'An Integrated Approach to Water Conservation for Agriculture in the Texas Southern High Plains'

9th Annual Report 2005-2014

to the

Texas Water Development Board

Texas Alliance For Water Conservation

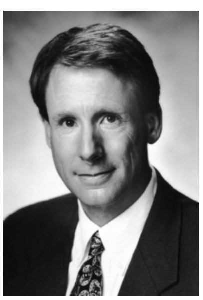
TAWC

"Water is Our Future"

September 12, 2014

Texas Alliance for Water Conservation participants:

C. West, P. Brown, R. Kellison, P. Johnson, J. Pate, S. Maas, S. Borgstedt



Appreciation is expressed to
Senator Robert Duncan
and the
Texas Water Development Board

With their vision for the future of Texas and their passion for the protection of our Water Resources this project is made possible

The future of our region and our state depends on the protection and appropriate use of our water resources.

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Water Conservation Demonstration Producer Board

Glenn Schur, Chair

Boyd Jackson, Co-Chair

Eddie Teeter, Secretary

Keith Phillips

Mark Beedy

Jeff Don Terrell

Jody Foster

Lanney Bennett

Louis (Bubba) Ehrlich

Rick Kellison (ex-officio), Project Director

The Producer Board of Directors is composed of producer representatives within the focus area of Hale and Floyd Counties and is specifically charged to:

1) Ensure the relevance of this demonstration project to meet its objectives;
2) Help translate the results into community action and awareness;
3) Ensure the credibility and appropriateness of work carried out under this project;
4) Assure compatibility with and sensitivity to producer needs and concerns; and
5) Participate in decisions regarding actions that directly impact producers.

The board elects their chair, co-chair, and secretary. Individuals serving on this board include representation of, but are not limited to producers cooperating in specific demonstration sites. The Chair serves as a full voting member of the Management Team. The Project Director serves in an *ex officio* capacity on the Producer Board. Meetings of the Producer Board of Directors are on an as-needed basis to carry out the responsibilities of the project and occur at least once annually in conjunction with the overall Management Team.

The value of this board to the project continues to be a key factor in its success.

TEXAS ALLIANCE FOR WATER CONSERVATION 2013 PARTICIPANTS

Texas Tech University
Dr. Chuck West, Project Administrator*
Mr. Rick Kellison, Project Director*
Mr. Philip Brown*
Dr. David Doerfert*
Dr. Phillip Johnson*
Dr. Stephan Maas*
Dr. Steve Fraze*
Dr. Rudy Ritz*
Dr. Sara Trojan*
Ms. Samantha Borgstedt, Communications Director*
Ms. Christy Barbee, Secretary/Bookkeeper

Texas A&M AgriLife Extension
Dr. Steven Klose
Mr. Jeff Pate*
Dr. Calvin Trostle*
Mr. Jay Yates*
Dr. Nithya Rajan

High Plains Underground Water Conservation District No. 1
Mr. Jason Coleman*
Mr. Keith Whitworth
Mr. Jim Conkwright (retired)
Mr. Gerald Crenwelge (retired)

USDA - Natural Resources Conservation Service
Mr. Monte Dollar (retired)*

USDA – Agricultural Research Service
Dr. Ted Zobeck
Dr. Veronica Acosta-Martinez

Producer Board Chairman
Mr. Glenn Schur*

Graduate Research Assistants
Swetha Dorbala
Morgan Newsom
Jarrott Wilkinson
Rachel Oates
Jennifer Zavaleta
Lisa Fultz
Marko Davinic
Nichole Sullivan
Miranda Gillum
Mallory Newsom
Nellie Hill
Melissa Murharam
Sanaz Shafian

* Indicates Management Team member

Producers of Hale and Floyd counties

Ronnie Aston	Bernie Ford	Brett Marble	Dan Smith
Mark Beedy	Gerald Ford	Charles Nelson	Don Sutterfield
Lanney Bennett	Jody Foster	Danny Nutt	Brian Teeple
Randy Bennett	Scott Horne	Keith Phillips	Eddie Teeter
Troy Bigham	Boyd Jackson	John Paul Schacht	Jeff Don Terrell
Bill Dollar	Jimmy Kemp	Glenn Schur	Aaron Wilson
Louis (Bubba) Ehrlich			

The dedication of all these participants is gratefully acknowledged.

‘AN INTEGRATED APPROACH TO WATER CONSERVATION FOR AGRICULTURE IN THE TEXAS SOUTHERN HIGH PLAINS’

Objective

To conserve water in the Texas Southern High Plains while continuing agricultural activities providing the needed productivity and profitability for producers, communities, and the region.

Background

The Texas High Plains currently generates a combined annual economic value of crops and livestock that exceeds $9.9 billion ($2.4 crops; $7.5 livestock; Texas Agricultural Statistics, Texas Department of Agriculture, 2012) but is highly dependent on water from the Ogallala Aquifer. Groundwater supplies have been declining significantly in the South Plains region (average depth to water during 2009-2014 declined 6.85 feet in High Plains Underground Water Conservation District No. 1[1], while costs of energy required to pump water have escalated. Improved irrigation technologies including low energy precision application (LEPA) and subsurface drip irrigation (SDI) have increased irrigation efficiencies to over 95% but have not always led to decreased water use. Furthermore, agriculture is changing in the Texas High Plains in response to a growing dairy industry and to current U.S. policy placing emphasis on renewable biofuels, especially ethanol. Both the dairy and the ethanol industries are increasing demands for grain crops, primarily corn. Feeds demanded by the dairy industry also include corn for silage and alfalfa, both of which require irrigation at levels above the current major cropping systems in this region. In addition to increasing water scarcity, unstable grain prices, fertilizer costs and uncertain energy costs are driving changes in this region.

Diversified systems that include both crops and livestock have long been known for complementary effects that increase productivity. Research conducted at Texas Tech over the past 15 years has shown that an integrated cotton/forage/beef cattle system, compared with a continuous cotton monoculture, lowered irrigated water use by about 25%, increased profitability per unit of water invested, diversified income sources, reduced soil erosion, reduced nitrogen fertilizer use by about 40%, and decreased needs for other chemicals, while maintaining similar cotton yields per acre between the two systems (Allen et al., 2005; 2012). Profitability was found to be similar for the integrated system as compared to the cotton monoculture system (Johnson et al., 2013). Furthermore, soil health was improved, more carbon was sequestered, and soil microbial activities were higher in the integrated system compared with the cotton monoculture (Acosta-Martinez et al., 2004; 2008; 2010). This and other research on crop production, agricultural climatology, economics, and communication dynamics provided basic information for designing the demonstration project. Results from the demonstration sites serve to validate the research and inform approaches to current and future research.

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[1] High Plains Water District 2014 Water Level Measurements document source: http://www.hpwd.org/S/2014-Water-Level-Magazine.pdf

No single technology will successfully address water conservation. Rather, the approach must be an integration of agricultural systems, best irrigation technologies, improved plant genetics, and management strategies that reduce water demand, optimize water use and value, and maintain an appropriate level of productivity and profitability. Water conservation must become both an individual goal and a community ethic. Educational programs are needed at all levels to raise awareness of the necessity for water conservation to prolong the regional economic benefits of agriculture. As state and global populations increase with an increasing demand for agricultural products, the future of the Texas High Plains, and indeed the State of Texas and the world, depends on our ability to protect and appropriately use our water resources. Nowhere is there greater opportunity to demonstrate the implications of successfully meeting these challenges than in the High Plains of west Texas.

A multidisciplinary and multi-university/agency/producer team, coordinated though Texas Tech University, assembled during 2004 to address these issues. In September of 2004 the project *'An Integrated Approach to Water Conservation for Agriculture in the Texas Southern High Plains'* was approved by the Texas Water Development Board and funding was received in February, 2005 to begin the demonstration project conducted in Hale and Floyd Counties. A producer Board of Directors was elected to oversee all aspects of this project. Initially, 26 producer sites were identified to represent 26 different 'points on a curve' that characterize and compare cropping and livestock grazing system monocultures with integrated cropping systems and integrated crop/livestock approaches to agriculture in this region. The purpose is to understand where and how water conservation can be achieved while maintaining acceptable levels of profitability. Results of this study assist area producers in meeting the challenges of declining water supplies and reduced pumping capacities by demonstrating various production systems and water saving technologies.

The first nine years of the Texas Alliance for Water Conservation (TAWC) project are considered Phase I of our continuing effort to demonstrate and compare irrigation systems and crop types for agronomic and economic water use efficiencies. A new source of funding via the Texas Water Development Board for TAWC was approved by the Texas Legislature in 2013 to conduct Phase II during 2014-2018 cropping seasons. Phase II will expand the number of counties containing demonstration sites and incorporate intensive workshops and upgraded online decision tools.

A key strategy of this project is that all sites are producer-owned and producer-driven. The producers make all decisions about their agricultural practices, management strategies, and marketing decisions. Thus, practices and systems at any specific site were subject to change from year to year as producers strove to address changes in market opportunities, weather, commodity prices, and other factors that influence their decisions. This project allowed us to measure, monitor, and document the effects of these decisions. The same producers did not all participate every year. A small number withdrew participation, and they were replaced in subsequent years at the discretion of Producer Board. Nonetheless, the project provided a valuable survey of changes in agricultural practices in this region and the information to interpret what is driving these changes.

Sites were originally selected by the Producer Board of Directors in response to the request for sites that would represent a range of practices from high-input, intensive management systems to low-input, less intensive practices. The sites represented a range from monoculture cropping practices (one type or species of annual crop at the site per year), multi-cropping systems (more than one crop species per year on a field), integrated crop and livestock systems (part of the site produced annual crops and part forage-based livestock production), and all-forage/livestock systems. Irrigation practices included subsurface drip, center pivot, furrow, and dryland systems.

It is important to note that these data and their interpretations are based on certain assumptions which are critical to objectively compare information across different sites. These assumptions are necessary to avoid differences that would be unique to a particular producer or site but which have nothing to do with understanding how these systems function. Thus, we have adopted certain constants for productivity and efficiency calculations, such as pumping depth of wells, in order to make unbiased economic and agronomic comparisons (see p. 192 for detailed assumptions). This approach means that the economic data for an individual site are valid for comparisons of systems but do not represent the actual economic results of that site. Actual economic returns for each site were calculated and confidentially shared with the individual producer but are not a part of this report. Likewise, the identity of the participating producers is not matched to the demonstration sites.

This is the last annual report of Phase I of TAWC, and therefore is a compendium of data over the life of the project. Results should be interpreted with caution for the first year of the project because of the challenge of setting up data collection systems all at once. Data collection technologies gradually changed over time as better equipment and monitors became available, which allowed us to install upgrades in subsequent years. As each annual report updates and completes each previous year, the current year's annual report is the most correct and comprehensive accounting of results to date and will contain revisions and additions for the previous years.

OVERALL SUMMARY OF YEARS 2005-2013

With 9 years completed of this study, trends and patterns are emerging and more useful information is accumulating. Each year's results are highly influenced by weather, availability of irrigation water, input and commodity prices, anticipated prices for crops and livestock, and previous years' experiences. Amount and distribution of precipitation and irrigation water to buffer inadequate precipitation are key drivers of production and profit. During the 9 years, annual precipitation ranged from a low of 5.3 inches (2011) to a high of 28.5 inches (2010), averaging 16.9 inches (Figure 1), which is 1.6 inches lower than the long-term mean (18.5 inches) for the region. Six of 9 years exhibited below-average rainfall, with the last 3 years, 2011-2013, substantially below average. The record-setting drought of 2011 (5.3 inches) was followed by droughts in 2012 (9.9 inches) and 2013 (13.2 inches). The 2013 growing season for summer crops began with soil profiles essentially depleted of rainfed water, since only 2 inches of rain had fallen from November 2012 through May 2013. Consequently, average irrigation applied during the 9 years was greatest in 2011 through 2013 (Figure 1). Despite the fairly dry conditions of 2013, yields of corn for grain and silage were greatly increased over those of 2011 and 2012, and attained the 2005-2010 yield averages (Table 24, page 203). Corn benefited from very timely rains in July coinciding with the critical pollination time.

Crop insurance played a role in 2013 in the producers' ability to recoup initial input costs where crops failed. For example, at sites 12 and 29, dryland cotton emergence failed and the crop was abandoned, thereby enabling insurance payments. In addition, at sites 4, 5 and 6, the wheat crop planted for grain failed and insurance was collected. Insurance indemnity payments within the crop budgets were handled one of two ways. If the producer's record book indicated what the insurance indemnity payment was, this value was incorporated into the budgeting process. If this value was not available or the producer did not know the particular insurance payment, the indemnity was estimated. This was done by using average county yields to simulate a farm's T yield (or trigger yield); a 65% coverage level was assumed for all grain and fiber crops, and a 2013 harvest price was used as the payment price. If the producer indicated any residual crop at the time of abandonment or if there was sufficient evidence to indicate that there was some crop left standing in the field at the time of the insurance claim, this was deducted from the 65% coverage yield. The net result was an estimate for the indemnity payment from crop insurance. This method was standardized for all dryland and irrigated crops within the TAWC sites.

Figures 1 and 2 show annual changes in returns above all costs and gross margins in relation to precipitation and irrigation. Gross margin equals total revenue less total variable costs. Returns above all costs equals gross margin less fixed costs and is the same as net returns. See page 192 for definitions of economic terms.

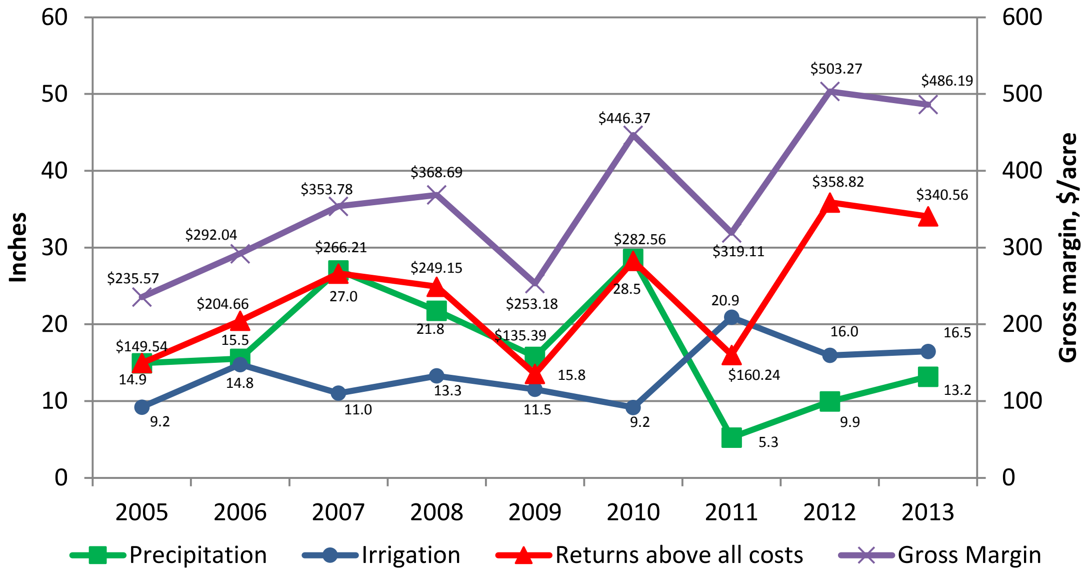


Figure 1. Average precipitation (inches), irrigation applied (inches), returns above all costs ($/acre), and gross margin ($/acre) for irrigated sites only.

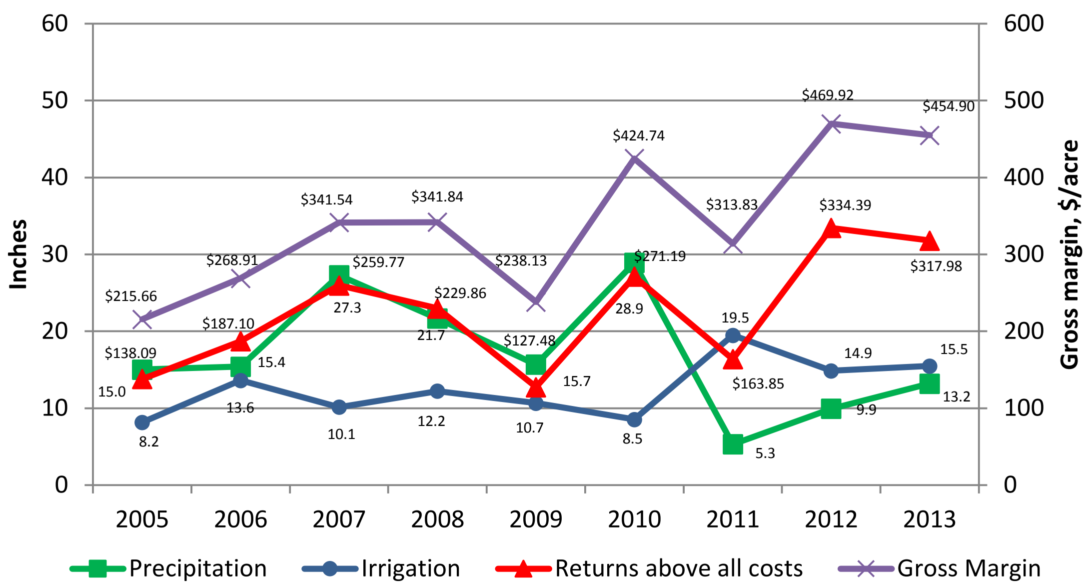


Figure 2. Average precipitation (inches), irrigation applied (inches), returns above all costs ($/acre), and gross margin ($/acre) for all sites, irrigated and dryland.

Amount of irrigation applied averaged over 9 years on the irrigated sites only (Figure 1) was 13.6 inches, with a range of 9.2 to 20.9 inches. When all sites including the non-irrigated fields (Figure 2) are included in the means, average irrigation applied declines from 13.6 to 12.6 inches, pointing out the importance of inclusion of non-irrigated acres within a producer's overall enterprise in assessing water use. As water availability declines, two basic strategies can be used alone or in combination to stretch water supplies: a) apply less water per acre to a level that still maintains profitable yields (70-80% of crop ET demand); and b) apply available water to fewer acres. Both approaches have merit depending on the crop species and variety, how water is allocated over the cropland, and the distribution of precipitation within a year. Choices of crop species/variety and the land allocation of water are under the control of the producer. Distribution of precipitation is not under their control and therefore only involves retrospective responses.

Total returns above all costs of production in 2013 ($317.98/acre), including irrigated and dryland sites, was slightly decreased from 2012, which was the highest of all years of the project (Figure 2). Profitability in 2005 and 2009 was negatively impacted by high production costs in relation to values of crops and livestock. Low profitability in 2011 reflected reduction in livestock numbers and yield losses in crops, but was buffered by insurance payments. The relatively high returns in 2012 and 2013 were favored by high commodity prices across many crop types and adequate irrigation available to attain profitable yields in cotton.

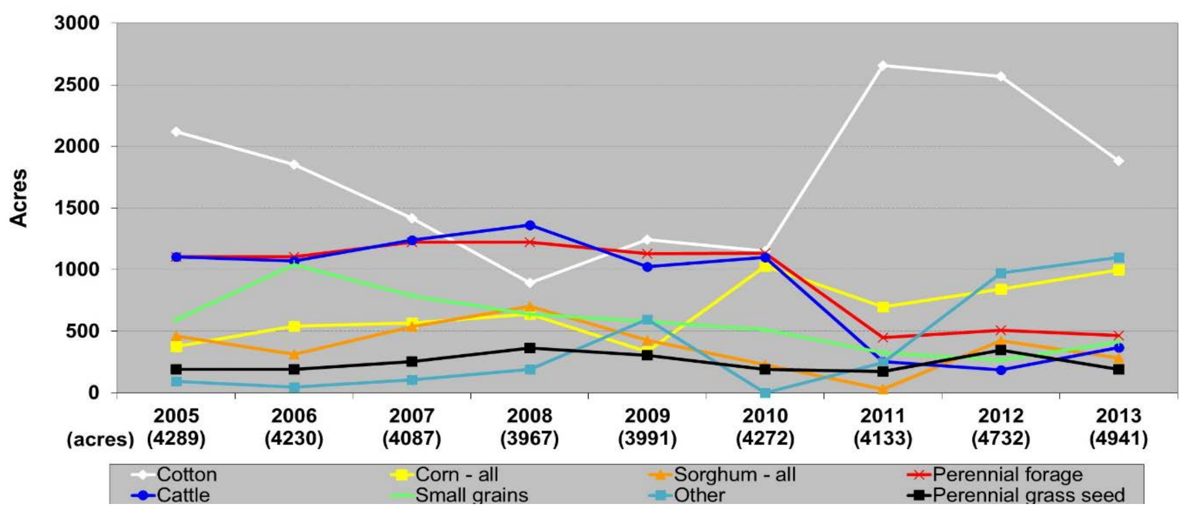


Figure 3. Number of acres that include cotton, corn, sorghum, perennial forages, cattle, small grains and other crops within the producer systems located in Hale and Floyd Counties.

Producers in the TAWC project make their own decisions each season on enterprise selection and production practices. Land use reflects current crop and livestock prices, contracts, expected profitability, water supply, and decisions to terminate leases, sell property, or retire. Therefore, the number of acres and number of sites of the enterprise choices have varied. Figures 3 and 4 show the acreages and number of sites, respectively, that were devoted to cotton, corn, sorghum, perennial forages, cattle, small grains, and other crops. The total of enterprise acres exceeds total acres in the project in any given year because of double cropping and multi-use for livestock, e.g. harvesting a seed crop followed by harvesting hay from the regrowth in the same field. In 2013, cotton acreage dropped from the high acreage in 2012 (Figure 3), while acreages of corn, other (mainly seed crops), and cattle pasture increased from 2012. The large reductions of cattle herds observed in 2011 had not recovered in 2013, owing to persistent drought effects suppressing pasture recovery and the high cost and long lag time in rebuilding herds.

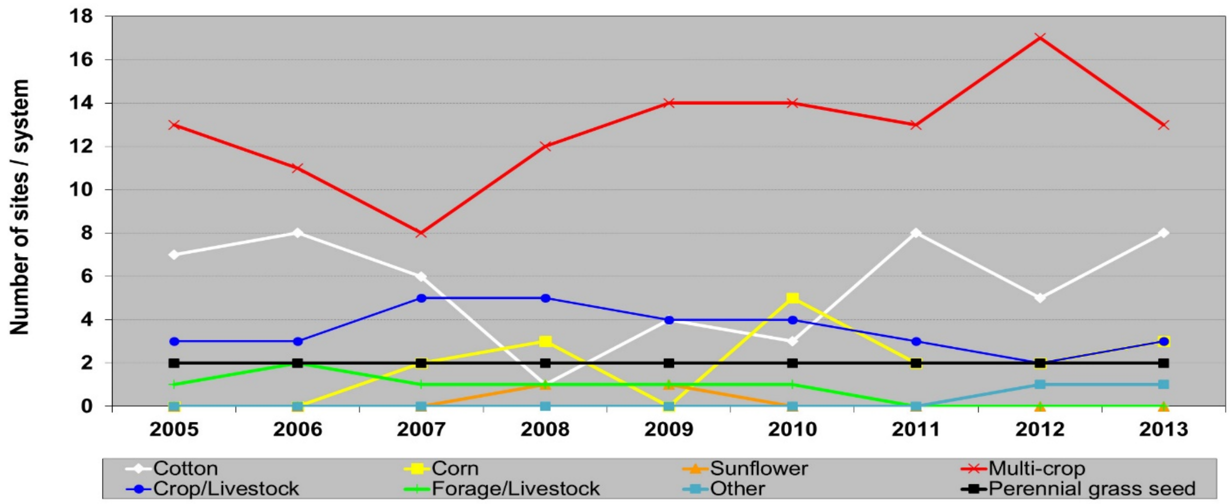


Figure 4. Number of sites/system located in the demonstration project in Hale and Floyd Counties.

The trends in number of sites where different production systems are practiced are dynamic (Figure 4), but generally follow the trends in acreage distribution (Figure 3). Cotton was dominant in the first 2 years and most recent 3 years. The alternatives to cotton showed greater year-to-year fluctuation in the latter 5 years than in the first 4 years. Other notable trends are the upsurge in corn sites after 2009 and an uptick in cattle grazing operations in 2013.

Water Use and Profitability

Patterns are emerging with respect to profitability in relation to irrigation applied. This is important because of the constant need to increase water use efficiency by the crops and prolong the groundwater supply, while maintaining or even increasing profitability of agricultural production in the High Plains. To examine systems for meeting criteria of relatively low water use and high profitability, we arbitrarily selected a maximum of 15 inches of irrigation and a minimum of $300 gross margin per acre as a desired target for performance. Please note that these levels were selected only to identify whether certain sites and cropping systems consistently performed to those criteria and *not* to relate system performance to pumping restrictions nor to state a minimum amount of revenue required for economic viability.

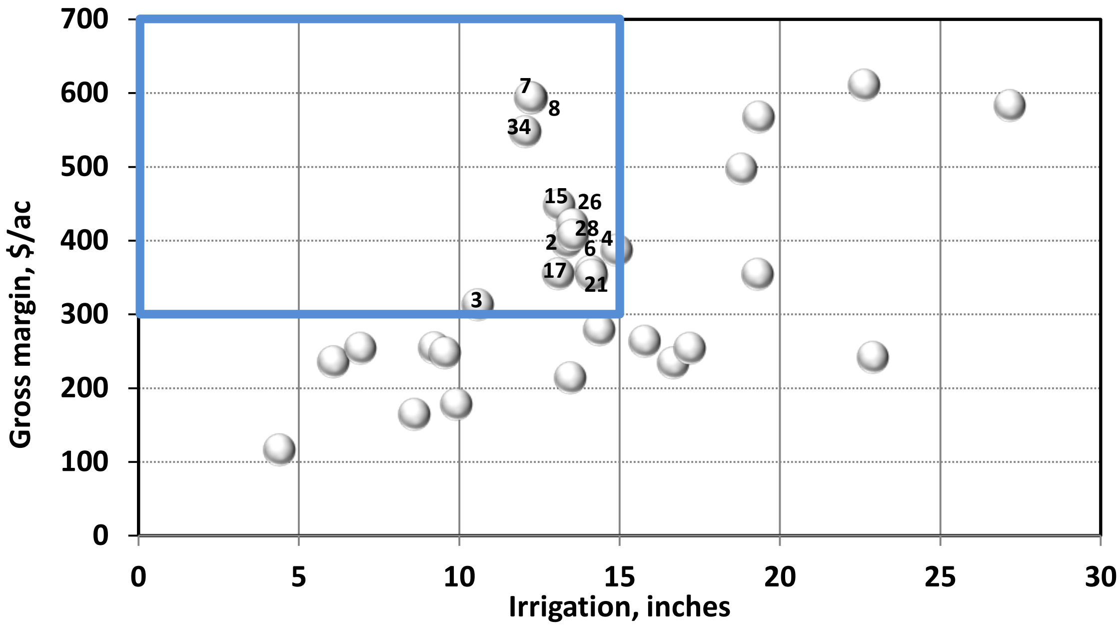


Figure 5. Gross margin per acre in relation to inches of applied irrigation averaged over 2005 to 2013. Each point represents one site, of which 23 were irrigated in all years. The blue box brackets those sites which met the arbitrary criteria of 15 inches maximum irrigation and $300 minimum gross margin per acre. Sites within the box are described in Table 1.

Table 1. Description of cropping system and irrigation type used in 2013 for sites plotted in Figure 5 which meet criteria of 15 or fewer inches of irrigation and $300 or more gross margin/acre. Descriptions of 2013 cropping systems by site are shown.

Site	Cropping system	Irrigation type
2	Cotton/corn grain rotation	Subsurface drip
3	Cotton/grain sorghum	Mid elevation spray application
4	Multi-crop with cotton, alfalfa, cattle	Low elevation spray application
6	Multi-crop, cotton/wheat	Low elevation spray application
7	Continuous sideoats grama grass seed	Low elevation spray application
8	Continuous sideoats grama grass seed	Subsurface drip
15	Cotton	Subsurface drip
17	Multi-crop corn, sunflower, cow-calf	Mid elevation spray application
21	Multi-crop corn, wheat, forage sorghum	Low energy precision application
26	Multi-crop rotations, corn, wheat	Low elevation spray application
28	Cotton in 2013, with corn in 2012	Subsurface drip
34	Multi-crop corn, sunflower (2 yrs only)	Low elevation spray application

Twelve sites met the arbitrary criteria of 15 or fewer inches of irrigation and $300 or more gross margin/acre, when averaged over 2005-2013 (Figure 5). Five sites that met the $300 gross margin per acre criterion but with average irrigation over 18 inches (points located to the right of the blue box in Figure 5) were cotton/corn rotations. Inclusion of corn in multi-cropping systems can produce high gross margins, but requires more irrigation than cotton. Sites 2, 17, 21, 26, 28, and 34 all included corn in the multi-crop rotations and met the double criteria of 15 inches and $300/acre, indicating that inclusion of corn in the cropping system can result in high return at low water use, averaged over years. The two sites with grass seed production (7 and 8) were the highest ranked sites for gross return per acre. Site 34 only occurred in 2012 and 2013.

2013 Project Year

Producer sites can be categorized according to type of farming system insofar as a site represents a conceptual farm. The system categories in use in 2013 were corn monoculture (entire site in corn only), cotton monoculture (entire site in cotton only), grass seed monoculture (entire site in grass seed production consisting of sideoats grama), integrated crop/livestock (site included cattle on pasture plus an annual crop and/or hay), multi-cropping (more than one annual crop species harvested in the reporting year). Systems occurring in previous years but not in 2013 included cow-calf pasture, sunflower monoculture, and dryland multi-cropping. A site categorized in one system is recategorized each year that the crop choice changes.

In 2013, corn monoculture and grass seed each accounted for 7% of the sites, while integrated crop/livestock occupied 10%, cotton monoculture occupied 28% and multi-cropping occupied 45%. Averaged over the 9 years of the project, percentage allocations of the systems were similar to 2013 except that integrated crop/livestock was 13%, cotton was 22%, cattle grazing was 3%, and sunflower monoculture was 1% of the sites.

This section compares the cropping systems for net returns per acre and per acre-inch of irrigation, and usage of irrigation and nitrogen fertilizer for 2013. Grass seed production had by far the highest average net returns per acre at nearly $700, followed by multi-cropping and cotton monoculture (Figure 6). Corn monoculture showed the lowest returns per acre.

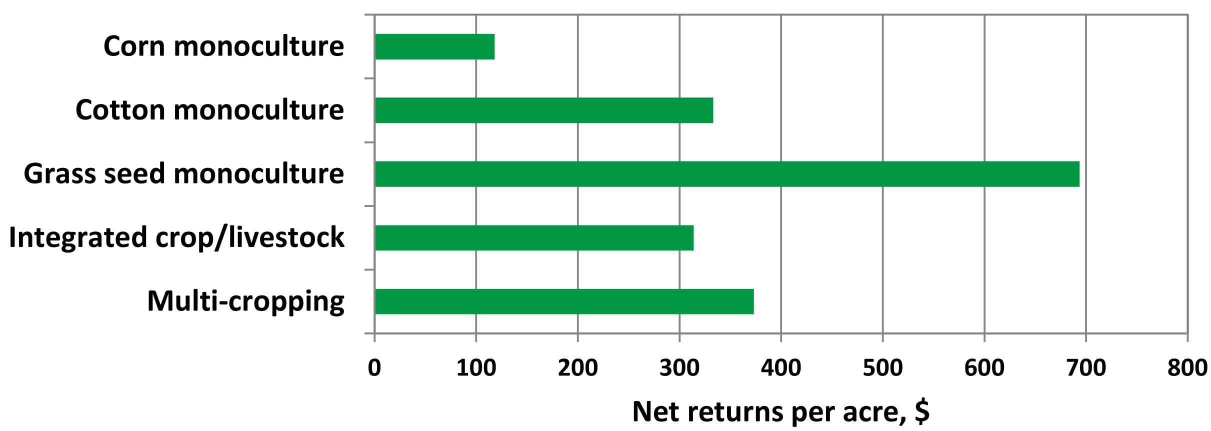


Figure 6. Net returns per acre for five cropping systems in 2013.

When these systems were examined in terms of net returns per acre-inch of irrigation applied (Figure 7, green bars), again, corn was lowest and grass seed monoculture was highest, while other systems were intermediate. The blue bars in Figure 7 indicate average inches of irrigation applied per system. Grass seed had the lowest application (12.2 inches) and corn monoculture had the highest (20.1 inches).

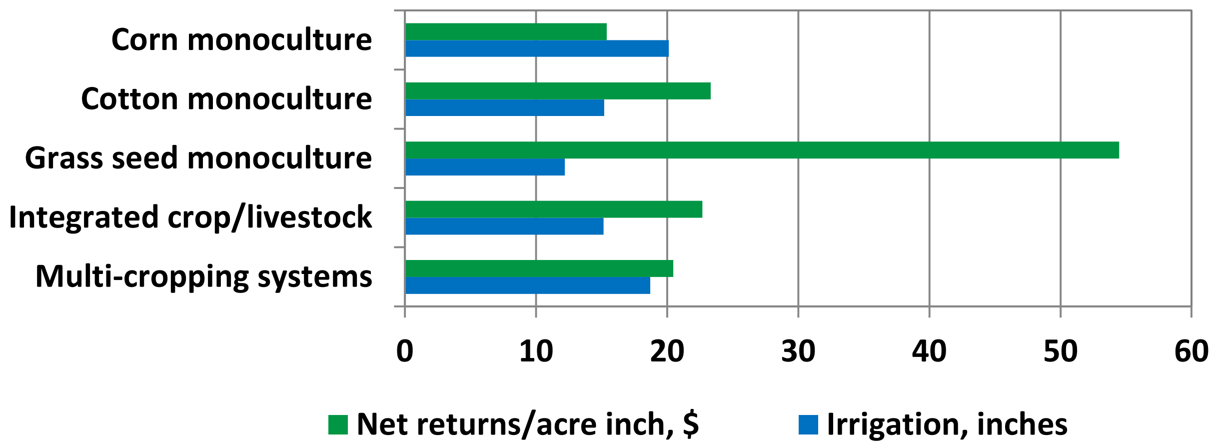


Figure 7. Net returns per acre-inch irrigation water (green bars), and inches of irrigation applied (blue bars), 2013.

Corn monoculture and multi-cropping had the highest application rates of nitrogen (N) fertilizer at 162 and 181 lbs/acre, respectively (Figure 8). The lowest N applied was to the cotton monoculture at around 114 lbs/acre. The significance of N fertilizer application is that it constitutes a major input cost and therefore greatly influences the calculation of net return.

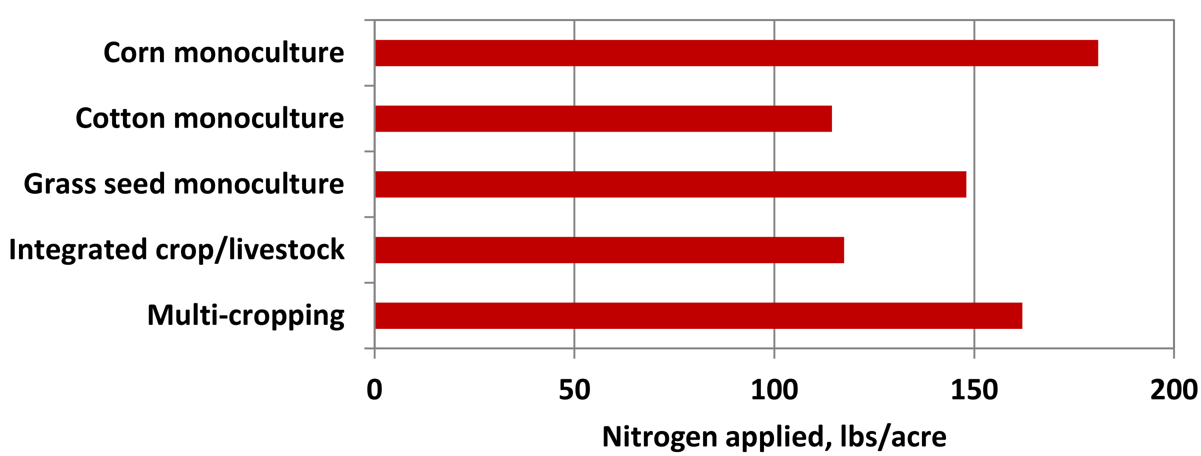


Figure 8. Pounds per acre of nitrogen applied in fertilizer by cropping system, 2013.

Project years 1 through 9 (2005-2013)

Average net returns per acre averaged over 9 years of the project indicate that grass seed monoculture was the most profitable system at $462/acre, double that of cotton monoculture and multi-cropping systems (Figure 9). The grass seed system also had the highest net return per acre-inch of irrigation applied, and used the same amount of irrigation as cotton monoculture (Figure 10). Grass seed is a high-value specialty crop, which yielded the greatest net returns per acre in 8 out of 9 years. Since it is produced with limited contracts, grass seed would not present a cropping option for a large number of producers. Nevertheless, contract seed crops provide opportunities for some producers to diversify their income. While multi-cropping and cotton monoculture yielded similar average net returns per acre (around $230/acre), integrated crop-livestock was at $193 and corn monoculture was around $157/acre (Figure 9).

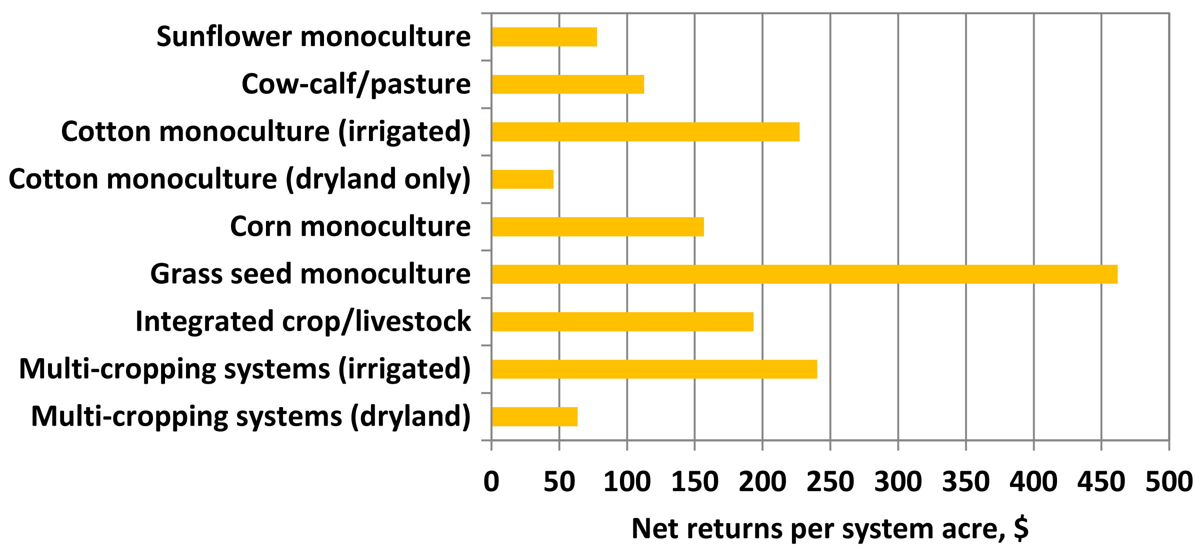


Figure 9. Net returns per system acre, average of 2005-2013, or for those years which those systems occurred. Data for cow-calf includes 2005-2010 only.

Irrigation applied was greatest for corn monoculture, followed by multi-cropping (Figure 10, blue bars). Irrigated cotton monoculture used about the same amount of irrigation as grass seed and the integrated crop-livestock system. Net returns per acre-inch of irrigation applied were highest for grass seed, followed by cow-calf/pasture (Figure 10, green bars); the latter owing to the low irrigation. With fairly high net returns per acre-inch of irrigation and low water usage, cattle production on perennial forages may offer a sustainable option as groundwater becomes more depleted. Net returns for irrigated cotton monoculture were ranked third. Corn monocultures were not present in some of the earlier years of this project and thus their means reflect fewer years. The droughts of 2011 and 2012 hit corn yields particularly hard, therefore with fewer years in the mean, the effects of drought have a proportionally greater effect on this crop's performance. Sunflowers represent a specialty crop in this region and required less irrigation water than any system type with the exception of the cow-calf/pasture; however, returns per unit of water applied were also relatively low. Dryland systems have always had the lowest average net returns in this project.

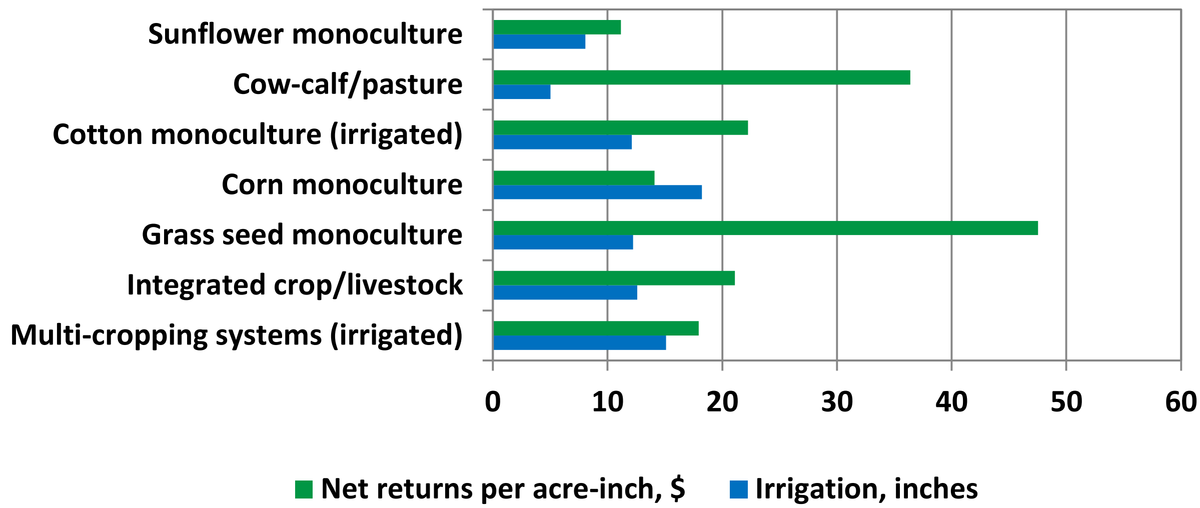


Figure 10. Net returns per acre-inch of irrigation water (green bars), and inches of irrigation applied (blue bars), average of 2005-2013. Data for cow-calf/pasture includes 2005-2010 only.

Dryland cotton and multi-cropping systems received the least nitrogen fertilizer per acre, whereas corn monoculture received by far the most (Figure 11). Cow-calf perennial grass pastures were the second lowest users of N fertilizer. For warm-season pasture grasses, 50 to 60 lbs of N/acre annually is generally considered adequate. In contrast, corn monocultures represented the other extreme with over 200 lbs N/acre received annually. All other systems received from about 110 - 130 lbs/acre of N.

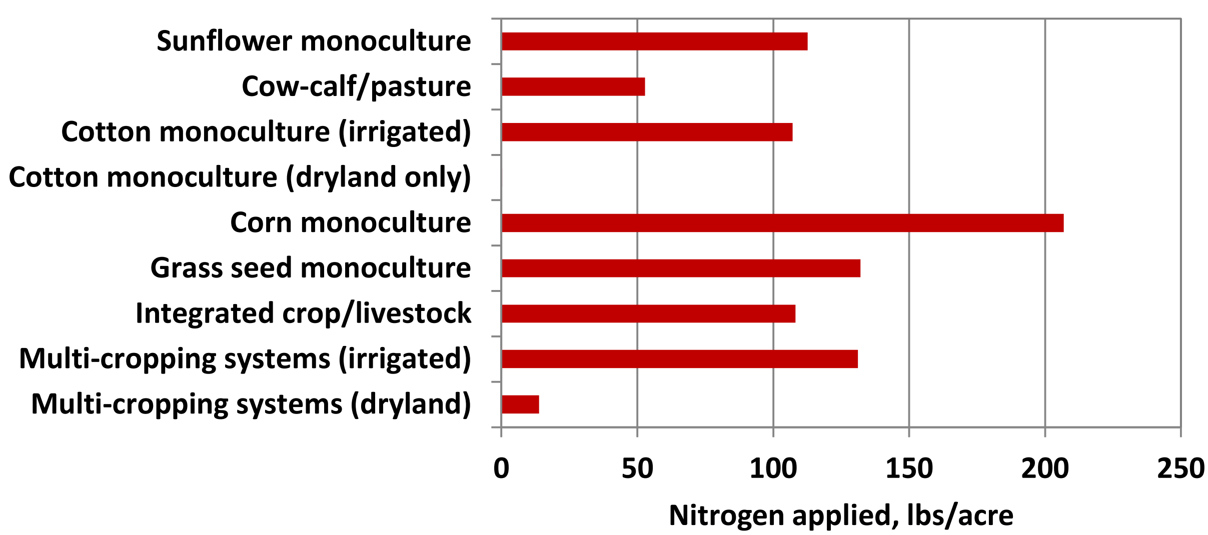


Figure 11. Pounds of nitrogen per acre applied in fertilizer, average of 2005-2013. Data for cow-calf/pasture includes 2005-2010 only.

Discussion

Over the 9 years of the project we have observed a number of system configurations under varied environmental conditions, irrigation technologies, and market conditions. Management is the key to how these systems behave under the extreme year to year variations experienced. Producers make strategic and tactical production decisions to maintain economic viability and utilize available resources efficiently. Strategic decisions relate to crop and livestock enterprise selection, whether it is year-to-year crop selection or longer term planning. Planting perennial grasses for seed and pasture production, integrating livestock into an operation, and the selection of irrigation technologies are examples of strategic decisions. Tactical decisions relate to enterprise management within the growing season, such as variety selection, fertilizer management, irrigation scheduling and harvest timing.

There are a number of irrigation management technologies such as Smart Crop, AquaSpy and NetIrrigate which aid specifically in the tactical decision process. We have provided some of these technologies to producers within the TAWC project. Information received from these technologies in conjunction with measurement of evapotranspiration (ET) on a field by field basis has helped producers gain insight into better irrigation management techniques. Feedback from producers who have used these technologies has helped us formulate tools to address the short-term and long-term irrigation management challenges facing the region. Continual adoption of water-saving technologies and monitoring will contribute to advances in the efficiency of water applied and amounts of water saved.

Two management tools were developed and made available to producers in the region through the TAWC Solutions web site (**http://www.tawcsolutions.org**) in early 2011. Use of these tools by producers within and outside TAWC has grown. The Water Allocation Tool, the Irrigation Scheduling Tool, and the Resource Allocation Analyzer are the three practical tools available on this web site. These tools are free of charge to any producer.

The dissemination of results and information from the project through various outreach efforts is an important part of the project. An activity continued from previous years was the winter field day held in January 2013 at Muncy, TX. A new activity was a series of four field walks at a participating farm in June-September to demonstrate how to schedule irrigation in relation to meeting crop needs. A field walk to a perennial grass demonstration site occurred in mid-August to demonstrate options for forage grasses. These field days allowed attendees to visit several project sites and observe the technologies that are currently being demonstrated within the project to better manage and monitor irrigation use and timing. In addition to the field days, the project was represented at several farm shows within the region, which allowed further dissemination of findings and information regarding the project and demonstrations and producer interaction on the management tools that are being provided on the TAWC Solutions website. Detailed listings of outreach presentations, articles and activities are listed on pages 19, 21 and 232.

The long term ability of this project to observe and monitor a variety of crop and integrated crop/livestock systems under various environmental conditions is now allowing us to provide valuable information on irrigation management and water conservation techniques to producers in the area. The management of the Ogallala water resource is critical to the continued economic success of agriculture in the region. Producers face many technical and climatic challenges. The information we are providing from this project will assist producers in meeting these challenges and allow the region to continue to lead in agricultural production through innovation.

2013 WEATHER DATA (SEE APPENDIX FOR 2005-2012 DATA)

The project sites and the region again received below average rainfall for the 2013 calendar year with an average of 13.3 inches measured across the project, as indicated in Figure 12 and illustrated in Table 2. Below average rainfall was received in March through June, but nearly double average rainfall was received in July with about normal rain in August and September. Mean temperatures ran slightly above normal through the growing season with the exception of July which was about average for the long term means. As a result of the above average rainfall in July and warmer than normal temperatures, 2013 was a very good cropping year on average for the TAWC sites in the area.

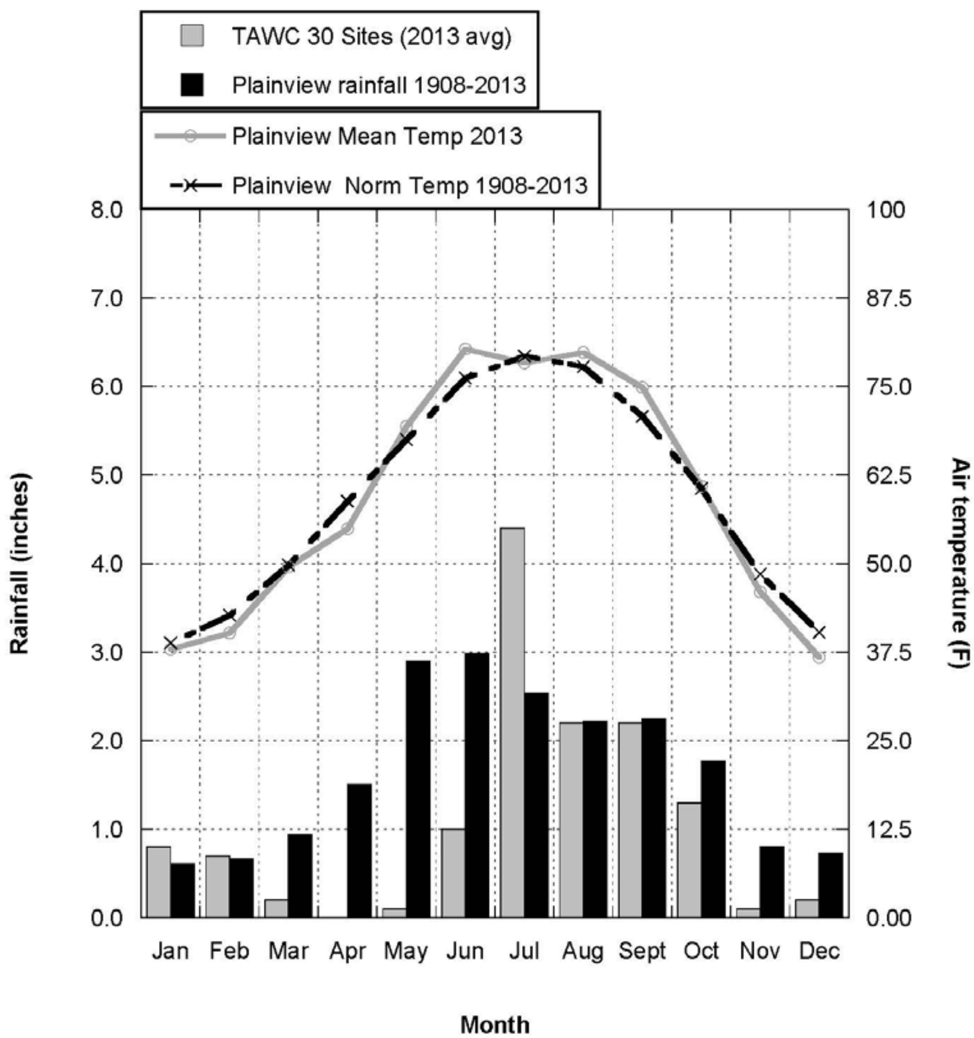


Figure 12. Temperature and precipitation for 2013 in the demonstration area compared with long term averages.

Table 2. Precipitation (inches) at each site in Hale and Floyd Counties during 2013.

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2	1.2	0.6	0.2	0.1	0.2	1.2	4.8	2.8	2.9	1.6	0.1	0.2	15.8
3	0.1	0.4	0.1	0.0	0.2	0.0	3.4	0.2	1.5	0.5	0.0	0.0	6.3
4	0.4	0.8	0.4	0.1	0.2	0.4	5.5	1.8	1.5	1.0	0.5	0.2	12.6
5	1.1	1.0	0.2	0.0	0.0	0.1	4.4	1.8	2.8	0.9	0.1	0.1	12.4
6	0.4	0.8	0.0	0.0	0.0	1.0	4.8	2.7	2.8	1.6	0.1	0.2	14.3
7	0.5	0.7	0.0	0.1	0.2	1.0	3.0	1.2	1.8	0.4	0.1	0.1	9.1
8	0.5	0.7	0.0	0.1	0.2	1.0	3.0	1.2	1.8	0.4	0.1	0.1	9.1
9	1.6	0.8	0.2	0.1	0.2	2.4	6.8	3.2	2.4	1.5	0.2	0.5	19.7
10	1.1	1.0	0.2	0.1	0.2	1.2	5.0	4.4	2.2	1.5	0.3	0.4	17.4
11	1.2	0.6	0.2	0.1	0.2	1.6	4.1	2.0	2.2	1.6	0.2	0.2	14.1
12	0.8	0.8	0.1	0.0	0.1	2.0	3.2	0.1	2.8	1.4	0.1	0.4	11.8
14	0.5	0.7	0.1	0.1	0.3	0.4	4.0	2.0	2.6	1.5	0.1	0.3	12.6
15	0.1	0.0	0.1	0.1	0.1	1.1	2.8	2.6	2.6	1.1	0.1	0.2	10.8
17	1.2	0.4	0.1	0.0	0.1	1.0	4.4	2.2	2.6	1.8	0.1	0.2	14.0
18	0.4	0.8	0.1	0.0	0.1	0.6	3.4	0.7	1.9	0.4	0.1	0.3	8.7
19	1.2	0.9	0.2	0.0	0.2	2.5	4.6	1.2	2.7	1.9	0.1	0.3	15.7
20	1.4	0.8	0.3	0.1	0.2	1.2	5.8	4.2	2.2	1.0	0.0	0.0	17.2
21	1.1	0.4	0.1	0.0	0.0	1.6	3.8	3.3	3.2	1.4	0.1	0.2	15.1
22	1.0	1.1	0.4	0.1	0.1	1.1	6.1	0.6	2.0	2.2	0.3	0.1	15.1
24	1.0	0.8	0.3	0.0	0.0	0.9	6.0	1.4	1.2	2.0	0.2	0.0	13.8
26	1.1	1.0	0.2	0.0	0.0	0.1	4.4	1.8	2.8	0.9	0.1	0.1	12.4
27	0.9	0.6	0.2	0.1	0.1	1.0	5.6	2.8	2.2	1.1	0.1	0.1	14.7
28	1.1	1.0	0.2	0.1	0.2	1.2	5.0	4.4	2.2	1.5	0.3	0.4	17.4
29	1.2	1.1	0.2	0.0	0.4	1.6	3.6	2.4	2.5	1.6	0.1	0.3	14.9
30	1.1	1.0	0.2	0.0	0.0	0.1	4.4	1.8	2.8	0.9	0.1	0.1	12.4
31	0.4	0.8	0.4	0.1	0.2	0.4	5.5	1.8	1.5	1.0	0.5	0.2	12.6
32	0.1	0.0	0.1	0.1	0.1	1.1	2.8	2.6	2.6	1.1	0.1	0.2	10.8
33	0.1	0.0	0.1	0.1	0.1	1.1	2.8	2.6	2.6	1.1	0.1	0.2	10.8
34	0.4	0.8	0.0	0.0	0.0	1.0	4.8	2.7	2.8	1.6	0.1	0.2	14.3
35	1.2	1.0	0.1	0.0	0.1	1.8	5.4	2.6	3.2	1.1	0.2	0.4	17.0
Average	0.8	0.7	0.2	0.0	0.1	1.1	4.4	2.2	2.4	1.3	0.1	0.2	13.4

2013 SUPPLEMENTARY GRANTS TO PROJECT

Supplementary grants and grant requests are considered complementary and outside of the TAWC project, but were obtained or attempted through leveraging of the base platform of the Texas Coalition for Sustainable Integrated Systems and Texas Alliance for Water Conservation (TeCSIS) program, and therefore represents added value to the overall TAWC effort.

West, C. 2013. Long-term agroecosystems research and adoption in the Texas Southern High Plains. Southern SARE grant. $100,000 (funded).

2013 DONATIONS TO PROJECT (SEE APPENDIX FOR 2005-2012 DATA)

August 15, 2013 Field Day sponsors:

Texas Corn Producers Board	$ 500.00
Texas Grain Sorghum Producers	$ 250.00
Plains Cotton Growers	$ 250.00
United Sorghum Check-Off Program	$ 250.00
Dupont-Pioneer	$ 800.00
AquaSpy	$ 250.00
Eco-Drip	$ 250.00
Hurst Farm Supply	$ 800.00
Bayer Crop Science	$ 800.00
Total	$4,150.00

2013 VISITORS TO THE DEMONSTRATION PROJECT SITES

Total Number of Visitors	230

2013 Presentations (See Appendix for 2005-2012 data)

Date	Presentation	Spokesperson(s)
7-10-Jan. 2013	Field evaluation of a remote sensing based irrigation scheduling tool Beltwide Cotton Conference San Antonio, TX	Rajan, Maas
13-Mar.	John Deere Crop Sense capacitance probe use by TAWC – Lubbock, TX	Pate
2 Apr.	Southern Pasture Forage Crop Improvement Conference, Overton, TX	West, Brown
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
22-Jul.	TAWC and Its Purpose – 4-H Ag. Ambassadors – Lubbock, TX	Pate
9-Aug.	Radio Interview – Field Walk Update – KFLP	Pate
13-Aug.	High Plains Water District board of directors – Lubbock, TX	Kellison
19-Sept.	International Grasslands Conference – Sydney, Australia	Kellison, Brown
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
14-15-Dec.	Remote sensing based water management from the watershed to the field level. CIMMYT and the Gates Foundation- Mexico City	Maas, Rajan
14-15-Dec.	Remote sensing based soil moisture detection. Abstracts, Workshop “Beyond Diagnostics: Insights and Recommendations from Remote Sensing.” CIMMYT and the Gates Foundation- Mexico City	Shafian, Maas
7-Jan. 2014	Sorghum U – Levelland, TX	Kellison
7 Jan. 2014	Fieldprint Calculator: A measurement of agricultural sustainability in the Texas High Plains Beltwide Cotton Conference, New Orleans	Stokes, Johnson, Robertson, Underwood
7-Jan. 2014	Poster- LEPA vs. LESA Irrigation – Beltwide Cotton Conference – New Orleans, La.	Pate, Yates
16-Jan. 2014	TWDB Director Bech Bruun & staff – Lubbock, TX	Kellison
28-Jan. 2014	Randall County Producers	Kellison
12-Feb. 2014	Texas Panhandle-High Plains Water Symposium	Kellison
13 Feb. 2014	Nebraska Independent Crop Consultants Assoc. annual meeting. Talk on TAWC	West
24-Feb. 2014	TWDB Directors-Lubbock, TX	Kellison

2013 Related Non-refereed Publications

Maas, S., and N. Rajan. Remote sensing based water management from the watershed to the field level. Workshop "Beyond Diagnostics: Insights and Recommendations from Remote Sensing." CIMMYT, Gates Foundation, 14-15 Dec 2013, Mexico City.

Shafian, S., and S. Maas. Remote sensing based soil moisture detection. Abstracts, Workshop "Beyond Diagnostics: Insights and Recommendations from Remote Sensing." CIMMYT, Gates Foundation, 14-15 December 2013, Mexico City. (Invited)

West, C.P., C.P. Brown, and V.G. Allen. 2013. Integrated crop/forage/livestock systems for the Texas High Plains. 67th Southern Pasture and Forage Crop Improvement Conference. 22-24 Apr., 2013, Tyler, Texas.

Mitchell, D., P. Johnson, V. Allen, and C. Zilverberg. 2013. Integrating cotton and beef production in the Texas Southern High Plains: A simulation approach. Abstract for Southern Agric. Econ. Assoc., February 2-5, 2013, Orlando, FL.

Mitchell, D., and P. Johnson. 2013. Economic impacts of the 2011 drought on the Southern High Plains. Abstract for Am. Agric. Econ. Assoc., August 4-6, 2013, Washington, DC.

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. January 4-7, 2014, New Orleans, LA.

2013 Related Refereed Journal Articles

Johnson, P., J. Zilverberg, V.G. Allen, J. Weinheimer, C.P. Brown, R. Kellison, and E. Segarra. 2013. Integrating cotton and beef production in the Texas Southern High Plains: III. An economic evaluation. Agronomy Journal. 105:929-937.

Davinic M., J. Moore-Kucera, V. Acosta-Martinez, J. Zak, and V. Allen. 2013. Soil fungal groups' distribution and saprophytic functionality as affected by grazing and vegetation components of integrated cropping-livestock agroecosystems. Applied Soil Ecology 66:61-70.

Weinheimer, J., P. Johnson, D. Mitchell, J. Johnson, and R. Kellison. 2013. Texas High Plains imitative for strategic and innovative irrigation management and conservation. Journal of Contemporary Water Research & Education. 151:43-49.

Rajan, N., S. Maas and C. Song. 2013. Extreme drought effects on carbon dynamics of a semi-arid pasture. Agronomy Journal 105:1749-1760.

Li, Yue, F. Hou, J. Chen, C.P. Brown, and V.G. Allen. 2013. Steers grazing a rye cover crop influence growth of rye and no-till cotton. Agronomy Journal 105:1571-1580.

Li, Yue, V.G. Allen, J. Chen, F. Hou, C.P. Brown, and P. Green. 2013. Allelopathic influence of a wheat or rye cover crop on growth and yield of no-till cotton. Agron. J. 105:1581.

Fultz, L.M., J. Moore-Kucera, T.M. Zobek, V. Acosta-Martínez, and V.G. Allen. 2013. Aggregate carbon pools after 13-years of integrated crop-livestock management in semi-arid soils. Soil Science Society of America Journal 77:1659-1666.

