearheaded by cooperating growers dedicated to implementing water conservation technologies and practices with a goal of growing 200 bushels of corn utilizing only 12 inches of irrigation water per crop acre. The district's Board of Directors established the 12 inch goal based on an estimated corn crop need of 26 inches of water. Those 26 inches of water include six inches of soil water, eight inches of rainfall and 12 inches of irrigation water applied to the crop during the growing season. When compared to Texas A&M AgriLife Extension's AgriPartner field demonstration program that averaged 21 inches of irrigation water over 10 years, the "200-12" Project demonstrates the next level of water conservation strategies necessary for irrigation producers to stay financially viable into the future.

During the first year of the "200-12" Project (2010), three district directors, Harold Grall, Danny Krienke and Phil Haaland, dedicated personal irrigated farmland acres to the "200-12" Project. The cooperators implemented new and proven irrigation management technologies and practices to aid in the strategic management of each reduced irrigation water demonstration site. The first year of the project proved a success with the three participants producing an average of 89 percent of their normal yields with an average saving of 9 inches of irrigation water.

In 2011, six additional participants, Hartley Feeders (Dennis Buss), Chad Hicks, Joe Reinart, James Born, Steve Shields, and Brian Bezner joined the project and implemented the project's strategic management practices. While 2010 had been a year of above average rainfall 2011 saw rainfall well below average. That lack of critical rainfall indicated early on that the 12 inches of irrigation water goal was not likely to be achievable; however one field project came close. Due to extreme drought, six participants were forced to divert project water to other fields to prevent devastating financial loss.

In 2012, Brent Clark, David Ford, Frische Brothers, Richard Schad and Tommy Laubhan joined the project while James Born and Steve Shields chose not to participate. Each 2012 participant committed two fields to the project, one called the “200-12” field, the other the Control field. Overall, 2012 was better than 2011 for rainfall, but beginning soil water and seasonal rainfall was still below normal and did limit production to less than expected and needed. High temperatures during the last two weeks in July and the first week in August (and no rain) created a need for more irrigation water. Also six fields did receive hail damage that reduced the harvest yields. Due to the lack of supplemental rainfall, one participant was forced to divert water to other fields to prevent a devastating financial loss. Another participant harvested silage to prevent total loss of the crop.

In 2013, Chad Hicks did not participate in the program resulting in eleven cooperating producers in the project. Together these cooperators dedicated twenty-two demonstration fields encompassing 1672 acres. 2013 proved to be a better project year and all acres dedicated to the project were harvested for grain. The eleven “200-12” fields’ yields averaged 200 bushels per acre and production averaged 11.17 bushels (625 lbs) per inch of irrigation water. Net return per inch of irrigation water averaged $33.73 for the “200-12” fields compared to $30.09 for the Control fields.

In 2014, the Frische Brothers did not participate in the program resulting in ten cooperating producers in the final year of the project. Together these cooperators dedicated twenty demonstration fields encompassing 1471 acres. Corn production averaged 198 bushels per acre in the “200-12” fields compared to 215 bushels per acre in the “control” fields. Irrigation averaged 17.59 inches in the “200-12” fields compared to 20.12 inches in the “control”. Corn production averaged 11.83 bushels (662 lbs) per inch of irrigation in the “200-12” fields compared to 10.97 bushels (563 lbs) per inch in the “control”. Net return averaged $368.03 per acre from the “200-12” fields compared to $397.03 from the “control”. Average net gain from the “control” fields is $29.00 per acre. Average value of the additional 2.53 inches of irrigation applied to “control” fields is $11.46 per inch. Irrigation, rainfall plus net soil water averaged 28.46 inches in the “200-12” fields compared to 30.40 inches in the “control”. Irrigation plus rainfall averaged 27.68 inches but soil water only 0.78 inches in the “200-12” fields. Average rainfall of 10.09 inches exceeds the “200-12” project goal of 8.0 inches, but 0.78 inches of soil water is much less than the goal of 6 inches, so irrigation had to be more.

What We Learned

- Low energy precision application (LEPA) assisted in boosting yields verses other application types.
- Later planting dates can reduce irrigation requirements due to increased time to receive rainfall.
- Drought tolerant hybrids boosted yields in limited water situations.
- Crop residue is essential to reduce water evaporation, increase water infiltration, and reduce wind erosion.
- Growers must be conscious of the amount of irrigation applied to produce a certain yield, managing on a yield per inch of water basis.
- More knowledge of pre-season and seasonal soil moisture levels will assist in the conservation of water.
- Satellite crop imagery has potential as an additional management tool, but needs further development.

Over the course of the project, irrigation was reduced by 1,286.89 acre-feet (6.29 inches). If six inches of irrigation was reduced over the one million acres of irrigated cropland within the district, it is possible to save up to 500,000 acre-feet of groundwater per year and prolong the viability of irrigated agriculture in the area. The savings would supply five years of water for the City of Austin. 2014 will be the final year for the “200-12” Project. The district will continue the “200-12” project ideology into the future and may apply the principles to other crops produced in the area. Table 1 summarizes the water savings of the project.

Table 1: Total Water Savings for the Northern Panhandle Portion of the Texas High Plains Initiative.

Year	Acreage	Total Irrigation (in.)	Total Irrigation (ac-ft)	Water Savings (in.)	Water Savings (ac-ft)
2010	270	11.30	254.20	7.89	177.50
2011 (1)	682	15.33	871.19	9.24	525.25
2012 (2)	819	16.02	1093.25	5.93	404.51
2013	686	18.08	1033.30	3.14	179.63
2014	604	16.19	815.02	4.10	206.51
Total	**3061**	**15.94**	**4066.96**	**5.85**	**1493.40**

Notes:
(1) In 2011, 3 of 9 producers harvested grain, 3 harvested silage, and 3 abandoned their field
(2) In 2012, 1 of 12 producers harvested silage

The Texas High Plains Initiative for Strategic and Innovative Irrigation Management and Conservation

Introduction

The Texas High Plains (THP) is one of the most productive agricultural regions in the world. Fertile soils, favorable growing conditions and irrigation water from the Ogallala aquifer has allowed the THP to become an important food and fiber production region in the Southern Great Plains. Crop production plays a crucial role in the THP economy and provides the economic engine for the region. In the THP, there are 13.5 million acres of cropland, of which 4.6 million acres are irrigated. Recent estimates indicate that 5.8 million acre-feet of water is pumped annually for irrigation, accounting for nearly 95% of the region's total water use.

More than 25 crops are commercially produced in the area with corn, cotton, grain sorghum, and wheat being the primary irrigated crops. Irrigated cotton and corn represent the greatest demand for irrigation water with annual consumption in excess of 2.3 and 1.5 million acre-feet, respectively. This region typically produces about one fourth of total U.S. cotton production and 65 percent of Texas corn production. Furthermore, the THP is home to one of the greatest concentrations of confined livestock operations in the world, with approximately 30% of total U.S. fed beef being produced in the region.

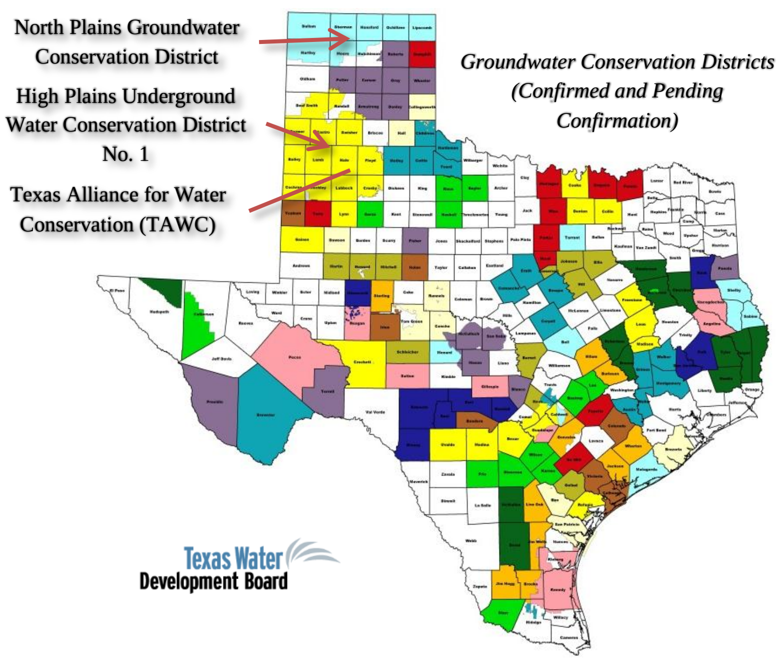


Figure 1: Map of Groundwater Conservation Districts in the State of Texas (TWDB, 2014).

Within the THP there are two distinct agricultural production regions separated north to south by topography, climate, and hydrologic characteristics. The northern portion of the THP, referred to as the Northern Panhandle, is more suited for grain production, while the southern portion, the South Plains, produces a variety of crops with cotton rotations the predominant enterprise. As shown in Figure 1, the North Plains Groundwater Conservation District (district) is located in the Northern Panhandle and serves all or portions of eight counties. The High Plains Underground Water Conservation District No. 1 is located in the South Plains and serves all or portions of 16 counties. The Texas Alliance for Water Conservation (TAWC) demonstration project is located in Hale and Floyd Counties.

The semi-arid nature of the THP, which typically receives from 8 to 12 inches of growing season rainfall, has resulted in dependency on the Ogallala aquifer to support the intensive crop production in the region. The region's ability to continue to produce irrigated crops has declined as water use has exceeded recharge, leading to the continued depletion of the aquifer. Some estimates indicate that the remaining usable life of the Ogallala for irrigated agriculture is less than 30 years for much of the region, particularly in the South Plains. If the Ogallala aquifer continues to decline at its current rate, the regional economy, rural communities, and the agricultural industries that depend on agricultural production in the region will be detrimentally impacted. The State of Texas has shown a strong commitment to water conservation and planning efforts and has given local groundwater conservation districts the authority to implement water use regulations. Whether agricultural water use from the Ogallala aquifer is restricted by regulation or from depletion, agricultural producers in the THP must continue to adopt water conservation technologies and practices to remain profitable and financially viable.

NPGCD's "200-12" Reduced Irrigation on Corn Demonstration Project

In 2009, the district began planning a demonstration project, dubbed the "200-12 Project," that would use the latest water conservation technologies and practices to grow 200 bushels of corn on 12 inches of irrigation water per acre. The project is based on 12 inches of irrigation, 8 inches of seasonal rainfall and 6 inches of available soil water, to establish 26 inches of total water as guidelines for achieving the goal. The district acknowledges adjustments may be necessary when rainfall and/or soil water are less than the guidelines call for. Corn irrigation averaged 21 inches per acre, while irrigation, rainfall and net soil water averaged 31 inches over the 10 year AgriPartner field demonstration project conducted by Texas A&M AgriLife Extension from 1998-2007. The AgriPartner project included 129 field scale corn demonstrations on 18,815 acres with approximately 150 cooperating growers over the ten year period.

The "200-12" Project demonstrates how water conservation technologies and irrigation management practices can reduce groundwater use and allow agricultural producers to remain financially viable with limited and diminishing groundwater resources. The "200-12" Project is designed as a five year initiative that provides field-scale profitability and feasibility demonstrations of producing 200 bushels of corn, utilizing 12 inches of irrigation water, combined with seasonal rainfall and available water within the crop's root zone.

Participants

Northern Panhandle

Over the first four years, fourteen cooperating producers dedicated 2,457 irrigated acres to the project. Figure 2 is a map of the locations of each "200-12" participants.

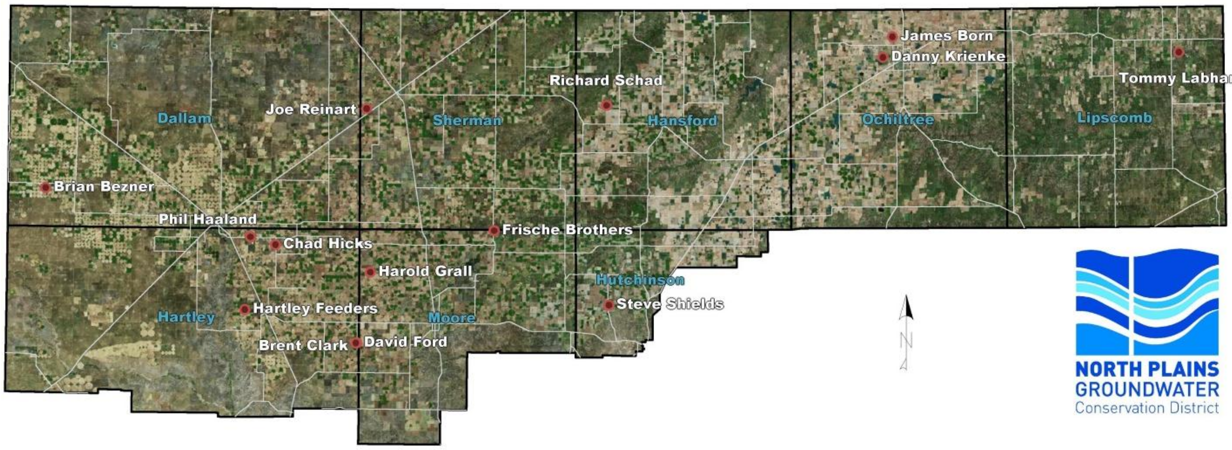


Figure 2: Map of the Participants in the Northern Panhandle Portion of the Texas High Plains Initiative.

Current NPGCD's Board of Directors

Danny Krienke has been involved in Panhandle water issues for over 38 years. A third-generation farmer in the Texas High Plains, Mr. Krienke is the secretary of the Board of Directors for North Plains Groundwater Conservation District. As the chairman of the district's agriculture committee, Mr. Krienke was one of the founders and original cooperators in the "200-12" Project. Mr. Krienke also serves as a member of Texas Regional Water Planning Group A and is the past chairman of Groundwater Management Area 1. Mr. Krienke represents Ochiltree County, where his family has farmed since his grandfather purchased the land in 1923. He's spent 38 years as a farmer, using both irrigated and dry land techniques and 10 years as a staff member of the Texas A&M Extension Service's Whole Field Irrigation Farm Demonstration Program.

Figure 3: Current and Past Members of the NPGCD's Board of Directors Participating in the Northern Panhandle Portion of the Texas High Plains Initiative. From Left to Right, Phil Haaland, Harold Grall, Brian Bezner, and Danny Krienke.

Harold Grall came to the Texas Panhandle in the mid 70's to attend college and pursue a career path in the agribusiness sector of farming. He graduated from West Texas State University with a degree in agricultural economics and moved to Moore County to begin his mentorship with one of the area's premier farming operations owned and operated by Dale and Joan Coleman. After almost a decade later under his mentor's leadership, Mr. Grall moved into a large farming operation in his own right. He was elected to the North Plains Groundwater Conservation District's Board of Directors as the Moore County representative in 2008, currently holding the position of Vice President. Under Mr. Coleman's direction, and based on his own convictions, Mr. Grall developed a farm management philosophy centered on maximizing efficiency of all resources. As a member of the district's agriculture committee, Mr. Grall was one of the founders and original cooperators in the "200-12" Project. Dale Coleman said it best when he was quoted in an interview for Progressive Farmer Magazine: "Harold Grall is the best crop I ever raised."

Past NPGCD's Board of Directors

Phil Haaland served as the Hartley County Director on the North Plains Groundwater Conservation District's Board of Directors until May 10, 2014. Mr. Haaland is a Past President of the board and served on the board for 21 years. As a member of the district's agriculture committee, Mr. Haaland was one of the founders and original cooperators in the "200-12" Project. Mr. Haaland has been involved with agriculture all of his life, with 49 years of farming experience, 15 in Minnesota and the other 34 in the Texas Panhandle. Mr. Haaland has also been a Pioneer seed dealer since moving to Texas in 1979.

Brian Bezner served as the Dallam County Director on the North Plains Groundwater Conservation District's Board of Directors until May 10, 2014, last serving as the Vice President. He joined the three other board members in the "200-12" Project in 2011.

Producers

James Born of Ochiltree County participated in the "200-12" Project in 2011 only, dedicating 115 acres.

Brent Clark of Hartley County joined the "200-12" project in 2012. He dedicated 484 acres over the 2 years he participated in the project.

David Ford of Hartley County joined the "200-12" Project in 2012. He dedicated 240 acres over the 2 years he participated in the project.

Frische Brothers of Moore County joined the "200-12" Project in 2012. He dedicated 214 acres over the 2 years he participated in the project.

Hartley Feeders (Dennis Buss) of Hartley County joined the "200-12" Project in 2011. He dedicated 362 acres over the 3 years he participated in the project.

Chad Hicks and 14 Mile Ranch of Hartley County joined the "200-12" Project in 2011, and participating in 2012. He dedicated 410 acres over the 2 years he participated in the project.

Tommy Laubhan of Lipscomb County joined the "200-12" Project in 2012. He dedicated 244 acres over the 2 years he participated in the project.

Joe Reinart of Sherman County joined the "200-12" Project in 2011. He dedicated 302 acres over the 3 years he participated in the project.

Richard Schad of Hansford County joined in the "200-12" Project in 2012. He dedicated 329 acres over the 2 years he participated in the project.

Steve Shields of Hutchinson County participated in the "200-12" Project in 2011 only. He dedicated 65 acres to the project.

For the fifth and final year, Danny Krinke, Harold Grall, Phil Haaland, Brian Bezner, Brent Clark, David Ford, Hartley Feeders, Tommy Laubhan, Joe Reinart, and Richard Schad will all participate in the project.

South Plains

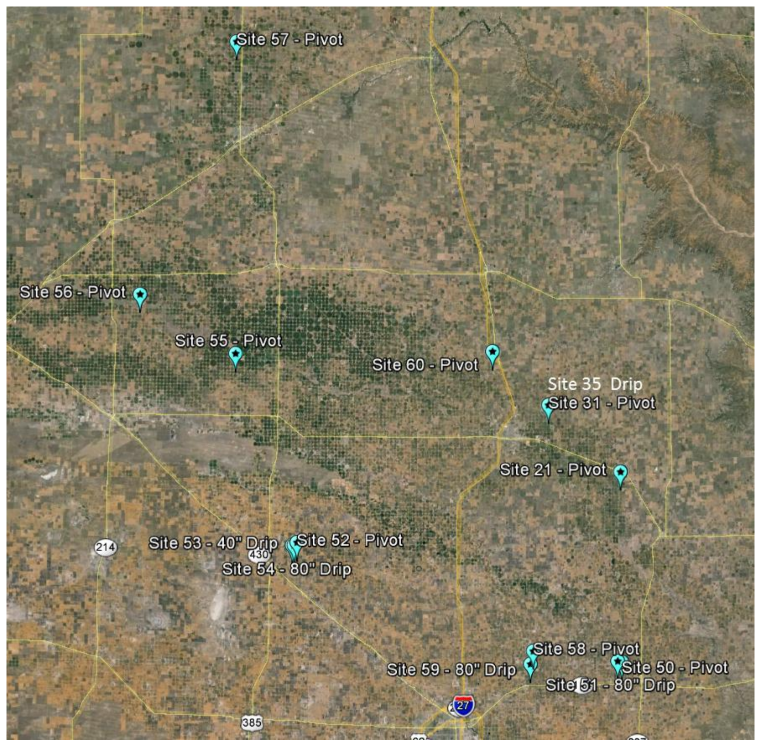


Figure 4: Location of Demonstration Sites in the South Plains Portion of the Texas High Plains Initiative.

The 2012 crop year represented the initial year for the project in the Southern Plains area. Criteria used to select sites for the project included: location within the area, irrigation system, and crops typically grown. Five producers were initially selected to participate in the project. Figure 2 shows the location of the demonstration sites. The participating producers were: Bob Meyer, Deaf Smith County; Jerry Don Glover, Parmer County; Noah Estrada, Castro County; Blake Davis, Lamb County; and Arthur Farms, Crosby County. Two producers within the Texas Alliance for Water Conservation (TAWC) were also included in the project, Glen Schur, Hale County and Eddie Teeter, Floyd County. In 2013, two additional producers were added, Barry Evans, Swisher County, and Randy McGee, Lubbock County. In 2014, there were 13 sites representing 1317 acres.

Methods

In the Northern Panhandle, each cooperator individually selected fields irrigated by center pivot systems for his demonstration. In 2012, the district added a control field, managed by the cooperator, to compare the demonstration results to normal farming practices. Prior to 2012, the district used the records from the cooperator's farming operation to provide a comparison. irrigation was managed within the district's "200-12" Project protocols and guidelines in one field called the "200-12". Each cooperator managed irrigation in the second field, called the

Control, according to his normal practices. Each cooperator individually chose commercially available corn hybrids based on their experience as growers. Seeding and fertilizer rates, as well as pesticide and herbicide applications, were also selected by each cooperator. At each demonstration field, the district installed water meters to record and verify the amount of irrigation applied on each field, rain gauges to measure rainfall, gypsum block moisture sensors at 1, 2, 3, 4 and 5 foot depths in the crop's root zone to monitor soil water content, and AquaSpy™ continuous soil moisture monitoring probes down to 60 inches.

In the South Plains, irrigation monitoring systems were installed at each site using technologies from PivoTrac® and Net Irrigate™. These systems provide producers with real time monitoring of irrigation system performance related to pumping amounts and the location of the system in the field. Each site was equipped with capacitance probes to measure soil moisture. The producers also had access to the online irrigation management tools, TAWC Solutions, provided by the Texas Alliance for Water Conservation (TAWC). Field data was collected for each site each year. Field data included seed, fertilizer, herbicides, insecticides, harvest aids, tillage operations, irrigation, and crop insurance. Cost and return budgets were prepared for each site to determine cost of production and profitability. Crop consultants were retained in the project as a resource to work with producers and participate in the educational and outreach actives of the project. Dr. Dan Krieg is a retired faculty member of the Plant and Soil Science Department at Texas Tech University and is an internationally recognized expert in cotton production physiology. Mr. Bob Glodt is a recognized crop consultant that has experience in using the technologies and tools available in the project to assist producers in crop management decisions.

Continuous Soil Moisture Monitoring

The probes utilizing capacitance base technologies to determine a moisture level at various depths were installed in each field. John Deere Field Connect™, AquaSpy™ and Eco Drip™ probes were the some of the brands of capacitance probes utilized in the project.

The data from the probes were available to producers on a real time basis. The information from the capacitance probes included measurement of moisture levels at various levels in the soil profile. The information was delivered in a graphical form which allowed producers to visualize where water was in the soil profile, the rate of water use by plants, and at what level plant rooting was actively drawing water. Having access to this information allowed producers to better manage irrigation to take into account the effects of rainfall events on soil moisture and the effectiveness of irrigation events in filling the soil profile. Figure 5 is an example of the graphical form displayed by the AquaSpy™ website.

Figure 5: The summary graph for all sensors in an AquaSpy™ Probe. A) The green area is the optimal level for the soil moisture for the crop. B) The red line represents the refill point. C) The blue line represents the field capacity for the soil.

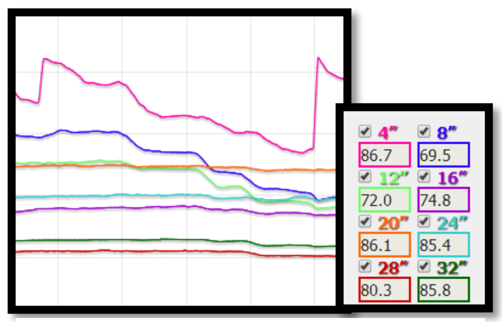


Figure 6: The Sensor Graph for the AquaSpy Probes.

Figure 5 is an example of a graph summarizing all of the sensor's data in an AquaSpy™ probe. The rises in the graph indicates an irrigation or rainfall event and the falls in the graph are the result of plant use. The stair stepping effect of the falls in the graph is the result of the plant intake rate changing from day to night, with the highest intake rate during the day. Figure 6 is the graph of the individual sensors of the AquaSpy™ probes. This graph allows the user to view the water use of each sensor level. In this example, the crop is using the soil moisture at the 4, 8 and 12 inch levels, showing the root zone is 12 inches deep. For more information regarding AquaSpy's™ product, visit their website at www.aquaspy.com.

Remote Continuous Tracking and Control of Center Pivots

Each Center Pivot irrigation system was equipped with remote continuous tracking and control to monitor and manage irrigation application frequency. ® is one of multiple providers of remote tracking systems available to farmers in the area. The PivoTrac® website provides real-time information of the pivot, i.e. current status, time running wet, irrigation applied, rainfall, application rate, pivot speed, current position. For more information regarding PivoTrac's® product, visit their website at www.texaspivot.com.

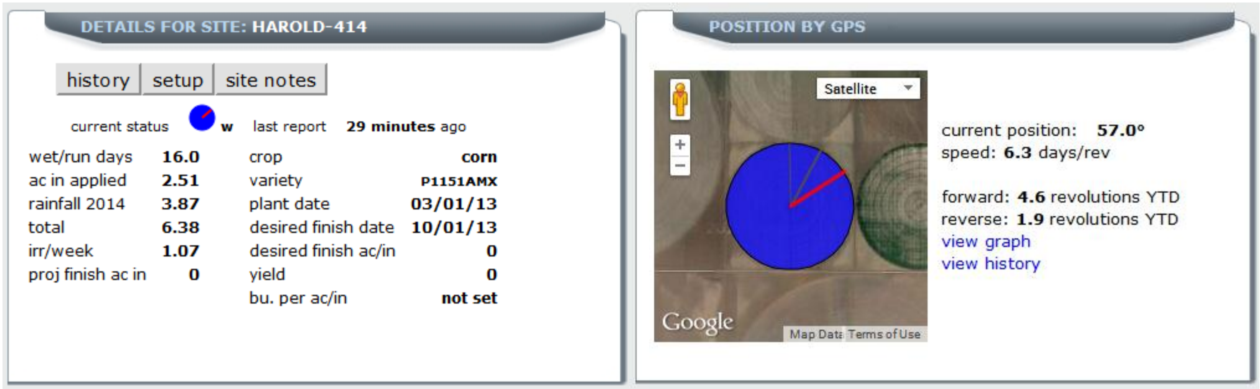


Figure 7: An Example of the Information Provided by the PivoTrac's® Service.

Better Harvest's Nitrogen Management Program

In the Northern Panhandle, Better Harvest provides a nitrogen management program to maximize the beneficial use of applied nitrogen. The program collects four samples; pre plant, 4 leaf, tassel and harvest; over the growing season. A report is sent to the producer with recommendations. For more information regarding Better Harvest's program, visit their website at www.betterharvest.com.

HydroBio Advanced Remote Sensing

In the Northern Panhandle, HydroBio uses satellite imagery to estimate the plant water requirement and uses the information to produce an irrigation schedule for the crop. Other benefits include imagery that can identify areas of concern within the field. The user accesses the prescriptions and supporting data through a web-based system. The district decided to use HydroBio's services in a limited quantity for the fourth year of the project. Figure 8 is an example of the data received for the services. The lighter colors represent the areas of highest water use and the darker colors the areas of lowest water use.

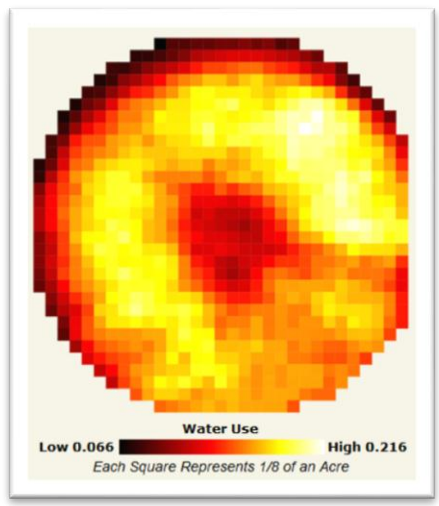


Figure 8: An Example of HydroBio's Satellite Imagery.

The purpose was to learn the function of the imagery process and the potential as an additional beneficial irrigation and water management tool for growers. The satellite imagery appears promising, however additional improvements are needed in monitoring soil moisture, especially beginning soil moisture. For more information regarding HydroBio's service, visit their website at www.hydrobioars.com.

CropMetrics Electrical Conductivity Mapping

CropMetrics use electromagnetic (EM) instrument to provide relative field specific differences to potentially improve crop production within the survey area. Resulting survey data is used primarily to guide precision agriculture practices such as variable rate seeding, fertilizer and irrigation. The survey provides seven layers of data. The layers are aspect, depressions, dual EM topsoil, dual EM subsoil, elevation, landscape and slope. The dual EM subsoil layer describes relative differences in soil texture and associated characteristics to approximately 36 inches. Dual EM Subsoil data is important to managing irrigation and writing Variable Rate Irrigation (VRI) prescriptions. The VRI prescriptions were loaded on PivoTrac's® automatic center pivot speed control system. Variable Rate Irrigation by center pivot speed control was conducted in two "200-12" fields and one Control field in 2012 to initiate and learn the process. VRI prescriptions were written for three fields in 2013 but never initiated because of unexpected center pivot and pump interruptions. For more information regarding CropMetrics' service, visit their website at www.cropmetrics.com.

TAWC Solutions Irrigation Management Tools

Water management decision-making tools have been developed for producers from TAWC project research results and have been provided in a web-based format to producers across the region at no charge. These tools are available on the *TAWC Solutions* web site at: http://www.TAWCsolutions.org/. A mobile application for cell phone use is currently being developed.

The TAWC Resource Allocation Analyzer and Irrigation Scheduling tool can be accessed by selecting the "TAWC Tools" drop-down menu on the TAWC Solutions website (Figure 9). Tools available include the Resource Allocation Analyzer, the Irrigation Scheduling Tool, Basic Irrigation Calculator, and the contiguous Acre Inch Calculator.

Figure 9: TAWC Solutions Website

The Resource Allocation Analyzer allows producers to evaluate their crop production alternatives with the objective to maximize profitability given a specified level of available irrigation water. Producers provide cost and return information for alternative enterprises in the input screen (Figure 10), yield expectations, and irrigation availability to create and evaluate numerous scenarios. The results of the analysis provide the producer with the acres of each alternative crop that could be planted to maximize profits and give a specified amount of water availability.

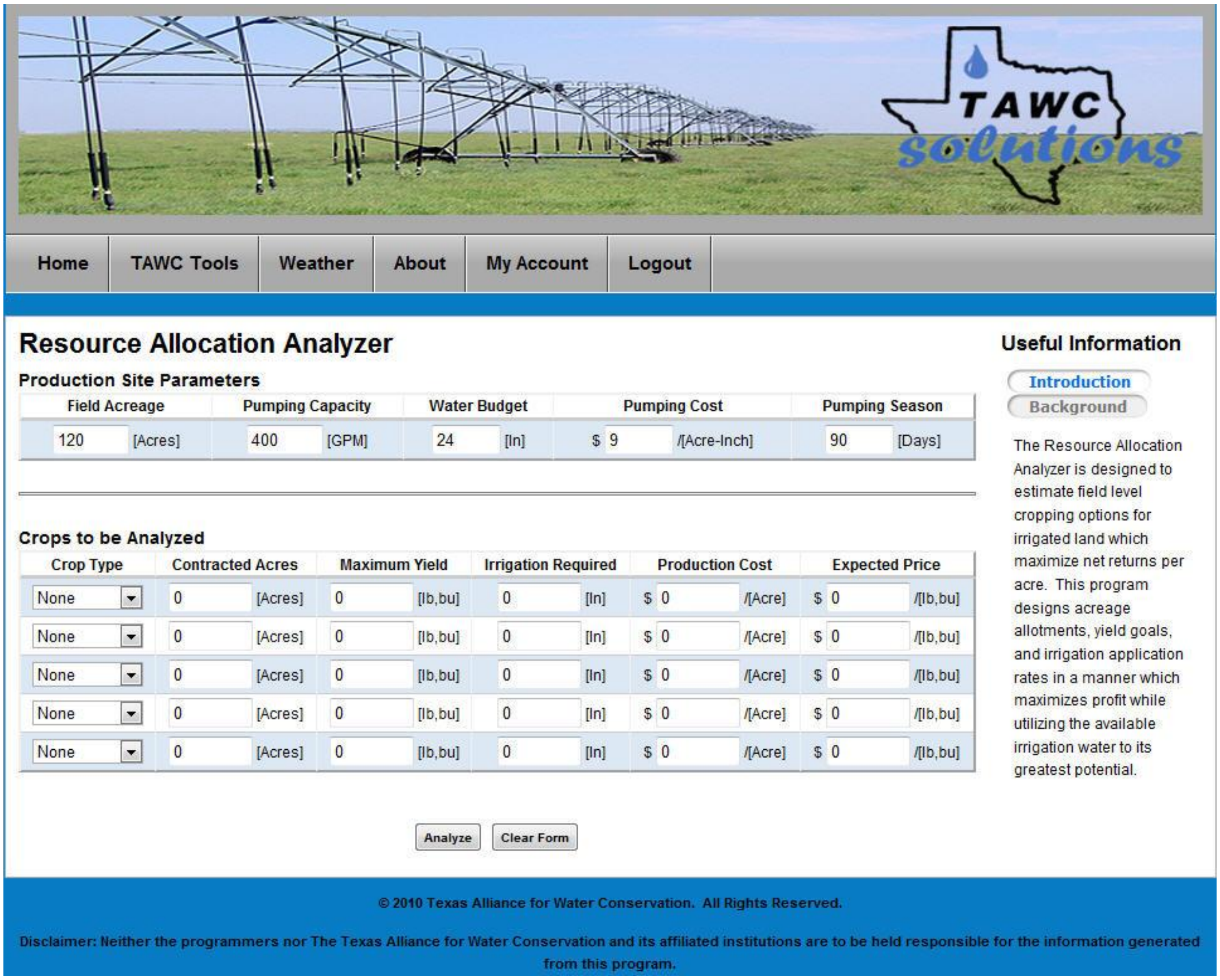
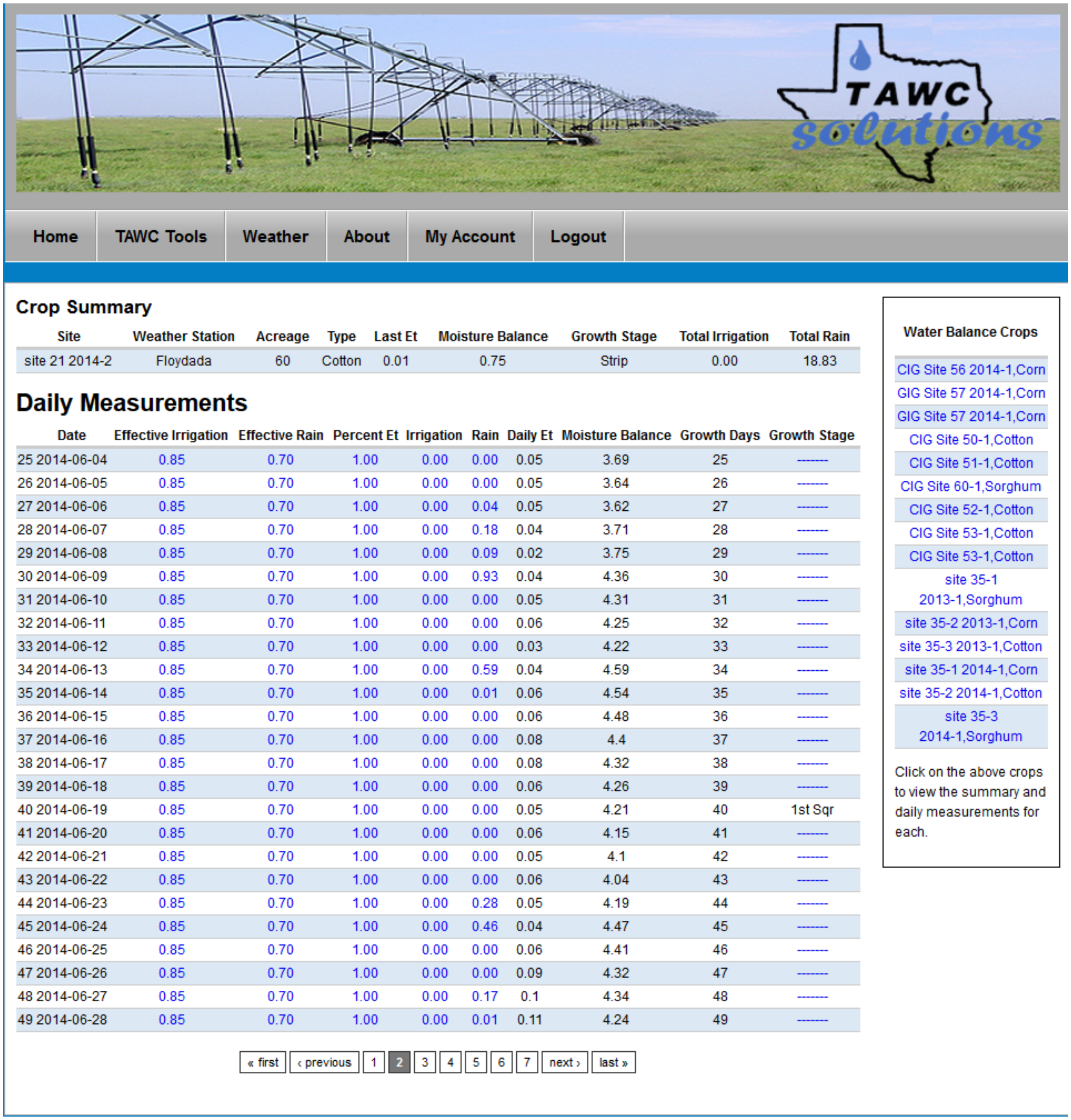


Figure 10: TAWC Resource Allocation Analyzer

The Irrigation Scheduling tool estimates crop water use by calculating the potential evapotranspiration (ET) of a crop. The program uses the planting date, weather data and crop coefficients specific to crop species and stage of development to calculate ET. The tool can assist producers in scheduling irrigations by calculating the estimated soil moisture balance in relation to crop water demand. Producers specify the weather station to obtain weather data, irrigation amounts and timing, and the beginning soil moisture level for each field. This data is used to construct a "checkbook" type soil moisture balance table (Figure 11) that can be used in conjunction with the estimated crop water demand to determine when irrigation is necessary to meet crop water demand.