2013 Popular Press

Ag Day Lubbock. By Rebecca Rivers, Fox 34 News, 29 October 2013. Floyd County cotton harvest underway. http://www.myfoxlubbock.com/content/agdaylubbock/story/cotton-harvest-water-management/U-3ISR-Dh0yVFDOwdQYDuA.cspx

Ehmke, Tanner. 2 October 2013. Conserving water on the Texas High Plains: Integrating Crops, Livestock, and New Technology. *Crop & Soils*, Volume 46, Number 5, p. 6-13.

https://www.agronomy.org/publications/cns/articles/46/5/6

Martin, Norman. 17 August 2013. Texas Alliance for Water Conservation holds Pioneers in Agriculture Field Day. CASNR NewsCenter. http://www.depts.ttu.edu/agriculturalsciences/news/?p=2855

Borgstedt, Samantha. 25 July 2013. StepUp: Texas Alliance for Water Conservation holds field walk series. CASNR NewsCenter. http://www.depts.ttu.edu/agriculturalsciences/news/?p=2706

Musico, Josie. 20 June 2013. Something to Moo about: Conference describes new trends in cattle industry. Texas and Southwest Cattle Raisers Association Lubbock Avalanche-Journal. http://lubbockonline.com/local-news/2013-07-20/something-moo-about-conference-describes-new-trends-cattle-industry#.U_YGQOog91M

Ag Day Lubbock. By Rebecca Rivers, Fox 34 News, 25 June 2014. Water management playing a vital role in production. http://www.myfoxlubbock.com/content/agdaylubbock/story/water-management-conservation-tawc/kTSCJH9Tpk6vPT-EWBTbHw.cspx

Martin, Norman. 5 December 2013. TAWC recognized with major American Water Resources Association award. CASNR NewsCenter. http://www.depts.ttu.edu/agriculturalsciences/news/?p=2429

2013 Theses and Dissertations

Hill, Nellie L. 2013. Social network analysis of Texas Alliance for Water Conservation producers. M.S. Thesis, Texas Tech University, Lubbock, TX.

SITE DESCRIPTIONS

Background

This project officially began with the announcement of the TWDB grant in September, 2004. However, it was February, 2005, before all of the contracts and budgets were finalized and actual field site selections could begin. By February, 2005, the Producer Board had been named and was functioning, and the Management Team was identified to expedite the decision-making process. Initial steps were taken immediately to advertise and identify individuals to hold the positions of Project Director and Secretary/Accountant. Both positions were filled by June of 2005. By autumn 2005, the FARM Assistance position was also filled.

Working through the Producer Board, 26 sites were identified that included 4,289 acres in Hale and Floyd counties (Figure 13). Soil moisture monitoring points installed, maintained and measured by the High Plains Underground Water Conservation District No. 1 were purposely located close to these sites, and global positioning system (GPS) coordinates position coordinates were taken for each monitoring point. This was completed during 2005 and was operational for much of the 2005 growing season. All data recorded from these points continue to be maintained by the High Plains Underground Water District No. 1.

Total number of acres devoted to each crop and livestock enterprise and management type in 2005-2013 are given in Tables 3-11. These sites include subsurface drip, center pivot, and furrow irrigation as well as dryland examples. It is important to note when interpreting data from Year 1 (2005, Table 3), that this was an incomplete year. We were fortunate that this project made use of already existing and operating systems; thus there was no time delay in establishment of systems. Efforts were made to locate missing information on water use while the original 26 sites were brought on-line. Such information is based on estimates as well as actual measurements during this first year and should be interpreted with caution. The resulting 2005 water use data, however, provided useful information as we began this long-term project. It is also important to note that additional improvements were made in 2006 in calibration of water measurements and other protocols.

In year 2 (2006), site 25 was lost to the project due to a change in land ownership, but was replaced by site 27, thus the project continued to monitor 26 sites. Total acreage in 2006 was 4,230, a decline of about 60 acres between the two years. Crop and livestock enterprises on these sites and the acres committed to each use by site are given in Table 4.

In year 3 (2007), all sites present in 2006 remained in the project through 2007. Total acreage was 4,245, a slight increase over year 2 due to expansion of Site 1 (Table 5).

In year 4 (2008), 25 sites comprised 3,967 acres (Table 6). Sites 1, 13, 16, and 25 of the original sites had left the project, and sites 28 and 29 were added.

In year 5 (2009), all sites present in 2008 remained in the project. Site 30 with 21.8 acres was added. Thus, 26 total sites were present in 2009 for a total of 3,991 acres (Table 7).

In year 6 (2010), three new sites were added as part of the implementation phase of the project (Table 8). These sites were designed to limit total irrigation for 2010 to no more than 15 inches. Crops grown included cotton, seed millet and corn. The purpose of these added sites was to demonstrate successful production systems while restricting the water applied. With the addition of sites 31, 32, and 33, the project now totaled 29 sites and increased the project acreage from 3,991 acres to 4,272 acres, although these new sites were treated separately in this year. The new sites also increased the number of producers involved in the project by one.

In year 7 (2011), the previously mentioned implementation sites were incorporated into the whole project and no longer differentiated from other sites in management or data analysis due to changes in water policy. In addition, site 5 was converted from a livestock-only system to an annual cropping system. The site acreage declined from 626.4 to 487.6 by dropping the grassland corners, but maintaining the cropping system under the center pivot. Site maps were adjusted for 2012 to better reflect this change. Total acres for the project decreased from 4272 acres in 2010 to 4133 acres in 2011 as a result (Table 9).

In year 8 (2012), site 34 was added to the project (Table 10). The new 726.6 acres was partially offset by the exit of site 23 (121.1 acres). The 2012 report includes new satellite imagery of each site, and site information has been updated accordingly. As always, minor corrections to site acreages continue to occur as discrepancies are discovered. Total acres for the project increased from 4133 acres in 2011 to 4732 acres in 2012 as a result of these site changes.

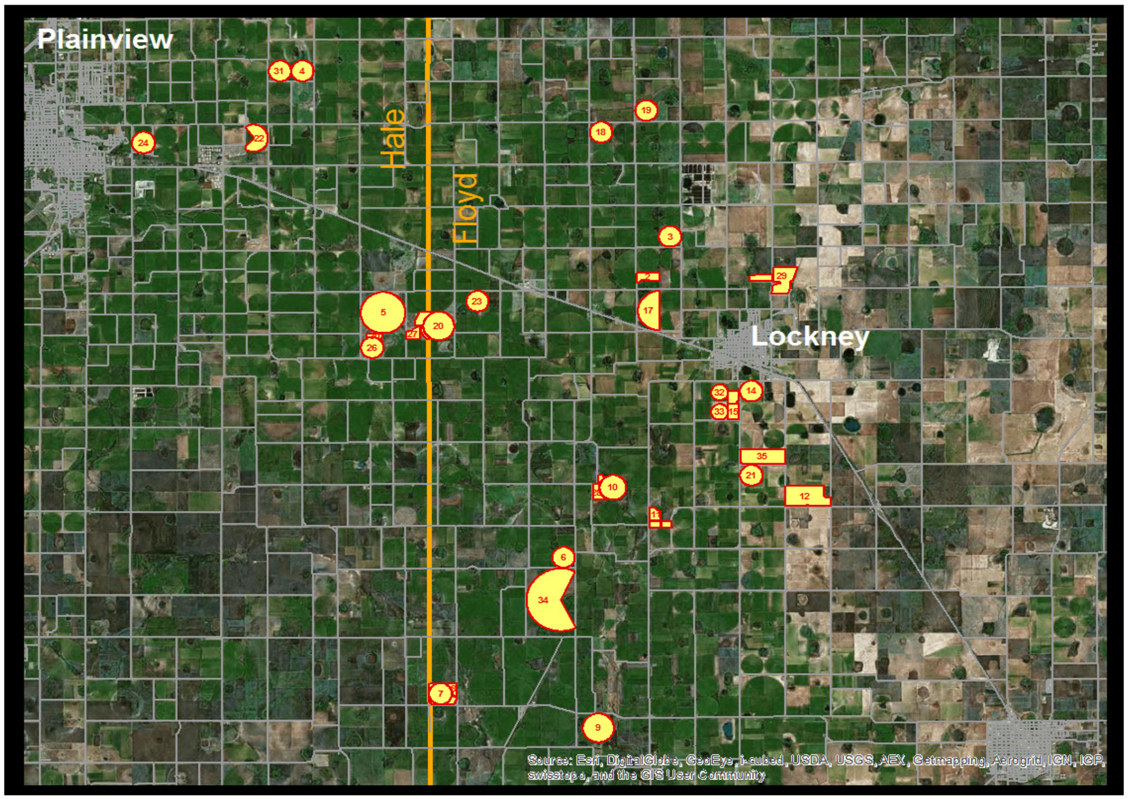
In year 9 (2013), site 35 was added to the project (Table 11). The new 229.2 acres is a drip irrigated site. Total acres for the project increased from 4732 acres in 2012 to 4961 acres in 2013 as a result of these site changes.

All numbers in this report continue to be checked and verified. *THIS REPORT SHOULD BE CONSIDERED A DRAFT AND SUBJECT TO FURTHER REVISION*. However, each year's annual report reflects completion and revisions made to previous years' reports as well as the inclusion of additional data from previous years. Thus, the most current annual report will contain the most complete and correct report from all previous years and is an overall summarization of the data to date.

The results of years 1-9 follow and are presented by site (Tables 3-11).

Texas Alliance for Water Conservation 2013

Scale: 1:200,000



Site Acres

Site	Acres	Site	Acres
2	59.9	19	120.3
3	123.3	20	233.3
4	122.9	21	122.6
5	484.1	22	148.7
6	122.7	24	129.7
7	130.0	26	125.1
8	61.8	27	108.5
9	237.7	28	51.5
10	173.6	29	221.5
11	92.5	30	21.8
12	283.8	31	121.9
14	124.1	32	70.0
15	101.1	33	70.0
17	220.7	34	726.6
18	122.2	35	229.3

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"Water is Our Future"

May 2013

Figure 13. Site map index for 2013 (year 9).

Table 3. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 26 producer sites in Hale and Floyd Counties during 2005.

Site	irrigation type	cotton	corn grain	corn silage	sorghum grain	sorghum forage	Pearl millet	sunflowers	alfalfa	grass seed	perennial pasture	cattle	wheat	rye	triticale	oats
1	SDI	62.3														
2	SDI	60.9														
3	PIV	61.8			61.5											
4	PIV	109.8							13.3							
5	PIV/DRY								69.6		551.3	620.9				
6	PIV	122.9										122.9	122.9			
7	PIV									130.0						
8	SDI									61.8						
9	PIV	137.0									95.8	232.8		232.8		
10	PIV	44.5									129.1	129.1				
11	FUR	92.5														
12	DRY	151.2				132.7										
13	DRY	201.5											118.0			
14	PIV	124.2														
15	FUR	95.5														
16	PIV	143.1														
17	PIV	108.9		58.3							53.6					
18	PIV	61.5			60.7											
19	PIV	75.3					45.1									
20	PIV			115.8		117.6							117.6			
21	PIV	122.7														
22	PIV	72.7	76.0													
23	PIV	51.5						48.8								
24	PIV	64.7	65.1													
25	DRY	90.9			87.6											
26	PIV	62.9	62.3													
Total	**2005 acres**	**2118.3**	**203.4**	**174.1**	**209.8**	**250.3**	**45.1**	**48.8**	**82.9**	**191.8**	**829.8**	**1105.7**	**358.5**	**232.8**	**0.0**	**0.0**

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation (acres may overlap due to multiple crops per year and grazing).

Table 4. Irrigation type and total acres, by site, of crops, forages and acres grazed by cattle in 26 producer sites in Hale and Floyd Counties during 2006.

Site	irrigation type	cotton	corn grain	corn silage	sorghum grain	sorghum forage	Pearl millet	sunflowers	alfalfa	grass seed	perennial pasture	cattle	wheat	rye	triticale	oats
1	SDI	135.2														
2	SDI	60.9														
3	PIV	123.3														
4	PIV	44.4				65.4			13.3				65.4			
5	PIV/DRY								69.6		551.3	620.9				
6	PIV	122.9														
7	PIV									130.0						
8	SDI									61.8						
9	PIV	137.0									95.8	95.8		137.0		
10	PIV					44.5					129.1	129.1				44.5
11	FUR	92.5														
12	DRY	132.7											151.2			
13	DRY	118.0											201.5			
14	PIV	124.2														
15	FUR	67.1			28.4											
16	PIV	143.1														
17	PIV	58.3		108.9							53.6	162.5	108.9			
18	PIV	60.7				61.2										61.2
19	PIV	75.1					45.3									
20	PIV			117.6		115.8									115.8	
21	PIV	61.3	61.4									61.3	61.3			
22	PIV	72.7	76													
23	PIV	51.5	48.8													
24	PIV	65.1		64.7												
26	PIV	62.3	62.9													
27	SDI	46.2														
Total	**2006 acres**	**1854.5**	**249.1**	**291.2**	**28.4**	**286.9**	**45.3**	**0.0**	**82.9**	**191.8**	**829.8**	**1069.6**	**588.3**	**137.0**	**115.8**	**105.7**

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation (acres may overlap due to multiple crops per year and grazing)

Table 5. Irrigation type and total acres, by site, of crops, forages and acres grazed by cattle in 26 producer sites in Hale and Floyd Counties during 2007.

Site	irrigation type	cotton	corn grain	corn silage	sorghum grain	sorghum forage	pearlmillet	sunflowers	alfalfa	grass seed	perennial pasture	cattle	wheat	rye	triticale	oats
1	SDI	135.2														
2	SDI	60.9														
3	PIV	61.5				61.8							61.8			
4	PIV	65.4							13.3			109.8	109.8			
5	PIV/DRY										620.9	620.9				
6	PIV	122.9														
7	PIV									130.0						
8	SDI									61.8						
9	PIV				137.0						95.8	95.8		232.8		
10	PIV			44.5							129.1	129.1				
11	FUR	92.5														
12	DRY	151.2			132.7											
13	DRY	201.5											118.0			
14	PIV	124.2														
15	FUR	66.7			28.8											
16	PIV	143.1														
17	PIV	108.9									167.2	167.2	108.9			
18	PIV				61.5								60.7			
19	PIV	75.8					45.6									
20	PIV			117.6		115.8									233.4	
21	PIV		61.3							61.4						
22	PIV	148.7														
23	PIV		105.2													
24	PIV		129.8													
26	PIV		62.3				62.9					62.9				
27	SDI	16.2		46.2												
Total	**2007 acres**	**1574.7**	**358.6**	**208.3**	**360.0**	**177.6**	**108.5**	**0.0**	**13.3**	**253.2**	**1013.0**	**1185.7**	**459.2**	**232.8**	**233.4**	**0.0**

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation

Table 6. Irrigation type and total acres, by site, of crops, forages and acres grazed by cattle in 25 producer sites in Hale and Floyd Counties during 2008.

Site	irrigation type	total acres (no overlap)	cotton	corn grain	sunflowers	grain sorghum	grain sorghum for seed	grain sorghum for silage	forage sorghum for hay	pearl millet for seed	alfalfa	grass seed	hay	perennial pasture	cattle	wheat for grain	wheat for silage	wheat for grazing	grazing of crop residue	barley for seed	fallow or pens/facilities
2	SDI	60.9			60.9																
3	PIV	123.3	61.8			61.5										61.5					
4	PIV	123.1				65.4					13.3		13.3	13.3	44.4	44.4		44.4			
5	PIV/DRY	628.0											81.2	620.9	620.9						5.5
6	PIV	122.9	92.9	30.0																	
7	PIV	130.0										130.0	130.0	130.0							
8	SDI	61.8										61.8	61.8	61.8							
9	PIV	237.8	137.0											95.8	95.8						5.0
10	PIV	173.6		44.5									42.7	129.1	129.1	44.5					
11	FUR	92.5	47.3			45.2															
12	DRY	283.9						151.2													132.7
14	PIV	124.2	124.2																		
15	FUR	95.5	67.1													28.4					
17	PIV	220.8		108.9								111.9		111.9	220.8				108.9		
18	PIV	122.2	61.5			60.7											60.7				
19	PIV	120.4	75.0							45.4											
20	PIV	233.4				117.6		115.8					117.6			233.4					
21	PIV	122.7							61.3			61.4	122.7	61.4						61.3	
22	PIV	148.7		148.7																	
23	PIV	105.1	60.5		44.6																
24	PIV	129.8		129.8																	
26	PIV	125.2		40.4			22.5			62.3					125.2				125.2		
27	SDI	108.5	46.2	62.3																	
28	SDI	51.5		51.5																	
29	DRY	221.6	117.3												104.3			104.3			
	Total 2008 acres	**3967.4**	**890.8**	**616.1**	**105.5**	**350.4**	**22.5**	**267.0**	**61.3**	**107.7**	**13.3**	**365.1**	**569.3**	**1224.2**	**1340.5**	**412.2**	**60.7**	**148.7**	**234.1**	**61.3**	**143.2**
# of sites		**25**	**11**	**8**	**2**	**5**	**1**	**2**	**1**	**2**	**1**	**4**	**7**	**8**	**7**	**5**	**1**	**2**	**2**	**1**	**3**
Site	**irrigation type**	**total acres (no overlap)**	**cotton**	**corn grain**	**sunflowers**	**grain sorghum**	**grain sorghum for seed**	**grain sorghum for silage**	**forage sorghum for hay**	**pearl millet for seed**	**alfalfa**	**grass seed**	**hay**	**perennial pasture**	**cattle**	**wheat for grain**	**wheat for silage**	**wheat for grazing**	**grazing of crop residue**	**barley for seed**	**fallow or pens/facilities**

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation

Table 7. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 26 producer sites in Hale and Floyd Counties during 2009.

Site	irrigation type	System acres	cotton	corn grain	Corn silage	sunflowers	grain sorghum	grain sorghum for silage	forage sorghum for hay	alfalfa	grass seed	hay	perennial pasture	cattle	wheat for grain	wheat for silage	wheat for grazing	grazing of crop residue	Oat silage	fallow or pens/facilities
2	SDI	60.9	60.9																	
3	PIV	123.3	61.8				61.5													
4	PIV	123.1	13.3				28.4			16.0			16.0	98.3	65.4			98.3		
5	PIV/DRY	626.4										89.2	620.9	620.9						5.5
6	PIV	122.9	90.8	32.1																
7	PIV	129.9									129.9	129.9	129.9							
8	SDI	61.8									61.8	61.8	61.8							
9	PIV	237.8	137.0										100.8	100.8						
10	PIV	173.6	44.5										129.1	129.1						
11	FUR	92.5	68.1				24.4													
12	DRY	283.9						151.2												132.7
14	PIV	124.2	61.8												62.4					
15	FUR/SDI	102.8	102.8																	
17	PIV	220.8				108.9					53.6		111.9	111.9						
18	PIV	122.2	60.7												61.5					
19	PIV	120.3	60.2												60.1					
20	PIV	233.3	117.6		115.7															
21	PIV	122.6							61.2		61.4	61.4	61.4		61.2					
22	PIV	148.7	148.7																	
23	PIV	101.4						101.4								60.5			40.9	
24	PIV	129.7		64.6		65.1														
26	PIV	125.2		62.3		62.9								62.9			62.9			
27	SDI	108.5	48.8	59.7																
28	SDI	51.5	51.5																	
29	DRY	221.7	116.4												104.3					
30	PIV	21.8				21.8														
	Total 2009 acres	**3990.8**	**1244.9**	**218.7**	**115.7**	**258.7**	**114.3**	**252.6**	**61.2**	**16.0**	**306.7**	**342.3**	**1231.8**	**1123.9**	**414.9**	**60.5**	**62.9**	**98.3**	**40.9**	**138.2**
# of sites		**26**	**16**	**4**	**1**	**4**	**3**	**2**	**1**	**1**	**4**	**4**	**8**	**6**	**6**	**1**	**1**	**1**	**1**	**2**
Site	**irrigation type**	**System acres**	**cotton**	**corn grain**	**Corn silage**	**sunflowers**	**grain sorghum**	**grain sorghum for silage**	**forage sorghum for hay**	**alfalfa**	**grass seed**	**hay**	**perennial pasture**	**cattle**	**wheat for grain**	**wheat for silage**	**wheat for grazing**	**grazing of crop residue**	**Oat silage**	**fallow or pens/facilities**

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation

Table 8. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 26 producer sites in Hale and Floyd Counties during 2010.

Site	irrigation type	System acres	cotton	corn grain	Corn silage	sunflowers	grain sorghum	grain sorghum for silage	forage sorghum for hay	alfalfa	grass seed	hay	perennial forage	cattle	wheat for grain	wheat for silage	wheat for grazing	grazing of crop residue	Triticale silage
2	SDI	60.9		60.9															
3	PIV	123.3	61.8				61.5												
4	PIV	123.0	78.6						28.4	16.0			16.0		28.4				
5	PIV/DRY	628.0											628	628					
6	PIV	122.8	62.2	60.6															
7	PIV	130.0									130.0	130.0	130						
8	SDI	61.8									61.8	61.8	61.8						
9	PIV	237.8	137.0										100.8	100.8					
10	PIV	173.6		87.2									86.4	86.4					
11	FUR	92.5	69.6				22.9												
12	DRY	283.9																	
14	PIV	124.2	62.4												61.8				
15	FUR/SDI	102.8	102.8																
17	PIV	220.8		108.9									111.9	220.8					
18	PIV	122.2	61.5												60.7				
19	PIV	120.4	59.2												61.2				
20	PIV	233.4	115.8		117.6														115.8
21	PIV	122.6	61.2	61.4															
22	PIV	148.7		148.7															
23	PIV	121.1		121.1															121.1
24	PIV	129.7		129.7															
26	PIV	125.2	62.9	62.3										62.3	62.3		62.3		
27	SDI	108.5	59.7		48.8														
28	SDI	51.5	51.5																
29	DRY	221.7	104.3				117.4												
30	SDI	21.8		21.8															
	Total 2010 acres	**4012.2**	**1150.5**	**862.6**	**166.4**	**0.0**	**201.8**	**0.0**	**28.4**	**16.0**	**191.8**	**191.8**	**1134.9**	**1098.3**	**274.4**	**0.0**	**62.3**	**0.0**	**236.9**
# of sites		**26**	**15**	**10**	**2**	**0**	**3**	**0**	**1**	**1**	**2**	**2**	**7**	**5**	**5**	**0**	**1**	**0**	**2**
Site	irrigation type	System acres	cotton	corn grain	Corn silage	sunflowers	grain sorghum	grain sorghum for silage	forage sorghum for hay	alfalfa	grass seed	hay	perennial forage	cattle	wheat for grain	wheat for silage	wheat for grazing	grazing of crop residue	Triticale silage

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation

Table 9. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 29 producer sites in Hale and Floyd Counties during 2011.

Site	irrigation type	System acres	cotton	corn grain	Corn silage	fallow	grain sorghum	grain sorghum for silage	forage sorghum for hay	alfalfa	grass seed	hay	perennial forage	cattle	wheat for grain	wheat for silage	wheat for grazing	grazing of crop residue	Triticale silage	seed millet
2	SDI	60.9	41.3			**19.6**														
3	PIV	123.3	123.3																	
4	PIV	123.0	79.0						13.3	16.0					28.0					
5	PIV	487.6	347.8			**139.8**														
6	PIV	122.8	92.9	29.9																
7	PIV	130.0									130.0	130.0	130							
8	SDI	61.8									42.5	42.5	61.8							
9	PIV	237.8	137.0										100.8	100.8						
10	PIV	173.6	131.5										42.1	42.1						
11	FUR	92.5	74.5					18.0												
12	DRY	283.9	283.9																	
14	PIV	124.2	124.2																	
15	SDI	102.8	57.2		45.6															
17	PIV	220.8	108.9										111.9	111.9						
18	PIV	122.2	100.0												61.5					
19	PIV	120.4	120.4																	
20	PIV	233.4	117.6		115.8							117.6							117.6	
21	PIV	122.6	61.4	61.2																
22	PIV	148.7	148.7																	
23	PIV	121.1			121.1														121.1	
24	PIV	129.7	65.1	64.6																
26	PIV	125.2	62.9	62.3																
27	SDI	108.5	48.8		59.7															
28	SDI	51.5	51.5																	
29	DRY	221.7	221.7																	
30	SDI	21.8				21.8														
31	PIV	121.0	55.4																	66.1
32	PIV	70.0		70.0																
33	PIV	70.0		70.0																
	Total 2011 acres	**4132.8**	**2655.0**	**358.0**	**342.2**	**181.2**	**0.0**	**18.0**	**13.3**	**16.0**	**172.5**	**290.1**	**446.6**	**254.8**	**89.5**	**0.0**	**0.0**	**0.0**	**238.7**	**66.1**
# of sites		**29**	**23**	**6**	**4**	**3**	**0**	**1**	**1**	**1**	**2**	**3**	**5**	**3**	**2**	**0**	**0**	**0**	**2**	**1**
Site	**irrigation type**	**System acres**	**cotton**	**corn grain**	**Corn silage**	**fallow**	**grain sorghum**	**grain sorghum for silage**	**forage sorghum for hay**	**alfalfa**	**grass seed**	**hay**	**perennial forage**	**cattle**	**wheat for grain**	**wheat for silage**	**wheat for grazing**	**grazing of crop residue**	**Triticale silage**	**seed millet**

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation
**Yellow notes abandoned, Tan partially abandoned, Brown fallowed

Table 10. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 29 producer sites in Hale and Floyd Counties during 2012.

Site	irrigation type	System acres	cotton	corn grain	Corn silage	fallow	grain sorghum	Seed Sorghum	forage sorghum for hay	alfalfa	grass seed	hay	perennial forage	cattle	wheat for grain	wheat for silage	wheat for grazing	Sunflowers	Triticale silage	seed millet
2	SDI	60.0	24	36																
3	PIV	123.3	123.3																	
4	PIV	123.0	29.6					50.5	13.2	16					26.9					
5	PIV	484.1	398.3			**85.5**														
6	PIV	122.7		60.6		62.1														
7	PIV	130.0									130	130	130							
8	SDI	61.8									61.8	61.8	61.8							
9	PIV	237.8	137										100.8							
10	PIV	173.6			87.2								86.4							
11	FUR	92.5	92.5				92.5													
12	DRY	283.8	283.8			283.8														
14	PIV	124.1	62.4												61.7					
15	SDI	101.1	101.1				101.1													
17	PIV	220.7	54.5	54.4									111.8	111.8						
18	PIV	122.2																		
19	PIV	120.4	59.2			61.2														
20	PIV	233.3	115.7	117.6															115.7	
21	PIV	122.6	61.2						61.4						61.4					
22	PIV	148.7	148.7																	
24	PIV	129.7	65.1	64.6																
26	PIV	125.2	62.3															62.9		
27	SDI	108.4	59.6		48.8															
28	SDI	51.5	51.5	51.5																
29	DRY	221.6	117.3				104.3													
30	SDI	21.8	21.8																	
31	PIV	121.9	66.8																	55.1
32	PIV	70.0	70	70																
33	PIV	70.0		70																
34	PIV	726.6	364	182		362.6														
	Total 2012 acres	**4732.4**	**2569.7**	**706.7**	**136**	**855.2**	**297.9**	**50.5**	**74.6**	**16**	**191.8**	**191.8**	**490.8**	**111.8**	**150**	**0**	**0**	**62.9**	**115.7**	**55.1**
# of sites		**29**	**23**	**9**	**2**	**5**	**3**	**1**	**2**	**1**	**2**	**2**	**5**	**1**	**3**	**0**	**0**	**1**	**1**	**1**
Site	**irrigation type**	**System acres**	**cotton**	**corn grain**	**Corn silage**	**fallow**	**grain sorghum**	**Seed Sorghum**	**forage sorghum for hay**	**alfalfa**	**grass seed**	**hay**	**perennial forage**	**cattle**	**wheat for grain**	**wheat for silage**	**wheat for grazing**	**Sunflowers**	**Triticale silage**	**seed millet**

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation

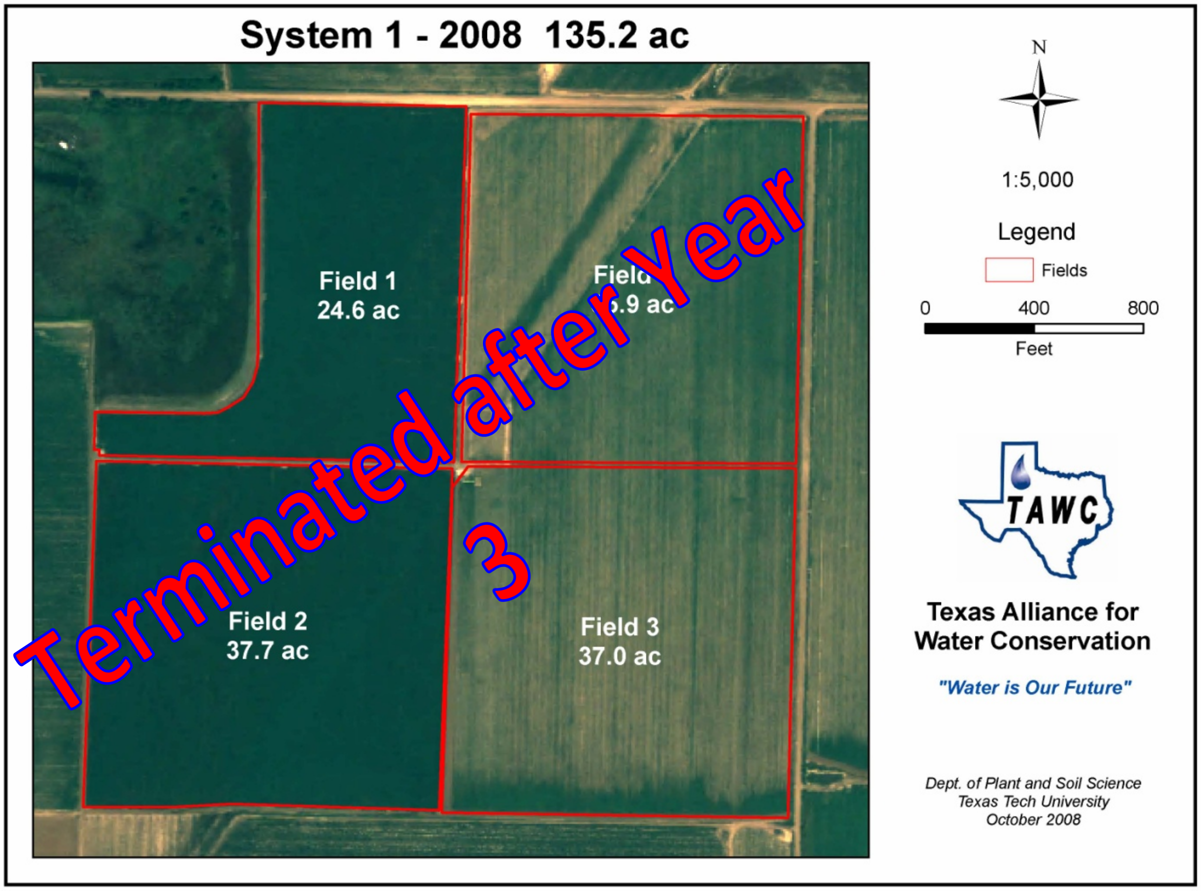
**Yellow denotes field was abandoned due to hail/drought, tan denotes partially abandoned, brown denotes fallowe

Table 11. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 29 producer sites in Hale and Floyd Counties during 2013.

Site	irrigation type	System acres	Cotton	Corn grain	Corn silage	Fallow	Grain sorghum	Seed sorghum	Haygrazer	Alfalfa	Grass seed	Hay	Perennial forage	Cattle grazed	Wheat for grain	Wheat silage	Grazed wheat	Sunflower	Triticale silage	Seed millet
2	SDI	60	31.5	28.4																
3	PIV	123.3	61.5				61.8													
4	PIV	123	50.5						26.8	16		16	16	26.8	26.8					29.6
5	PIV	484.1	119.4											85.8	85.8			122.9		156
6	PIV	122.7	60.6									62.1			62.1					
7	PIV	130									130	130	130							
8	SDI	61.8									61.8	61.8	61.8							
9	PIV	237.8	77				59.9						100.8	100.8						
10	PIV	173.6	42.1		87.2								44.3	44.3						
11	FUR	92.5	92.5																	
12	DRY	283.8	283.8																	
14	PIV	124.1	124.1																	
15	SDI	101.1	101.1																	
17	PIV	220.7		54.5									111.8	111.8				54.4		
18	PIV	122.2				122.2														
19	PIV	120.3	120.3																	
20	PIV	233.3	117.6		115.7														117.6	
21	PIV	122.6		61.4					61.2			61.2			61.2					
22	PIV	148.7	148.7																	
24	PIV	129.7		65.1														64.6		
26	PIV	125.2		62.2											62.9					
27	SDI	108.4	48.8		59.6															
28	SDI	51.4	51.4																	
29	DRY	221.7	221.7																	
30	SDI	21.8		21.8																
31	PIV	121.9	55.1																	66.8
32	PIV	70			70															
33	PIV	70		70																
34	PIV	726.6		241.2														485.4		
35	PIV	209.1	75	60.9			73.2													
	Total acres 2013	**4941.4**	**1882.7**	**665.5**	**332.5**	**122.2**	**194.9**	**0**	**88**	**16**	**191.8**	**331.1**	**464.7**	**369.5**	**298.8**	**0**	**0**	**727.3**	**117.6**	**252.4**
	# of sites	**30**	**19**	**9**	**4**	**1**	**3**	**0**	**2**	**1**	**2**	**5**	**6**	**5**	**5**	**0**	**0**	**4**	**1**	**3**
Site	irrigation type	System acres	Cotton	Corn grain	Corn silage	Fallow	Grain sorghum	Seed sorghum	Haygrazer	Alfalfa	Grass seed	Hay	Perennial forage	Cattle grazed	Wheat for grain	Wheat silage	Grazed wheat	Sunflower	Triticale silage	Seed millet
			Failed												**Failed** **Altered**					

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation
**Red denotes field crop failure, Yellow denotes original purpose altered, brown denotes fallowed

SITE1



DESCRIPTION

Total site acres:	135.2
Field No. 1 Acres:	24.6
Major soil type:	Estacado clay loam; 1 to 3%
Field No. 2 Acres:	37.7
Major soil type:	Lofton clay loam, 0 to 1% Pullman clay loam, 1 to 3%
Field No. 3 Acres:	37.0
Major soil type:	Pullman clay loam, 0 to 1%
Field No. 4 Acres:	35.9
Major soil type:	Pullman clay loam; 0 to 1%

IRRIGATION

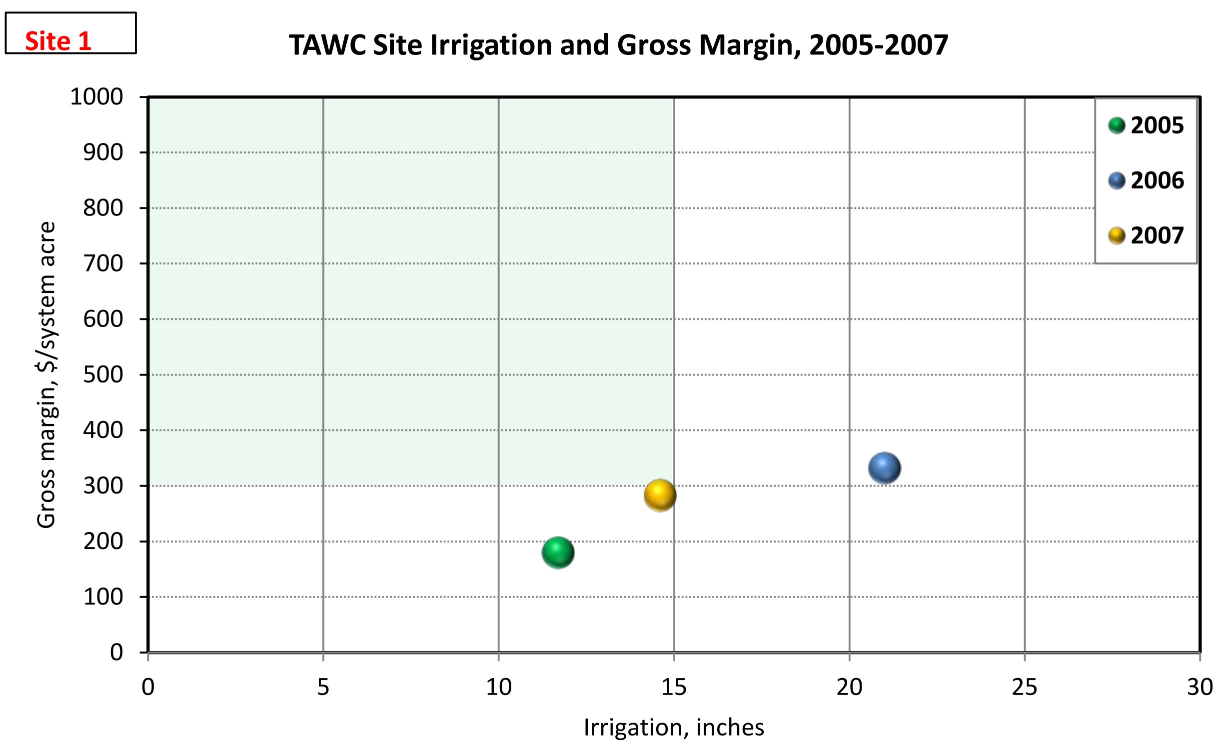
Type: Subsurface Drip (SDI)
(Field 1 and 2 installed prior to 2004 crop year)
(Field 3 and 4 installed prior to 2006 crop year)

Pumping capacity, gal/min:	850
Number of wells:	2
Fuel source:	Electric Natural gas

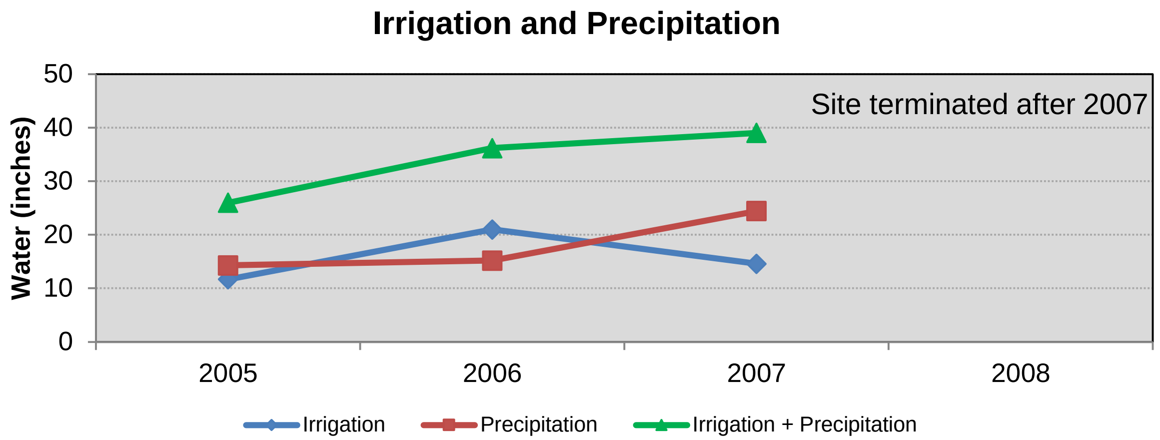
Comments: Drip irrigation cotton and corn system, conventional tillage with crops planted on 40-inch centers.

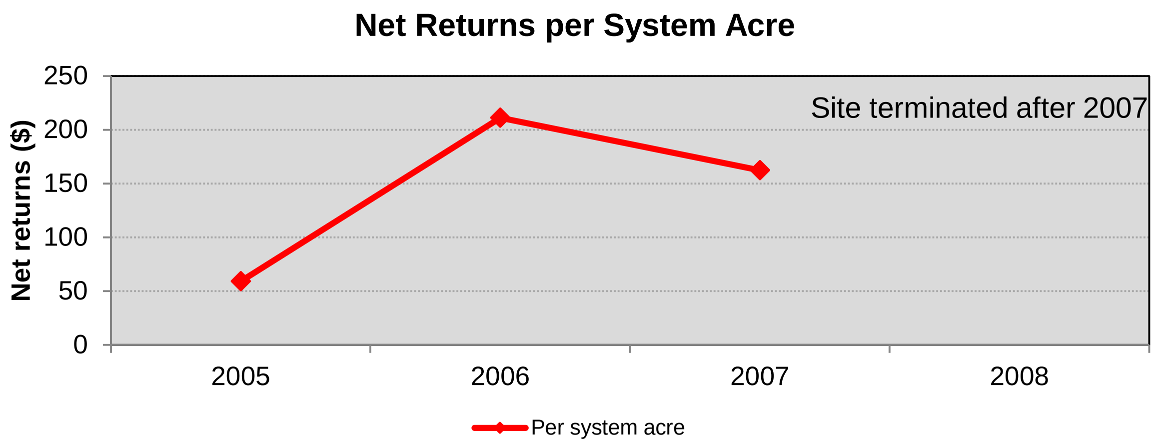
Site 1

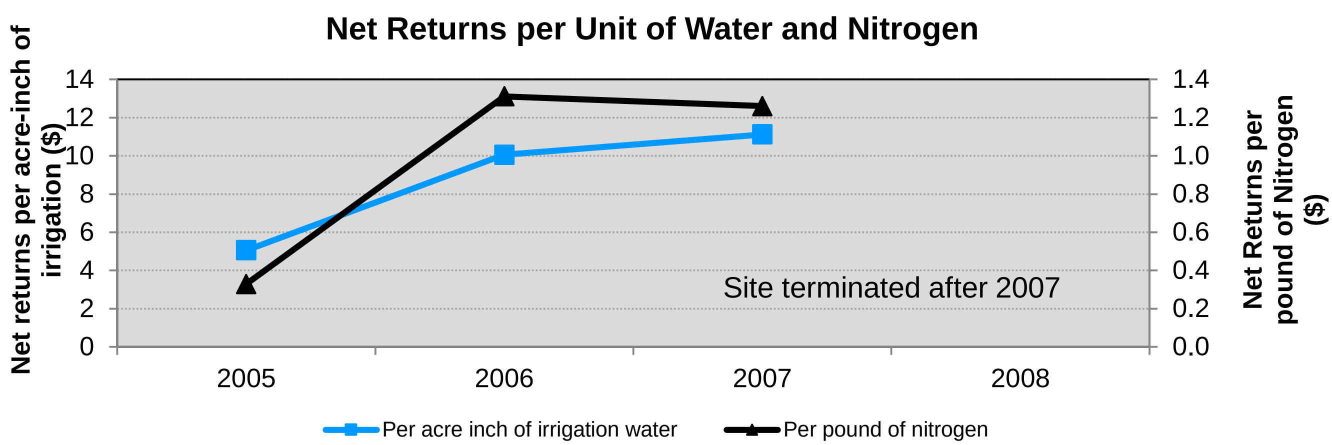
	Livestock	Field 1	Field 2	Field 3	Field 4
2005	None	Cotton	Cotton		
2006	None	Cotton	Cotton	Cotton	Cotton
2007	None	Cotton	Cotton	Cotton	Cotton
2008	Site terminated in 2008				



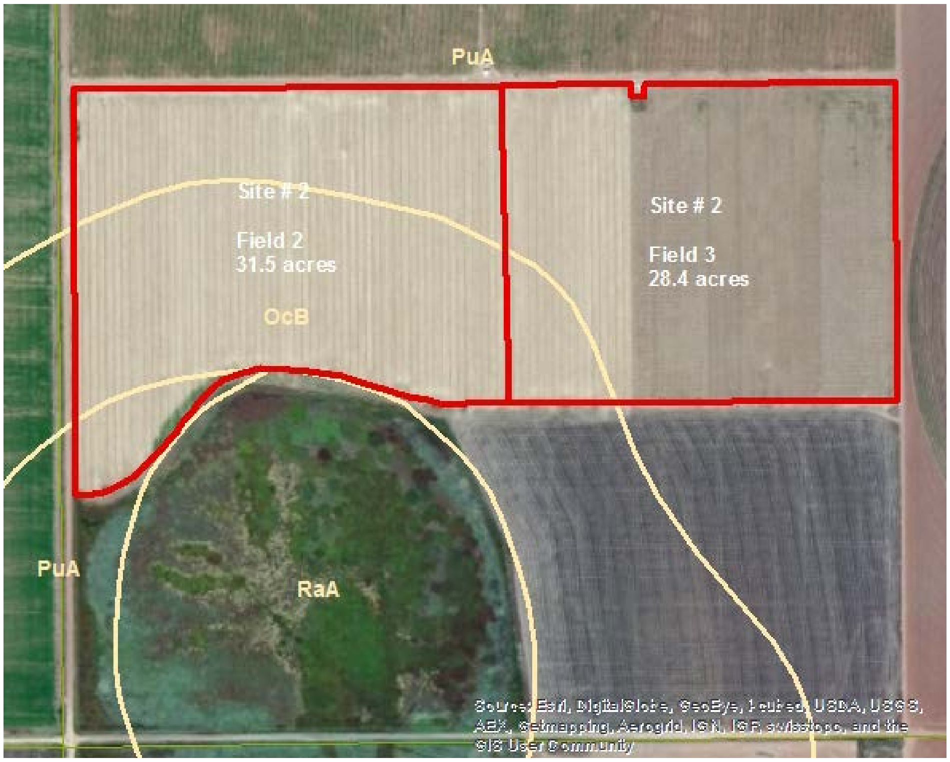
Site 1


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
Site terminated after 2007
2005
2006
2007
2008
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
250
200
150
100
50
0
Site terminated after 2007
2005
2006
2007
2008
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre-inch of irrigation ($)
14
12
10
8
6
4
2
0
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Net Returns per pound of Nitrogen ($)
Site terminated after 2007
2005
2006
2007
2008
Per acre inch of irrigation water
Per pound of nitrogen

SITE 2



DESCRIPTION

Total site acres: 60

Field No. 2 Acres: 36
Major soil type: PuA-Pullman clay loam, 0 to 1%
OcB-Olton clay loam, 1 to 3%

Field No. 3 Acres: 24

Major soil type: PuA-Pullman clay loam, 0 to 1%
OcB-Olton clay loam, 1 to 3%

IRRIGATION

Type: Sub-surface Drip
(SDI, installed prior to 2004 crop year)

Pumping capacity, gal/min: 360

Number of wells: 2

Fuel source: Electric

Site 2

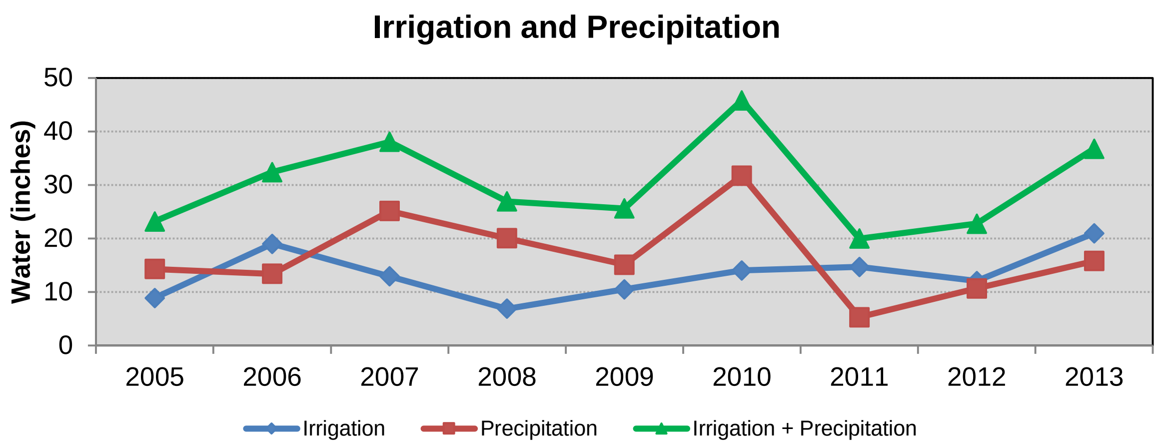
	Livestock	Field 1	Field 2
2005	None	Cotton	
2006	None	Cotton	
2007	None	Cotton	
2008	None	Sunflowers	
2009	None	Cotton	
2010	None	Corn	
	Livestock	Field 2	Field 3
2011	None	Cotton	Fallowed
2012	None	Corn	Cotton
2013	None	Cotton	Corn

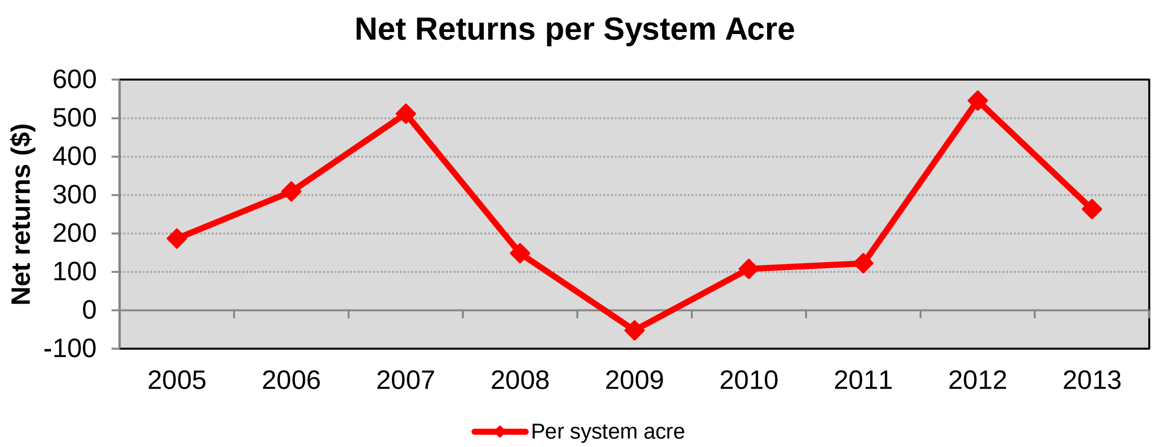
Comments: This drip site was planted to corn and cotton on 30-inch centers in 2013. In prior years the cropping mix for this site was corn, cotton or sunflowers.

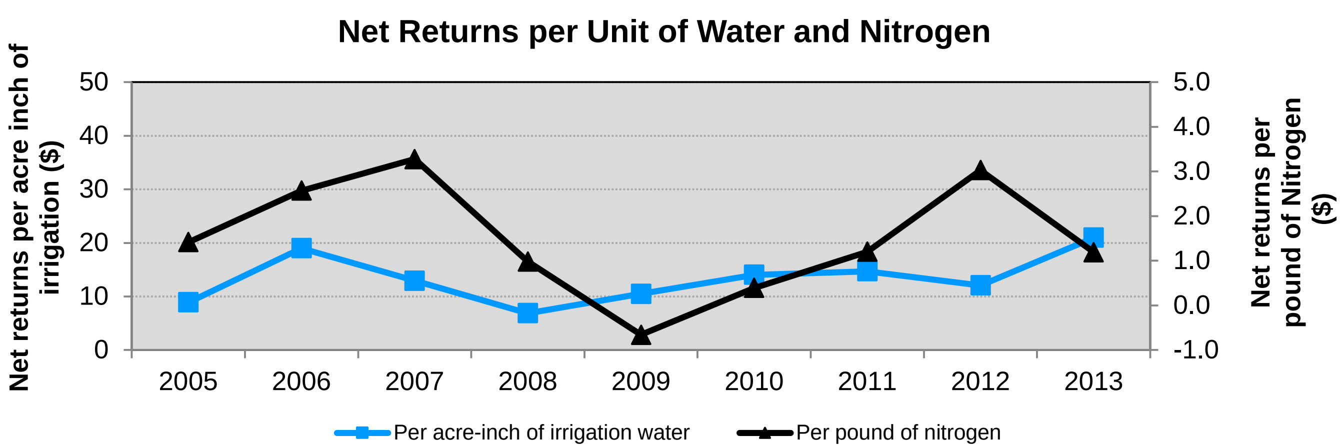
Corn over Drip Irrigation

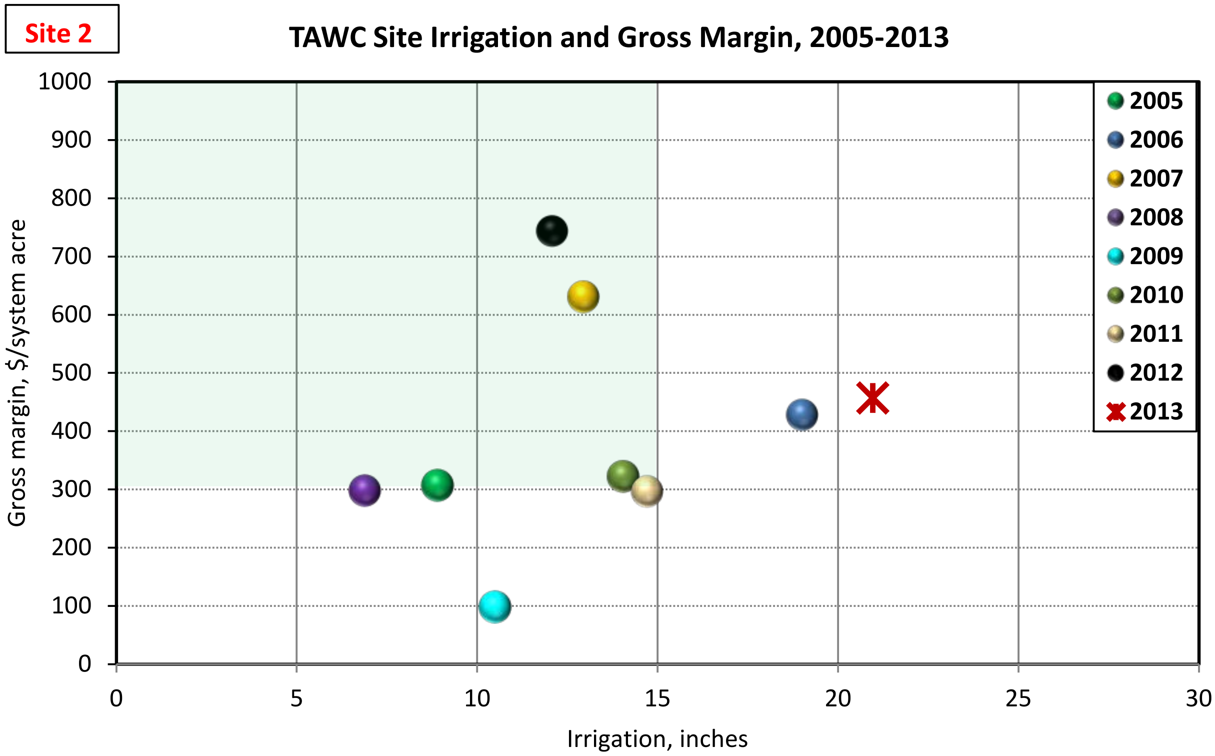
Cotton field

Site 2

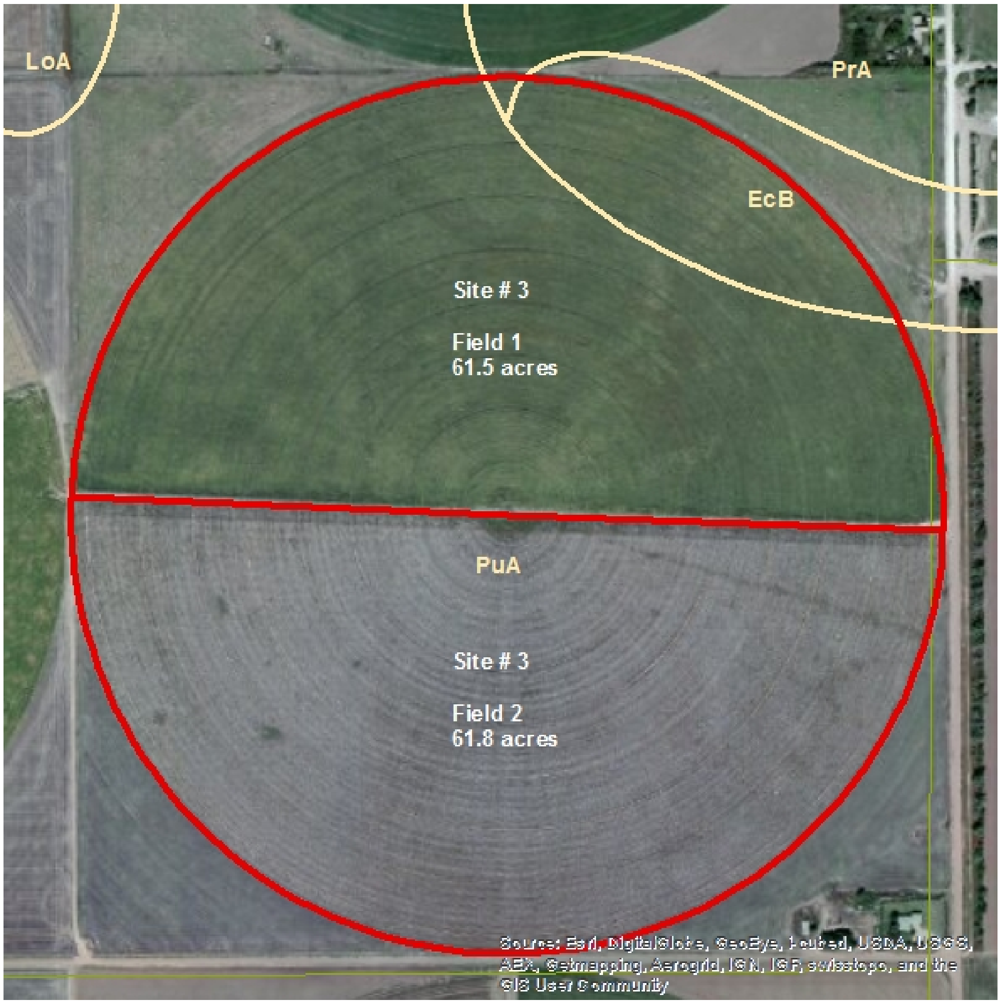

Irrigation and Precipitation
Water (inches)
0
10
20
30
40
50
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
-100
0
100
200
300
400
500
600
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
0
10
20
30
40
50
Net returns per pound of Nitrogen ($)
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 2
TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
Irrigation, inches
0
100
200
300
400
500
600
700
800
900
1000
0
5
10
15
20
25
30
2005
2006
2007
2008
2009
2010
2011
2012
2013

Site 3



Description

Total site acres:	123.3
Field No. 1 Acres:	61.5
Major soil type:	PuA-Pullman clay loam; 0 to 1% EcB-Estacado clay loam; 1 to 3%
Field No. 2 Acres:	61.8
Major soil type:	PuA-Pullman clay loam; 0 to 1%

Irrigation

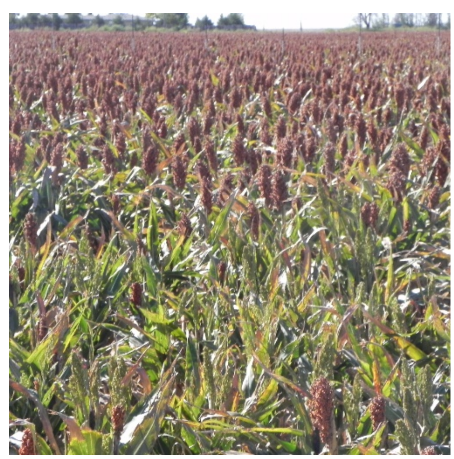
Type:	Center Pivot (MESA)
Pumping capacity, gal/min:	450
Number of wells:	2
Fuel source:	1 Natural gas 1 Electric

Site 3

	Livestock	Field 1	Field 2
2005	None	Grain Sorghum	Cotton
2006	None	Cotton	Cotton
2007	None	Cotton following Wheat cover crop	Wheat for grain followed by Grain Sorghum
2008	None	Wheat for grain followed by Grain Sorghum	Cotton
2009	None	Wheat/Grain Sorghum	Cotton
2010	None	Cotton	Wheat/Grain Sorghum
2011	None	Cotton	Cotton
2012	None	Cotton	Cotton
2013	None	Cotton	Grain Sorghum

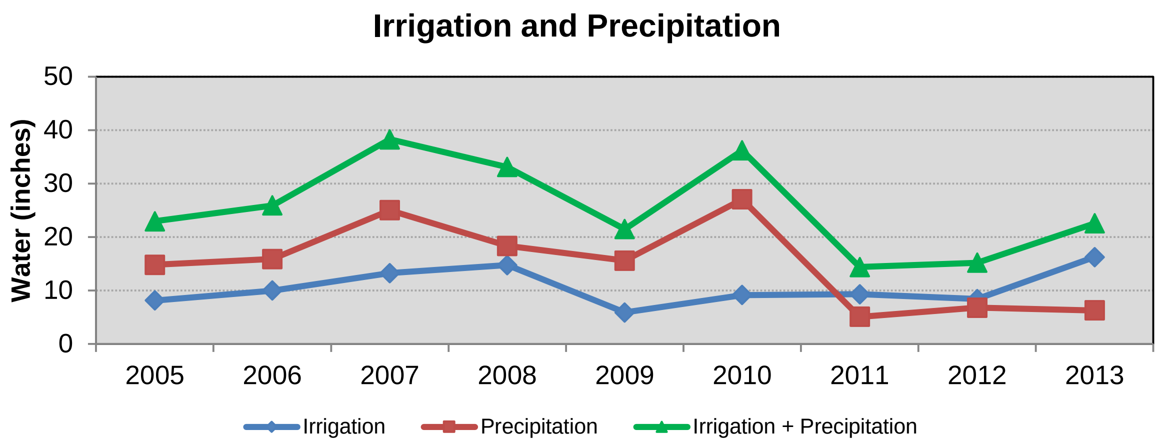
Comments: This is a pivot irrigated system using conventional tillage, and row crops are planted on 40-inch centers. Crops have included cotton, wheat and grain sorghum. In 2013 this site was planted to cotton in a skip-row pattern.

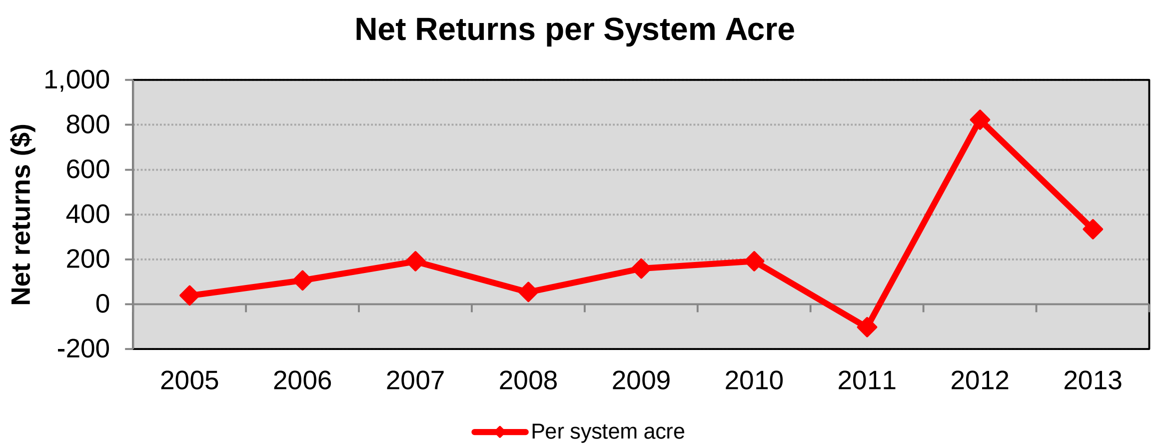
Cotton planted between wheat

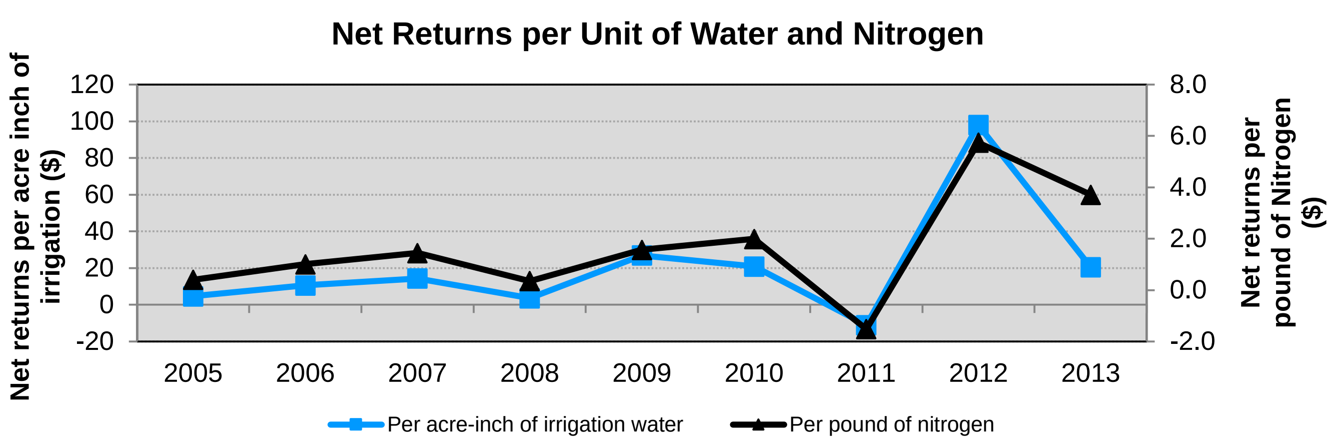


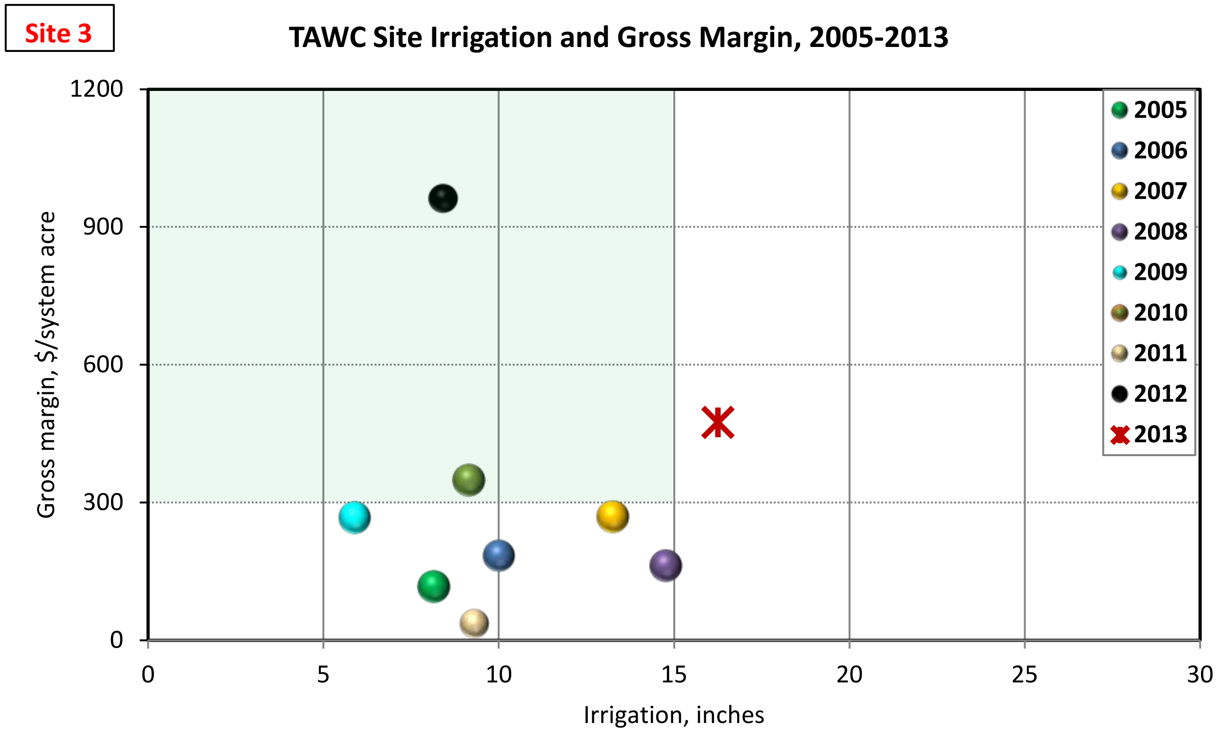
October grain sorghum

Site 3

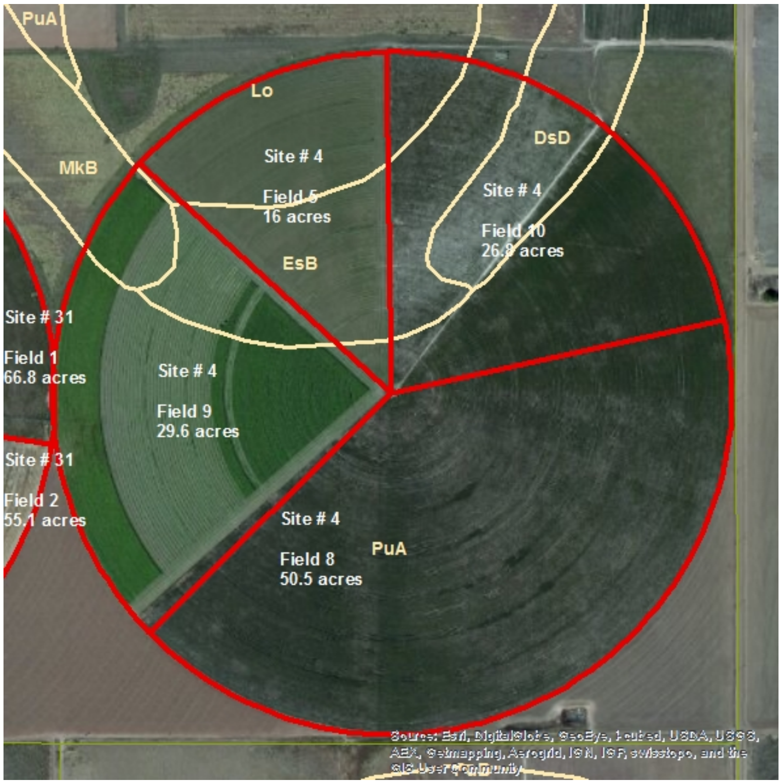

Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
1,000
800
600
400
200
0
-200
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
120
100
80
60
40
20
0
-20
8.0
6.0
4.0
2.0
0.0
-2.0
Net returns per pound of Nitrogen ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 3
TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1200
900
600
300
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

Site 4



Description

Total site acres:	122.9
Field No. 5 Acres:	16.0
Major soil type:	EsB-Estacado loam, 1 to 3% Lo-Lofton clay loam
Field No. 8 Acres:	50.5
Major soil type:	EsB-Estacado loam, 1 to 3% PuA-Pullman clay loam, 0 to 1%
Field No. 9 Acres:	29.6
Major soil type:	PuA-Pullman clay loam, 0 to 1% EsB-Estacado loam, 1 to 3%
Field No. 10 Acres:	26.8
Major soil type:	PuA-Pullman clay loam, 0 to 1% DsD-Drake soils, 3 to 8% Estacado loam, 1 to 3%

Irrigation

Type:	Center pivot (LESA)
Pumping capacity, gal/min:	500
Number of wells:	3
Fuel source:	1 Natural gas 2 Electric

Site 4 Strip tillage used on all fields

Year	Livestock	Field 1	Field 2	Field 3	Field 4	Field 5
2005	None	Alfalfa for hay	Cotton following wheat cover crop	Cotton following wheat cover crop		
2006	None	Alfalfa for hay	Wheat for silage, followed by forage sorghum for silage and hay	Cotton		
2007	Cow-calf	Alfalfa for hay	Wheat for grazing (winter-spring) and cover crop, followed by cotton	Wheat for grain, followed by Wheat for grazing (fall-winter)		
2008	Cow-calf	Alfalfa for hay	Grain sorghum	Wheat for grain, followed by wheat for grazing (fall-winter) and partly planted to Alfalfa		
2009	None	Cotton	Wheat/hay	Split into Fields 4 and 5	Grain sorghum	Alfalfa
2010	None	Cotton	Cotton		Wheat/forage sorghum	Alfalfa
	Livestock	Field 1	Field 5		Field 6	Field 7
2011	None	Haygrazer	Alfalfa		Cotton	Wheat
	Livestock	Field 1	Field 5	Field 7	Field 8	Field 9
2012	None	Wheat/haygrazer	Alfalfa	Wheat	Sorghum	Cotton
	Livestock	Field 5	Field 8	Field 9	Field 10	
2013	Cow-calf	Alfalfa-hay fed to cows/calves	Cotton	Millet	Wheat/haygrazer-fed to cows/calves	

Site 4

July alfalfa

Harvested hay

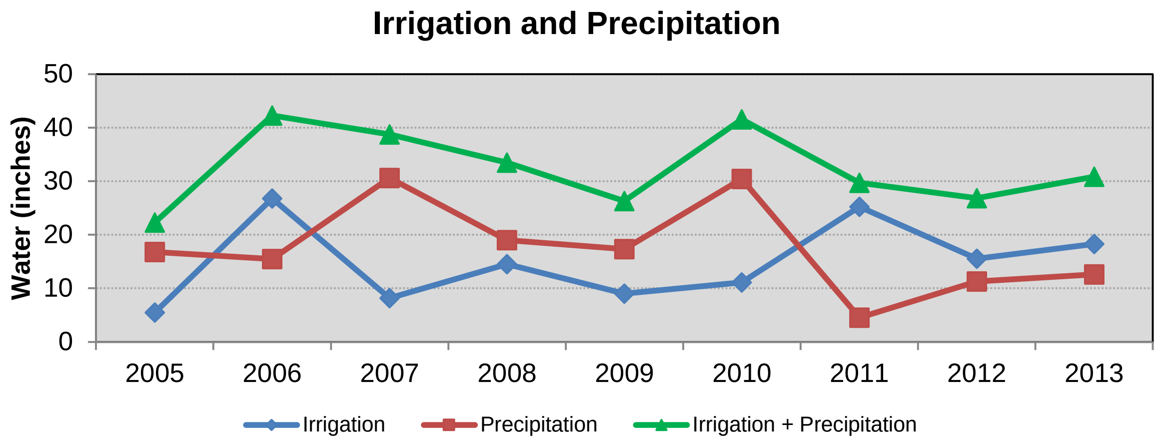
June wheat

November wheat

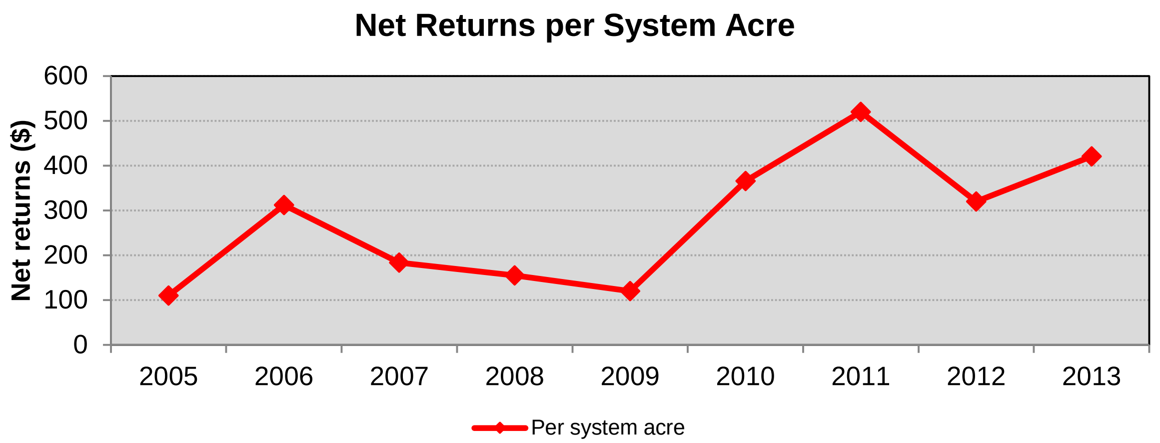
November cotton

Standing residue

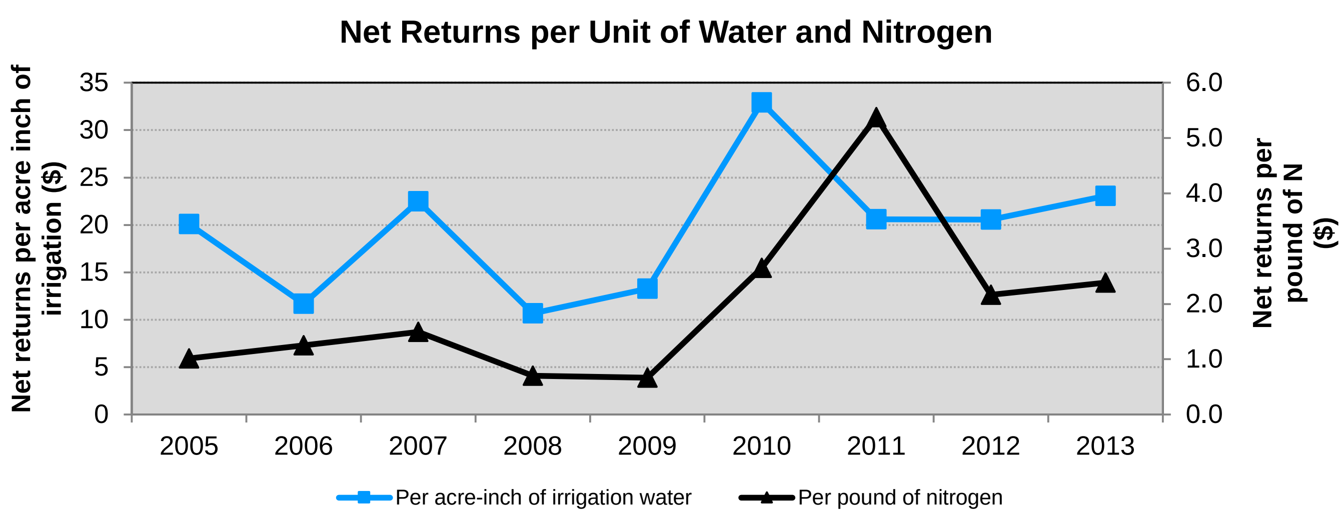
Site 4



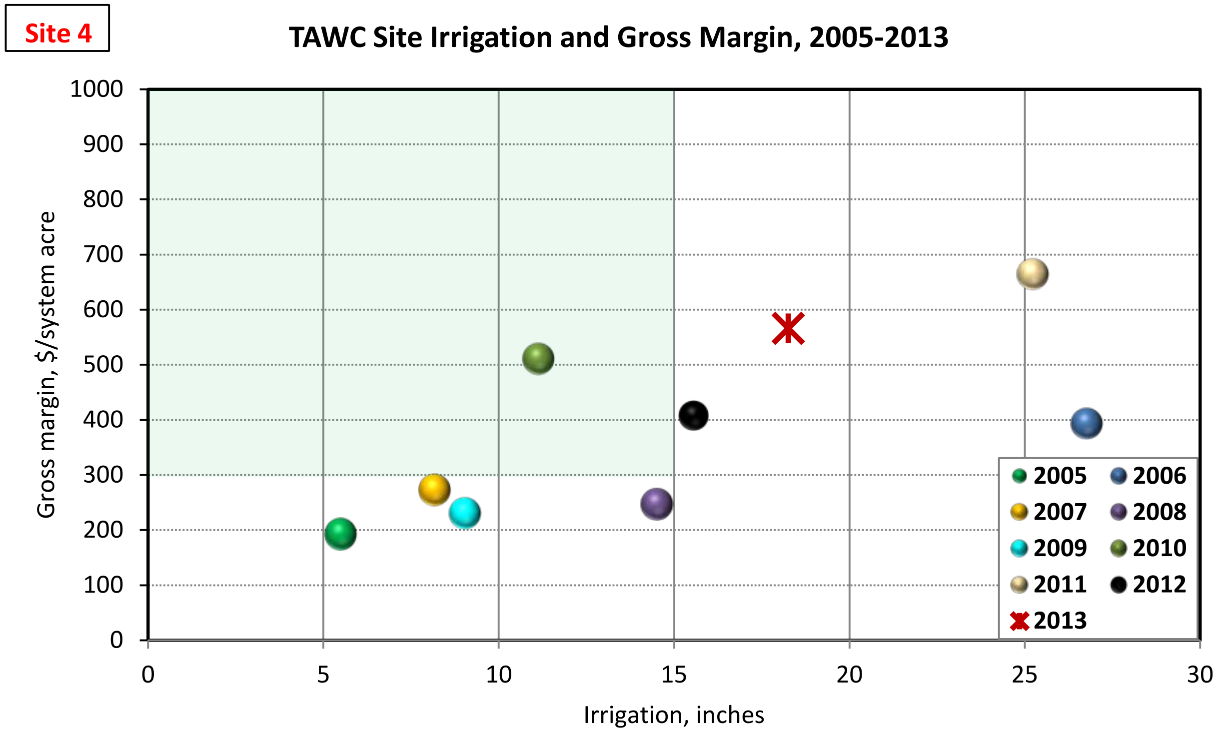
Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation



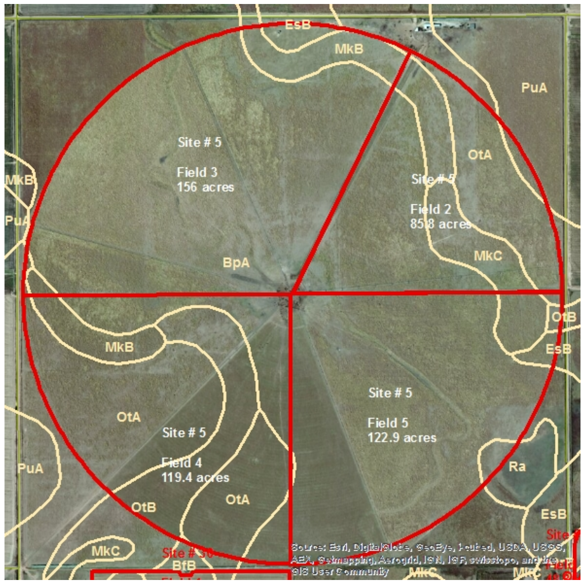
Net Returns per System Acre
Net returns ($)
600
500
400
300
200
100
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre



Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
35
30
25
20
15
10
5
0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 4
TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

SITE 5



DESCRIPTION

Total site acres: 484.1

IRRIGATED

Field No. 2 Acres: 85.8
Major soil type: BpA-Bippus loam, 0 to 1%
MkB/MkC-Mansker loam, 0 to 3 and 3 to 5%
OtA/OtB-Olton loam, 0 to 1% and 1 to 3%

Field No. 3 Acres: 156
Major soil type: BpA-Bippus loam, 0 to 1%
MkB-Mansker loam, 0 to 3%

Field No. 4 Acres: 119.4
Major soil type: OtA-Olton loam, 0 to 1%

Bippus loam, 0 to 1%
Mansker loam, 0 to 3%

Field No. 5 Acres: 122.9
Major soil type: BpA-Bippus loam, 0 to 1%
MkB-Mansker loam, 0 to 3%

IRRIGATION

Type: Center Pivot (MESA)

Pumping capacity, gal/min: 1100

Number of wells: 4

Fuel source: Electric

Site 5 ***Crops - Irrigated***

Year	Livestock	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6
2005	Cow-calf	Klein/Plains/Dahl/Blue grama/Buffalograss mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Plains/Klein/Blue grama mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Plains/Klein/Blue grama mixture for grazing	Alfalfa/Plains/Blue grama/Klein mixture for grazing
2006	Cow-calf	Klein/Plains/Dahl/Blue grama/Buffalograss mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Renovated, Plains/Klein/Blue grama/Dahl mixture for grazing and hay	Plains/Blue grama/Klein mixture for grazing	Plains/Klein/Blue grama mixture for grazing	Alfalfa/Plains/blue grama/Klein mixture for grazing
2007	Cow-calf	Klein/Plains/Dahl/Blue grama/Buffalograss mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Plains/Klein/Blue grama/Dahl mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Renovated, Plains/Klein/Dahl mixture for grazing and hay	Dahl/Green sprangletop/Plains mixture for grazing and hay
2008	Cow-calf	Klein/Plains/Dahl/Blue grama/Buffalograss mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Plains/Klein/Blue grama/Dahl mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Renovated, Plains/Klein/Dahl mixture for grazing and hay	Dahl/Green sprangletop/Plains mixture for grazing and hay
2009	Cow-calf	Klein/Plains/Dahl/Blue grama/Buffalograss mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Plains/Klein/Blue grama/Dahl mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Renovated, Plains/Klein/Dahl mixture for grazing and hay	Dahl/Green sprangletop/Plains mixture for grazing and hay
2010	Cow-calf	Klein/Plains/Dahl/Blue grama/Buffalograss mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Plains/Klein/Blue grama/Dahl mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Renovated, Plains/Klein/Dahl mixture for grazing and hay	Dahl/Green sprangletop/Plains mixture for grazing and hay
	Livestock	Field 12	Field 13				
2011	None	Fallowed	Cotton/abandoned				
	Livestock	Field 1	Field 2				
2012	None	Cotton	Cotton				
	Livestock	Field 2	Field 3	Field 4	Field 5		
2013	None	Wheat	Millet	Cotton	Sunflower		

Site 5 *Crops - Dryland*

	Field 7	Field 8	Field 9	Field 10	Field 11	Fields 12 and 13
2005	Plains/Blue grama mixture for grazing	Plains/Blue grama/Sand dropseed/Buffalograss mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Pens and barns
2006	Plains/Blue grama mixture for grazing	Plains/Blue grama/Sand dropseed/Buffalograss mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Pens and barns
2007	Plains/Blue grama mixture for grazing	Plains/Blue grama/Sand dropseed/Buffalograss mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Pens and barns
2008	Plains/Blue grama mixture for grazing	Plains/Blue grama/Sand dropseed/Buffalograss mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Pens and barns
2009	Plains/Blue grama mixture for grazing	Plains/Blue grama/Sand dropseed/Buffalograss mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Pens and barns
2010	Plains/Blue grama mixture for grazing	Plains/Blue grama/Sand dropseed/Buffalograss mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Pens and barns
	Livestock	Field 7,8,9,10,11				
2011	None	Corners/grass Plains/Blue grama Mixture for grazing (Not part of system-dropped in 2011)				

Comments: In 2013 this pivot irrigated site was planted to wheat, millet, cotton and sunflower. The cotton was planted on 30-inch centers and a cotton picker is used for harvest.

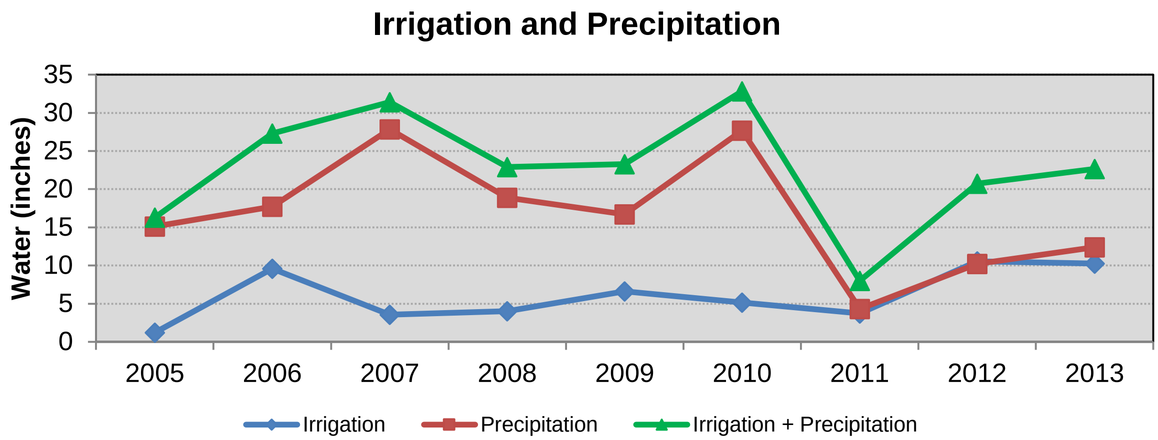
Site 5

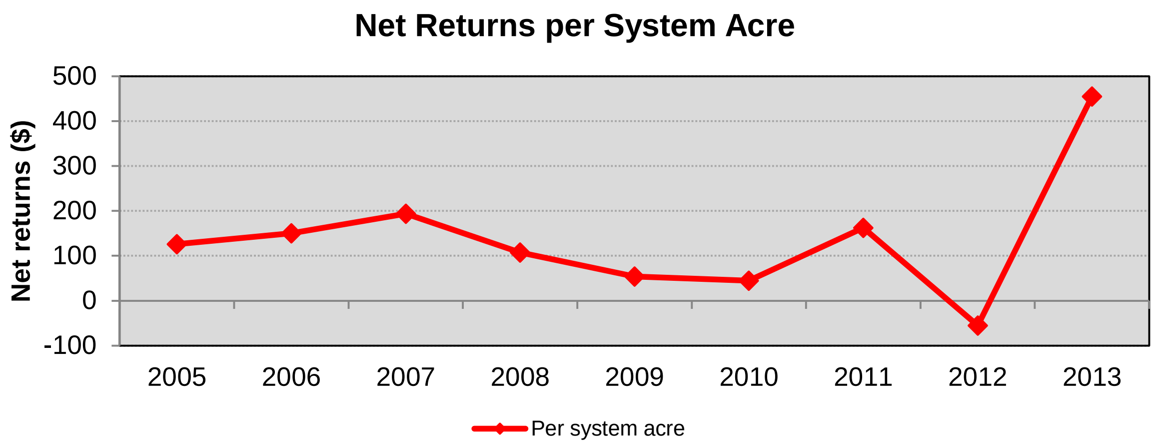
July sunflower field

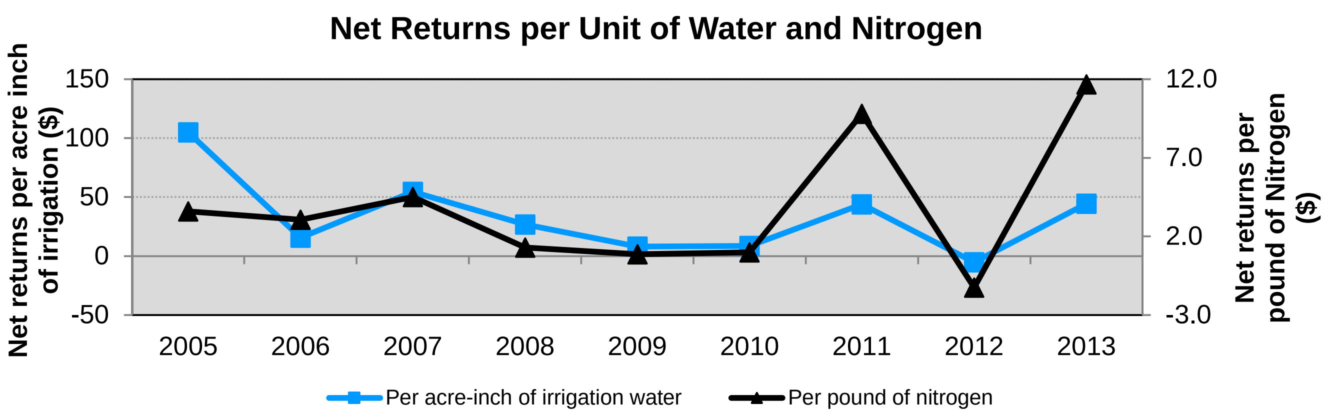
July cotton

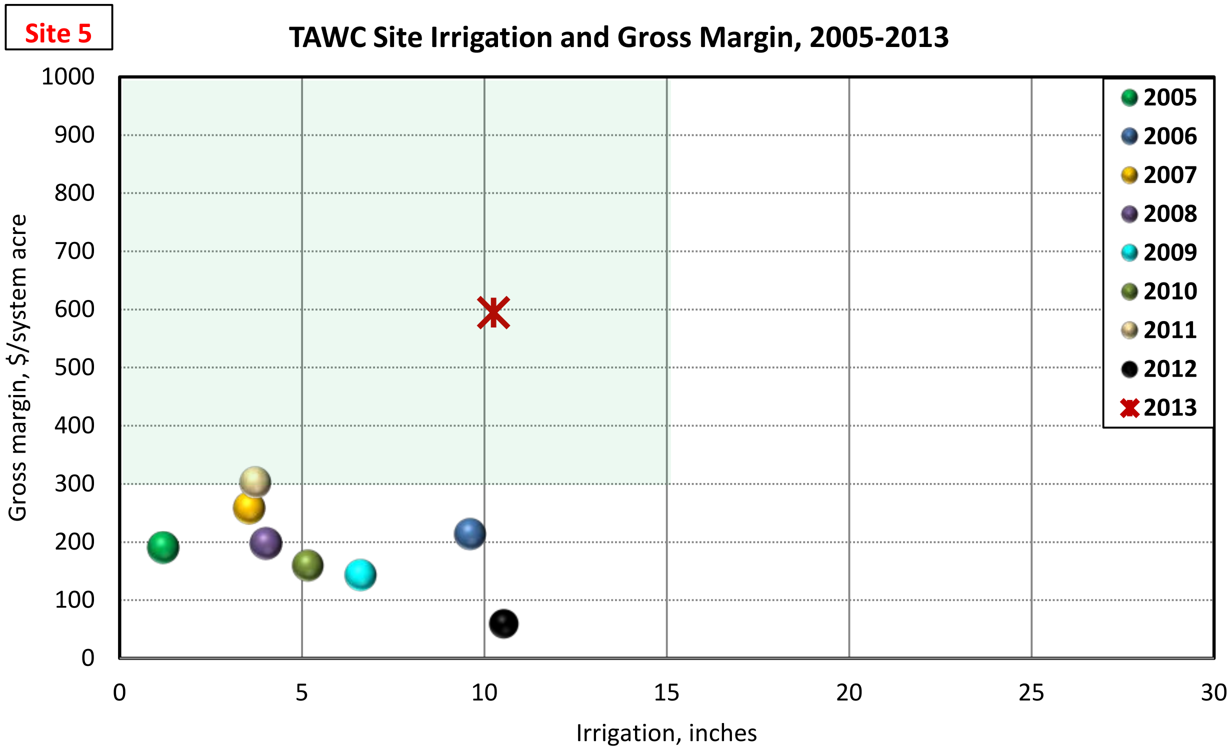
October millet field

Site 5


Irrigation and Precipitation
Water (inches)
35
30
25
20
15
10
5
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
500
400
300
200
100
0
-100
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
150
100
50
0
-50
12.0
7.0
2.0
-3.0
Net returns per pound of Nitrogen ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen



Site 5
TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

Site 6

Description

Total site acres:	122.7
Field No. 9 Acres:	60.6
Major soil type:	PuA-Pullman clay loam, 0 to 1% PuB-Pullman clay loam, 1 to 3%
Field No. 10 Acres:	62.1
Major soil type:	PuA-Pullman clay loam, 0 to 1% LoA-Lofton clay loam, 0 to 1%

Irrigation

Type:	Center Pivot (LESA)
Pumping capacity, gal/min:	500
Number of wells:	4
Fuel source:	Natural gas

Site 6

	Livestock	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8
2005	Stocker steers	Wheat for grazing and cover followed by Cotton							
2006	None	Cotton							
2007	None	Cotton							
2008	None	Split into Fields 2 and 3	Cotton	Corn for grain					
2009	None		Split into Fields 4 and 5		Cotton	Corn			
2010	None					Corn	Corn	Cotton	Cotton
2011	None					Cotton	Cotton	Cotton	Corn/Abandoned
	Livestock	Field 9	Field 10						
2012	None	Corn	Fallow						
	Livestock	Field 9	Field 10						
2013	None	Cotton	Wheat						

Comments: In 2013 this site was planted to cotton on 40-inch centers and wheat.

Site 6

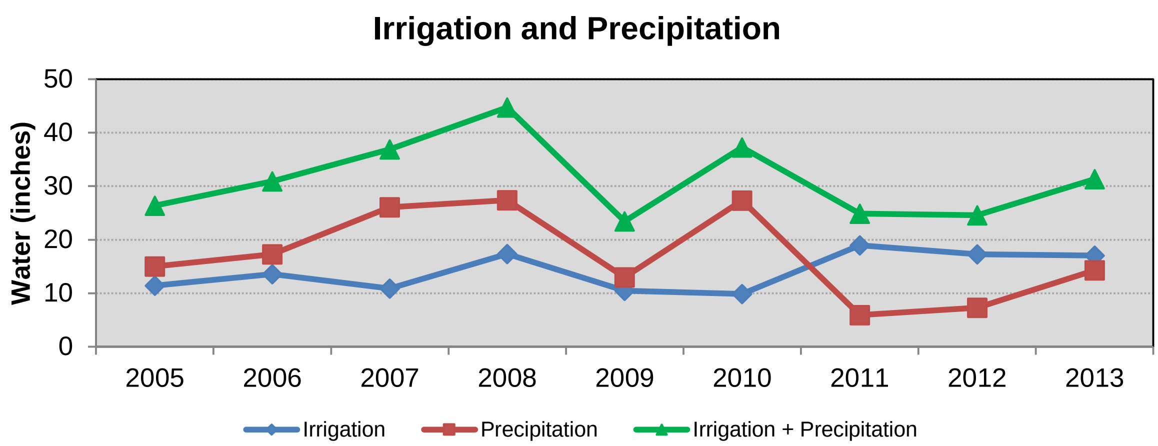
Wheat failec

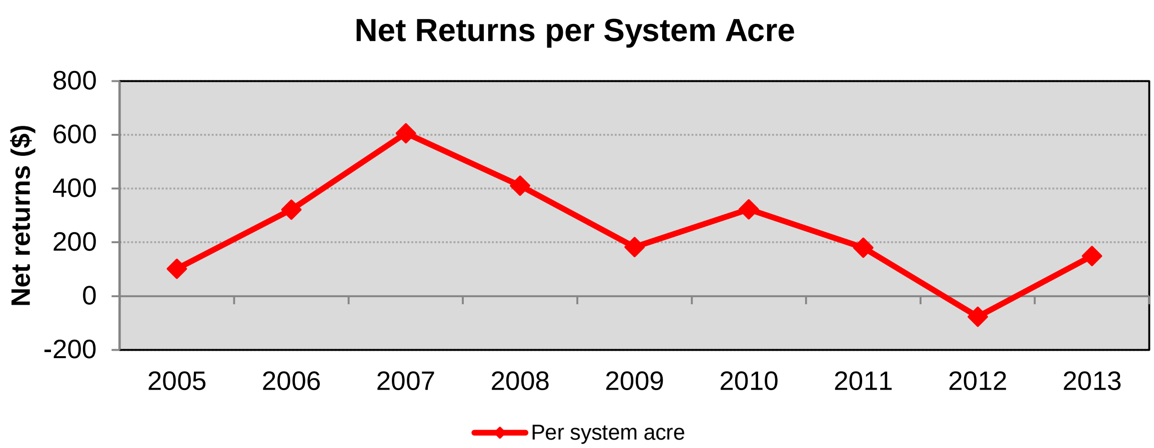
Wheat hay

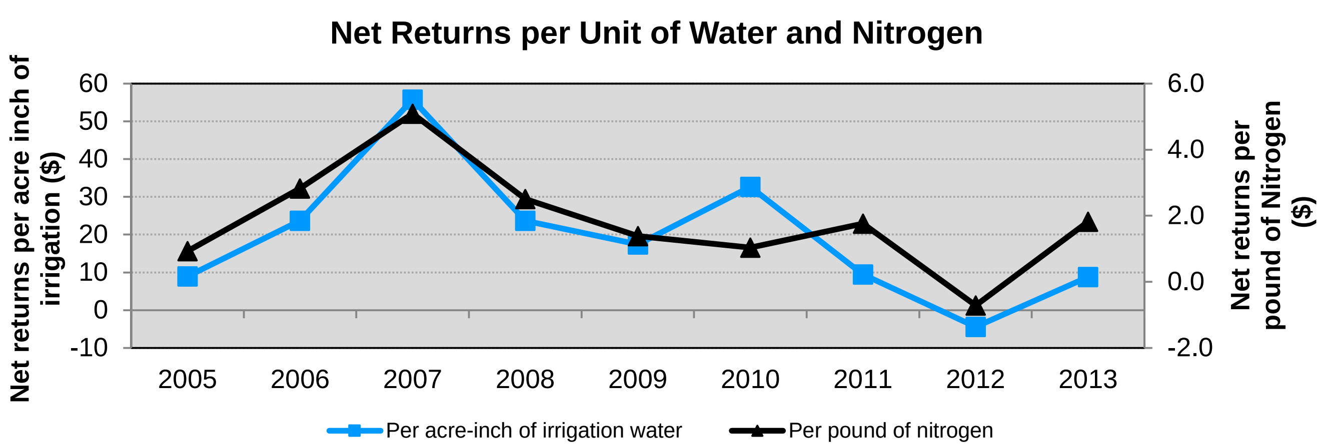
July cotton

End of October ready for harvest

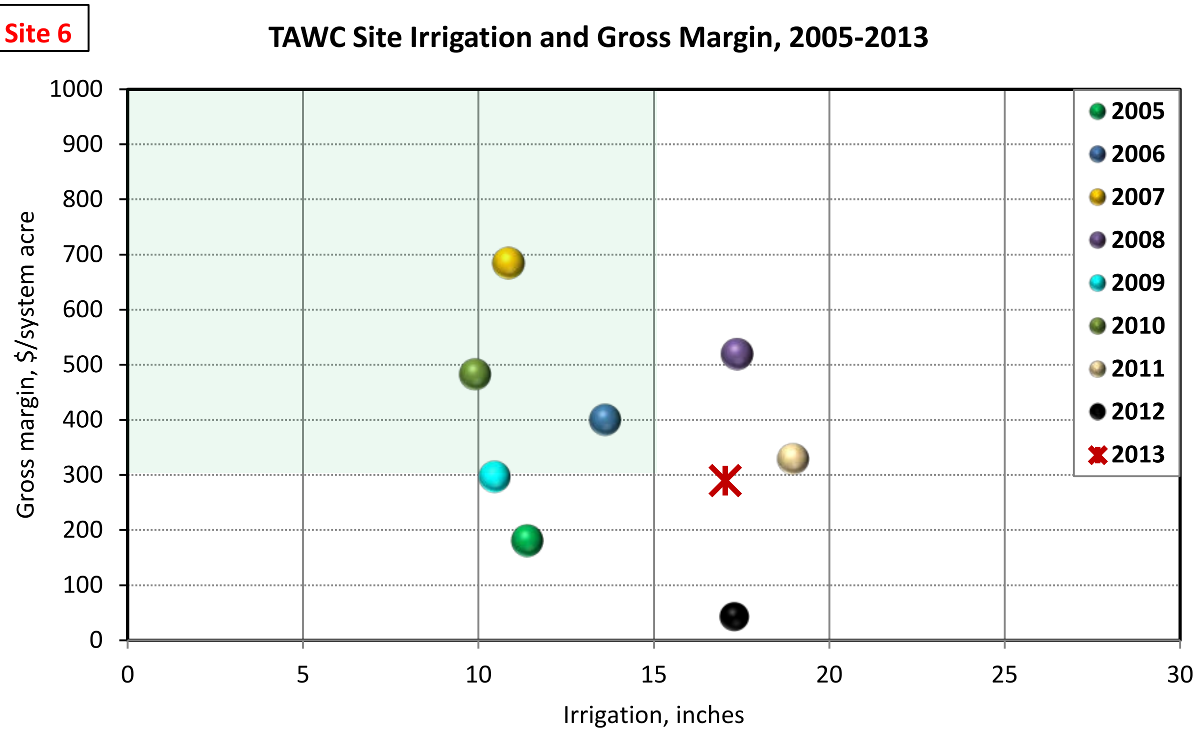
Site 6


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
800
600
400
200
0
-200
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre

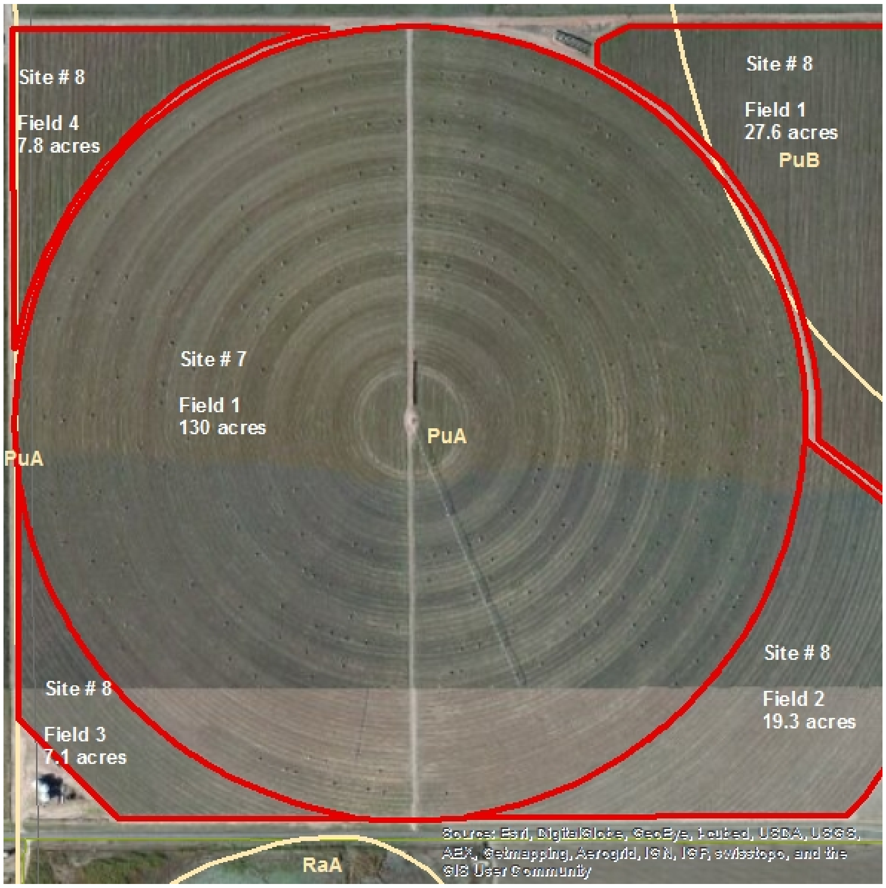

Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
60
50
40
30
20
10
0
-10
6.0
4.0
2.0
0.0
-2.0
Net returns per pound of Nitrogen ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen

Site 6



TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

Site 7



Description

Total site acres: 130.0

Field No. 1 Acres: 130.0
Major soil type: PuA-Pullman clay loam, 0 to 1%

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 500

Number of wells: 4

Fuel source: Electric

Site 7

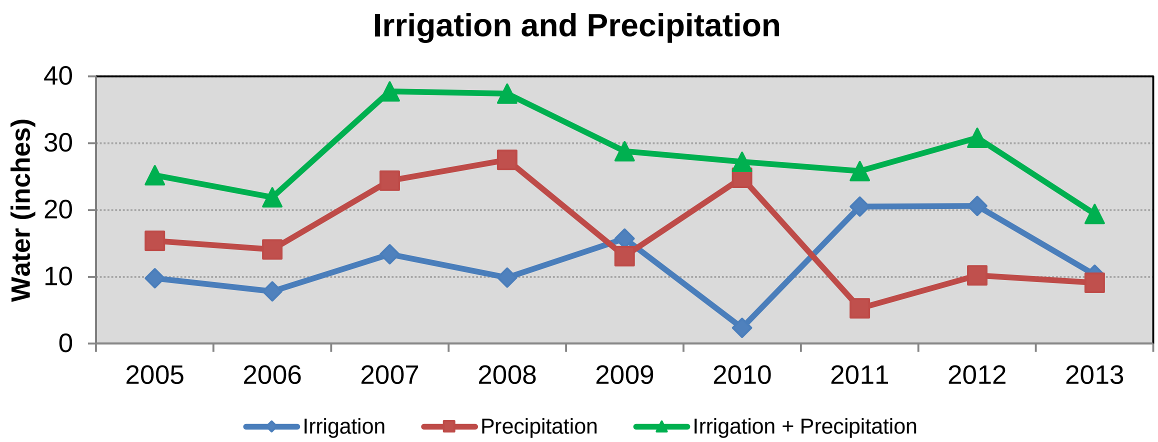
	Livestock	Field 1	
2005	None	Sideoats grama for seed and hay	
2006	None	Sideoats grama for seed and hay	
2007	None	Sideoats grama for seed and hay	
2008	None	Sideoats grama for seed and hay	
2009	None	Sideoats grama for seed and hay	
2010	None	Sideoats grama for seed and hay	
2011	None	Sideoats grama for seed and hay	
2012	None		Sideoats grama for seed and hay
2013	None		Sideoats grama for seed and hay

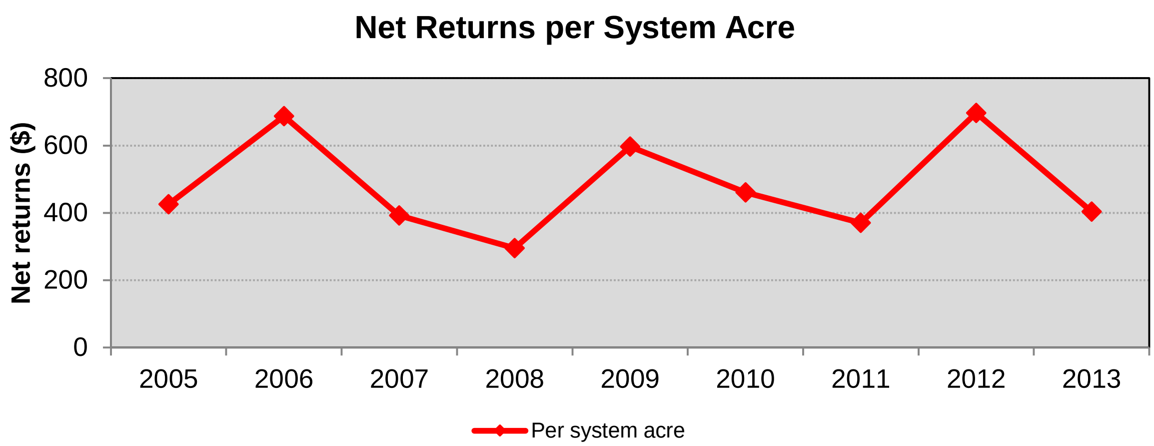
Comments: This is a pivot irrigated field of sideoats grama grown for seed production and the grass residue is round baled for hay and sold. This field was established to grass 18 years ago.

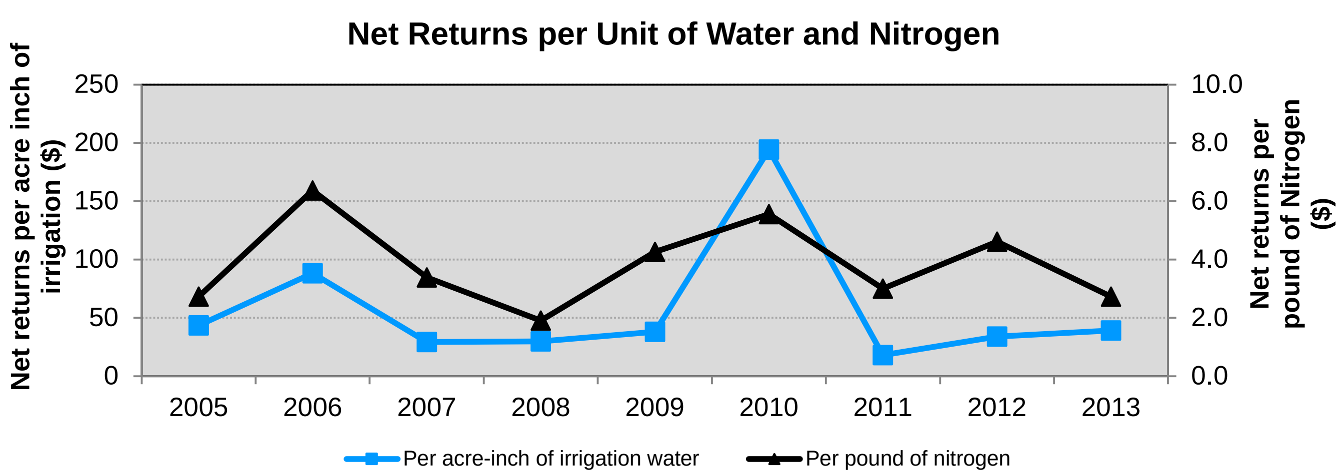
June sideoats grama irrigation

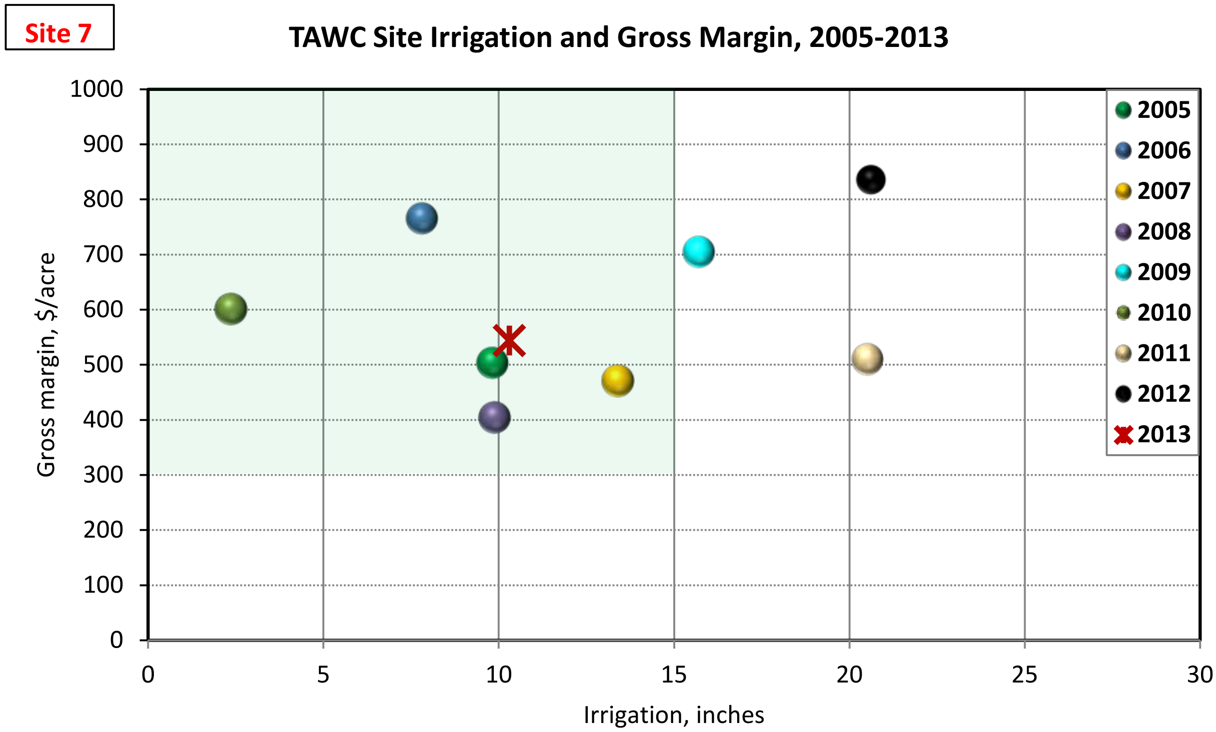
Sideoats seed ready for harvest

Site 7

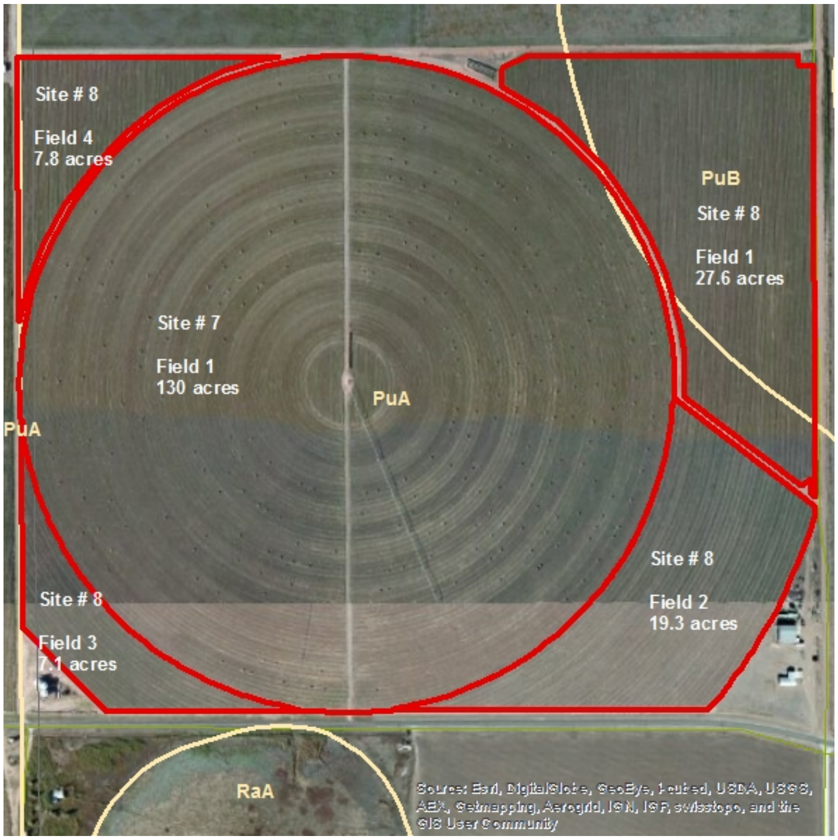

Irrigation and Precipitation
Water (inches)
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
800
600
400
200
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
250
200
150
100
50
0
10.0
8.0
6.0
4.0
2.0
0.0
Net returns per pound of Nitrogen ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 7
TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

Site 8



Description

Total site acres: 61.8

Field No. 1 Acres: 27.6
Major soil type: PuB-Pullman clay loam, 1 to 3%

Field No. 2 Acres: 19.3
Major soil type: PuA-Pullman clay loam, 0 to 1%

Field No. 3 Acres: 7.1
Major soil type: PuA-Pullman clay loam, 0 to 1%

Field No. 4 Acres: 7.8
Major soil type: PuA-Pullman clay loam, 0 to 1%

Irrigation

Type: Sub-surface Drip (SDI)

Pumping capacity, gal/min: 360

Number of wells: 4

Fuel source: Electric

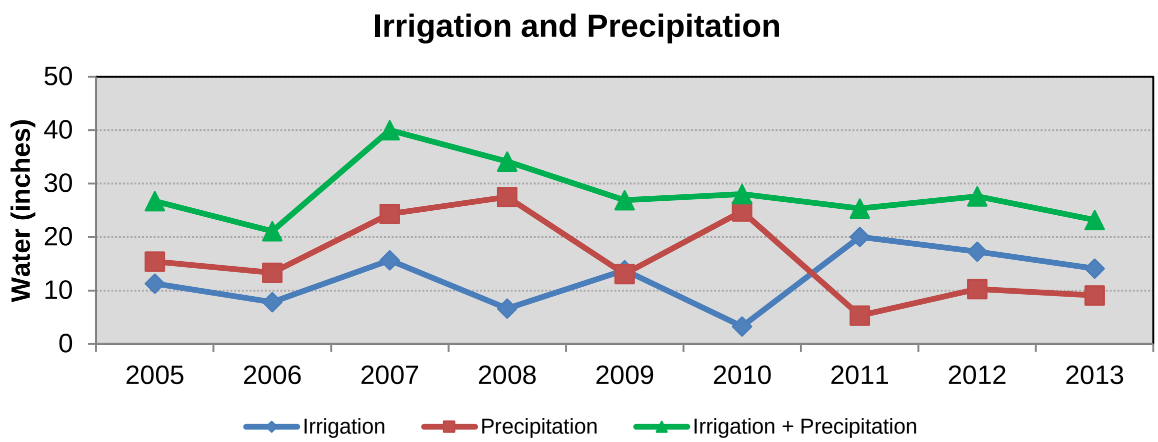
Site 8

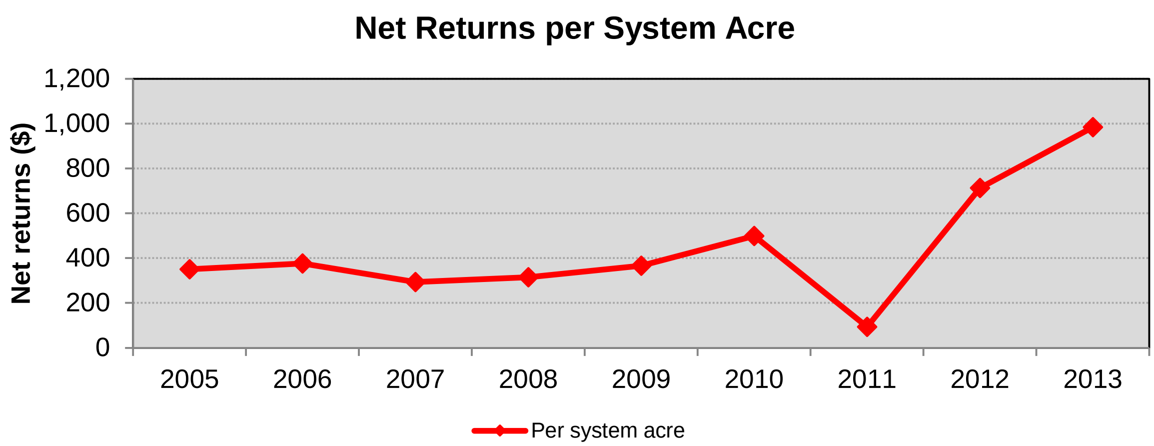
	Livestock	Field 1	Field 2	Field 3	Field 4
2005	None	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay
2006	None	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay
2007	None	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay
2008	None	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay
2009	None	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay
2010	None	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay
2011	None	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay
2012	None	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay
2013	None	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay

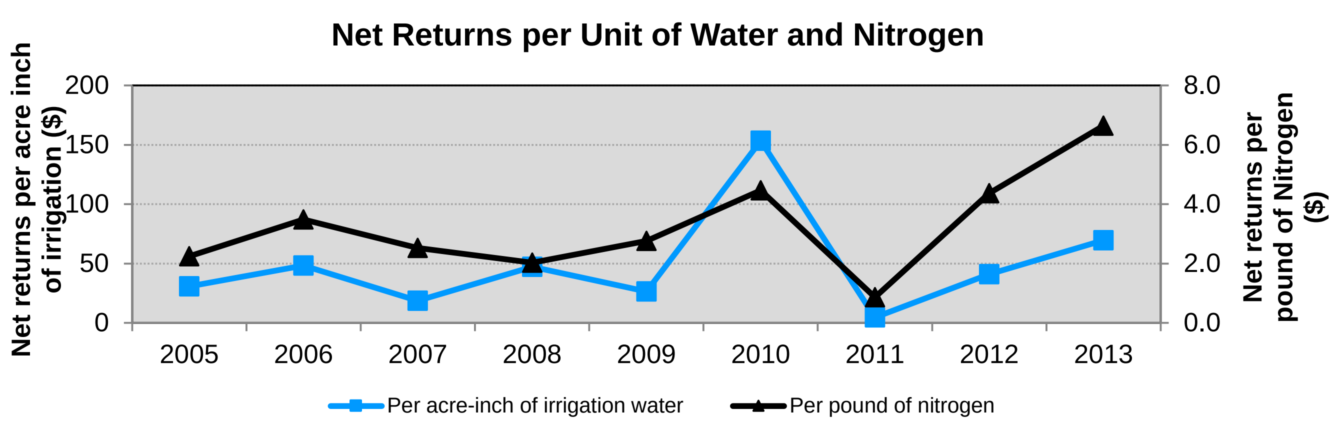
Comments: This is a drip irrigated field of side-oats grama grown for seed production and the grass residue is round baled for hay and sold. These four fields were put into drip irrigation nine years ago. Prior to the installation of drip these fields were furrow irrigated.