Crop Summary

Site	Weather Station	Acreage	Type	Last Et	Moisture Balance	Growth Stage	Total Irrigation	Total Rain
site 21 2014-2	Floydada	60	Cotton	0.01	0.75	Strip	0.00	18.83

Daily Measurements

	Date	Effective Irrigation	Effective Rain	Percent Et	Irrigation	Rain	Daily Et	Moisture Balance	Growth Days	Growth Stage
25	2014-06-04	0.85	0.70	1.00	0.00	0.00	0.05	3.69	25	-------
26	2014-06-05	0.85	0.70	1.00	0.00	0.00	0.05	3.64	26	-------
27	2014-06-06	0.85	0.70	1.00	0.00	0.04	0.05	3.62	27	-------
28	2014-06-07	0.85	0.70	1.00	0.00	0.18	0.04	3.71	28	-------
29	2014-06-08	0.85	0.70	1.00	0.00	0.09	0.02	3.75	29	-------
30	2014-06-09	0.85	0.70	1.00	0.00	0.93	0.04	4.36	30	-------
31	2014-06-10	0.85	0.70	1.00	0.00	0.00	0.05	4.31	31	-------
32	2014-06-11	0.85	0.70	1.00	0.00	0.00	0.06	4.25	32	-------
33	2014-06-12	0.85	0.70	1.00	0.00	0.00	0.03	4.22	33	-------
34	2014-06-13	0.85	0.70	1.00	0.00	0.59	0.04	4.59	34	-------
35	2014-06-14	0.85	0.70	1.00	0.00	0.01	0.06	4.54	35	-------
36	2014-06-15	0.85	0.70	1.00	0.00	0.00	0.06	4.48	36	-------
37	2014-06-16	0.85	0.70	1.00	0.00	0.00	0.08	4.4	37	-------
38	2014-06-17	0.85	0.70	1.00	0.00	0.00	0.08	4.32	38	-------
39	2014-06-18	0.85	0.70	1.00	0.00	0.00	0.06	4.26	39	-------
40	2014-06-19	0.85	0.70	1.00	0.00	0.00	0.05	4.21	40	1st Sqr
41	2014-06-20	0.85	0.70	1.00	0.00	0.00	0.06	4.15	41	-------
42	2014-06-21	0.85	0.70	1.00	0.00	0.00	0.05	4.1	42	-------
43	2014-06-22	0.85	0.70	1.00	0.00	0.00	0.06	4.04	43	-------
44	2014-06-23	0.85	0.70	1.00	0.00	0.28	0.05	4.19	44	-------
45	2014-06-24	0.85	0.70	1.00	0.00	0.46	0.04	4.47	45	-------
46	2014-06-25	0.85	0.70	1.00	0.00	0.00	0.06	4.41	46	-------
47	2014-06-26	0.85	0.70	1.00	0.00	0.00	0.09	4.32	47	-------
48	2014-06-27	0.85	0.70	1.00	0.00	0.17	0.1	4.34	48	-------
49	2014-06-28	0.85	0.70	1.00	0.00	0.01	0.11	4.24	49	-------

« first ‹ previous 1 2 3 4 5 6 7 next › last »

Water Balance Crops

CIG Site 56 2014-1,Corn
GIG Site 57 2014-1,Corn
GIG Site 57 2014-1,Corn
CIG Site 50-1,Cotton
CIG Site 51-1,Cotton
CIG Site 60-1,Sorghum
CIG Site 52-1,Cotton
CIG Site 53-1,Cotton
CIG Site 53-1,Cotton
site 35-1 2013-1,Sorghum
site 35-2 2013-1,Corn
site 35-3 2013-1,Cotton
site 35-1 2014-1,Corn
site 35-2 2014-1,Cotton
site 35-3 2014-1,Sorghum

Click on the above crops to view the summary and daily measurements for each.

Figure 11: TAWC Irrigation Scheduling Tool

Crop Budgets

Cost and return budgets were prepared for each site each year to estimate the cost of production and profitability of the production systems. The field data collected for each site was used to prepare the budgets. The costs of various inputs such as fertilizer, chemicals, tillage and harvest operation; and prices received for crops were standardized across each site for each year to allow a better comparison between sites. Gross margin (cash receipts less cash expenses) was used as the measure of profitability in order to avoid the variation between producers in fixed expenses.

Data Collection

During the growing season, NPGCD personnel collected data and maintained recording equipment weekly in each of the northern demonstration fields. Cooperators and the district conservationist used the real-time data from AquaSpy™ and PivoTrac®, along with the data collected at least weekly from each demonstration field, to monitor crop and soil moisture conditions, as well as to schedule irrigation frequency and volumes in the "200-12" fields. Where the "200-12" and Control fields were both irrigated by the same center pivot system, PivoTrac® delivered a text message to the district conservationist who recorded when irrigation stopped in one field and began in the other field.

The time the irrigation system was in the "200-12" or Control field, along with weekly gallon per minute (gpm) water meter readings, established a method to track irrigation. All demonstrations began at planting and ended at harvest, which each cooperator managed. The district compared harvest and irrigation results from the "200-12" field with that from the Control field for each grower, and to that of other fields which the cooperator farmed. Yields for each field were adjusted to reflect 15.5% moisture content for corn based on the formula used by the National Corn Growers Association. The district analyzed production gains and losses based on accepted corn price and growers expenses relating to irrigation, seed, fertilizer and harvest costs. The district did not analyze land costs because land costs are highly variable between growers and across the district.

Overall Summary for the 2010 thru 2014 Crop Season

Northern Panhandle

2010 Crop Season

In 2010, three district directors (Harold Grall, Danny Krienke and Phil Haaland) dedicated their own irrigated acres for the first year of the "200-12" Project. The cooperators implemented new and proven irrigation management technologies and practices to aid in the strategic management of each reduced irrigation water demonstration site.

Harold Grall of Moore County dedicated 120 acres for the on-farm demonstration. He saved ten inches of irrigation for the year when compared to his normal practices. Mr. Grall had an Actual Production History (APH) of 217 bushels for the field in the previous nine years. He yielded 198 bushels in the "200-12" program in 2010. His farm average yield for other fields was ten percent less than normal. Mr. Grall saved $100.34 per acre in costs on corn produced in 2010 due to the reduction in irrigation, seed, fertilizer and harvest costs. The reduced corn yield cost $89.87 per acre. The demonstration's net gain was $10.47 per acre with ten inches less irrigation water used compared to typical production from the same field.

Danny Krienke of Ochiltree County dedicated 120 acres for the on-farm demonstration. He saved five inches of applied irrigation for the year when compared to his normal practices. Mr. Krienke had an adjusted APH of 196 bushels from this field for 2010. The field demonstration produced 192 bushels for the year. Mr. Krienke saved $61 per acre in cost on corn produced in 2010 due to the reduction in irrigation, seed, fertilizer, and harvest costs. The reduced corn yield cost $18.92 per acre. The demonstration's net gain was $42.08 per acre, with 5 inches less irrigation water used compared to typical production from the same field.

Phil Haaland of Hartley County dedicated 30 acres for the district's on-farm demonstration from a 120 acre field in which he was demonstrating hybrid seeding rates for a separate demonstration project. On the 30 acres, Haaland saved eleven inches of applied irrigation for the year. Haaland's field has an APH of 240 bushels and came in with 191 bushels for the year. In simulating a 250 gallons per minute well on a 120 acre circle, Mr. Haaland saved $122.46 per acre in costs on corn produced this year due to the reduction in irrigation, seed, fertilizer and harvest costs. The reduced corn yield cost $231.77 per acre. This demonstration's net loss was $109.31 per acre with eleven inches less irrigation water used compared to a typical production from the same field. If the production capacity of the irrigation pivot was actually 250 gallons per minute, Haaland said he would have only irrigated half a circle (60 acres) which would have increased his yield and would have been closer to break-even.

In 2010, the project reduced irrigation in the "200-12" fields by 177.50 acre-feet (7.89 inches). Table 2 and 3 shows water savings and results for the 2010 growing season.

Table 2: 2010 Water Savings for the Northern Panhandle Portion of the Texas High Plains Initiative.

Producer	Field Size (ac)	Total Irrigation (in.)	Total Irrigation (ac-ft)	Water Savings (in.)	Water Savings (ac-ft)
Harold Grall	120	10.86	108.60	10.00	100.00
Danny Krienke	120	11.76	117.60	5.00	50.00
Phil Haaland	30	11.20	28.00	11.00	27.50
Total	**270**	**11.30**	**254.20**	**7.89**	**177.50**
Notes:	The water savings is compared to the producer's other fields.				

Table 3: 2010 Results for the Northern Panhandle Portion of the Texas High Plains Initiative.

Producer	Yield (bu/ac)	Yield Per Ac-In of Irrigation (bu/ac-in)	Net Gain ($/ac)
Harold Grall	198	18.23	$ 10.47
Danny Krienke	192	16.33	$ 42.08
Phil Haaland	191	17.05	$ (109.31)
Total	**194**	**17.20**	**$ 11.21**

2011 Crop Season

2010 was a year with above average rainfall, while 2011 was the opposite, with well below average rainfall. The total lack of supplemental rainfall showed early that our goal of 12 inches of irrigation was not likely to be achievable; however one “200-12” field came close. Due to extreme drought, six participants were forced to divert water to fields that required more input to prevent devastating financial loss.

Harold Grall of Moore County dedicated 120 acres to the on-farm demonstration. Grall saved ten inches of irrigation for the year compared to his normal practices on twenty other fields. Mr. Grall had an Actual Production History (APH) of 217 bushels for the field in the previous nine years. Grall’s acreage yielded 198 bushels in the “200-12” Project in 2010 and 178 in 2011. Even though the yield was 20 bushels less per acre in 2011, it was still considered an excellent result given the much lower than normal rainfall received. His farm average yield for other fields was 28 percent less than normal. Production averaged 164 bushels per acre on the other fields, 14 bushels less than the 178 harvested in the “200-12” field. Mr. Grall saved $94.64 per acre in reduced irrigation, seed and fertilizer but increased harvest costs in 2011. The 14 bushel increase in corn yield amounts to $90.72 per acre. The demonstration’s net gain was $185.36 per acre with ten inches less irrigation compared to production from the average of Grall’s twenty other fields.

Steve Shields of Hutchinson County dedicated 65 acres to the district’s on-farm demonstration. Shield’s field had an APH of 180 bushels and produced 153 bushels during the 2011 demonstration year. Shields states the 153 bushels per acre yield is about average in comparison to seven other fields he farms where production ranged from 126 to 190 bushels. He thinks corn yields were 25 to 30 percent less on his farms in 2011. Shields used about five inches of irrigation in pre-water and following planting, battling the challenging climatic conditions. He did not save any money in reduced irrigation, fertilizer, seed and harvest costs. Irrigation was similar to his other fields. A first year project cooperator using a new center pivot, Shields says he is okay with the 153 bushel yield considering the dry conditions. He remarked, “I had to make a crop.”

Danny Krienke of Ochiltree County dedicated 120 acres to the on-farm demonstration. Krienke reduced irrigation by seven inches for the season compared to normal practices for four other fields he farms, where irrigation totaled 28 inches and production averaged 168 bushels per acre. Krienke had an adjusted APH of 196 bushels from the field for 2010. The field demonstration produced 192 bushels during the 2010 demonstration and 121 bushels in 2011. He calculated corn production was 28 percent less than normal from his fields in 2011. Krienke saved $110.19 per acre in cost on corn produced in 2011 due to the reduction in irrigation, seed, fertilizer, and harvest costs. The reduced corn yield cost $304.56 per acre.The demonstration’s net loss was $194.37 per acre, with 7 inches less irrigation water used compared to his four other fields. Krienke was forced to make pump repairs the first week in July at a critical plant growth stage.

The five days of no irrigation limited corn yield and was typical of what happens with limited pumping capacity.

Phil Haaland had expectations to harvest a grain crop, but near 100 degree temperatures and no meaningful rainfall from May thru September prevented development of a harvestable crop. His 15 acres were harvested for corn silage in July.

Dennis Buss and Hartley Feed Yard made a diligent effort to produce a grain crop on his 62 acres. The plants, already under moisture stress were blasted beyond recovery by 113 degree temperatures and 45 mph winds during a weekend in June. His two wells declined by 100 gallons per minute and available water was diverted to another 60 acres, which also failed. The field was harvested for silage in July.

Brian Bezner received 2.25 inches of rainfall in June and had a promising crop, but did not have sufficient irrigation water to maintain the potential. His 60 acres were harvested for silage.

James Born experienced mechanical failures and down time with a center pivot with limited water already committed to too many acres on a first year farm. His 115 acres of corn stressed in June and was abandoned in favor of grain sorghum that was planted later.

Chad Hicks and 14 Mile Ranch could not irrigate the demonstration as planned because water was also committed to other crop acres in combination with additional wells. His 50 acres were abandoned in July after plants became severely stressed. In 2011, many wells were over extended and could not keep up with the demand.

Joe Reinart shared water from the well that was to irrigate his demonstration with other crop acres. The plants became severely stressed and the 75 acres were abandoned in late June. Three hundred five of the 682 acres (45 %) committed to the "200-12" demonstration project were harvested as planned, 137 (20 %) were harvested for corn silage and 240 (35 %) were abandoned.

In 2011, the project reduced irrigation in the "200-12" fields by 525.25 acre-feet (9.24 inches). Table 4 and 5 is the water savings and results for the 2011 growing season.

Table 4: 2011 Water Savings for the North Panhandle Portion of the Texas High Plains Initiative.

Producer	**Field Size (ac)**	**Total Irrigation (in.)**	**Total Irrigation (ac-ft)**	**Water Savings (in.)**	**Water Savings (ac-ft)**
Harold Grall (1)	120	18.78	187.80	9.50	95.00
Steve Shields (1)	65	31.21	169.05	0.00	0.00
Danny Krienke (1)	20	21.32	35.53	7.00	11.67
Danny Krienke (1)	100	23.56	196.33	5.00	41.67
Phil Haaland (2)	15	13.09	16.36	7.90	9.88
Hartley Feeders (2)	62	12.02	62.10	9.00	46.50
Brian Bezner (2)	60	14.22	71.10	6.80	34.00
James Born (3)	115	7.07	67.75	13.90	133.21
Chad Hicks (3)	50	6.08	25.33	14.90	62.08
Joe Reinart (3)	75	6.37	39.81	14.60	91.25
Total	**682**	**15.33**	**871.19**	**9.24**	**525.25**

Notes:
(1) The water savings is compared to the producer's other fields. (Sustainable)
(2) The water savings is compared to AgriPartner Program Irrigation of 21 inches of water on the same size field. Not Sustainible (Silage)
(3) The water savings is compared to AgriPartner Program Ierrigation for 21 inches of water on the same size field. Not Sustainible (Abandoned)

Table 5: 2011 Results for the North Panhandle Portion of the Texas High Plains Initiative.

Producer	**Yield (bu/ac)**	**Yield Per Ac-In of Irrigation (bu/ac-in)**	**Net Gain ($/ac)**
Harold Grall (1)	178	9.48	$ 185.36
Steve Shields (1)	153	4.90	$ -
Danny Krienke (1)	121	5.68	$ (194.37)
Danny Krienke (1)	131	5.56	$ (129.57)
Phil Haaland (2)	Silage	-	$ -
Hartley Feeders (2)	Silage	-	$ -
Brian Bezner (2)	Silage	-	$ -
James Born (3)	Abandoned	-	$ -
Chad Hicks (3)	Abandoned	-	$ -
Joe Reinart (3)	Abandoned	-	$ -
Total	**146**	**6.40**	**$ 7.92**

2012 Crop Season

Overall, 2012 was better than 2011 but beginning soil water and seasonal rainfall was below normal and limited production to less than expected and needed. High temperatures during the last two weeks in July and the first week in August, with only limited to no rainfall created the need for more irrigation. Six fields received hail damage that reduced harvest yields. Due to the lack of supplemental rainfall, one participant was forced to divert water to fields that required more input to prevent devastating financial loss. Another participant harvested silage.

Joe Reinart of Sherman County dedicated 135 acres to the on-farm demonstration in two separate fields irrigated by different center pivot systems. Reinart strip tilled and planted 60 acres of corn at 25,000 seeds per acre May 16 for his “200-12” field. He strip tilled and planted 75 acres at 33,000 seeds per acre on April 23 for his Control field. The “200-12” field produced a 170 bushel per acre corn yield. Irrigation totaled 18.20 inches. Production in the Control field was 205 bushels per acre, where seasonal irrigation was 21.25 and pre-water 6.50 inches to establish a total of 27.75 inches. The “200-12” field’s net loss was $116.91 per acre with 9.55 inches less irrigation used compared to production from the “control” field. Reinart stated, “if you didn’t have to count the outside and southwest side of the circle, it all would have been really good corn”.

Harold Grall of Moore County dedicated 240 acres to the on-farm demonstration in two separate fields irrigated by different center pivots. Grall strip tilled and planted 120 acres of corn on May 28 at 28,000 seeds per acre for his “200-12” field. Grall planted 120 acres, also strip tilled, on May 24 at 26,000 seeds per acre for his Control field. The “200-12” field produced a 167 bushel per acre corn yield. Irrigation totaled 16.87 inches. Production in the Control field was 140 bushels per acre, where seasonal irrigation was 18.07 inches. There was no pre-water in either field. In comparison, the “200-12” field produced 27 more bushels per acre than the Control with 1.20 less inches of irrigation. The “200-12” field’s net gain was $163.66 per acre with 1.20 inches less irrigation used compared to production from the Control field.

Tommy Laubhan of Lipscomb County dedicated 122 acres in the same field irrigated by the same center pivot to the on-farm demonstration. Laubhan strip tilled and planted 61 acres of corn in the southwest quarter of the circle on May 4 at a seeding rate of 31,000 seeds per acre for his “200-12” field. He planted the northwest quarter, 61 acres, also strip tilled, on May 4 at 31,000 seeds per acre for his Control field. The “200-12” field produced a 165 bushel per acre corn yield. Irrigation totaled 20.31 inches. Production in the Control field was 174 bushels per acre. Seasonal irrigation totaled 22.78 inches. There was no pre-season irrigation. The “200-12” field’s net loss was $44.40 per acre with 2.47 inches less irrigation used compared to production from the “control” field. Laubhan thinks the primary reason corn yield was greater in the Control is that the soil is better in more of the field for crop production. His farm average yield was 186 bushels per acre. Laubhan says the NPGCD “200-12” project provides good information and that he is glad to participate.

Hartley Feeders (Dennis Buss) of Hartley County dedicated 180 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Hartley Feeders strip tilled and planted 60 acres of corn on May 28 at 28,000 seeds per acre in the north half of the circle for their “200-12” field. Hartley Feeders planted 120 acres, also strip tilled, on May 28 at 28,000 seeds per acre for their Control field. The “200-12” field produced 160 bushels per acre corn yield. Irrigation totaled 20.68 inches. Production in the Control field was 115 bushels per acre, where seasonal irrigation totaled 21.54 inches. In comparison, the “200-12” field produced 45 more bushels per acre than the Control with 0.86 inches less irrigation. The “200-12” field’s net gain was $285.38 per acre with 0.86 inches less irrigation used compared to production from the Control field. Dennis Buss thinks the primary reason for the lower yield in the Control field is that the field was not strip tilled when 3.45 inch rain fell in April. The “200-12” field was already strip tilled and stored more of the early season rainfall.

Brent Clark of Hartley County dedicated 240 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Clark strip tilled and planted 120 acres of corn on April 23 at 27,000 seeds per acre for his “200-12” field. Clark planted 120 acres on April 23 at 32,000 seeds per acre, also strip tilled, for his Control field. The “200-12” field produced a 143 bushel per acre corn yield. Irrigation totaled 14.90 inches. Production in the Control field was 133 bushels per acre, where seasonal irrigation totaled 18.63 inches. In comparison, the “200-12” field produced ten more bushels per acre than the Control with 3.73 inches less irrigation. The “200-12” field’s net gain was $120.40 per acre with 3.75 inches less irrigation used compared to production from the Control field. Both fields were affected by significant hail damage but recovered to produce a partial crop.

Richard Schad of Hansford County dedicated 164 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Schad strip tilled and planted 41 acres of corn on May 11 at 24,000 seeds per acre in the west half circle for his “200-12” field. Schad planted 123 acres on May 1 at 32,500 seeds per acre, also strip tilled, for his Control. The “200-12” field produced a 135 bushel per acre corn yield. Irrigation totaled 19.53 inches. Production in the Control field was 205 bushels per acre, where irrigation was 20.59 inches. Pre-season irrigation was 3.11 inches for the “200-12” field and 5.11 for the Control. In comparison, the Control field produced 72 more bushels per acre than the “200-12” with 1.06 additional inches of irrigation. The “200-12” field’s net loss was $376.51 per acre with 1.06 inches less irrigation used compared to production from the “control” field. Schad stated, “I was really stretched for water to irrigate the fields. We had two new center pivots and another one moved to previous dry land acres. There were delays getting the irrigation systems ready and the crops planted. I thought we had lost too much of the crops in July when it didn’t rain. However, crop yields were much better than expected earlier in the season.”

Danny Krienke of Ochiltree County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Krienke strip tilled and planted 60 acres of corn on May 21 at 27,000 seeds per acre in the southwest quarter of the circle for his “200-12” field. He planted the southeast quarter circle 60 acres on May 21 at 27,000 seeds per acre, also strip tilled, for his Control field. The “200-12” field produced a 134 bushel per acre corn yield. Irrigation totaled 24.57 inches. Production in the Control field was 131 bushels per acre. Seasonal irrigation totaled 26.62 inches. There was no pre-season irrigation. The “200-12” field produced three more bushels per acre than the Control and irrigation was 2.10 inches less. The “200-12” field’s net gain was $28.59 per acre with 2.10 inches less irrigation used compared to production from the Control field.

Phil Haaland of Hartley County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Haaland strip tilled and planted 15 acres from, 270 to 315 degrees in the circle, to corn on May 24 at 26,000 seeds per acre for his "200-12" field. He planted the remaining 105 acres in the circle on May 24 at 30,000 seeds per acre, also strip tilled, for his Control field. The "200-12" field produced a 116 bushel per acre corn yield. Irrigation totaled 24.47 inches. Production in the Control field was 209 bushels per acre. Seasonal irrigation totaled 28.08 inches. Pre-season irrigation was 3.33 inches in both fields. In comparison, the "200-12" field produced 93 less bushels per acre than the Control and irrigation was 3.61 inches less. The "200-12" field's net loss was $554.32 per acre with 3.61 inches less irrigation used compared to production from the Control field. It was too long between irrigations for the "200-12" field in July. Haaland says the lack of rainfall during the 2012 growing season created another unwanted challenge for growers.

Frische Brothers of Moore County dedicated 107 acres in one field irrigated by the same center pivot to the on-farm demonstration. Frische Brothers strip tilled and planted 53 acres of corn in the west half circle on May 6 at 28,000 seeds per acre for their "200-12" field. They planted the east half, 53 acres, on May 6 at 28,000 seeds per acre, also strip tilled, for their Control field. The "200-12" field produced a 104 bushel per acre corn yield. Irrigation totaled 13.52 inches. Production in the Control field was 105 bushels per acre. Seasonal irrigation totaled 14.64 inches. Pre-season irrigation was 1.50 inches in both fields. Plants in both fields were damaged by hail in mid-June. In comparison, the "200-12" field produced one less bushel per acre than the Control and irrigation was 1.12 inches less. The "200-12" field's net loss was $0.87 per acre with 1.12 inches less irrigation used compared to production from the Control field. Myles Frische said the hail caused a reduction in plant population plus additional evapotranspiration due to less canopy. And, with hindsight, the crop likely should have been replanted.

David Ford of Hartley County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Ford strip tilled and planted 60 acres of corn in the south half circle on May 15 at 28,000 seeds per acre for his "200-12" field. He planted the north half circle 60 acres on May 15 at 32,000 seeds per acre, also strip tilled, for his Control field. The "200-12" field produced an 86 bushel per acre corn yield. Irrigation totaled 15.61 inches. Production in the Control field was 173 bushels per acre. Seasonal irrigation totaled 20.64 inches. Pre-season irrigation was 2.60 inches in both fields. Both fields were damaged by hail at the seven leaf stage. The "200-12" field's net loss was $487.61 per acre with 5.03 inches less irrigation used compared to production from the Control field. Ford says the 2012 demonstration was not a good comparison due to the hail damage. Also Ford says that reduced corn irrigation following a previous cotton crop is not a good farming practice.

Chad Hicks & 14 Mile Ranch dedicated 360 acres in two fields irrigated by separate center pivot irrigation systems to the on-farm demonstration. Hicks strip tilled and planted 49 acres of corn on May 7 at 24,000 seeds per acre for his "200-12" field. Hicks planted 310 acres, also strip tilled, in the north half of a 620 acre circle on May 17 at 28,000 seeds per acre for his Control field. The “200-12” field produced a 14 bushel per acre corn yield. Irrigation totaled 6.20 inches. There was not sufficient water available to irrigate the crop as needed after mid- June. The water was applied on larger crop acres that included the Control field. Production in the Control field was 218 bushels per acre, where seasonal irrigation and pre-water totaled 23.74 inches. Preseason irrigation was 1.95 inches in the “200-12” field and 3.89 in the Control. The “200-12” field’s net loss was $1024.54 per acre with 17.54 inches less irrigation used compared to production from the “control” field. Unfortunately, Hicks lack of available water for his “200-12” field when rainfall is less than normal is a condition all growers are addressing, and it is the purpose of the NPGCD’s “200-12” reduced corn irrigation project.

Brian Bezner dedicated 244 acres in two fields irrigated by separate center pivot irrigation systems to the on-farm demonstration. Bezner strip tilled and planted 120 acres of corn on May 16 at 27,000 seeds per acre for his “200-12” field. He planted 124 acres on June 2, following wheat, at 33,000 seeds per acre, also strip tilled, for his Control field. The “200-12” field was harvested for corn silage on August 17. With only limited rainfall, available irrigation water was not sufficient to produce a grain crop. The field produced 8.73 tons of silage per acre. Irrigation totaled 9.54 inches. Production in the Control field was 194 bushels per acre, where seasonal irrigation totaled 26.59 inches. There was no pre-season irrigation in either field. The “200-12” field’s net loss for corn grain is $929.26 per acre with 17.05 inches more irrigation used compared to production from the “200-12” silage field.

In 2012, the project reduced irrigation in the “200-12” fields by 404.51 acre-feet (5.93 inches). Table 6 and 7 show the water savings and results for the 2012 growing season.

Table 6: 2012 Water Saving for the Northern Panhandle of the Texas High Plains Initiative.

Producer	Field Size (ac)	Total Irrigation (in.)	Total Irrigation (ac-ft)	Water Savings (in.)	Water Savings (ac-ft)
Joe Reinart 200-12	60	18.20	91.00	9.55	47.75
Joe Reinart Control	75	27.75	173.44	-	-
Harold Grall 200-12	120	16.87	168.70	1.20	12.00
Harold Grall Control	120	18.07	180.70	-	-
Tommy Laubhan 200-12	61	20.31	103.24	2.47	12.56
Tommy Laubhan Control	61	22.78	115.80	-	-
Hartley Feeders 200-12	60	20.68	103.40	0.86	4.30
Hartley Feeders Control	120	21.54	215.40	-	-
Brent Clark 200-12	120	14.90	149.00	3.73	37.30
Brent Clark Control	120	18.63	186.30	-	-
Richard Schad 200-12	41	19.53	66.73	1.06	3.62
Richard Schad Control	123	20.59	211.05	-	-
Danny Krienke 200-12	60	24.57	122.85	2.05	10.25
Danny Krienke Control	60	26.62	133.10	-	-
Phil Haaland 200-12	15	24.47	30.59	3.61	4.51
Phil Haaland Control	105	28.08	245.70	-	-
Frische Brothers 200-12	53	13.52	59.71	1.12	4.95
Frische Brothers Control	53	14.64	64.66	-	-
David Ford 200-12	60	15.61	78.05	5.03	25.15
David Ford Control	60	20.64	103.20	-	-
Chad Hicks 200-12	49	6.02	24.58	17.54	71.62
Chad Hicks Control	310	23.74	613.28	-	-
Brian Bezner 200-12 (1)	120	9.54	95.40	17.05	170.50
Brian Bezner Control	124	26.59	274.76	-	-
200-12 Total	**819**	**16.02**	**1093.25**	**5.93**	**404.51**
Control Total	**1331**	**270**	**2517.39**	**-**	**-**

Notes: All water savings is based on the control field for each producer.
(1) Brian Bezner cut his 200-12 field for silage.

Table 7: 2012 Results for the Northern Panhandle of the Texas High Plains Initiative.

Producer	Yield (bu/ac)	Yield Per Ac-In of Irrigation (bu/ac-in)	Net Gain ($/ac)
Joe Reinart 200-12	170	9.34	$ (116.91)
Joe Reinart Control	205	7.39	$ -
Harold Grall 200-12	167	9.90	$ 163.66
Harold Grall Control	140	7.75	$ -
Tommy Laubhan 200-12	165	8.12	$ (44.40)
Tommy Laubhan Conrtol	174	7.64	$ -
Hartley Feeders 200-12	160	7.74	$ 285.38
Hartley Feeders Control	115	5.34	$ -
Brent Clark 200-12	143	9.60	$ 120.40
Brent Clark Control	133	7.14	$ -
Richard Schad 200-12	135	6.91	$ (376.51)
Richard Schad Control	207	10.05	$ -
Danny Krienke 200-12	134	5.45	$ 28.59
Danny Krienke Control	131	4.92	$ -
Phil Haaland 200-12	116	4.74	$ (554.32)
Phil Haaland Control	209	7.44	$ -
Frische Brothers 200-12	104	7.69	$ (0.87)
Frische Brothers Control	105	7.17	$ -
David Ford 200-12	86	5.51	$ (487.61)
David Ford Control	173	8.38	$ -
Chad Hicks 200-12	14	2.33	$ (1,024.54)
Chad Hicks Control	218	9.18	$ -
Brian Bezner 200-12 (1)	Silage	-	$ -
Brian Bezner Control	194	7.30	$ -
200-12 Total	**127**	**7.03**	**$ (73.33)**
Control Total	**167**	**7.48**	**$ -**

Almost all acres dedicated to the project in 2012 were harvested. Only two percent (49 acres) of the “200-12” field acreage was basically abandoned due to the lack of available water. Another 5 percent (120 acres) was harvested as corn silage. Corn yields averaged 138 bushels per acre in ten “200-12” fields. Irrigation averaged 18.86 inches. Average Irrigation, rainfall plus net soil water totaled 25.36 inches. Production averaged 167 bushels per acre in 12 Control fields. Average Irrigation was 22.47 inches. Irrigation, rainfall and net soil water averaged 27.78 inches.

2013 Crop Season

In 2013, eleven cooperating producers dedicated twenty-two demonstration fields encompassing 1672 acres. All 1672 acres dedicated to the project were harvested for corn grain. Corn yields averaged 200 bushels per acre in eleven “200-12” fields. Irrigation averaged 18.36 inches. Average pre-water in five “200-12” fields was 2.37 inches. Production averaged 11.17 bushels (625 lbs.) per inch of irrigation. Average Irrigation, rainfall plus net soil water totaled 26.25 inches. Production averaged 226 bushels per acre in eleven Control fields. Average Irrigation was 23.28 inches. Production was 9.84 bushels (551 lbs.) per inch of irrigation. Irrigation, rainfall and net soil water averaged 31.34 inches. No pre-water was applied in 10 of the 22 fields. Two of the practices used for the “200-12” fields are only slightly less than those used in the Control fields. Net return per inch of irrigation averaged $33.73 for the “200-12” fields compared to $30.09 for the Control fields. Results from the 2013 cooperating producers are as follows:

Joe Reinart of Sherman County dedicated 92 acres to the on-farm demonstration in two separate fields irrigated by different center pivot systems. Reinart strip tilled and planted 27 acres of corn at 25,000 seeds per acre on June 12 for his “200-12” field. He strip tilled and planted 65 acres at 32,000 seeds per acre on May 5 for his Control field. The “200-12” field produced 200 bushels per acre. Irrigation totaled 12.55 inches. Reinart only read and used the soil probe to irrigate the “200-12” field. Production in the Control field was 238 bushels per acre, where seasonal irrigation was 24.11 and pre-water 4.15 inches to establish a total of 28.26 inches. The “200-12” field’s net loss was $18.14 per acre with 15.71 inches less irrigation used compared to production from the “control” field. Reinart stated, “An additional 600 acres across the rest of our farm that mirrored the “200-12” field averaged 185 bushels per acre. And that “we will continue to plant early and late corn using the strategies learned from the “200-12” project”.

Harold Grall of Moore County dedicated 240 acres to the on-farm demonstration in two separate fields irrigated by different center pivots. Grall strip tilled and planted 120 acres of corn on June 4 at 26,000 seeds per acre for his “200-12” field. Grall planted 120 acres, also strip tilled, on June 2 at 24,000 seeds per acre for his Control field. The “200-12” field produced 198 bushels per acre. Irrigation totaled 15.06 inches. Production in the Control field was 195 bushels per acre, where in-seasonal irrigation was 16.75 inches and pre-water 6.26 inches. Total irrigation for the Control field was 23.01 inches. Grall said “Soil water was low in the Control field following the 2012 crop, so I decided to pre-water to help make a crop, considering I have only 300 gallons per minute to irrigate 120 acres. The soil water was better in the 200-12 field.” In comparison, the “200-12” field produced 3 more bushels per acre than the Control with 7.95 less inches of irrigation. The “200-12” field’s net gain was $49.64 per acre with 7.95 inches less irrigation used compared to production from the Control field.

Brent Clark of Hartley County dedicated 244 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Clark strip tilled and planted 122 acres of corn on April 25 at 28,000 seeds per acre for his “200-12” field. Clark planted 122 acres on April 25 at 32,000 seeds per acre, also strip tilled, for his Control field. The “200-12” field produced a 219 bushel per acre corn yield. Irrigation totaled 17.26 inches. Production in the Control field was 239 bushels per acre, where irrigation totaled 20.21 inches. In comparison, the Control field produced 20 more bushels per acre than the “200-12” field with 2.95 more inches of irrigation. The “200-12” field’s net loss was $41.93 per acre with 2.95 inches less irrigation used compared to production from the “control” field. Clark said “The corn in the “200-12” field stressed for water more than I wanted when the pump was being repaired during five days at the critical growth stage during the first week in July.” Variable rate irrigation (VRI) was planned for the “200-12” field but not initiated due to the untimely pump repair.

Danny Krienke of Ochiltree County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Krienke strip tilled and planted 40 acres of corn on May 18 at 28,000 seeds per acre in the northeast quarter of the circle for his “200-12” field. He planted 40 acres in the north portion of the circle on May 18 at 28,000 seeds per acre, also strip tilled, for his Control field. The northwest 40 acres were planted at 36,000 seeds per acre on June 25 for another comparison. The corn hybrid was short season. The “200-12” field produced 231 bushels per acre. Irrigation totaled 19.04 inches. Production in the Control field was 240 bushels per acre. Seasonal irrigation totaled 25.15 inches. There was no pre-season irrigation. The Control field produced nine more bushels per acre than the “200-12” and irrigation was 6.11 inches more. The “200-12” field’s net loss was $2.72 per acre with 6.11 inches less irrigation used compared to production from the “control” field. Yield from the late planted field was 201 bushels per acre. Irrigation totaled 19.96 inches. The “200-12” field’s net gain was $149.45 per acre with 0.92 inches less irrigation compared to the late planted short season hybrid field.

Brian Bezner dedicated 222 acres in two fields irrigated by separate center pivot irrigation systems to the on-farm demonstration. Bezner strip tilled and planted 98 acres of corn on May 20 at 27,000 seeds per acre for his “200-12” field. He planted 124 acres on May 17 at 32,000 seeds per acre, also strip tilled, for his Control field. The “200-12” field produced 206 bushels per acre. Irrigation was 18.92 inches. Production in the Control field was 274 bushels per acre, where seasonal irrigation totaled 22.86 inches. There was no pre-season irrigation in either field. The “200-12” field’s net loss for corn grain is $256.72 per acre with 3.94 inches less irrigation used compared to production from the “control” field. Variable rate irrigation (VRI) was planned in conjunction with Syngenta but never initiated because separate soil moisture sensors did not indicate the need.

Richard Schad of Hansford County dedicated 165 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Schad strip tilled and planted 41 acres of corn on May 18 at 26,000 seeds per acre in the east half circle for his “200-12” field. Schad planted 124 acres on May 17 at 32,000 seeds per acre, also strip tilled, for his Control. The “200-12” field produced a 196 bushel per acre corn yield. Pre-Irrigation was 3.20 inches and in-season irrigation was 15.76, making a total of 18.96 inches. Production in the Control field was 230 bushels per acre, where pre-water was 2.80 inches, in-season irrigation was 14.59 and total irrigation was 17.39 inches. In comparison, the Control field produced 34 more bushels per acre than the “200-12” with 1.57 less inches of irrigation. The “200-12” field’s net loss was $121.65 per acre with 1.57 inches more irrigation used compared to production from the “control” field. Schad stated, “two timely rains came immediately following irrigation of the “200-12” fields, which could have reduced irrigation had I known. I am stretched for water, rotate irrigation between four center pivots and must keep the water moving”.

Frische Brothers of Moore County dedicated 107 acres in one field irrigated by the same center pivot to the on-farm demonstration. Frische Brothers strip tilled and planted 53 acres of corn in the west half circle on May 7 at 28,000 seeds per acre for their “200-12” field. They planted the east half, 53 acres, on May 7 at 28,000 seeds/acre, also strip tilled, for their Control field. The “200-12” field produced a 176 bushel per acre corn yield. Pre-Irrigation was 3.00 inches, in season 14.01 and the total 17.01 inches. Production in the Control field was 223 bushels per acre. Pre-water was 3.00 inches, seasonal 19.40 and total irrigation 22.40 inches. In comparison, the

“200-12” field produced 47 less bushels per acre than the Control and irrigation was 5.39 inches less. The “200-12” field’s net loss was $189.55 per acre with 5.39 inches less irrigation used compared to production from the Control field. Seasonal rainfall totaled only 4.85 inches. Frische Brothers is another demonstration field where rainfall was similar to previous years.

Phil Haaland of Hartley County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Haaland strip tilled and planted 4 acres from, 124 to 136 degrees in the circle, to corn on May 15 at 28,000 seeds per acre for his “200-12” field. He planted the remaining 116 acres in the circle on May 15 at 35,000 seeds per acre, also strip tilled, for his Control field. The “200-12” field produced a 191 bushel per acre corn yield. Irrigation totaled 19.04 inches of which 3.01 were pre-water. Production in the Control field was 287 bushels per acre. Seasonal irrigation totaled 27.35 inches. Pre-season irrigation was 4.93 inches making total irrigation 32.28 inches. In comparison, the “200-12” field produced 96 less bushels per acre than the Control and irrigation was 13.24 inches less. The “200-12” field’s net loss was $312.25 per acre with 13.24 inches less irrigation used compared to production from the Control field. Haaland said “The lack of beneficial rainfall here during the growing season, like in other areas, made continuous irrigation essential.”

David Ford of Hartley County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Ford strip tilled and planted 60 acres of corn in the east half circle on May 15 at 28,000 seeds per acre for his “200-12” field. He planted the west half circle 60 acres on May 15 at 28,000 seeds per acre, also strip tilled, for his Control field. The “200-12” field produced a 178 bushel per acre corn yield. Irrigation totaled 19.08 inches, of which 2.31 inches were pre-water. Production in the Control field was 191 bushels per acre. Seasonal irrigation was 19.97 inches, pre-water 2.10 and total irrigation 22.07 inches. The “200-12” field’s net loss was $42.54 per acre with 2.99 inches less irrigation used compared to production from the Control field. Ford said “Blowing was a problem early, especially on about 10 acres in the west Control half, where plant population was decreased. I could not get it stopped. Also, there was not enough timely rainfall to help when needed most.” Ford added “Reduced corn irrigation following a previous cotton crop is not a good farming practice.” The 2013 corn crop followed wheat.

Hartley Feeders (Dennis Buss) of Hartley County dedicated 120 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Hartley Feeders strip tilled and planted 60 acres of corn on May 18 at 28,000 seeds per acre in the north half of the circle for their “200-12” field. Hartley Feeders planted the north half 60 acres, also strip tilled, on May 19 at 28,000 seeds per acre for their Control field. The “200-12” field produced a 218 bushel per acre corn yield. Irrigation totaled 24.01 inches, of which pre-water was 1.56 inches. Production in the Control field was 176 bushels per acre, where seasonal irrigation was 20.35 inches, pre-water 0.72 and total irrigation 21.07 inches. In comparison, the “200-12” field produced 42 more bushels per acre than the Control with 2.94 inches more irrigation. The “200-12” field’s net gain was $181.78 per acre with 2.95 inches more irrigation used compared to production from the

Control field. Dennis Buss said “The soil probe really helped save water this summer. I was able to stop irrigation for the ‘200-12’ field a whole week, twice. Also, Better Harvest saved a lot of money in fertilizer and corn was less stressed,” said Buss. Buss added, “The ‘control’ field has an area of less productive soil that likely contributed to the reduced yield there, plus the crop used all irrigation and soil water available in July. A good rain then would have helped.”