Sideoats residue baled after seed harvest

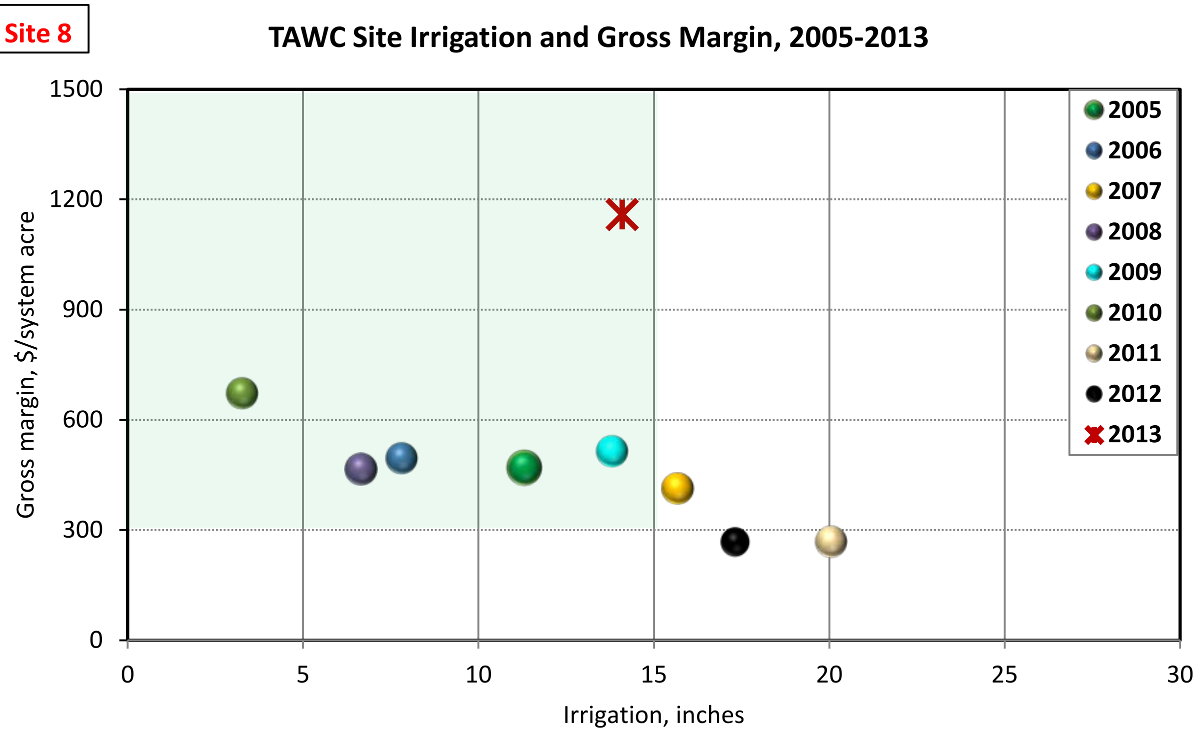
Site 8


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation

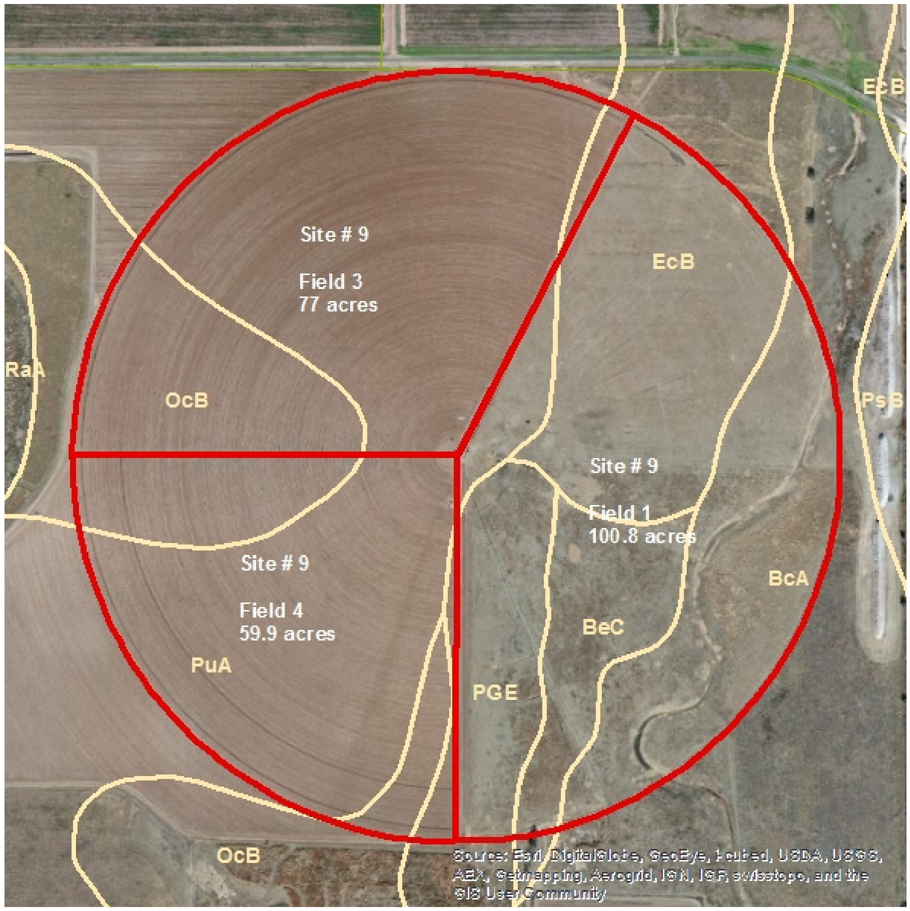

Net Returns per System Acre
Net returns ($)
1,200
1,000
800
600
400
200
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
200
150
100
50
0
Net returns per pound of Nitrogen ($)
8.0
6.0
4.0
2.0
0.0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen

Site 8


TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1500
1200
900
600
300
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

SITE 9



DESCRIPTION

Total site acres:	237.7
Field No. 1 Acres:	100.8
Major soil type:	EcB-Estacado clay loam; 1 to 3% BcA-Bippus clay loam; 0 to 2% BeC-Berda loam, 3 to 5% PGE-Potter soil, 3 to 20%
Field No. 3 Acres:	77.0
Major soil type:	PuA-Pullman clay loam; 0 to 1% OcB-Olton clay loam, 1 to 3%
Field No. 4 Acres:	59.9
Major soil type:	PuA-Pullman clay loam; 0 to 1% OcB-Olton clay loam, 1 to 3%

IRRIGATION

Type:	Center Pivot (MESA)
Pumping capacity, gal/min:	900
Number of wells:	4
Fuel source:	2 Natural gas
	2 Diesel

Site 9

	Livestock	Field 1	Field 2	
2005	Stocker steers	Klein/Buffalo/Blue grama/Annual forb mix interseeded with Rye for grazing	Rye for grazing and cover crop followed by Cotton	
2006	Stocker steers	Klein/Buffalo/Blue grama/Annual forb mix interseeded with Rye for grazing	Cotton following Rye cover crop	
2007	Stocker heifers	Klein/Buffalo/Blue grama/Annual forb mix interseeded with Rye for grazing	Grain Sorghum following Rye cover crop	
2008	Cow-calf	Klein/Buffalo/Blue grama/Annual forb mix for grazing	Cotton	
2009	None	Klein/Buffalo/Blue grama/Annual forb mix for grazing	Cotton	
2010	Cow-calf	Klein/Buffalo/Blue grama/Annual forb mix for grazing and hay	Cotton	
2011	Stocker	Klein/Buffalo/Blue grama/Annual forb mix for grazing and hay	Cotton	
2012	Stocker	Klein/Buffalo/Blue grama/Annual forb mix for grazing and hay	Cotton	
	Livestock	Field 1	Field 3	Field 4
2013	Stocker	Klein/Buffalo/Blue grama/Annual forb mix for grazing and hay	Cotton	Grain Sorghum

Comments: This site was returned to conventional tillage after 11 years of no-till production. Field 1 is predominantly kleingrass and used for cow-calf production. Field 3 was planted to cotton on 40-inch centers and Field 4 to Grain Sorghum.

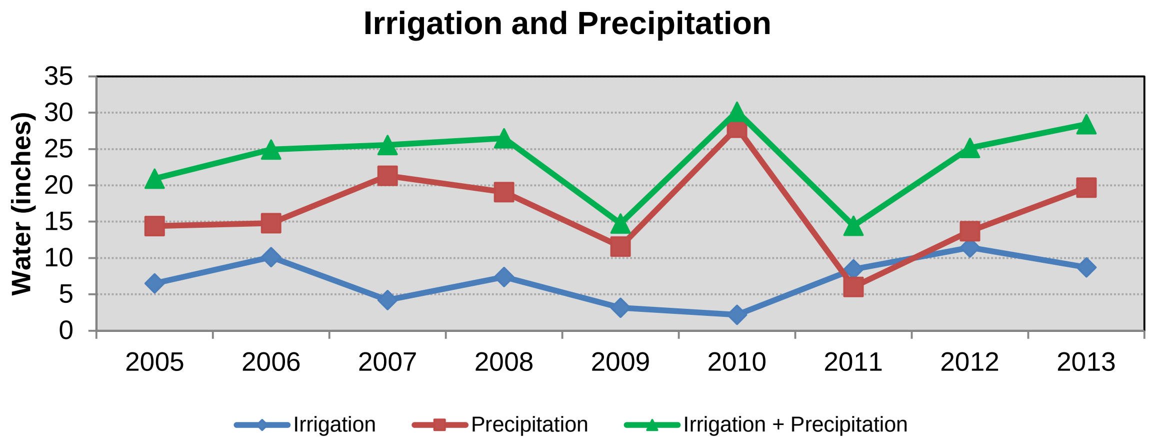
Cattle on grass

End September grain sorghum

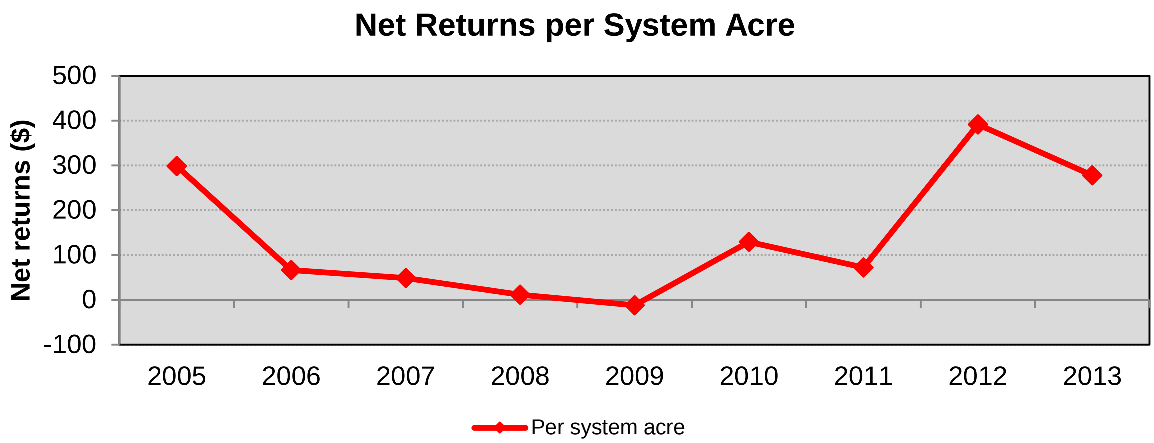
July cotton

Kliengrass pasture

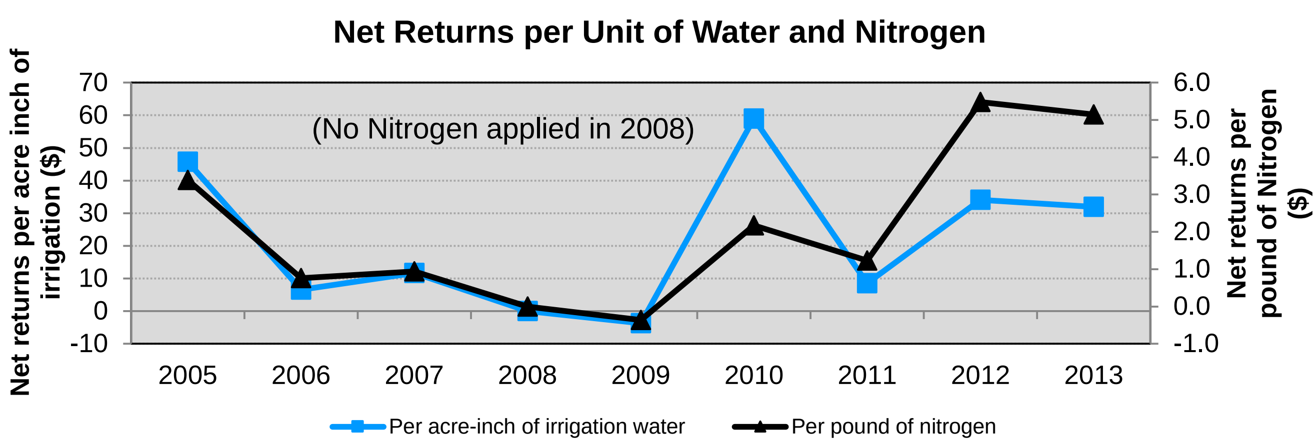
Site 9



Irrigation and Precipitation
Water (inches)
35
30
25
20
15
10
5
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation

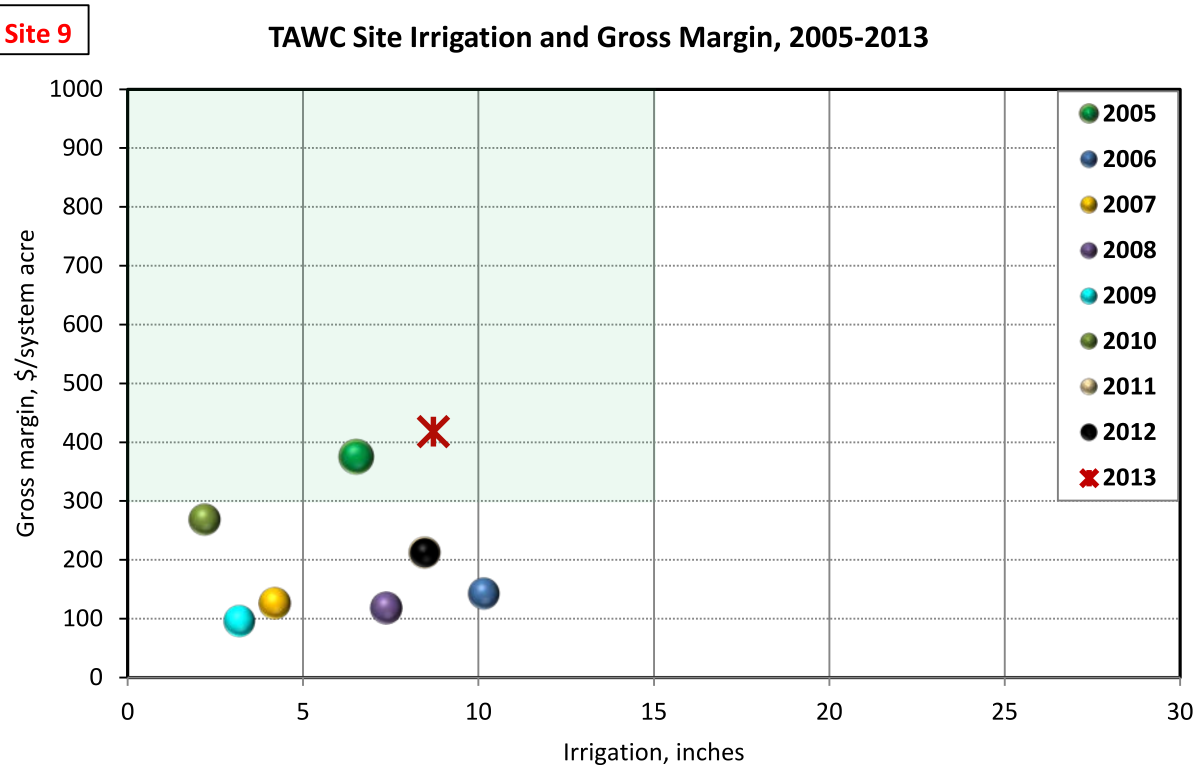


Net Returns per System Acre
Net returns ($)
500
400
300
200
100
0
-100
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre

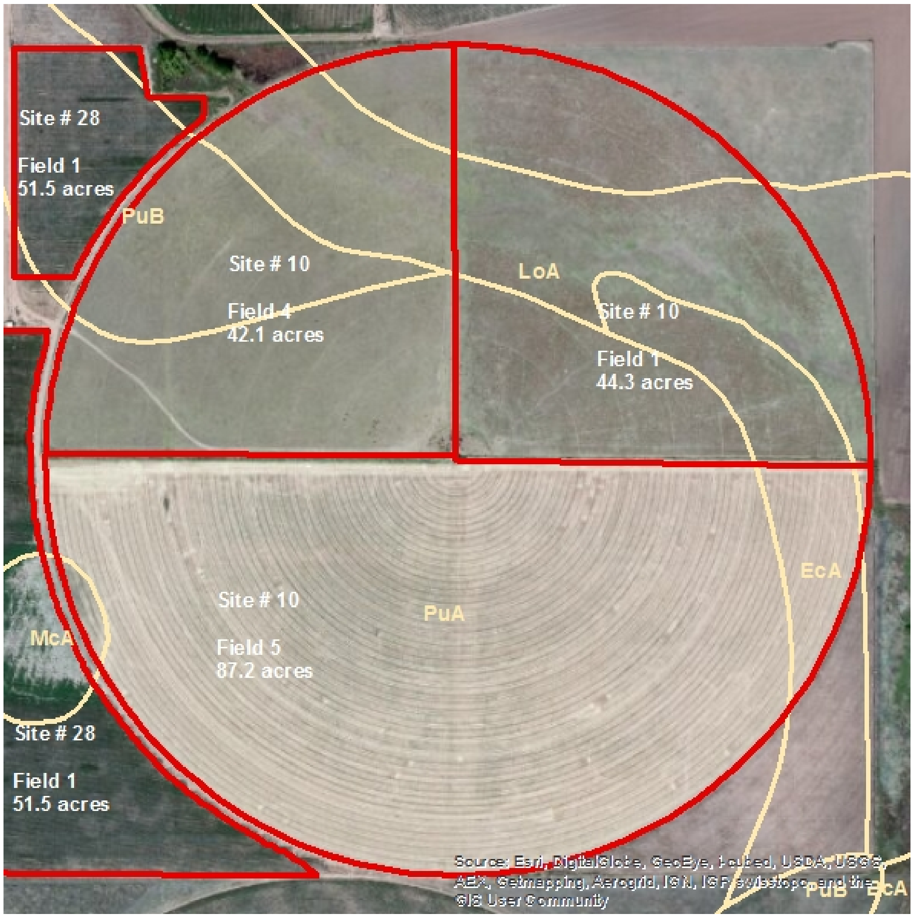


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
(No Nitrogen applied in 2008)
70
60
50
40
30
20
10
0
-10
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
Net returns per pound of Nitrogen ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen

Site 9


TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

SITE 10



DESCRIPTION

Total site acres: 173.6

Field No. 1 Acres: 44.3

Major soil type:
PuA-Pullman clay loam; 0 to 1%
LoA-Lofton clay loam; 0 to 1%
Estacado clay loam; 0 to 1%

Field No. 4 Acres: 42.1

Major soil type:
PuA-Pullman clay loam; 0 to 1%
LoA-Lofton clay loam; 0 to 1%

Field No. 5 Acres: 87.2

Major soil type:
PuA-Pullman clay loam; 0 to 1%
EcA-Estacado clay loam; 0 to 1%

IRRIGATION

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 800

Number of wells: 2

Fuel source: Electric

System 10

	Livestock	Field 1	Field 2	Field 3	Field 4
2005	Cow-calf	Dahl planted, no grazing this year	Cotton	Dahl for grazing and hay	Bermudagrass planted, some grazing
2006	Cow-calf	Dahl for grazing	Oats for hay followed by Forage Sorghum for hay	Dahl for grazing	Bermudagrass for grazing and hay
2007	Cow-calf	Dahl for grazing	Corn for silage following Wheat cover crop	Dahl for grazing and seed	Bermudagrass for grazing
2008	Cow-calf	Dahl for grazing	Wheat for grain followed by Corn for grain	Dahl for grazing and hay	Bermudagrass for grazing
2009	Cow-calf	Dahl for grazing	Cotton	Dahl for grazing	Bermudagrass for grazing
2010	Cow-calf	Dahl for grazing	Corn	Corn	Bermudagrass for grazing
2011	Cow-calf	Cotton	Cotton	Cotton	Bermudagrass for grazing
	Livestock	Field 1	Field 4	Field 5	
2012	Cow-calf	Dahl for grazing	Bermudagrass for grazing	Corn Silage	
2013	Cows	Dahl for grazing	Bermuda converted to cotton	Corn	

Comments: This is a two cell, pivot irrigated row crop, improved forage, cow-calf system. Old-World bluestem is used for livestock grazing. One-half of this system was planted to corn on 40-inch centers for 2013.

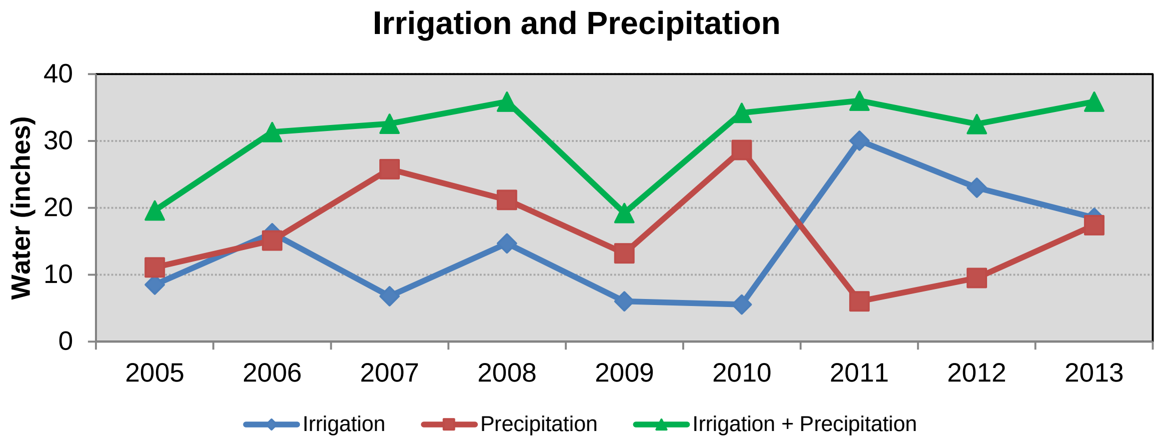
Preparation for planting

Bermuda pasture converted to cotton

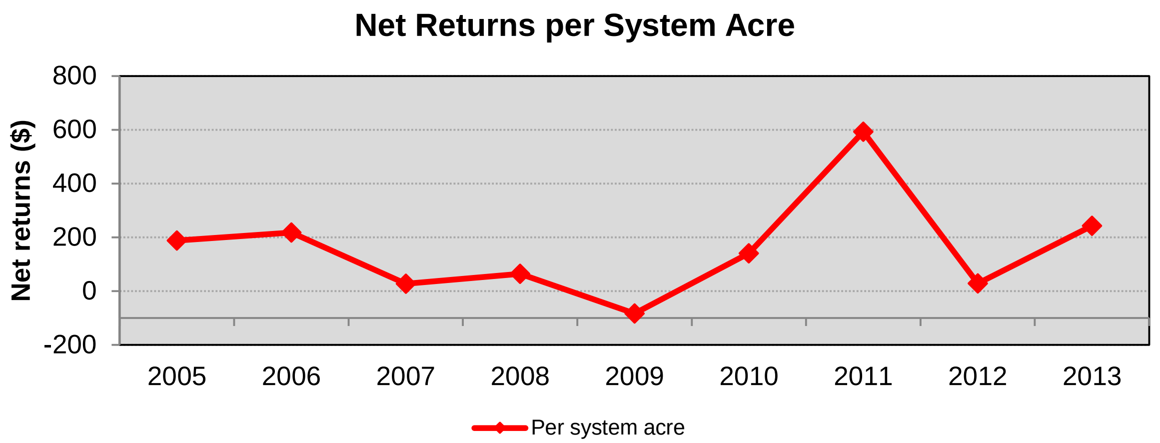
WW-B.Dahl for grazing

July Corn

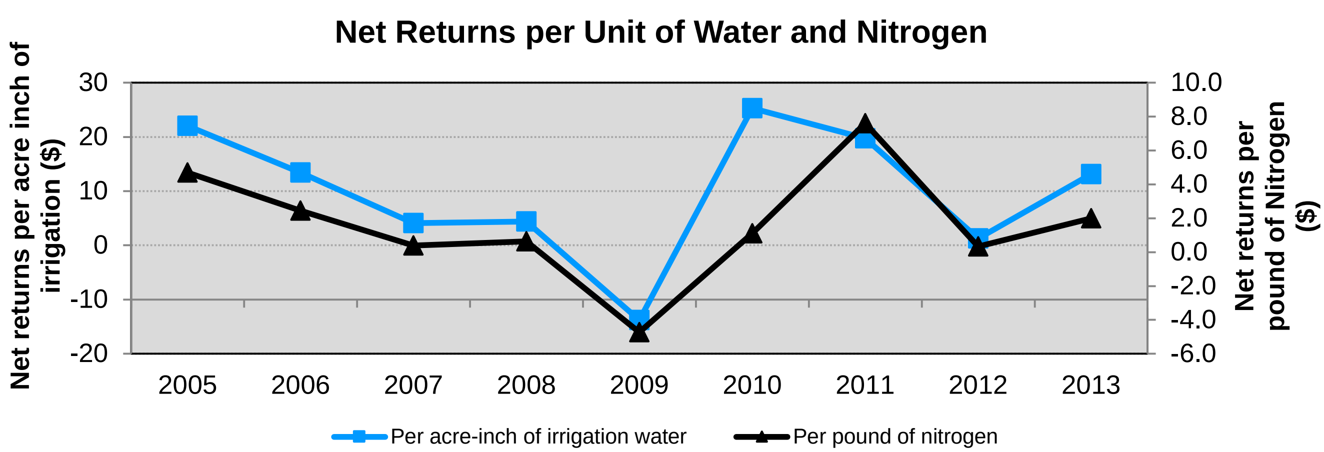
Site 10



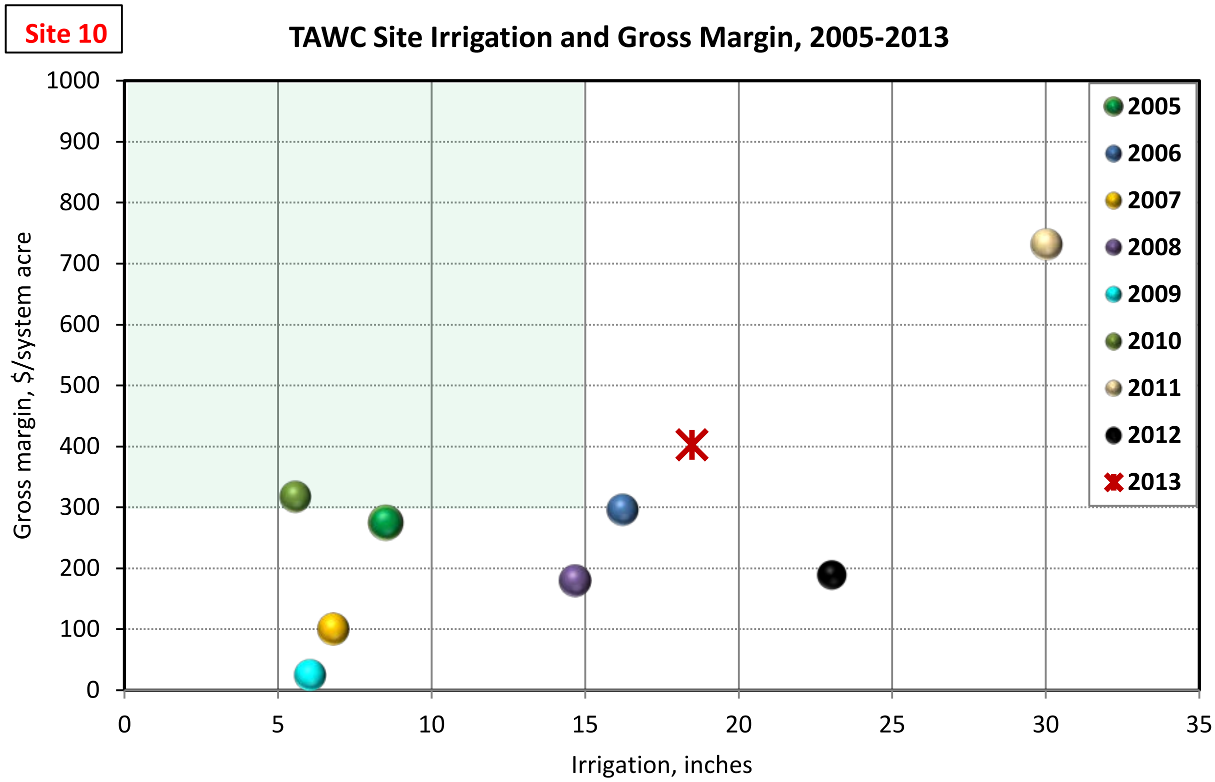
Irrigation and Precipitation
Water (inches)
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Net returns ($)
800
600
400
200
0
-200
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre



Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
30
20
10
0
-10
-20
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
Net returns per pound of Nitrogen ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen



Site 10
TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
Irrigation, inches
0
100
200
300
400
500
600
700
800
900
1000
0
5
10
15
20
25
30
35
2005
2006
2007
2008
2009
2010
2011
2012
2013

SITE 11

DESCRIPTION

Total site acres:	92.5
Field No. 2 Acres:	24.4
Major soil type:	PuA-Pullman clay loam; 0 to 1%
Field No. 3 Acres:	22.9
Major soil type:	PuA-Pullman clay loam; 0 to 1%
Field No. 5 Acres:	45.2
Major soil type:	LoA-Lofton clay loam; 0 to 1% OcB-Olton clay loam; 1 to 3% PuA-Pullman clay loam; 0 to 1% EcB-Estacado clay loam; 1 to 3%

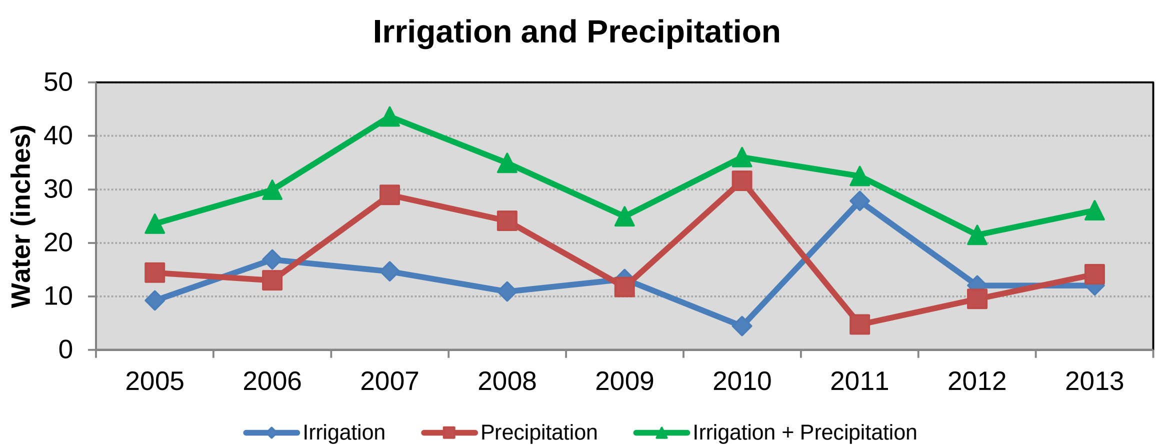
IRRIGATION

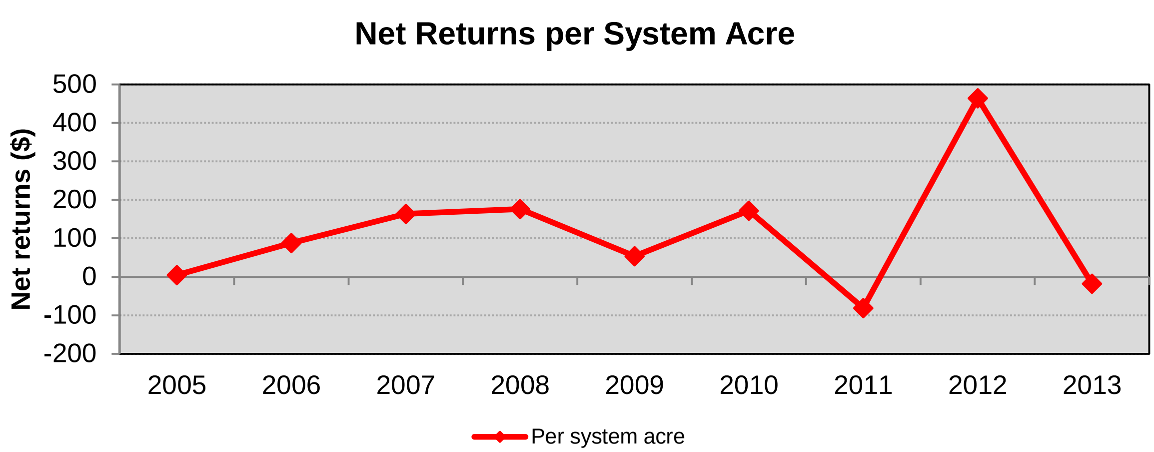
Type:	Furrow
Pumping capacity, gal/min:	490
Number of wells:	1
Fuel source:	Electric

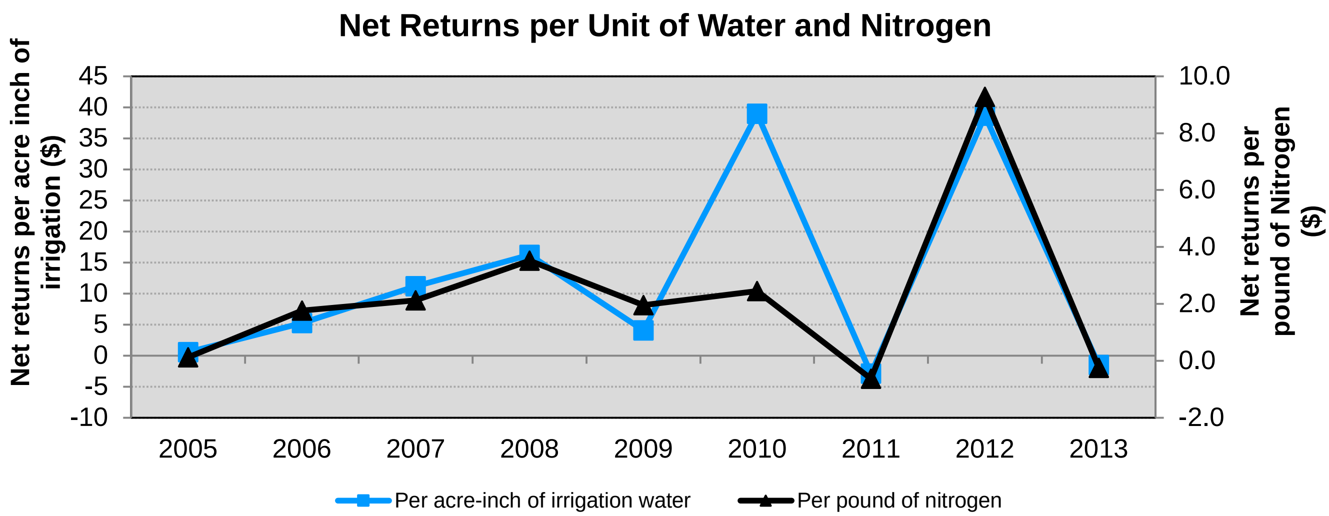
Late November cotton ready
for harvest

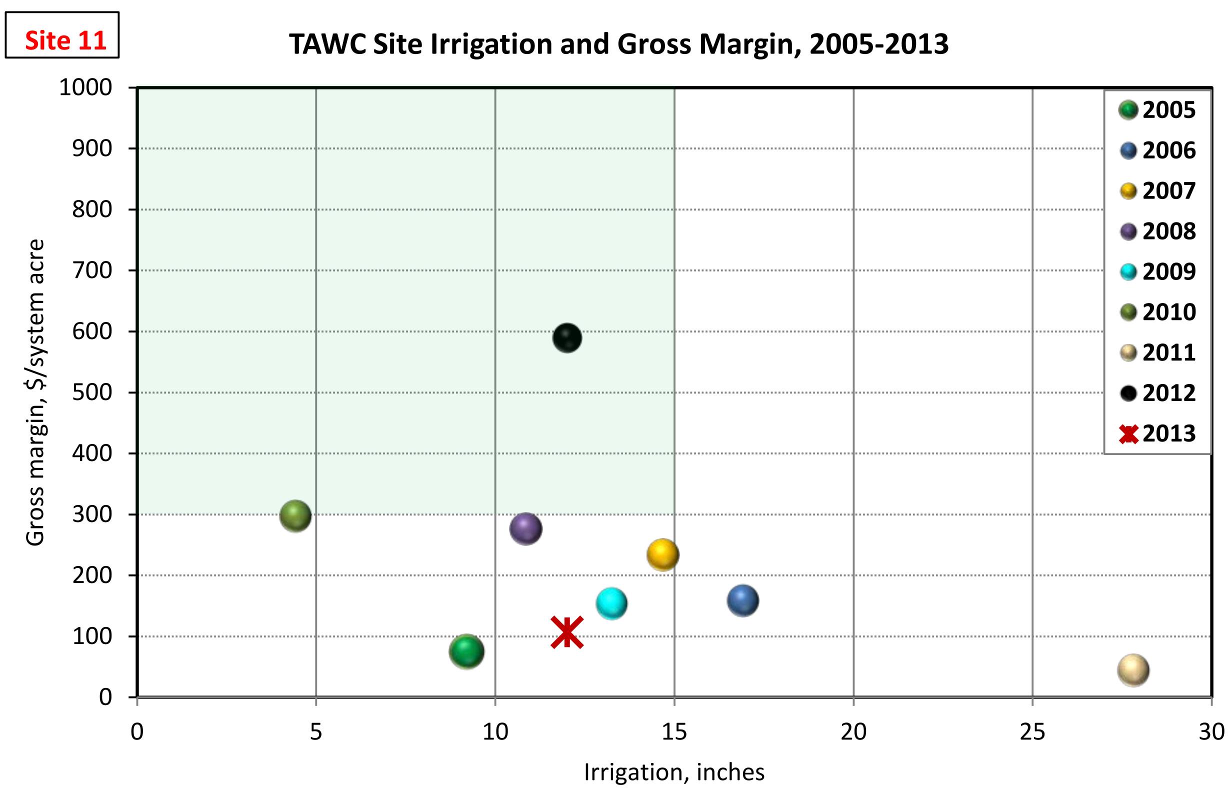
Cotton stripped

Site 11

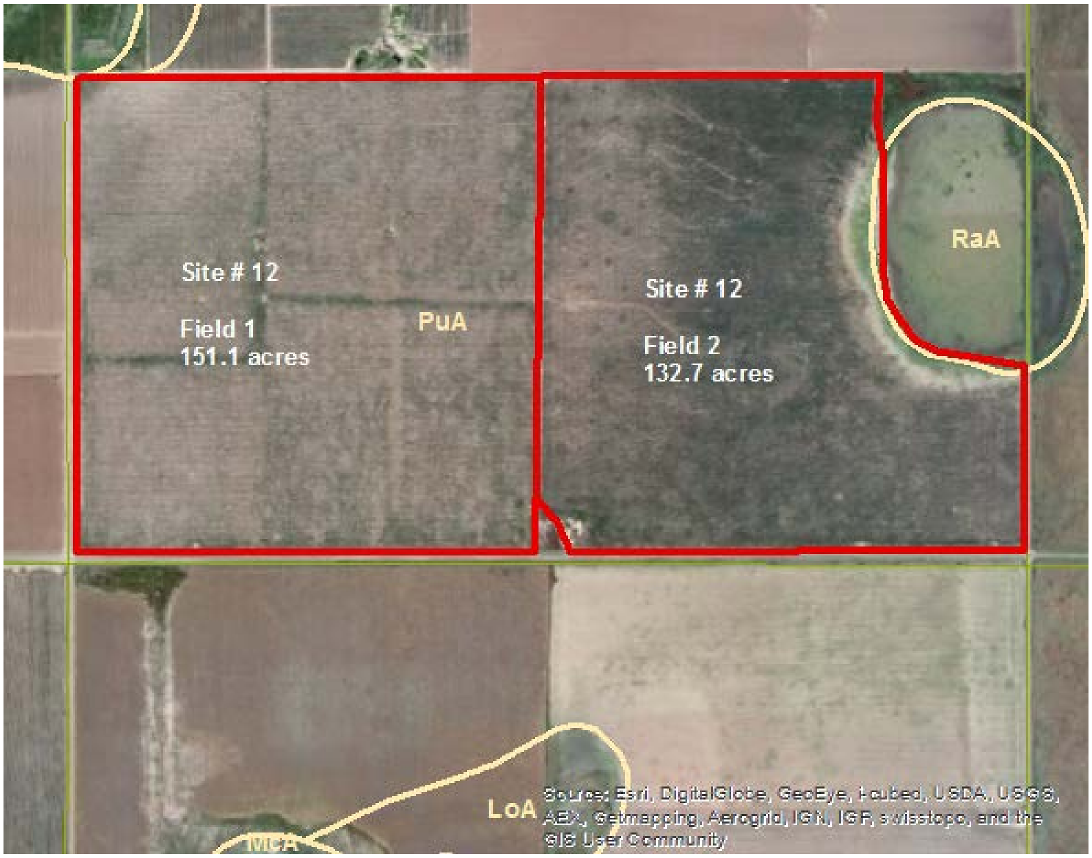





Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
Net returns per pound of Nitrogen ($)
45
40
35
30
25
20
15
10
5
0
-5
-10
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 11
TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

SITE 12



DESCRIPTION

Total site acres:	283.8
Field No. 1 Acres:	151.2
Major soil type:	PuA-Pullman clay loam; 0 to 1%
Field No. 2 Acres:	132.7
Major soil type:	PuA-Pullman clay loam; 0 to 1%

IRRIGATION

Type:	Dryland
Pumping capacity, gal/min:	na
Number of wells:	na
Fuel source:	na

Site 12
Dryland Site

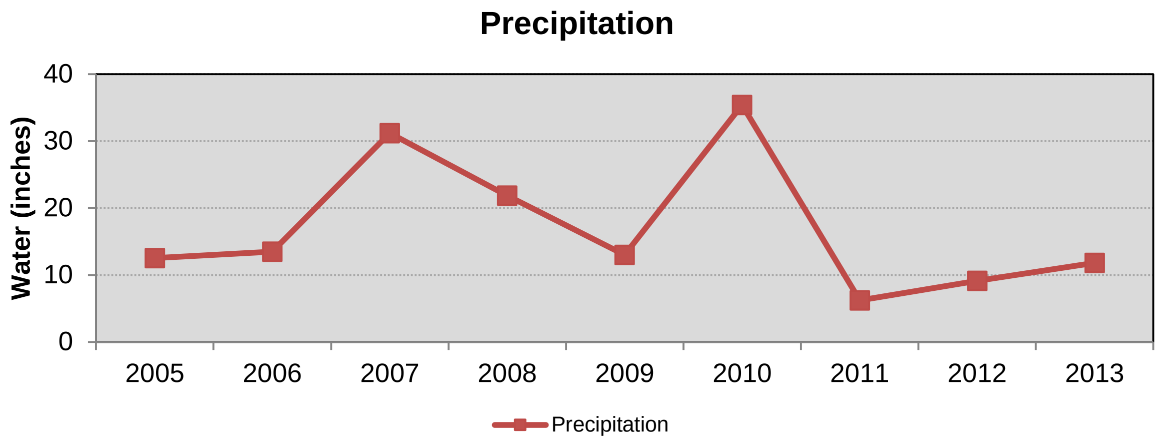
	Livestock	Field 1	Field 2
2005	None	Cotton following wheat cover crop	Forage sorghum for cover following Wheat
2006	None	Wheat for grain	Cotton following previous year cover of Forage Sorghum
2007	None	Cotton	Grain sorghum following wheat cover crop
2008	None	Grain sorghum for silage	Fallow, volunteer Wheat for cover crop
2009	None	Grain sorghum for silage	Fallow
2010	None	Cotton	Cotton
2011	None	Cotton	Cotton
2012	None	Fallow	Fallow
2013	None	NO DATA	NO DATA

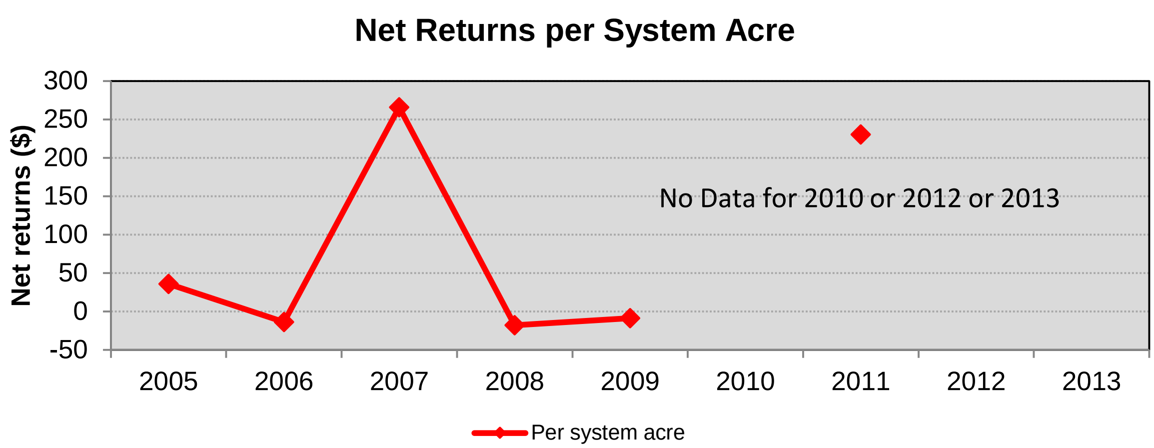
Comments: No data available in 2013.

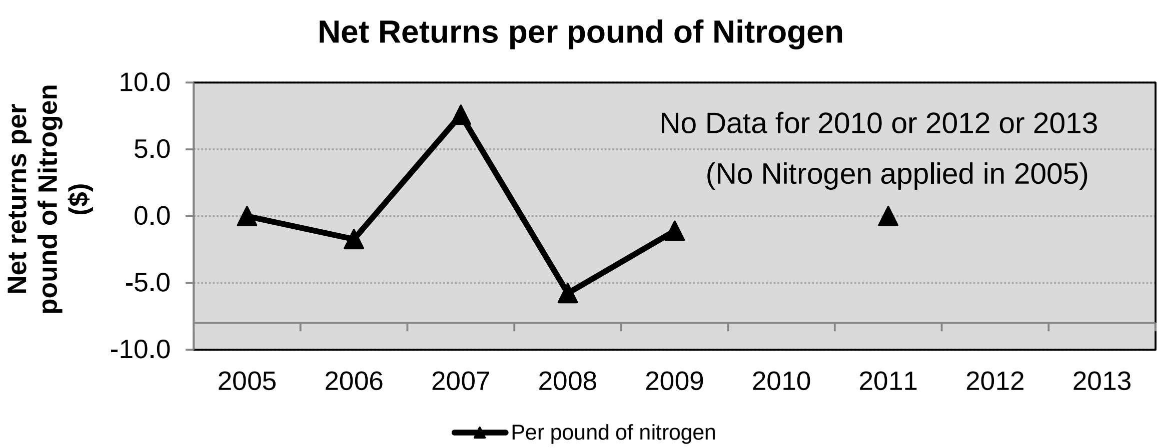
Prepared ground

Waiting for rain

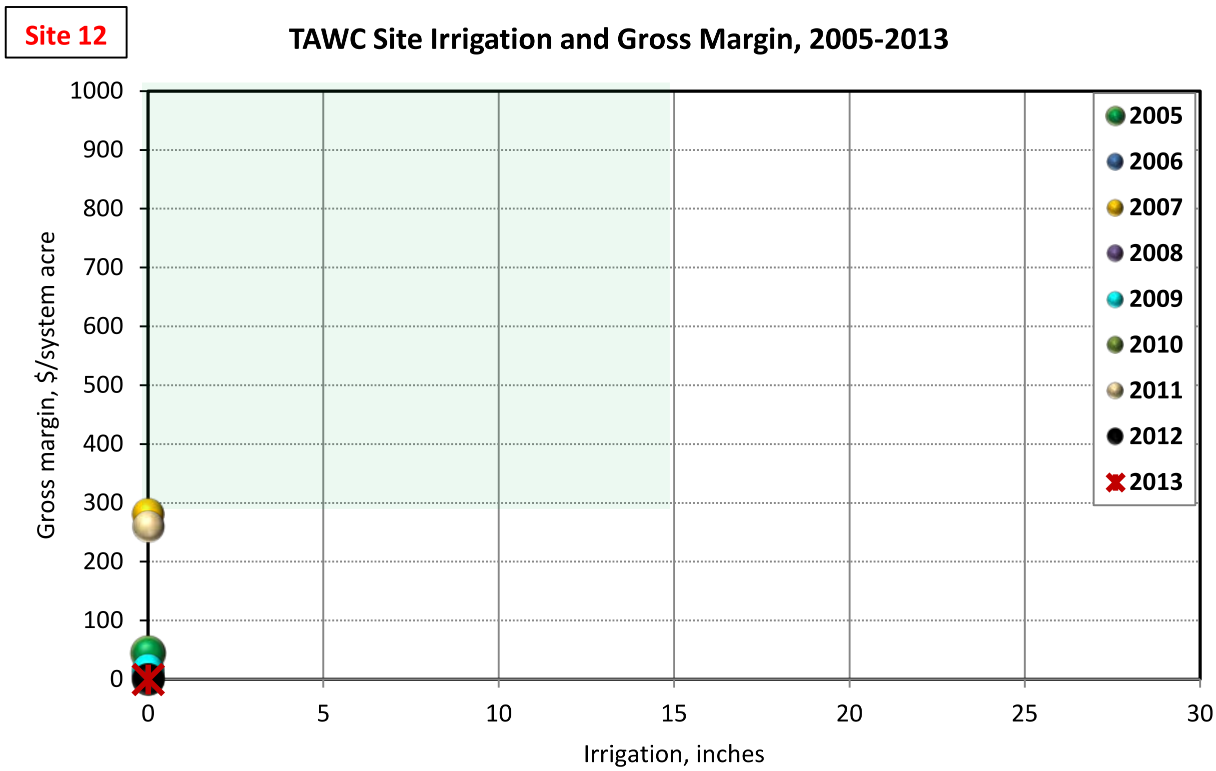
Site 12 – Dryland Site



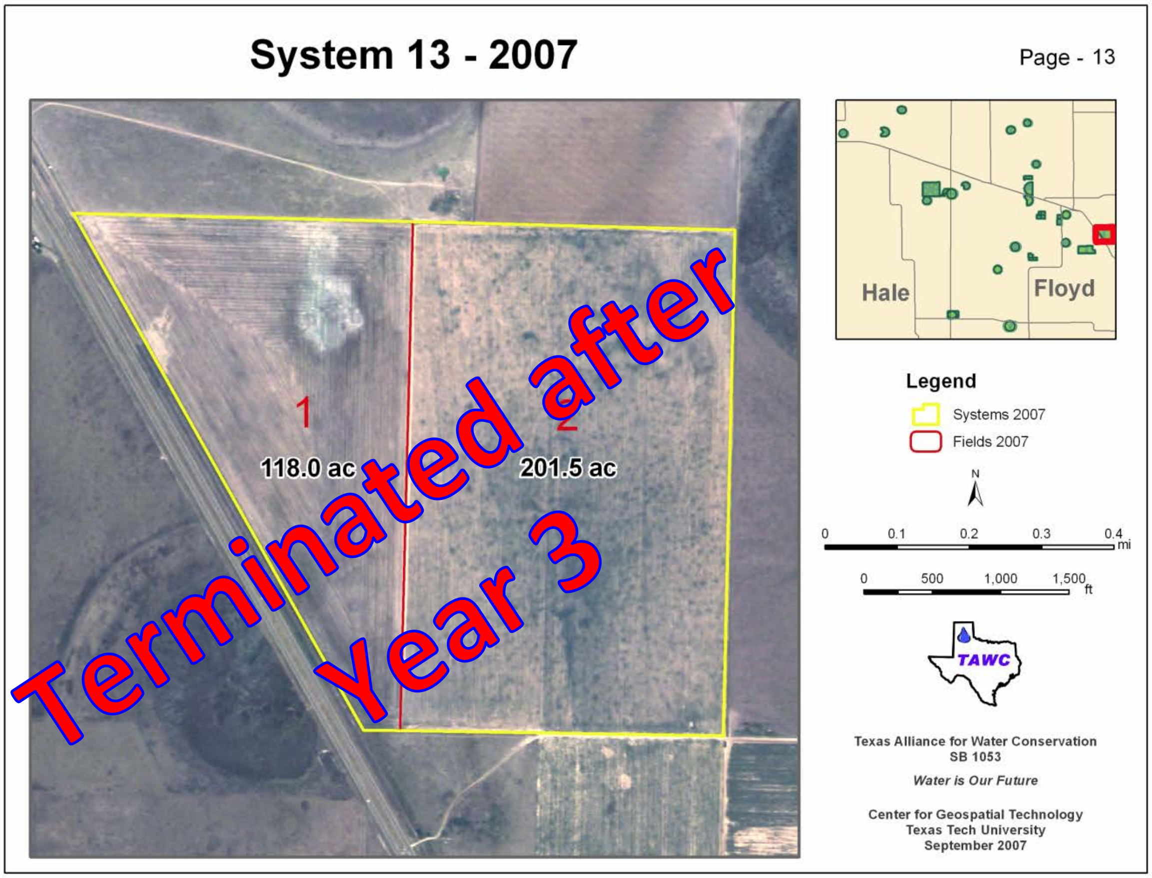




Dryland Site



SITE 13



DESCRIPTION

Total site acres: 319.5

Field No. 1 Acres: 118.0
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 201.5
Major soil type: Pullman clay loam; 0 to 1% slope

IRRIGATION

Type: Dryland

Pumping capacity, gal/min:

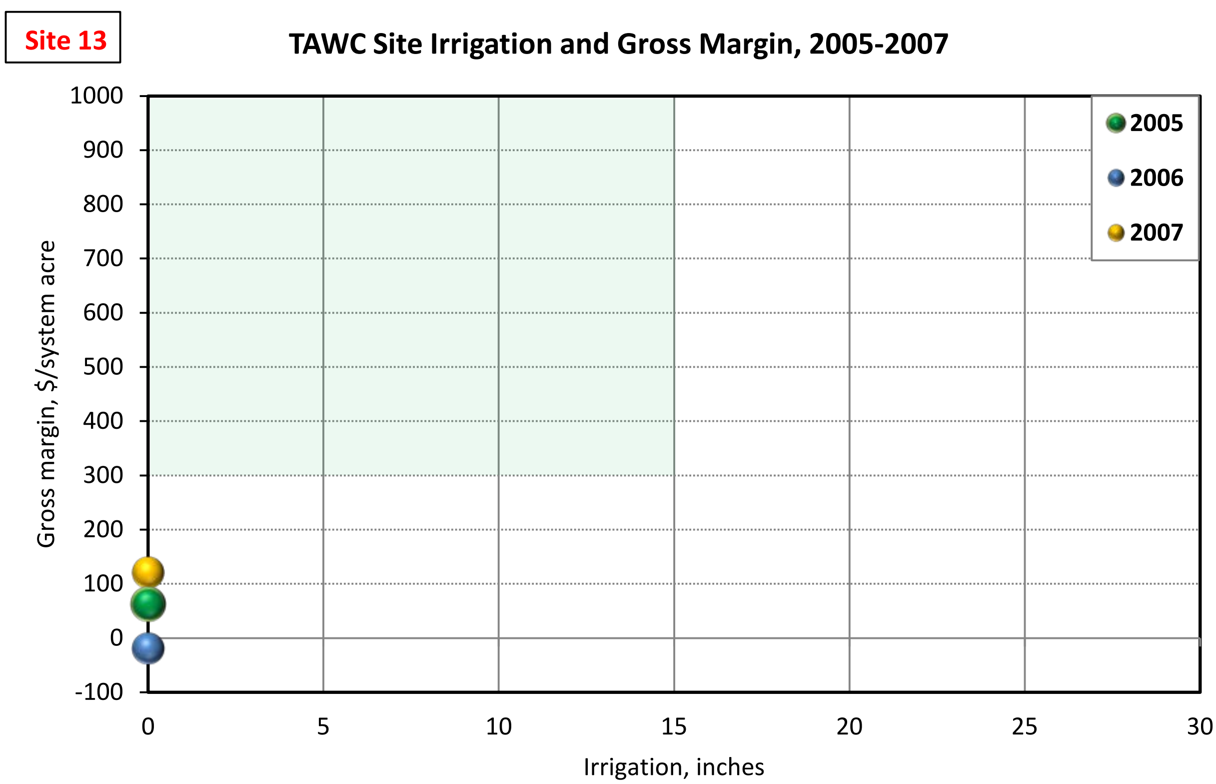
Number of wells:

Fuel source:

Comments: This dryland site used cotton and small grains in rotation. Cotton was planted on 40-inch centers under limited tillage. Small grains were drilled after cotton harvest.

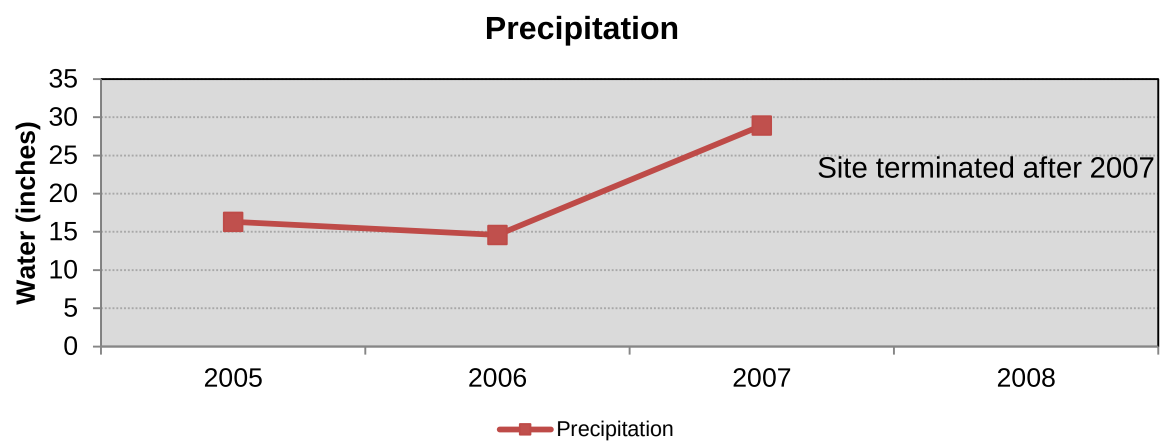
Site 13
Dryland Site

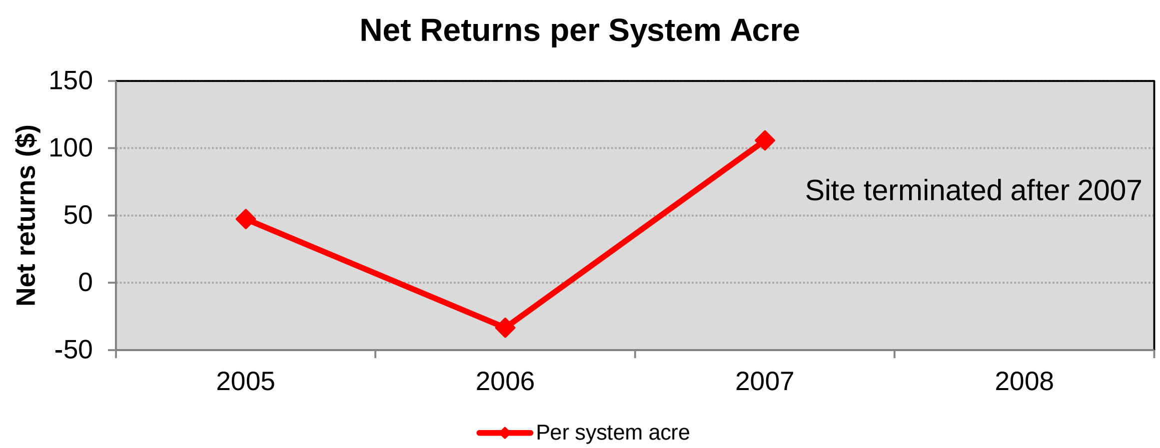
	Livestock	Field 1	Field 2
2005	None	Wheat for grain	Cotton following previous year's cover of Wheat stubble
2006	None	Cotton following previous year's cover of wheat stubble	Wheat lost to drought
2007	None	Wheat for grain	Cotton following wheat cover crop
2008	Site terminated for 2008		

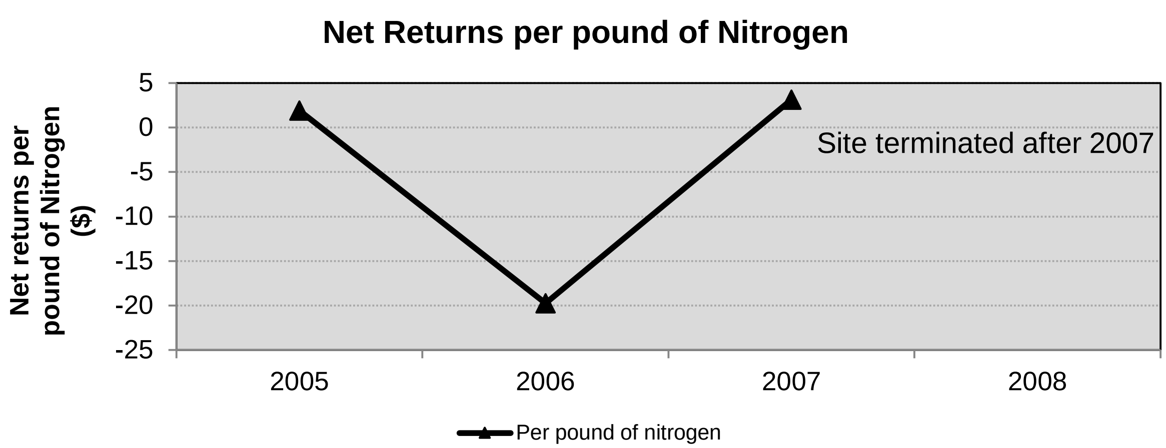


Dryland Site

Site 13 – Dryland Site







Site 14

Description

Total site acres: 124.1

Field No. 4 Acres: 124.1
Major soil type: PuA-Pullman clay loam; 0 to 1%

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 300

Number of wells: 3

Fuel source: Electric

Site 14

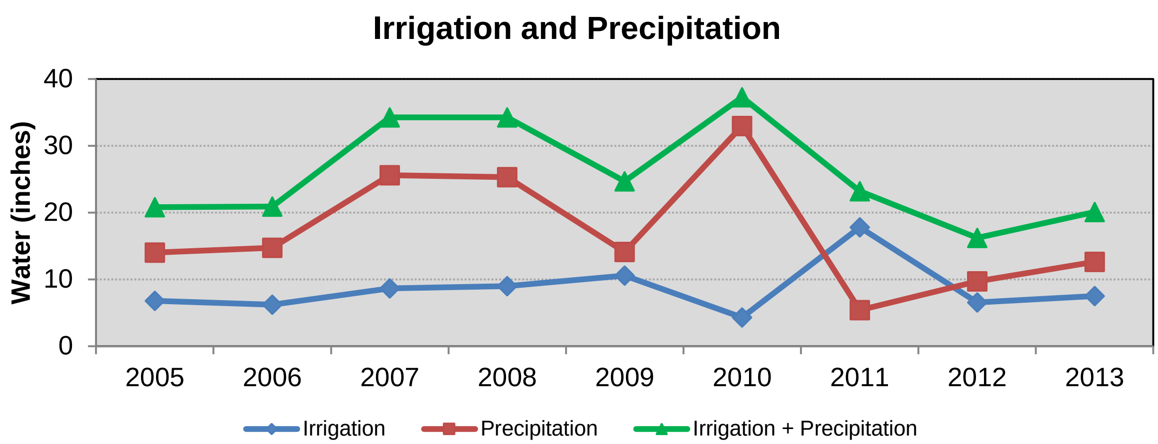
	Livestock	Field 1	Field 2	Field 3
2005	None	Cotton		
2006	None	Cotton		
2007	None	Cotton		
2008	None	Split into Fields 2 and 3	Cotton	Cotton
2009	None		Cotton	Wheat
2010	None		Wheat	Cotton
2011	None		Cotton	Cotton
2012	None		Wheat	Cotton
	Livestock	Field 4		
2013	None	Cotton		

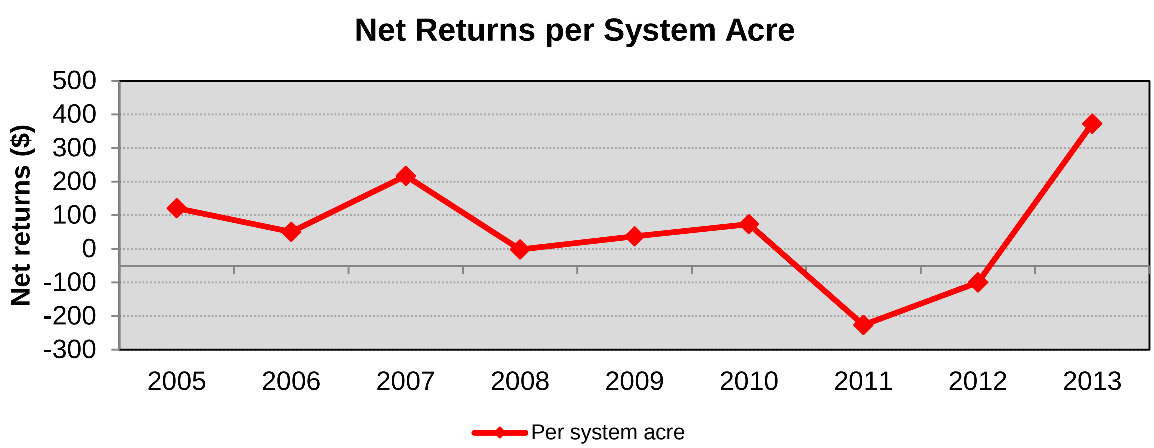
Comments: This is a pivot irrigated cotton and wheat rotation system with limited irrigation from 2012 was converted to single cotton field in 2013. This producer uses conventional tillage on 40-inch centers.