Tommy Laubhan of Lipscomb County dedicated 122 acres in the same field irrigated by the same center pivot to the on-farm demonstration. Laubhan strip tilled and planted 61 acres of corn in the southeast quarter of the circle on May 12 at a seeding rate of 31,700 seeds per acre for his “200-12” field. He planted the northeast quarter, 61 acres, also strip tilled, on May 12 at 31,700 seeds per acre for his Control field. The “200-12” field produced a 189 bushel per acre corn yield. Irrigation totaled 21.07 inches. Production in the Control field was 191 bushels per acre. Seasonal irrigation totaled 21.40 inches. There was no pre-season irrigation. The “200-12” field’s net loss was $7.40 per acre with 0.33 inches less irrigation used compared to production from the “control” field. Laubhan lost his center pivot on June 3 in a storm that also dumped 4.05 inches of rainfall on his two fields. A new system was in place and running on June 15. Two hail storms in August damaged his crop resulting in 35 percent adjustment by insurance. Laubhan said “The NPGCD ‘200-12’ project provides good information and I am glad to participate.”

In 2013, the project reduced irrigation in the “200-12” fields by 179.63 acre-feet (3.14 inches). Table 8 and 9 show the water savings and results for the 2013 growing season.

Table 8: 2013 Water Savings for the Northern Panhandle of the Texas High Plains Initiative.

Producer	Field Size (ac)	Average Irrigation (in.)	Total Irrigation (ac-ft)	Avg.Water Savings (in.)	Water Savings (ac-ft)
Joe Reinart 200-12	27	12.55	28.24	15.71	35.35
Joe Reinart Control	65	28.26	153.08	-	-
Harold Grall 200-12	120	15.06	150.60	1.69	16.90
Harold Grall Control	120	23.01	230.10	-	-
Brent Clark 200-12	122	17.26	175.48	2.95	29.99
Brent Clark Control	122	20.21	205.47	-	-
Danny Krienke 200-12	40	19.04	63.47	6.11	20.37
Danny Krienke Control	40	25.15	83.83	-	-
Brian Bezner 200-12	98	18.92	154.51	3.94	32.18
Brian Bezner Control	124	22.86	236.22	-	-
Richard Schad 200-12	41	18.96	64.78	0.00	0.00
Richard Schad Control	124	17.39	179.70	-	-
Frische Brothers 200-12	53	17.01	75.13	5.39	23.81
Frische Brothers Control	53	22.40	98.93	-	-
Phil Haaland 200-12	4	19.04	6.35	13.24	4.41
Phil Haaland Control	116	32.28	312.04	-	-
David Ford 200-12	60	19.08	95.40	2.99	14.95
David Ford Control	60	22.07	110.35	-	-
Hartley Feeders 200-12	60	22.45	112.25	0.00	0.00
Hartley Feeders Control	60	21.06	105.30	-	-
Tommy Laubhan 200-12	61	21.07	107.11	0.33	1.68
Tommy Laubhan Control	61	21.40	108.78	-	-
200-12 Total	**686**	**18.08**	**1033.30**	**3.14**	**179.63**
Control Total	**945**	**23.16**	**1823.80**	**-**	**-**

Notes: All water savings is based on the control field for each producer.

Table 9: 2014 Results for the Northern Panhandle of the Texas High Plains Initiative.

Producer	Yield (bu/ac)	Yield Per Ac-In of Irrigation (bu/ac-in)	Net Return ($/ac)	Net Return Per Ac-In of Irrigation ($)	Net Gain ($/ac)
Joe Reinart 200-12	200	15.94	$ 660.17	$ 52.60	$ (18.14)
Joe Reinart Control	238	8.42	$ 678.30	$ 24.00	-
Harold Grall 200-12	198	13.15	$ 625.42	$ 41.53	$ 49.64
Harold Grall Control	195	8.47	$ 575.78	$ 25.02	-
Brent Clark 200-12	219	12.69	$ 694.29	$ 40.23	$ (41.93)
Brent Clark Control	239	11.83	$ 736.22	$ 36.43	-
Danny Krienke 200-12	231	12.13	$ 740.03	$ 38.87	$ (2.72)
Danny Krienke Control	240	9.54	$ 742.81	$ 29.54	-
Brian Bezner 200-12	206	10.89	$ 629.67	$ 33.28	$ (256.72)
Brian Bezner Control	274	11.99	$ 886.38	$ 38.77	-
Richard Schad 200-12	196	10.34	$ 590.10	$ 31.12	$ (121.65)
Richard Schad Control	230	13.23	$ 711.73	$ 40.93	-
Frische Brothers 200-12	176	10.35	$ 489.97	$ 28.80	$ (189.55)
Frische Brothers Control	223	9.96	$ 679.53	$ 30.34	-
Phil Haaland 200-12	191	10.03	$ 548.43	$ 28.80	$ (312.25)
Phil Haaland Control	287	8.89	$ 860.68	$ 26.66	-
David Ford 200-12	178	9.33	$ 485.89	$ 25.47	$ (42.54)
David Ford Control	191	8.65	$ 528.43	$ 23.94	-
Hartley Feeders 200-12	218	9.71	$ 644.95	$ 28.73	$ 181.78
Hartley Feeders Control	176	8.36	$ 463.24	$ 22.00	-
Tommy Laubhan 200-12	189	8.97	$ 493.63	$ 23.43	$ (7.40)
Tommy Laubhan Control	191	8.93	$ 501.03	$ 23.41	-
200-12 Average	**200**	**11.23**	**$ 600.23**	**$ 33.90**	**$ (48.54)**
Control Average	**226**	**9.84**	**$ 669.47**	**$ 29.19**	

2014 Crop Season

In 2014, ten cooperating producers dedicated twenty demonstration fields encompassing 1471 acres. All 1471 acres dedicated to the project were harvested for corn grain. Corn yields were 200 bushels per acre or more in seven "200-12" fields. Average yield in the ten fields was 198 bushels per acre. Irrigation averaged 17.59 inches. Pre-water was used in seven "200-12" fields. Average pre-water was 1.99 inches. Production averaged 11.83 bushels (662 lbs) per inch of irrigation. Average Irrigation, rainfall plus net soil water totaled 28.46 inches. Production averaged 215 bushels per acre in ten "control" fields. Average Irrigation was 20.12 inches. Production was 10.97 bushels (614 lbs) per inch of irrigation. Irrigation, rainfall and net soil water averaged 30.40 inches. No pre-water was applied in 4 of the 22 fields.

Harold Grall of Moore County dedicated 240 acres to the on-farm demonstration in two separate fields irrigated by different center pivots. Grall strip tilled and planted 120 acres of corn on June 4 at 28,000 seeds per acre for his "200-12" field. Grall planted 120 acres, also strip tilled, on June 12 at 28,000 seeds per acre for his "control" field. The "200-12" field produced 201 bushels per acre. Irrigation totaled 12.96 inches, that includes 1.02 inches of pre-water. Production in the "control" field was 222 bushels per acre, where in-season irrigation was 17.10 inches, pre-water 3.64 inches and total irrigation for the "control" field was 20.74 inches. Grall says "he thinks soil water was low in the "200-12" field following the 2013 crop, so he decided to pre-water to improve germination. In comparison, the "control" field produced 21 more bushels per acre than the “200-12” with 7.78 additional inches of irrigation. Net return from each inch of irrigation was $31.58 from the “200-12” field compared to $20.59 from the “control” field. The “control” field’s net gain was $17.86 per acre with 7.78 inches additional irrigation used compared to production from the “200-12” field. Net return from the additional 7.78 inches of irrigation applied to the “control” field is $2.29 per inch. Plants in the “200-12” field were damaged by hail in mid-July at the seven leaf stage, but recovered to make a good corn yield.

Danny Krienke of Ochiltree County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Krienke strip tilled and planted 60 acres of corn on June 16 at 26,000 seeds per acre in the northeast quarter of the circle for his “200-12” field. He planted 60 acres in the northwest quarter of the circle on June 16 at 28,000 seeds per acre, also strip tilled, for his “control” field. The “200-12” field produced 217 bushels per acre. Irrigation totaled 14.42 inches. No pre-water was applied. Production in the “control” field was 219 bushels per acre. Seasonal irrigation totaled 14.96 inches. Pre-season irrigation was 1.10 inches making total irrigation 16.06. The “control” field produced two more bushels per acre than the “200-12” and irrigation was 1.64 inches more. Net return from the “200-12” field was $455.90 compared to $444.70 from the “control”. Net return from each inch of irrigation was $31.62 from the “200-12” field compared to $27.69 from the “control” field. The “200-12” field’s net gain was $11.20 per acre with 1.64 inches less irrigation used compared to production from the “control” field.

David Ford of Hartley County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Ford strip tilled and planted 60 acres of corn in the east half circle on May 29 at 30,000 seeds per acre for his “200-12” field. He planted the west half circle 60 acres on May 29 at 30,000 seeds per acre, also strip tilled, for his “control” field. The “200-12” field produced a 206 bushel per acre corn yield. Irrigation totaled 14.86 inches, of which 2.04 inches was pre-water. Production in the “control” field was 199 bushels per acre. Seasonal irrigation was 11.31 inches, pre-water 2.54 and total irrigation 13.85 inches. The “200-12” field’s net gain was $13.10 per acre with 1.01 inches more irrigation used compared to production from the “control” field. Net gain from the “200-12” field was $405.43 per acre compared to $390.53 from the “control”. Net return from each inch of irrigation was $27.28 for the “200-12” field compared to $28.20 for the “control”. The 2014 corn crop followed corn.

Brian Bezner dedicated 238 acres in two fields irrigated by separate center pivot irrigation systems to the on-farm demonstration. Bezner strip tilled and planted 110 acres of corn on May 21 at 27,000 seeds per acre for his “200-12” field. He planted 128 acres on May 21 at 32,000 seeds per acre, also strip tilled, for his “control” field. The “200-12” field produced 168 bushels per acre. Irrigation was 12.25 inches that includes 1.28 inches of pre-water. Leaves on the plants in the “200-12” field were shredded and shattered by hail June 25 at the seven leaf stage. Production in the “control” field was 275 bushels per acre, where irrigation totaled 21.88 inches, including 1.17 inches of pre-water. Net return from the “200-12” field is $299.72 compared to $527.43 from the “control”. Net return from each inch of irrigation is $24.47 for the “200-12” field compared to $24.10 from the “control” field. The “control” field’s net gain is $227.71 per acre with 9.63 inches more irrigation used compared to production from the “200-12” field. Plant hail damage followed by inadequate water to help recover in July significantly limited corn yield in the “200-12” field.

Joe Reinart of Sherman County dedicated 102 acres to the on-farm demonstration in two separate fields irrigated by different center pivot systems. Reinart strip tilled and planted 27 acres of corn at 32,000 seeds per acre on June 4 for his “200-12” field. He strip tilled and planted 75 acres at 32,000 seeds per acre on April 25 for his “control” field. The “200-12” field produced 177 bushels per acre. Irrigation totaled 14.83 inches. Corn followed cotton in the “200-12” field. There was no beginning soil moisture and it was difficult to establish a good soil water profile. Production in the “control” field was 255 bushels per acre, where seasonal irrigation was 21.63 and pre-water 2.85 inches to establish a total of 24.48 inches. Net return was $312.43 per acre from the “200-12” field compared to $487.52 from the “control”. The “control” field’s net gain was $175.09 per acre with 9.65 inches more irrigation used compared to production from the “200-12” field. Net return from each inch of irrigation was $21.06 for the “200-12” field compared to $22.53 for the “control”. Reinart stated, “I think stalk issues in the “200-12” field cost us a few bushels per acre. Where we had Ch198-00 in other fields, other hybrids were out-yielding Ch198-00 by about 10 bushels per acre. Still, a good outcome for a year that started so poorly, especially following cotton.” Reinart also said, “We will continue to plant early and late corn on lots of circles using the strategies learned from the “200-12” project. Splitting planting dates for better water use has become a must on our farm.”

Brent Clark of Hartley County dedicated 122 acres in one field irrigated by the same center pivot to the on-farm demonstration. Clark strip tilled and planted 61 acres of corn in the east half of the circle on April 29 at 27,000 seeds per acre for his “200-12” field. Clark planted 61 acres in the west half of the circle on April 29 at 27,000 seeds per acre, also strip tilled, for his “control” field. The “200-12” field produced a 223 bushel per acre corn yield. Irrigation totaled 19.59 inches. Production in the “control” field was 227 bushels per acre, where irrigation totaled 19.01 inches. In comparison, the “control” field produced 4 more bushels per acre than the ““200-12”” field with 0.58 inches less irrigation. Net return from the “control” field was $455.49 per acre compared to $440.45 from the “200-12”. The “control” field’s net gain was $15.04 per acre with 0.58 inches less irrigation used compared to production from the “200-12” field. Net return from each inch of irrigation was $23.96 from the “control” field compared to $22.48 from the “200-12” field.

Hartley Feeders (Dennis Buss) of Hartley County dedicated 120 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Hartley Feeders strip tilled and planted 60 acres of corn on June 5 at 28,000 seeds per acre in the north half of the circle for their “200-12” field. Hartley Feeders planted the north half 60 acres of another circle, also strip tilled, on June 6 at 28,000 seeds per acre for their “control” field. The “200-12” field produced a 192 bushel per acre corn yield. Irrigation totaled 18.07 inches, of which pre-water was 1.82 inches.

Production in the “control” field was 171 bushels per acre, where seasonal irrigation was 12.93 inches, pre-water 3.08 and total irrigation 16.01 inches. In comparison, the “200-12” field produced 21 more bushels per acre than the “control” with 2.06 inches more irrigation. The “200-12” field’s net gain was $50.18 per acre with 2.06 inches more irrigation used compared to production from the “control” field. Net return was $353.89 per acre for the “200-12” field compared to $303.71 from the “control”. Net return from each inch of irrigation was $19.65 for the “200-12” field compared to $18.97 from the “control” field. Net return from the additional 2.06 inches of irrigation for the “200-12” field is $24.36. Dennis Buss said, “The soil probe really helped manage and save water. I was able to periodically stop irrigation when the soil profile had good water levels. Also, “Better Harvest saved a lot of money in fertilizer and corn was less stressed. The ‘control’ field has an area of less productive soil that likely contributed to the reduced yield there. More beneficial rain would have helped”.

Phil Haaland of Hartley County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Haaland strip tilled and planted 2.7 acres from, 284 to 292 degrees in the circle, to corn on May 19 at 30,000 seeds per acre for his “200-12” field. He planted the remaining 117 acres in the circle on May 19 at 37,000 seeds per acre, also strip tilled, for his “control” field. The “200-12” field produced a 219 bushel per acre corn yield. Irrigation totaled 21.89 inches, of which 3.00 was pre-water. Production in the “control” field was 266 bushels per acre. Seasonal irrigation totaled 28.72 inches. Pre-season irrigation was 3.00 inches making total irrigation 31.72 inches. In comparison, the “200-12” field produced 47 less bushels per acre than the “control” and irrigation was 9.83 inches less. Net return from the “200-12” field was $403.97 per acre compared to $481.12 from the “control” field. The “200-12” field’s net loss was $76.15 per acre with 9.83 inches less irrigation used compared to production from the “control” field. Net return from each inch of irrigation was $18.45 for the “200-12” field compared to $15.16 from the “control”. Net return from the additional 9.83 inches of irrigation applied to the “control” field is $7.74 per inch.

Tommy Laubhan of Lipscomb County dedicated 124 acres in the same field irrigated by the same center pivot to the on-farm demonstration. Laubhan strip tilled and planted 62 acres of corn in the south half circle May 7 at a 32,000 seeding rate per acre for his “200-12” field. He planted the north half circle 62 acres, also strip tilled, on May 7 at 32,000 seeds per acre for his “control” field. The “200-12” field produced a 181 bushel per acre corn yield. Irrigation totaled 21.28 inches. Production in the “control” field was 192 bushels per acre. Seasonal irrigation totaled 22.84 inches. Pre-season irrigation was 2.12 inches in each field and is included in total irrigation. The “control” field’s net gain is $22.24 per acre with 1.56 inches additional irrigation used compared to production from the “200-12” field. Net return for the “200-12” field is $265.90 compared to $288.14 from the “control”. Net return from each inch of irrigation is $12.49 for the “200-12” field compared to $12.61 for the “control”. Net return from the additional 1.56 inches of irrigation applied to the “control” field is $14.25. Laubhan says, “P1266AM corn hybrid did not handle iron chlorosis as well as needed and it will go. There are hybrids that have done better here. Soil in the north half circle ‘control’ field appears to have better overall potential crop production than that in the south half circle ‘200-12’ field”.

Richard Schad of Hansford County dedicated 165 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Schad strip tilled and planted 41 acres of corn May 20 at 27,400 seeds per acre in the west half circle for his “200-12” field. Schad planted 124 acres on May 20 at 32,200 seeds per acre, also strip tilled, for his “control”. Both the “200-12” and “control” fields were damaged by a wind storm June 30 at the 7 to 8 leaf growth stage. Shad estimates 10 to 20 percent green snap damage. A bad hailstorm hit both fields July 16 at 10 leaves shredding leaves and damaging stalks. Shad said he had held water back on the “200-12” field prior to the storms, therefore the plants were not quite as far along. He said, “Ch214-00DGVT2 is a tough hybrid with great ear flex that recovered to produce a good yield following the storm damages.” He said, “The ‘control’ field was damaged more than he expected and yielded far less.” The “200-12” field produced a 199 bushel per acre corn yield. Pre-Irrigation was 8.65 inches and in season 17.11 making a total of 25.76 inches. Production in the “control” field was 126 bushels per acre where pre-water was 4.26 inches, in season 10.34 and total irrigation at 14.60 inches. In comparison, the “200-12” field produced 73 more bushels per acre than the “control” with 11.16 more inches of irrigation. The “200-12” field’s net gain was $168.77 per acre with 11.16 inches more irrigation used compared to production from the “control” field. Net return was $333.38 for the “200-12” field compared to $164.61 for the “control”. Net return from each inch of irrigation is $12.94 from the “200-12” field compared to $11.27 from the “control”.

In 2014, the project reduced irrigation in the “200-12” fields by 206.51 acre-feet (4.10 inches). Table 10 and 11 show the water savings and results for the 2014 growing season.

Table 10: 2014 Water Savings for the Northern Panhandle of the Texas High Plains Initiative.

Producer	Field Size (ac)	Average Irrigation (in.)	Total Irrigation (ac-ft)	Avg. Water Savings (in.)	Water Savings (ac-ft)
Harold Grall 200-12	120	12.96	129.60	7.78	77.80
Harold Grall Control	120	20.74	207.40	-	-
Danny Krienke 200-12	60	14.42	72.10	1.64	8.20
Danny Krienke Control	60	16.06	80.30	-	-
David Ford 200-12	60	14.86	74.30	0.00	0.00
David Ford Control	60	13.85	69.25	-	-
Brian Bezner 200-12	110	12.25	112.29	9.63	88.28
Brian Bezner Control	128	21.88	233.39	-	-
Joe Reinart 200-12	27	14.83	33.37	9.65	21.71
Joe Reinart Control	75	24.48	153.00	-	-
Brent Clark 200-12	61	19.59	99.58	0.00	0.00
Brent Clark Control	61	19.01	96.63	-	-
Hartley Feeders 200-12	60	18.07	90.35	0.00	0.00
Hartley Feeders Control	60	16.01	80.05	-	-
Phil Haaland 200-12	3	21.89	5.47	9.83	2.46
Phil Haaland Control	117	31.72	309.27	-	-
Tommy Laubhan 200-12	62	21.28	109.95	1.56	8.06
Tommy Laubhan Control	62	22.84	118.01	-	-
Richard Schad 200-12	41	25.76	88.01	0.00	0.00
Richard Schad Control	124	14.60	150.87	-	-
200-12 Total	**604**	**16.19**	**815.02**	**4.10**	**206.51**
Control Total	**867**	**20.74**	**1498.16**	**-**	**-**
Notes:	All water savings is based on the control field for each producer.				

Table 11: 2014 Results for the Northern Panhandle of the Texas High Plains Initiative.

Producer	Yield (bu/ac)	Yield Per Ac-In of Irrigation (bu/ac-in)	Net Return ($/ac)	Net Return Per Ac-In of Irrigation ($)	Net Gain ($/ac)
Harold Grall 200-12	201	15.51	$ 409.25	$ 31.58	$ (17.86)
Harold Grall Control	222	10.70	$ 427.11	$ 20.59	-
Danny Krienke 200-12	217	15.05	$ 455.90	$ 31.62	$ 11.20
Danny Krienke Control	219	13.64	$ 444.70	$ 27.69	-
David Ford 200-12	206	13.86	$ 405.43	$ 27.28	$ 14.90
David Ford Control	199	14.37	$ 390.53	$ 28.20	-
Brian Bezner 200-12	168	13.71	$ 299.72	$ 24.47	$(227.71)
Brian Bezner Control	275	12.57	$ 527.43	$ 24.11	-
Joe Reinart 200-12	177	11.94	$ 312.43	$ 21.07	$(175.09)
Joe Reinart Control	255	10.42	$ 487.52	$ 19.91	-
Brent Clark 200-12	223	11.38	$ 440.45	$ 22.48	$ (15.04)
Brent Clark Control	227	11.94	$ 455.49	$ 23.96	-
Hartley Feeders 200-12	192	10.63	$ 353.89	$ 19.58	$ 50.18
Hartley Feeders Control	171	10.68	$ 303.71	$ 18.97	-
Phil Haaland 200-12	219	10.00	$ 403.97	$ 18.45	$ (77.15)
Phil Haaland Control	266	8.39	$ 481.12	$ 15.17	-
Tommy Laubhan 200-12	181	8.51	$ 265.90	$ 12.50	$ (22.24)
Tommy Laubhan Control	192	8.41	$ 288.14	$ 12.62	-
Richard Schad 200-12	199	7.73	$ 333.38	$ 12.94	$ 168.77
Richard Schad Control	126	8.63	$ 164.61	$ 11.27	-
200-12 Average	**198**	**11.83**	**$ 368.03**	**$ 22.20**	**$ (38.00)**
Control Average	**215**	**10.97**	**$ 397.04**	**$ 20.25**	**-**

South Plains

Each year's results are highly influenced by weather, irrigation water availability, input and commodity prices, anticipated prices for crops, and previous years' experiences. The amount and distribution of precipitation and irrigation water to buffer inadequate precipitation are key drivers of production and profit. The tables below describe the data that was collected.

Producer sites can be categorized according to type of farming system insofar as a site represents a conceptual farm. The system categories in use from 2012 to 2014 were cotton monoculture (entire site in cotton only), corn monoculture (entire site in corn only), grain sorghum monoculture, and multi-crop with sorghum/ cotton, cotton/ millet, wheat/ hay grazer/cotton, wheat/hay grazer/corn, alfalfa/hay grazer, and silage/alfalfa. Tables 12, 13 and 14 provide the descriptions of the cropping systems for 2012, 2013, and 2014, respectively.

Table 12: Descriptions of 2012 Cropping Systems for the South Plains Portion of the Texas High Plains Initiative.

Site	Cropping System	Irrigation Type
50	Cotton Monoculture	Low Elevation Spray Application
51	Cotton Monoculture	Subsurface Drip
52	Cotton Monoculture	Low Elevation Spray Application
53	Cotton Monoculture	Subsurface Drip
54	Cotton Monoculture	Subsurface Drip
55	Multi-crop, cotton/sorghum	Low Elevation Spray Application
56	Corn Monoculture	Low Elevation Spray Application
57	Corn Monoculture	Low Elevation Spray Application
21	Multi-crop, wheat/hay grazer/alfalfa	Low Elevation Spray Application
31	Multi-crop, cotton/millet	Low Energy Precision Application

Table 13: Descriptions of 2013 Cropping Systems for the South Plains Portion of the Texas High Plains Initiative.

Site	Cropping System	Irrigation Type
50	Grain Sorghum Monoculture	Low Elevation Spray Application
51	Grain Sorghum Monoculture	Subsurface Drip
52	Grain Sorghum Monoculture	Low Elevation Spray Application
53	Grain Sorghum Monoculture	Subsurface Drip
54	Grain Sorghum Monoculture	Subsurface Drip
56	Corn Monoculture	Low Elevation Spray Application
57	Corn Monoculture	Low Elevation Spray Application
58	Multi-crop, wheat/alfalfa	Low Elevation Spray Application
59	Multi-crop, corn silage/alfalfa	Subsurface Drip
60	Cotton Monoculture	Low Elevation Spray Application
21	Multi-crop, wheat/hay grazer/alfalfa	Low Elevation Spray Application
31	Multi-crop, cotton/millet	Low Energy Precision Application
35	Cotton Monoculture	Subsurface Drip
35	Corn Monoculture	Subsurface Drip
35	Grain Sorghum Monoculture	Subsurface Drip

Table 14: Descriptions of 2014 Cropping Systems for the South Plains Portion of the Texas High Plains Initiative.

Site	Cropping System	Irrigation Type
50	Cotton Monoculture	Low Elevation Spray Application
51	Cotton Monoculture	Subsurface Drip
52	Cotton Monoculture	Low Elevation Spray Application
53	Cotton Monoculture	Subsurface Drip
54	Cotton Monoculture	Subsurface Drip
56	Corn Monoculture	Low Elevation Spray Application
57	Corn Monoculture	Low Elevation Spray Application
58	Multi-crop, hay grazer/alfalfa	Low Elevation Spray Application
59	Alfalfa Monoculture	Subsurface Drip
60	Grain Sorghum Monoculture	Low Elevation Spray Application
21	Multi-crop, cotton/wheat/hay grazer	Low Elevation Spray Application
31	Multi-crop, cotton/millet	Low Energy Precision Application
35	Cotton Monoculture	Subsurface Drip
35	Corn Monoculture	Subsurface Drip
35	Grain Sorghum Monoculture	Subsurface Drip

Tables 15, 16 and 17 show which crops were planted for each site in 2012, 2013, and 2014, respectively. In 2012, producers planted cotton, corn grain, corn silage, grain sorghum, millet, wheat, hay grazer, and alfalfa. Site 55 was terminated after Year 1. In 2013, crop insurance played a role in the producers' ability to recoup initial input costs where crops failed. Cotton crops failed due to inclement weather and were replanted to grain sorghum at sites 50, 51, 52, and 53. In addition, cotton on site 60 failed and was replanted to grain sorghum in 2014.

Table 15: 2012 Crop Acres by Site for the South Plains Portion of the Texas High Plains Initiative.

Site	Cotton (ac)	Corn Grain (ac)	Corn Silage (ac)	Grain Sorghum (ac)	Millet (ac)	Wheat (ac)	Hay Grazer (ac)
50 – Pivot	121						
51 – 80" Drip	46						
52 – Pivot	135						
53 – 40" Drip	50						
54 – 80" Drip	85						
55 – Pivot	60			60			
56 – Pivot			80				
57 – Pivot		124					
21 – Pivot	61					61	61
31 – Pivot	66				55		
Total	**624**	**124**	**80**	**60**	**55**	**61**	**61**

Table 16: 2013 Crop Acres by Site for the South Plains Portion of the Texas High Plains Initiative.

Site	Cotton (ac)	Corn Grain (ac)	Corn Silage (ac)	Grain Sorghum (ac)	Millet (ac)	Wheat (ac)	Hay Grazer (ac)	Alfalfa (ac)
50 – Pivot	122*			122				
51 - 80" Drip	46*			46				
52 – Pivot	135*			135				
53 - 40" Drip	50*			50				
54 - 80" Drip	85							
56 – Pivot			45					
57 – Pivot		115						
58 – Pivot						60		60
59 - 80" Drip			75					76
60 – Pivot	60							
21 – Pivot		61				61	61	
31 – Pivot	67				67			
35 – Drip	92							
35 – Drip		54						
35 – Drip				75				
Total	**304**	**230**	**120**	**261**	**67**	**121**	**121**	**136**

***Crop acres were planted then failed due to inclement weather**

Table 17: 2014 Crop Acres by Site for the South Plains Portion of the Texas High Plains Initiative.

Site	Cotton (ac)	Corn Grain (ac)	Corn Silage (ac)	Grain Sorghum (ac)	Millet (ac)	Wheat (ac)	Hay Grazer (ac)	Alfalfa (ac)
50 – Pivot	121							
51 - 80" Drip	45.7							
52 – Pivot	135							
53 - 40" Drip	50							
54 - 80" Drip	85							
56 – Pivot			80					
57 – Pivot		115						
58 – Pivot							60 **	60
59 - 80" Drip								93
60 – Pivot	59.5*			60				
21 – Pivot	60.6					61.3	61.3	
31 – Pivot	66*			120				
35 – Drip	80							
35 – Drip		75						
35 – Drip				75				
Total	**577**	**190**	**80**	**135**		**61.3**	**121.3**	**153**

*Crop acres were planted then failed ** Triticale Hay

Tables 18, 19, and 20 provide summaries of water use efficiency with regard to yield and profitability for each site over the period 2012 to 2014. These tables show applied irrigation, crop yield, yield per acre inch of water, revenue per acre inch, and gross margin per acre inch. Gross Margin was used as the measure of profitability. See section titled “Definition of Terms” for explanation of key economic variables.

The average irrigation applied ranged from 8 to 23.4 inches over the three years of the project and was greater for millet, wheat/hay grazer, and corn. Gross margin per acre inch ranged from

-$15.90 to $80.50. Gross margin/acre inch was the highest for alfalfa. Corn, corn silage, cotton, and grain sorghum had similar returns.

Table 18: Summary of Water Use Efficiency with Regard to Yield and Profitability for the South Plains Portion of the Texas High Plains Initiative, 2012.

Site	Crop	Applied Irrigation (in)	Yield	Yield Per Ac-In	Revenue Per Ac-In	Gross Margin Per Ac In
50 – Pivot	Cotton	14.57	547 lbs	37.5 lbs	$ 40.51	$ 7.78
51 – 80" Drip	Cotton	9.30	877 lbs	94.3 lbs	$ 102.17	$ 19.15
52 – Pivot	Cotton	19.00	1181 lbs	62.2 lbs	$ 68.49	$ 27.13
53 – 40" Drip	Cotton	17.75	1312 lbs	73.9 lbs	$ 81.45	$ 39.24
54 – 80" Drip	Cotton	15.00	1036 lbs	69.1 lbs	$ 76.10	$ 31.58
55 – Pivot	Cotton	19.10	1353 lbs	70.8 lbs	$ 78.03	$ 34.48
55 – Pivot	Grain Sorghum	22.50	137 bu	6.10 bu	$ 75.07	$ 56.34
56 – Pivot	Corn Silage	16.25	18 tons	1.11 tons	$ 48.18	$ 16.71
57 – Pivot	Corn Grain	20.85	153 bu	7.34 bu	$ 69.68	$ 38.04
21 – Pivot	Wheat	7.60	23.6 bu	3.1 bu	-	-
21 – Pivot	Hay Grazer	15.60	4.6 bales	0.30 bales	-	-
21 – Pivot	Wheat/HG	23.20	-	-	$ 31.75	$ 7.59
21 – Pivot	Cotton	15.60	1540 lbs	98.7 lbs	$ 108.78	$ 60.46
31 – Pivot	Cotton	19.00	1188 lbs	62.5 lbs	$ 71.72	$ 26.19
31 – Pivot	Millet	22.00	2014 lbs	91.5 lbs	$ 24.54	$ 3.54

Table 19: Summary of Water Use Efficiency with Regard to Yield and Profitability for the South Plains Portion of the Texas High Plains Initiative, 2013.

Site	Crop	Applied Irrigation (in)	Yield	Yield Per Ac-In	Revenue Per Ac-In	Gross Margin Per Ac-In
50 – Pivot	Cotton	7.30	Crop Insurance		$ 50.45	$ 11.86
	Grain Sorghum	8.50	85.9 bu	10.08 bu	$ 47.97	$ 21.72
51 - 80" Drip	Cotton	7.75	Crop Insurance		$ 47.40	$ (2.08)
	Grain Sorghum	7.50	120.6 bu	16.10 bu	$ 76.92	$ 45.95
52 - Pivot	Cotton	7.30	Crop Insurance		$ 54.64	$ 10.91
	Grain Sorghum	7.90	127.9 bu	16.18 bu	$ 77.04	$ 39.32
53 - 40" Drip	Cotton	6.80	Crop Insurance		$ 53.95	$ 12.42
	Grain Sorghum	7.40	151.4 bu	20.45 bu	$ 97.37	$ 55.84
54 - 80" Drip	Cotton	8.80	1127 lbs	128.07 lbs	$ 126.98	$ 56.92
56 – Pivot	Corn Silage	14.60	20 tons	1.37 tons	$ 61.64	$ 32.22
57 – Pivot	Corn Grain	17.80	172.5 bu	9.69 bu	$ 48.46	$ 16.39
58 – Pivot	Wheat Hay	9.10	1.3 tons	0.14 tons	$ 8.57	$(15.29)
58 – Pivot	Alfalfa	18.30	7.1 tons	0.39 tons	$ 96.99	$ 73.03
59 - 80" Drip	Corn Silage	15.50	27.7 tons	1.79 tons	$ 80.42	$ 48.10
59 - 80" Drip	Alfalfa	23.10	9.5 tons	0.41 tons	$ 102.81	$ 70.13
60 – Pivot	Cotton	11.60	1533 lbs	132.16 lbs	$ 130.33	$ 58.45
21 – Pivot	Corn Grain	20.70	239 bu	11.55 bu	$ 78.51	$ 41.28
21 – Pivot	Wheat	15.50	24.9 bu	1.61 bu	-	-
21 – Pivot	Hay Grazer	3.60	4.3 bales	1.19 bales	-	-
21 – Pivot	Wheat/HG	19.10	-	-	$ 22.38	$ (0.70)
31 – Pivot	Cotton	14.10	1364 lbs	96.74 lbs	$ 95.36	$ 40.56
31 – Pivot	Millet	24.80	3384 lbs	136.45 lbs	$ 53.06	$ 26.42
35 – Drip	Cotton	18.20	1891 lbs	103.89 lbs	$ 93.60	$ 36.90
35 – Drip	Grain Sorghum	18.20	157.5 bu	8.65 bu	$ 41.17	$ 9.64
35 – Drip	Corn	25.70	257.8 bu	10.03 bu	$ 56.37	$ 21.92

Table 20: Summary of Water Use Efficiency with Regard to Yield and Profitability for the South Plains Portion of the Texas High Plains Initiative, 2014.

Site	Crop	Applied Irrigation (in)	Yield	Yield Per Ac In	Revenue Per Ac-In	Gross Margin Per Ac-In
50 - Pivot	Cotton	8.35	1283 lbs	153.6 lbs	$ 121.05	$ 28.49
51 - 80" Drip	Cotton	9.40	1507 lbs	160.3 lbs	$ 126.97	$ 44.93
52 - Pivot	Cotton	15.50	997 lbs	64.3 lbs	$ 50.90	$ (9.45)
53 - 40" Drip	Cotton	8.44	1368 lbs	162 lbs	$ 128.34	$ 37.33
54 - 80" Drip	Cotton	8.30	1337 lbs	161 lbs	$ 127.55	$ 32.86
56 - Pivot	Corn Silage	14.40	24.7 tons	1.72 tons	$ 52.42	$ 19.68
57 - Pivot	Corn Silage	11.54	18.9 tons	1.64 tons	$ 50.12	$ 10.88
58 - Pivot	Triticale Hay	12.60	1.78 tons	0.14 tons	$ 19.78	$ (6.38)
58 - Pivot	Alfalfa	20.70	7.10 tons	0.34 tons	$ 90.55	$ 59.20
59 - 80" Drip	Alfalfa	15.10	10.34 tons	0.68 tons	$ 180.78	$ 123.86
60 - Pivot	Grain Sorghum	9.80	87.46 bu	8.90 bu	$ 27.63	$ (7.74)
21 - Pivot	Cotton	10.40	1156 lbs	111.2 lbs	$ 88.01	$ 7.12
21 - Pivot	Wheat	10.50	23.8 bu	2.274 bu	-	-
21 - Pivot	Hay Grazer	5.00	9.2 bales	1.84 bales	-	-
21 - Pivot	Wheat/HG	19.10	-	-	$ 60.97	$ 29.59
31 - Pivot	Cotton/Sorghum	18.00	125.0 bu	6.95 bu	$ 50.83	$ 6.92
31 - Pivot	Seed Sorghum	18.75	92.3 bu	4.93 bu	$ 96.51	$ 71.08
35 – Drip	Cotton	18.70	1233 lbs	65.9 lbs	$ 52.20	$ 0.90
35 – Drip	Grain Sorghum	8.30	127.0 bu	15.3 bu	$ 57.32	$ (6.49)
35 – Drip	Corn	15.90	158.0 bu	9.94 bu	$ 59.52	$ 15.34

Tables 21, 22 and 23 provide summaries of crop water demand and evapotranspiration for 2012, 2013, and 2014, respectively. These tables show applied irrigation, effective rainfall, total water, crop water demand, and the percentage of crop water demand from irrigation and total water.

Table 21: Summary of Crop Water Demand and Evapotranspiration for the South Plains Portion of the Texas High Plains Initiative, 2012.

Site	Crop	Applied Irrigation (in)	Rainfall 70% of Actual (in)	Total Water (in)	Crop Water Demand (in)	% CWD from Irrigation	% CWD from Total Water
50 – Pivot	Cotton	14.57	6.65	21.22	20.9	70%	102%
51 – 80” Drip	Cotton	9.30	6.09	15.39	19.4	48%	79%
52 – Pivot	Cotton	19.00	3.85	22.85	22.2	86%	103%
53 – 40” Drip	Cotton	17.75	3.85	21.60	22.4	79%	96%
54 – 80” Drip	Cotton	15.00	3.85	18.85	22.4	67%	84%
55 – Pivot	Cotton	19.10	3.50	22.60	20.0	96%	113%
55 – Pivot	Sorghum	22.50	3.43	25.93	26.2	86%	99%
56 – Pivot	Corn Silage	16.25	2.45	18.70	26.2	62%	71%
57 – Pivot	Corn Grain	20.85	2.80	23.65	28.0	74%	84%
21 – Pivot	Wheat	7.60	4.10	11.70	-	-	-
21 – Pivot	Hay Grazer	15.60	2.20	17.80	-	-	-
21 – Pivot	Cotton	15.60	4.40	20.00	23.6	66%	85%
31 – Pivot	Cotton	19.00	6.20	25.20	22.0	86%	115%
31 – Pivot	Millet	22.00	5.50	27.50	-	-	-

Table 22: Summary of Crop Water Demand and Evapotranspiration for the South Plains Portion of the Texas High Plains Initiative, 2013.

Site	Crop	Applied Irrigation (in)	Rainfall 70% of Actual (in)	Total Water (in)	Crop Water Demand (in)	% CWD from Irrigation	% CWD from Total Water
50 – Pivot	Sorghum	15.2	8.12	23.32	24.07	63%	97%
51 – 80" Drip	Sorghum	15.0	8.12	23.12	24.07	63%	97%
52 – Pivot	Sorghum	15.2	10.07	25.27	23.24	65%	109%
53 – 40" Drip	Sorghum	14.2	10.07	25.27	22.85	62%	106%
54 – 80" Drip	Cotton	8.8	12.55	21.35	21.11	42%	101%
56 – Pivot	Corn Silage	14.6	10.71	25.31	25.18	58%	101%
57 – Pivot	Corn	17.8	6.73	24.53	27.68	64%	89%
58 – Pivot	Wheat	9.1	10.94	20.04	-	-	-
58 – Pivot	Alfalfa	18.3	10.94	29.24	-	-	-
59 – Drip	Corn	15.5	10.94	26.44	33.73	46%	78%
59 – Drip	Alfalfa	23.1	10.94	34.01	-	-	-
60 – Pivot	Cotton	11.6	12.21	23.81	20.34	57%	117%
21 – Pivot	Hay Grazer	3.6	7.49	11.09	-	-	-
21 – Pivot	Wheat	15.5	7.49	22.99	-	-	-
21 – Pivot	Corn	20.7	7.49	28.19	36.88	56%	76%
31 – Pivot	Cotton	14.1	12.16	26.26	19.04	74%	138%
31 – Pivot	Millet	24.8	12.16	36.96	-	-	-
35 – Drip	Cotton	18.2	8.32	26.52	20.01	91%	133%
35 – Drip	Sorghum	18.2	8.32	26.52	27.54	66%	96%
35 – Drip	Corn	25.7	5.17	30.87	36.83	70%	84%

Table 23: Summary of Crop Water Demand and Evapotranspiration for the South Plains Portion of the Texas High Plains Initiative, 2014.