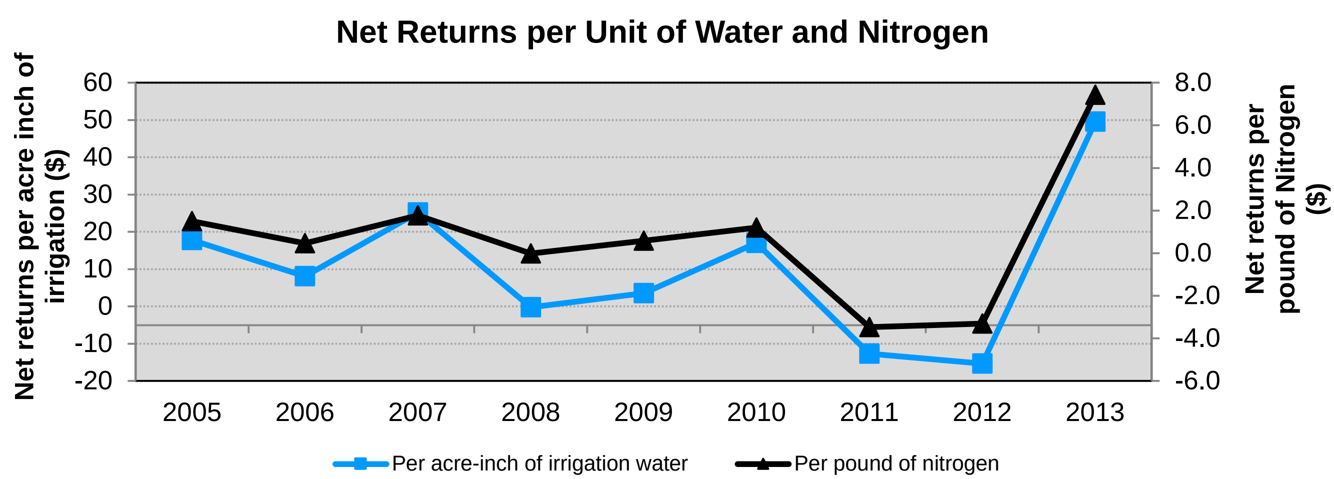
Pre-watering for cotton planting

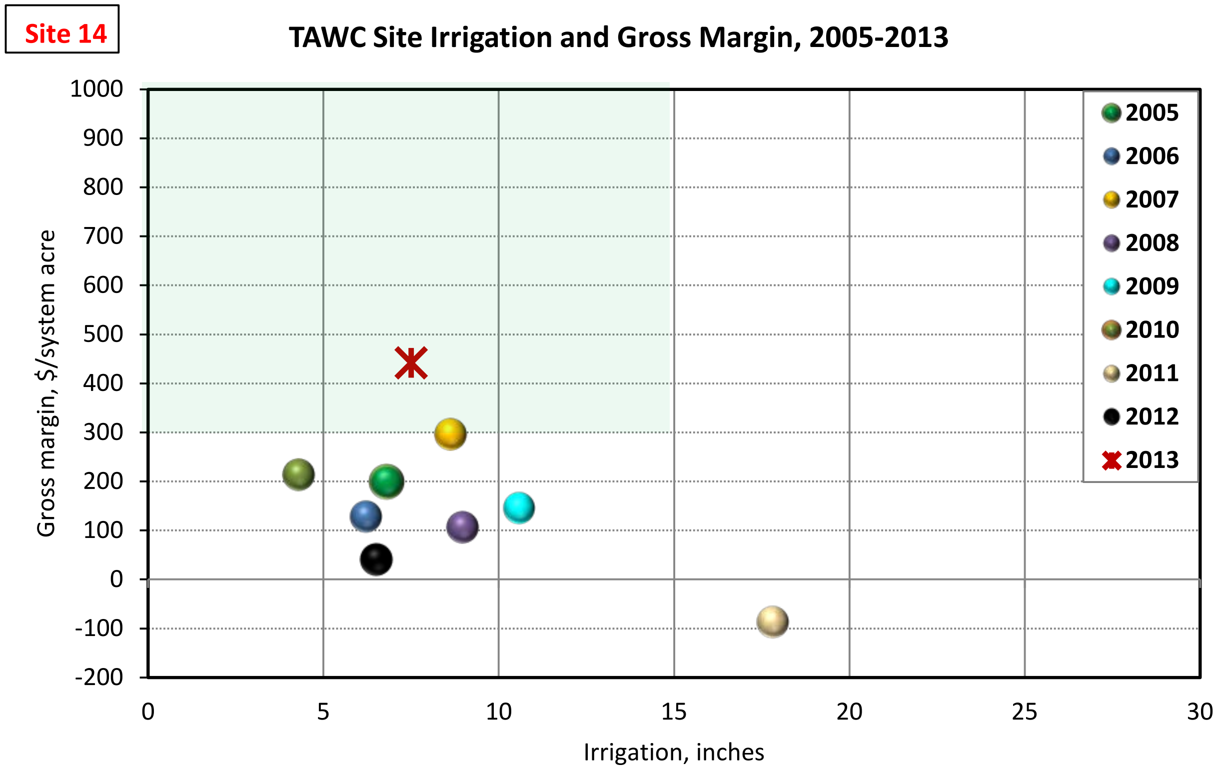
July skip cotton (2 in 2 out)

Site 14


Irrigation and Precipitation
Water (inches)
0
10
20
30
40
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
500
400
300
200
100
0
-100
-200
-300
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
60
50
40
30
20
10
0
-10
-20
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
Net returns per pound of Nitrogen ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 14
TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
-100
-200
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

Site 15

Description

Total site acres:	101.1
Field No. 8 Acres:	56.7
Major soil type:	PuA-Pullman clay loam; 0 to 1%
Field No. 9 Acres:	44.4
Major soil type:	PuA-Pullman clay loam; 0 to 1%

Irrigation

Type:	Subsurface Drip
Pumping capacity, gal/min:	290
Number of wells:	1
Fuel source:	electric

Site 15

	Livestock	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9
2005	None	Cotton	Cotton							
2006	None	Cotton	Split into Fields 3 and 4	Cotton	Grain sorghum					
2007	None	Cotton		Grain Sorghum	Cotton					
2008	None	Split into Fields 5 and 6		Cotton	Wheat harvested, volunteer sheat for cover crop, replanted to Wheat	Cotton	Cotton			
2009	None			Cotton	Cotton	Cotton	Acres added to become Field 7	Cotton		
2010	None			Split into Fields 8 and 9				Split into Fields 8 and 9	Cotton	Cotton
2011	None								Corn	Cotton
2012	None								Milo	Milo
2013	None								Cotton	Cotton

Comments: This has been a cotton, wheat and grain sorghum system in previous years. This year both fields were planted to cotton on 40-inch centers.

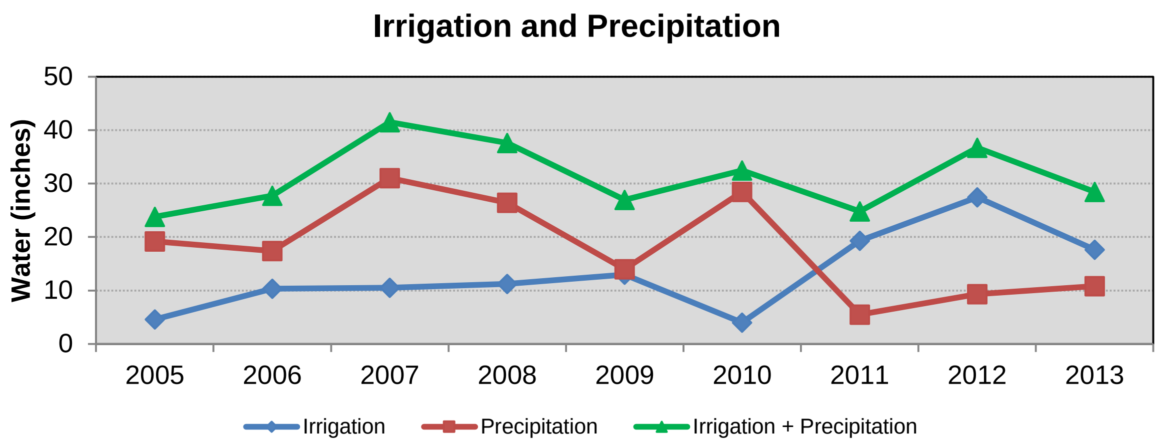
Planting cotton

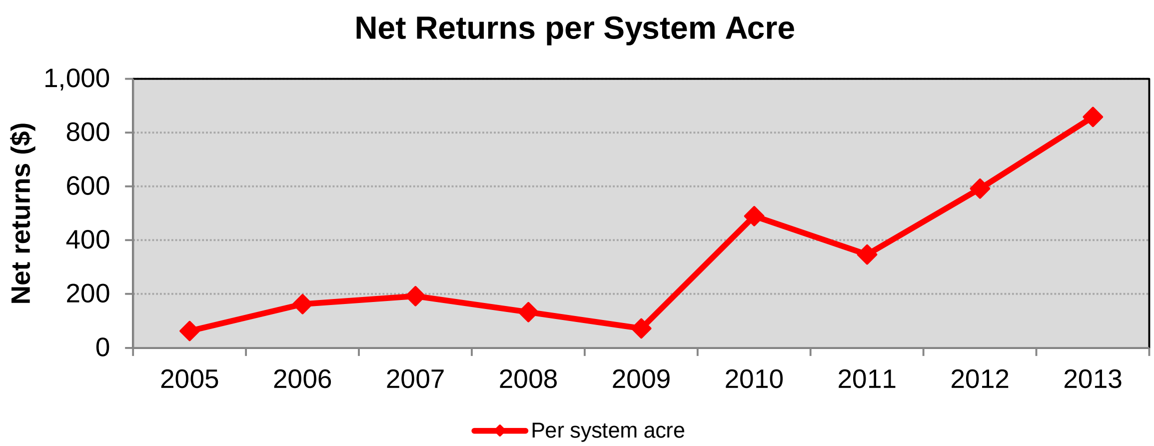
June cotton

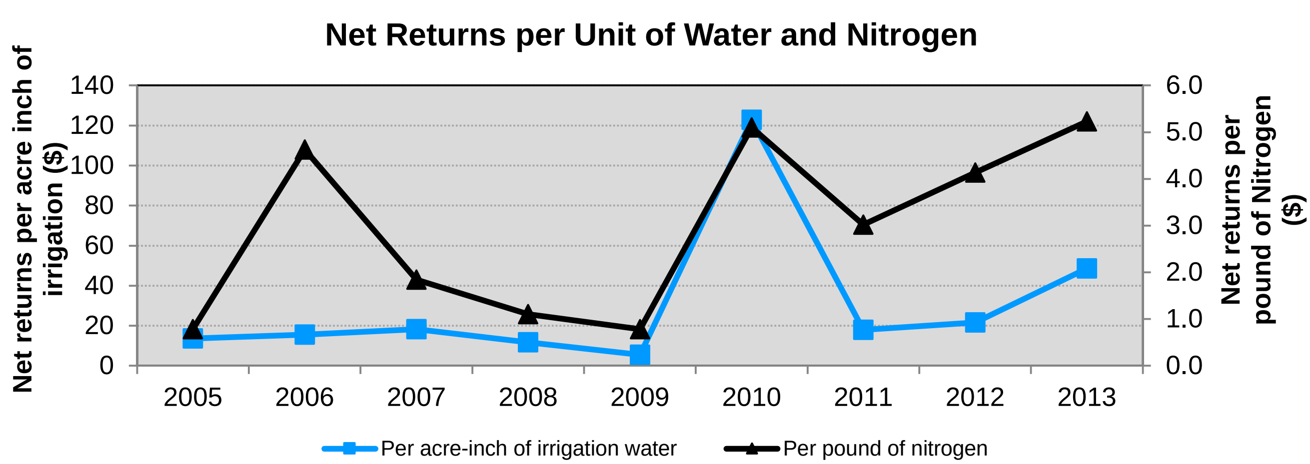
Late July cotton

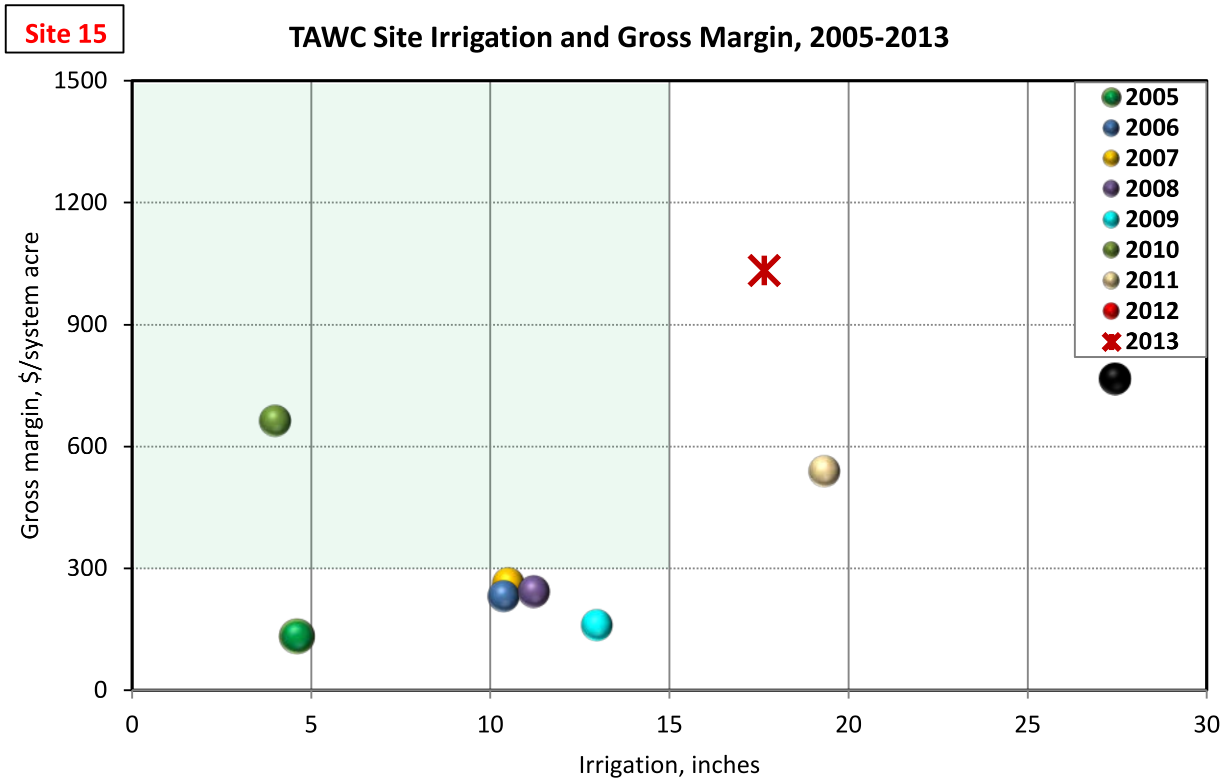
Cotton harvest

Site 15

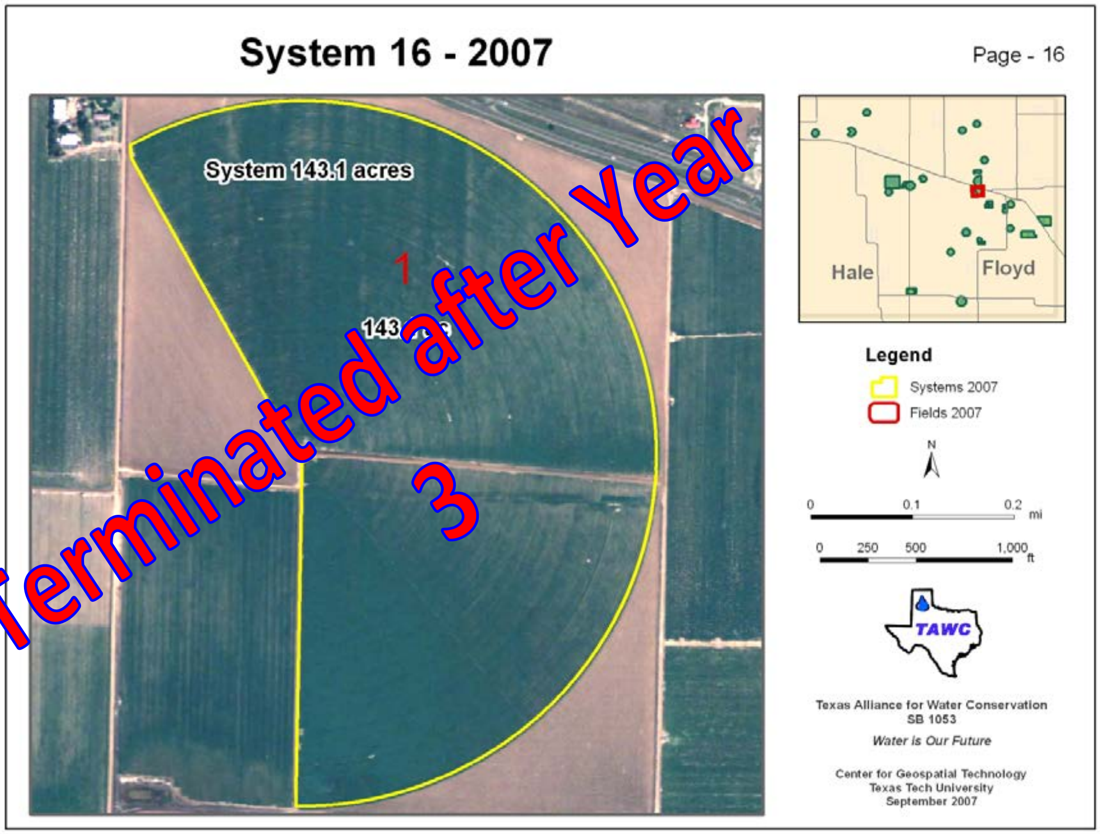

Irrigation and Precipitation
Water (inches)
0
10
20
30
40
50
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
0
200
400
600
800
1,000
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
0
20
40
60
80
100
120
140
Net returns per pound of Nitrogen ($)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 15
TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1500
1200
900
600
300
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

Site 16

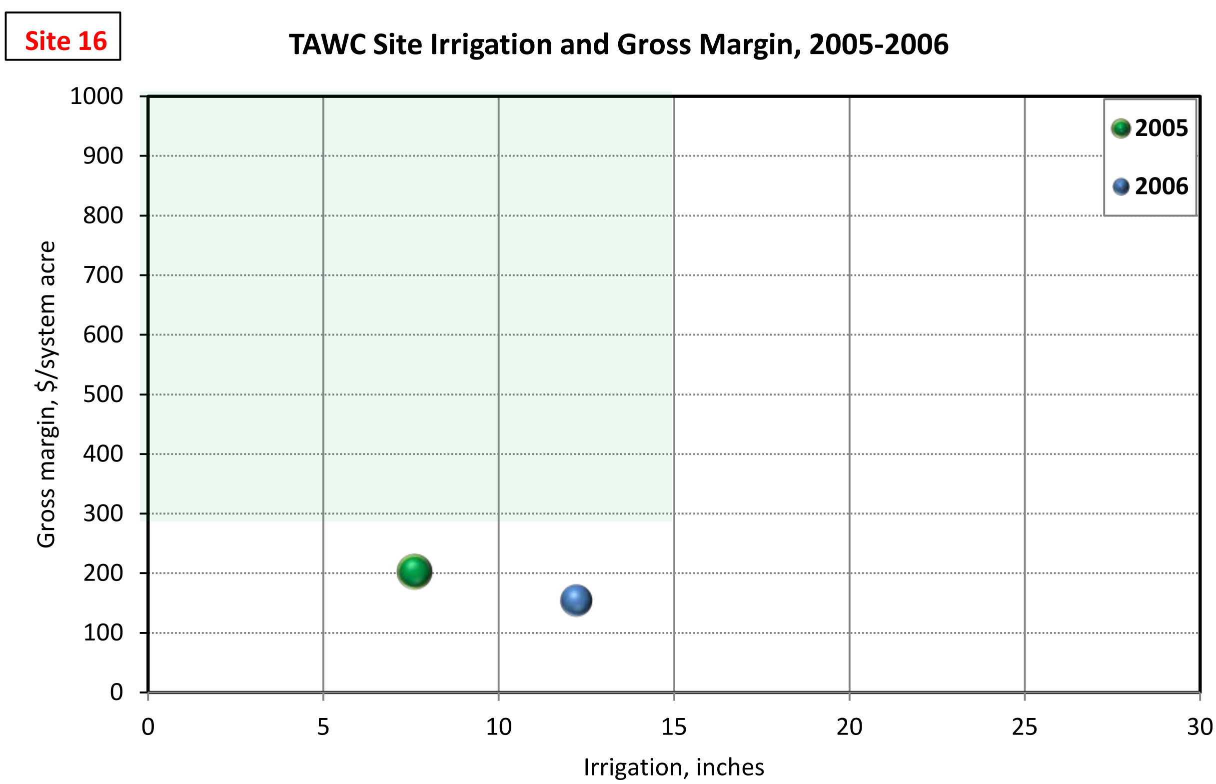


Description		**Irrigation**	
Total site acres:	143.1	Type:	Center Pivot (LESA)
Field No. 1 Acres:	143.1	Pumping capacity, gal/min:	600
Major soil type:	Pullman clay loam; 0 to 1%	Number of wells:	3
		Fuel source:	Electric

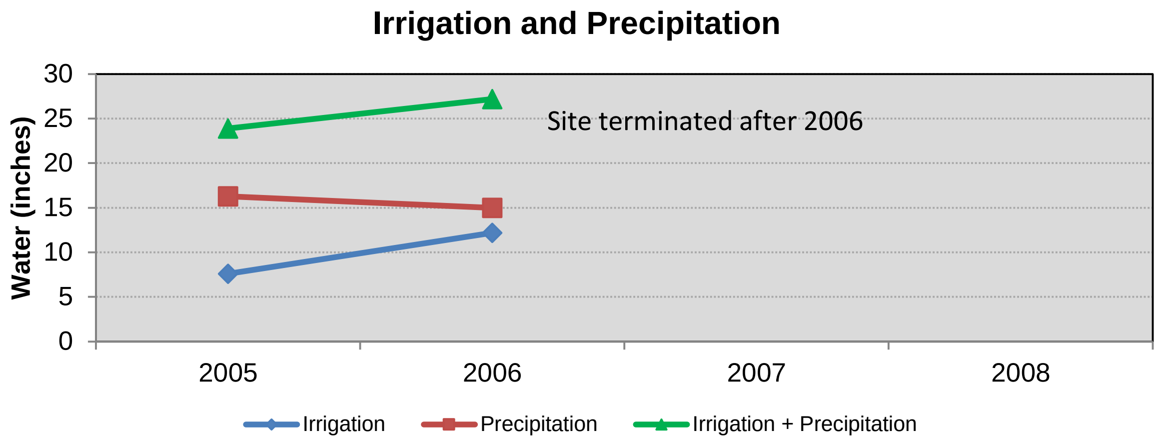
Comments: This pivot irrigated cotton site used conventional tillage and planted on 40-inch centers.

Site 16

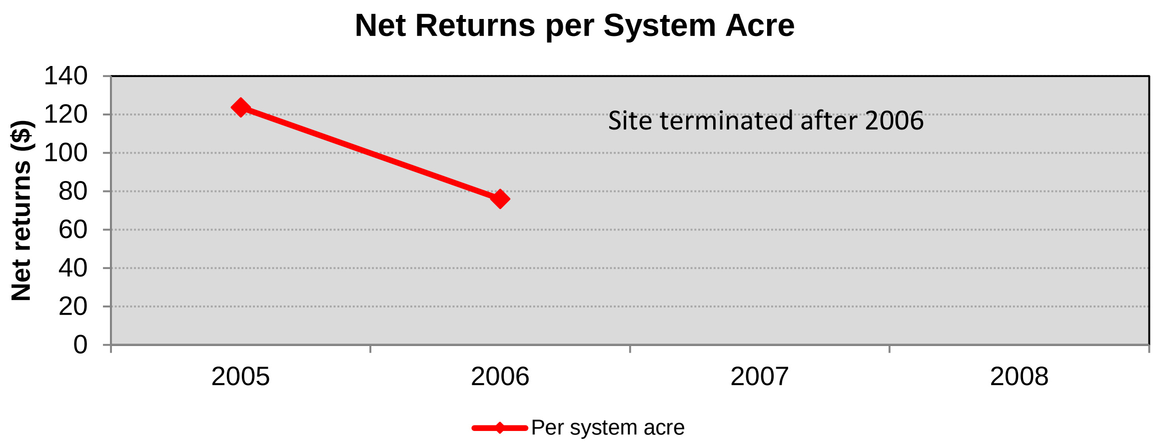
	Livestock	Field 1
2005	None	Cotton
2006	None	Cotton
2007	None	Cotton following wheat cover crop
2008	Site terminated for 2008	



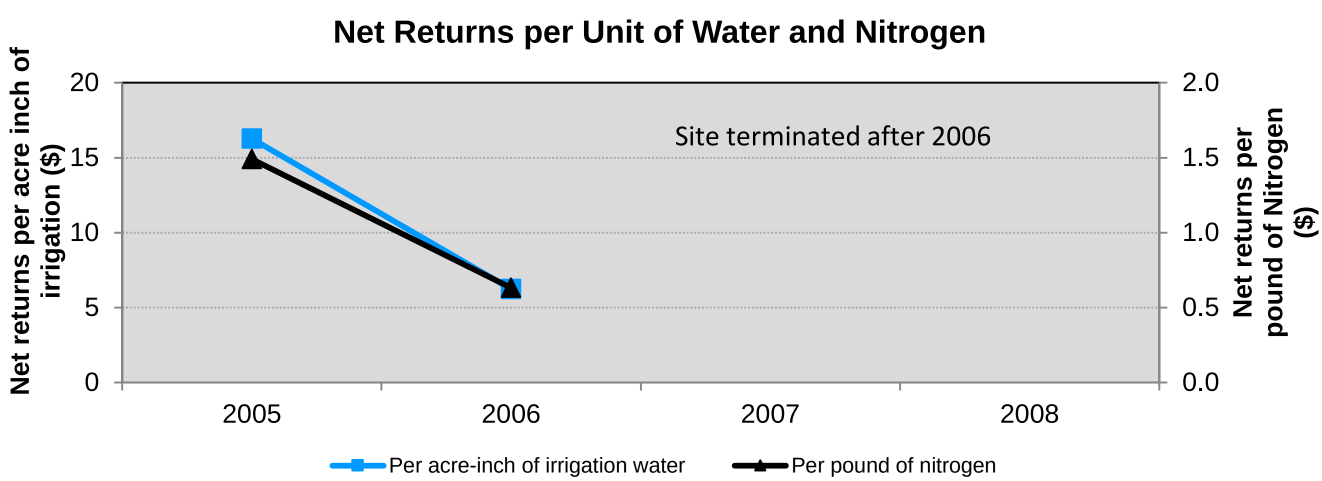
Site 16



Irrigation and Precipitation
Water (inches)
30
25
20
15
10
5
0
Site terminated after 2006
2005
2006
2007
2008
Irrigation
Precipitation
Irrigation + Precipitation

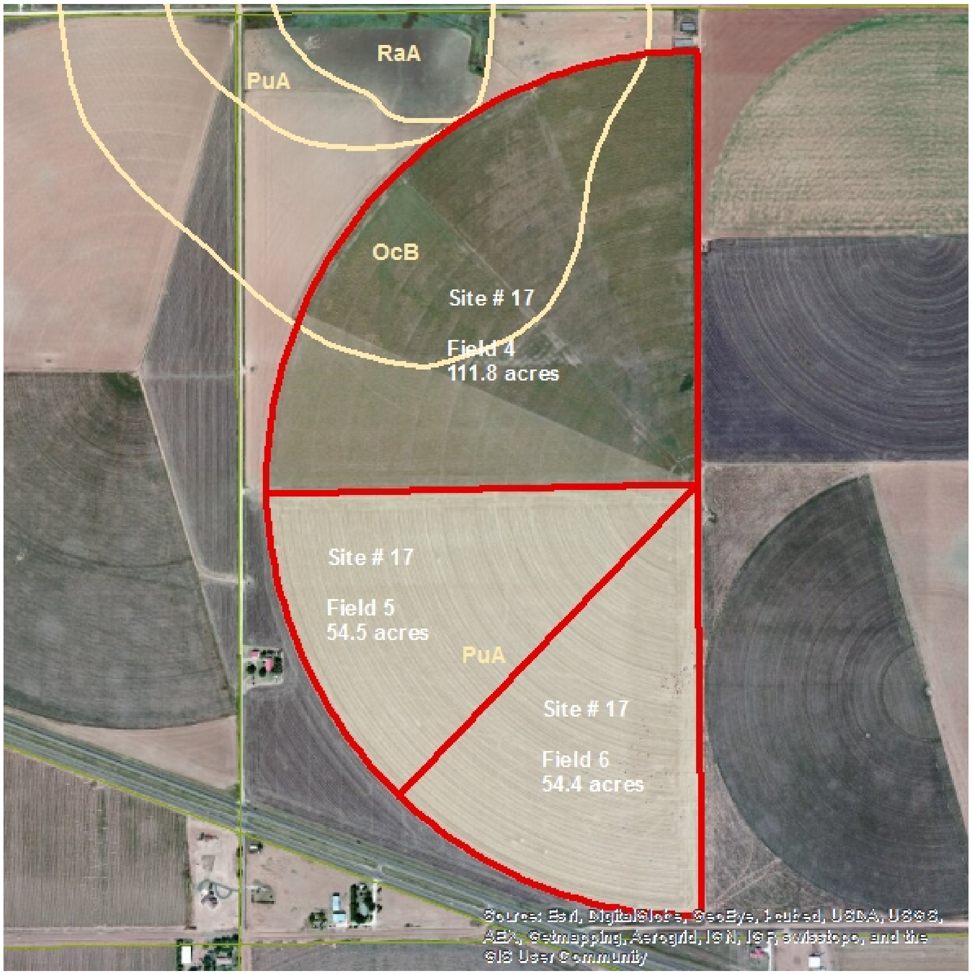


Net Returns per System Acre
Net returns ($)
140
120
100
80
60
40
20
0
Site terminated after 2006
2005
2006
2007
2008
Per system acre



Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
20
15
10
5
0
2.0
1.5
1.0
0.5
0.0
Net returns per pound of Nitrogen ($)
Site terminated after 2006
2005
2006
2007
2008
Per acre-inch of irrigation water
Per pound of nitrogen

Site 17



Description

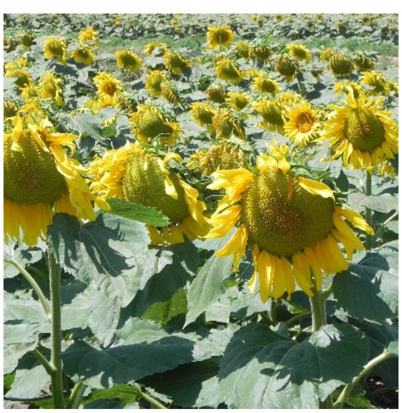
Total site acres:	220.7
Field No. 4 Acres:	111.8
Major soil type:	PuA-Pullman clay loam; 0 to 1% OcB-Olton clay loam; 1 to 3%
Field No. 5 Acres:	54.5
Major soil type:	PuA-Pullman clay loam; 0 to 1%
Field No. 6 Acres:	54.4
Major soil type:	PuA-Pullman clay loam; 0 to 1%

Irrigation

Type:	Center Pivot (MESA)
Pumping capacity, gal/min:	900
Number of wells:	8
Fuel source:	Electric

Site 17

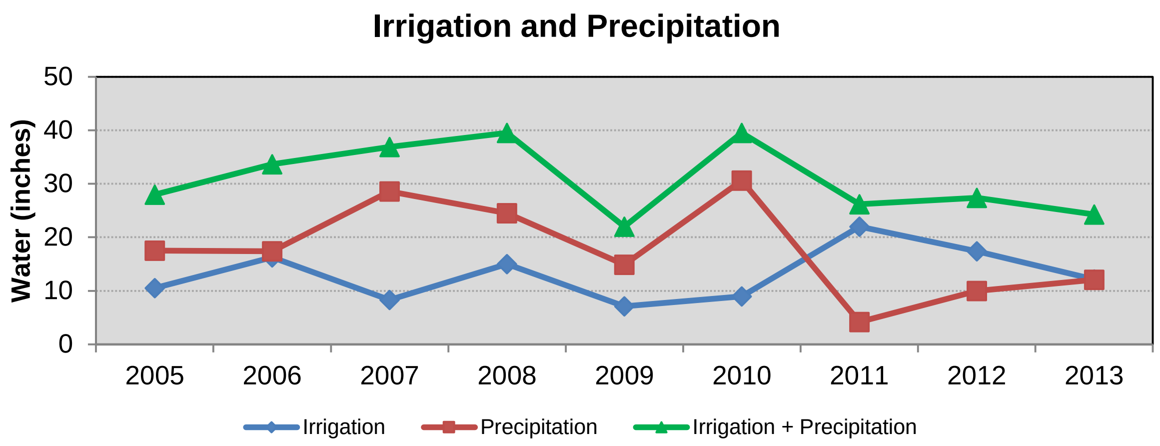
	Livestock	Field 1	Field 2	Field 3
2005	None	WW-B. Dahl grass for hay	Corn for silage, followed by wheat for grazing and cover	Cotton following cover crop of wheat
2006	Cow-calf	WW-B. Dahl grass for grazing and hay	Wheat for grazing and cover followed by cotton	Corn for silage, followed by wheat for grazing and cover
2007	Cow-calf	WW-B. Dahl grass for grazing and seed	WW-B. Dahl grass for grazing, hay, seed, established after wheat cover crop	Wheat for grazing and cover followed by cotton
2008	Cow-calf	WW-B. Dahl grass for grazing and seed	WW-B. Dahl grass for grazing and seed	Corn for grain and grazing of residue
2009	Cow-calf	WW-B. Dahl grass for grazing and seed	WW-B. Dahl for grazing	Sunflowers
2010	Cow-calf	WW-B. Dahl grass for grazing	WW-B. Dahl for grazing	Corn
2011	Cow-calf	WW-B. Dahl grass for grazing	WW-B. Dahl for grazing	Cotton
	Livestock	**Field 4**	**Field 5**	**Field 6**
2012	Cow-calf	WW-B. Dahl grass for grazing	Cotton	Corn
2013	Cow-calf	WW-B. Dahl grass for grazing	Corn	Sunflower



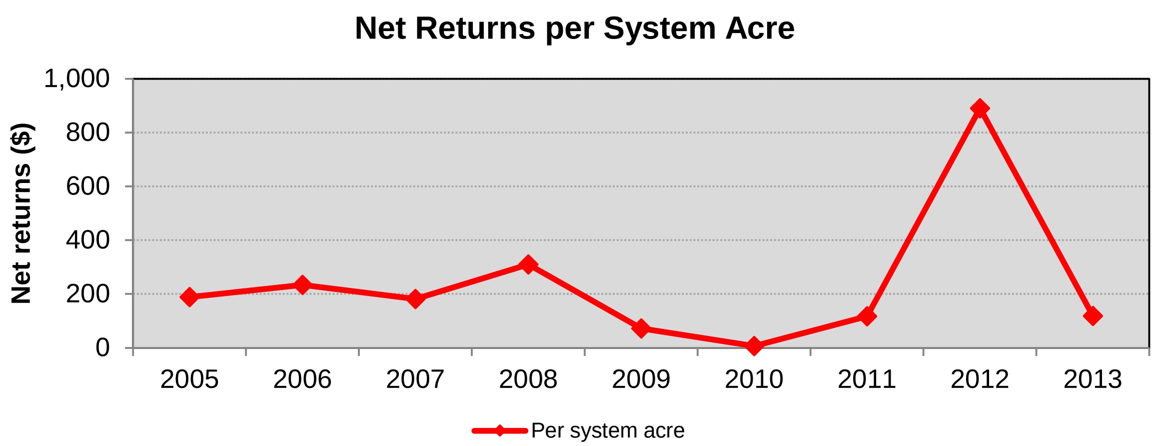
Late July sunflower

WW B.Dahl grass ready for grazing

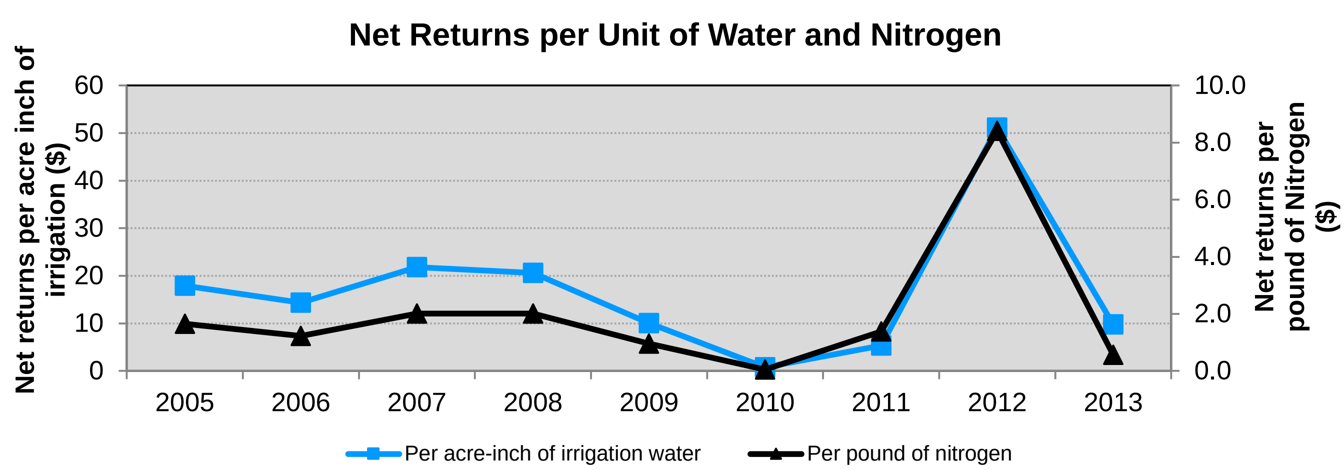
Site 17



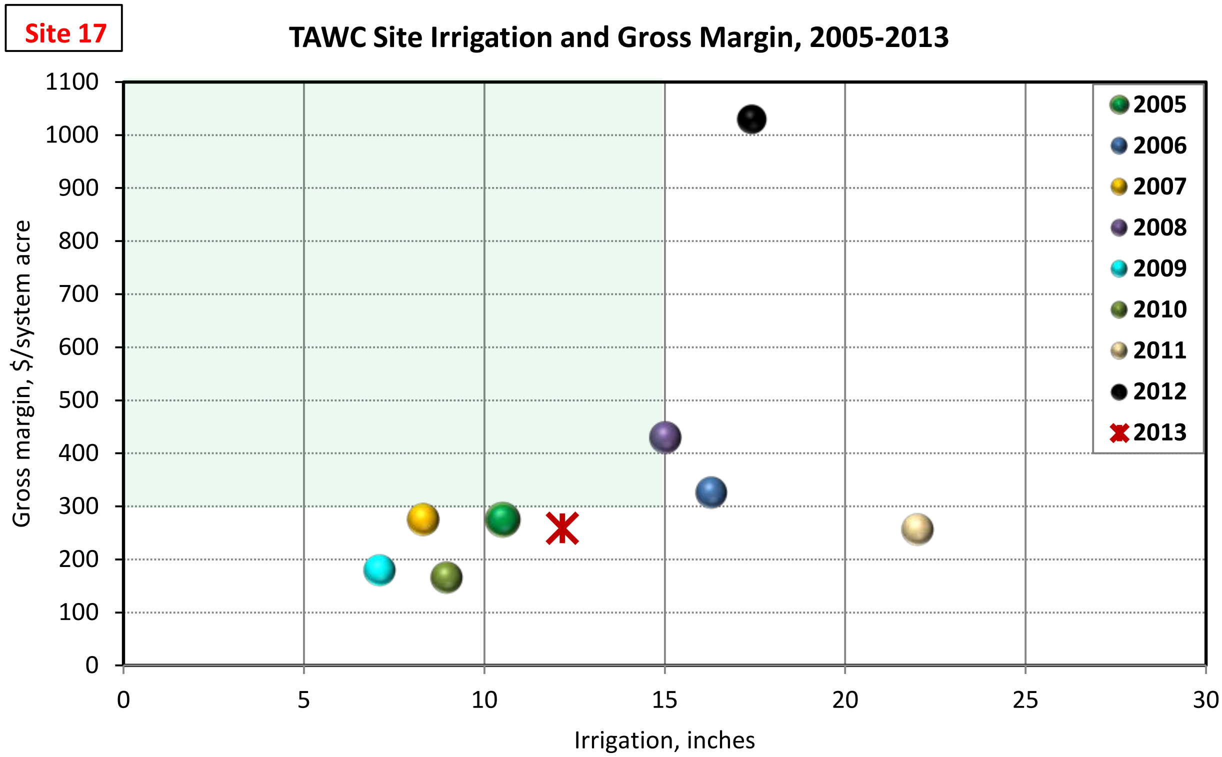
Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Net returns ($)
1,000
800
600
400
200
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre



Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
60
50
40
30
20
10
0
10.0
8.0
6.0
4.0
2.0
0.0
Net returns per pound of Nitrogen ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 17
TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1100
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

Site 18

Description

Total site acres:	122.2
Field No. 1 Acres:	60.7
Major soil type:	PuA-Pullman clay loam; 0 to 1%
Field No. 2 Acres:	61.5
Major soil type:	PuA-Pullman clay loam; 0 to 1%

Irrigation

Type:	Center Pivot (LEPA)
Pumping capacity, gal/min:	250
Number of wells:	3
Fuel source:	Electric

Site 18

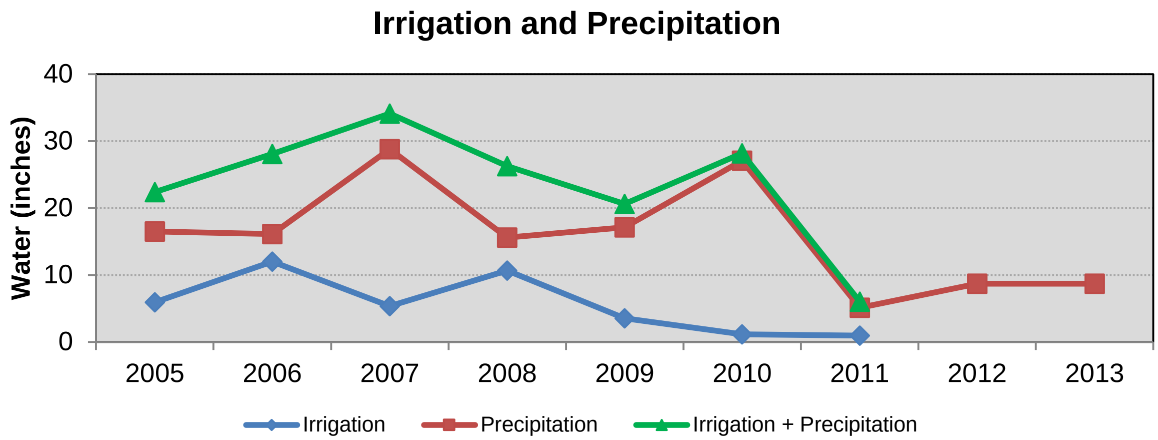
	Livestock	Field 1	Field 2
2005	None	Cotton	Grain sorghum
2006	None	Cotton	Oats for silage followed by forage sorghum for hay
2007	None	Wheat for grain	Grain sorghum
2008	None	Wheat for silage followed by grain sorghum	Cotton
2009	None	Cotton	Wheat
2010	None	Wheat	Cotton
2011	None	Cotton Abandoned	Wheat/cotton Abandoned both
2012	None	Cotton	Cotton
2013	None	Fallow	Fallow

Comments: Fallow for 2013

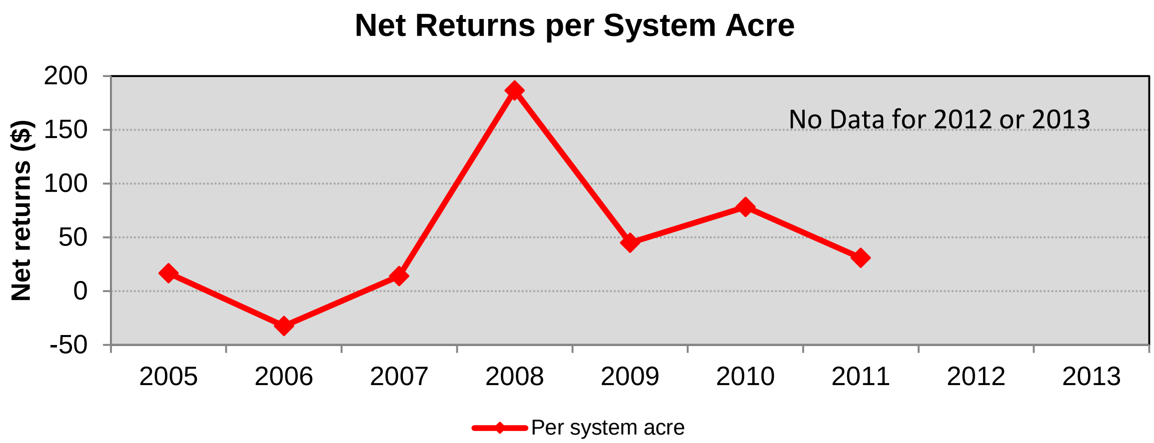
Fields fallowed

Fields fallowed

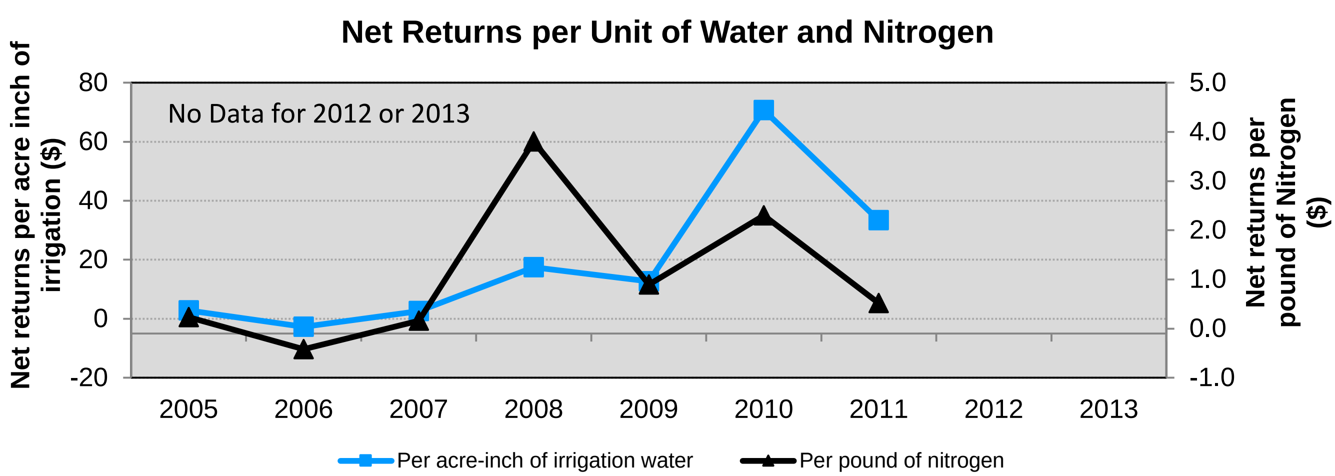
Site 18



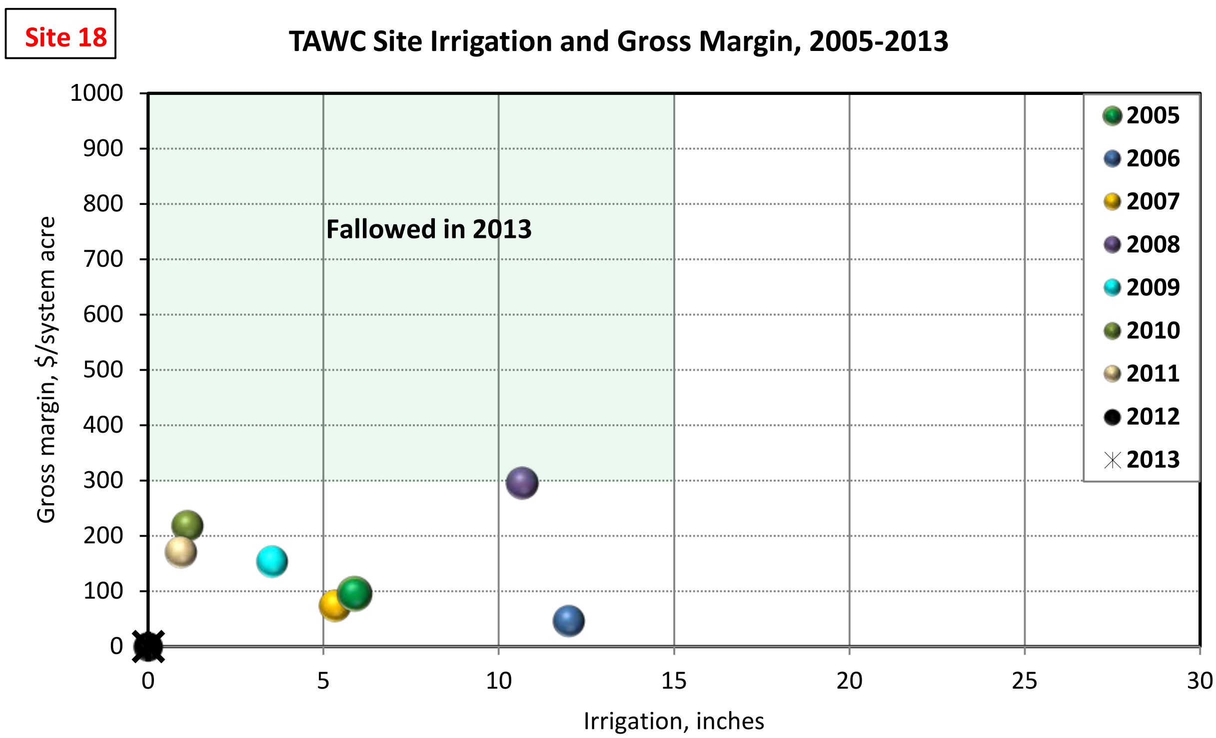
Irrigation and Precipitation
Water (inches)
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation



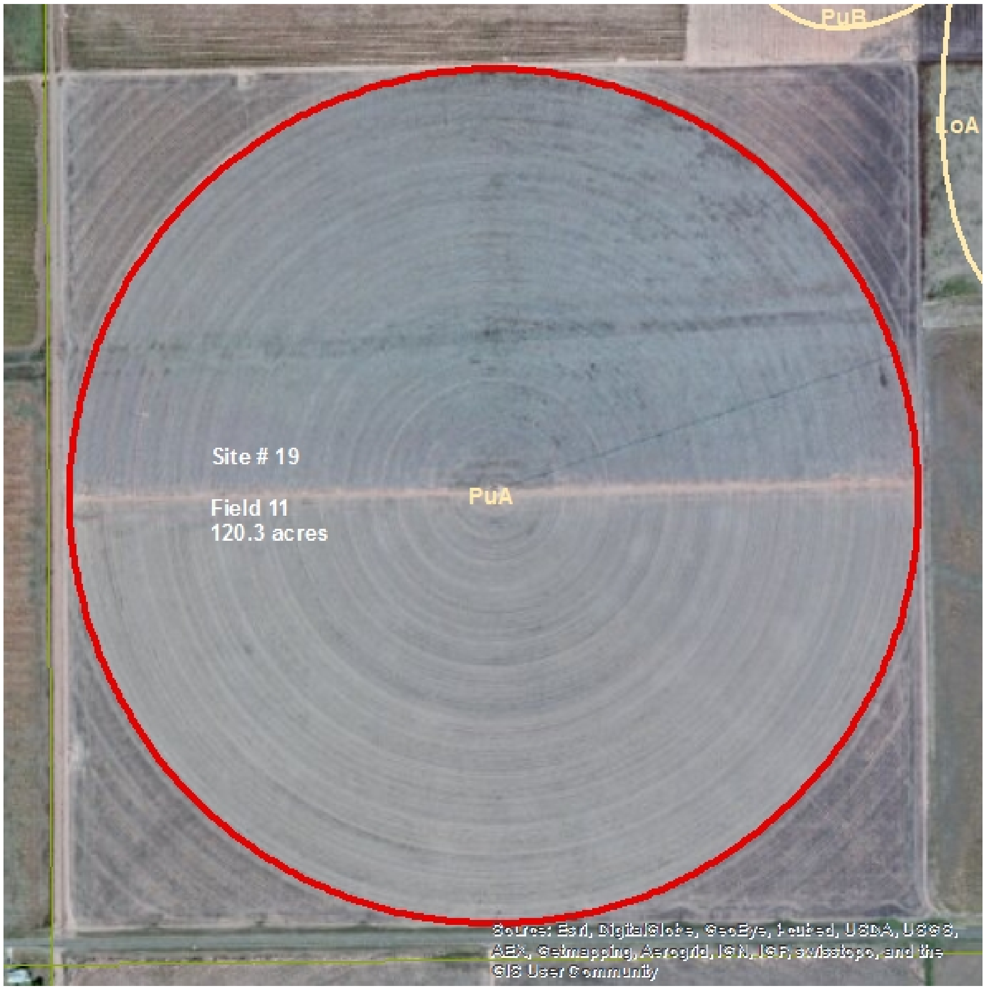
Net Returns per System Acre
Net returns ($)
200
150
100
50
0
-50
No Data for 2012 or 2013
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre



Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
80
60
40
20
0
-20
No Data for 2012 or 2013
Net returns per pound of Nitrogen ($)
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 18
TAWC Site Irrigation and Gross Margin, 2005-2013
Fallowed in 2013
Gross margin, $/system acre
Irrigation, inches
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
2005
2006
2007
2008
2009
2010
2011
2012
2013

Site 19



Description

Total site acres: 120.3

Field No. 11 Acres: 120.3
Major soil type: PuA-Pullman clay loam; 0 to 1%

Irrigation

Type: Center Pivot (LEPA)

Pumping capacity, gal/min: 400

Number of wells: 3

Fuel source: Electric

Site 19

	Livestock	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
2005	None	Cotton	Pearlmillet for seed								
2006	None	Split into Fields 3 and 4		Pearlmillet for seed	Cotton						
2007	None			Split into Fields 5 and 6		Cotton	Pearlmillet for seed				
2008	None					Split into Fields 7 and 8		Cotton	Pearlmillet for seed		
2009	None							Split into Fields 9 and 10		Wheat	Cotton
2010	None									Cotton	Wheat
2011	None									Cotton	Cotton
2012	None									Cotton	Fallow
	Livestock									Field 11	
2013	None									Cotton	

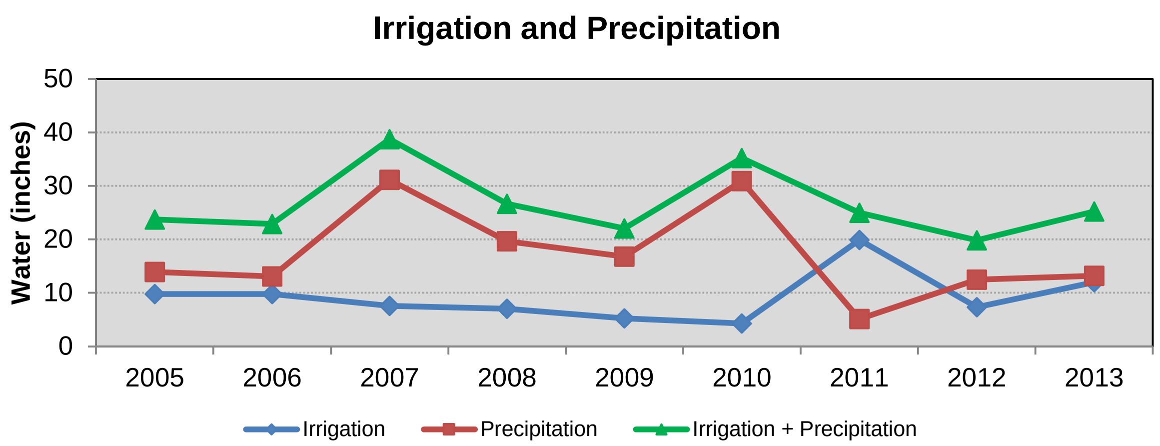
Comments: This is a pivot irrigated cotton and wheat site using conventional tillage. Cotton is planted on 40-inch centers in a skip-row pattern.