Site	Crop	Applied Irrigation (in)	Rainfall 70% of Actual (in)	Total Water (in)	Crop Water Demand (in)	% CWD from Irrigation	% CWD from Total Water
50 – Pivot	Cotton	8.35	15.69	24.04	18.09	86.7%	132.9%
51 – 80" Drip	Cotton	9.40	14.73	24.13	18.09	52.0%	133.4%
52 – Pivot	Cotton	15.55	19.37	34.92	18.88	82.3%	185.0%
53 – 40" Drip	Cotton	8.44	19.37	27.81	18.88	44.7%	147.3%
54 – 80" Drip	Cotton	8.30	19.37	27.67	18.88	44.0%	146.6%
56 – Pivot	Corn Silage	14.40	10.73	25.13	22.38	64.3%	112.3%
57 – Pivot	Corn Silage	11.54	10.13	21.67	18.7	61.7%	115.9%
58 – Pivot	Triticale Hay	12.60					
58 – Pivot	Alfalfa	20.70			-	-	-
59 – Drip	Alfalfa	15.10			-	-	-
60 – Pivot	Sorghum	9.80	8.27	18.07	22.04	44.5%	82.0%
21 – Pivot	Cotton	10.40	18.59	28.99	19.32	53.8%	150.1%
21 – Pivot	Wheat	10.50			-	-	-
21 – Pivot	Hay Grazer	5.00			-	-	-
31 – Pivot	Sorghum	18.00					
31 – Pivot	Sorghum	18.75					
35 – Drip	Cotton	18.70	18.59	37.29	19.38	95.5%	192.4%
35 – Drip	Sorghum	8.30	13.19	21.49	22.41	37.0%	95.9%
35 – Drip	Corn	15.90	14.35	30.25	32.06	49.6%	94.4%

Comparison of Pivot and Subsurface Drip Sites

Two participating producers had pivot and subsurface drip sites which allowed for a comparison of each type of irrigation system under the same management. Sites 50 and 51 are pivot and 80" subsurface drip, respectively, located in Crosby County. Sites 52, 53, and 54 are pivot, 40" subsurface drip and 80" subsurface drip, respectively, located in Lamb County. Table 13 gives a summary of the water use efficiency for sites with pivot and subsurface drip systems. Based on the observations of the years 2012 – 2014, the drip sites appear to be more efficient with respect to production per inch of applied irrigation which is reflected in revenue and profitability (gross margin) per acre inch.

Sites 50 and 51

In 2012, a comparison of sites 50 and 51 indicated that the drip irrigated site (site 51) produced higher yields and yield per acre inch with less applied irrigation compared to the pivot site. The drip irrigated cotton yielded 94.3 lbs of lint per acre inch compared to 37.5 lbs of lint per acre inch for the pivot irrigated cotton. Revenue and gross margin per acre inch of applied irrigation was higher for the subsurface drip versus the pivot. Data from the moisture probe on the pivot site (see page 76 and 79) show that the early season irrigations were not moving water to the center of the crop row, reducing the effectiveness of the irrigations. The pivot was slowed down which allowed for better penetration of water in the soil profile, however, hot weather in August and a lack of stored soil moisture caused moisture levels to decline which effected yields. The moisture probe data on the drip site shows that soil moisture levels declined throughout July, but held above critical levels.

In 2013, sites 50 and 51 were initially planted to cotton; however, the cotton was lost due to weather and replanted to grain sorghum. The subsurface drip (site 51) had a higher yield with less applied irrigation. The drip irrigated sorghum yielded 16.10 bu per acre inch compared to 10.08 bu per acre inch for the pivot irrigated sorghum. Revenue and gross margin per acre inch of applied irrigation was higher for the drip site versus the pivot.

In 2014, sites 50 and 51 were similar in cotton lint production per acre inch with 154 and 160 lbs, respectively. Revenues per acre inch were also similar; however, gross margin per acre inch was significantly higher for the drip system, site 51. The lower gross margin for site 50 was associated with a higher cost of weed control under the pivot system. Weed control has become an issue in cotton production due to the appearance of glysophate resistant weeds. The higher weed control cost for site 50 appeared to be due to the difficulty in controlling resistant weeds.

Sites 52, 53, and 54

Sites 52, 53, and 54 represent a pivot, 40" subsurface drip and 80" subsurface drip, respectively. In 2012, the subsurface drip sites had higher yield per acre inch of applied irrigation, 73.9 lbs and 69.1 lbs on site 53 and 54, respectively, compared to the pivot site at 62.2 lbs per acre inch.

Revenue and gross margin per acre inch of applied irrigation was higher for the drip site versus the pivot. The 40” drip had a higher yield and yield per acre inch compared to the 80” drip.

In 2013, sites 52, 53, and 54 were initially planted to cotton, however, the cotton was lost due to weather on sites 52 and 53 and was replanted to grain sorghum. The subsurface drip (site 53) had a higher yield versus the pivot with slightly less applied irrigation. The drip irrigated sorghum yielded 20.45 bu per acre inch compared to 16.18 bu per acre inch for the pivot irrigated sorghum. Revenue and gross margin per acre inch of applied irrigation was higher for the drip site versus the pivot.

In 2014, sites 52, 53, and 54 were in cotton production and produced cotton lint per acre inch of 64, 162, and 161 lbs, respectively. The water used efficiency of the drip sites (53 & 54) was significantly greater than the pivot site (52). Almost twice as much irrigation was applied to the pivot site with lower resulting yield compared to the drip sites. Revenues per acre inch for the drip sites were greater than twice the pivot site at $128 compared to $51 for the pivot site. Gross margins for the pivot site were -$9.45 per acre inch compared to an average of $35.00 for the drip sites.

Table 24: Summary of Water Use Efficiency for Sites with Pivot and Subsurface Drip Systems.

Site	Crop	Applied Irrigation Inches	Yield	Yield Per Ac In	Revenue $/Ac In	Gross Margin $/Ac In
2012						
50 – Pivot	Cotton	14.57	547 lbs	37.5 lbs	40.51	7.78
51 – 80” Drip	Cotton	9.3	877 lbs	94.3 lbs	102.17	19.15
52 – Pivot	Cotton	19	1181 lbs	62.2 lbs	68.49	27.13
53 – 40” Drip	Cotton	17.75	1312 lbs	73.9 lbs	81.45	39.24
54 – 80” Drip	Cotton	15	1036 lbs	69.1 lbs	76.1	31.58
2013						
50 - Pivot	Grain Sorghum	8.5	85.9 bu	10.08 bu	47.97	21.72
51 - 80" Drip	Grain Sorghum	7.5	120.6 bu	16.10 bu	76.92	45.95
52 - Pivot	Grain Sorghum	7.9	127.9 bu	16.18 bu	77.04	39.32
53 - 40" Drip	Grain Sorghum	7.4	151.4 bu	20.45 bu	97.37	55.84
54 - 80" Drip	Cotton	8.8	1127 lbs	128.07 lbs	126.98	71.47
2014						
50 - Pivot	Cotton	8.35	1283 lbs	154 lbs	121.05	28.49
51 - 80" Drip	Cotton	9.4	1507 lbs	160 lbs	126.97	44.93
52 - Pivot	Cotton	15.55	997 lbs	64 lbs	50.9	-9.45
53 - 40" Drip	Cotton	8.44	1368 lbs	162 lbs	128.34	37.33
54 - 80" Drip	Cotton	8.3	1337 lbs	161 lbs	127.55	32.86

Comparison of Bubble and Spray Modes on a LEPA Equipped Pivot

In the Southern High Plains, spray types of irrigation systems (LESA and MESA) have gradually been replaced by systems that have less evaporative losses (LEPA and SDI), resulting in a greater proportion of the applied water reaching the crop rooting zone. However, LEPA systems may be configured in a spray mode or a bubble mode as shown in Figure 12. The spray mode allows coverage of a greater soil surface area, while the bubble mode concentrates the water in the area between rows. The greater soil surface area being wetted using the spray mode increases potential evaporative loss. A comparison of the two modes of irrigation was conducted on site 31. Selected spans of the pivot system were configured in the spray and bubble modes over the 2011 and 2012 irrigation seasons.

Figure 12: Photos of the Spray (Left) and Bubble (Right) Modes of the LEPA System.

The bubble mode had greater crop yields and profits per acre in both 2011 and 2012. In 2011, cotton yielded 1,001 lbs per acre using the bubble mode compared to 879 lbs per acre using the spray mode, indicating 122 lbs greater yield and $103.70 greater profit per acre. Millet produced using the bubble mode yielded 1,950 lbs per acre and 1,721 lbs per acre using the spray mode, resulting in 230 lbs more yield and $69.00 more profit per acre. In 2012, cotton produced with bubble mode yielded 1,057 lbs per acre compared to 896 lbs per acre using the spray mode, indicating 161 lbs more yield and $108 greater profit per acre. These comparisons were made in the same center-pivot field and received the same amount of water. This suggests that shifting from the spray mode to the bubble mode results in greater efficiency of water use translating into increased profitability.

AquaSpy™ capacitance probes were installed in the pivot span for each irrigation mode to assess the movement of water in the soil profile. Figure 13 shows that the rate of soil water depletion between cotton bloom and maturity was slower with bubble mode than with the spray mode when comparing cotton planted in two adjacent pivot spans receiving the same amount of water. A comparison of the soil water content shows a higher level of available water in the soil profile with the bubble mode across the growing season. This comparison indicates that with the bubble mode more irrigation water was moving down in the soil profile which would indicate less evaporation from the soil surface.

Bubble Mode **Spray Mode**

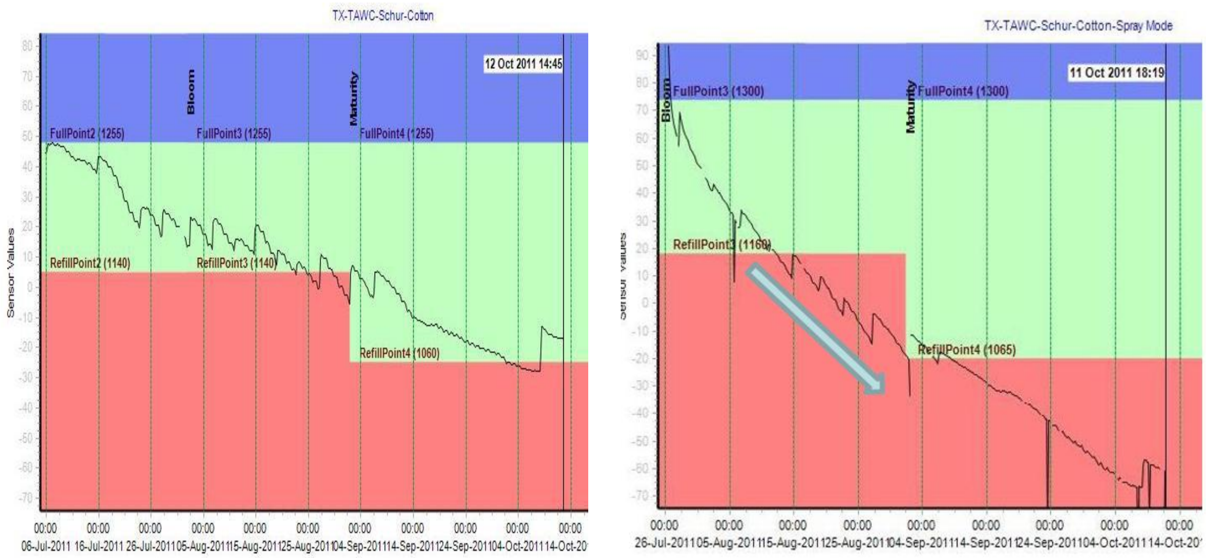


Figure 13: Comparison of Bubble and Spray Modes of Irrigation on Cotton in 2011. The x- axis denotes time during the growing season, and the y-axis denotes an index of soil water content using AquaSpy^{TM} sensors, averaged over a 48-inch soil profile. The arrows track the rate of soil water depletion.

Balancing Crop Water Demand with Irrigation Capacity

During the extreme drought experienced in 2011 many producers in the region were unable to meet the crop water demand from irrigation alone, resulting in reduced yields and in some instances crop abandonment. This experience in conjunction with declining well yields has prompted many producers to reduce irrigated acres to balance irrigation capacity with crop water demand. Producers with center pivots have reduced irrigated acres under the pivot and/or planted crops with different crop water demands. The producer for site 35 has chosen to plant different crops and stagger planting dates in order to balance crop water demand to available irrigation capacity.

Evaluation of 2013 & 2014 crop water use and water use efficiency of cotton, corn and sorghum on Site 35.

Site 35 is 240 acres of subsurface drip. The irrigation system has the capacity to deliver 3.13 GPM per acre which is approximately 0.17 acre inches per day over the 240 acre field. The field is divided into approximately three sections planted in three crops – corn, cotton, and grain sorghum. The objective was to stagger daily crop water demand by crop selection and planting dates to better balance the capacity of the irrigation system to meet water demand at critical crop growth stages. The following analysis is for the 2013 and 2014 production years with the daily crop water demand calculated at 70% of ET.

2013 Data Analysis

In 2013, Site 35 was planted to 54 acres of corn, 92 acres of cotton, and 75 acres of grain sorghum. Figure 14 shows the daily crop water demand for each crop at 70% of ET.

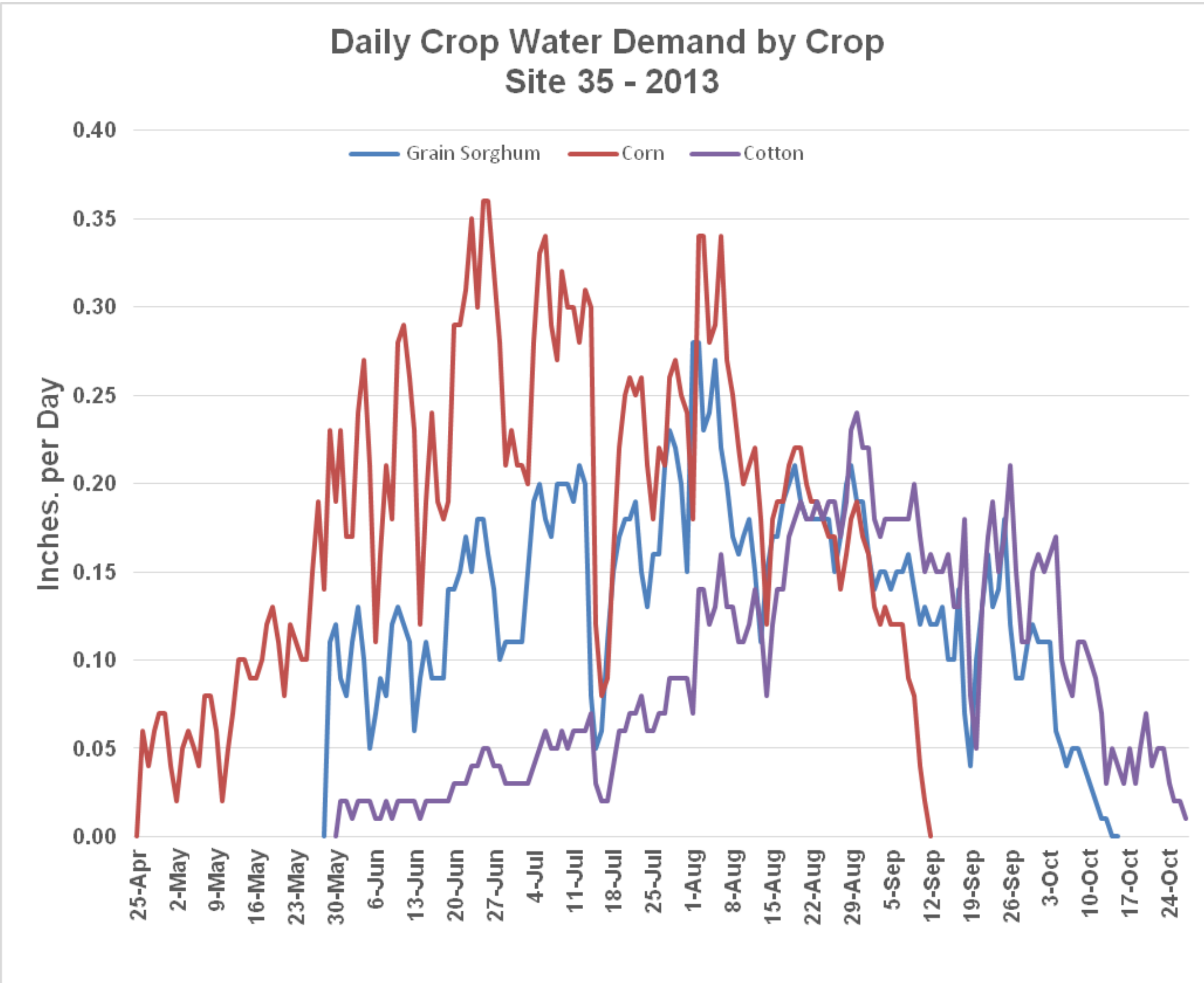


Figure 14: Daily Crop Water Demand in 2013 for Corn, Cotton, and Grain Sorghum at 70% of ET.

Daily crop water demand was calculated using daily PET from the Aiken Mesonet Station (TTU West Texas Mesonet System) and using established crop coefficients for each crop. Daily PET peaked in June and July ranging from 0.30-0.40 inches/day. By early July corn was using close to 100% PET. Grain sorghum was planted about 30 days later than corn and was using considerably less water per day during the peak PET period than corn. Cotton was planted in late May, similar to grain sorghum, and due to its slower leaf area development was using only 15-20% of PET during the first 40-50 days after emergence. Crop water demand increased rapidly beginning in early August due to the canopy approaching closure and light interception approaching 100%. Daily PET began to decline slowly during this same period compared to the PET in June, resulting in declining daily crop water use for all crops. From May 1 through September 31 accumulated PET for this area was 37.8 inches averaging 0.25 inches/day. Rainfall during the growing season amounted to 15.68 inches averaging 0.1 inches/day. Most events were less than 0.1 inches/day with the exception of a period in July and again in September when several daily volumes were in excess of 1.5 inches/day. Effective rainfall was calculated to be 70% of measured rain resulting in 10.98 inches of crop usable water.

Irrigation capacity was equivalent to 3.13 GPM/acre for the entire 240 acres of drip irrigated crops in this field, which amounts to 0.17 acre inches/day for the entire field. Staggered planting dates were used to manage the irrigation applications to better meet crop demand during critical developmental stages of each crop. Figure 15 shows the average daily crop water demand weighted by the acres of each crop. The red line represents the daily irrigation capacity for the entire field. Crop water demand in excess of the irrigation capacity would be expected to be met with rainfall and stored moisture in the soil profile. Figure 15 indicates that adequate irrigation water was supplied to these three crops in 2013 to meet the crop demand with the exception of August. However, early season irrigation coupled with rainfall was adequate enough to minimize the risk of significant plant water stress during critical developmental periods by having tolerable stored soil water.

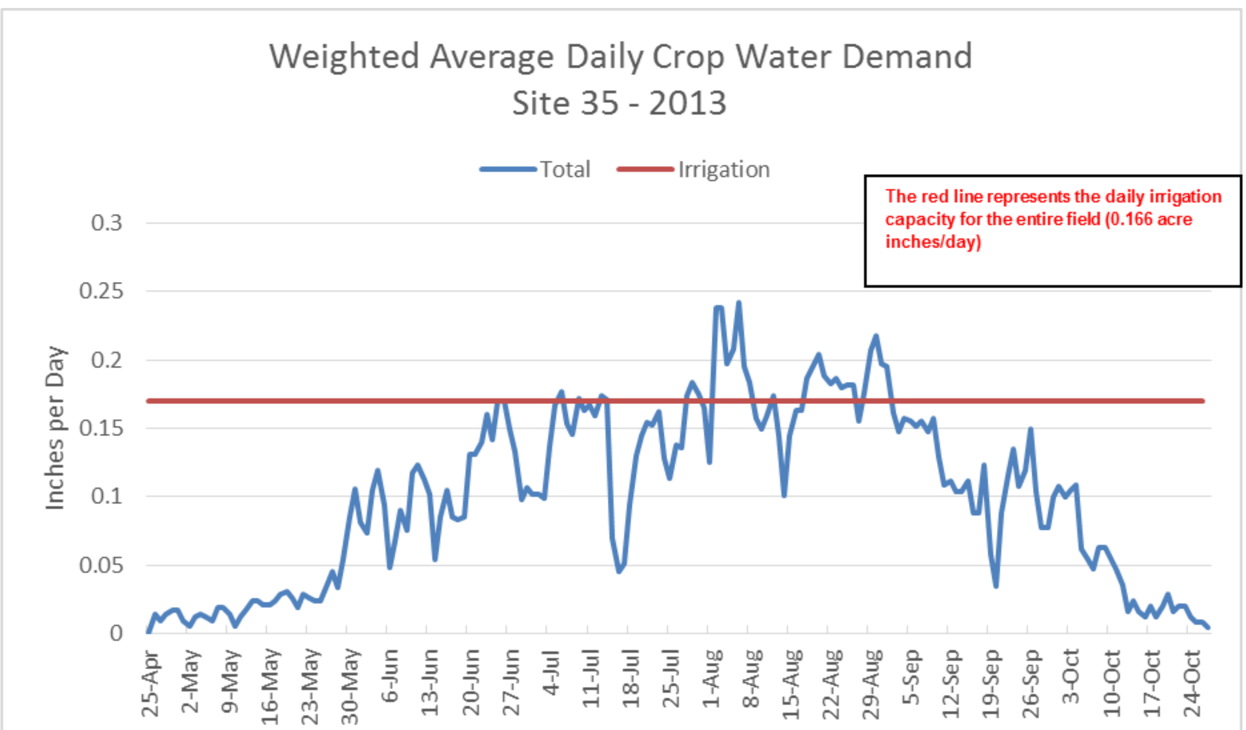


Figure 15: Average Daily Crop Water Demand in 2013 Weighted by Acres of Each Crop.

Irrigation water applied to cotton was 18.2 inches resulting in a harvested yield of 1,892 pounds lint/acre. Total water use efficiency was 65 pounds lint per inch of total water. Irrigation water use efficiency was 104 pounds lint per inch of irrigation water.

Irrigation water applied to corn was 25.7 inches resulting in a harvested yield of 257 bushels/acre. Total water use efficiency was 7.0 bushels per inch of total water. Irrigation water use efficiency was 10 bushels per inch of irrigation water.

Irrigation water applied to grain sorghum was 18.3 inches resulting in a harvested yield of 8,820 pounds grain per acre. Total water use efficiency was 301.2 pounds per inch of total water. Irrigation water use efficiency was 482 pounds per inch of irrigation water.

2014 Data Analysis

In 2014, Site 35 was planted to 80 acres of corn, 80 acres of cotton, and 75 acres of grain sorghum. Figure 16 shows the daily crop water demand for each crop at 70% of ET.

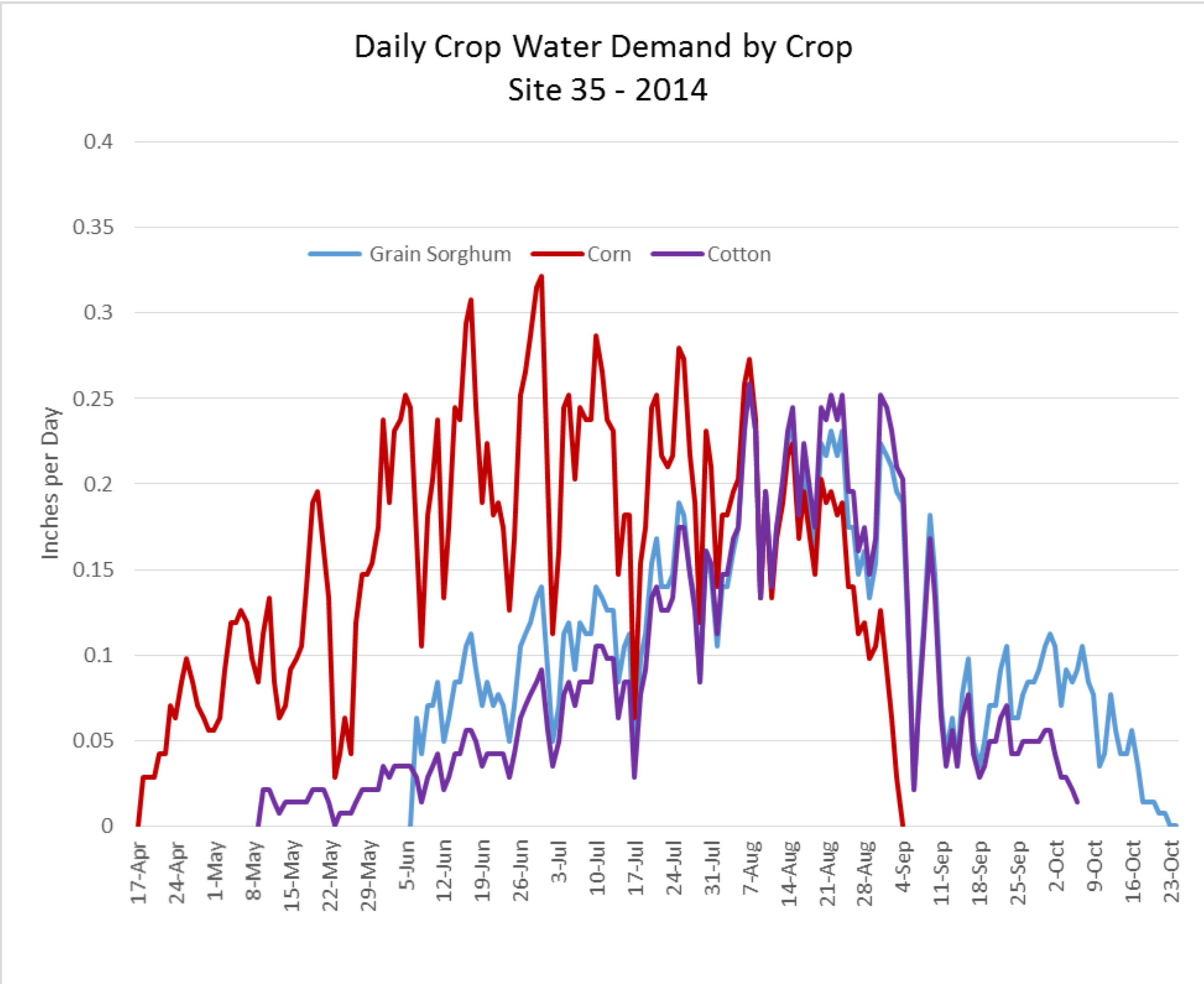


Figure 16: Daily Crop Water Demand in 2014 for Corn, Cotton and Grain Sorghum at 70% of ET.

The 2014 production year was a much better year than 2013 in terms of rainfall and PET. Rainfall was not only in larger quantities per event, but in many cases the event extended over three to four days resulting in considerably better use than in 2013. Total rainfall from May 1 through early September was 20.1 inches resulting in 14 inches of effective rain. Total PET over the growing season was 32.6 inches averaging 0.22 inches/day. The temperatures were lower and the humidity was higher than 2013 resulting in more favorable growing conditions for all crops. Figure 16 depicts the staggered planting dates for the three crops and the daily crop water use by each crop across the growing season. Peak water use for corn was again in June and July but averaged less than 0.30 inches/day. By delaying sorghum planting until early June, the sorghum escaped the high PET in June and was reaching its peak in August when the daily PET was subsiding. Cotton was planted in early May but due to the slow leaf area development it reached peak crop water use of 0.25 in/day when PET was declining.

As shown in Figure 17, rainfall and irrigation capacity were more than adequate to meet crop demand until August when the daily demand averaged about 0.20 inches/day with a short period approaching 0.25 inches/day. Adequate stored soil water was available to meet crop demand during this period and plant water stress never occurred resulting in excellent crop yields for all three crops.

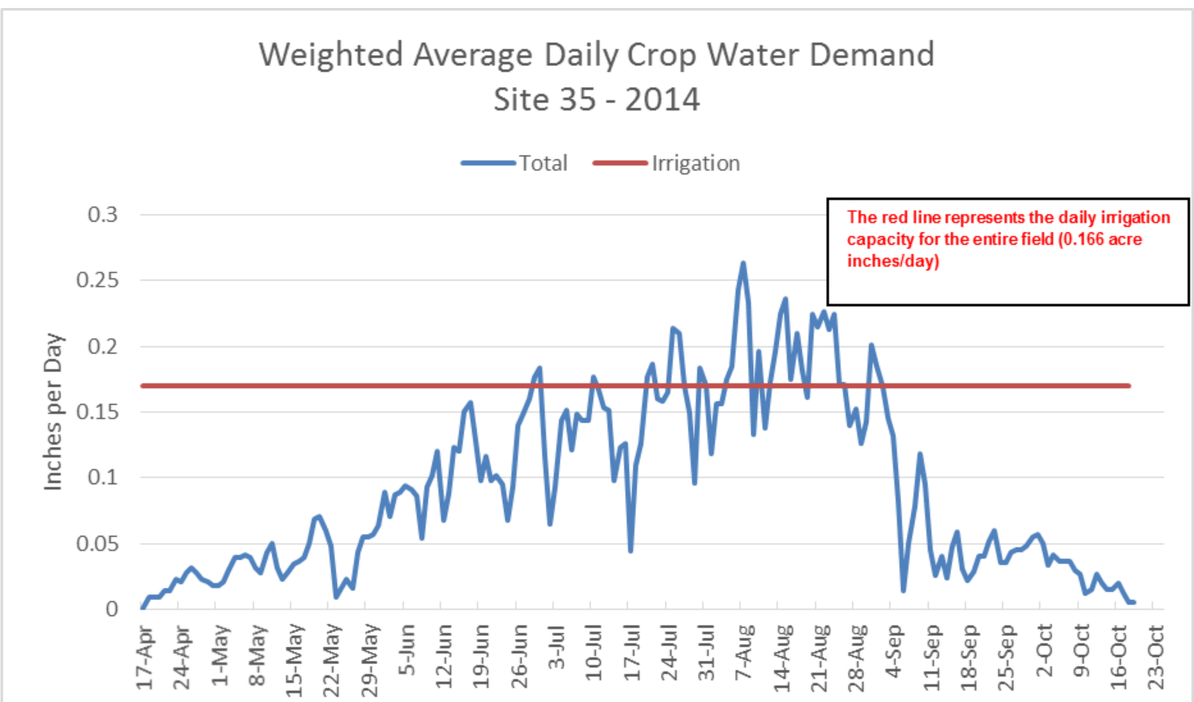


Figure 17: Average Daily Crop Water Demand in 2014 Weighted by Acres of Each Crop.

Irrigation water applied to cotton was 18.7 inches, resulting in a harvested yield of 1,233 pounds lint/acre. Total water use efficiency was 38 pounds lint per inch of total water. Irrigation water use efficiency was 66 pounds lint per inch of irrigation water.

Irrigation water applied to corn was 15.9 inches resulting in a harvested yield of 158 bushels/acre. Total water use efficiency was 5.3 bushels per inch of total water. Irrigation water use efficiency was 9.94 bushels per inch of irrigation water.

Irrigation water applied to grain sorghum was 8.3 inches resulting in a harvested yield of 7,112 pounds grain per acre. Total water use efficiency was 368.5 pounds per inch of total water. Irrigation water use efficiency was 857 pounds per inch of irrigation water.

The harvested yields and associated water use efficiencies in 2014 were lower than in 2013 primarily because excess rain fell in late May and early June resulting in significant leaching of pre-plant Nitrogen. Soil sampling on the corn field revealed a loss of 80 pounds of nitrogen per acre based on what had been applied.

Fieldprint Calculator

The sustainability of agricultural production has become an important issue for various stakeholders involved in agricultural production, marketing, processing, and retailing. The Fieldprint Calculator is a tool designed by Field to Market, the Keystone Alliance for Sustainable Agriculture, which can aid producers in identifying sustainable production practices by calculating a set of sustainability metrics that measure the sustainability level of their farming practices, and evaluate changes that may improve sustainability in the future. The "sustainability footprint" generated by the Fieldprint Calculator is based on seven metrics - land use (ac/lb) , irrigation water use (in/lb), energy use (gallons of diesel/lb), greenhouse gas emissions (lbs CO_2/lb), soil conservation (tons of soil loss/ac/yr), soil carbon (index), and water quality (index) - which are used to determine areas that are efficient or need improvement in order to produce at as high a level of sustainability as possible.

For this project, only five metrics were chosen for evaluation: land use, irrigation water use, energy use, greenhouse gas emissions, and soil conservation. Land use refers to the production efficiency of a particular field and is directly related to yield. If one field produces more yield per acre than another, it is more efficient and has a lower land use metric, meaning it requires less land to produce the same amount of crop. Irrigation water use is the amount of water applied per unit of crop production. Energy use accounts for all direct and indirect energy from production inputs used for an operation. Direct energy use is from inputs such as fuel used for irrigation and tillage operations. Indirect energy is energy used in the manufacture and transportation of inputs such as fertilizer and chemicals, and capital assets such as equipment. Greenhouse gas emissions are measured as the amount of CO_2 produced and is generally related to direct and indirect energy usage. The soil conservation metric accounts for estimated soil erosion in the field.

Several of the sites in the project were evaluated using the Fieldprint Calculator to assess sustainability. A total of 140 observations for fields in the region across eight years were used to construct an index for each metric, where an index value of 100 represents the average. The index values for each field were created from data obtained from the Fieldprint Calculator data output source. A graphic representation of the “sustainability footprint” is shown as a spidergram where the blue line represents the index value for the specific production site and the red line represents the average index value. A smaller “sustainability footprint” is considered better in this instance, therefore the smaller the index value, the more sustainable the operation.

The Fieldprint Calculator is a beneficial tool when comparing different production sites, particularly drip and pivot irrigated sites. A producer can evaluate the sustainability of each site to determine which is more efficient, allowing them to adopt more appropriate management strategies. Comparisons of drip and pivot irrigated sites are presented below. Sites 50 and 51 are managed by Arthur Farms and sites 52, 53, and 54 are managed by Blake Davis. These sites were chosen for comparison because soil types and production operations are similar given the same site managers for both drip and pivot irrigated sites.

Sites 50 and 51 represent pivot and drip irrigated sites, respectively, for a producer in Crosby County. A comparison of the “sustainability footprint” for the years 2012 and 2014, when the sites were in cotton production, indicates that the drip irrigated site had a smaller or “better” sustainability footprint. The result is due to greater water use efficiency (higher yield per acre inch) for the drip site as shown in Table 13. The lower amount of applied irrigation also reduced the level of energy use and greenhouse gas produced.

Sites 52, 53, and 54 represent a pivot, 40” drip, and 80” drip irrigated sites, respectively, for a producer in Lamb County. A comparison of the “sustainability footprint” for the years 2012 through 2014 indicates that the drip irrigated sites had a better “sustainability footprint” as well. Again, the result can be attributed to greater water use efficiency (higher yield per acre inch) for the drip sites as shown in Table 13, as well as reduced levels of energy use and greenhouse gas emissions.

Overall, the improved “sustainability footprints” for sites 50 through 54 from 2012 to 2014 can be attributed to many factors. In years where irrigation levels are higher due to lower in-season rainfall, higher values may be attributed to at least three metrics: irrigation, energy use, and greenhouse gas emissions (carbon). However, the effect of increased irrigation on these metrics is dependent on the resulting yields. As shown in Table 13, the water use efficiency as measured by yield per acre inch of applied irrigation was higher in 2014 versus 2012. Consequently, the metrics were higher in most cases in 2012 than in 2014 when rainfall was higher and irrigation levels lower.

After analyzing the index values, spidergrams, and yield per acre inch, it is apparent that the drip irrigated sites are overall more sustainable than the pivot sites. For both cotton and grain sorghum, the drip sites had greater yields per acre inch and overall have lower index values when compared to the pivot irrigated sites. The drip sites present greater water use efficiency than the pivot irrigated sites, therefore in this area, the drip irrigated sites are more sustainable. A more in-depth discussion of the Fieldprint Calculator and its application to production sites in the Texas High Plains region may be found in:

Stokes, K., P. Johnson, B. Robertson, and B. Underwood. 2014. Fieldprint Calculator: A Measurement of Agricultural Sustainability in the Texas High Plains. 2014 Beltwide Cotton Conferences Proceedings, pg. 406-412. Selected for presentation at the 2014 Beltwide Cotton Conference. Co-sponsored by the National Cotton Council and the Cotton Foundation, January 4-7, 2014, New Orleans, LA.

Gillum, M. and P. Johnson. 2015. Fieldprint Calculator: Results from the Texas High Plains. 2015 Beltwide Cotton Conferences Proceedings, in press. Selected for presentation at the 2015 Beltwide Cotton Conference. Co-sponsored by the National Cotton Council and the Cotton Foundation, January 5-7, 2015, San Antonio, TX.

Spidergrams for Sites 50 & 51

Site 50

Arthur Farms
Location: Crosby County
Latitude 33.67642, Longitude -101.43787
121 Acres
Crop: Cotton
Irrigation Type: Center Pivot (LESA)
Soil Type: Pullman Clay Loam
Tillage: Conventional

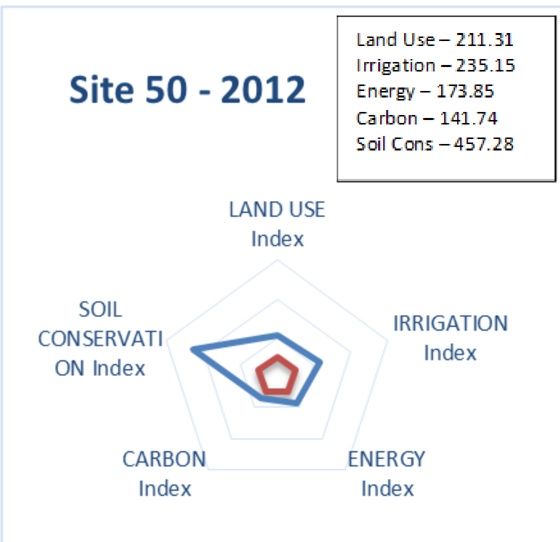


Figure 18: Sustainability Footprint for Site 50, 2012.

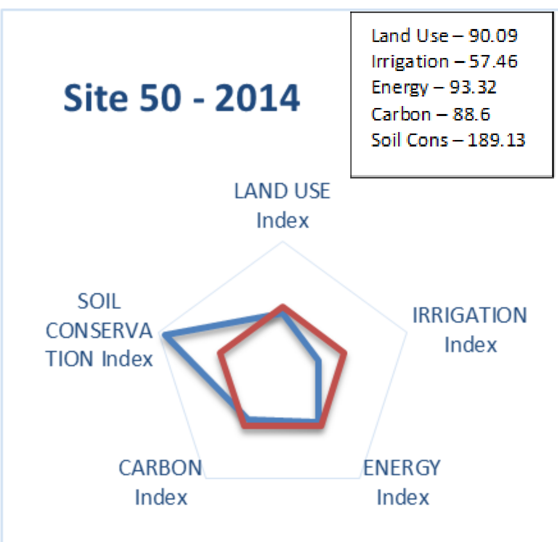


Figure 20: Sustainability Footprint for Site 50, 2014.