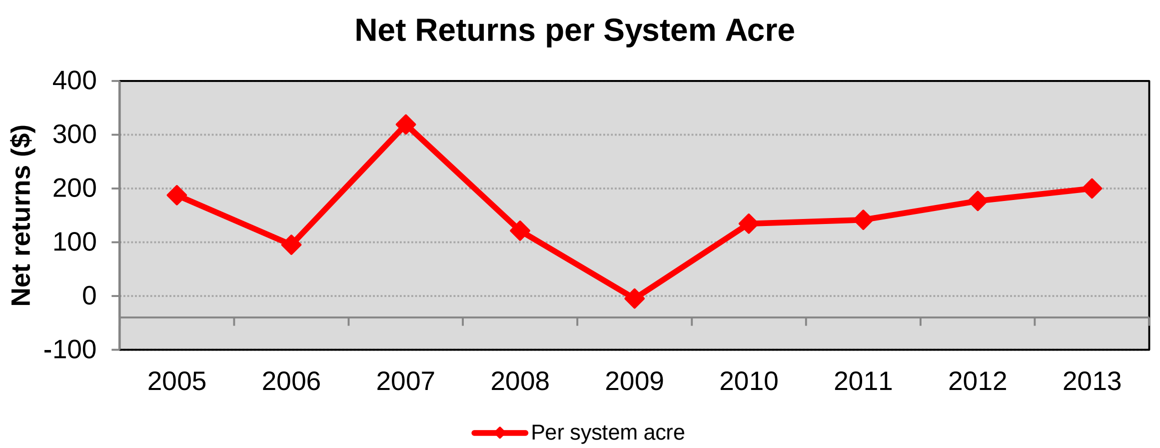
June 1 cotton emerging

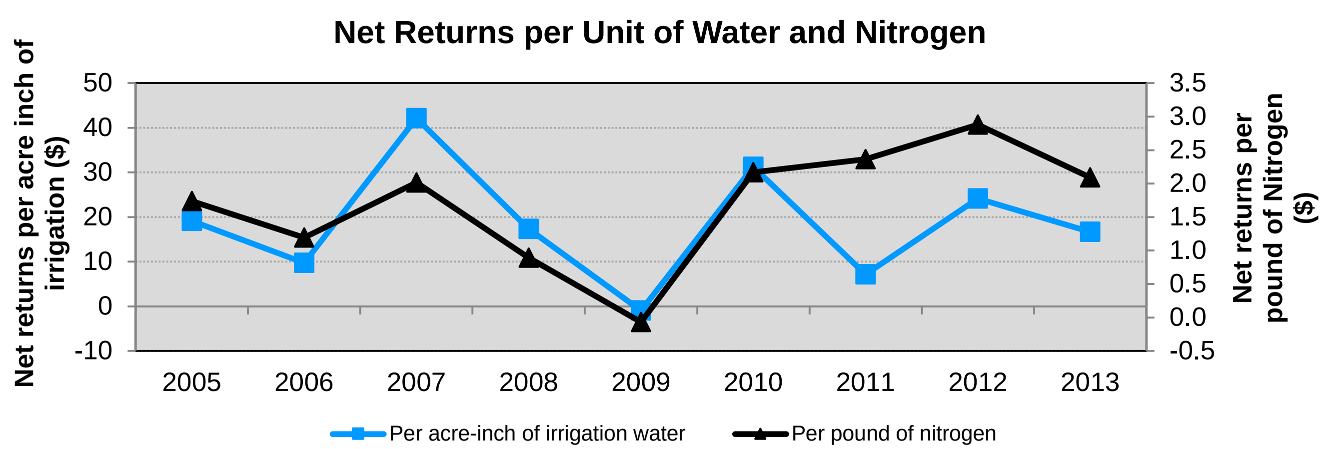
June 1 cotton (2 in 2 out)

September 30 cotton

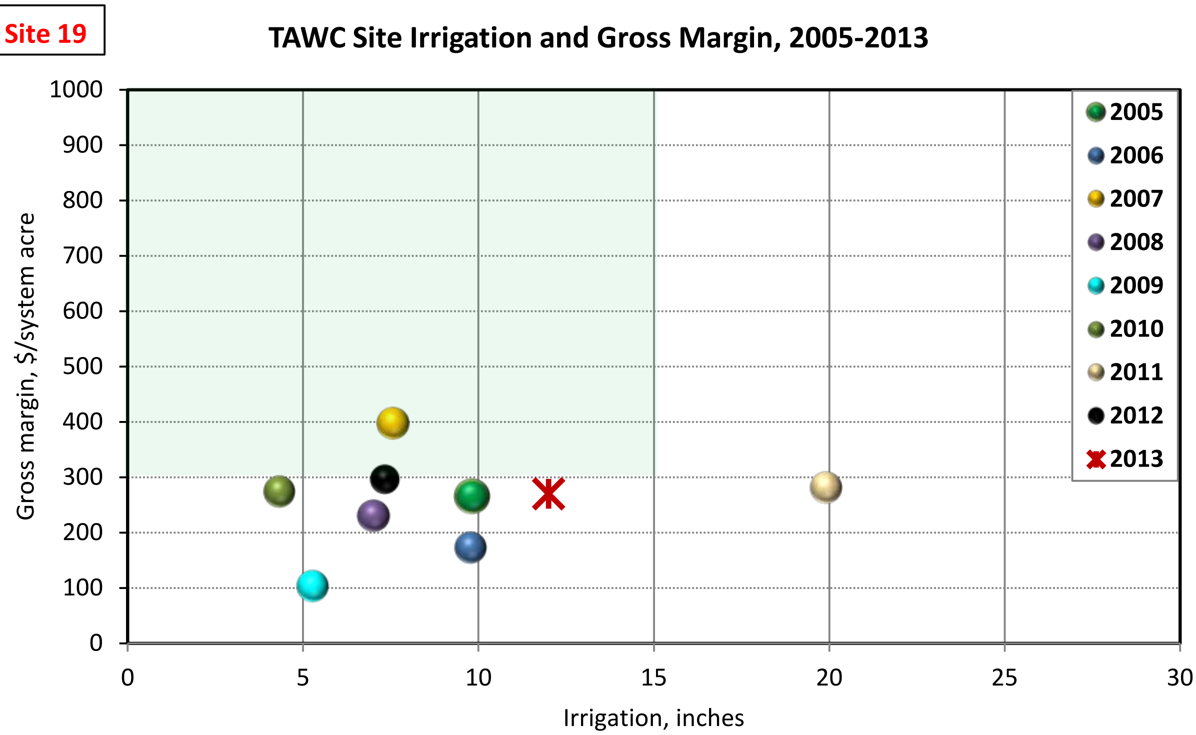
Site 19


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation

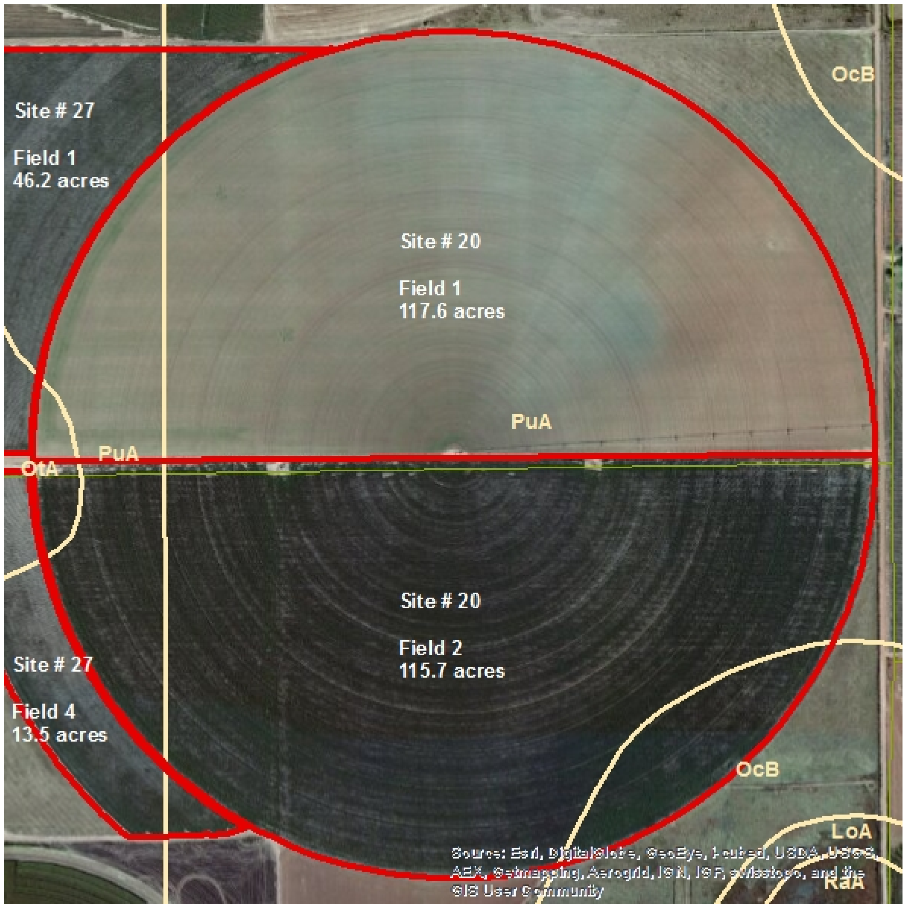

Net Returns per System Acre
Net returns ($)
400
300
200
100
0
-100
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
50
40
30
20
10
0
-10
Net returns per pound of Nitrogen ($)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen

Site 19


TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

Site 20



Description		**Irrigation**	
Total site acres:	233.3	Type:	Center Pivot (LEPA)
Field No. 1 Acres:	117.6	Pumping capacity,	
Major soil type:	PuA-Pullman clay loam; 0 to 1%	gal/min:	1000
Field No. 2 Acres:	115.7	Number of wells:	3
Major soil type:	PuA-Pullman clay loam; 0 to 1%		
	OcB-Olton clay loam, 1 to 3%	Fuel source:	Electric

Site 20

	Livestock	Field 1	Field 2
2005	None	Wheat for silage followed by forage sorghum for silage	Corn for silage
2006	None	Corn for silage	Triticale for silage followed by forage sorghum for silage
2007	None	Triticale for silage, followed by corn for silage	Triticale for silage, followed by forage sorghum for silage
2008	None	Wheat for grain followed by grain sorghum for grain and residue for hay	Wheat for grain followed by grain sorghum for silage
2009	None	Cotton	Corn for silage
2010	None	Corn for silage	Triticale for silage followed by cotton
2011	None	Triticale for silage/hay and cotton double crop	Corn for silage
2012	None	Corn	Triticale for silage followed by cotton
2013	None	Cotton	Corn

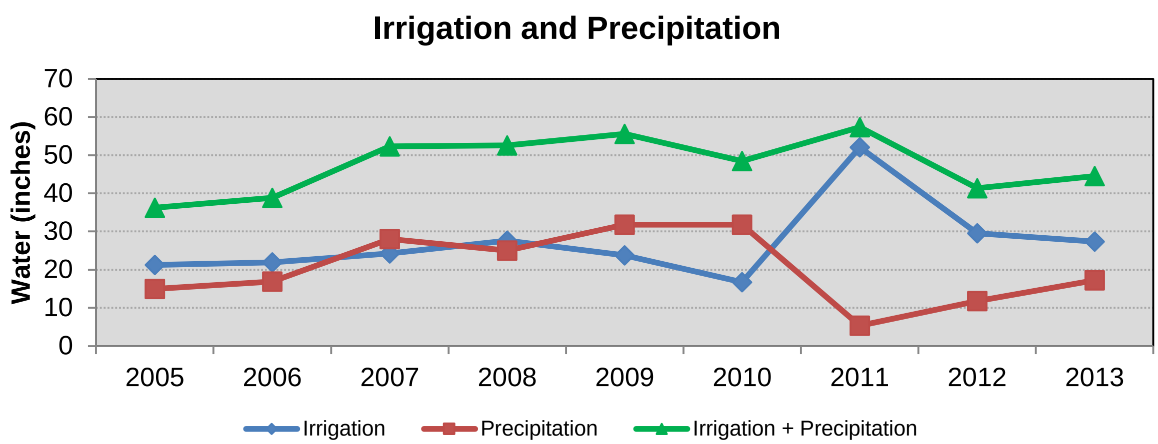
Comments: This site was planted to cotton and corn for silage.

Triticale for silage

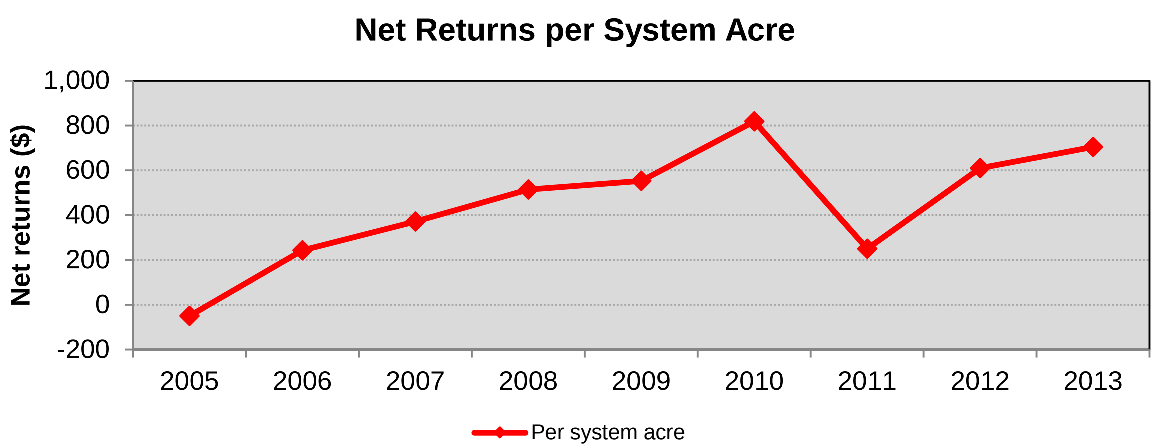
July cotton

July corn

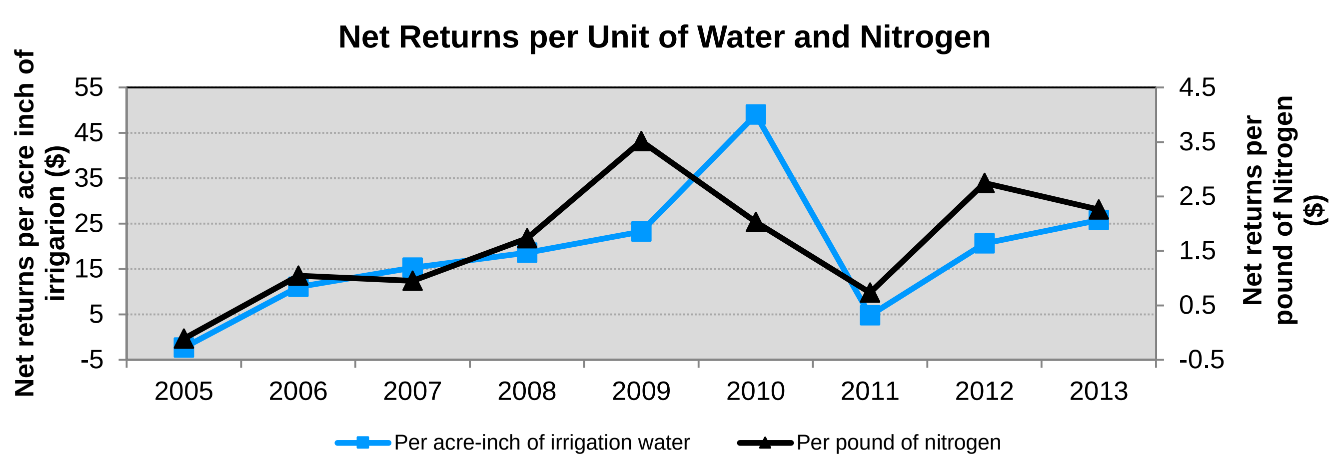
Site 20



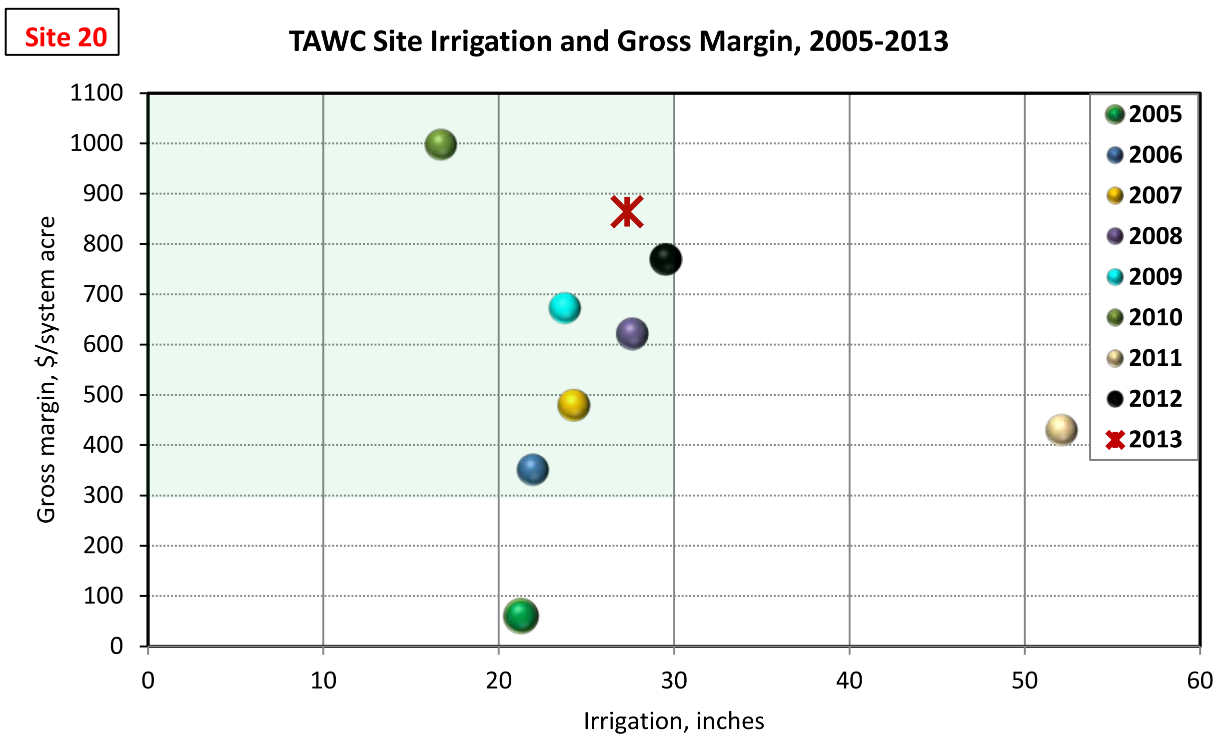
Irrigation and Precipitation
Water (inches)
70
60
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation



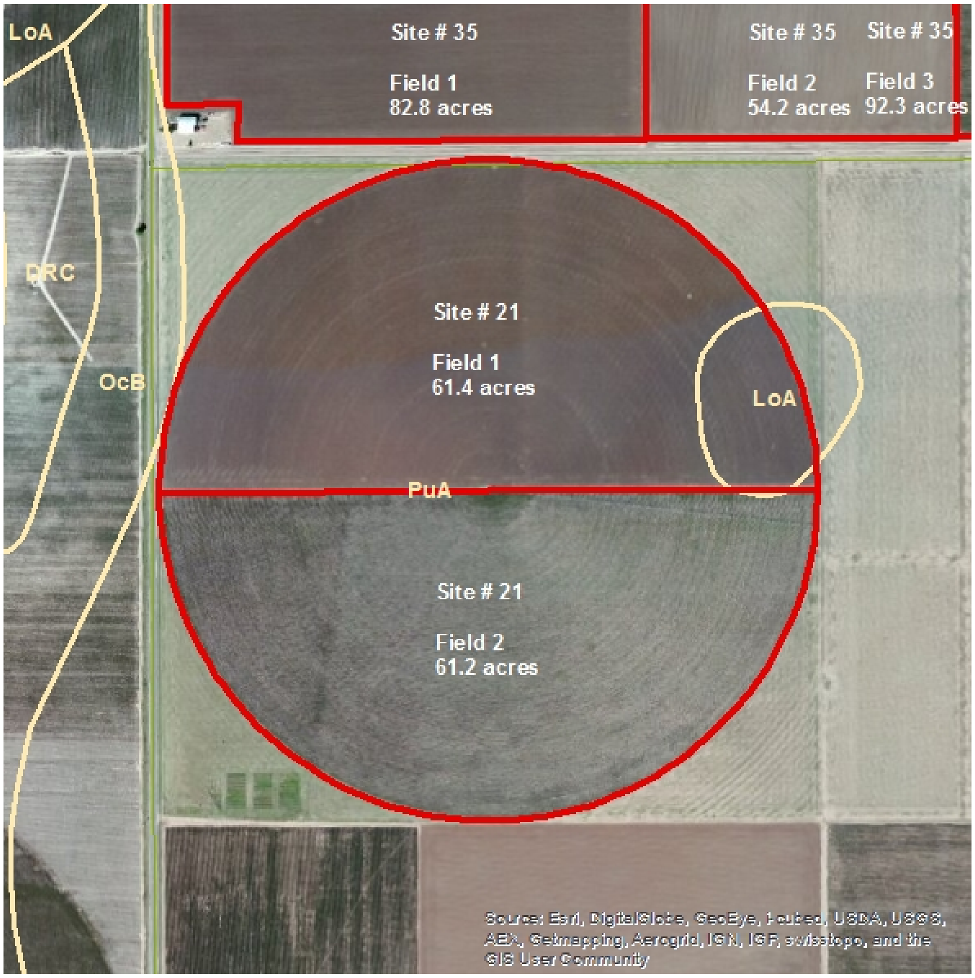
Net Returns per System Acre
Net returns ($)
1,000
800
600
400
200
0
-200
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre



Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigarion ($)
55
45
35
25
15
5
-5
4.5
3.5
2.5
1.5
0.5
-0.5
Net returns per pound of Nitrogen ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 20
TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
Irrigation, inches
0
100
200
300
400
500
600
700
800
900
1000
1100
0
10
20
30
40
50
60
2005
2006
2007
2008
2009
2010
2011
2012
2013

Site 21

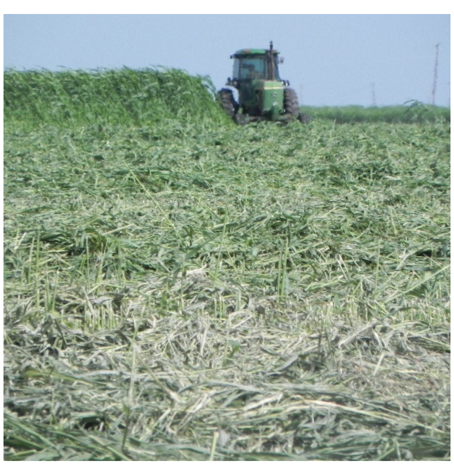


Description		**Irrigation**	
Total site acres:	122.6	Type:	Center Pivot (LEPA)
Field No. 1 Acres:	61.4	Pumping capacity,	
Major soil type:	PuA-Pullman clay loam; 0 to 1%	gal/min:	500
	LoA-Lofton clay loam; 0 to 1%		
Field No. 2 Acres:	61.2	Number of wells:	1
Major soil type:	PuA-Pullman clay loam; 0 to 1%		
		Fuel source:	Electric

Site 21

	Livestock	Field 1	Field 2
2005	None	Cotton	Cotton
2006	Stocker steers	Corn for grain	Wheat for grazing and cover followed by cotton
2007	None	Sideoats grama grass for seed and hay	Corn for grain
2008	None	Sideoats grama grass for seed and hay	Barley for seed followed by forage sorghum for hay
2009	None	Sideoats grama grass for seed and hay	Wheat/forage sorghum for hay
2010	None	Corn	Cotton
2011	None	Cotton	Corn abandoned
2012	None	Wheat/Haygrazer sudangrass	Cotton
2013	None	Corn	Wheat/Haygrazer double crop

Comments: This is a pivot irrigated site with one-half planted to cotton and one-half planted to wheat/haygrazer double crop. Both crops are planted on 40-inch centers using conventional tillage. Following wheat harvest this field was drilled to forage sorghum for hay production.



August forage sorghum harvest

July corn

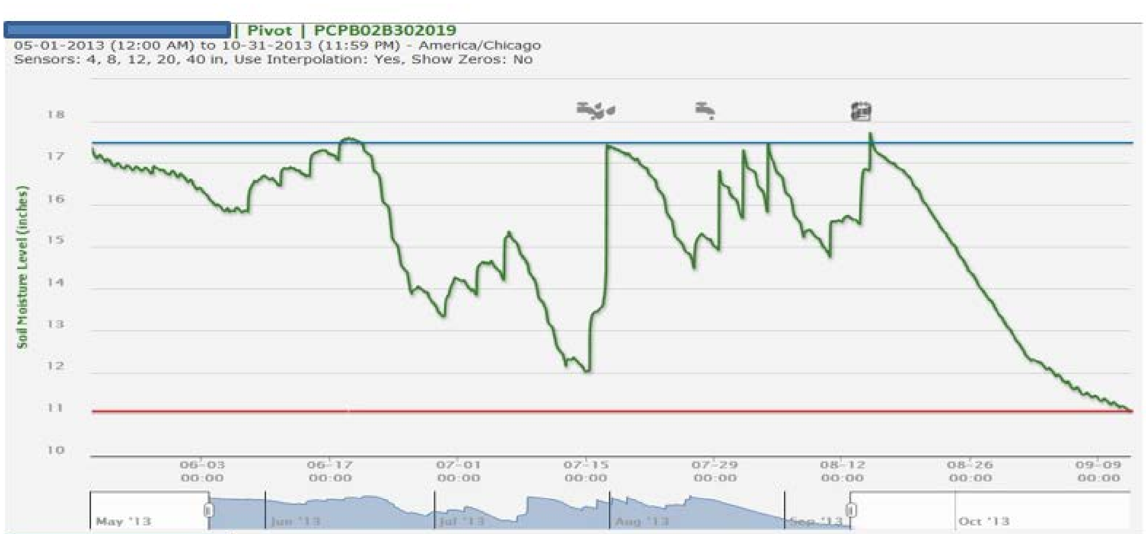
John Deere CropSense™

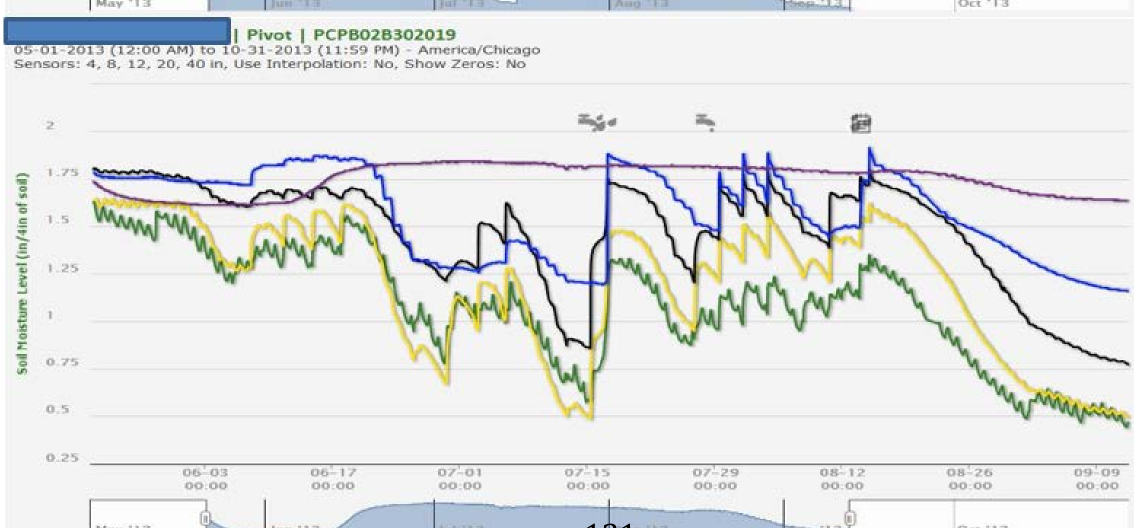
TAWC 2013 Grower Review

Chris Arnold, Senior Technical Service Representative

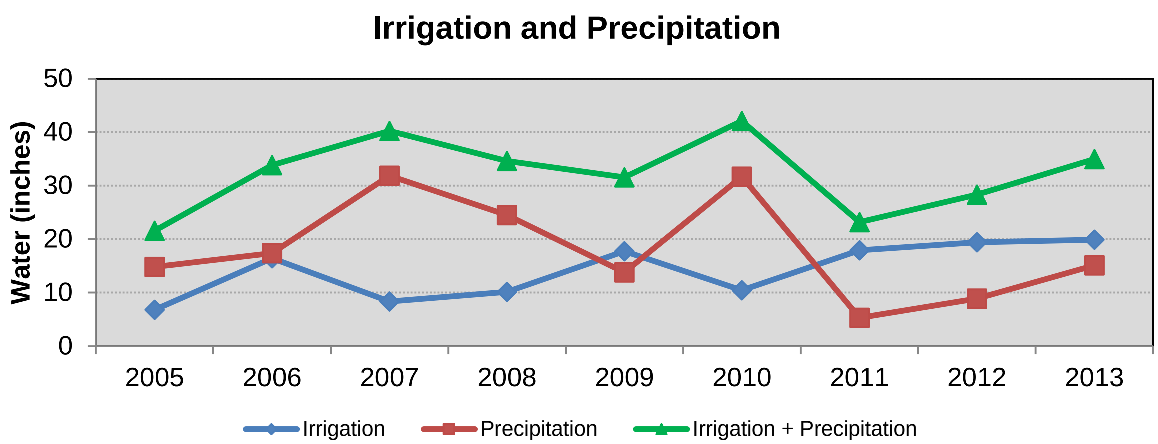
Site 21
Pivot Corn

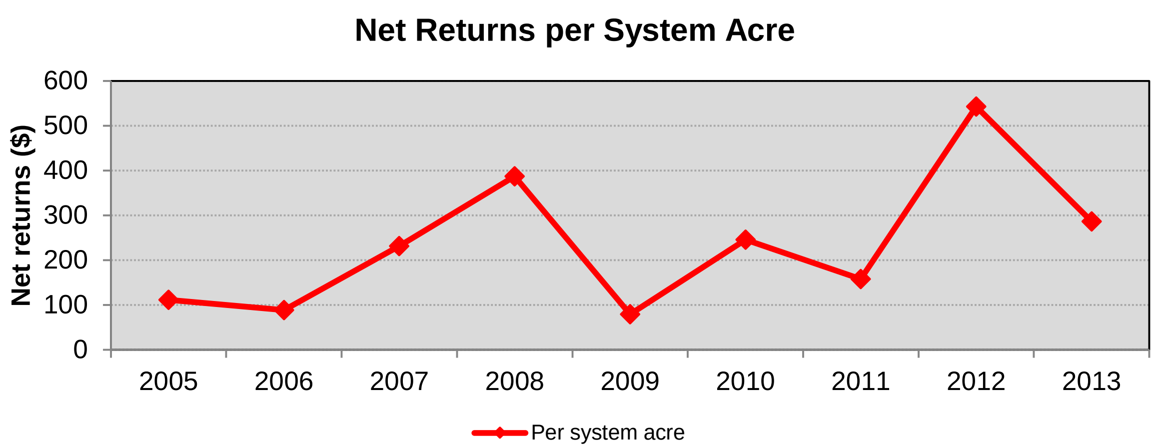
June Irrigation cycle of 4 passes built profile moisture to the 40-inch level with root activity only in the top 12 inches. Stopping the irrigation passes allowed the crop to pull moisture from the 20" profile and establish a good stepping pattern. The 2 irrigation cycles in July of 4 passes each were building profile moisture with root activity seen immediately to the 20" level after each pass in the late July passes. 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 stills seeing profile building then field has greater well capacity than crop water use.

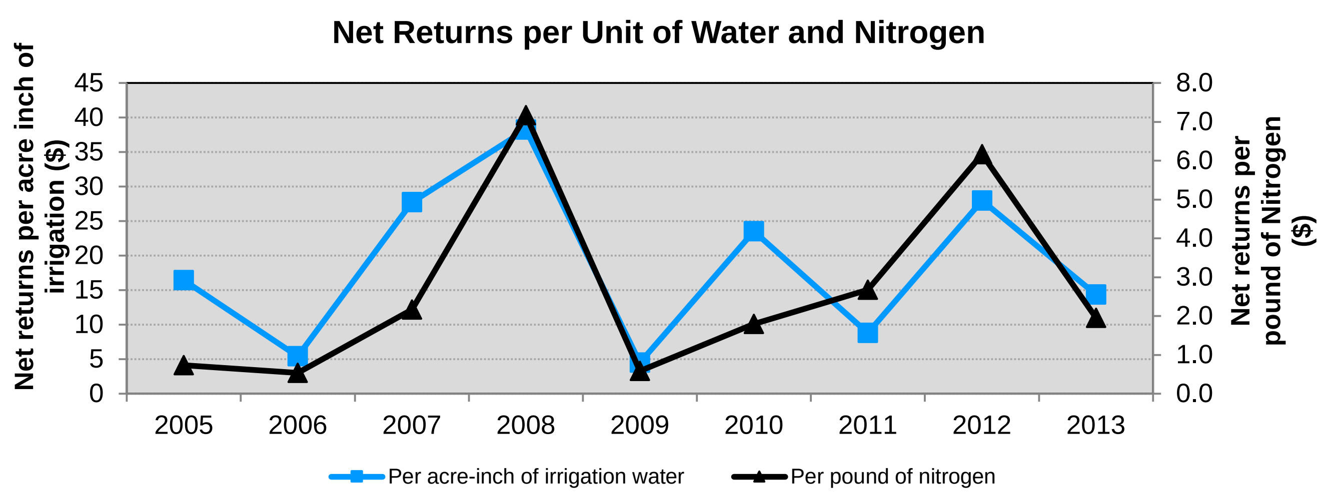




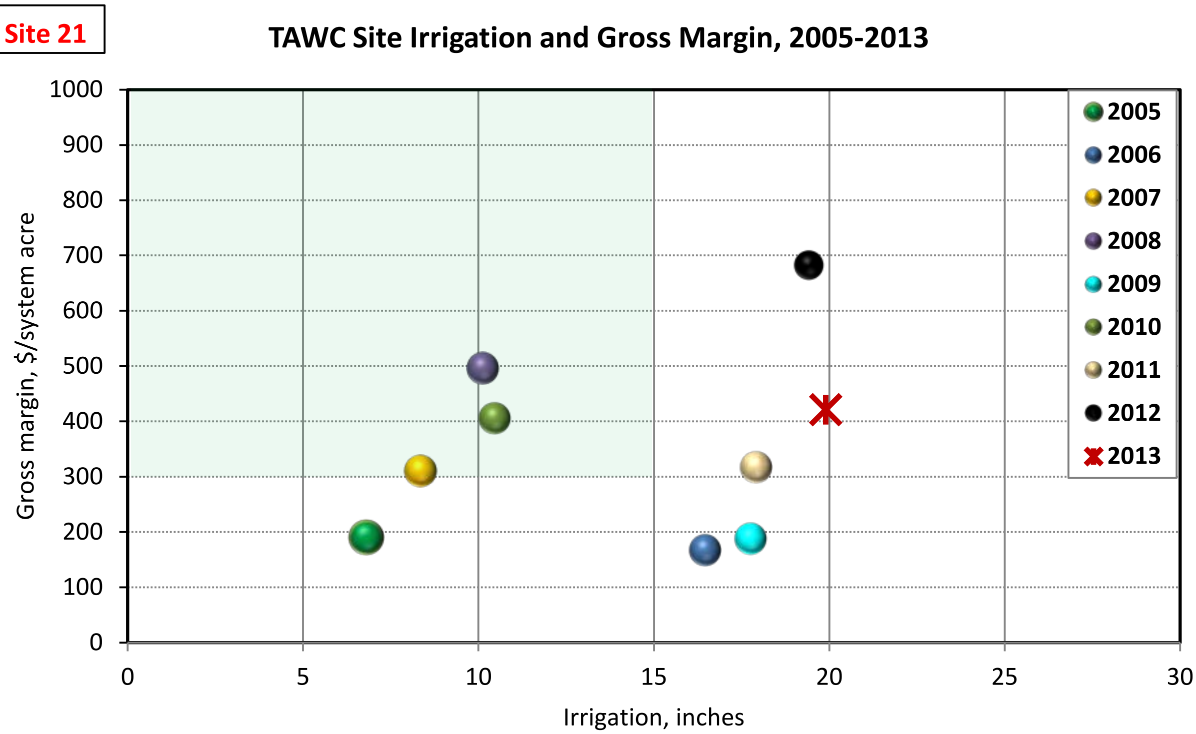
Site 21


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
600
500
400
300
200
100
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
45
40
35
30
25
20
15
10
5
0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Net returns per pound of Nitrogen ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen

Site 21


TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

Site 22

Description

Total site acres: 148.7

Field No. 3 Acres: 148.7
Major soil type: PuA-Pullman clay loam; 0 to 1%
EsB-Estacado loam; 1 to 3%

Irrigation

Type: Center Pivot (LEPA)

Pumping capacity, gal/min: 800

Number of wells: 4

Fuel source: Electric

Comments: This is a pivot irrigated corn and cotton system. In 2013 the whole site was planted to cotton on 30-inch centers.

Soil moisture probe

September 30 Cotton

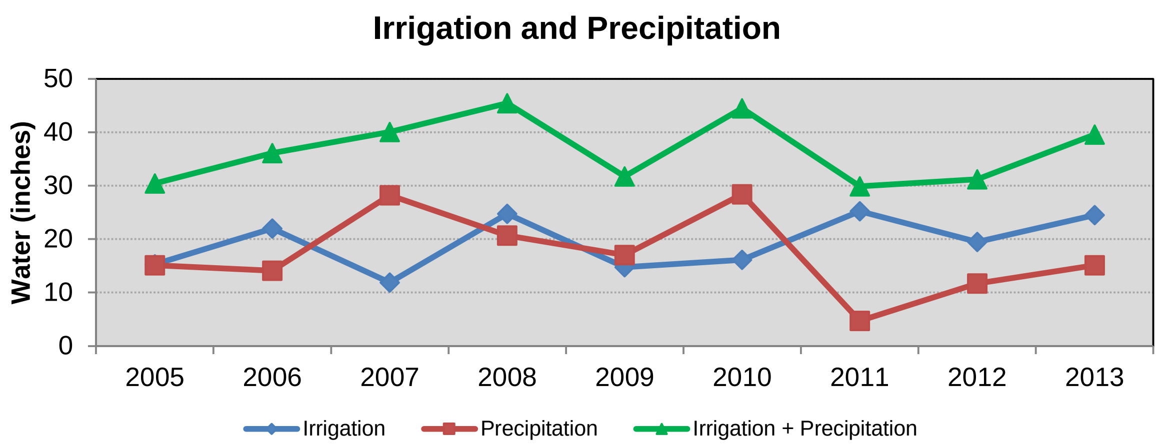
John Deere CropSense™

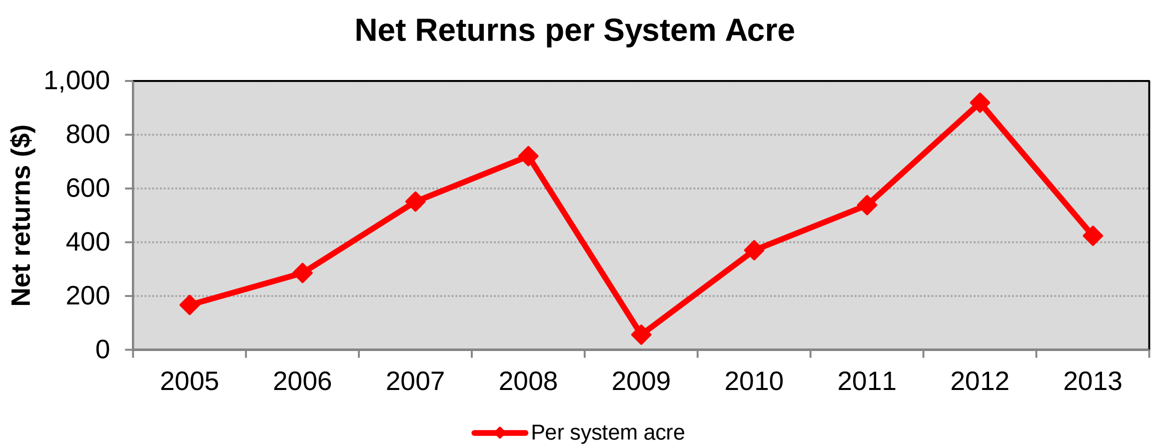
TAWC 2013 Grower Review
Chris Arnold, Senior Technical Service Representative

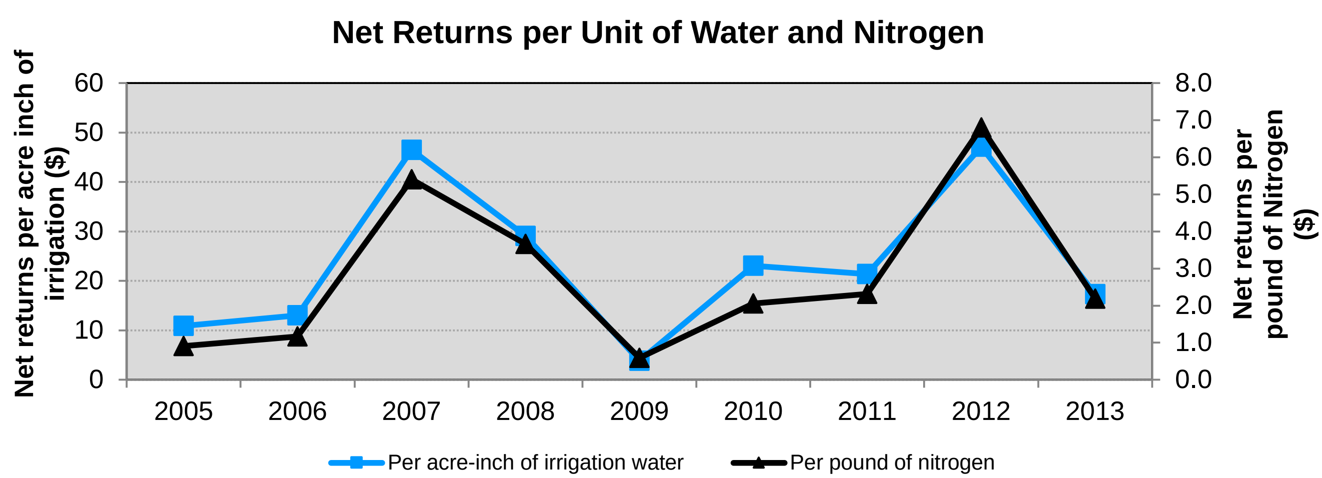
Site 22
Pivot Cotton

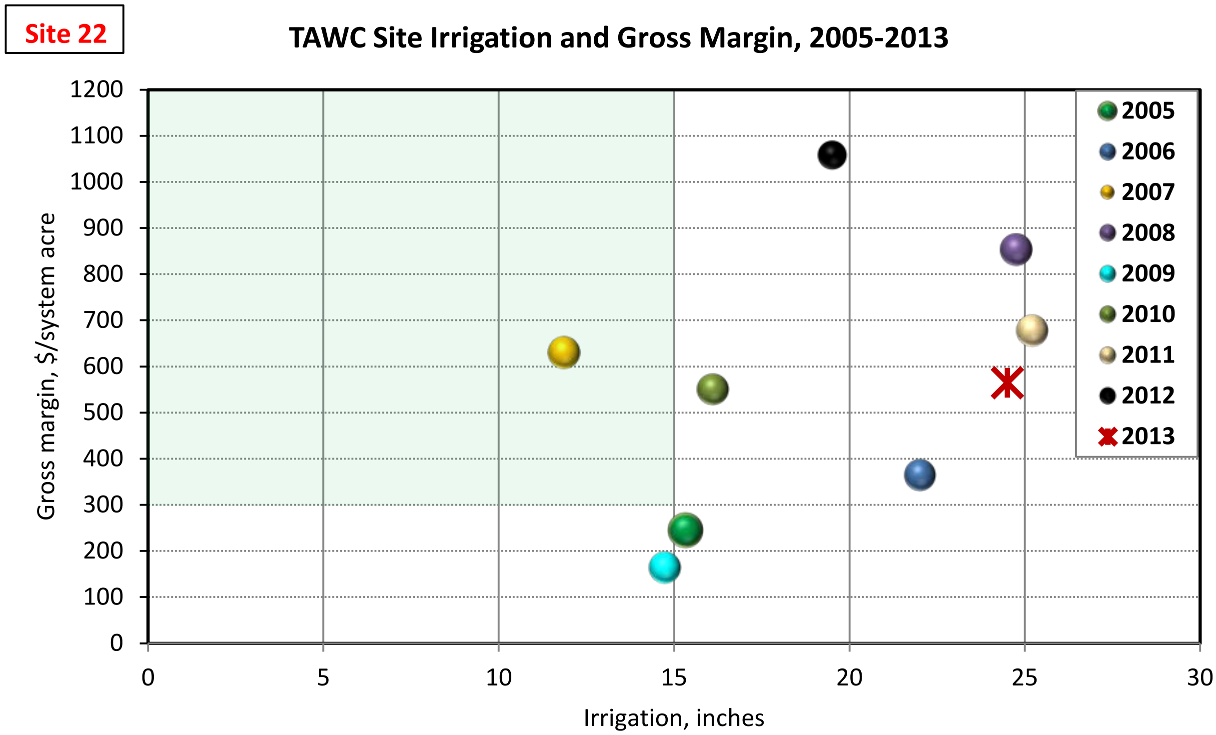
Early season shows 40” profile drier than the 12” and 20” levels till July 15 when the rain event completely filled the profile and water moved passed the 40” sensor. After that event water moved passed the 40” sensor 6 more times with irrigation and rainfall events. Root activity was not seen at the 40” level. Good activity at the 20” and above levels from early July to end of season. Early season irrigation passes were fast and shallow and barely making it to the 12” sensor. Later season passes slowed down and were actually moving water past the 40” sensor. When this occurs, pivot is keeping up and exceeding crop use, system could be shut down a day or two between passes to allow the profile to deplete more and hold the application amount in the upper profile without leaching.

Site 22

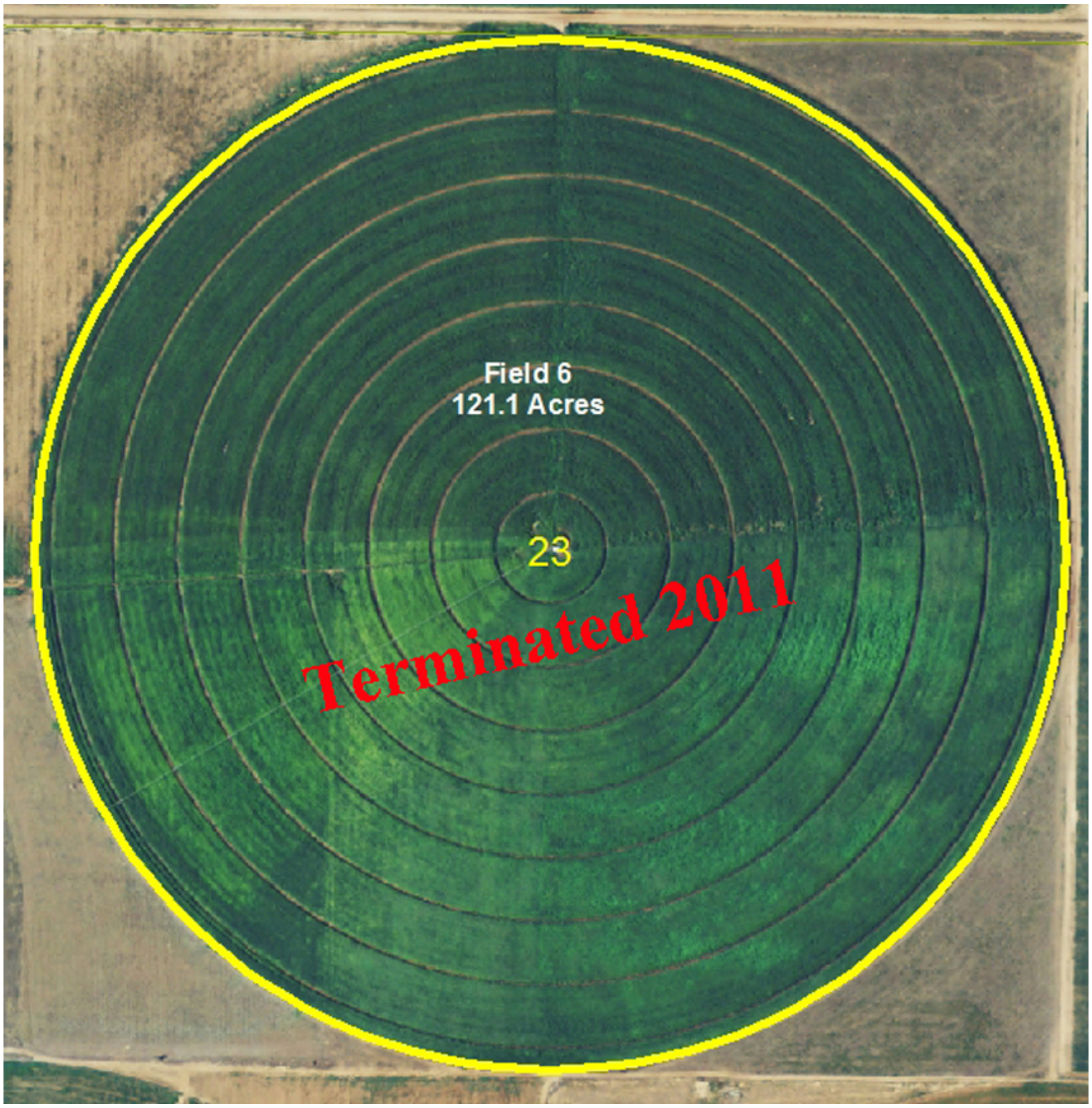

Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
1,000
800
600
400
200
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
60
50
40
30
20
10
0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Net returns per pound of Nitrogen ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 22
TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

Site 23



Description

Total site acres:	121.1
Field No. 6 Acres:	121.1
Major soil type:	Pullman clay loam; 0 to 1%

Irrigation

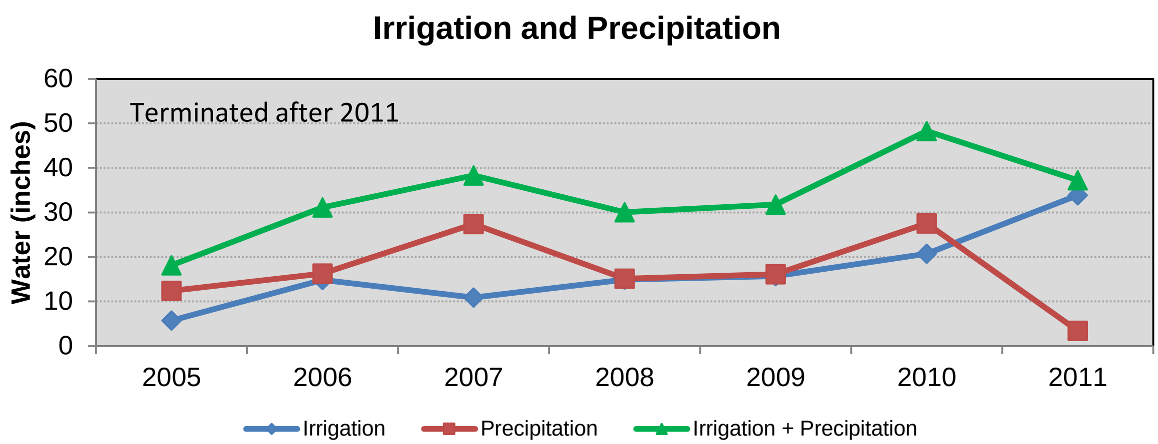
Type:	Center Pivot (LESA)
Pumping capacity, gal/min:	800
Number of wells:	2
Fuel source:	Natural gas

Site 23

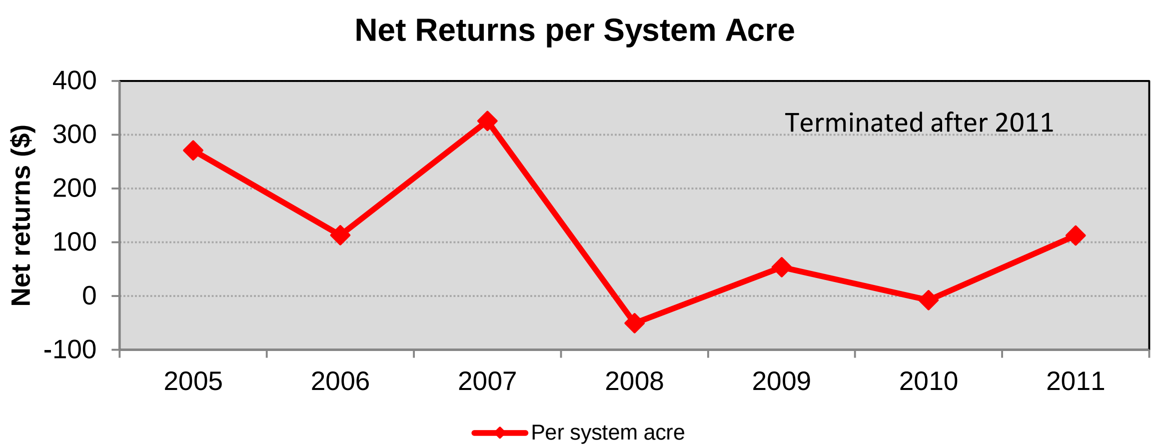
	Livestock	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6
2005	None	Cotton	Sunflowers for seed	Cotton (dryland)			
2006	None	Cotton	Corn for grain	Cotton			
2007	None	Corn for grain	Corn for grain	Corn for grain			
2008	None	Split into Fields 4 and 5		Sunflowers	Sunflowers	Cotton	
2009	None			Combined with Field 4	Oats/forage sorghum for silage	Wheat/forage sorghum for silage	
2010	None				Combined to create Field 6		Triticale for silage/corn for silage
2011	None						Triticale/corn silage

Comments: This pivot was planted to triticale then double cropped to corn with both crops being harvested for silage.

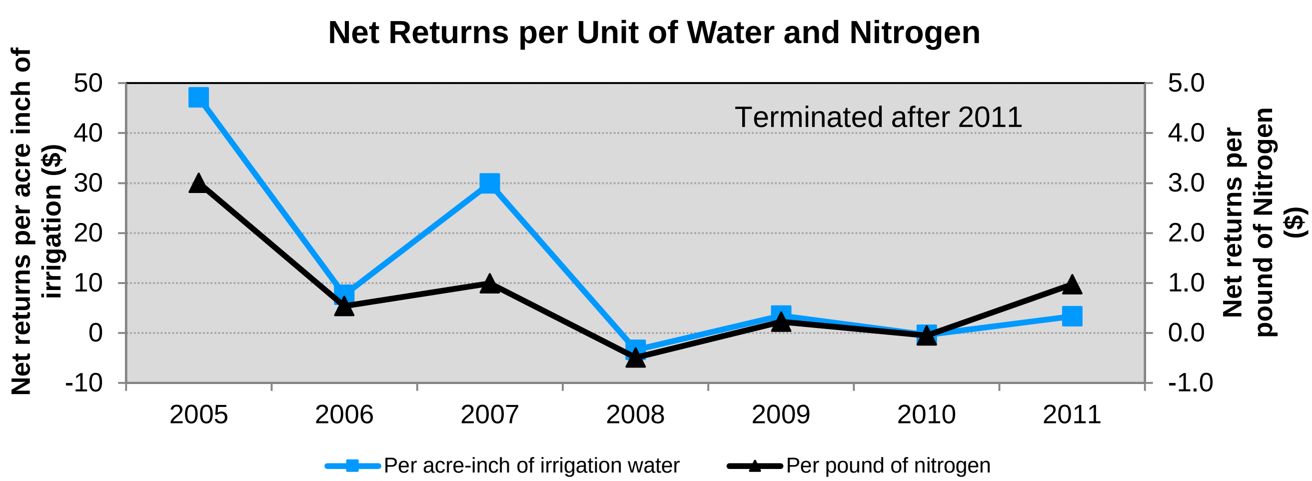
Site 23



Irrigation and Precipitation
Terminated after 2011
Water (inches)
60
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation

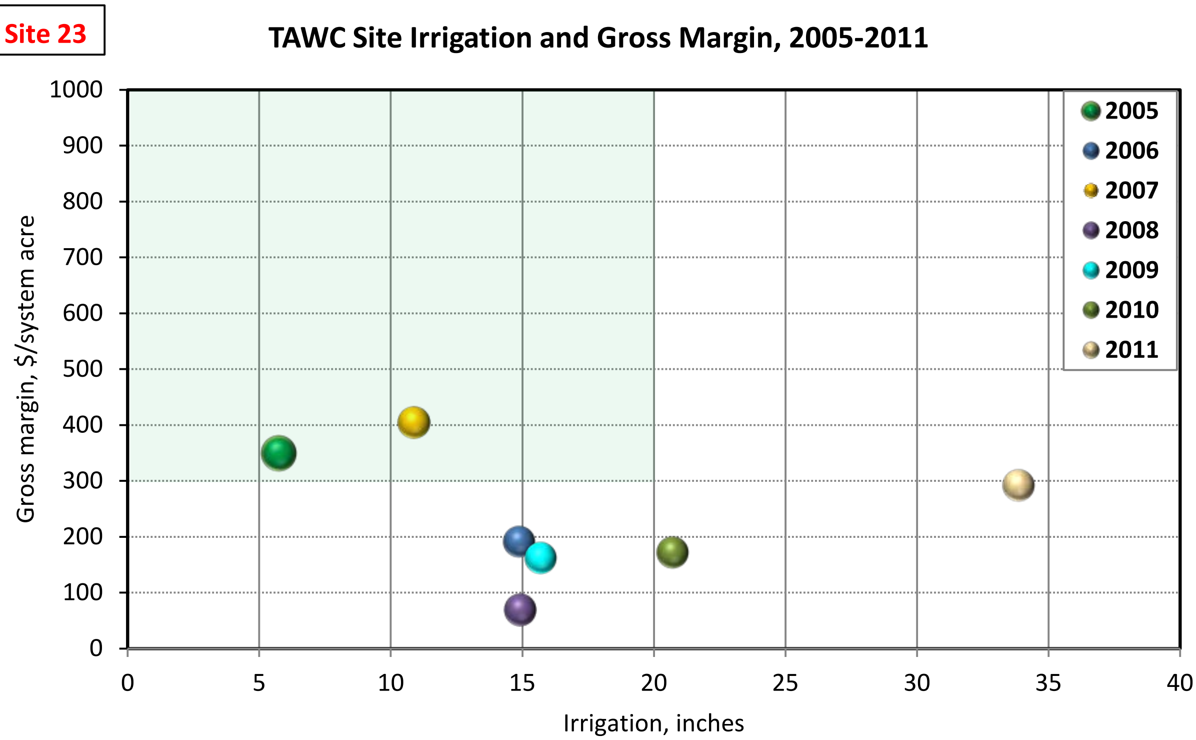


Net Returns per System Acre
Terminated after 2011
Net returns ($)
400
300
200
100
0
-100
2005
2006
2007
2008
2009
2010
2011
Per system acre



Net Returns per Unit of Water and Nitrogen
Terminated after 2011
Net returns per acre inch of irrigation ($)
50
40
30
20
10
0
-10
Net returns per pound of Nitrogen ($)
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
2005
2006
2007
2008
2009
2010
2011
Per acre-inch of irrigation water
Per pound of nitrogen

Site 23


TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
35
40
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011

SITE 24

DESCRIPTION

Total site acres:	129.7
Field No. 1 Acres:	64.6
Major soil type:	PuA-Pullman clay loam; 0 to 1%
Field No. 2 Acres:	65.1
Major soil type:	PuA-Pullman clay loam; 0 to 1%

IRRIGATION

Type:	Center Pivot (LESA)
Pumping capacity, gal/min:	700
Number of wells:	1
Fuel source:	Diesel

Site 24

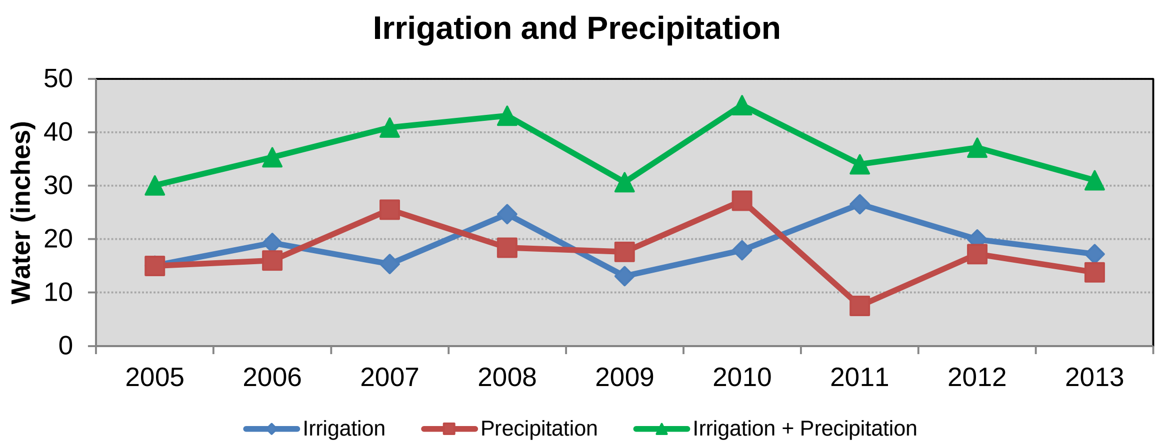
	Livestock	Field 1	Field 2
2005	None	Cotton	Corn for grain
2006	None	Corn for grain	Cotton
2007	None	Corn for grain	Corn for grain
2008	None	Corn for grain	Corn for grain
2009	None	Corn	Sunflowers
2010	None	Corn	Corn
2011	None	Corn	Cotton
2012	None	Cotton	Corn
2013	None	Corn	Sunflower

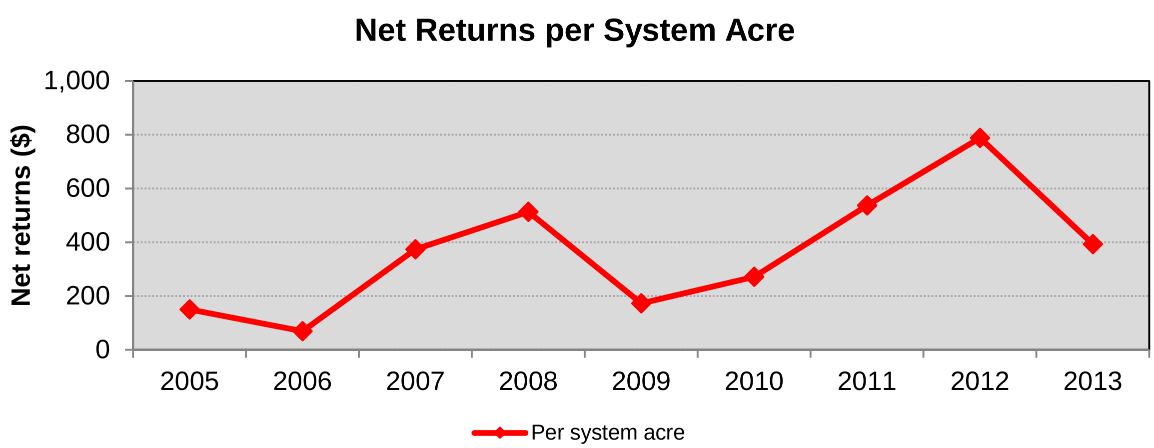
Comments: This has been a corn/cotton/sunflower pivot irrigated system using conventional tillage. In 2013 this system was planted to white food corn and sunflower.

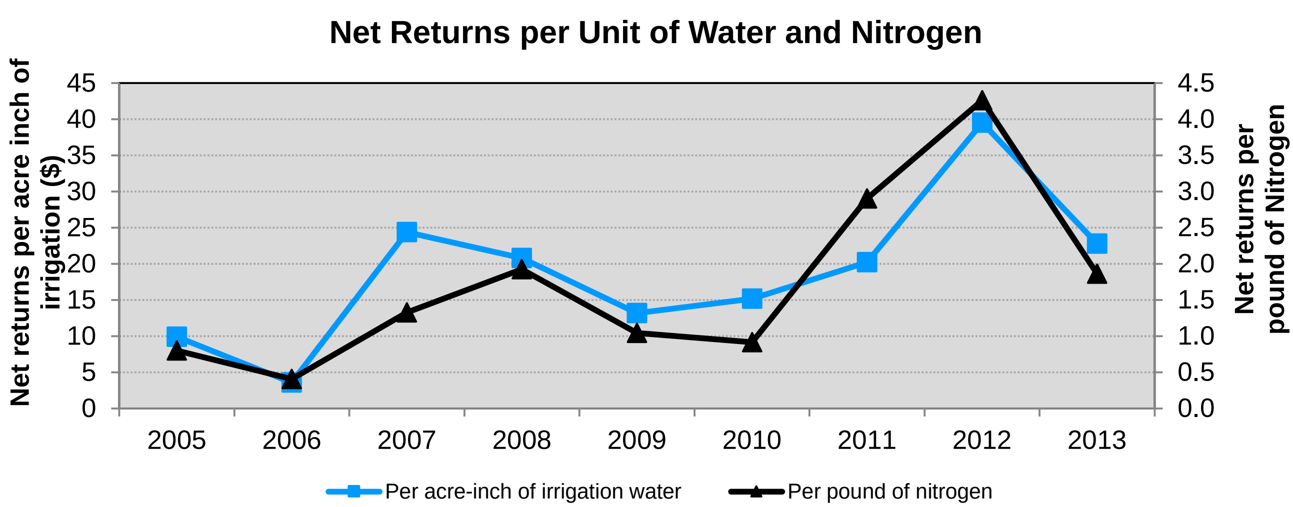
June corn

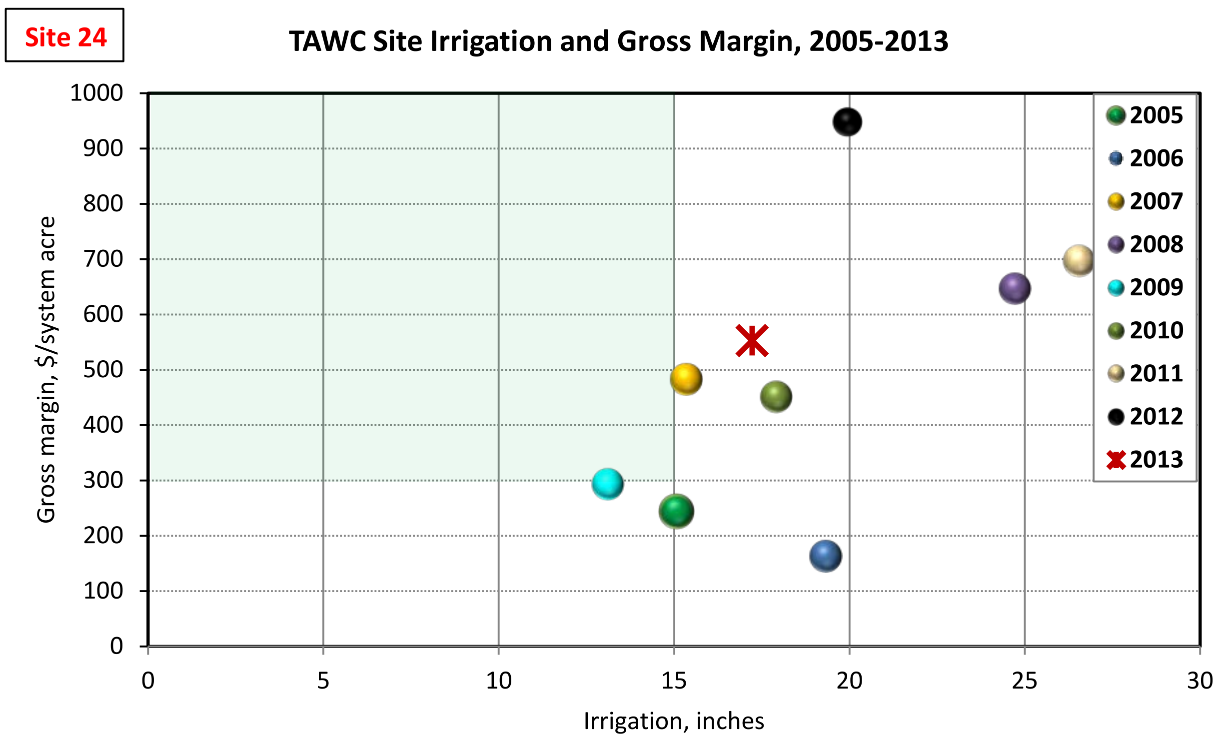
July corn

Site 24

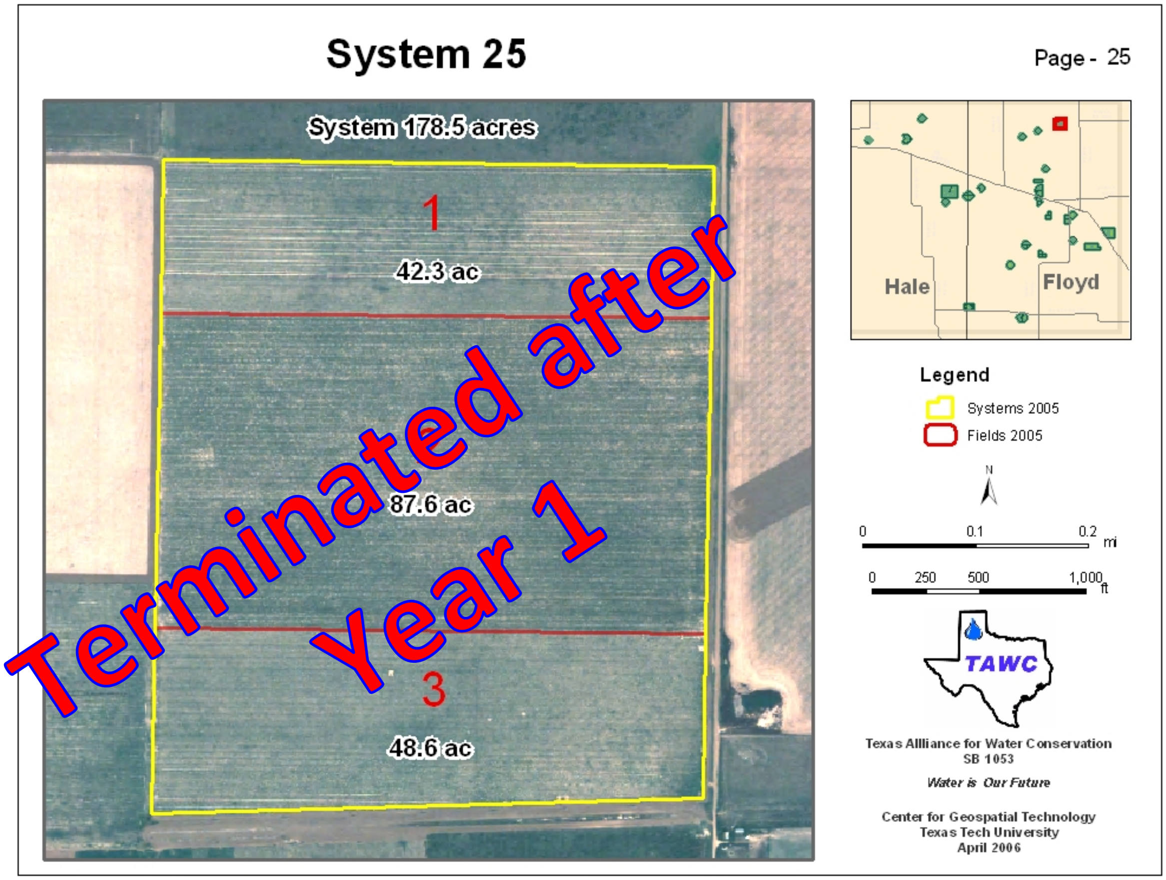

Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
1,000
800
600
400
200
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
45
40
35
30
25
20
15
10
5
0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Net returns per pound of Nitrogen ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 24
TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

SITE 25



DESCRIPTION

Total site acres: 178.5

Field No. 1 Acres: 42.3
Major soil type: Pullman clay loam; 0 to 1%

Field No. 2 Acres: 87.6
Major soil type: Pullman clay loam; 0 to 1%

Field No. 3 Acres: 48.6
Major soil type: Pullman clay loam; 0 to 1%

IRRIGATION

Type: Dryland

Pumping capacity, gal/min:

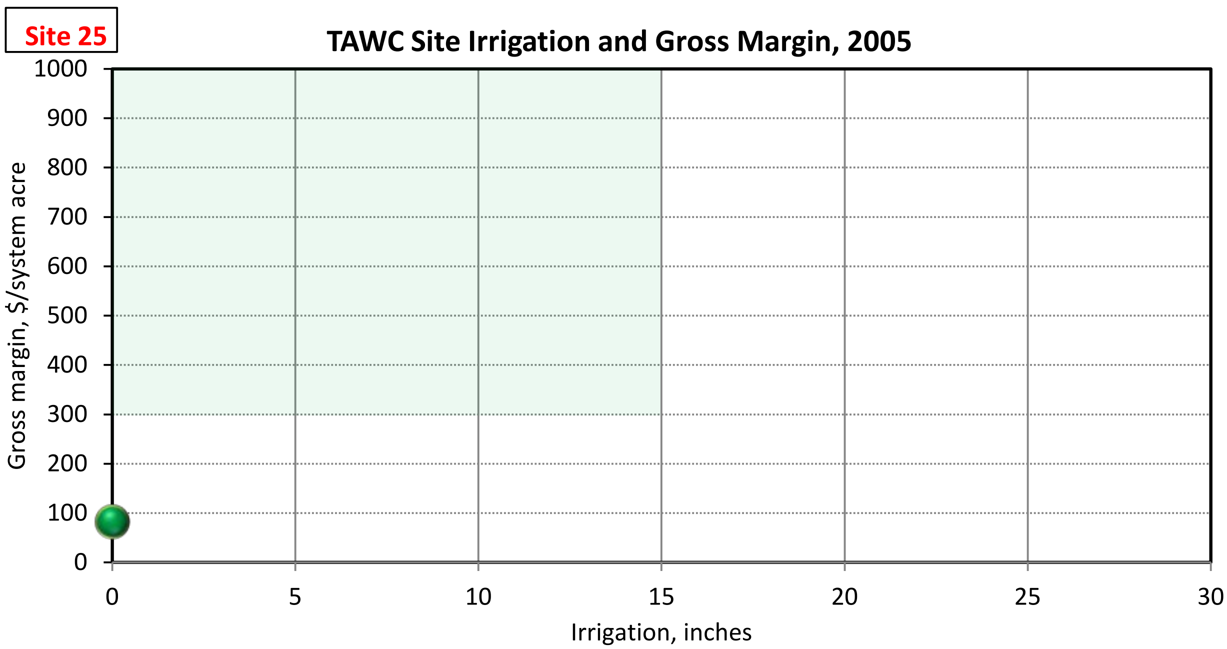
Number of wells:

Fuel source:

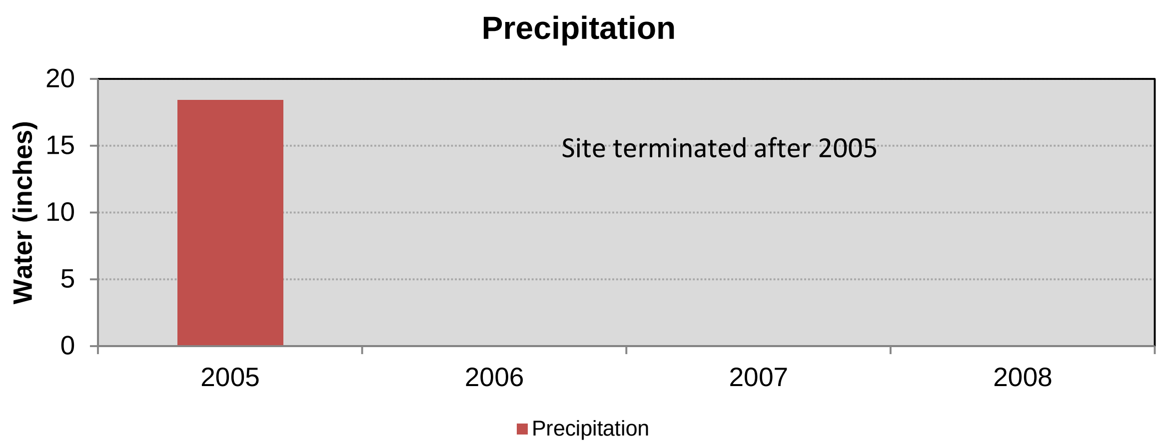
Comments: At this dryland site cotton and grain sorghum wee grown in rotation. The cotton was planted in standing grain sorghum stalks. Cotton and grain sorghum were planted on 40-inch centers.

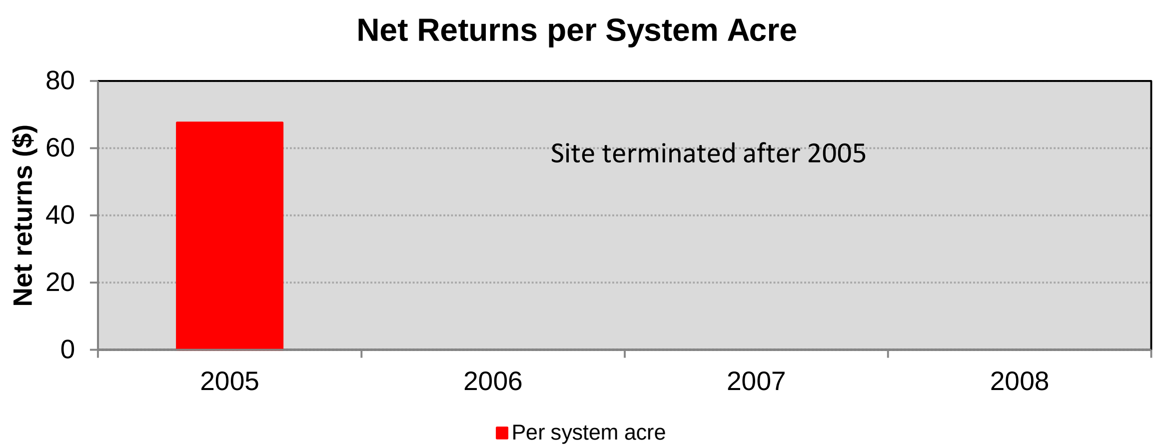
Site 25
Dryland

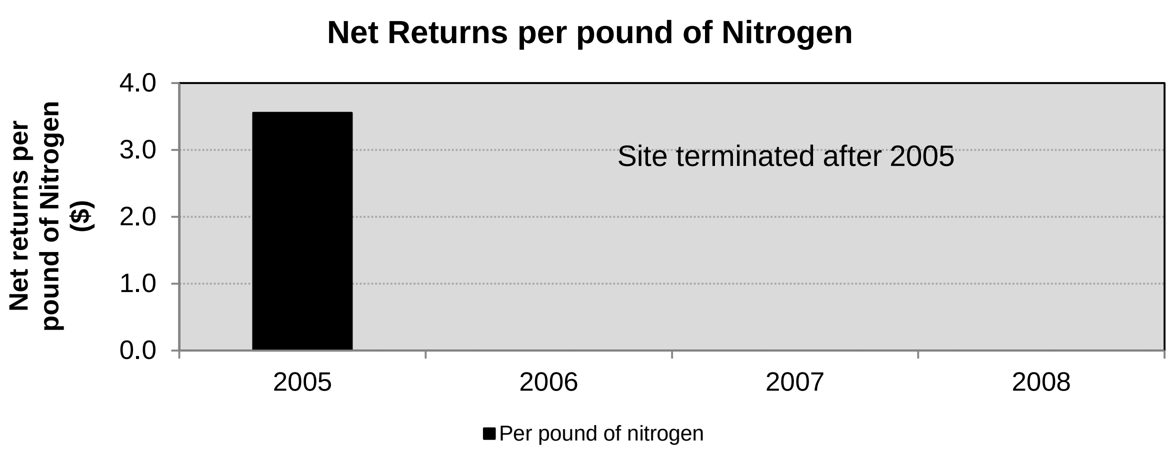
	Livestock	Field 1	Field 2	Field 3
2005	None	Cotton	Grain sorghum	Cotton
2006	Site terminated in 2006			



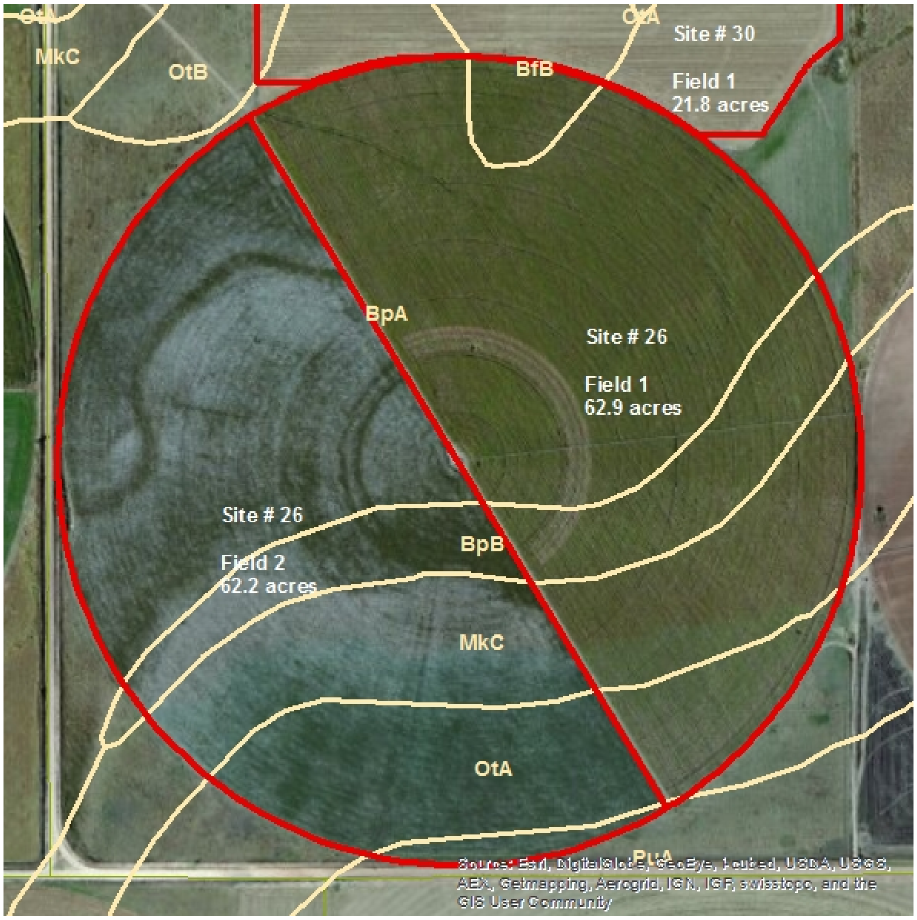
Site 25 - Dryland







SITE26



DESCRIPTION

Total site acres: 125.1

Field No. 1 Acres: 62.9
Major soil type: BpA-Bippus loam; 0 to 1%
MkC-Mansker loam; 3 to 5%
OtA-Olton loam; 0 to 1%

Field No. 2 Acres: 62.2
Major soil type: BpB-Bippus loam; 0 to 3%
MkC-Mansker loam; 3 to 5%
OtA-Olton loam; 0 to 1%

IRRIGATION

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 600

Number of wells: 2

Fuel source: 1 Electric

1 Diesel

Site 26

	Livestock	Field 1	Field 2	Field 3	Field 4
2005	None	Cotton	Corn for grain		
2006	None	Corn for grain	Cotton		
2007	Cow-calf	Pearlmillet for seed and grazing of residue	Corn for grain		
2008	Cow-calf	Split into Fields 3 and 4	Pearlmillet for seed and grazing of residue	Grain sorghum for seed and grazing of residue	Corn for grain and grazing of residue
2009	Stocker	Sunflowers	Corn	Combined to make fields 1 and 2	
2010	Cow-calf	Wheat for grazing/corn for grain	Cotton		
2011	None	Cotton	Corn		
2012	None	Sunflowers	Cotton		
2013	None	Wheat	Corn		

Comments: This was a sunflower/corn system for 2013. Cotton was planted on 30-inch centers.

May corn

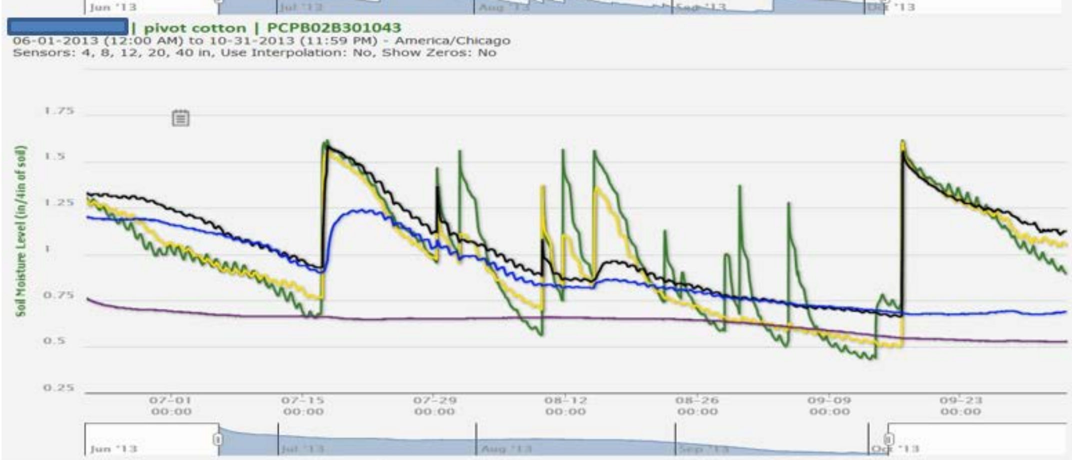
July corn

John Deere CropSense™

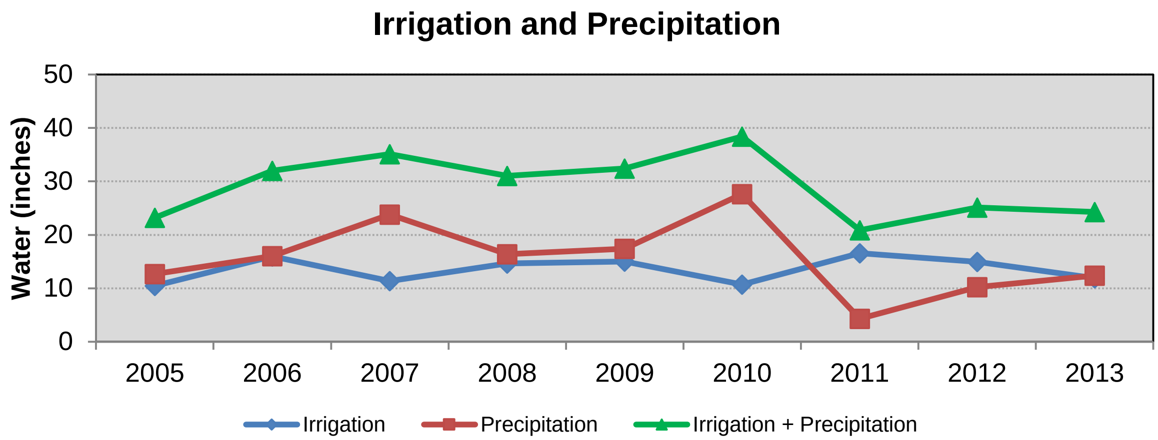
TAWC 2013 Grower Review
Chris Arnold, Senior Technical Representative

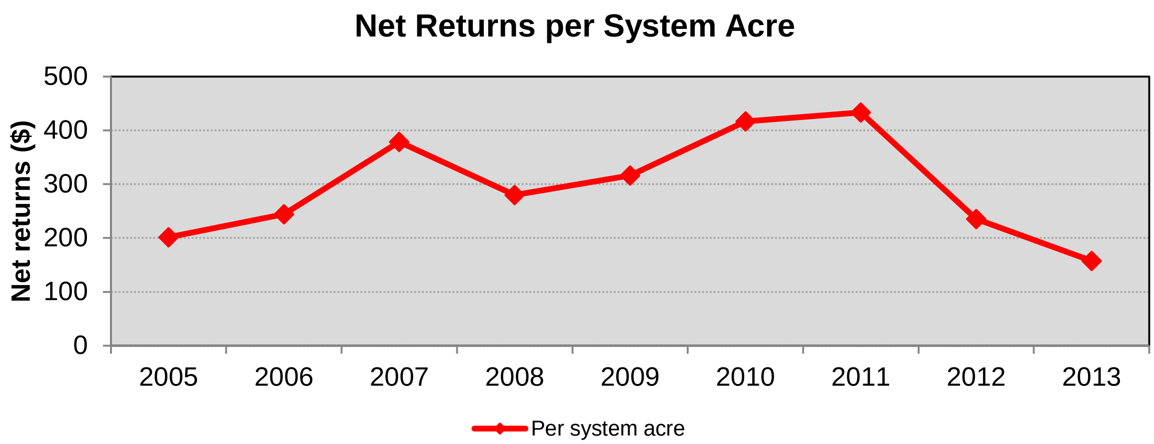
Site 26
Pivot Cotton

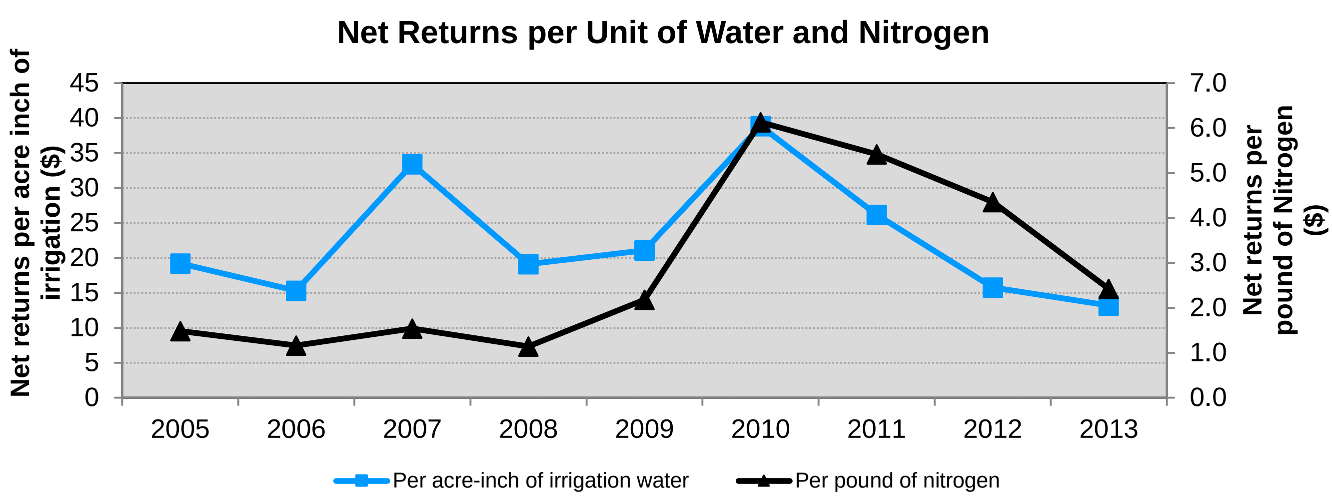
Irrigation and rainfall events moved water to the 20” level, 40” level remained drier all season with no water movement into that level and no root activity seen there all season. The 20” profile became depleted by early August and the 12” profile was depleted by late August with no significant stepping seen at those levels. Irrigation events were fast and shallow with water movement to the 12” zone earlier in the season and by late season only to the 8” level. This location would benefit from slowing down and pushing more water into the lower profile especially earlier season as the 40” profile was dry and later season benefits would be to wet up greater soil volume to keep at least 12-20” of root profile active.

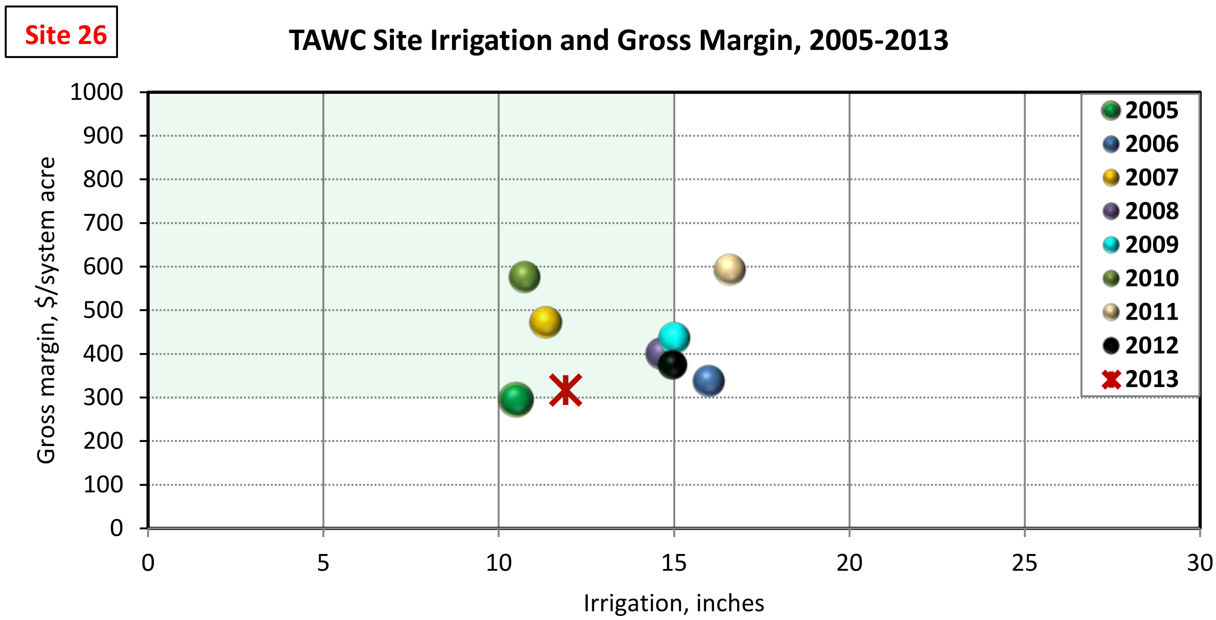


Site 26


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
500
400
300
200
100
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
45
40
35
30
25
20
15
10
5
0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Net returns per pound of Nitrogen ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 26
TAWC Site Irrigation and Gross Margin, 2005-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011
2012
2013

Site 27

Description

Total site acres: 108.4

Field No. 1 Acres: 46.1
Major soil type: PuA-Pullman clay loam; 0 to 1%
OtA-Olton loam; 0 to 1%
AcB-Acuff loam; 1 to 3%

Field No. 3 Acres: 48.8
Major soil type: PuA-Pullman clay loam; 0 to 1%

Field No. 4 Acres: 13.5
Major soil type: AcB-Acuff loam; 1 to 3%
OtA-Olton loam; 0 to 1%
PuA-Pullman clay loam; 0 to 1%

Irrigation

Type: Subsurface Drip
(SDI, installed prior to 2006 crop year)
Pumping capacity, gal/min: 400

Number of wells: 2

Fuel source: Electric

Site 27

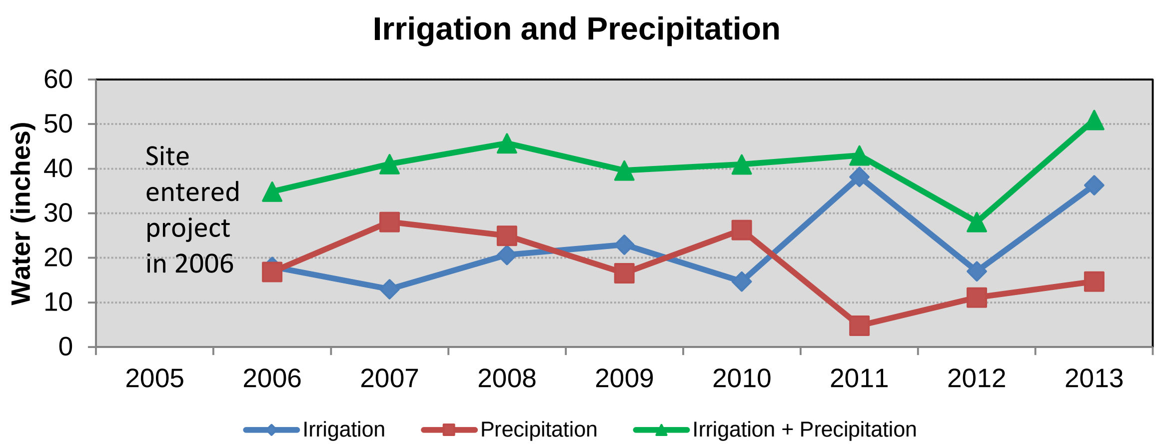
	Livestock	Field 1	Field 2	Field 3	Field 4
2005	Entered project in Year 2				
2006	None	Cotton following wheat cover crop			
2007	None	Corn for silage	Cotton following wheat cover crop		
2008	None	Cotton following wheat cover crop	Additional acres added to create Field 3	Corn for grain	Corn for grain – high moisture
2009	None	Corn for silage		Cotton	Corn for silage
2010	None	Cotton		Corn for silage	Cotton
2011	None	Corn abandoned		Cotton abandoned	Corn abandoned
2012	None	Cotton		Corn for silage	Cotton
2013	None	Corn		Cotton	Corn

Comments: Corn is planted on 20-inch centers with cotton planted on 40-inch centers.

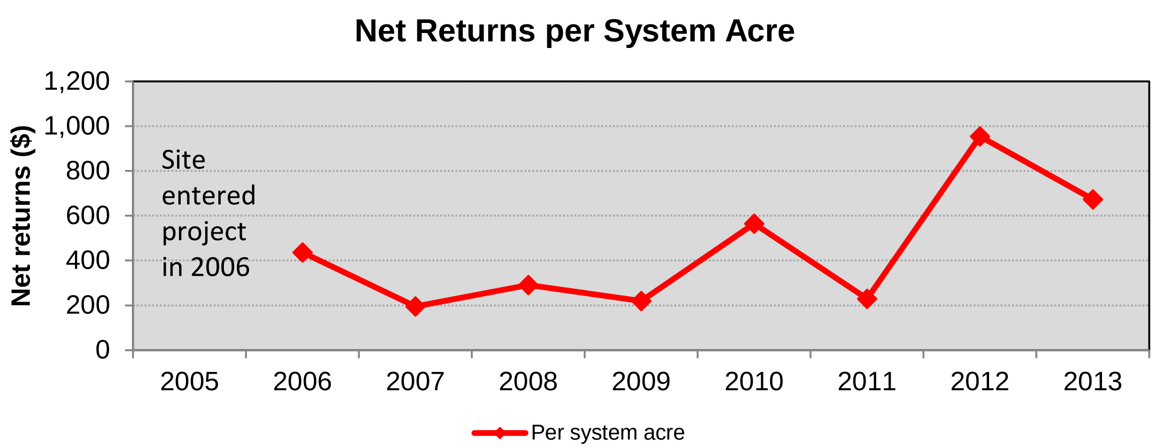
May corn

July corn for silage

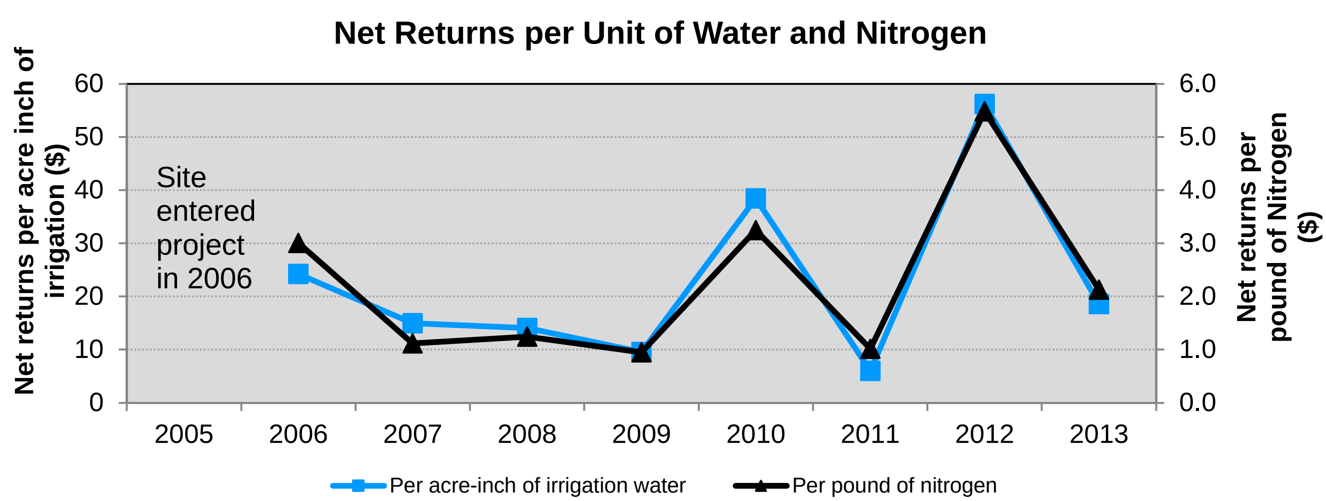
Site 27



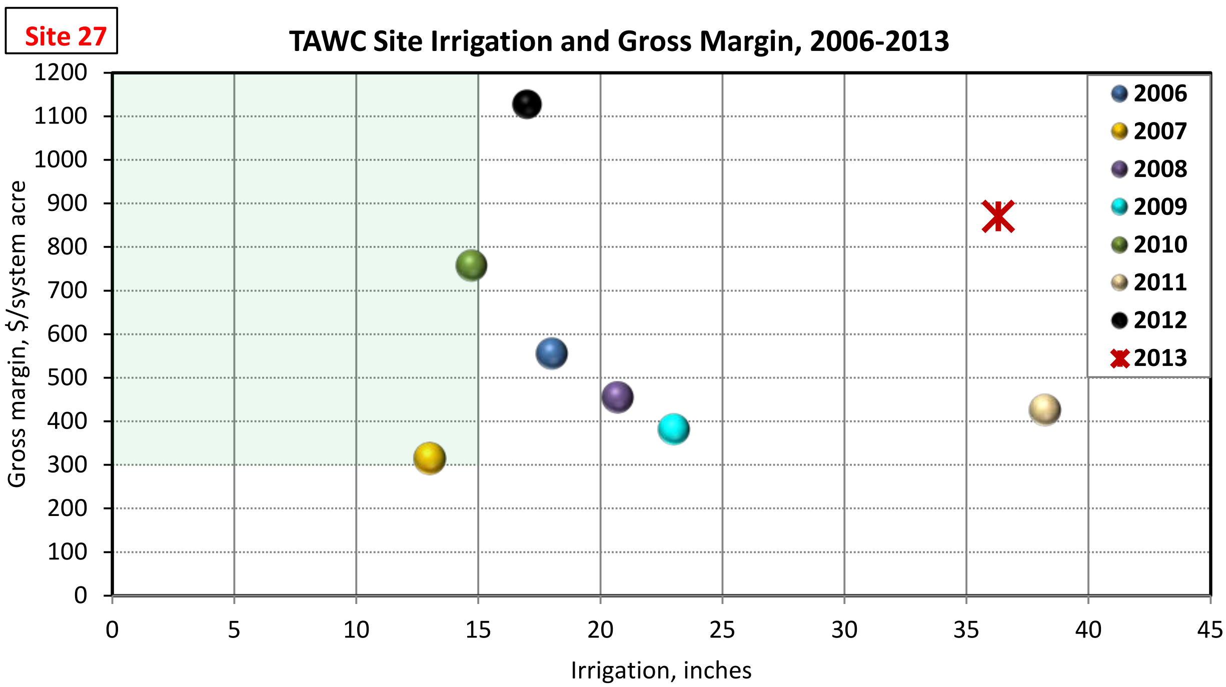
Irrigation and Precipitation
Water (inches)
60
50
40
30
20
10
0
Site entered project in 2006
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation



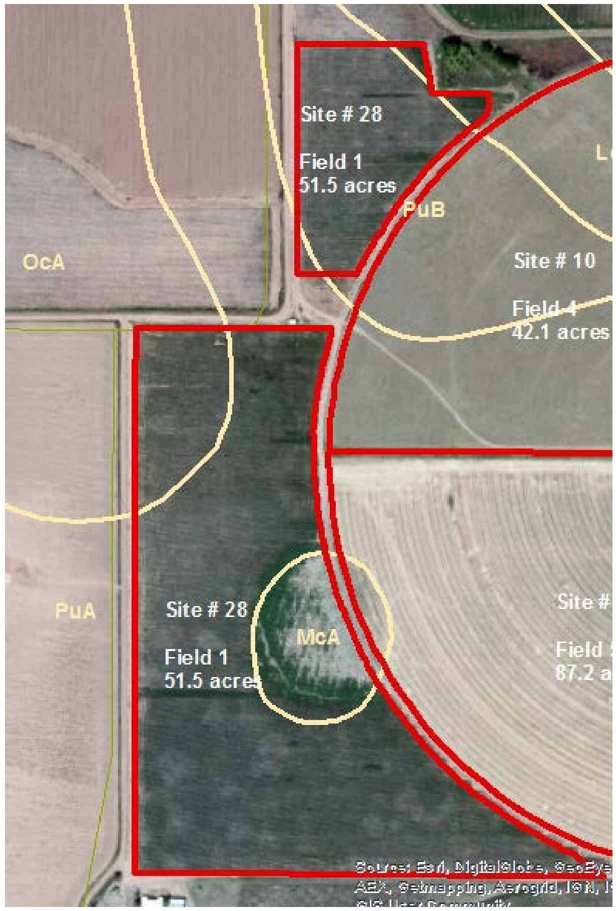
Net Returns per System Acre
Net returns ($)
1,200
1,000
800
600
400
200
0
Site entered project in 2006
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre



Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
60
50
40
30
20
10
0
Site entered project in 2006
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Net returns per pound of Nitrogen ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 27
TAWC Site Irrigation and Gross Margin, 2006-2013
Gross margin, $/system acre
Irrigation, inches
2006
2007
2008
2009
2010
2011
2012
2013
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
0
5
10
15
20
25
30
35
40
45

SITE 28



DESCRIPTION

Total site acres:	51.4
Field No. 1 Acres:	51.4
Major soil type:	PuA/PuB-Pullman clay loam; 0 to 1% and 1 to 3% McA-McLean clay, 0 to 1%

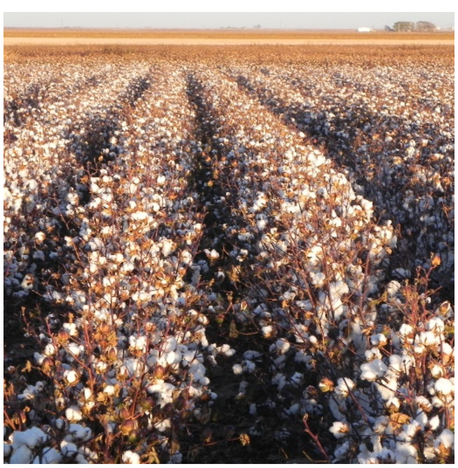
IRRIGATION

Type:	Subsurface Drip (SDI)
Pumping capacity, gal/min:	300
Number of wells:	1
Fuel source:	electric

Site 28

	Livestock	Field 1
2005	Entered project in Year 4	
2006		
2007		
2008	None	Corn for grain
2009	None	Cotton
2010	None	Cotton
2011	None	Cotton
2012	None	Cotton
2013	None	Cotton

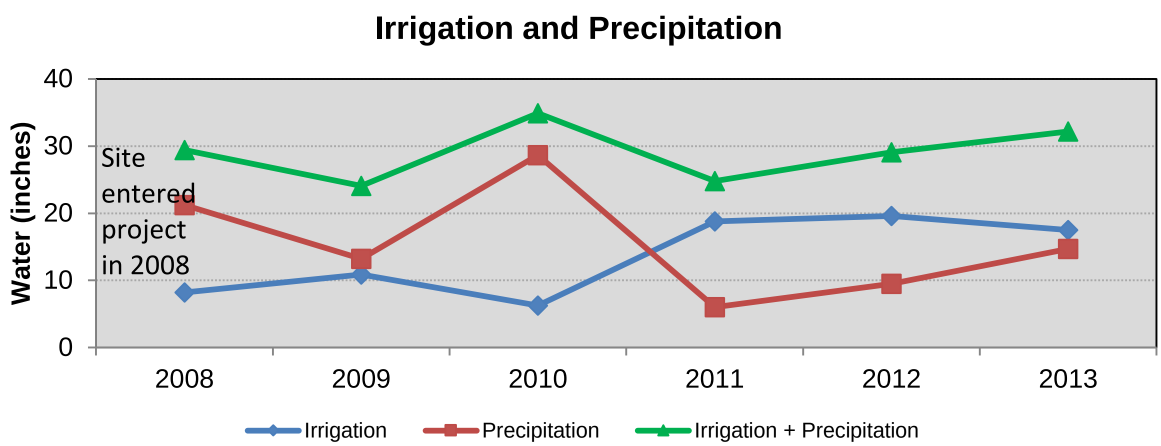
Comments: This is the sixth year for this drip irrigated site to be in the project. In 2013 this site was planted to cotton on 40-inch centers.



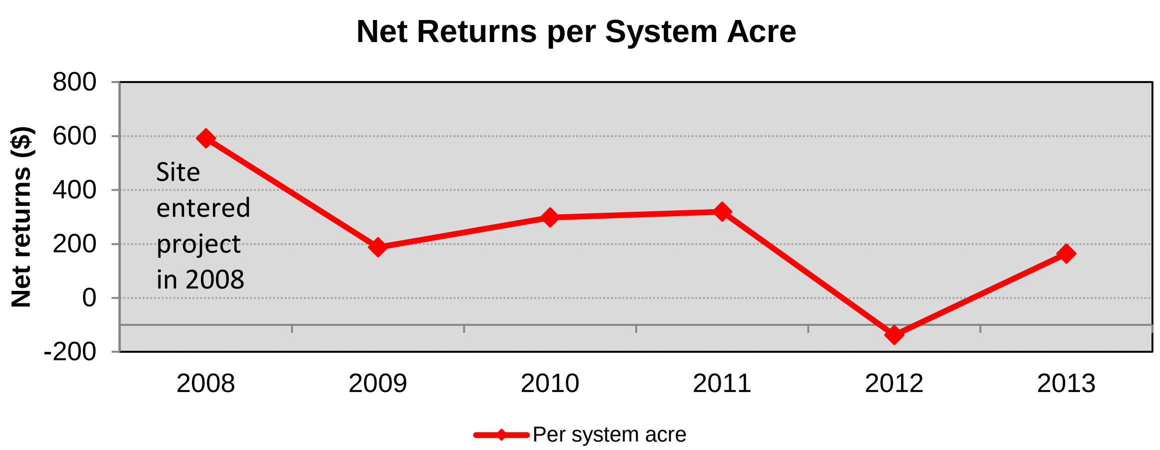
October cotton

Harvested cotton

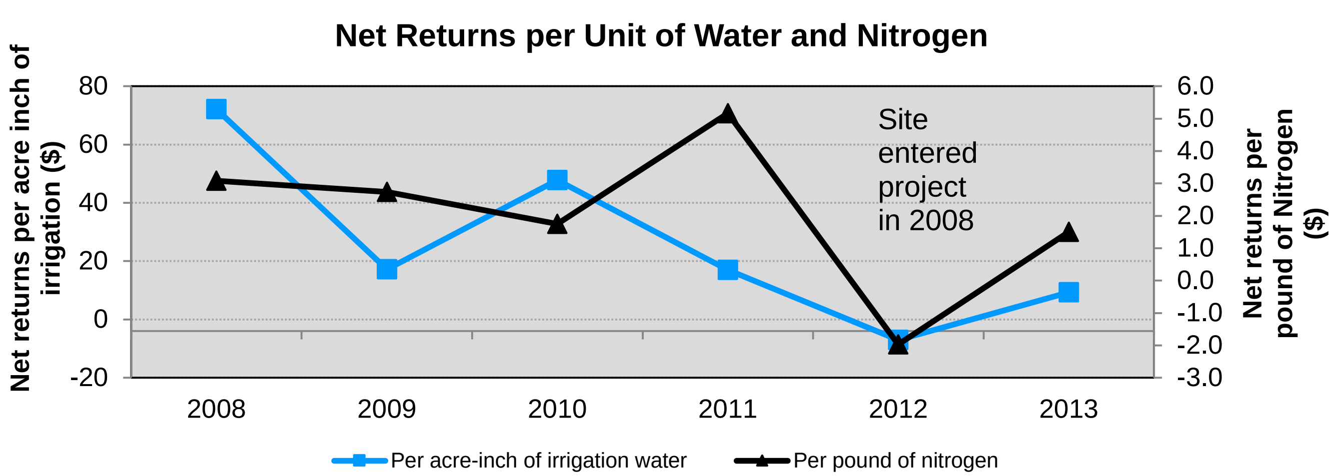
Site 28



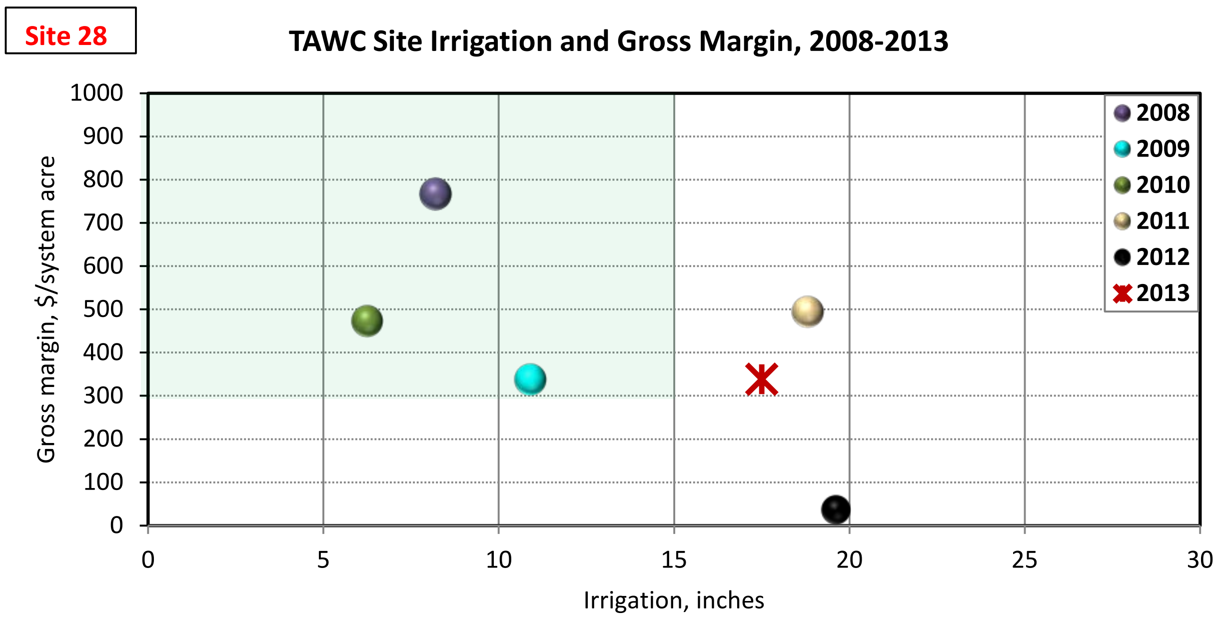
Irrigation and Precipitation
Water (inches)
40
30
20
10
0
Site entered project in 2008
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation



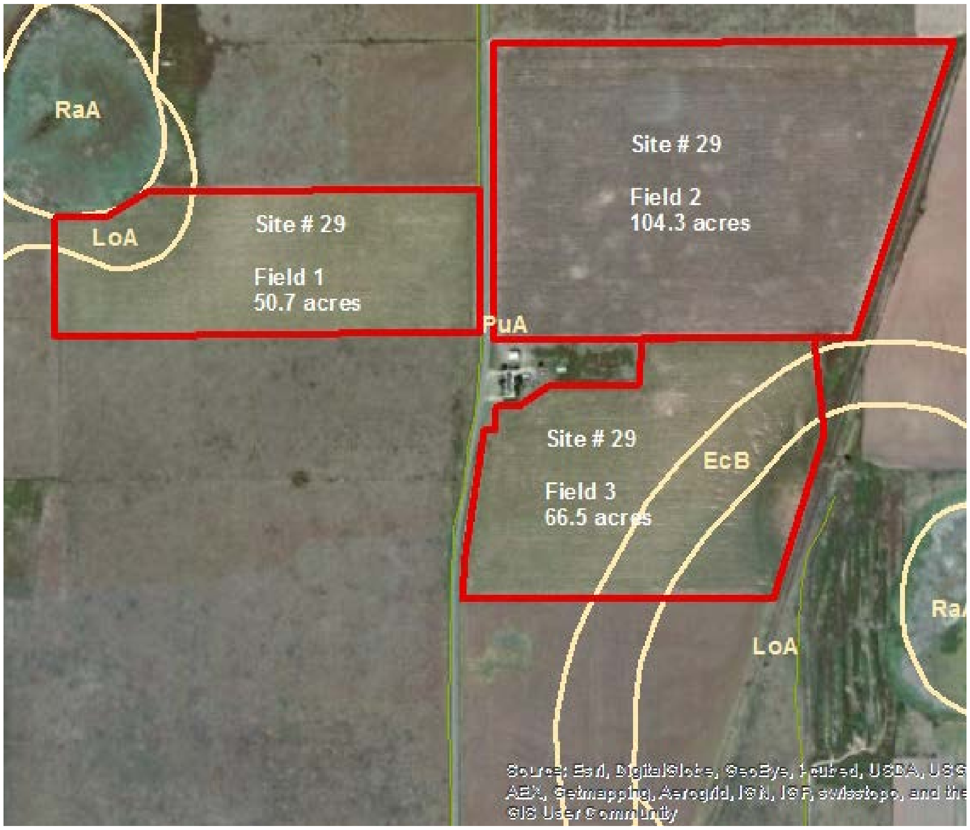
Net Returns per System Acre
Net returns ($)
800
600
400
200
0
-200
Site entered project in 2008
2008
2009
2010
2011
2012
2013
Per system acre



Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
80
60
40
20
0
-20
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
Net returns per pound of Nitrogen ($)
Site entered project in 2008
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 28
TAWC Site Irrigation and Gross Margin, 2008-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2008
2009
2010
2011
2012
2013

Site 29



Description

Total site acres: 221.6

Field No. 1 Acres: 50.7
Major soil type: PuA-Pullman clay loam; 0 to 1%
LoA-Lofton clay loam; 0 to 1%

Field No. 2 Acres: 104.3
Major soil type: PuA-Pullman clay loam; 0 to 1%

Field No. 3 Acres: 66.6
Major soil type: PuA-Pullman clay loam; 0 to 1%
EcB-Estacado clay loam; 1 to 3%
LoA-Lofton clay loam; 0 to 1%

Irrigation

Type: Dryland

Pumping capacity, gal/min: na

Number of wells: na

Fuel source: na

Site 29
Dryland Site

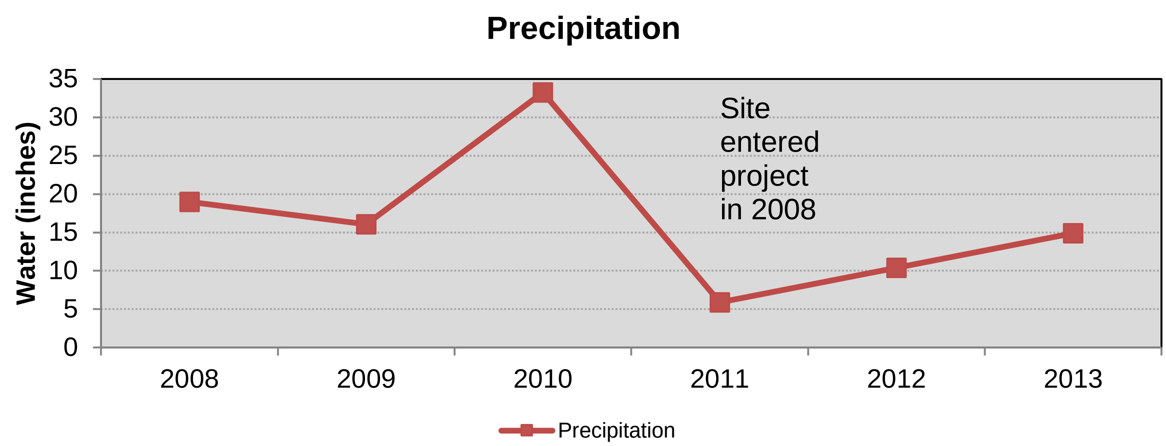
	Livestock	Field 1	Field 2	Field 3
2005	Entered project in Year 4			
2006				
2007				
2008	None	Cotton following wheat cover crop	Fallow, followed by wheat for cover and grazing	Cotton following wheat cover crop
2009	None	Cotton	Wheat	Cotton
2010	None	Cotton	Cotton	Grain sorghum
2011	None	Cotton	Cotton	Cotton
2012	None	Cotton	Milo	Cotton
2013	None	Cotton	Cotton	Cotton

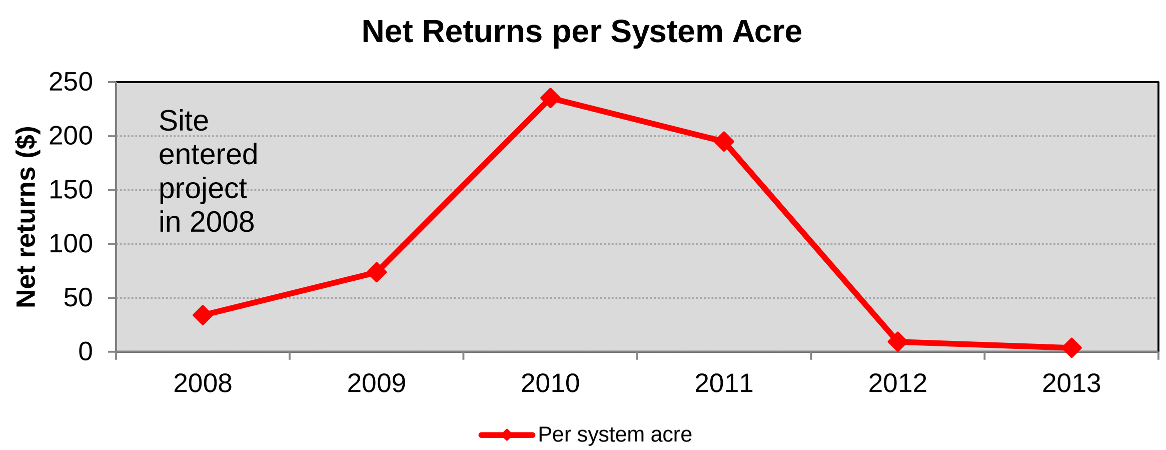
Comments: This is a conventional till dryland site typically using cotton and grain sorghum in rotation. In 2013 all fields were planted to 40-inch cotton.