Site 51

Arthur Farms
Location: Crosby County
Latitude 33.67840, Longitude -101.44864
46 Acres
Crop: Cotton
Irrigation Type: Subsurface Drip
Soil Type: Olton Clay Loam
Tillage: Conventional

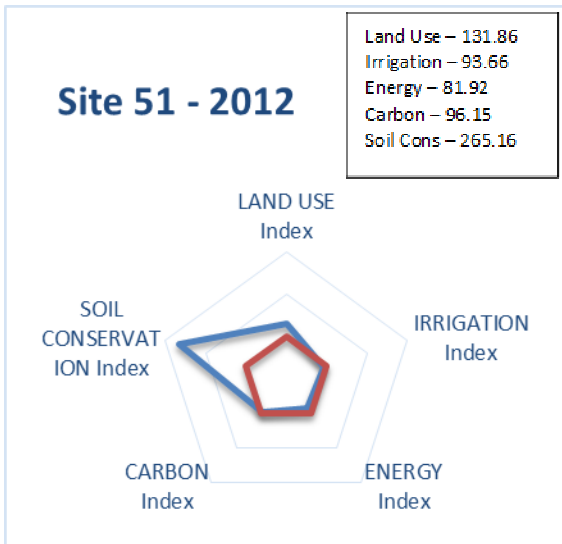


Figure 19: Sustainability Footprint for Site 51, 2012.

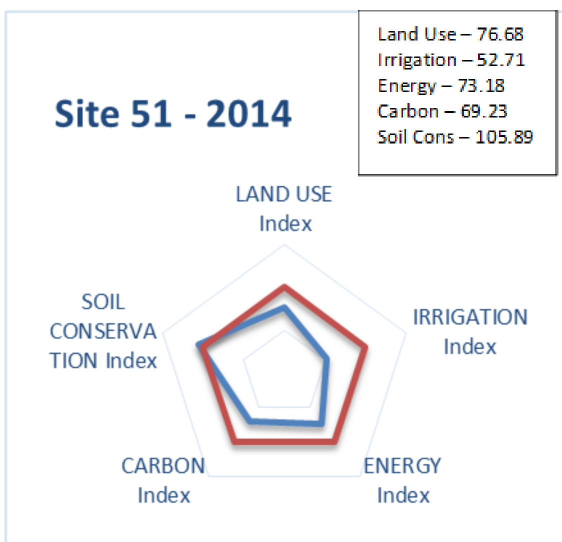


Figure 21: Sustainability Footprint for Site 51, 2014.

Spidergrams for Sites 52, 53, & 54

Site 52

Blake Davis
Location: Lamb County
Latitude 33.92834, Longitude -102.25682
135 Acres
Crop: Cotton
Irrigation Type: Center Pivot (LESA)
Soil Type: Amarillo fine sandy loam (62%), Acuff loam (31%), Olton clay loam (5%) and Midessa fine sandy loam (2%)
Tillage: No-till

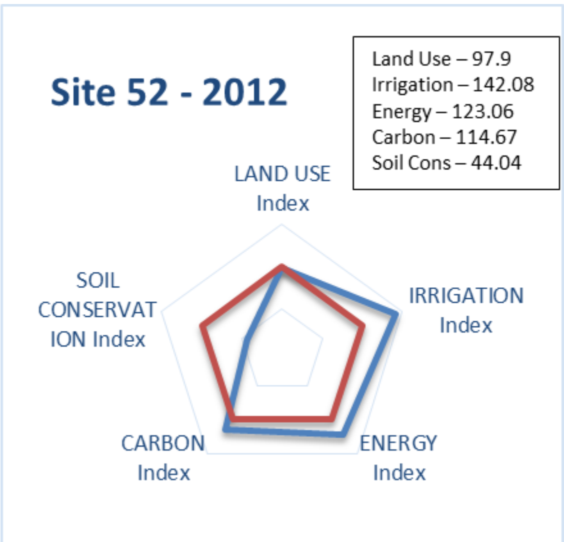


Figure 22: Sustainability Footprint for Site 52, 2012.

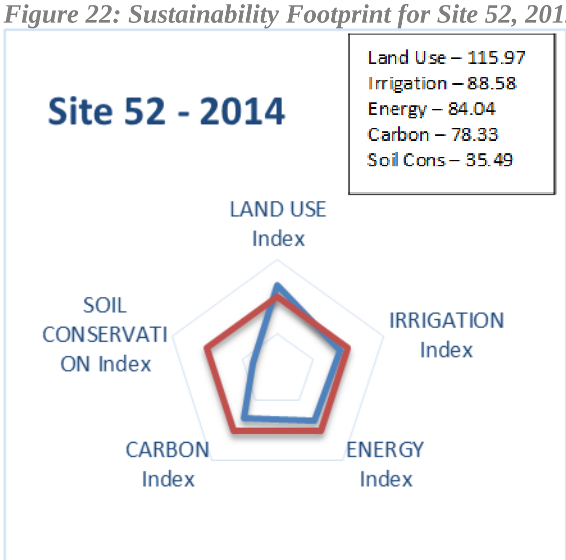


Figure 24: Sustainability Footprint for Site 52, 2014.

Site 53

Blake Davis
Location: Lamb County
Latitude 33.92431, Longitude -102.26865
50 Acres
Crop: Cotton
Irrigation Type: 40" Subsurface Drip
Soil Type: Acuff loam (77%), Zita loam (14%), Mansker loam (7%) and Olton clay loam (2%)
Tillage: Conventional

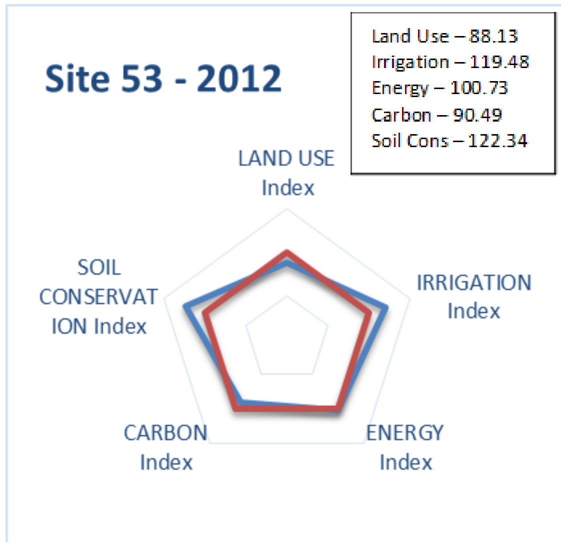


Figure 23: Sustainability Footprint for Site 53, 2012.

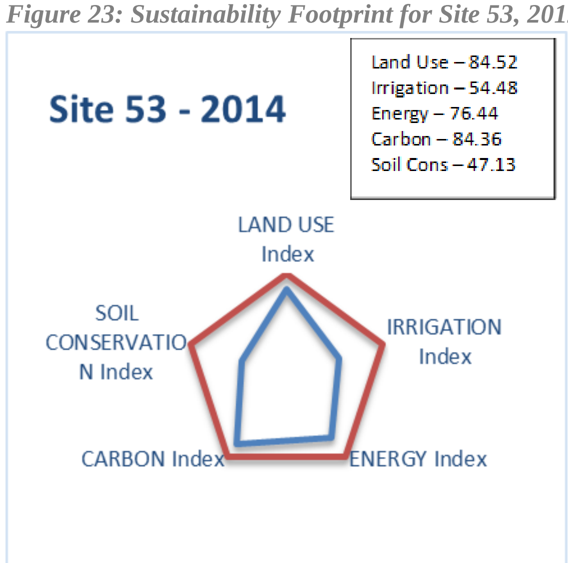


Figure 25: Sustainability Footprint for Site 53, 2014.

Site 54

Blake Davis
Location: Lamb County
Latitude 33.92112   Longitude -102.26485
85 Acres
Crop: Cotton
Irrigation Type: 80" Subsurface Drip
Soil Type: Olton clay loam (89%), Acuff loam (9%) and Zita loam (2%)
Tillage: Conventional

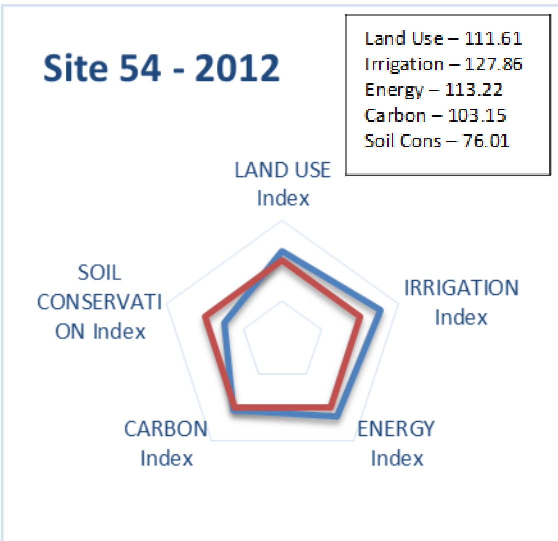


Figure 26: Sustainability Footprint for Site 54, 2012.

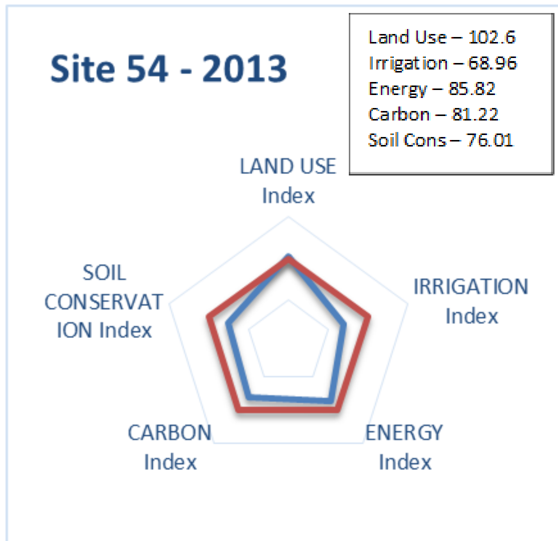


Figure 27: Sustainability Footprint for Site 54, 2013.

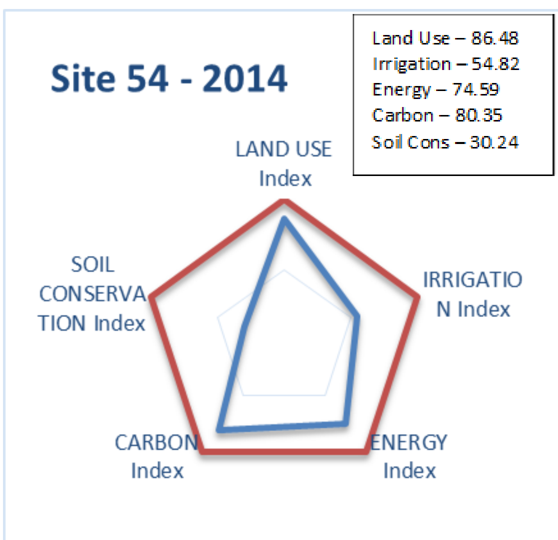


Figure 28: Sustainability Footprint for Site 54, 2014.

Educational Outreach Activities

Outreach activities were held throughout the course of the project to disseminate water management information to producers, consultants, and industry personnel. These efforts included meetings, field days, and field tours.

Northern Panhandle

Throughout the initial 5-years of the "200-12" Project, the district maintained a focus on educational outreach and best practices transfer. The district held multiple field days across the district each year. The field days averaged about 100 attendees annually and allowed producers and other interested stakeholders to see first-hand what practices were being used and how they were working.

Figure 29: Growers gain insight during the 2010 Dalhart Field Day presented in cooperation with Pioneer Hybrid, Inc.

In 2010, the district hosted the field day in Perryton, TX, but joined with Pioneer Hybrid, Inc. for the Dalhart Field Day and Texas A&M AgriLife Research for the field day at the North Plains Research Field in Etter, TX. With the addition of the Efficient Profitable Irrigation on Corn (EPIC) project in years 2011-2014, Texas A&M AgriLife Extension began co-hosting the field days and sharing information on the district-funded and complementary EPIC project. In 2011, the district also began to cooperate with Pioneer Hybrid, Inc. to present information on the "200-12 Project" at Pioneer's Annual Winter Crop Production Clinics in January. Partnering with other groups who share common interests allowed the reach of in-district presentations to be increased to about 300 attendees annually.

Figure 30: Moore County director, Harold Grall, explains the "200-12 Project" to corn growers from Iowa, Nebraska and Illinois.

In addition to the field days and crop clinics, district's board members and staff have presented data from the project at a variety of meetings each year. Not only has the district taken the program to the people, but the district has hosted multiple groups who were interested in the project including, corn growers from Iowa, a delegation from Mexico, as well as Texas State legislators.

The "200-12 Project" also received the Texas Water Conservation Advisory Committee's Blue Legacy Award in 2011 and the Texas Commission on Environmental Quality's Environmental

Excellence Award in 2012. Both awards created opportunities for more outreach through media releases and presentations both inside and outside the district.

__Presentations__

Table 25: Presentation Presented by NPGCD Staff During 2011.

Date	Presentation	Location	Spokesperson(s)
10-Jan	Pioneer Crop Production Clinic	Dalhart, TX	Leon New
11-Jan	Pioneer Crop Production Clinic	Dumas, TX	Leon New
13-Jan	High Plains Irrigation Conference	Amarillo, TX	
24-Feb	Channel Seed Education Meetings	Dumas, TX	Leon New
24-Mar	Dumas Noon Lions Club Membership Meeting	Dumas, TX	
18-Jul	Spearman Rotary Club	Spearman, TX	
27-Jul	Sunray Lions Club	Sunray, TX	
19-Aug	Hutchinson County Field Day in Cooperation with Texas A&M AgriLife	Morse, TX	Leon New
24-Aug	Ochiltree County Field Day in Cooperation with Texas A&M AgriLife	Perryton, TX	Leon New, Danny Krienke
25-Aug	Moore County Field Day in Cooperation with Texas A&M AgriLife	Etter, TX	Leon New, Harold Grall
26-Aug	Dallam/Hartley County Field Day in Cooperation with Texas A&M AgriLife	Dalhart, TX	Leon New, Phil Haaland
26-Sep	Voice of America Video and Radio Interview	International	
30-Nov	Amarillo Farm and Ranch Show, Commodities Symposium	Amarillo, TX	
30-Nov	Texas Alliance of Groundwater Districts	Austin, TX	

Table 26: Presentation Presented by NPGCD Staff During 2012.

Date	Presentation	Location	Spokesperson(s)
9-Jan	Pioneer Crop Production Clinic	Dalhart, TX	Leon New
10-Jan	Pioneer Crop Production Clinic	Dumas, TX	Leon New
12-Jan	Pioneer Crop Production Clinic	Spearman, TX	Leon New
19-Jan	High Plains Irrigation Conference	Amarillo, TX	Harold Grall
25-Jan	Site Visit by The Iowa Corn Growers Association		
8-Feb	Texas Panhandle Water Conservation Symposium	Amarillo, TX	
15-Feb	Dalhart Ag Appreciation Day	Dalhart, TX	
3-Apr	Perryton Lions Club	Perryton, TX	
4-Apr	United States Committee on Irrigation and Drainage Conference	Austin, TX	
1-Jul	CBS Los Angeles Bureau Segment on National Feed		
15-Aug	Dumas Rotary Club	Dumas, TX	
21-Aug	Hutchinson County Field Day in Cooperation with Texas A&M AgriLife	Morse, TX	Leon New
22-Aug	Ochiltree County Field Day in Cooperation with Texas A&M AgriLife	Perryton, TX	Leon New, Danny Krienke
23-Aug	Moore County Field Day in Cooperation with Texas A&M AgriLife	Etter, TX	Leon New, Harold Grall
24-Aug	Sherman County Field Day in Cooperation with Texas A&M AgriLife	Stratford, TX	Leon New, Joe Reinart
28-Aug	Texas Alliance of Groundwater Districts Texas Groundwater Summit	Austin, TX	Booth
17-Sep	Cooperator Field Tours		
19-Sep	Cooperator Field Tours		
6-Nov	Perryton Lions Club	Perryton, TX	
27 thru 29-Nov	Amarillo Farm and Ranch Show	Amarillo, TX	Booth

Table 27: Presentation Presented by NPGCD Staff During 2013.

Date	Presentation	Location	Spokesperson(s)
11-Jan	Groundwater Management Districts Association 38th Annual Conference	Austin, TX	
17-Jan	Pioneers in Agriculture Series	Muncy, TX	
17-Jan	High Plains Irrigation Conference	Amarillo, TX	Booth
25-Feb	Texas Ag Water Forum	Austin, TX	
20-Mar	Northeast Panhandle Corn Conference	Perryton, TX	Leon New
30-Jul	RFDTV "Out on the Land"	TV Show	Steve Walthour, David Ford
20-Aug	Hutchinson County Field Day in Cooperation with Texas A&M AgriLife	Morse, TX	Leon New
21-Aug	Moore County Field Day in Cooperation with Texas A&M AgriLife	Etter, TX	Leon New, Harold Grall
22-Aug	Ochiltree County Field Day in Cooperation with Texas A&M AgriLife	Perryton, TX	Leon New, Danny Krienke
23-Aug	Dallam/Hartley County Field Day in Cooperation with Texas A&M AgriLife	Dalhart, TX	Leon New, Phil Haaland
27 Thru 29-Aug	Texas Alliance of Groundwater Districts Texas Groundwater Summit	San Marcos, TX	Booth
3 Thru 5-Dec	Amarillo Farm and Ranch Show	Amarillo, TX	Booth

Table 28: Presentation Presented by NPGCD Staff During 2014.

Date	Presentation	Location	Spokesperson(s)
13-Jan	Pioneer Crop Production Clinic	Dalhart, TX	Leon New
14-Jan	Pioneer Crop Production Clinic	Dumas, TX	Leon New
15-Jan	Pioneer Crop Production Clinic	Stratford, TX	Leon New
16-Jan	Pioneer Crop Production Clinic	Spearman, TX	Leon New
16-Jan	High Plains Irrigation Conference	Amarillo, TX	Leon New
28-Jan	Colorado Farm Show	Greeley, CO	Steve Walthour, Danny Kreinke
12-Feb	Panhandle and Southern High Plains Water Conservation Symposium	Amarillo, TX	Danny Kreinke
8-Aug	Sherman County Field Day in Cooperation with Texas A&M AgriLife	Stratford, TX	Leon New, Joe Reinart
10-Aug	Ochiltree County Field Day in Cooperation with Texas A&M AgriLife	Perryton, TX	Leon New, Danny Krienke
11-Aug	Moore County Field Day in Cooperation with Texas A&M AgriLife	Etter, TX	Leon New, Harold Grall
26 Thru 28-Aug	Texas Alliance of Groundwater Districts Texas Groundwater Summit	San Marcos, TX	Booth
2 Thru 4-Dec	Amarillo Farm and Ranch Show	Amarillo, TX	Booth

Table 29: Presentation Presented by NPGCD Staff During 2015.

Date	Presentation	Location	Spokesperson(s)
12-Jan	Pioneer Crop Production Clinic	Dalhart, TX	Leon New
13-Jan	Pioneer Crop Production Clinic	Dumas, TX	Leon New
14-Jan	Pioneer Crop Production Clinic	Stratford, TX	Leon New
15-Jan	High Plains Irrigation Conference	Amarillo, TX	Booth
15-Jan	Pioneer Crop Production Clinic	Spearman, TX	Leon New

South Plains

A series of three producer meetings were held in the early spring of 2012 at project producers' barns located in Littlefield, Ralls, and Plainview. Each meeting was attended by approximately 30 producers, consultants, and industry members. Speakers presented at these meetings focusing on crop rotation, use of the Texas Alliance for Water Conservation's online tools, and irrigation management technologies.

Field Days were held each August at the Floyd County Unity Center in Muncy, Texas. At these field days, speakers made presentations and attendees toured selected sites to see irrigation management in action. Researchers and producers were at each event willing to answer any questions dealing with the irrigation and/or farming methods. All of these meetings were broadcasted live by KFLP All Ag, All Day Radio.

A series of weekly Cotton Irrigation Short Courses were also held in 2014 (March 11, 18, 25, April 1, 8). These meetings were held at the Plainview Country Club from 7:30am – 8:30am and focused on irrigation management. Bob Glodt, Dan Krieg and Jim Bordovsky were all guest presenters during these meetings and a steady crowd of approximately 25 producers from the Texas High Plains attended each meeting. Samantha Borgstedt and Mallory Newsom put together notebooks for attendees that include project handouts, presentation slides, and helpful fact sheets. Only four meetings were originally planned; however, the producers requested a fifth meeting to better learn the TAWC Solutions online tools.

Figure 31: Producers Listening to a Talk During the Field Day at Muncy.

Winter meetings were also held throughout the project. These took place at the Bailey County Electric Co-op in Muleshoe, Texas; South Plains College Sundown Room in Levelland, Texas Floyd County Unity Center in Muncy, Texas; and Scottish Rights Learning Center in Lubbock, Texas. Speakers presented on various agricultural topics centered on water management and each meeting was broadcasted live by KFLP All Ag, All Day Radio.

On January 21, 2015, the TAWC hosted the first annual TAWC Water College at the Bayer Museum of Agriculture. There were approximately 150 attendees at the event. The purpose of the water college was to provide producers and crop consultants with information on water management for specific crops to achieve the greatest benefit from applied irrigation. The TAWC Water College included presentations given by experts in the industry discussing soil moisture probe technologies; soil and water relationships; grain sorghum, corn, and cotton water and fertility issues; weed control in crop fields; and the latest in irrigation research. In addition, local irrigation supply companies, farm equipment dealers, farm credit businesses, and commodity groups brought display booths to answer any questions and give details to all attendees. The TAWC Water College was sponsored by: Bayer Crop Science, National Sorghum Checkoff, Cotton Inc., DuPont Pioneer, Eco-Drip, Texas Sorghum Producers, Texas Corn Producers, AgTexas Farm Credit, Plains Cotton Growers, Capital Farm Credit, Diversity D Irrigation Services, Zimmatic Irrigation Services, Lubbock Electric, Hurst Farm Supply, and Texas Tech University Agricultural & Applied Economics Department.

Presentations

Table 30: Presentation Presented by the South Plains Portion of the Texas High Plains Initiative During 2012.

Date	Presentation	Spokesperson(s)
6-Mar	Lubbock Kiwanis Club	Kellison
7-Mar	Monthly Management Team Meeting	Kellison
3-Apr	AgriLife Extension Meeting	Kellison
12-Apr	Monthly Management Team Meeting	Kellison
10-May	Monthly Management Team Meeting	Kellison
10-May	Carilllon Center	Kellison
11-May	Tours-Comer Tuck with the Texas Water Development Board	Kellison
14-May	Tours-Farm Journal Media	Kellison
17-May	Tours-Secretary of State Group	Kellison
14-June	Monthly Management Team Meeting	Kellison
21-June	Glenn Schur Farm	Kellison
10-July	Tours-Justin Weinheimer	Kellison
12-July	Texas Agricultural Coop Council	Kellison
12-July	Texas Independent Ginners Conference	Kellison
18-July	Monthly Management Team Meeting	Kellison
16-Aug	Monthly Management Team Meeting	Kellison
5-Sep	Leadership Sorghum Class 1	Kellison
20-Sep	Monthly Management Team Meeting	Kellison
18-Oct	Monthly Management Team Meeting	Kellison
24-Oct	Texas Agriculture Lifetime Leadership	Kellison
30-Oct	Special Management Team Meeting	Kellison
8-Nov	Monthly Management Team Meeting	Kellison
13-Dec	Monthly Management Team Meeting	Kellison
16-18-Nov	48th Annual American Water Resources Association Conference	Doerfert/Kellison/P. Johnson/Maas
20-Nov	Special Management Team Meeting	Kellison
4-Feb	Texas Seed Trade Association	Kellison
14-Feb	Monthly Management Team meeting	Kellison
21-Mar	Monthly Management Team meeting	Kellison
11-Apr	Monthly Management Team meeting	Kellison

Table 31: Presentation Presented by the South Plains Portion of the Texas High Plains Initiative During 2013.

Date	Presentation	Spokesperson(s)
13-Mar.	John Deere Crop Sense capacitance probe use by TAWC – Lubbock, TX	Pate
26-Apr.	Data plans for the initiative for strategic and innovative irrigation management and conservation. Presented at the Water Management and Conservation: Database Workshop – Lubbock, TX	Kellison, Johnson
8-May	TAWC Update and Highlights – For D-2 County Agents – Lubbock, TX	Pate
5-Jun.	Radio Interview – Field Walk Update – KFLP	Pate
3-Jul.	Radio Interview – Field Walk Update – KFLP	Pate
19-Jul.	Texas Southwestern Cattle Raisers Association, Lubbock, TX	Kellison
9-Aug.	Radio Interview – Field Walk Update – KFLP	Pate
13-Aug.	High Plains Water District board of directors – Lubbock, TX	Kellison
25-Sept.	TAWC update and highlights – Monsanto headquarters – St. Louis, Mo.	Pate
26-Sept.	Wayland Baptist University class – Lockney, TX	Kellison
2-Oct.	Congressman Frank Lucas – Lubbock, TX	West, Kellison
7-Oct.	TAIA Annual Meeting	Kellison
9-Oct.	Congressman Mike Conway	West, Kellison
10-Oct.	TAWC Field Walk – Lockney, TX	Kellison
2 Nov.	Am. Soc. Agronomy, Tampa, FL. Modeling Old World bluestem grass	West, Xiong

Table 32: Presentation Presented by the South Plains Portion of the Texas High Plains Initiative During 2014.

Date	Presentation	Spokesperson(s)
7-Jan.	Sorghum U – Levelland, TX	Kellison
7-Jan.	Fieldprint Calculator: A measurement of agricultural sustainability in the Texas High Plains Beltwide Cotton Conference, New Orleans	Stokes, Johnson, Robertson, Underwood
7-Jan.	Poster- LEPA vs. LESA Irrigation – Beltwide Cotton Conference – New Orleans, La.	Pate, Yates
16-Jan.	TWDB Director Bech Bruun & staff – Lubbock, TX	Kellison
28-Jan.	Randall County Producers	Kellison
12-Feb.	Texas Panhandle-High Plains Water Symposium	Kellison
13 Feb.	Nebraska Independent Crop Consultants Assoc. annual meeting. Talk on TAWC	West
24-Feb.	TWDB Directors-Lubbock, TX	Kellison
2-Apr.	Region "O" Water Planning Group	Kellison
24-Jun.	South Plains Underground Water Conservation District, Brownfield, TX	Kellison
13-Aug.	Water Management Technology, Littlefield, TX	Pate
14-Dec.	Water Management Technology, Olton, TX	Pate
16-Dec.	Swisher County Ag Days, Tulia, TX	Kellison

Conclusion

We learned that high efficiency LEPA center pivot irrigation systems are needed to help stretch available water and that crop residue remains essential. Irrigation systems must get more of the available water to the crop. Also, we learned that drought tolerant hybrids were commonly planted, mostly in May, and performed well. 2011 and 2012 delivered a clear message that rainfall is not what it once was. Overall, 2013 was an improved corn production year with more rainfall and cooler temperatures, but beginning soil moisture was low following 2012. Over the course of the project, irrigation was reduced by 1,286.89 acre-feet (6.29 inches). By reducing current irrigation volumes by as little as three inches over the one million acres of irrigated cropland within the district, it is possible to save up to 250,000 acre-feet of groundwater per year and prolong the viability of irrigated agriculture in the area. Table 33 summarizes the water savings of the project.

Table 33: Total Water Savings for the North Panhandle Portion of the Texas High Plains Initiative.

Year	Acreage	Average Irrigation (in.)	Total Irrigation (ac-ft)	Avg. Water Savings (in.)	Water Savings (ac-ft)
2010	270	11.30	254.20	7.89	177.50
2011 (1)	682	15.33	871.19	9.24	525.25
2012 (2)	819	16.02	1093.25	5.93	404.51
2013	686	18.08	1033.30	3.14	179.63
2014	604	16.19	815.02	4.10	206.51
Total	**3061**	**15.94**	**4066.96**	**5.85**	**1493.40**

Notes:
2 In 2011, 3 of 9 producers harvested grain, 3 harvested silage, and 3 abandoned their field
3 In 2012, 1 of 12 producers harvested silage

What We Learned

- Low energy precise application (LEPA) assisted in boosting yields verses other application types
- Later planting dates can reduce irrigation requirements due to increased time to receive rainfall
- Drought tolerant hybrids boosted yields in limited water situations
- Crop residue is essential to reduce water evaporation, increase water infiltration, and reduce wind erosion
- Growers must be conscious of the amount of irrigation applied to produce a certain yield, managing on a yield per inch of water basis
- More knowledge of pre-season and seasonal soil moisture levels will assist in the conservation of water
- Satellite crop imagery has potential as an additional management tool, but needs further development

Effects of the Project on Producer Operations

Site 50: While using moisture probes, the producer could see from the online readout that irrigation water was not reaching the root zone before evaporation occurred. In turn, he slowed his center pivot and applied a greater amount of water at longer frequencies in order to force water down into the root zone.

Site 52: After applying a granular fertilizer, the producer started his center pivot in the spray mode to dissolve the fertilizer and allow the water to carry it to the root zone. After looking at the online readout of his soil moisture probes, he realized that he was only getting 75% efficiency from his irrigation application due to evaporation and switched his center pivot to the LEPA mode, which improved his efficiency to 95%.

Site 53 & 54: By keeping a close watch on the online readout of his soil moisture, the producer was able to suspend irrigation 7 to 10 days earlier than the traditional time, because he determined there was sufficient soil moisture to fully mature the crop in two subsurface drip irrigation fields.

Site 56: By utilizing the availability of soil moisture through the use of continence probes, the producer is better able to time the planting of both summer (corn silage) and winter (wheat) crops. This producer has limited irrigation water and plants half of the center pivot in a summer crop and the other half in a winter crop. By utilizing this technology, he is better able to time planting based on moisture availability.

Site 57: This producer utilizes a series of irrigation wells to supply two center pivots. With the use of continence probe information, he can stagger the planting dates so that he can provide ample irrigation water to both crops. Therefore, when the water requirement is high for one crop it will be low for the other.

Site 58: By planting a high value crop (alfalfa) on half of a center pivot and fallowing the other half, this producer maximizes his profit over traditional crops. Through the use of soil moisture probes, he is better able to time irrigations between harvests, which allows for more cuttings of hay.

Site 60: This producer ran a pre-plant deep chisel down each furrow. When he began irrigation operations, the online readout from soil moisture probes indicated that the water was going too far below the root zone to benefit the crop. This was caused by the water following the channel created by the ripper. By changing his center pivot to the bubble mode, he was able to rectify the problem. This producer has also changed his record keeping system based on the value of water. Instead of calculating net profit per acre, his net profit is now calculated on net profit per acre inch of water applied.

Appendix A: South Plains

Site 50 - Arthur Farms Pivot

Location: Crosby County
Latitude: 33.67642, Longitude: -101.43787

121 Acres
Center Pivot – Low Elevation Spray Application
265 GPM

1 Well, 360 feet, pumping depth 300 feet
Natural Gas

System pressure of 10 PSI

Installed Equipment: Pivotrac® & John Deere Moisture Probe

Soil Type: Pullman silty clay loam (100%)

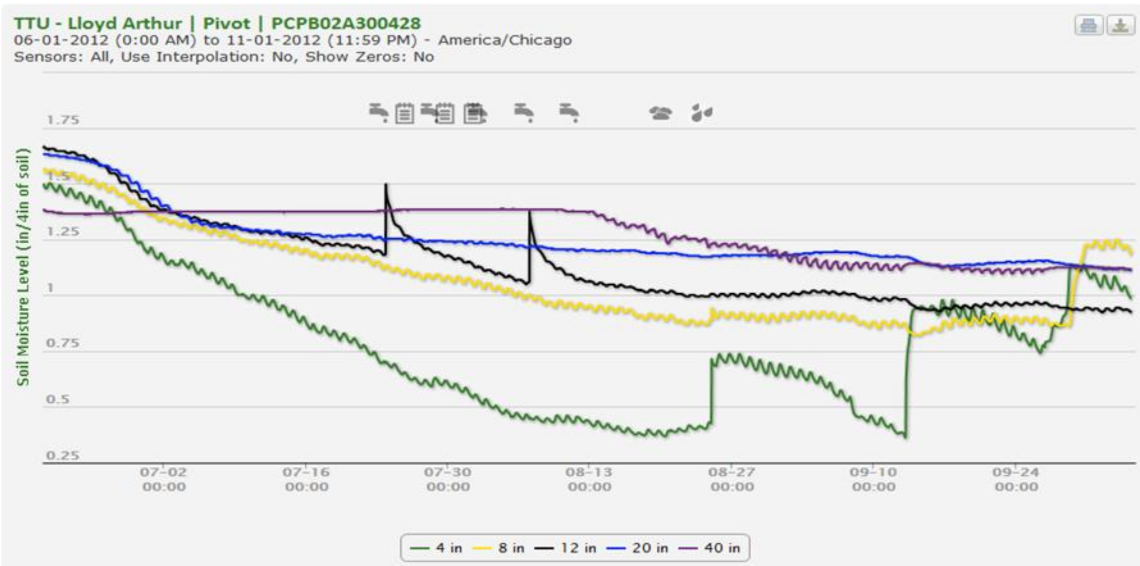
Crop Information			
Site 50			
	2012	2013	2014
Crop	Cotton (FM 1740)	Cotton (FM 1740)* Grain Sorghum (DK-47)	Cotton (FM 2484B2F)
Planted Acres	121 acres	Cotton: 122 acres Grain Sorghum: 122 acres	121 acres
Planting Date	5/16/2012	Cotton: 5/13/2013 Grain Sorghum: 6/13/2013	5/15/2014
Fertilizer	72-50-10-20	46-0-0-53	108-82-0-21
Herbicide	Trifluralin, Roundup	Cotton: Triflurex GS: Milo Pro	Trifluralin, Roundup
Insecticide	None	None	None
Harvest Aids	Aim, Cotton Pro	None	Super Boll, ET
Tillage	Cut Stalks, List, Rodweed, Plant, Sandfight	Cotton: Cut Stalks, List, Plant, Rodweed GS: Plant, Sandfight, Cultivate	Shred Stalks, Field Cultivator, List (2), Rodweed, Plant
Irrigation	14.57 inches	Cotton: 7.27 inches GS: 8.52 inches	8.35 inches
Harvest Date	10/06/2012	GS: 10/13/2013	10/24/2014
Yield	Cotton Lint 547 lbs/ac Cotton Seed 0.35 ton/ac	Insurance: Cotton Lint 371 lbs/ac Cotton Seed 0.26 tons/ac GS: 85.86 bu/ac	Cotton Lint 1,283 lbs/ac Cotton Seed 0.91 tons/ac
Yield per Acre Inch	37.5 lbs of Lint	GS: 10.08 bu	153.6 lbs of Lint

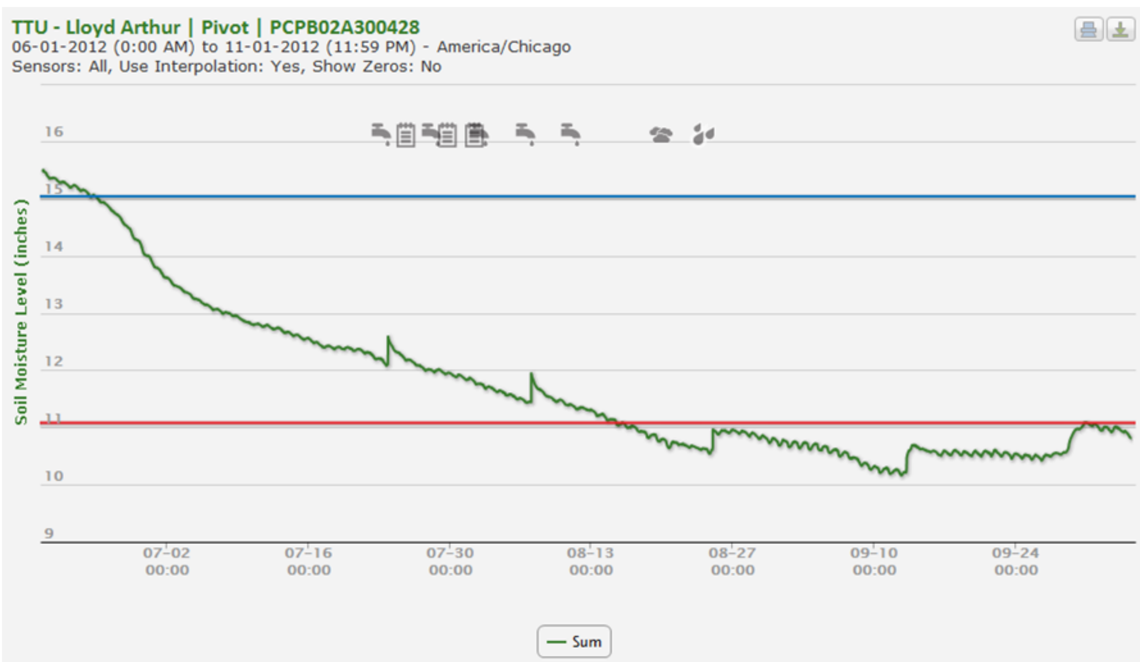
Economic Information				
Site 50				
	2012	2013	2013	2014
	Primary Crop	Primary Crop	Secondary Crop	Primary Crop
	($ per Acre)			
Gross Income:				
Cotton Lint	492.46	308.05	-	833.95
Cotton Seed	97.72	58.79	-	182.00
Grain Sorghum	-	-	408.68	-
Total Gross Income	590.18	366.84	408.68	1,015.95
Variable Production Costs:				
Production Inputs	192.15	176.46	74.28	384.58
Irrigation	148.61	95.97	112.46	110.22
Harvest	124.12	0.00	31.25	267.33
Interest	11.93	8.17	5.60	14.84
Total Variable Costs	476.81	280.60	223.59	776.97
Gross Margin	113.37	86.24	185.09	238.98
	($ per Acre Inch)			
Average Revenue per Inch of Irrigation	40.51	50.45	47.97	121.67
Gross Margin per Inch of Irrigation	7.78	11.86	21.72	$28.62

Moisture Probe Evaluation, 2012

Site 50

Crop rooting activity is seen across the entire probe with activity at the 40” level during August. Strong root activity early July to the 20” level. Irrigation events were not registering during early July as the application amount was not moving enough water to the center of the crop row. Pivot was slowed down about 5% and the next pass registers at the 12” sensor depth. Hot weather the next 2 passes exceed pivots ability to move water back to the crop row. Rain events in August help to meet crop needs and start to see the system build moisture at the end of season with additional rainfall events.





Site 51 - Arthur Farms Drip

Location: Crosby County
Latitude 33.67840, Longitude -101.44864

46 Acres
Drip
175 GPM

1 Well, 350 feet, pumping depth 300 feet
Natural Gas

System pressure of 18 PSI

Installed Equipment: Pivotrac® & John Deere Moisture Probe

Soil Type: Olton clay loam (100%)

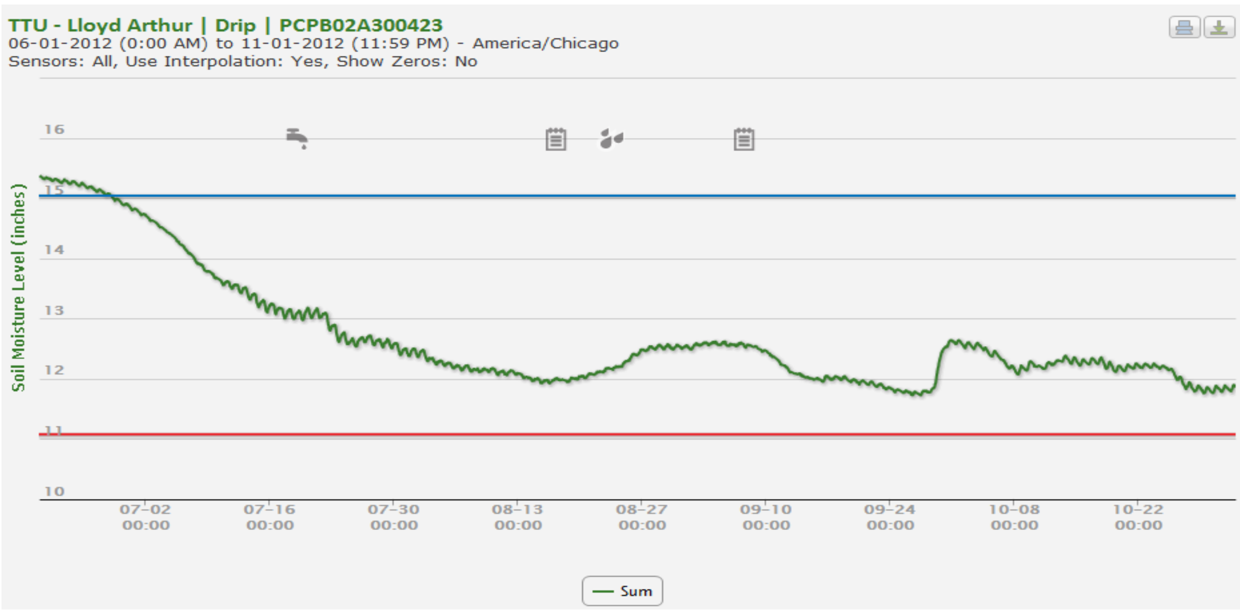
Crop Information Site 51			
	2012	2013	2014
Crop	Cotton	Cotton (DG 2570)* Grain Sorghum (DK 4420)	Cotton (DG 2570)
Planted Acres	46 acres	Cotton: 46 acres Grain Sorghum: 46 acres	46 acres
Planting Date	5/22/2012; replanted 7.7 ac 5/29/2012	Cotton: 5/16/2013 Grain Sorghum: 6/13/2013	5/2/2014
Fertilizer	Compost – 2 tons	Cotton: Compost–2.02 ton GS: 80-0-0	108-82-0-21
Herbicide	Roundup	GS: Milo Pro	Trifluralin, Roundup
Insecticide	None	None	None
Harvest Aids	None	None	Super Boll, ET
Tillage	Cut Stalks, List, Rodweed, Plant, Sandfight, Cultivate	Cotton: Cut Stalks, List, Rodweed, Cultivate, Plant, Sandfight GS: Plant, Sandfight, Cultivate	Shred Stalks, Field Cultivator, List, Plant, Sandfighter
Irrigation	9.3 inches	Cotton: 7.74 inches GS: 7.46 inches	9.40 inches
Harvest Date	10/06/2012	GS: 11/14/2013	10/15/2014
Yield	Cotton Lint 877 lbs/ac Cotton Seed 0.58 tons/ac	Insurance: Cotton Lint: 371 lbs/ac Cotton Seed: 0.26 tons/ac GS: 120.55 bu/ac	Cotton Lint 1,507 lbs/ac Cotton Seed 1.07 ton/ac
Yield per Acre Inch	94.3 lbs of Lint	GS: 16.16 bu	160.3 lbs of Lint

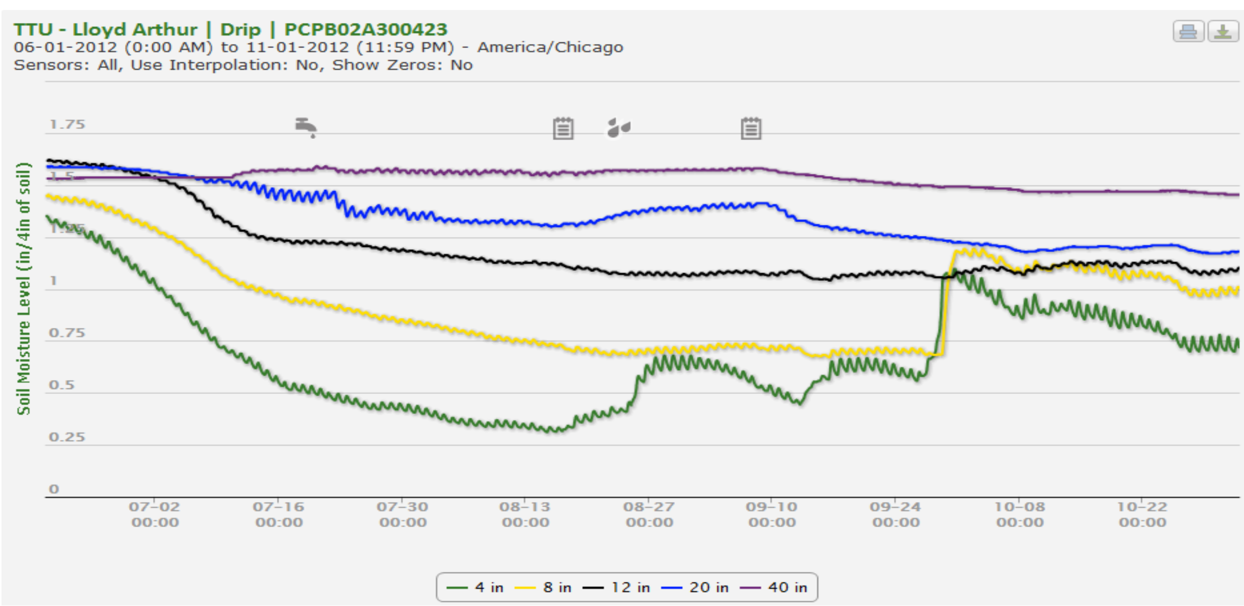
Economic Information Site 51				
	2012	2013	2013	2014
	Primary Crop	Primary Crop	Secondary Crop	Primary Crop
	($ per Acre)			
Gross Income:				
Cotton Lint	789.17	308.05	-	979.55
Cotton Seed	161.00	58.79	-	214.00
Grain Sorghum	-	-	573.84	-
Total Gross Income	950.17	366.84	573.84	1,193.55
Variable Production Costs:				
Production Inputs	322.63	269.62	90.47	329.84
Irrigation	94.86	102.17	98.47	124.08
Harvest	165.01	0.00	43.88	304.67
Interest	14.61	11.15	5.67	13.62
Total Variable Costs	597.11	382.94	238.49	772.21
Gross Margin	353.06	(16.10)	335.35	421.34
	($ per Acre Inch)			
Average Revenue per Inch of Irrigation	102.17	47.40	76.92	126.97
Gross Margin per Inch of Irrigation	37.96	($ 2.08)	45.95	44.82

Moisture Probe Evaluation, 2012

Site 51

Rooting activiy seen in the upper 20” of the profile, no activiy seen at the 40” depths. Lower profile was near capacity at the end of June with the upper 8” starting to deplete. The crop steadily pulls the upper 20” of the profile down, exceeding the system capacity through the middle of August. Rain events and decreased crop water use see the decline stop and then slowly start to build upper profile from rain and mid profile at the 20” level by the drip tape.

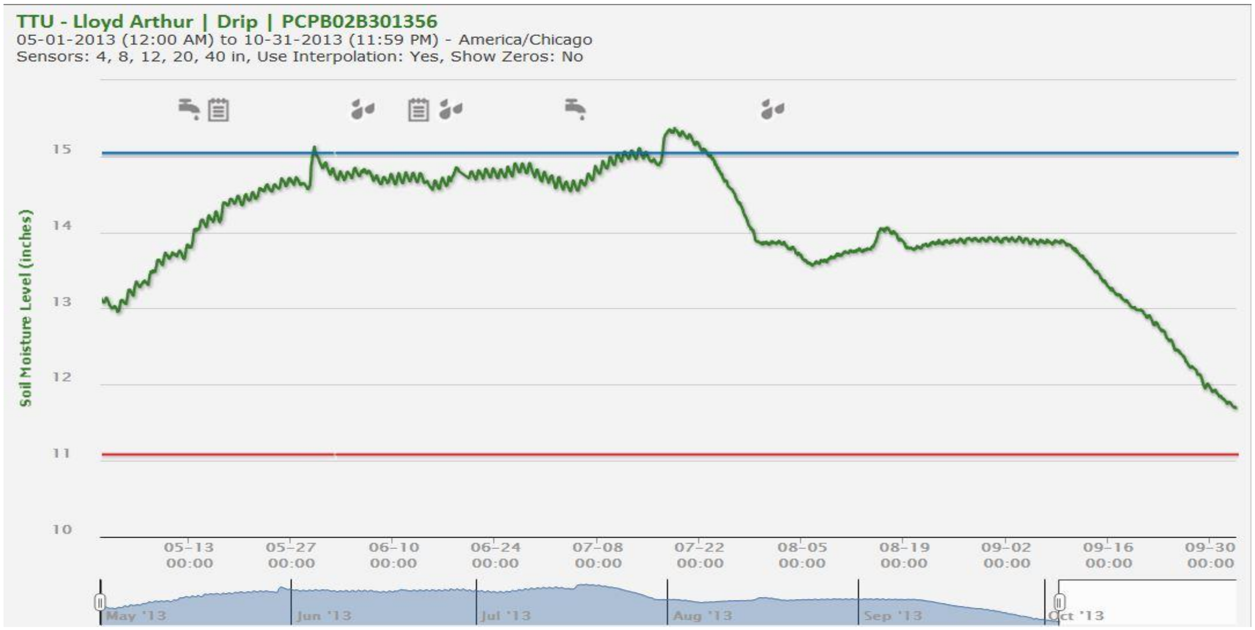


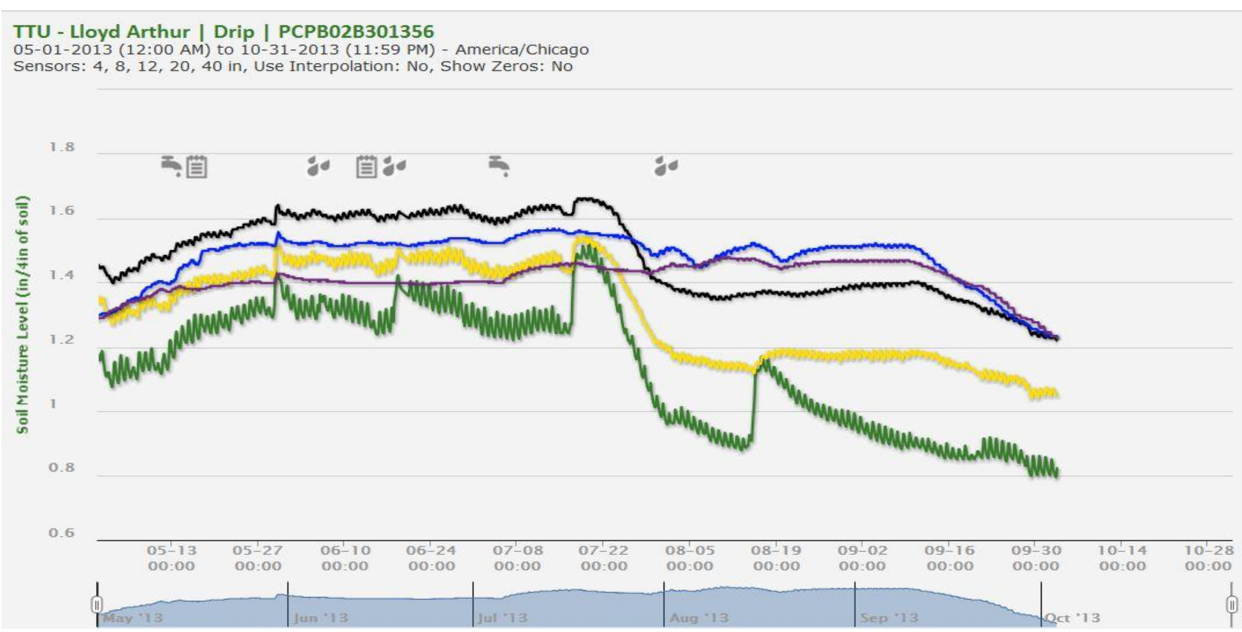


Moisture Probe Evaluation, 2013

Site 51

Preseason irrigation built a full profile with water moving into the 40" zone by end of May. Rain and irrigation kept the profile near field capacity all the way through July with the 40" zone continuing to build to near saturation. No significant root activity seen in the 20 and 40" zones until late season when profile was being drawn down.





Site 52 - Blake Davis Pivot

Location: Lamb County
Latitude: 33.92834, Longitude: -102.25682

135 Acres
Center Pivot – Low Elevation Spray Application

410 GPM, 3 Wells, 180-200 feet, pumping depth 300 feet
Electricity

System pressure of 15 PSI

Installed Equipment: PivoTrac® & John Deere Moisture Probe

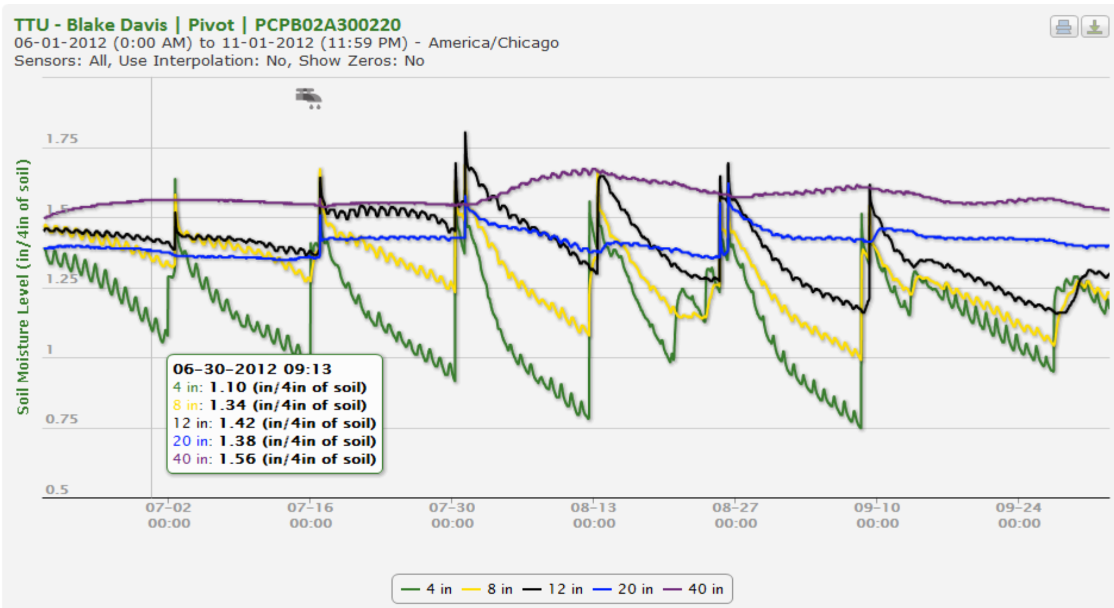
Soil Type: Amarillo fine sandy loam (62%), Acuff loam (31%), Olton clay loam (5%), and Midessa fine sandy loam (2%)

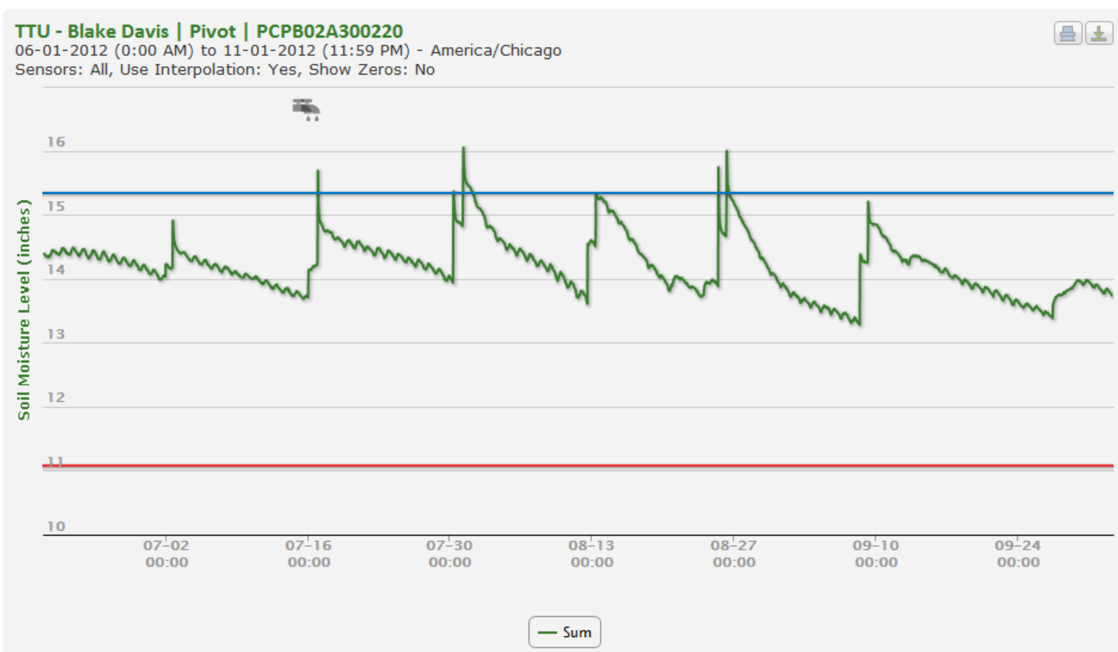
Crop Information Site 52			
	2012	2013	2014
Crop	Cotton (FM 2484)	Cotton (FM 2483)* Grain Sorghum (DK 4420)	Cotton (FM 1830)
Planted Acres	135 acres	Cotton: 135 acres Grain Sorghum: 135 acres	135 acres
Planting Date	5/04/2012	Cotton: 5/7/2013 Grain Sorghum: 6/11/2013	5/8/2014
Fertilizer	157-114-23-45	Cotton: none GS: 92-0-0	80-20-0-10
Herbicide	Touchdown	Cotton: Roundup, Prowl H2O GS: Milo Pro, Dual	Treflan, Direx, Roundup, Pentia
Insecticide	None	GS: Karate	None
Harvest Aids	Harvest Pro, Display, Gramoxone	None	Harvest Pro, Gramoxone
Tillage	Chisel, Plant	Cotton: Cut Stalks, Hoeme, Cultivate, Plant GS: Plant, Cultivate	Shred, Disc, Chisel, Field Cultivator, List, Rodweed, Plant, Cultivate
Irrigation	19.00 inches	Cotton: 7.3 inches GS: 7.9 inches	15.50 inches
Harvest Date	11/01/2012	GS: 10/13/2013	11/13/2014
Yield	Cotton Lint 1,181 lbs/ac Cotton Seed 0.85 tons/ac	Insurance: Cotton Lint: 371 lbs/ac Cotton Seed: 0.26 tons/ac GS: 127.86 bu/ac	Cotton Lint 997 lbs/ac Cotton Seed 0.71 tons/ac
Yield per Acre Inch	62.2 lbs of Lint	GS: 16.18 bu	64.3 lbs of Lint

Economic Information Site 52				
	2012	2013	2013	2014
	Primary Crop	Primary Crop	Secondary Crop	Primary Crop
	($ per Acre)			
Gross Income:				
Cotton Lint	1,062.90	308.05	-	648.05
Cotton Seed	238.42	58.79	-	141.20
Grain Sorghum	-	-	608.60	-
Total Gross Income	1,301.32	366.84	608.60	789.25
Variable Production Costs:				
Production Inputs	321.88	182.51	139.80	358.74
Irrigation	193.80	96.36	104.28	204.60
Harvest	252.07	0.00	46.54	217.43
Interest	18.05	8.32	7.37	16.90
Total Variable Costs	785.80	287.19	297.99	797.67
Gross Margin	515.52	79.65	310.61	(8.42)
	($ per Acre Inch)			
Average Revenue per Inch of Irrigation	68.49	54.64	77.04	50.92
Gross Margin per Inch of Irrigation	27.13	10.91	39.32	(0.54)

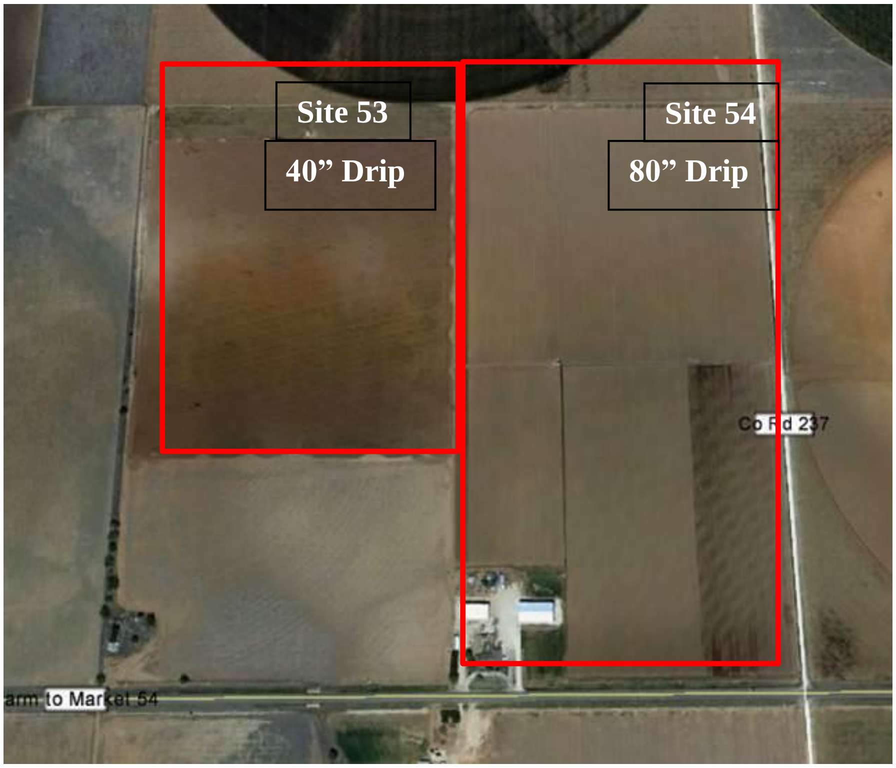
Site 52

Crop shows most activity above 20" through July, with a bit at the 20" level in August. Irrigation events moved water to the 40" profile over the course of the summer building the lower profile at 40". No root activity is seen at the 40" level all season. One concern I have is that activity flattened out quickly at the 20" level. There might be a possible clay lense or hard pan preventing the crop from rooting down into that lower moisture. This is evident in the sum graph as well, stepping stopping midway down the fairway of the budgett lines.





Site 53 & 54 - Blake Davis Drip



Location: Lamb County
Location 40” Drip: Latitude: 33.92431, Longitude: -102.26865
Location 80” Drip: Latitude: 33.92112, Longitude: -102.26485

Site 53
50 Acres
40” Drip
160 GPM
3 Wells, 180-200 feet, pumping depth 300 feet, Electricity
System pressure of 15 PSI
Soil Type: Acuff loam (77%), Zita loam (14%), Mansker loam (7%), and Olton clay loam (2%)

Site 54
85 Acres
80” Drip
180 GPM
2 Wells, 180-200 feet, pumping depth 300 feet, Electricity
System pressure of 14 PSI
Soil Type: Olton clay loam (89%), Acuff loam (9%), and Zita loam (2%)

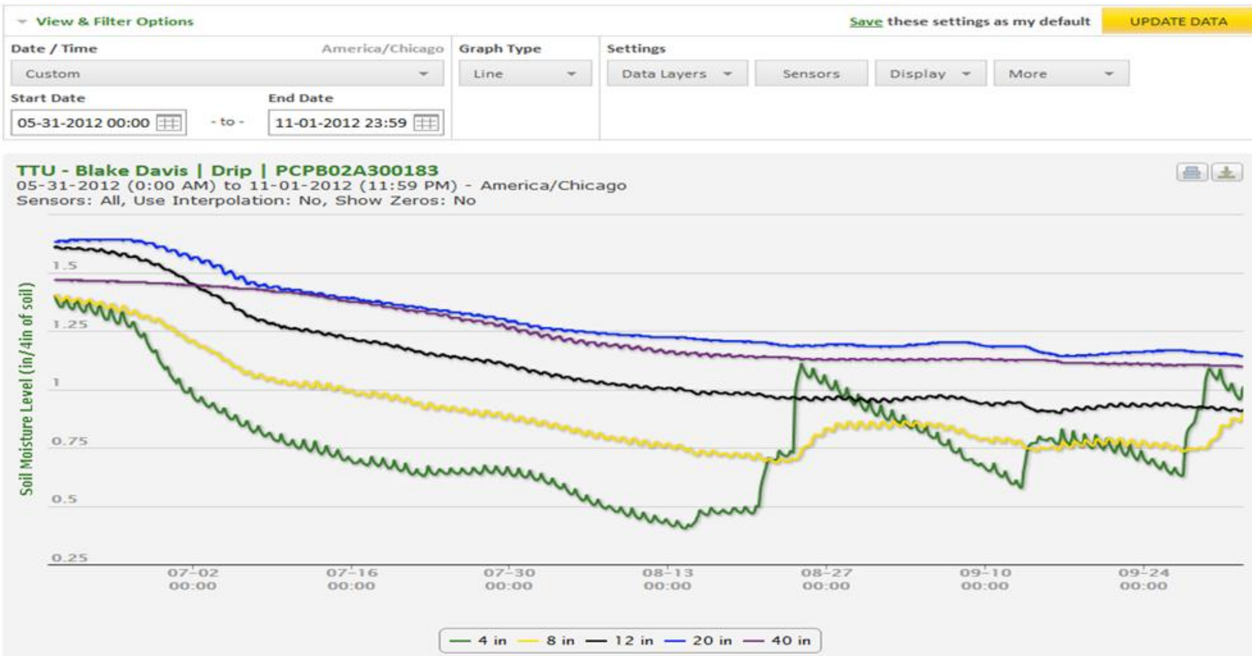
Crop Information			
Site 53			
	2012	2013	2014
Crop	Cotton	Cotton (FM 2484)* Grain Sorghum (DK 3707)	Cotton
Planted Acres	50 acres	Cotton: 50 acres Grain Sorghum: 50 acres	50 acres
Planting Date	5/03/2012	Cotton: 5/15/2013 Grain Sorghum: 6/14/2013	5/8/2014
Fertilizer	72-50-10-20	Cotton: none GS: 109-0-0	157-25-0-13
Herbicide	Touchdown	Cotton: Treflan, Roundup GS: Milo Pro, Dual	Treflan, Direx, Pentia & Roundup
Insecticide	Vydate	Karate	None
Harvest Aids	Harvest Pro, Display, Gramoxone	None	Harvest Pro
Tillage	Chisel, Plant, Cultivate	Cotton: : Chisel, Cut Stalks, List, Plant, Cultivate GS: Plant, Cultivate	Shred Stalks, Disc, Field Cultivator, Plant, Cultivate
Irrigation	17.75 inches	Cotton: 6.8 inches GS: 7.4 inches	8.44 inches
Harvest Date	10/20/2012	GS: 10/26/2013	11/14/2014
Yield	Cotton Lint 1,312 lbs/ac Cotton Seed 0.95 tons/ac	Insurance: Cotton Lint: 371 lbs/ac Cotton Seed: 0.26 tons/ac GS: 151.38 bu/ac	Cotton Lint 1,368 lbs/ac Cotton Seed 0.97 tons/ac
Yield per Acre Inch	73.9 lbs of Lint	GS: 20.45 bu	162 lbs of Lint

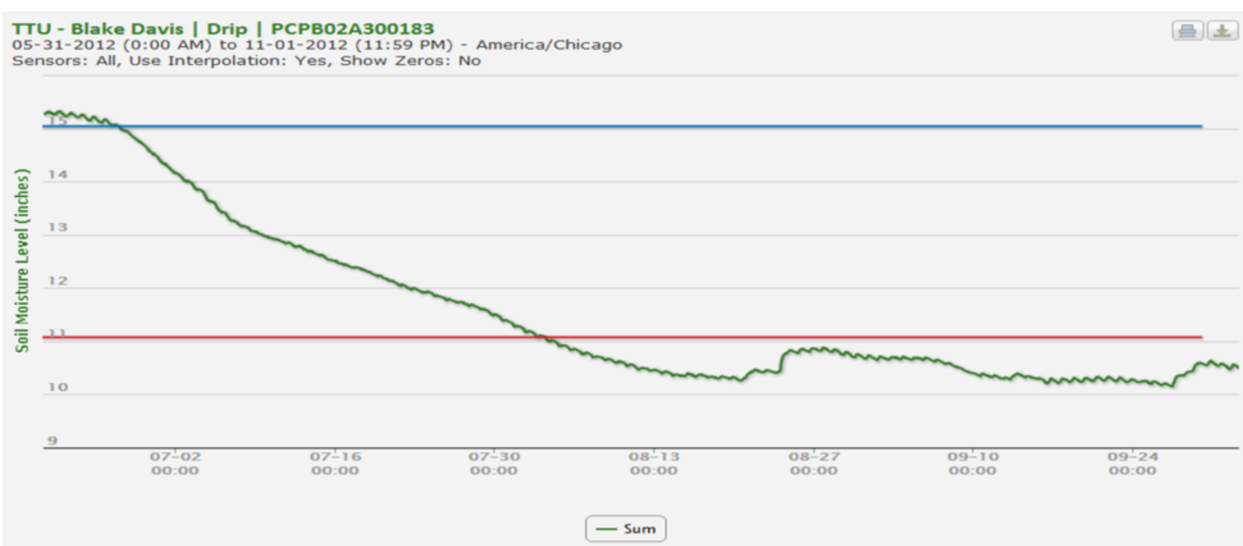
Economic Information Site 53				
	2012	**2013**	**2013**	**2014**
	Primary Crop	**Primary Crop**	**Secondary Crop**	**Primary Crop**
	($ per Acre)			
Gross Income:				
Cotton Lint	1,180.80	308.05	-	889.20
Cotton Seed	264.87	58.79	-	194.00
Grain Sorghum	-	-	720.55	-
Total Gross Income	1,445.67	366.84	720.55	1,083.20
Variable Production Costs:				
Production Inputs	276.27	184.38	147.27	385.81
Irrigation	181.05	89.76	97.68	111.41
Harvest	275.84	0.00	55.10	275.34
Interest	16.01	8.25	7.32	14.92
Total Variable Costs	749.16	282.39	307.37	787.48
Gross Margin	696.50	84.45	413.18	295.72
	($ per Acre Inch)			
Average Revenue per Inch of Irrigation	81.45	53.95	97.37	128.34
Gross Margin per Inch of Irrigation	39.24	12.42	55.84	35.04

Moisture Probe Evaluation, 2012

Site 53

Crop shows rooting activity in the upper 20” of the profile. There is a general downward trend in the 40” sensor as well, but not full steps. This would suggest capillary action to a root system active above that sensor. There is consistent moisture use out of all the upper profile and it exceeds system capability to meet crop demand. No major increase in soil moisture occurs until rain events near the end of the season. This only occurred at the 4” sensor range and slightly into the 8” sensor.





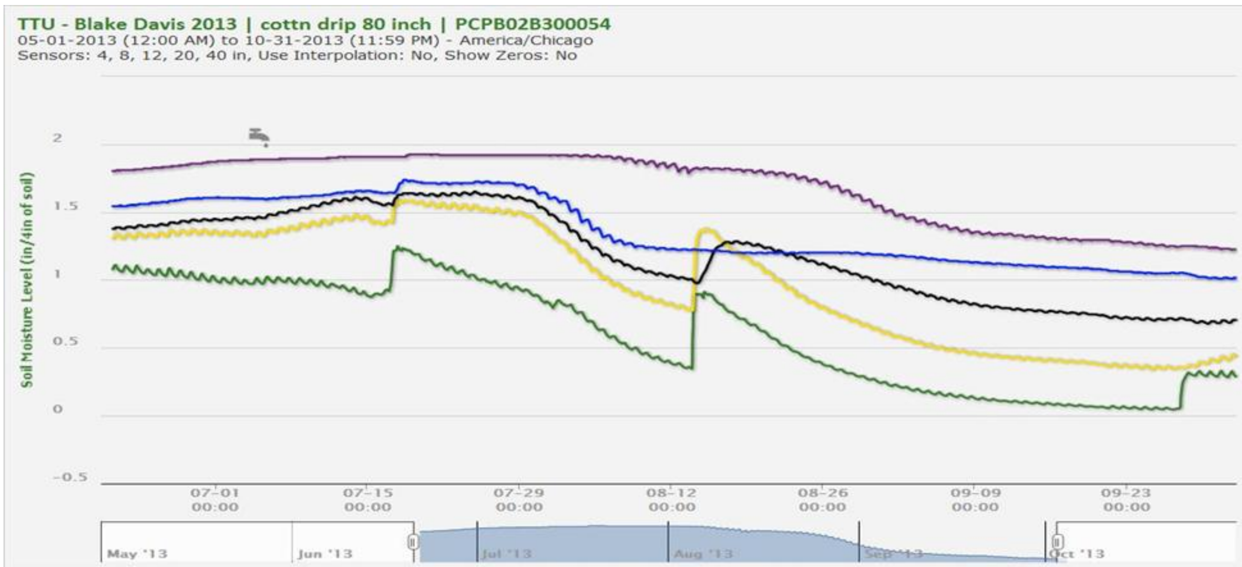
Crop Information			
Site 54			
	2012	2013	2014
Crop	Cotton	Cotton	Cotton
Planted Acres	89 acres	85 acres	80 acres
Planting Date	5/03/2012	5/02/2013	5/9/2014
Fertilizer	72-50-10-20	57-0-0	137-25-0-13
Herbicide	Touchdown	Treflan, Roundup	Treflan, Direx, Pentia & Roundup
Insecticide	Vydate	None	None
Harvest Aids	Harvest Pro, Display, Gramoxone	Prep	Harvest Pro & Gramoxone
Tillage	Chisel, Rodweed, Plant, Cultivate	Hoeme, Cut Stalks, Plant, List, Cultivate	Cut Stalks, Chisel, Field Cultivator, List, Rodweed, Plant, Cultivate
Irrigation	15.00 inches	8.8 inches	8.30 inches
Harvest Date	10/22/2012	10/17/2013	11/26/2014
Yield	Cotton Lint 1,036 lbs/ac Cotton Seed 0.75 tons/ac	Cotton Lint 1,127 lbs/ac Cotton Seed 0.83 tons/ac	Cotton Lint 1,337 lbs/ac Cotton Seed 0.95 tons/ac
Yield per Acre Inch	69.1 lbs of Lint	128.07 lbs of Lint	161 lbs of Lint

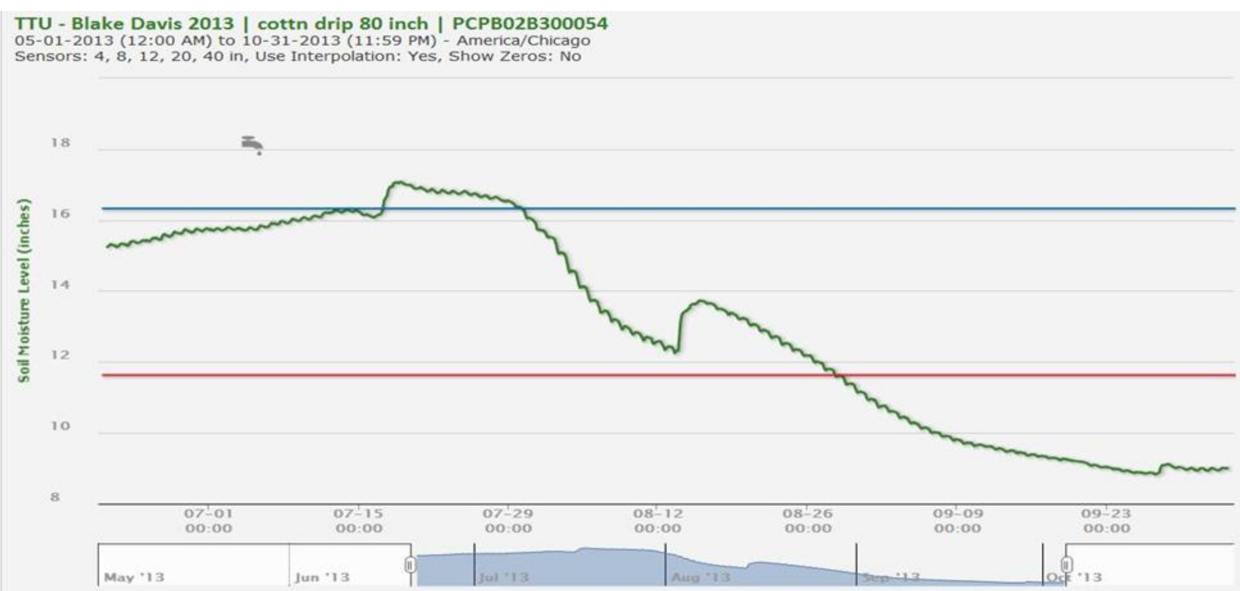
Economic Information			
Site 54			
	2012	2013	2014
	($ per Acre)		
Gross Income:			
Cotton Lint	932.40	901.60	869.05
Cotton Seed	209.15	215.80	189.58
Total Gross Income	1,141.55	1, 117.40	1,058.63
Variable Production Costs:			
Production Inputs	275.86	260.38	378.69
Irrigation	153.00	116.16	109.56
Harvest	223.90	228.62	281.71
Interest	15.01	11.30	14.65
Total Variable Costs	667.77	616.46	784.61
Gross Margin	473.78	500.94	274.02
	($ per Acre Inch)		
Average Revenue per Inch of Irrigation	76.10	126.98	127.54
Gross Margin per Inch of Irrigation	31.58	56.92	33.01

Moisture Probe Evaluation, 2013

Site 54

Early season irrigation was building profile. July 15 rain pushed water down to the 20” level. By late July crop water use was exceeding the irrigation application and significant stepping is seen down to the 40” zone. The interesting thing to note, there is a clay layer at 20” that won’t allow the crop to extract as much water from that level as from other parts of the profile. The 20” sensor flat lines in early August at a higher water holding level than the 4”,8” and 12” sensors, and not too much later we start to see the 40” sensor start stepping as the crop moves down to lower levels to get the needed water. Rain mid-August helped to catch up the upper profile.





Site 55 - Noah Estrada

*Site removed in 2013

Location: Castro County
Latitude 34.32372 Longitude -102.41385

121 Acres
Center Pivot – Low Elevation Spray Application
450 GPM

3 Wells, 385-400 feet, pumping depth 300 feet
Electricity

System pressure of 16 PSI

Soil Type: Olton clay loam (97%),
and Acuff loam (3%)

Crop Information Site 55 – Field 1	
	2012
Crop	Sorghum Seed
Planted Acres	60 acres
Planting Date	5/28/2012
Fertilizer	115-0-0-20
Herbicide	Valor, 2,4,-D, Roundup
Insecticide	Vydate
Harvest Aids	None
Tillage	Plant
Irrigation	22.50 inches
Harvest Date	10/04/2012
Yield	76.8 cwt/ac (137 bu/ac)
Yield per Acre Inch	3.41 cwt (6.1 bu)

Economic Information Site 55 – Field 1	
	2012
	($ per ac)
Gross Income:	
Grain	1,689.19
Total Gross Income	1,689.19
Variable Production Costs:	
Production Inputs	132.58
Irrigation	229.50
Harvest	46.79
Interest	12.67
Total Variable Costs	421.54
Gross Margin	1,267.65
	($ per ac in)
Average Revenue per Inch of Irrigation	75.07
Gross Margin per Inch of Irrigation	56.34

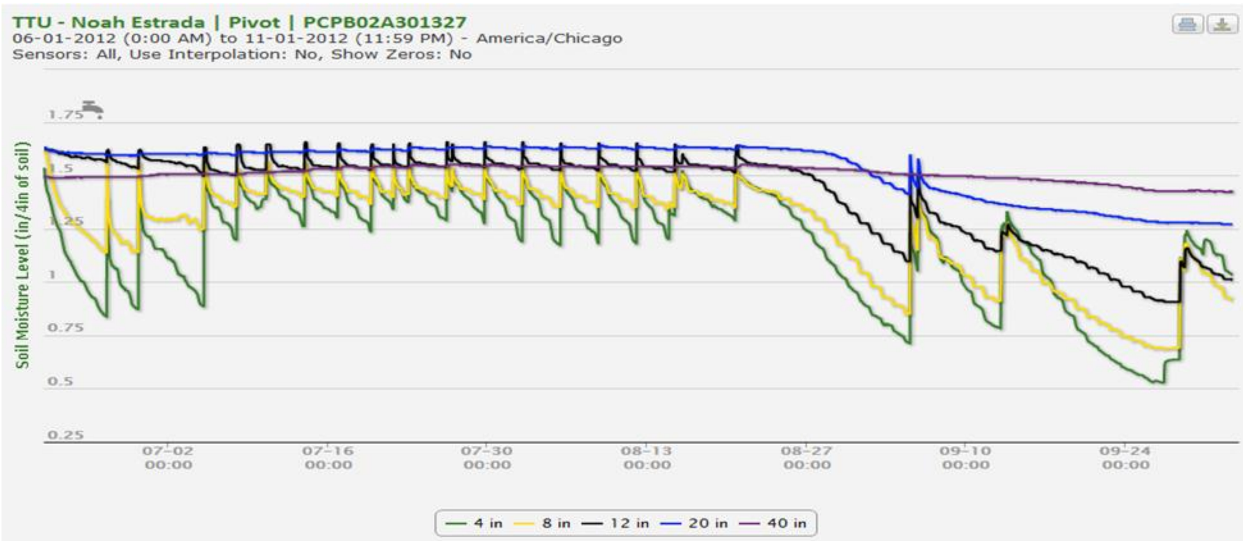
Crop Information Site 55 – Field 2	
	2012
Crop	Cotton (FM 2484)
Planted Acres	60 Acres
Planting Date	5/05/2012
Fertilizer	140-0-0-25
Herbicide	Valor, 2,4,-D, Dual, Roundup
Insecticide	Avicta (seed coat)
Harvest Aids	Pentia, Prep
Tillage	Plant
Irrigation	19.10 inches
Harvest Date	11/17/2012
Yield	Cotton Lint 1,353 lbs/ac Cotton Seed 0.97 tons/ac
Yield per Acre Inch	70.8 lbs of Lint

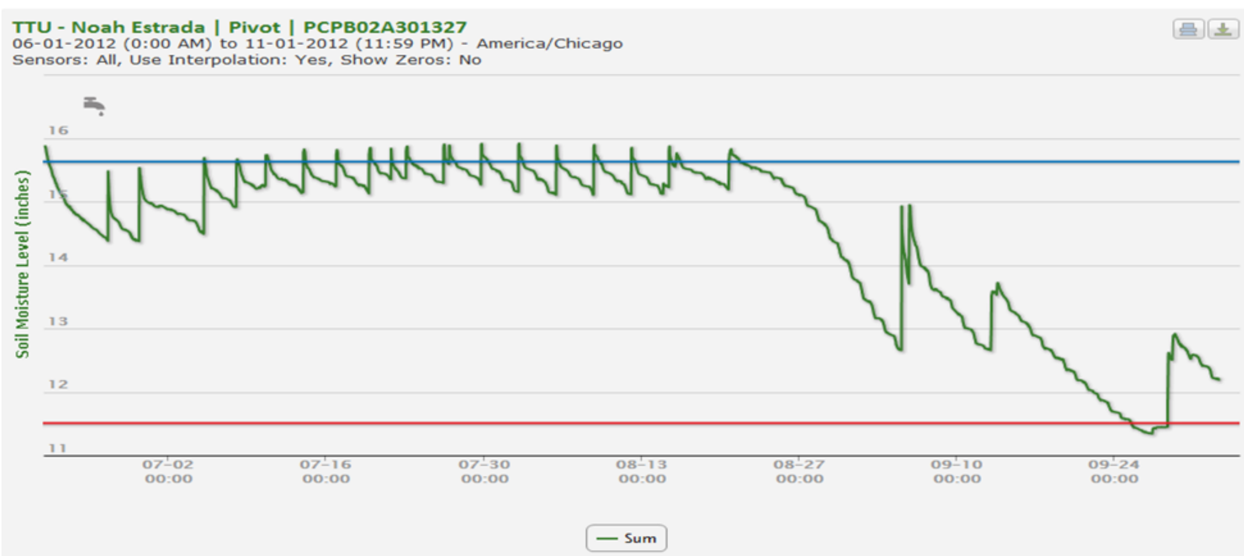
Economic Information Site 55 – Field 2	
	2012
	($ per ac)
Gross Income:	
Cotton Lint	1,217.70
Cotton Seed	272.76
Total Gross Income	1,490.46
Variable Production Costs:	
Production Inputs	301.92
Irrigation	194.82
Harvest	317.81
Interest	17.39
Total Variable Costs	831.93
Gross Margin	658.53
	($ per ac in)
Average Revenue per Inch of Irrigation	78.03
Gross Margin per Inch of Irrigation	34.48

Moisture Probe Evaluation, 2012

Site 55 Field 1

Crop developed active root system in the upper 12" of the profile for most of the season. No activity seen in the 20" level until the end of the season when the crop was finishing out and irrigation cycles had stopped. The profile was near field capacity all season long. The irrigation schedule was about every 4 days and the 20" to 40" profile was saturated most of the season. This pivot could be slowed down to allow more water use to occur between passes and the large applied amount to refill the profile. This would allow lower root system to pull water and nutrient from more of the profile during the growing season.





Site 56 - Jerry Don Glover

Location: Parmer County
Latitude: 34.44682, Longitude: -102.65717

125 Acres
Center Pivot – Low Elevation Spray Application
450 GPM

3 Wells, 385-400 feet, pumping depth 300 feet
Electricity

System pressure of 16 PSI

Soil Type: Olton clay loam (67%),
Amarillo fine sandy loam (15%),
Acuff loam (13%), and Estacado clay loam (5%)

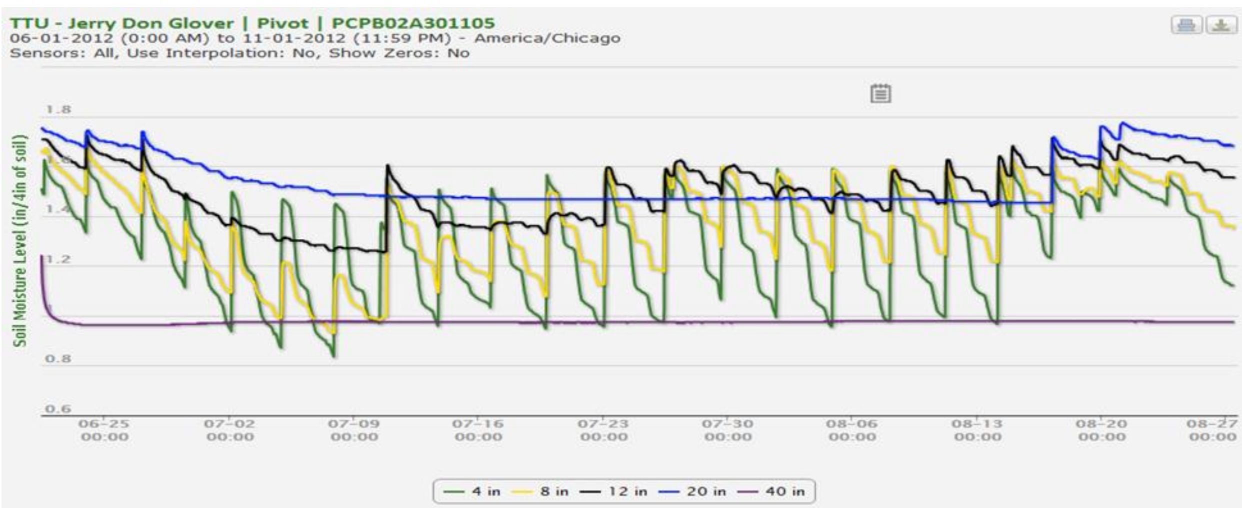
Crop Information			
Site 56			
	2012	2013	2014
Crop	Corn Silage (Chan. 7101R)	Corn Silage (Chan. 7101R)	Corn Silage (Pioneer 1625HR)
Planted Acres	80 acres	45 acres	45 acres
Planting Date	5/21/2012	5/13/2013	6/5/2014
Fertilizer	148-40-0-20	30-149-30-30, Manure	30-0-0-5, Manure
Herbicide	Bicep, Roundup	Roundup, Bicep Lite II	Bicep Lite II
Insecticide	Oberon	Oberon	None
Harvest Aids	None	None	None
Tillage	Strip till, Plant, Cultivate	Strip till, Plant	Chisel, Strip till, Plant
Irrigation	16.25 inches	14.60 inches	14.40 inches
Harvest Date	8/30/2012	8/25/2013	9/26/2014
Yield	18 tons/ac	20 tons/ac	24.67 tons/ac
Yield per Acre Inch	1.11 tons	1.37 tons	1.73 tons/ac

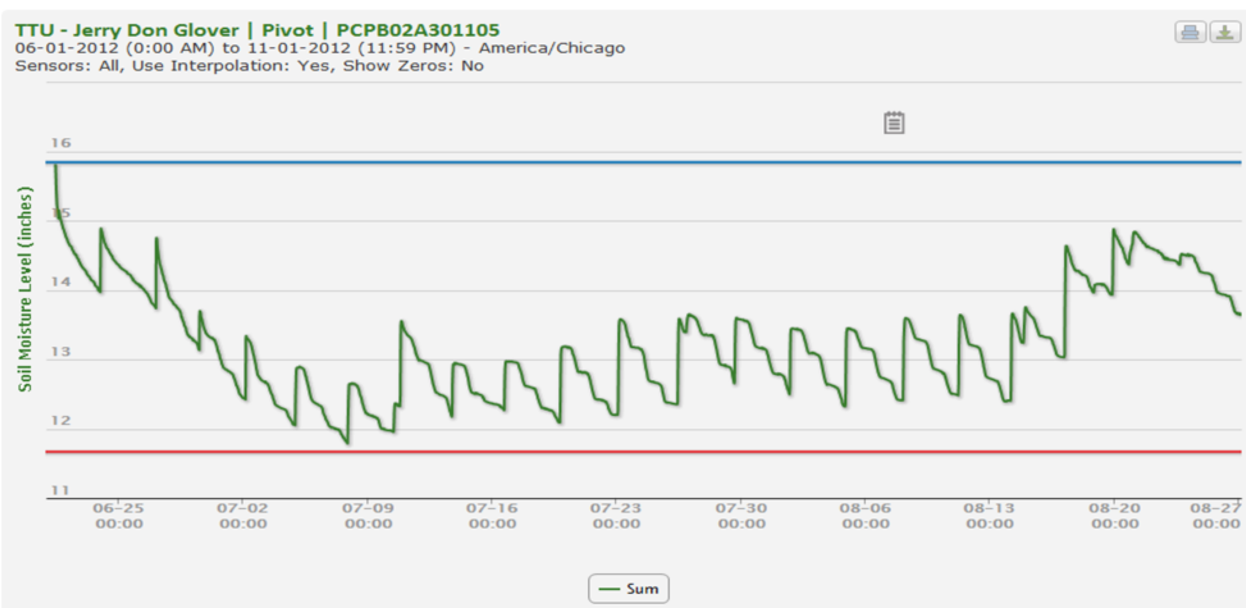
Economic Information			
Site 56			
	2012	2013	2014
	($ per Acre)		
Gross Income:			
Silage	783.00	900.00	754.90
Total Gross Income	783.00	900.00	754.90
Variable Production Costs:			
Production Inputs	328.40	417.10	267.73
Irrigation	165.75	192.72	190.08
Harvest	0.00	0.00	0.00
Interest	17.30	12.51	13.73
Total Variable Costs	511.45	429.62	471.55
Gross Margin	271.55	470.38	283.35
	($ per Acre Inch)		
Average Revenue per Inch of Irrigation	48.18	61.64	52.42
Gross Margin per Inch of Irrigation	16.71	32.22	19.68

Moisture Probe Evaluation, 2012

Site 56

Root activity seen mainly in the upper 12" of profile, while 20" sensor shows some stepping early in season. Frequent irrigations basically rewetted the upper 12" of profile and nothing moved into the lower profile. There is no sub moisture at the 40" profile on this field as it is the driest layer. Irrigation cycle was less than 3 day cycle. Slowing this machine down earlier in the season to allow moisture to move into lower profile and the crop to develop a deeper, active root system, would allow for more reserve for the crop. If anything were to happen to the well or pivot on this field it would be showing stress very quickly.





Site 57 - Bob Meyer

Location: Deaf Smith County
Latitude: 34.97939, Longitude: -102.41617

125 Acres
Center Pivot – Low Elevation Spray Application
750 GPM

4 Wells, 395-400 feet, pumping depth 300 feet
Electricity

System pressure of 17 PSI
Soil Type: Pullman clay loam (97%)
and Pep clay loam (3%)

Crop Information			
Site 57			
	2012	2013	2014
Crop	Corn (Planted to Pion. 32B09, hailed out and replanted to Pion. 35F40)	Corn (Pioneer 636 HR)	Corn Silage (Pioneer P0636)
Planted Acres	124 acres	115 acres	115 acres
Planting Date	5/24/2012 replanted 6/23/2012	6/27/2013	6/21/2014
Fertilizer	125-20-0-2.5	85-0-0	70-0-0
Herbicide	Salvo, Balance, Atrazine, Roundup	Roundup, Salvo, Balance, Atrazine, Rifle, Select, Crop Oil	Clothedine, Roundup, Status, Atrazine, Balance
Insecticide	None	None	None
Harvest Aids	None	None	None
Tillage	Strip till, Plant	Strip till, Plant	Strip till, Plant
Irrigation	20.85 inches	17.8 inches	11.54 inches
Harvest Date	11/3/2012	11/4/2013	10/10/2014
Yield	153 bu/ac	172.5 bu/ac	18.9 tons/ac
Yield per Acre Inch	7.34 bu	9.69 bu	1.64 tons

Economic Information			
Site 57			
	2012	2013	2014
	($ per Acre)		
Gross Income:			
Grain	918.00	862.50	578.34
Insurance	534.91	-	-
Total Gross Income	1,452.91	862.50	578.34
Variable Production Costs:			
Production Inputs	362.73	248.77	287.23
Irrigation	212.67	234.96	152.33
Harvest	64.26	72.45	0
Interest	20.14	14.51	13.19
Total Variable Costs	659.80	570.69	452.75
Gross Margin	793.11	291.81	125.59
	($ per Acre Inch)		
Average Revenue per Inch of Irrigation	69.68	48.46	50.12
Gross Margin per Inch of Irrigation	38.04	16.39	10.88

Site 58 - Randy McGee Pivot

Location: Lubbock County
Latitude: 33.70020, Longitude: -101.66121

119.8 Acres
Center Pivot – Low Elevation Spray Application
400 GPM

2 Wells, pumping depth 300 feet
Electricity

System pressure of 20 PSI

Installed Equipment: J.D. CropSense and Net Irrigate

Soil Type: Olton clay loam (81%), Pullman clay loam (11%) and Zita loam (9%)

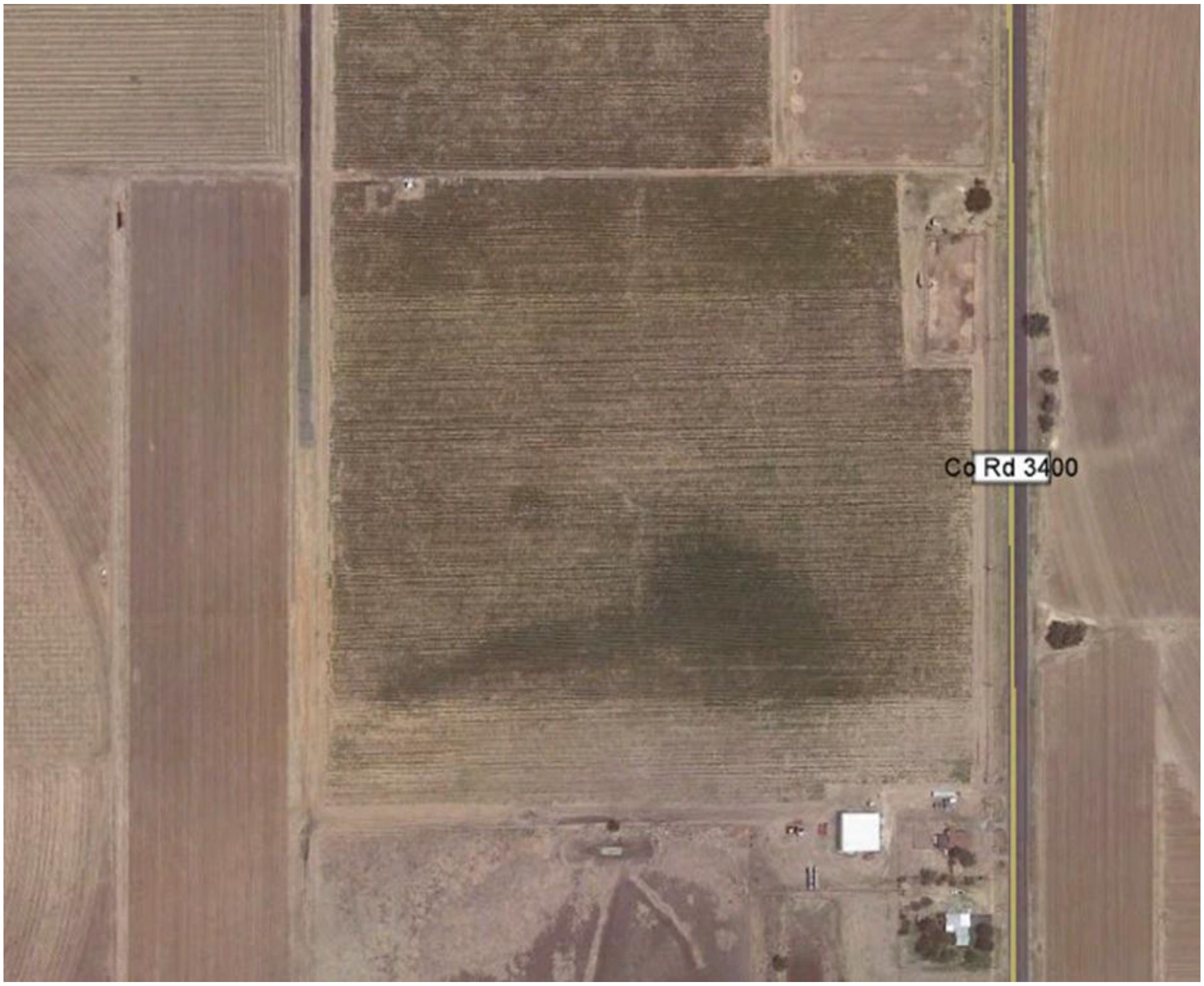
Crop Information		
Site 58 – Field 1		
	2013	2014
Crop	Wheat (Tam 111)	Triticale Hay
Planted Acres	60 acres	60 acres
Planting Date	10/7/2012	9/25/2013
Fertilizer	Potash	10-48-0
Herbicide	None	None
Insecticide	None	None
Harvest Aids	None	None
Tillage	Planter drill	Planter drill
Irrigation	9.1 inches	12.6 inches
Harvest Date	5/15/2013	5/21/2014
Yield	46.43 bu/ac	1.78 tons/ac
Yield per Acre Inch	5.1 bu	0.14 tons

Economic Information		
Site 58 – Field 1		
	2013	2014
	($ per Acre)	
Gross Income:		
Wheat	78.00	-
Triticale Hay	-	249.20
Total Gross Income	78.00	249.20
Variable Production Costs:		
Production Inputs	89.97	84.58
Irrigation	120.12	166.32
Harvest	39.00	71.20
Interest	6.30	7.53
Total Variable Costs	255.39	329.63
Gross Margin	(177.39)	(80.43)
	($ per Acre Inch)	
Average Revenue per Inch of Irrigation	$8.57	19.78
Gross Margin per Inch of Irrigation	($19.49)	($6.38)

Crop Information		
Site 58 – Field 2		
	2013	2014
Crop	Alfalfa (Pioneer)	Alfalfa (Pioneer)
Planted Acres	60 acres	60 acres
Planting Date	6/6/2013	Established
Fertilizer	None	12-46-4-15
Herbicide	None	Traxion, Gramoxone
Insecticide	None	None
Harvest Aids	None	None
Tillage	Planter	None
Irrigation	18.3 inches	20.7 inches
Harvest Date	Various	Various
Yield	7.1 tons/ac	7.1 tons/ac
Yield per Acre Inch	0.39 tons	0.34 tons

Economic Information		
Site 58 – Field 2		
	2013	2014
	($ per Acre)	
Gross Income:		
Alfalfa Hay	1775.00	1874.40
Total Gross Income	1775.00	1874.40
Variable Production Costs:		
Production Inputs	167.72	80.98
Irrigation	241.56	273.24
Harvest	284.00	284.00
Interest	12.28	10.63
Total Variable Costs	705.56	648.85
Gross Margin	1069.44	1225.55
	($ per Acre Inch)	
Average Revenue per Inch of Irrigation	96.99	90.55
Gross Margin per Inch of Irrigation	58.44	59.21

Site 59 – Randy McGee Drip



Location: Lubbock County
Latitude 33.67292 Longitude -101.66833

93 Acres
Sub-Drip Irrigation
350 GPM

2 Wells, pumping depth 300 feet
Electricity

System pressure of 25 PSI

Installed Equipment: Aqua Spy Probe and Net Irrigate

Soil Type: Olton clay loam (72%) and Pullman clay loam (28%)

Field 1 in 2014 was the combination of the 75 acres seeded to alfalfa and 18 acres of established alfalfa from field 2. This change by the producer was to better allocate available irrigation capacity. Field 2 was terminated from the project following the 2013 crop.

Crop Information		
Site 59 – Field 1		
	2013	2014
Crop	Corn Silage (Pioneer 0636 HR)	Alfalfa (Transition6.1 RR)
Planted Acres	75 acres	93 acres
Planting Date	4/26/2013	9/25/2013
Fertilizer	121-0-0-7	18.7 lbs of 3-15-0
Herbicide	Parallel, Glystar, Duke, Interlock	None
Insecticide	Hatchet	None
Harvest Aids	None	None
Tillage	Cut stalks, Disk, Chisel, Float, Plant	Drill
Irrigation	15.50 inches	15.10 inches
Harvest Date	9/7/2013	Various
Yield	27.7 tons/Ac	10.34 tons/ac
Yield per Acre Inch	1.79 tons	0.68 tons/ac

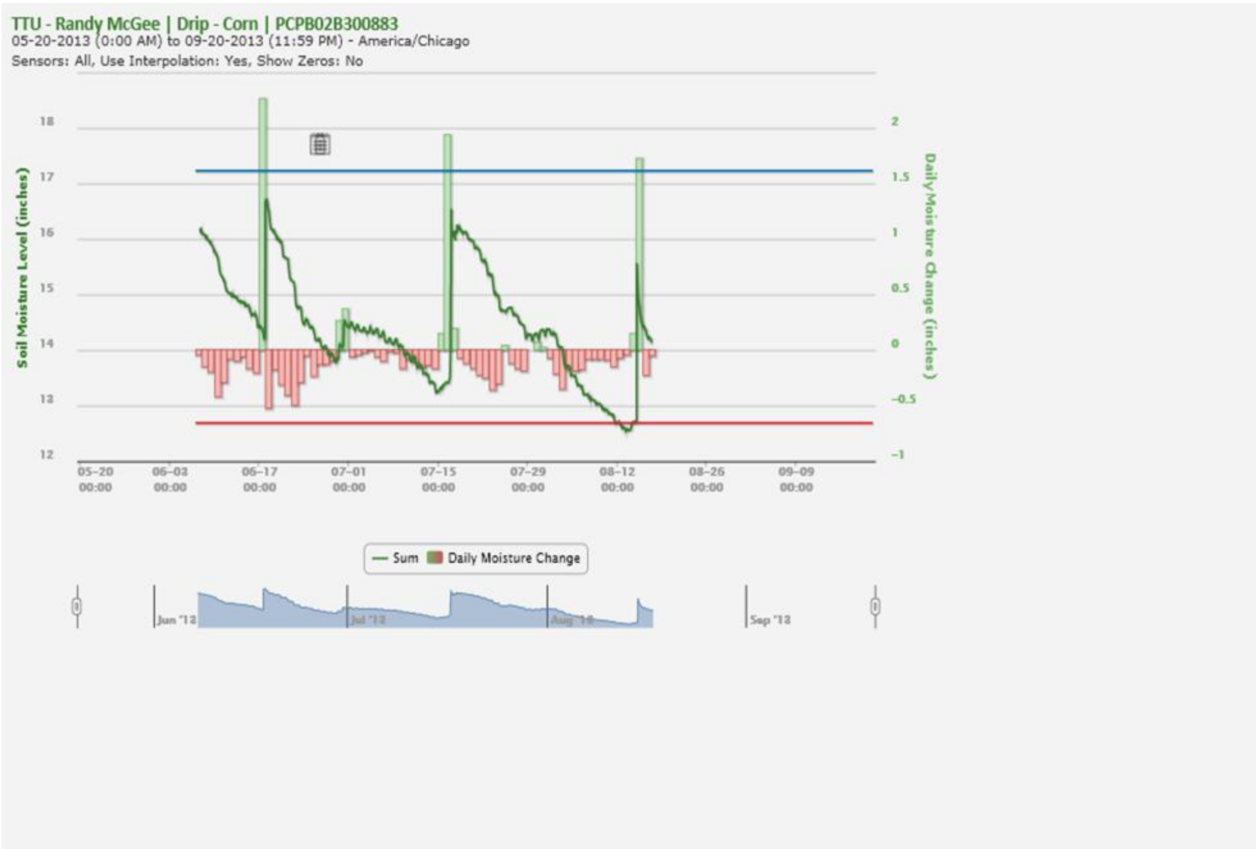
Economic Information		
Site 59 – Field 1		
	2013	2014
	($ per Acre)	
Gross Income:		
Corn Silage	1,246.50	-
Alfalfa	-	2,729.76
Total Gross Income	1,246.50	2,729.76
Variable Production Costs:		
Production Inputs	281.76	181.55
Irrigation	204.60	199.32
Harvest	0.00	413.60
Interest	14.59	11.43
Total Variable Costs	500.95	805.90
Gross Margin	745.55	1,923.86
	($ per Acre Inch)	
Average Revenue per Inch of Irrigation	80.42	180.78
Gross Margin per Inch of Irrigation	48.10	127.40

Crop Information Site 59 – Field 2	
	2013
Crop	Alfalfa (Pioneer)
Planted Acres	76 Acres
Planting Date	5/1/2013
Fertilizer	77-0-0-3
Herbicide	None
Insecticide	None
Harvest Aids	None
Tillage	Cut stalks, Disk, Chisel, Float, Plant
Irrigation	15.50 inches
Harvest Date	Various
Yield	9.5 tons/Ac
Yield per Acre Inch	0.41 tons

Economic Information Site 59 – Field 2	
	2013
	($ per Acre)
Gross Income:	
Alfalfa	2,375.00
Total Gross Income	2,375.00
Variable Production Costs:	
Production Inputs	145.39
Irrigation	304.92
Harvest	380.00
Interest	13.51
Total Variable Costs	843.82
Gross Margin	1531.18
	($ per Acre Inch)
Average Revenue per Inch of Irrigation	102.81
Gross Margin per Inch of Irrigation	66.28

Moisture Probe Evaluation, 2013

Site 59 Field 1 – Corn Silage



Site 60 - Barry Evans Pivot

Location: Swisher County
Latitude 34.32910 Longitude -101.76338

59.5 Acres
Center Pivot – Low Elevation Spray Application
290 GPM

3 Wells, pumping depth 280 feet
Electricity

System pressure of 18-20 PSI

Installed Equipment: J.D. CropSense and Net Irrigate

Soil Type: Pullman clay loam (93%) and Lofton clay loam (7%)

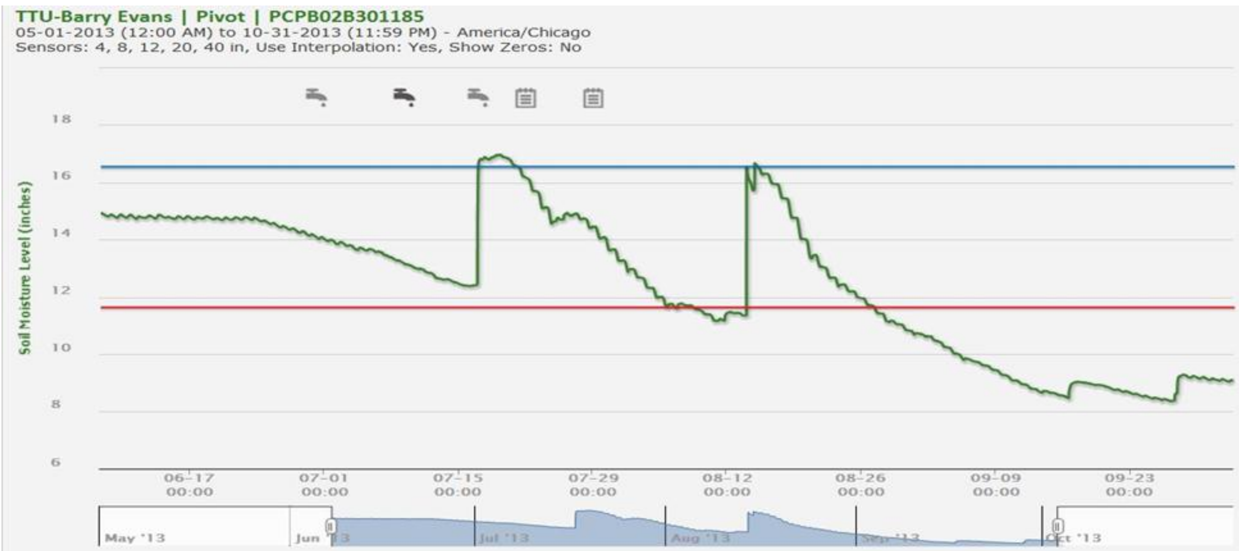
Crop Information		
Site 60		
	2013	2014
Crop	Cotton (FM 9250)	Grain Sorg. (GA 5875)
Planted Acres	59.5 acres	59.5 acres
Planting Date	5/10/2013	6/7/2014
Fertilizer	Manure	121-0-0
Herbicide	Roundup, Caparol, Cyclone, Crop Oil, Metochlor, Ignite, Pix Plus, MSMA, Valor	Atrazine, Metolachlor, Cyclone, Huskie
Insecticide	Acephate	None
Harvest Aids	Ethephon	None
Tillage	Planter	Drill
Irrigation	11.60 inches	9.80 inches
Harvest Date	10/7/2013	10/15/2014
Yield	Cotton Lint 1,533 lbs/ac Cotton Seed 1.1 tons/ac	Grain 48.98 cwt
Yield per Acre Inch	132.16 lbs of Lint	5.00 cwt

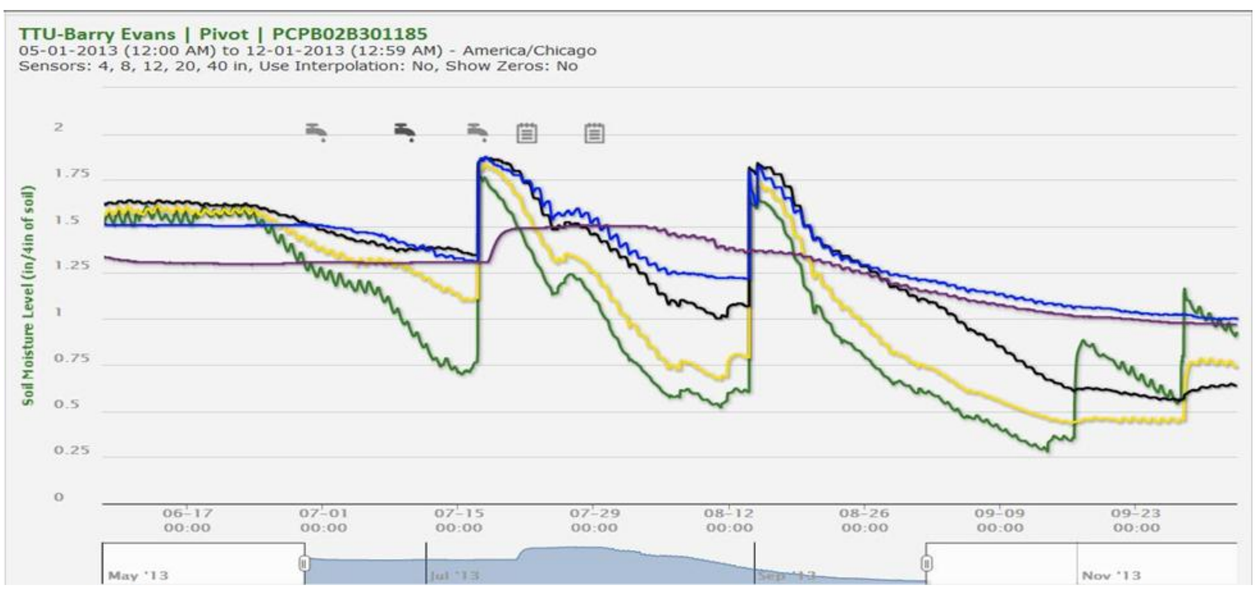
Economic Information		
Site 60		
	2013	2014
	($ per Acre)	
Gross Income:		
Cotton Lint	1,226.40	-
Cotton Seed	285.48	-
Grain Sorghum		270.86
Total Gross Income	1,511.88	270.86
Variable Production Costs:		
Production Inputs	356.53	184.16
Irrigation	153.12	129.36
Harvest	308.92	36.74
Interest	15.29	9.41
Total Variable Costs	833.85	359.66
Gross Margin	678.03	-88.80
	($ per Acre Inch)	
Average Revenue per Inch of Irrigation	130.33	27.64
Gross Margin per Inch of Irrigation	58.45	-9.06

Moisture Probe Evaluation, 2013

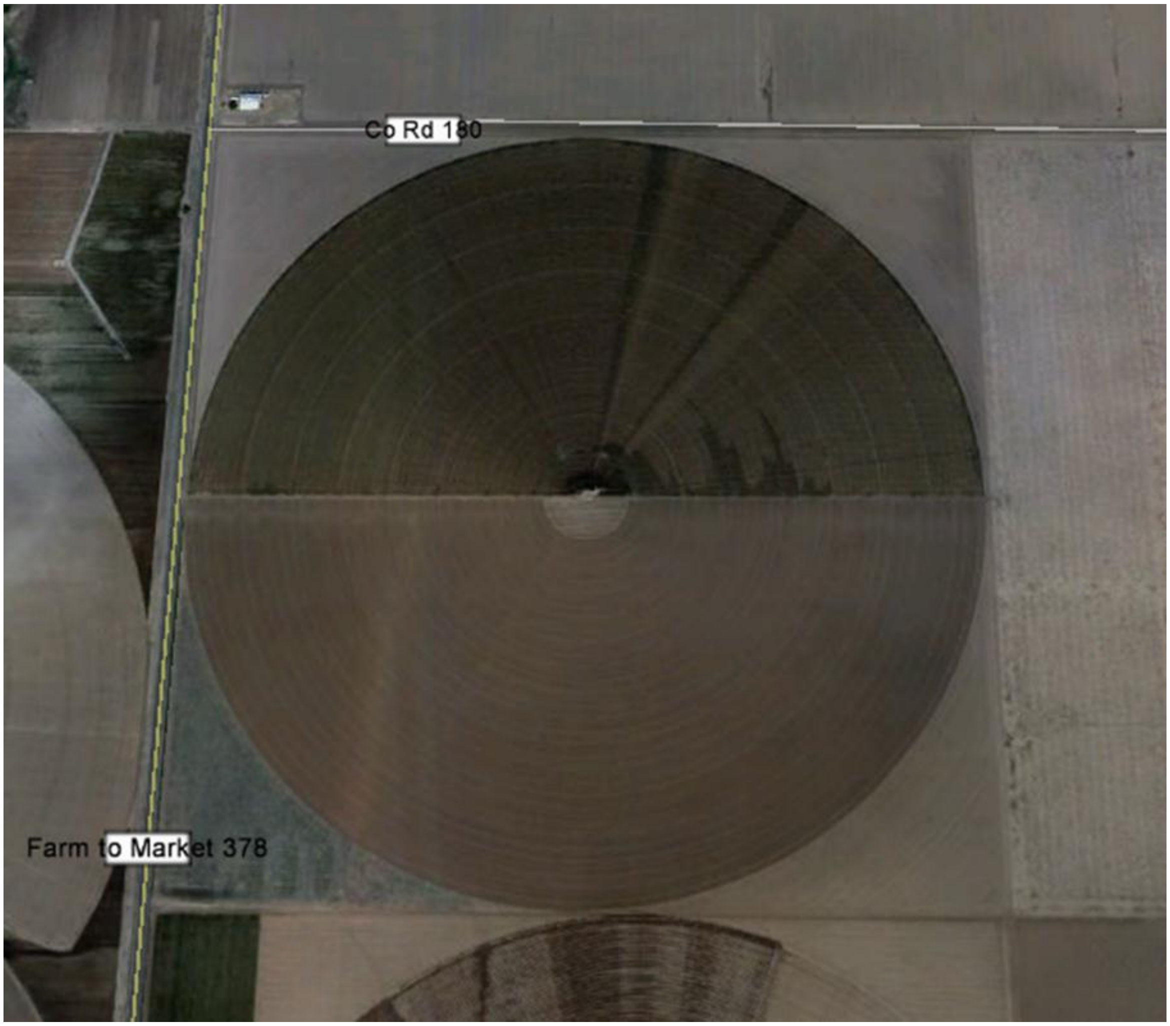
Site 60

Irrigation passes quit meeting crop use by late June and do not even register on the probe. The rainfall events refilled the profile July 15 and August 12. Root activity seen to 20" by July 15 and by the first of August activity seen at the 40" level. Would recommend slowing this machine down the next season and try to get a better wetted profile. The current passes are not soaking over to the probe and the evaporation loss is wasting water. By running slower and putting more water down with fewer passes will result in less total water evaporation loss over the course of the season and net more water for the crop.





Site 21 – Eddie Teeter



Location: Floyd County
Latitude: 34.075962, Longitude: -101.440029

123 Acres
Center Pivot
400 GPM

1 Wells, 350 feet, pumping depth 300 feet
Electricity

System pressure of 18 PSI

Soil Type: Pullman clay loam (95%)
and Lofton clay loam (5%)

Crop Information			
Site 21 - Field 1			
	2012	2013	2014
Crop	Wheat/Hay Grazer	Corn (Pioneer 32 B16)	Wheat/Hay Grazer
Planted Acres	61 acres	61 acres	61.2 acres
Planting Date	Wheat 10/18/2011 Hay Grazer 5/20/2012	4/25/2013	Wheat 10/05/2013 Hay Grazer 7/7/2014
Fertilizer	132-0-0	197-14-0, 2 lbs Z	136-0-0
Herbicide	None	Aatrex, Medal	None
Insecticide	None	None	None
Harvest Aids	None	None	None
Tillage	Shred, Disc, Drill,	Culitivate, List, Coulter, Bed Roller, Rodweed, Plant	Disc (2), Drill,
Irrigation	Wheat 7.6 inches Hay Grazer 15.6 inches Total 23.2 inches	20.7 inches	Wheat 10.5 inches Hay Grazer 5.0 inches Total 15.5 inches
Harvest Date	Wheat 5/26/2012 Hay Grazer 8/15/2012	9/27/2013	Wheat 6/29/2014 Hay Grazer 10/29/2014
Yield	Wheat 23.6 bu Hay Grazer 4.6 bales	239 bu	Wheat 23.79 bu Hay Grazer 9.2 bales
Yield per Acre Inch	Wheat 3.1 bu Hay Grazer 0.30 bales	11.55 bu	Wheat 2.27 bu Hay Grazer 1.84 bales

Economic Information			
Site 21 - Field 1			
	2012	2013	2014
	($ per Acre)		
Gross Income:			
Wheat	161.66	-	162.96
Hay Grazer	575.00	-	782.00
Corn	-	1625.20	-
Total Gross Income	736.66	1625.20	944.96
Variable Production Costs:			
Production Inputs	159.19	377.58	208.17
Irrigation	236.64	273.24	204.60
Harvest	150.98	100.38	61.23
Interest	13.85	19.52	12.38
Total Variable Costs	560.66	770.72	486.38
Gross Margin	176.00	854.48	458.38
	($ per Acre Inch)		
Average Revenue per Inch of Irrigation	31.75	78.51	60.97
Gross Margin per Inch of Irrigation	7.59	41.28	29.59

Crop Information			
Site 21 - Field 2			
	2012	2013	2014
Crop	Cotton (FM 1970)	Wheat/Hay Grazer	Cotton (FM 2484B2F)
Planted Acres	61 acres	61.2 acres	60.6 acres
Planting Date	5/02/2012	Wheat 11/2/2012 Hay Grazer 7/6/2013	5/10/2014
Fertilizer	112-0-0	96-0-0	103-0-0, NZN
Herbicide	Trifluralin, Capparo, Dual, Roundup	Atrazine	Trifluralin, Parrot, Brawl, Roundup, Cut Rate, R11, Hoeing
Insecticide	None	None	None
Harvest Aids	Penta	None	Stance, Prep, Folex, Cyclone
Tillage	Chisel, List, Rodweed, Plant, Rotary Hoe	Drill	Disc (3), Ripper, Cultivate, List, Bed Roller, Plant, Rotary Hoe (2)
Irrigation	15.60 inches	Wheat 15.5 inches Hay Grazer 3.6 inches Total 19.1 inches	10.4 inches
Harvest Date	10/18/2012	Wheat 6/29/2013 Hay Grazer 9/25/2013	10/28/2014
Yield	Cotton Lint 1,540 lbs Cotton Seed 1.11 tons	Wheat 24.9 bu Hay Grazer 4.28 bales	Cotton Lint 1,156 lbs Cotton Seed 0.82 tons
Yield per Acre Inch	98.7 lbs of lint	Wheat 1.61 bu Hay Grazer 1.19 bales	111.15 lbs of lint

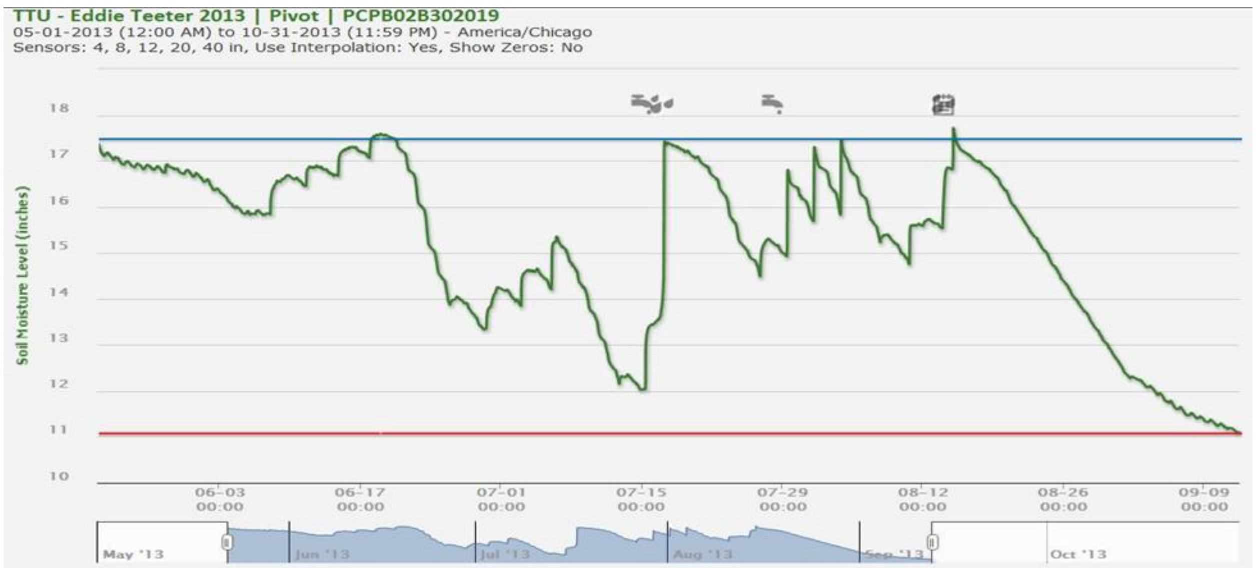
Economic Information			
Site 21 - Field 2			
	2012	2013	2014
	($ per Acre)		
Gross Income:			
Cotton Lint	1386.00	-	751.40
Cotton Seed	310.90	-	163.92
Wheat	-	170.57	-
Hay Grazer	-	256.80	-
Total Gross Income	1696.90	427.37	915.32
Variable Production Costs:			
Production Inputs	327.95	142.83	413.02
Irrigation	159.12	252.12	137.28
Harvest	249.67	34.03	274.45
Interest	17.05	11.85	16.51
Total Variable Costs	753.79	440.83	841.25
Gross Margin	943.11	-13.46	74.07
	($ per Acre Inch)		
Average Revenue per Inch of Irrigation	108.78	22.38	88.01
Gross Margin per Inch of Irrigation	60.46	-0.70	7.12

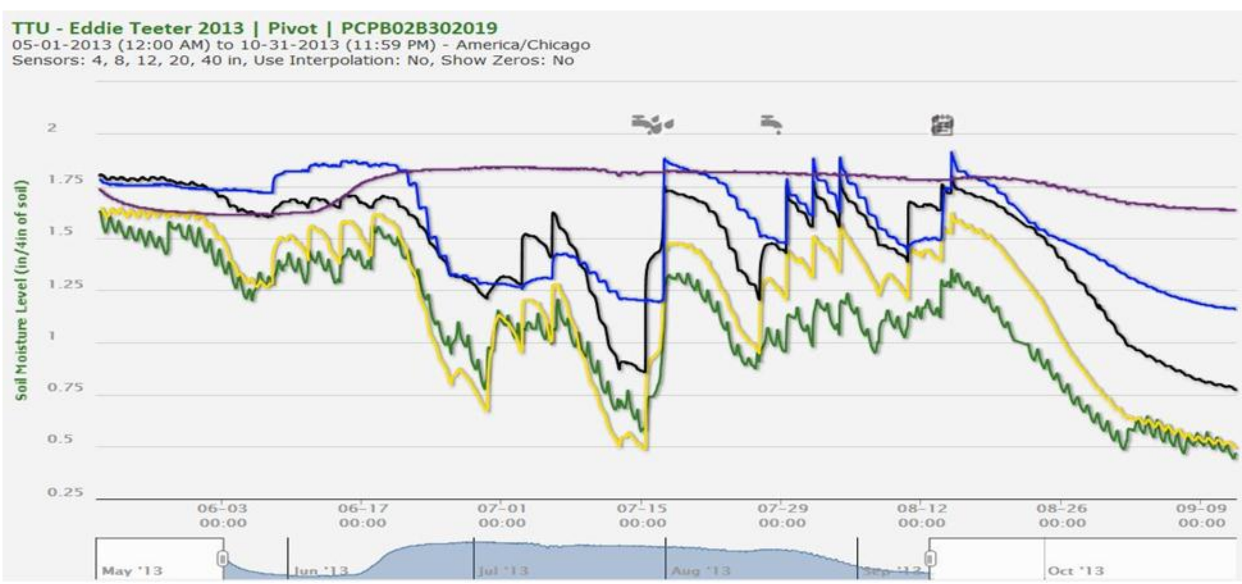
Economic Information Total for Site 21						
	2012		2013		2014	
	$/Ac	$/Ac In	$/Ac	$/Ac In	$/Ac	$/Ac In
Total Gross Income	966.78	49.83	1027.76	51.62	930.31	71.76
Variable Production Costs:						
Pre-Harvest	362.69	18.70	523.10	26.28	481.19	37.12
Harvest	200.33	10.33	67.26	3.38	167.31	12.91
Interest	15.45	0.80	15.69	0.79	14.44	1.11
Total Variable Costs	578.56	29.83	606.05	30.45	662.94	51.14
Gross Margin	559.56	28.84	421.21	21.17	267.27	20.62

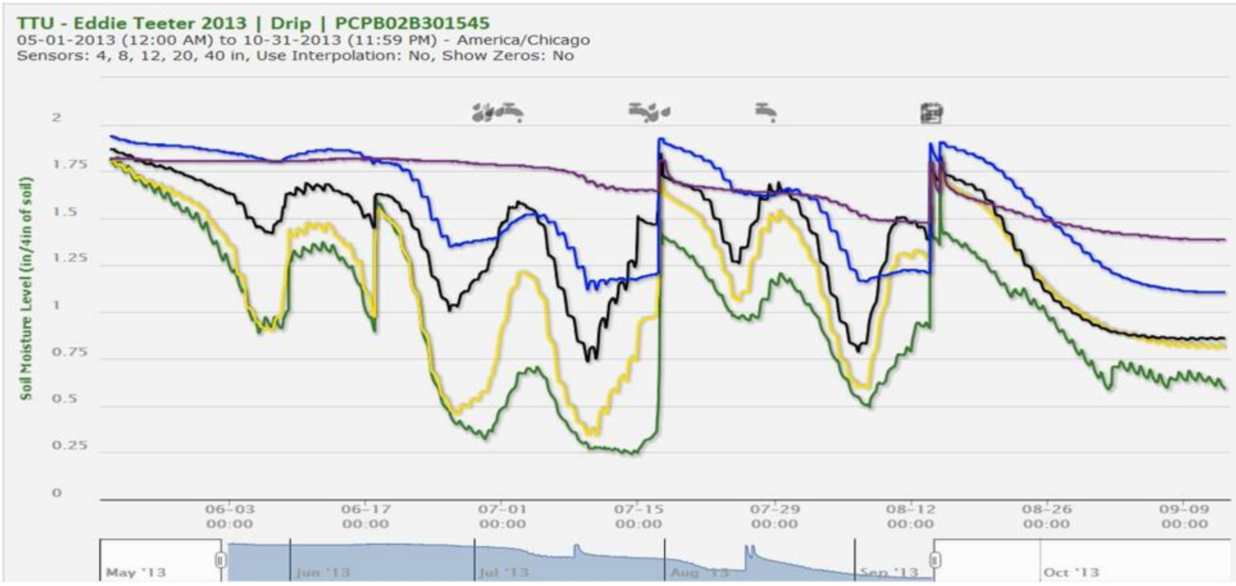
Moisture Probe Evaluation, 2013

Site 21 Field 1

June Irrigation cycle of 4 passes built profile moisture to the 40" level with root activity only in the top 12". Stopping the irrigation passes allowed the crop to pull moisture from the 20" profile and establish a good stepping pattern. The two irrigation cycles of 4 passes each in July were building profile moisture with root activity seen immediately to the 20" level after each pass in late July. These were good patterns and root activity for the season. No root activity seen at the 40" level all season. Possible water management suggestion: slow pivot down to see if longer cycle time and increased crop water use will match application. If profile continues building, then field has greater well capacity than crop water use.



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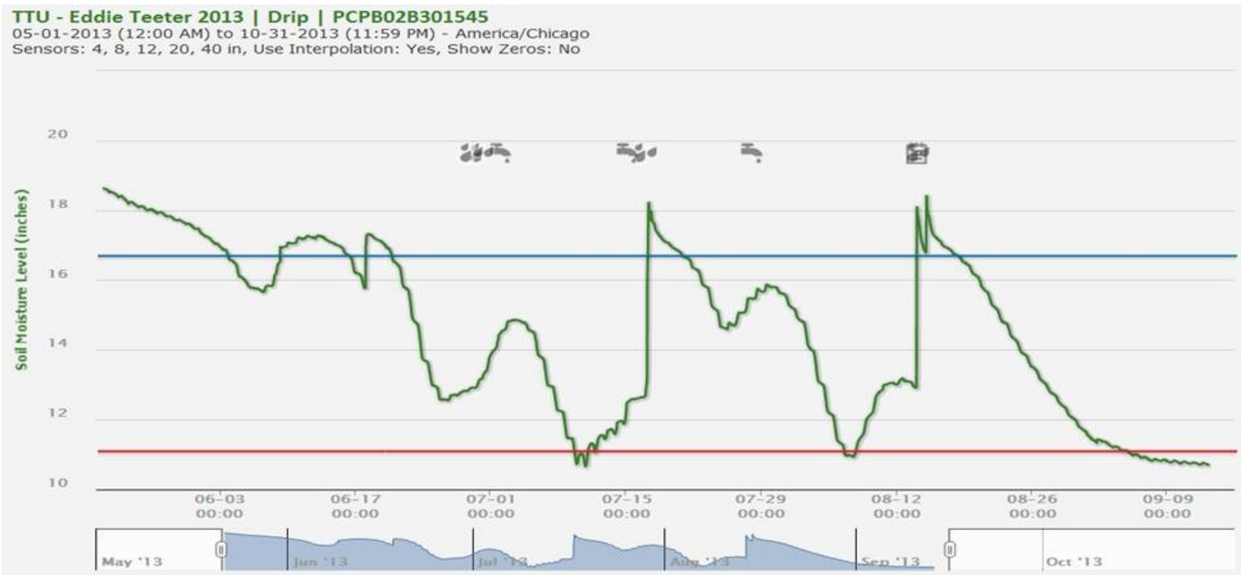
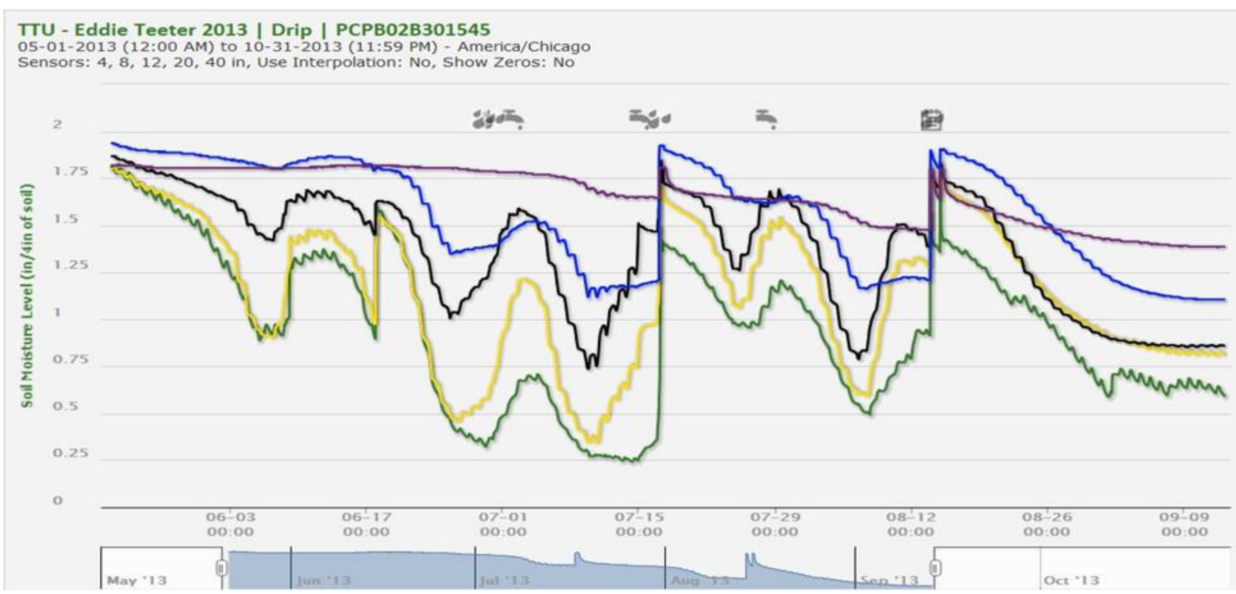
05-01-2013 (12:00 AM) to 10-31-2013 (11:59 PM) - America/Chicago
Sensors: 4, 8, 12, 20, 40 in, Use Interpolation: No, Show Zeros: No
Soil Moisture Level (in/4in of soil)
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
06-03 00:00
06-17 00:00
07-01 00:00
07-15 00:00
07-29 00:00
08-12 00:00
08-26 00:00
09-09 00:00
May '13
Jun '13
Jul '13
Aug '13
Sep '13
Oct '13

Moisture Probe Evaluation, 2013

Site 21 Field 2

Drip irrigation pattern looks very good with water movement noted in the upper 4 sensors of 20" and above. Good stepping activity and crop water use to 20" seen all season after irrigation and rainfall events. Two rain events in mid-July and mid-August both moved water past the 40" sensor. Slight root activity is seen at the 40" level in early July ahead of the July 15 rain event. Overall a very good irrigation pattern and management of rainfall over the season.





Site 31 - Glen Schur

Location: Hale County
Latitude: 34.215484, Longitude: -101.622763

121 Acres
Center Pivot
700 GPM

1 Wells, 350 feet, pumping depth 300 feet
Natural Gas

System pressure of 18 PSI

Soil Type: Pullman clay loam (100%)

Crop Information			
Site 31 – Field 1			
	2012	2013	2014
Crop	Cotton (FM 1944)	Millet Seed	Cotton (Insurance) Grain Sorghum
Planted Acres	66 acres	66.8 acres	66.0 acres
Planting Date	5/08/2012	5/25/2013	Cotton 5/5/2014 Gr. Sorg. 6/25/2014
Fertilizer	90-28-0-18	168-36-0, Zinc	163-21-0-18
Herbicide	Prowl, Caparol, Dual, Direx, Roundup	Atrazine, Peak, Banvel	Prowl, Roundup, First Shot, Caparol, Dual, Atrazine, Huskie
Growth Regulator	Pix	None	None
Insecticide	None	Karate	None
Harvest Aids	Prep, Aim, Gramoxone	None	None
Tillage	Strip till, planter	Mulch, Field Cultivator, Shredder, Planter	Strip till (2), fertilize (2), planter (2), cultivate (2)
Irrigation	19.00 inches	24.8 inches	18.0 inches
Harvest Date	11/3/2012	10/22/2013	11/15/2014
Yield	Cotton Lint 1,188 lbs/ac Cotton Seed 0.97 tons/ac	3,384 lbs/ac	70 cwt
Livestock		Grazed 50 pairs on millet stubble	
Yield per Acre Inch	62.5 lbs of Lint	136.5 lbs	3.89 cwt

Economic Information			
Site 31 – Field 1			
	2012	2013	2014
	($ per Acre)		
Gross Income:			
Cotton Lint	1,069.20	-	370.50
Cotton Seed	260.40	-	47.40
Millet Seed	-	1,285.92	-
Grain Sorghum	-	-	497.00
Grazing	-	29.94	-
Total Gross Income	1,362.65	1,315.86	914.90
Variable Production Costs:			
Production Inputs	395.41	292.73	478.81
Irrigation	193.80	327.36	237.60
Harvest	255.14	22.00	52.50
Interest	20.62	18.60	21.49
Total Variable Costs	864.97	660.69	790.40
Gross Margin	497.68	655.17	124.50
	($ per Acre Inch)		
Average Revenue per Inch of Irrigation	71.72	53.06	50.83
Gross Margin per Inch of Irrigation	26.19	26.42	6.92

Crop Information			
Site 31 – Field 2			
	2012	2013	2014
Crop	Millet Seed	Cotton (FM 1320 GLL)	Seed Sorghum
Planted Acres	55 acres	55.1 acres	54.0 acres
Planting Date	5/08/2012	5/23/2013	4/26/2014
Fertilizer	161-0-0-0	92-0-0-7	79-16-0
Herbicide	Atrazine, Peak, Banvel	Roundup, First Shot, Prowl, Caparol, Dual, Roundup	Propazine, Dual, Direx, Atrazine, Huskie
Growth Regulator	None	Pix	None
Insecticide	None	Bracket	Lorsban
Harvest Aids	None	Prep, Cyclone	None
Tillage	Mulch, Field Cultivator, Planter	Strip till, Coulter, Planter	Shred, Chisel, Planter, Cultivator (2)
Irrigation	22.00 inches	14.1 inches	18.75 inches
Harvest Date	10/15/2012	11/25/2013	10/5/2014
Yield	2,014 lbs/ac	Cotton Lint 1,364 lbs/ac Cotton Seed 0.869 tons/ac	51.70 cwt
Livestock	Grazed 50 pairs on millet stubble		
Yield per Acre Inch	91.5 lbs	96.74 lbs of Lint	2.76 cwt

Economic Information			
Site 31 – Field 2			
	2012	2013	2014
	($ per Acre)		
Gross Income:			
Seed Sorghum	-	-	1809.50
Millet Seed	503.50	-	-
Grazing	36.26	-	-
Cotton Lint	-	1,091.20	-
Cotton Seed	-	253.56	-
Total Gross Income	539.80	1,344.56	1809.50
Variable Production Costs:			
Production Inputs	211.11	285.58	177.78
Irrigation	224.40	186.12	247.50
Harvest	13.09	286.82	38.78
Interest	15.24	14.15	12.76
Total Variable Costs	463.84	772.68	476.82
Gross Margin	75.96	571.88	1332.68
	($ per Acre Inch)		
Average Revenue per Inch of Irrigation	24.54	93.40	96.51
Gross Margin per Inch of Irrigation	3.45	38.60	71.08

Economic Information						
Total for Site 31						
	2012		2013		2014	
	$/Ac	$/Ac In	$/Ac	$/Ac In	$/Ac	$/Ac In
Total Gross Income	988.63	45.69	1331.59	66.70	1406.93	76.72
Variable Production Costs:						
Pre-Harvest	519.35	24.00	538.78	26.99	556.29	30.34
Harvest	145.12	6.71	167.12	8.37	44.95	2.45
Interest	18.17	0.84	16.16	0.81	16.69	0.91
Total Variable Costs	682.64	31.55	722.06	36.17	617.63	33.70
Gross Margin	305.99	14.14	609.53	30.53	789.00	43.03

Site 35 - Eddie Teeter

Location: Floyd County
Latitude: 34.0835, Longitude: -101.4370

240 Acres
Subsurface Drip
750 GPM

2 Wells, 350 feet, pumping depth 300 feet
Electricity

System pressure of 18 PSI

Soil Type: Pullman clay loam (95%)
and Lofton clay loam (5%)

This site is subsurface drip that was divided into 3 fields which were planted to corn, grain sorghum and cotton. The purpose of having multiple crops was to allow the capacity of the irrigation system to be utilized to meet the peak water demand of each crop.

Crop Information		
Site 35 – Field 1		
	2013	2014
Crop	Grain Sorghum (Pioneer 84G62)	Corn (Pioneer 32B16White)
Planted Acres	83 acres	75 acres
Planting Date	5/29/2013	4/17/2014
Fertilizer	96-0-0	152-0-0
Herbicide	Milo Pro, Huskie, Aatrex & Brawl	Aatrex, Dual & Roundup
Insecticide	Karate & Vydate	Oberon
Harvest Aids	None	None
Tillage	Shred, Disc, Hoeme, Lister, Plant, Bed Roller, Cultivate (2)	Shred, Disc (3), Lister, Bed Roller, Plant
Irrigation	18.20 inches	15.90 inches
Harvest Date		10/07/2014
Yield	8,817 lbs (157.54 bu)	158.00 bu
Yield per Acre Inch	8,817 lbs (157.54 bu)	9.94 bu

Economic Information		
Site 35 – Field 1		
	2013	2014
	($ per Acre)	
Gross Income:		
Grain Sorghum	749.41	946.42
Total Gross Income	749.41	946.42
Variable Production Costs:		
Production Inputs	235.41	407.74
Irrigation	240.24	209.88
Harvest	68.12	66.36
Interest	14.27	18.53
Total Variable Costs	556.04	702.51
Gross Margin	193.37	243.91
	($ per Acre Inch)	
Average Revenue per Inch of Irrigation	41.18	59.52
Gross Margin per Inch of Irrigation	10.08	15.34

Crop Information		
Site 35 – Field 2		
	2013	2014
Crop	Corn (Pioneer YFD 44)	Cotton (FM 2484)
Planted Acres	54 acres	80 acres
Planting Date	4/25/2013	5/09/2014
Fertilizer	224-0-0	53-0-0
Herbicide	Aatrex, Medal, Sharpen	Triflurin, Parrot, Brawl, Roundup
Insecticide	Vydate	None
Harvest Aids	None	Prep, Stance, Folex, & Cyclone
Tillage	Shred, Disc, Hoeme, Lister, Plant, Bed Roller, Cultivate	Shred, Disc (2), Hoeme, Lister, Bed Roller, Plant, Rotary Hoe (2), Sandfighter, Cultivate (2)
Irrigation	25.70 inches	18.70 inches
Harvest Date	9/27/2013	11/15/2014
Yield	257.76 bu	Cotton Lint 1,233 lbs/ac Cotton Seed 0.87 tons/ac
Yield per Acre Inch	10 bu	0.34 tons

Economic Information		
Site 35 – Field 2		
	2013	2014
	($ per Acre)	
Gross Income:		
Corn	1,448.61	-
Cotton Lint		801.45
Cotton Seed		174.80
Total Gross Income	1,448.61	976.25
Variable Production Costs:		
Production Inputs	396.09	415.83
Irrigation	339.24	246.84
Harvest	108.26	276.86
Interest	22.06	19.88
Total Variable Costs	865.65	959.41
Gross Margin	582.96	16.84
	($ per Acre Inch)	
Average Revenue per Inch of Irrigation	56.37	52.20
Gross Margin per Inch of Irrigation	22.68	0.90

Crop Information		
Site 35 – Field 3		
	2013	2014
Crop	Cotton (FM 2484)	Grain Sorghum (Pioneer 85Y40)
Planted Acres	92 acres	75 acres
Planting Date	5/30/2013	6/06/2014
Fertilizer	64-0-0-0	128-0-0
Herbicide	Direx,Medal, Roundup	Volunteer, Bicep, Roundup
Insecticide	Acephate & Vydate	Besiege
Harvest Aids	Prep, Stance & Folex	None
Tillage	Shred, Disc, Hoeme, Lister, Plant, Bed Roller, Rotary Hoe, Cultivate	Shred, Disc, Lister, Bed Roller, Plant, Sandfighter, Rotary Hoe
Irrigation	18.20 inches	8.30 inches
Harvest Date	11/4/2013	10/27/2014
Yield	Cotton Lint 1,891 lbs/ac Cotton Seed 0.83 tons/ac	10/27/2014
Yield per Acre Inch	103.9 lbs of Lint	856 lbs

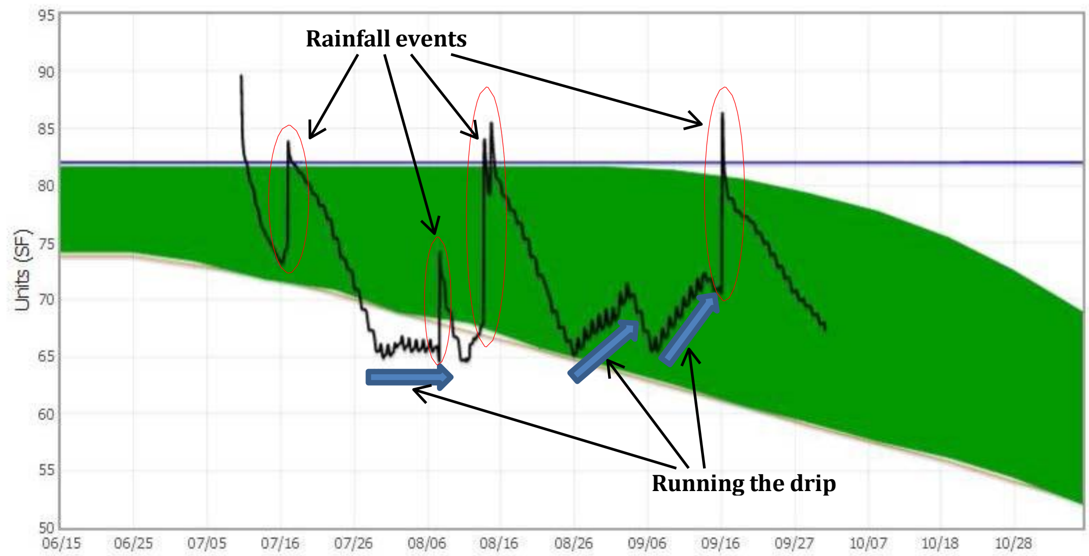
Economic Information		
Site 35 – Field 3		
	2013	2014
	($ per Acre)	
Gross Income:		
Cotton Lint	1,512.67	-
Cotton Seed	190.90	-
Grain Sorghum		475.73
Total Gross Income	1,703.57	475.73
Variable Production Costs:		
Production Inputs	356.97	352.87
Irrigation	240.24	352.87
Harvest	383.22	53.33
Interest	383.22	13.87
Total Variable Costs	998.35	529.63
Gross Margin	705.22	-53.91
	($ per Acre Inch)	
Average Revenue per Inch of Irrigation	93.60	-53.91
Gross Margin per Inch of Irrigation	38.75	-6.49

Economic Information				
Total for Site 35				
	2013		2014	
	$/Ac	$/Ac In	$/Ac	$/Ac In
Total Gross Income	1398.76	65.03	804.11	55.79
Variable Production Costs:				
Pre-Harvest	609.66	30.52	583.01	40.45
Harvest	203.96	10.21	140.13	9.72
Interest	18.29	0.92	17.49	1.21
Total Variable Costs	831.91	41.65	740.63	51.39
Gross Margin	466.85	23.37	63.48	4.40

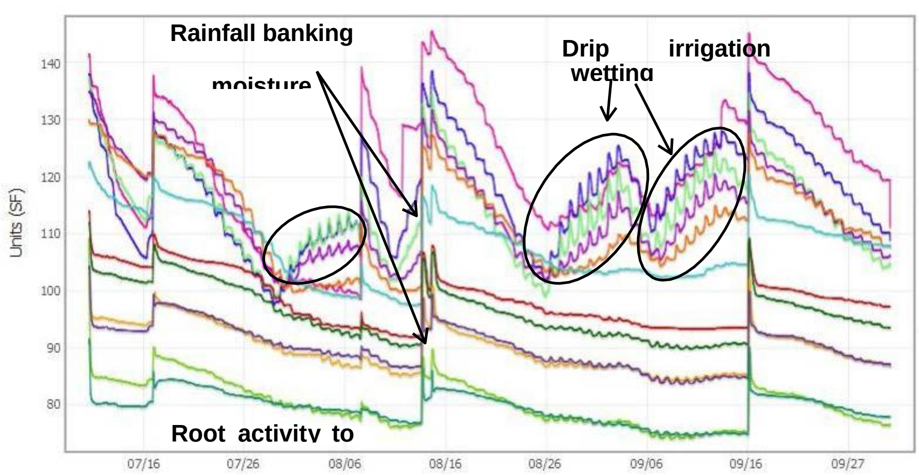
AquaSpy™

David Sloan, Principal Agronomist

Site 35 – Sub-surface Drip, Grain Sorghum (8816 lb/ac)



The above summary graph shows that whenever irrigation was running, it was either able to keep up with plant demand (flat line) or was able to apply more water than the plant was using and increase soil moisture. Significant rainfall events allowed shut-down of irrigation during which plant water use was not constrained (as shown by even stair steps and a uniform rate of soil moisture depletion). The sensor graph (below) shows that there were active roots to 48 inches and possibly deeper. It also shows the drip irrigation wet a zone from 12-20 inches, but that the topsoil stayed dry creating an insulating blanket against evaporation from the soil surface. Only the rainfall events were able to wet the subsoil, and the large event around the middle of August filled the soil profile and would have greatly helped yield and water use efficiency.



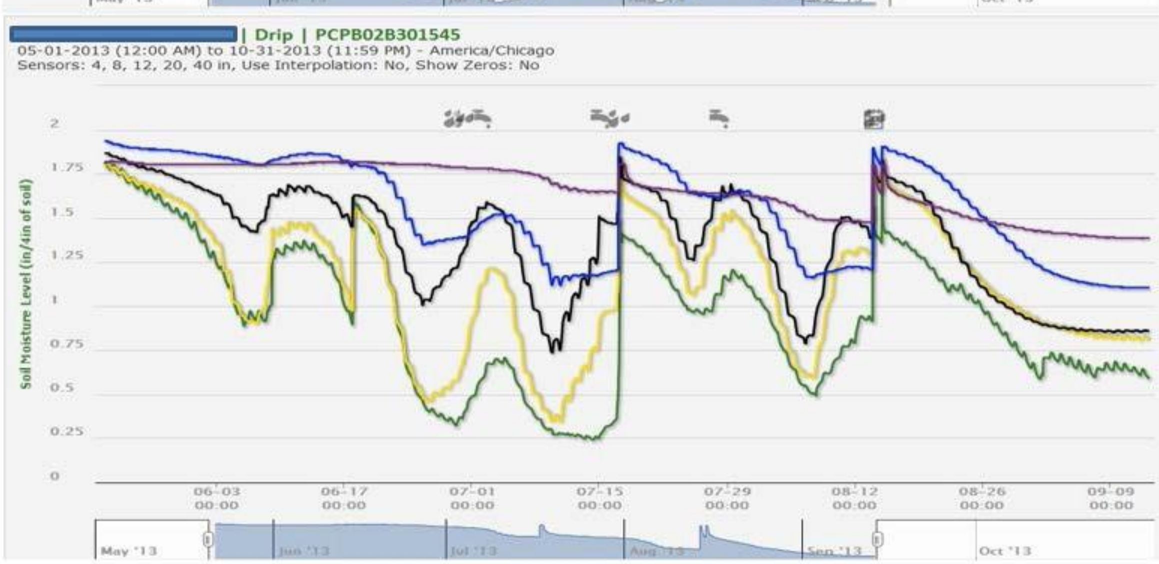
<u>*John Deere CropSense™*</u>

2013 Grower Review

Chris Arnold, Senior Technical Representative

Site 35, Sub-surface Drip, Corn

The drip irrigation pattern (lower graph) looks very good with water movement noted in the upper 4 sensors of 20 inches and above (all lines except the purple line, which is at 40). Good stepping activity and crop water use to 20 inches is seen all season after irrigation and rainfall events. Both rain events in mid-July and mid-August moved water past the 40-inch sensor. Slight root activity is seen at 40 inches in early July ahead of the July 15 rain event. Overall, we see a very good irrigation pattern and management of rainfall over the season.



Eco-Drip

2013 Grower Review

Brady Hinson, Crop Management Technologies

Site 35, Sub-surface Drip, Cotton

The above summary graph is very interesting. The graph looks like the plant endured a lot of stress throughout the year, but with help from the good Lord giving us timely rains, and help from the drip irrigation, good yields were attainable. The first time the summary graph dipped below the bottom line (60% plant available water) the drip irrigation was running. The line continued to go down because Site 35 was irrigating below ET. This means that the plant took up all the water that the drip supplied as fast as it could be applied as well as some of the moisture that was already in the soil.

The separate-levels graph shows that most water uptake was shallow, mainly because of the rains filling the top levels of the soil. The drip tape in this field is at 12 inches. There is not a lot of activity at 16-inches because Site 35 was irrigating below evapotranspiration, and the plant took up the water just as fast as it could be applied through the drip. In a drier year, we normally see much more root activity at the 32 and 40 inch sensors, but the timely rains allowed the plant to take up moisture from the most accessible areas.

Moisture Probe Evaluations, 2014

2014 TAWC Eddie Teeter Smartfield Results

Tom Speed, Vice President for Agronomic Services, Smartfield

Knowing when and how much to irrigate is a question that has been wrestled with since the beginning of irrigated agriculture. Using a plant based approached has proven to be extremely useful. Smartfield uses plant canopy temperature to quantify plant stress. Canopy temperatures integrate the main contributors of potential "plant stress" such as water availability, solar radiation and potential plant diseases that inhibit vascular water flow. Proprietary Smartfield algorithms utilize canopy temperature readings to determine the yield impact of "plant stress".

Smartfield technology was utilized in Eddie's corn, cotton and sorghum drip trials in 2014. Continuous canopy temperatures were collected on the three crops from June through September for the corn and July through September for the cotton and sorghum. Previous data has shown that canopy temperatures accumulated from flowering through grain or boll fill can be predictive of final yield.

Each of the three crops will be discussed separately since planting dates differed and environmental conditions varied based on time of season.

2014 Drip Corn

Average daily canopy temperatures for the 2014 drip corn stayed relatively low (about 75 degrees F) for the most critical times of the season. These critical growth stages include from 1 week pre tassel to 4-5 weeks post tassel. These average canopy temperatures are similar to 2013 readings when the crop yielded 240.5 bu/A. However in 2014, the corn yielded 158 bu/A. The canopy temperature readings suggest that a similar yield could have been achieved in 2014 as in 2013. I'm curious if harvest was delayed or if there was significant lodging? It appeared that plant population was adequate to achieve similar yield to 2013, so I don't think that was an issue. Was there a change in hybrid planted? Is there something else that I'm missing to help explain the yield difference between 2013 and 2014?

2014 Drip Cotton

The yield of the 2014 drip cotton was about 1.4 bales per acre less than 2013 (1233 lbs/A in 2014 and 1891 lbs/A in 2013). It was noted that the 2014 cotton crop cut out or reached nodes above white flower 3 to 4 much sooner in the season as compared to 2013. There were several consecutive days in early to mid-July where the canopy temperatures reached critical hot levels (around 94-96 degrees F). From other studies conducted with Texas Tech University faculty and on the Lubbock research farm, when cotton canopy temperatures reach this level (especially for 3 or more consecutive days), then the crop can be forced into a pre-mature cut out. This cut out can be somewhat mitigated if a mid to full maturity variety is planted, but if a relatively early maturing variety is planted, then the pre-mature cut out effect can be heightened. Canopy temperatures remained relatively low for the remainder of the season, however due to the pre-mature cut out, yield potential was reduced in 2014. Little rain fell during the last half of July and almost all of August. Eddie must have been irrigating well during this time because the canopy temperatures remained low, however the plant was already moving quickly towards cut out.

2014 Drip Grain Sorghum

The June planted grain sorghum got off to a good start and benefited from the mid-July rainfall. Overall, the grain sorghum canopy temperatures were slightly higher in 2014 when compared to 2013. In my estimation, this could explain the lower yield achieved in 2014 as compared to 2013. The cooler, wetter weather experienced in September could also have negatively impacted heat unit accumulation during grain fill on the 2014 sorghum crop.

Appendix B: References & Publications

References

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Note: The District's Annual Reports for the "200-12" Project can be found at http://northplainsgcd.org/downloads/category/13-200-12-project.html.