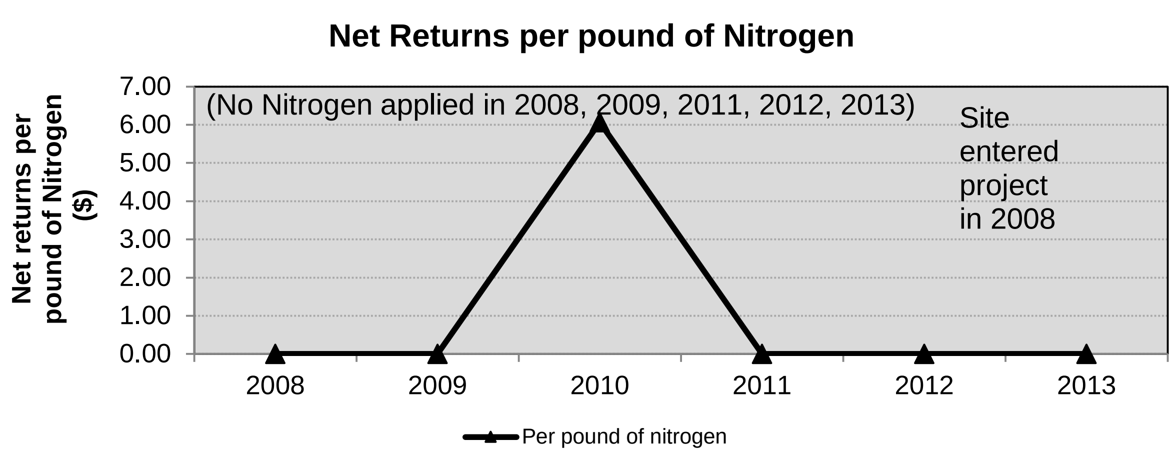
Cotton crop failure

Cotton crop failure

Site 29 – Dryland Site

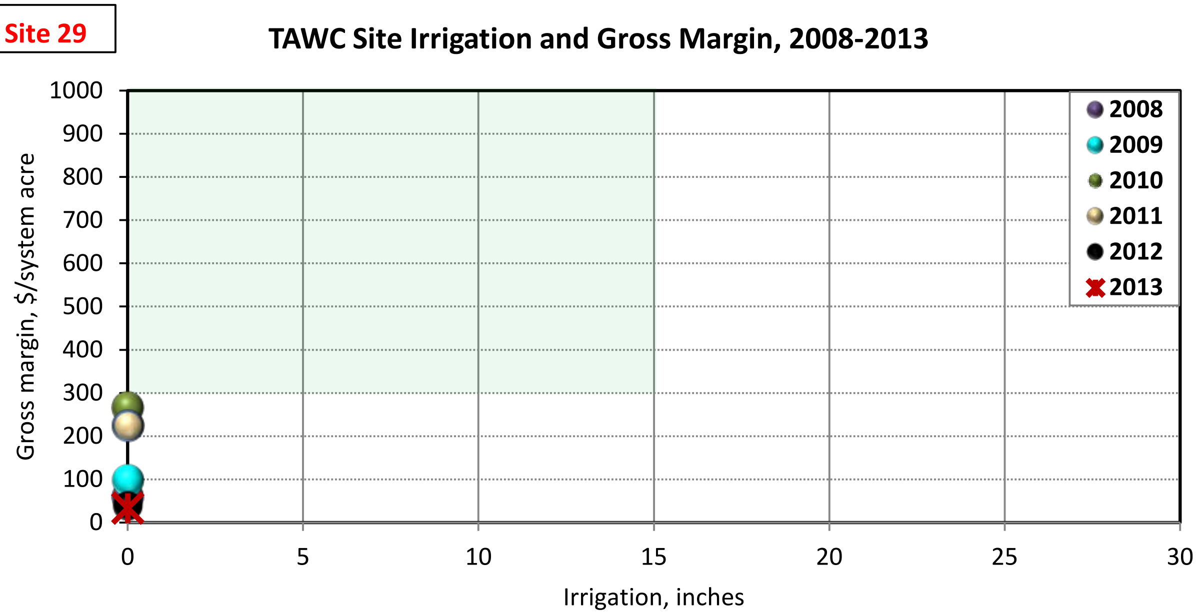




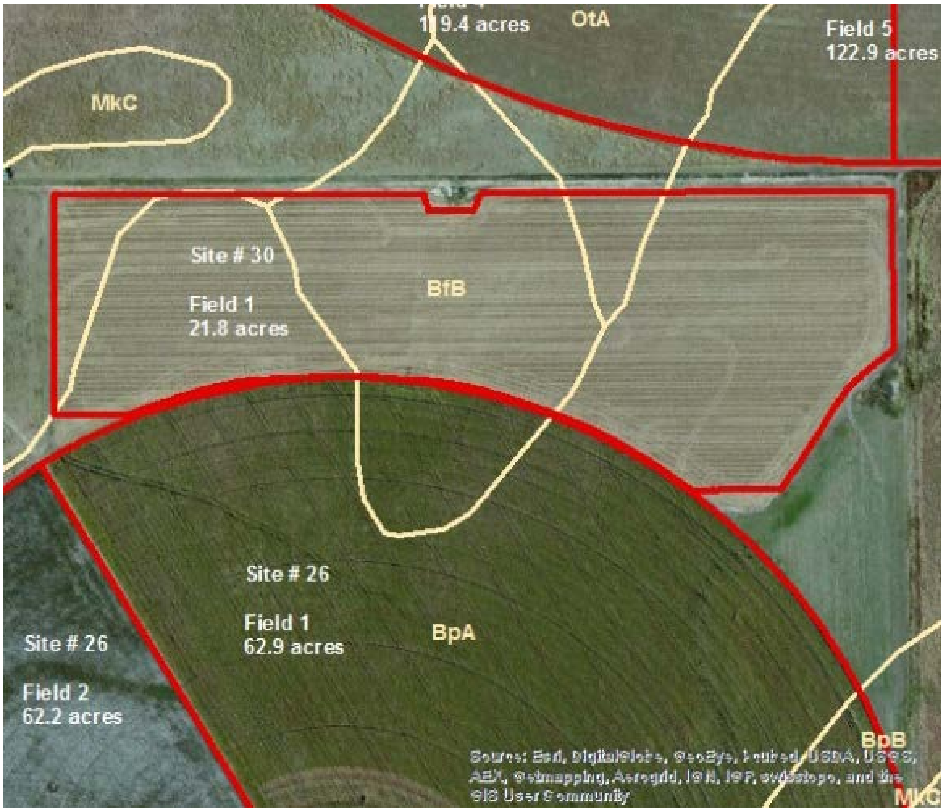


Dryland Site

Site 29



Site 30



Description

Total site acres: 21.8

Field No. 1 Acres: 21.8

Major soil type: OtA-Olton loam; 0 to 3%
BpA-Bippus loam; 0 to 1%
BfB-Bippus fine sandy loam; 1 to 3%

Irrigation

Type: Sub-surface Drip (SDI)

Pumping capacity, gal/min: 150

Number of wells: 1

Fuel source: Electric

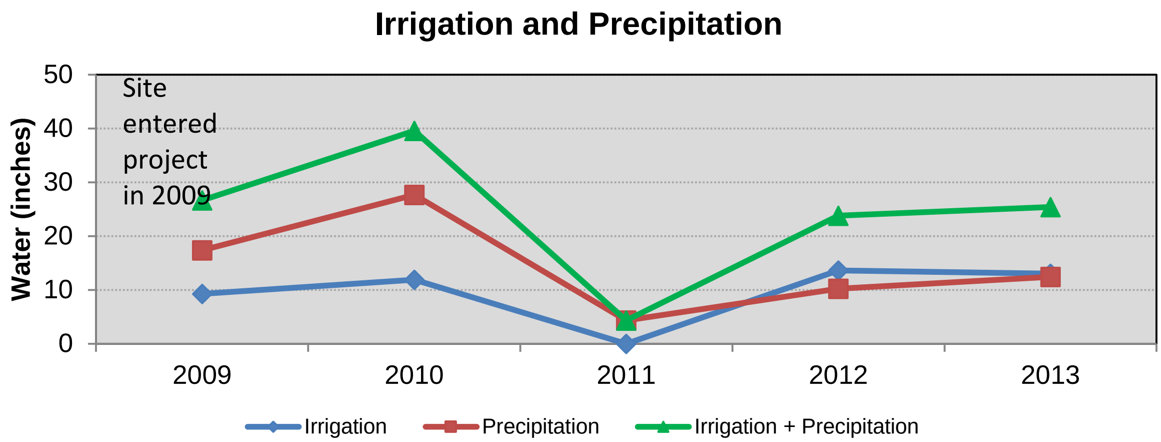
Site 30

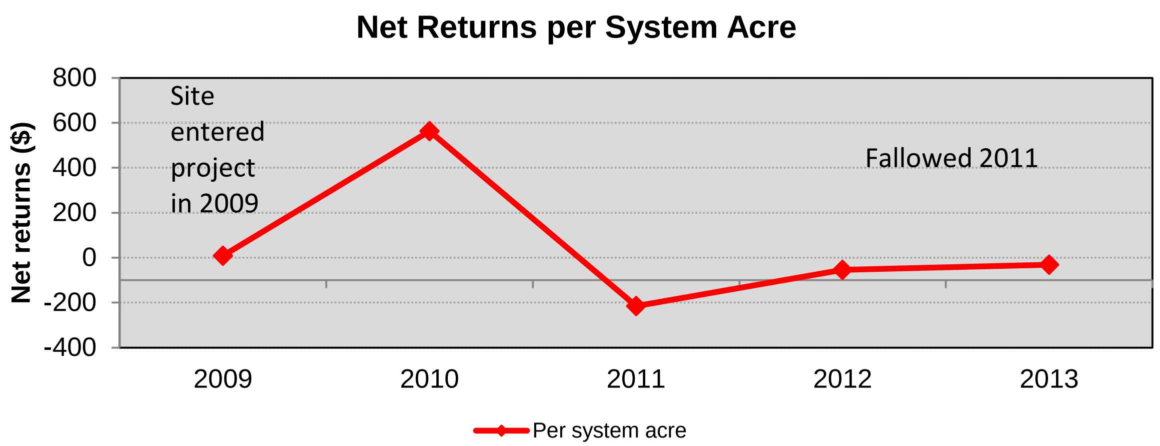
<table>
<tr><th></th><th>Livestock</th><th>Field 1</th></tr>
<tr><td>2005</td><td colspan="2" rowspan="4">Entered project in Year 5</td></tr>
<tr><td>2006</td></tr>
<tr><td>2007</td></tr>
<tr><td>2008</td></tr>
<tr><td>2009</td><td>None</td><td>Sunflowers</td></tr>
<tr><td>2010</td><td>None</td><td>Corn</td></tr>
<tr><td>2011</td><td>None</td><td>Not planted</td></tr>
<tr><td>2012</td><td>None</td><td>Cotton</td></tr>
<tr><td>2013</td><td>None</td><td>Corn</td></tr>
</table>

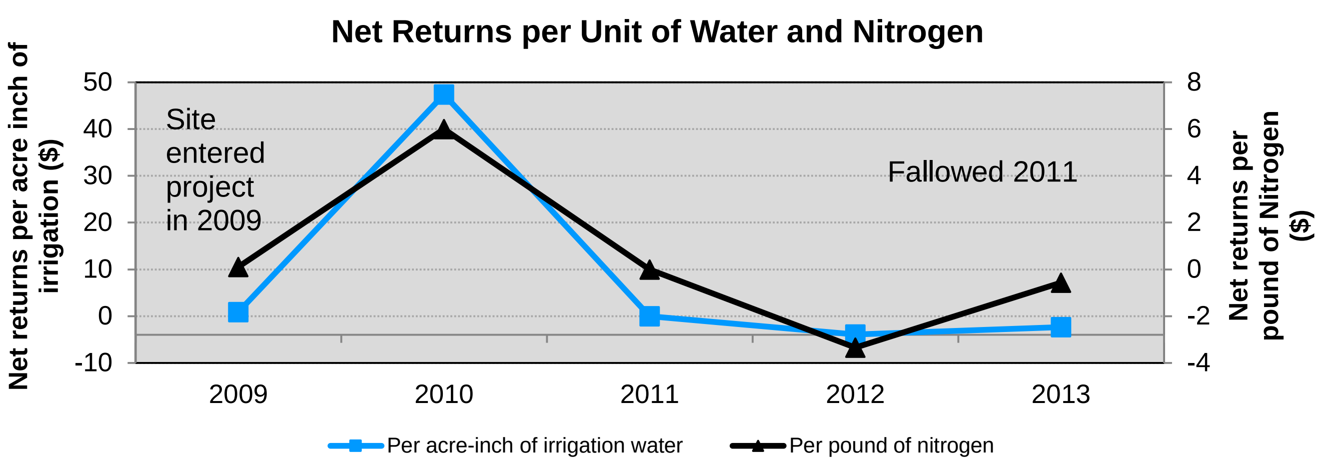
Comments: This site is drip irrigated and was planted to corn using conventional tillage.

July corn

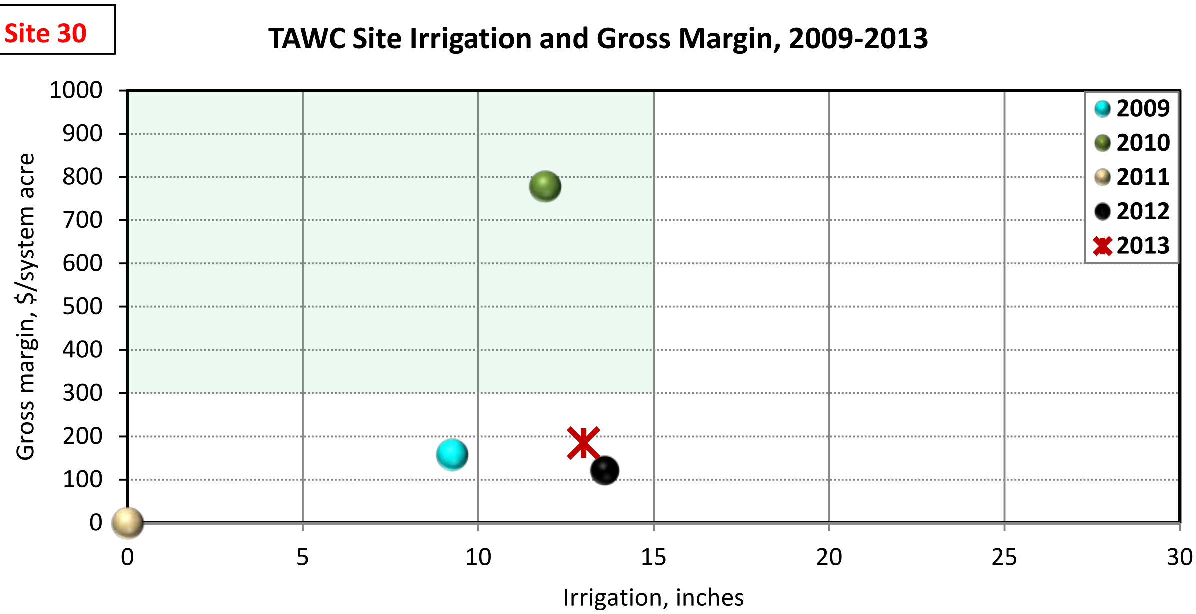
Site 30


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
Site entered project in 2009
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation

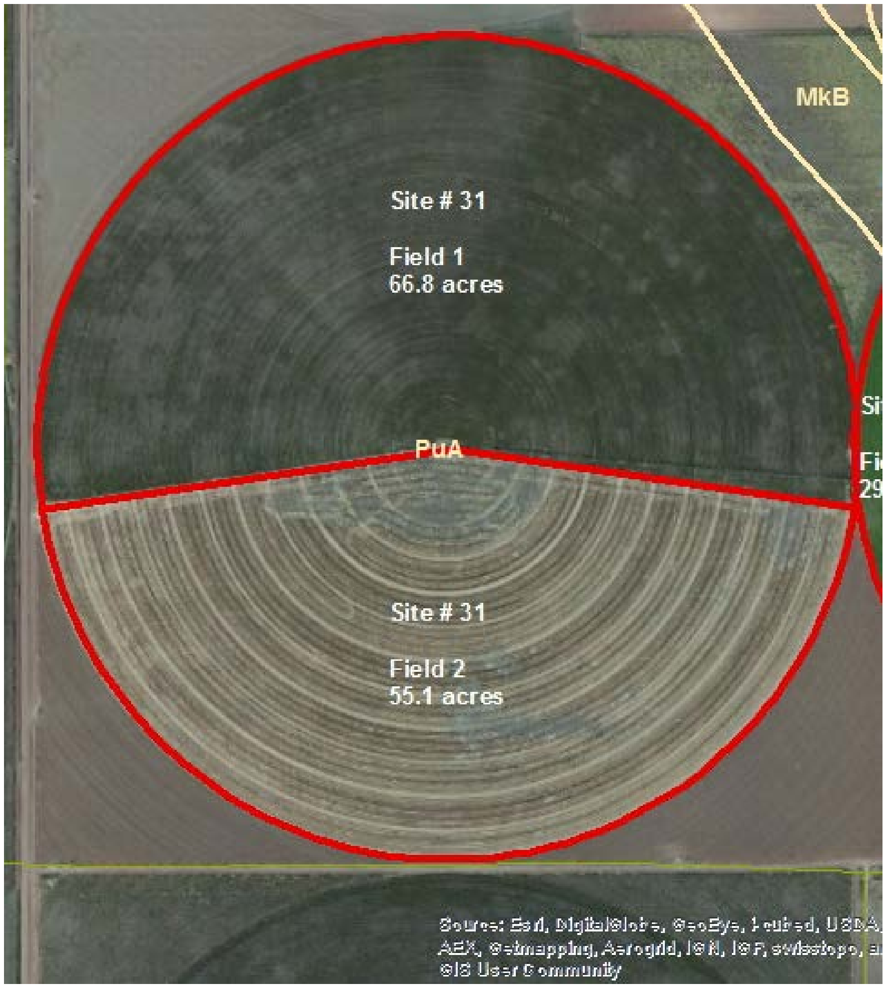

Net Returns per System Acre
Net returns ($)
800
600
400
200
0
-200
-400
Site entered project in 2009
Fallowed 2011
2009
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
50
40
30
20
10
0
-10
Site entered project in 2009
Fallowed 2011
8
6
4
2
0
-2
-4
Net returns per pound of Nitrogen ($)
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen

Site 30


TAWC Site Irrigation and Gross Margin, 2009-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2009
2010
2011
2012
2013

SITE 31



DESCRIPTION

Total site acres:	121.9
Field No. 1 Acres:	66.8
Major soil type:	PuA-Pullman clay loam, 0 to 1%
Field No. 2 Acres:	55.1
Major soil type:	PuA-Pullman clay loam, 0 to 1%

IRRIGATION

Type:	Center pivot
Pumping capacity, gal/min:	450
Number of wells:	2
Fuel source:	Natural gas Electric

Site 31

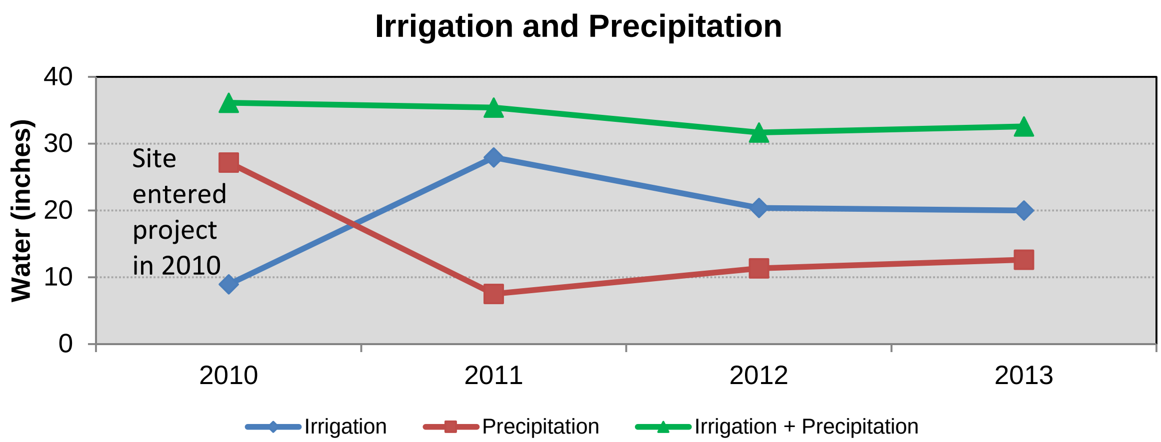
	Livestock	Field 1	Field 2
2005	Entered project in Year 6		
2006			
2007			
2008			
2009			
2010	None	Cotton	Seed millet
2011	None	Seed millet	Cotton
2012	None	Cotton	Seed millet
2013	None	Millet	Cotton

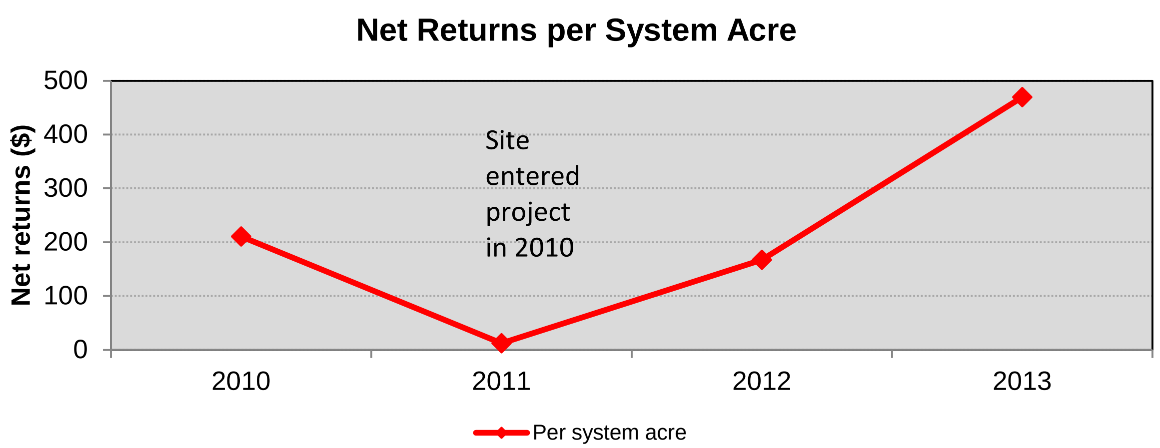
Comments: This is a pivot irrigated site which was planted to cotton and millet in 2013. Both crops were planted on 40-inch centers using conventional tillage.

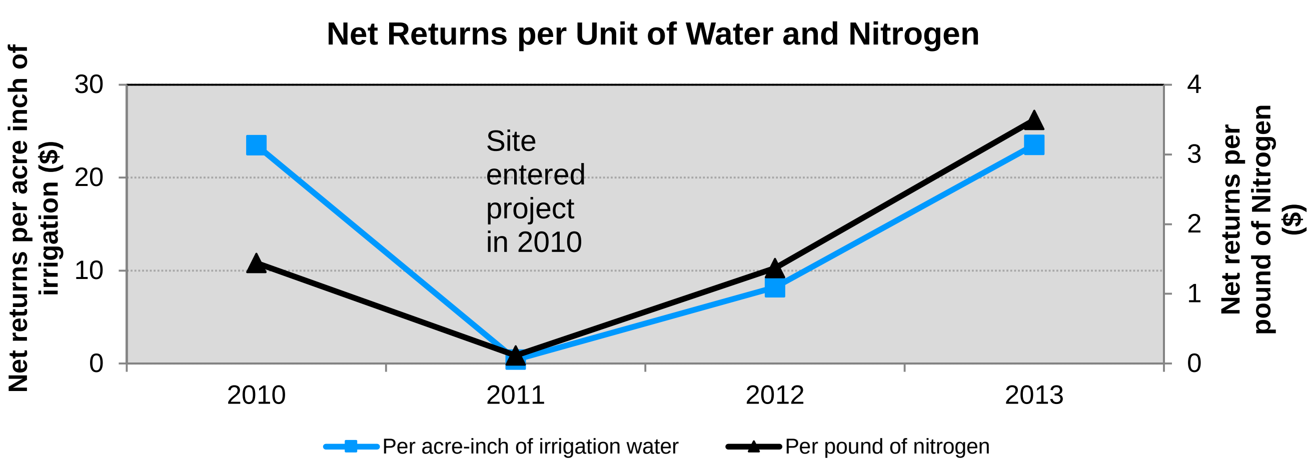
Harvested millet

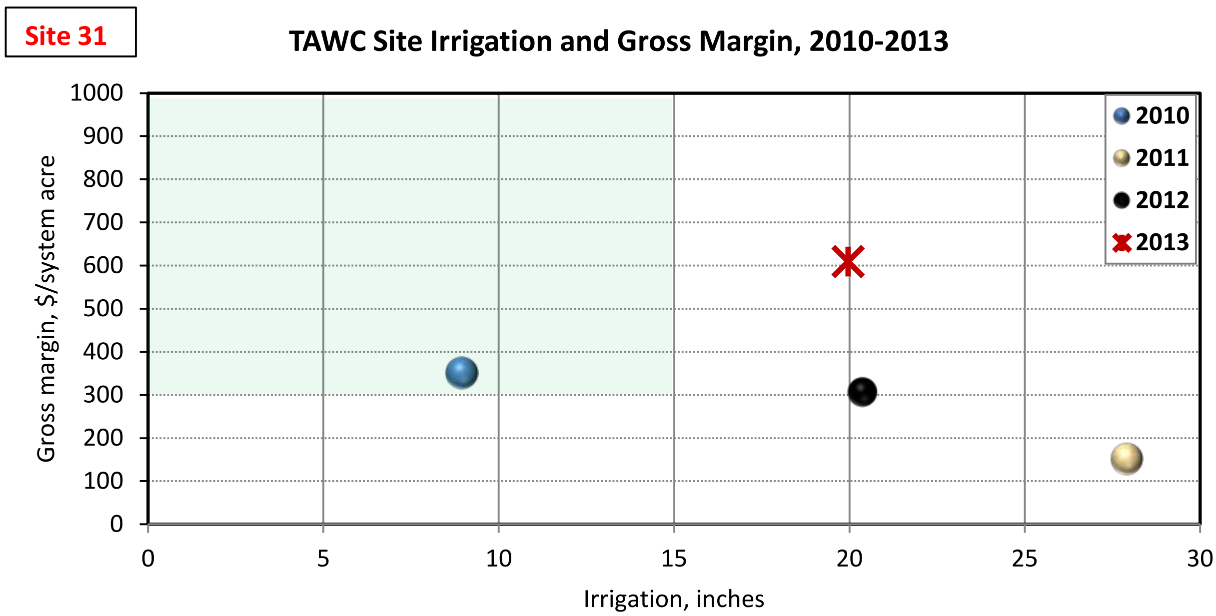
July cotton

Site 31


Irrigation and Precipitation
Water (inches)
40
30
20
10
0
Site
entered
project
in 2010
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
500
400
300
200
100
0
Site
entered
project
in 2010
2010
2011
2012
2013
Per system acre

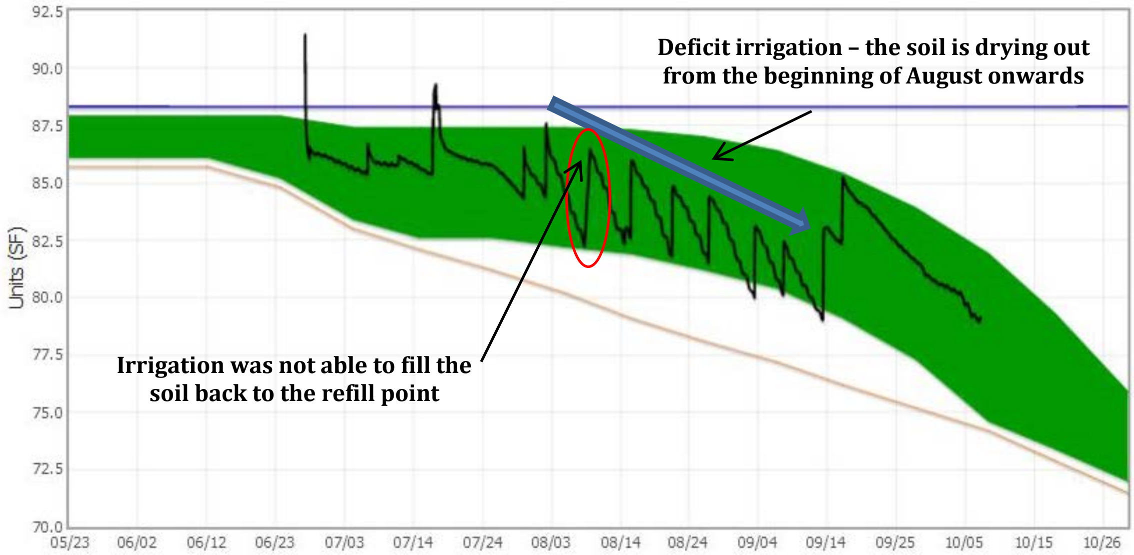

Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
30
20
10
0
Site
entered
project
in 2010
2010
2011
2012
2013
4
3
2
1
0
Net returns per pound of Nitrogen ($)
Per acre-inch of irrigation water
Per pound of nitrogen


Site 31
TAWC Site Irrigation and Gross Margin, 2010-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2010
2011
2012
2013

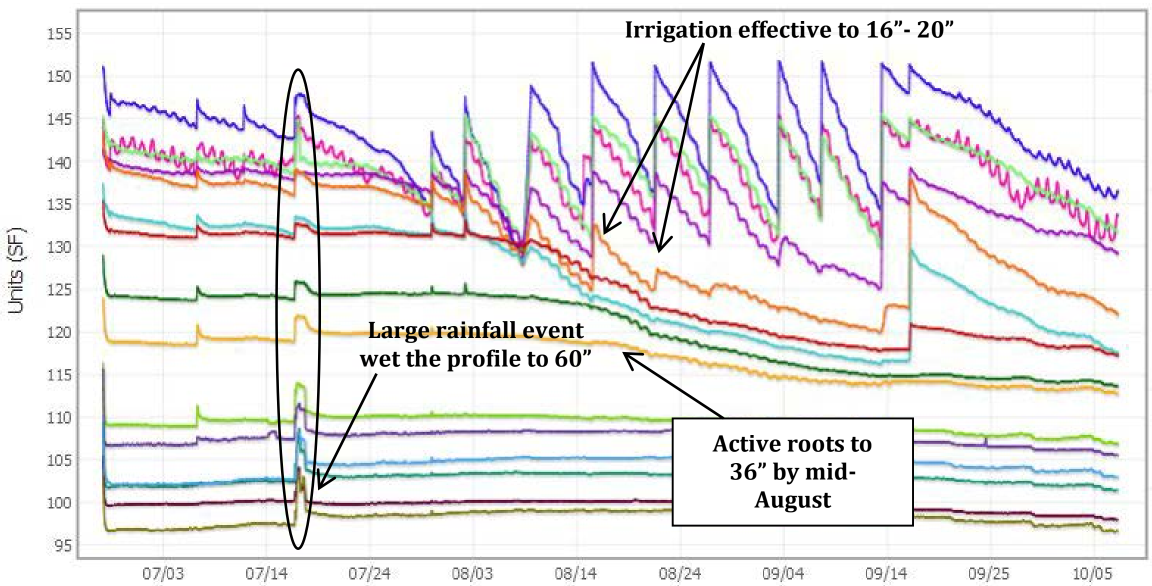
Aqua Spy

David Sloan, Principal Agronomist

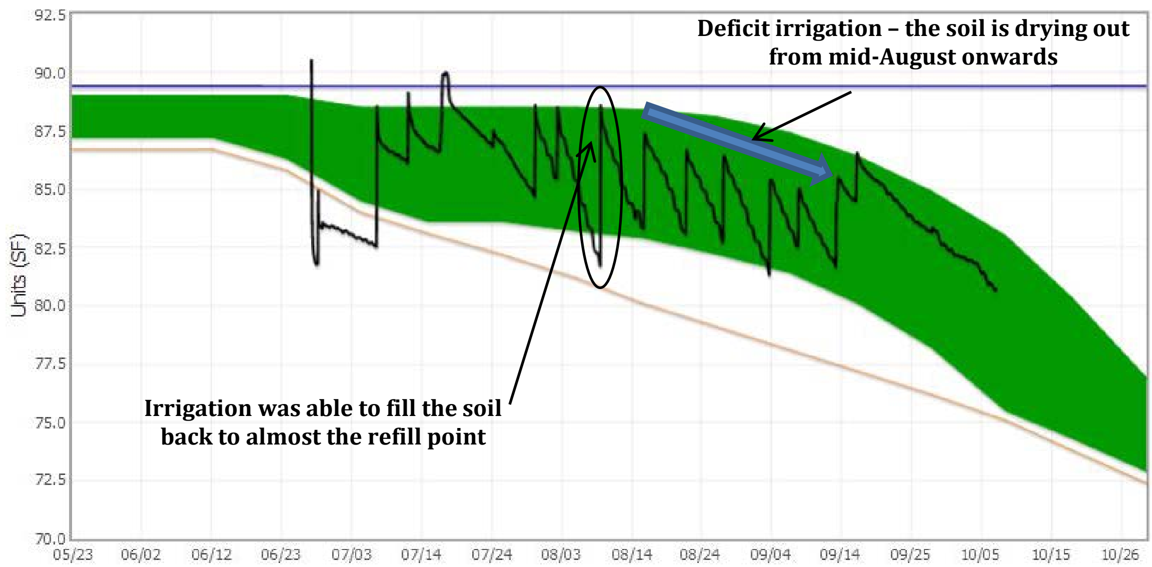
Site 31 – Pivot Spray Cotton (1028 lb/ac)



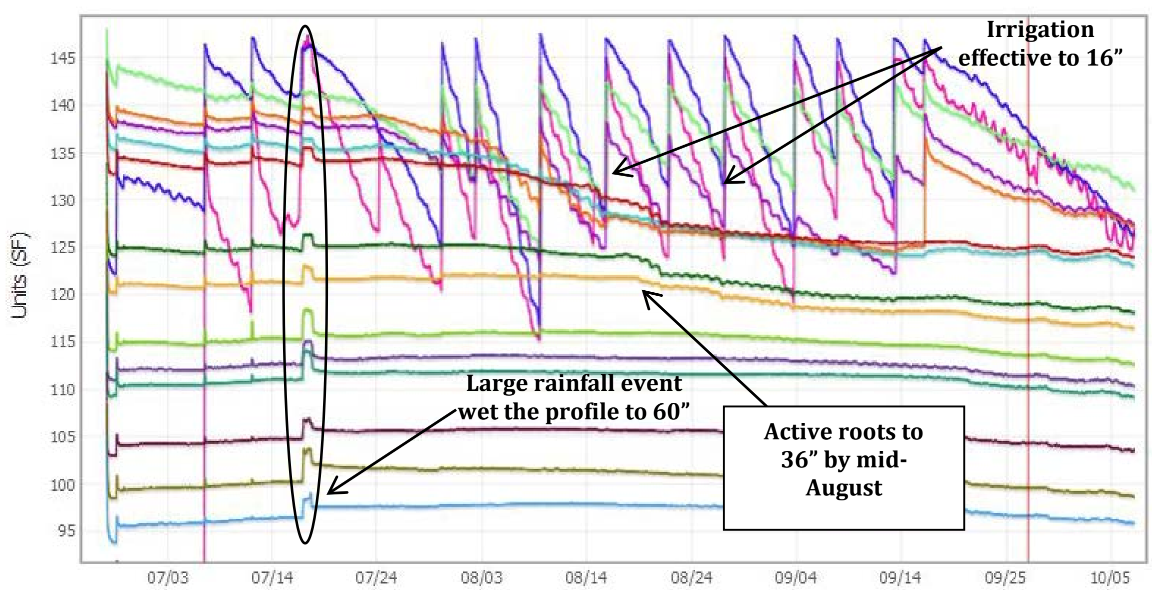
A significant rainfall in mid-July filled the profile in the top 3 feet and the wetting front passed below 5 feet. The first two irrigations after the rainfall kept up with plant demand; however, from the beginning of August onwards, irrigation was not able to keep up with demand and the soil began to dry out. The deficit irrigation in August and September was reasonably effective with most irrigations going down to 16-20 inches. From mid-August onwards, the moisture below 20" began to dry out and there was good extraction in the 3rd foot of soil. While roots could be observed at 60" by the end of the season, there was not significant moisture extraction at these lower levels. Water usage in the top 12" appeared to be lower than for the bubble treatment and this site seemed to go into irrigation deficit two weeks earlier. This likely caused the yield difference between the two treatments.



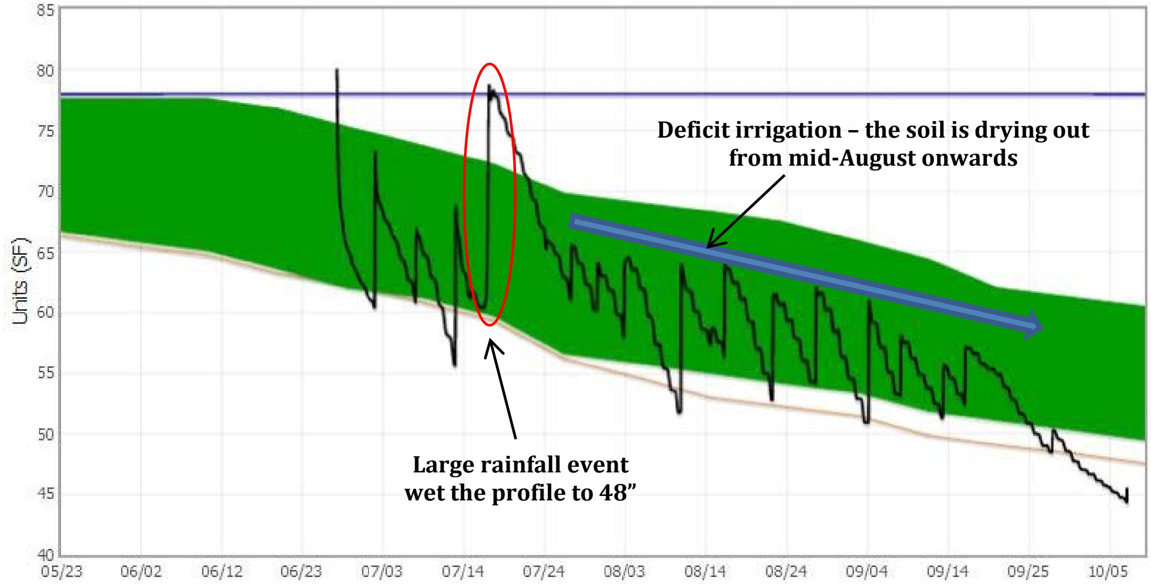
Site 31 – Pivot, Bubble Mode Nozzles, Cotton (1165 lb/ac)



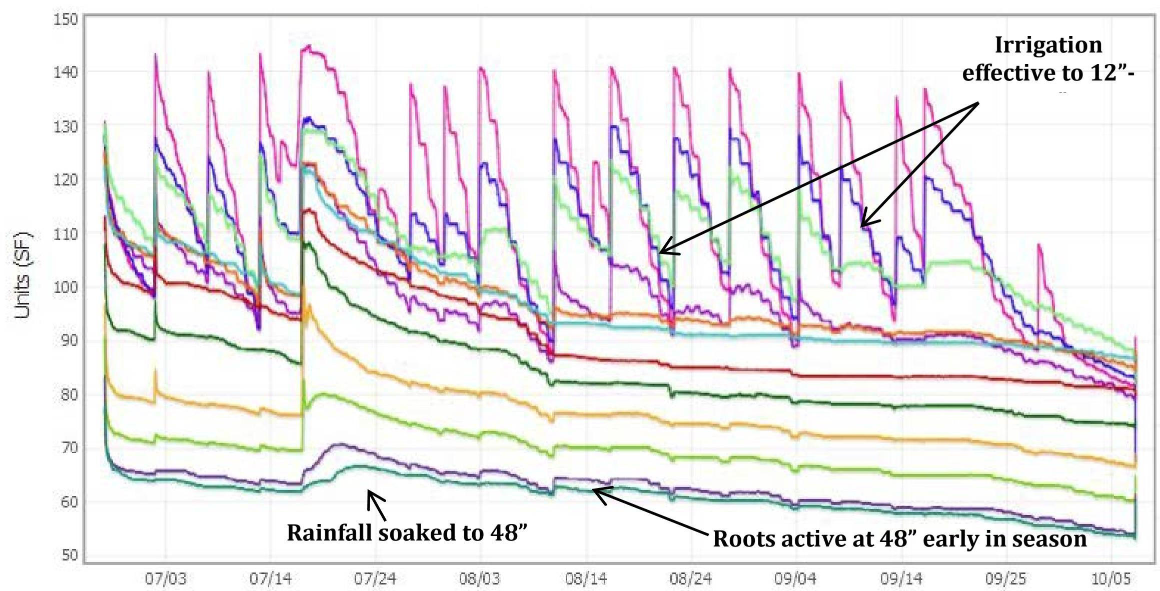
The bubble treatment began like the spray treatment; however, the bubble mode treatment was able to keep up with plant demand for two weeks longer than the spray treatment before going into deficit irrigation. An irrigation event at around Aug. 10 seemed to make the most obvious difference between the two fields. The bubble mode was able to refill the profile, whereas the spray mode was not. This coincided with peak water demand, so increased available water at this time would result in a yield increase. Root activity as this site went to 60 inches, but most of the activity was in the top 3 feet. There was much greater activity in the top 12 inches at this site compared to the spray site, possibly due to the bubble mode flooding a narrower band of soil close to the probe.



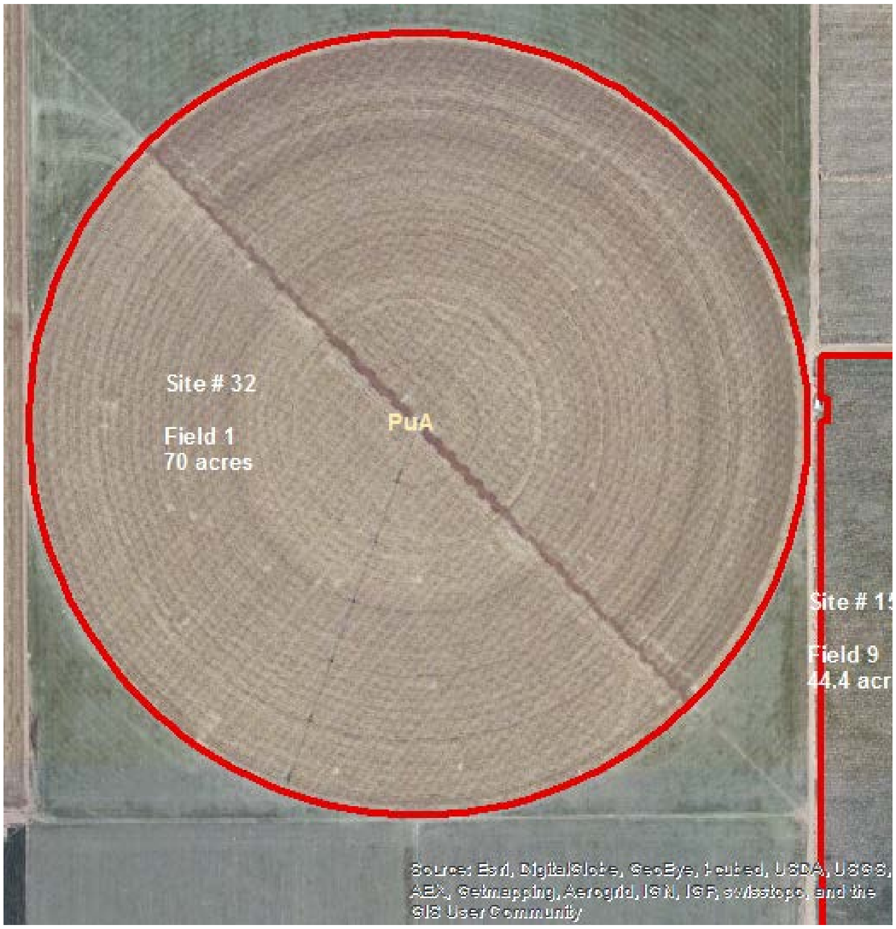
Site 31 – Pivot Bubble Nozzle, Millet (3384 lb/ac)



This field benefitted enormously from the large rainfall event in mid-July. A lot of the rainfall was captured, and moisture in the 2nd, 3nd, and 4th foot increased dramatically. The data indicate that the profile was mostly filled to 36 inches but that the 4th foot could have taken more. Irrigation on this site was generally only able to penetrate to 16 inches, similar to what was observed on the bubble cotton site. Roots went to 48 inches early in the season, and the data indicate that the crop may have experienced some water stress around Aug. 8. This is evident because the roots became active at all levels in order to keep up with plant water demand. It is interesting to note that this same phenomenon occurred prior to each irrigation during the latter part of the season. It is likely that without the large rainfall event in July, this crop would have suffered a significant yield reduction.



Site 32



Description

Total site acres: 70.0

Field No. 1 Acres: 70.0
Major soil type: PuA-Pullman clay loam, 0 to 1%

Irrigation

Type: Center pivot

Pumping capacity, gal/min: 350

Number of wells: 2

Fuel source: Electric

Site 32

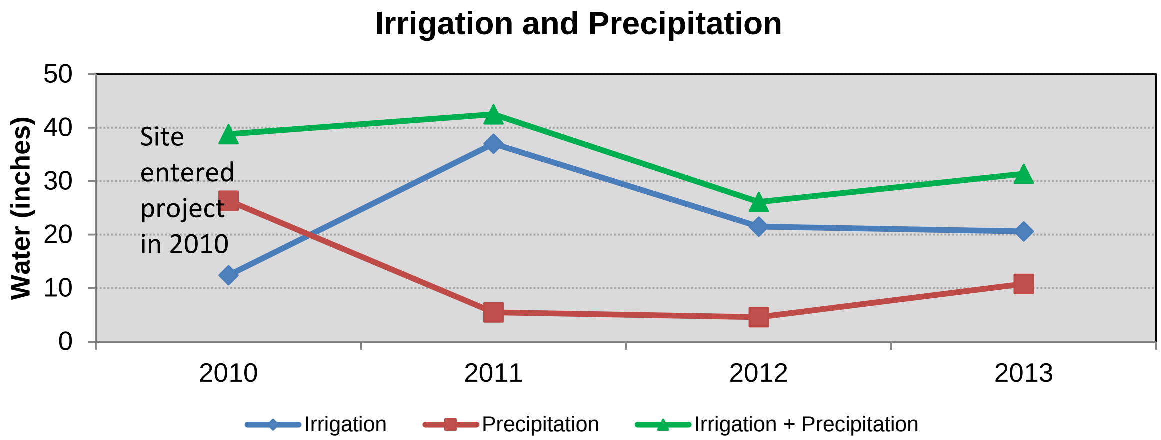
	Livestock	Field 1
2005	Entered project in Year 6	
2006		
2007		
2008		
2009		
2010	None	Corn
2011	None	Corn
2012	None	Corn
2013	None	Corn

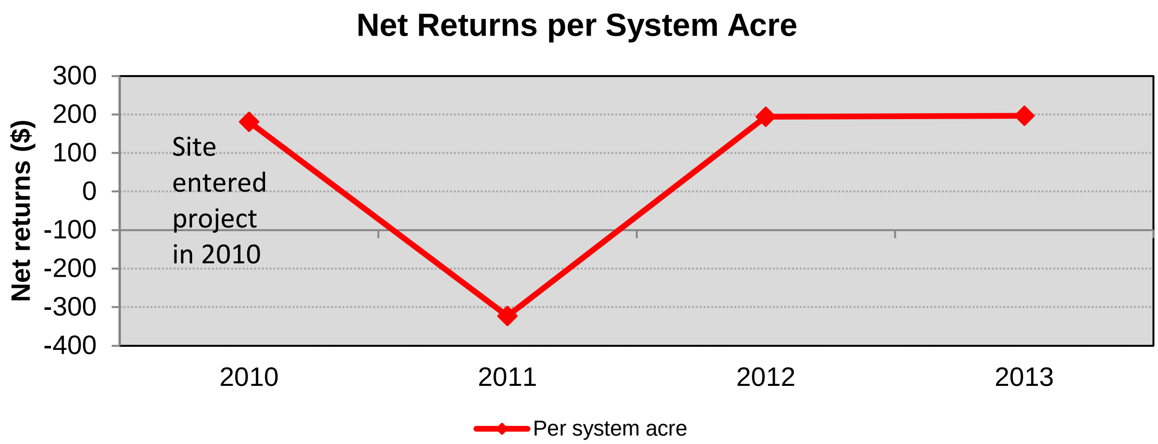
Comments: This is a pivot irrigated site which was planted to corn on 40-inch centers for 2013.

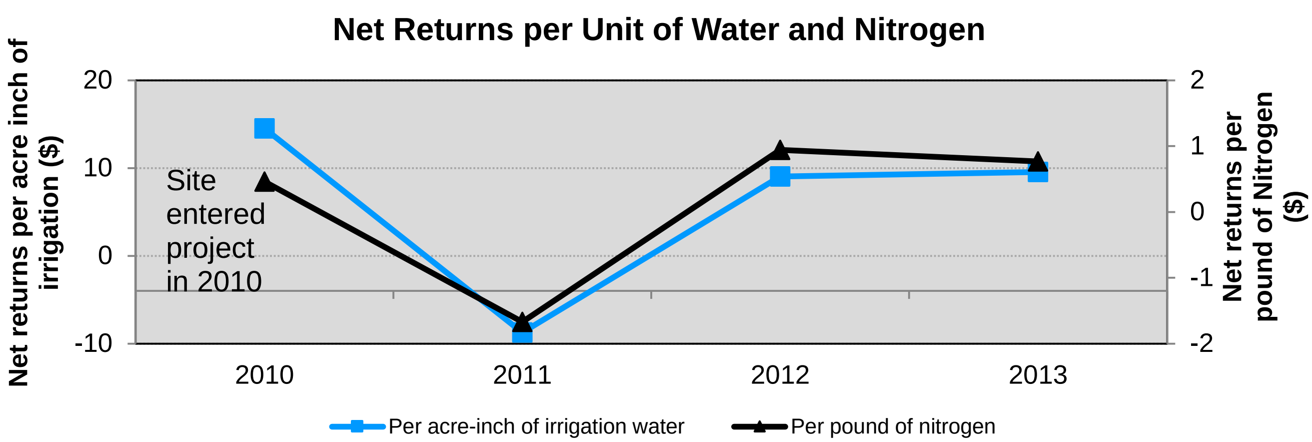
June corn

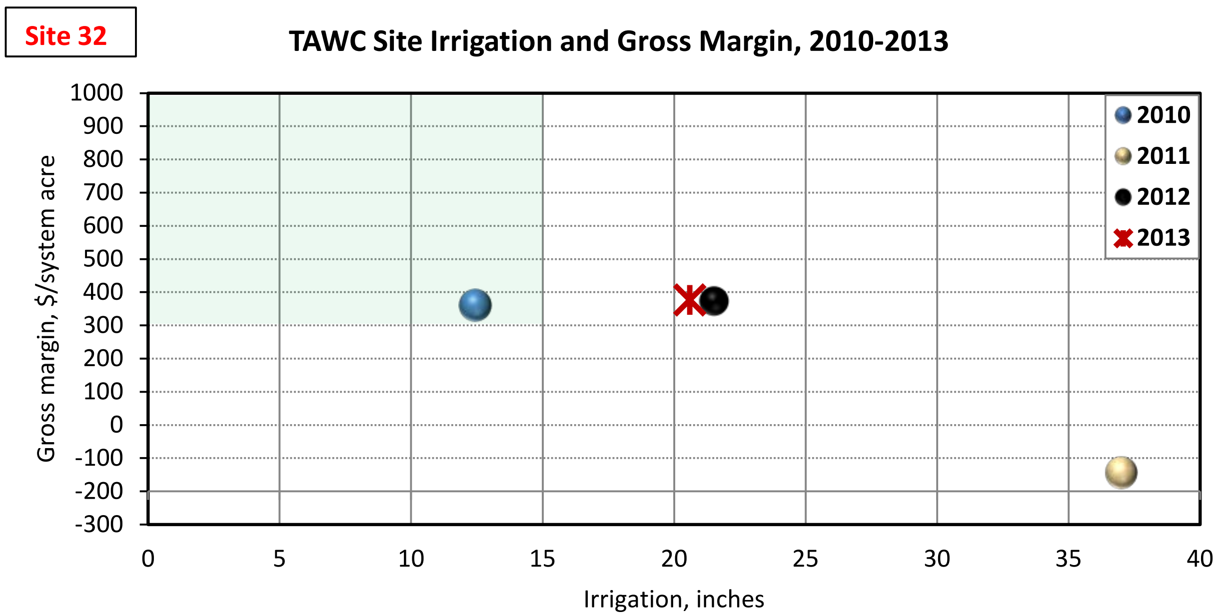
Corn for silage

Site 32

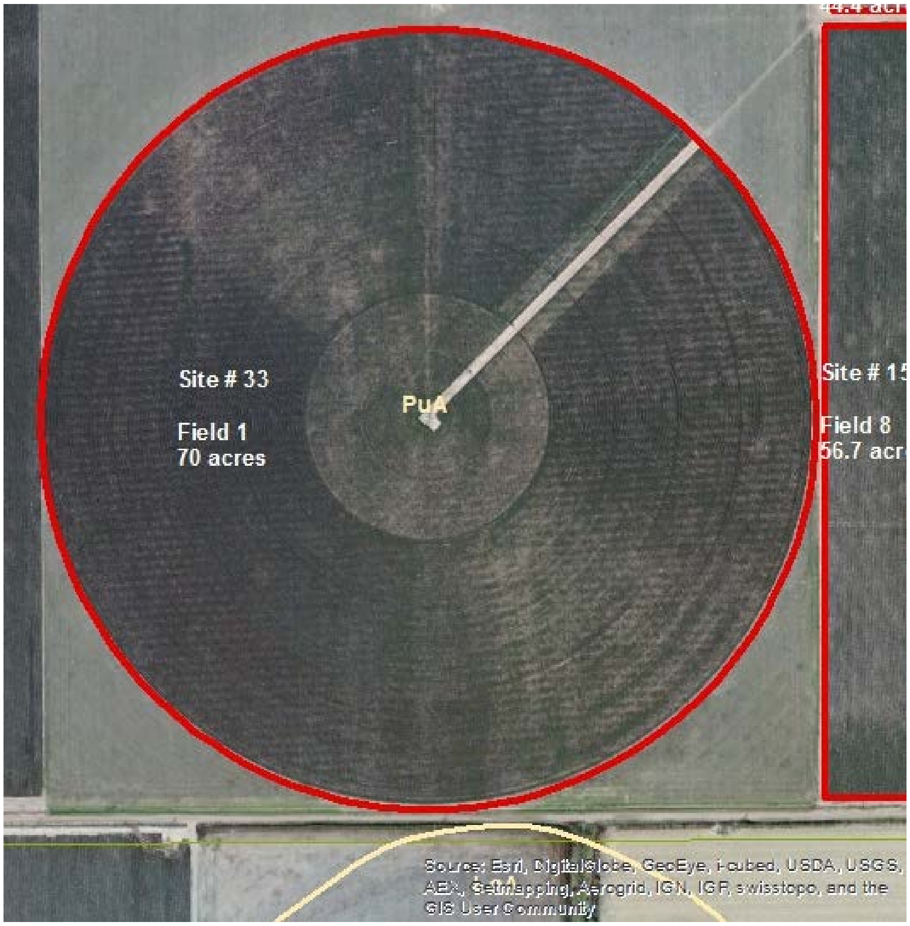

Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
Site
entered
project
in 2010
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
300
200
100
0
-100
-200
-300
-400
Site
entered
project
in 2010
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
20
10
0
-10
Site
entered
project
in 2010
2010
2011
2012
2013
2
1
0
-1
-2
Net returns per pound of Nitrogen ($)
Per acre-inch of irrigation water
Per pound of nitrogen


Site 32
TAWC Site Irrigation and Gross Margin, 2010-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
-100
-200
-300
0
5
10
15
20
25
30
35
40
Irrigation, inches
2010
2011
2012
2013

SITE 33



DESCRIPTION

Total site acres:	70.0
Field No. 1 Acres:	70.0
Major soil type:	PuA-Pullman clay loam, 0 to 1%

IRRIGATION

Type:	Center pivot
Pumping capacity, gal/min:	350
Number of wells:	2
Fuel source:	Electric

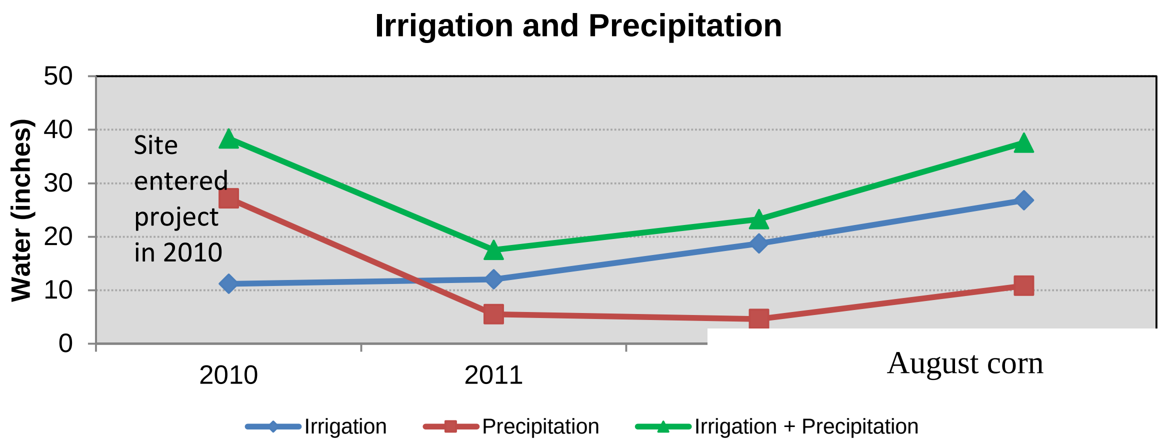
Site 33

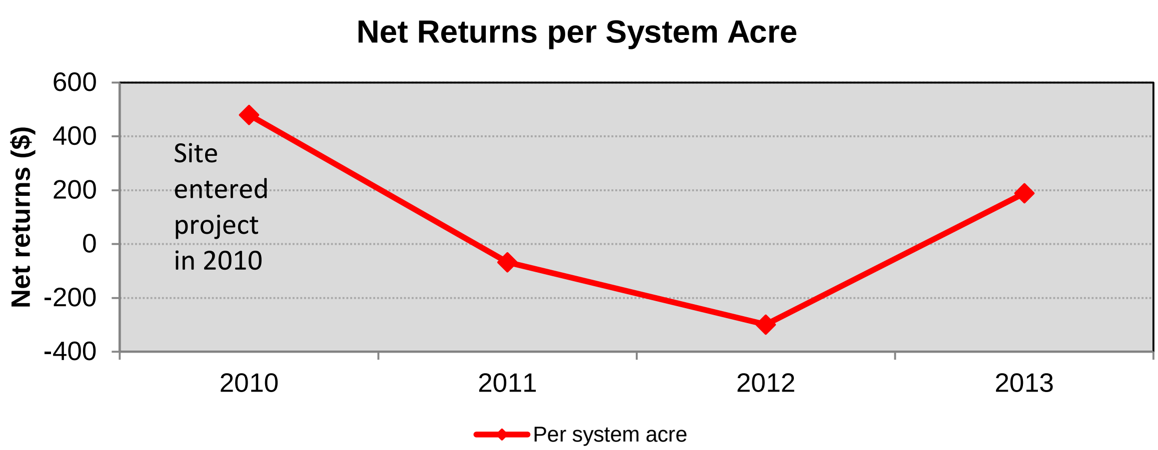
	Livestock	Field 1
2005	Entered project in Year 6	
2006		
2007		
2008		
2009		
2010	None	Cotton
2011	None	Corn
2012	None	Corn
2013	None	Corn

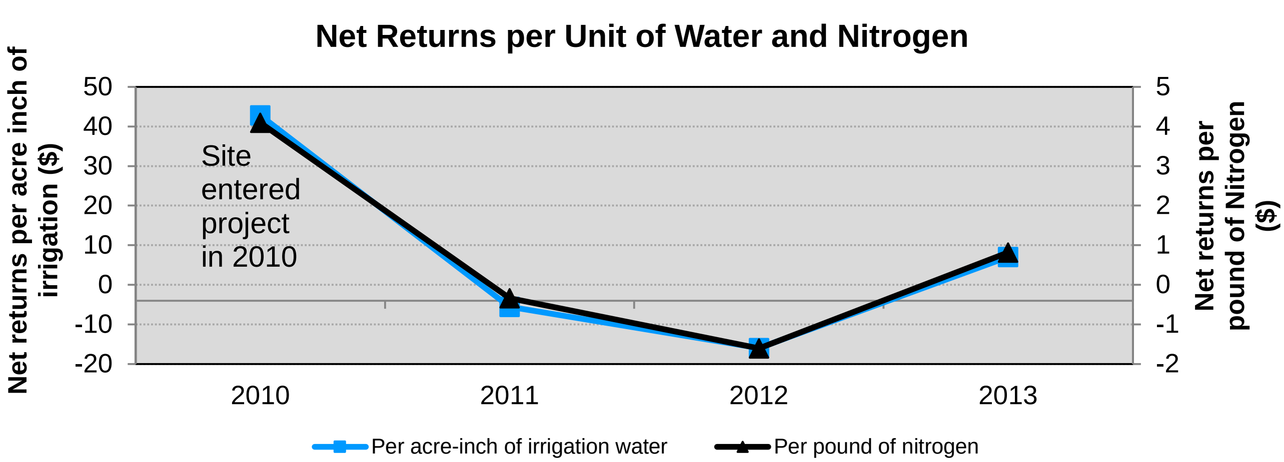
Comments: In 2013 this site was planted to corn on 40-inch centers using conventional tillage.

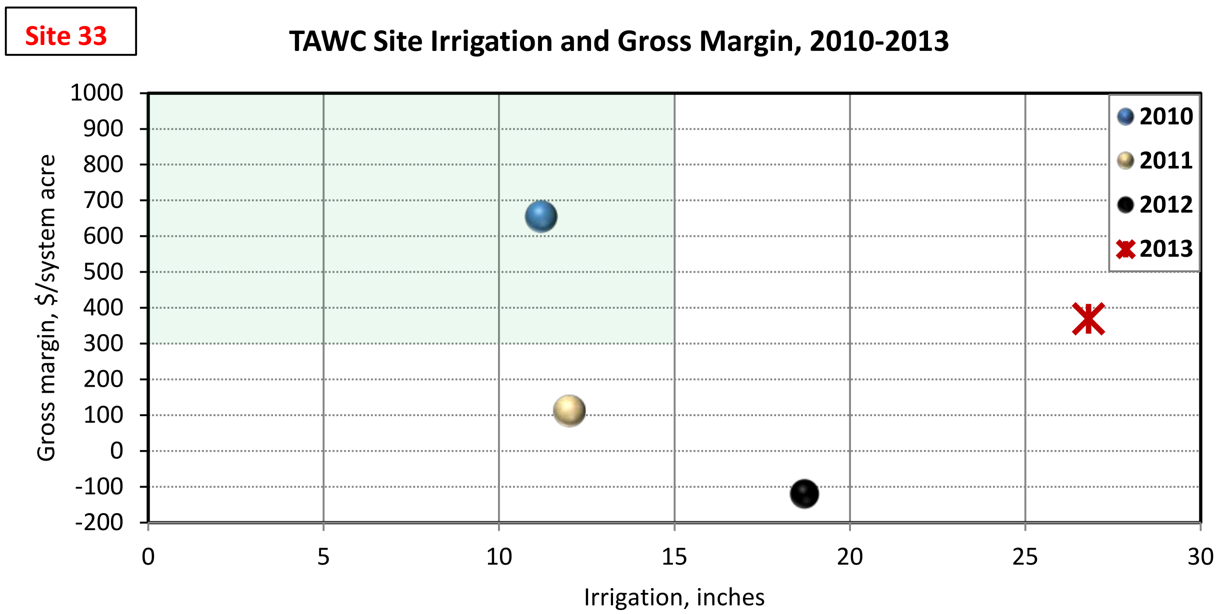
July corn

Site 33


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
Site entered project in 2010
2010
2011
August corn
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
600
400
200
0
-200
-400
Site entered project in 2010
2010
2011
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
50
40
30
20
10
0
-10
-20
Net returns per pound of Nitrogen ($)
5
4
3
2
1
0
-1
-2
Site entered project in 2010
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen


Site 33
TAWC Site Irrigation and Gross Margin, 2010-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
-100
-200
0
5
10
15
20
25
30
Irrigation, inches
2010
2011
2012
2013

SITE 34

DESCRIPTION

Total site acres:	726.6
Field No. 1 Acres:	179.4
Major soil type:	PuA-Pullman clay loam, 0 to 1%
Field No. 2 Acres:	363.7
Major soil type:	PuA-Pullman clay loam, 0 to 1% LoA-Lofton clay loam, 0 to 1% McA-McLean clay, 0 to 1%
Field No. 3 Acres:	183.5
Major soil type:	PuA-Pullman clay loam, 0 to 1%

IRRIGATION

Type:	Center pivot
Pumping capacity, gal/min:	?
Number of wells:	2
Fuel source:	Electric

Site 34

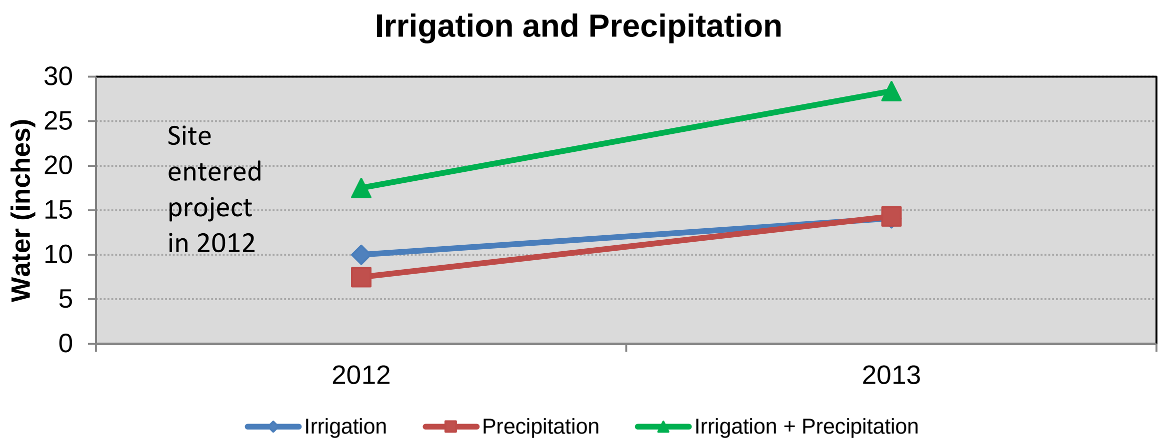
	Livestock	Field 1	Field 2	Field 3
2012	None	Corn	Corn	Corn
2013	None	Corn	Sunflower	Sunflower

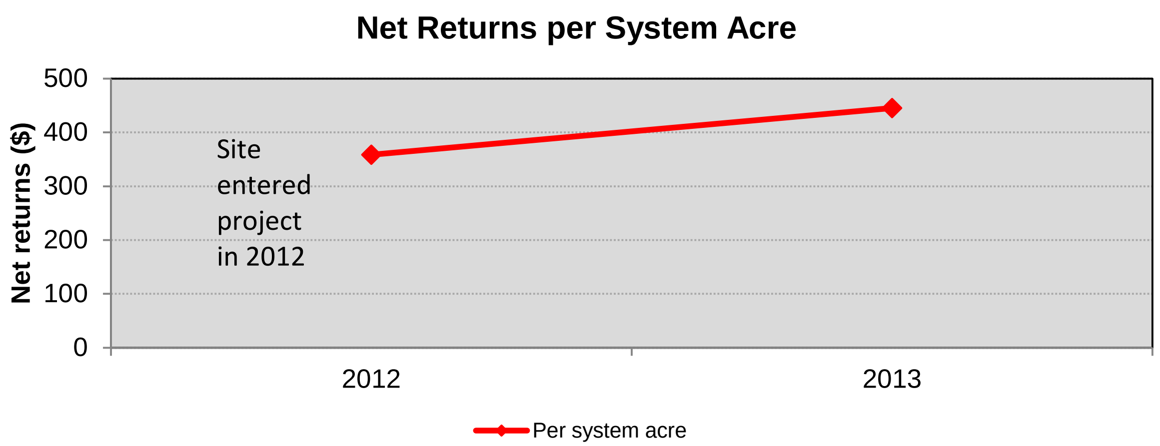
Comments: This site was added in 2012. This producer uses no-till and incorporates cotton, corn, sunflowers and wheat in rotation.

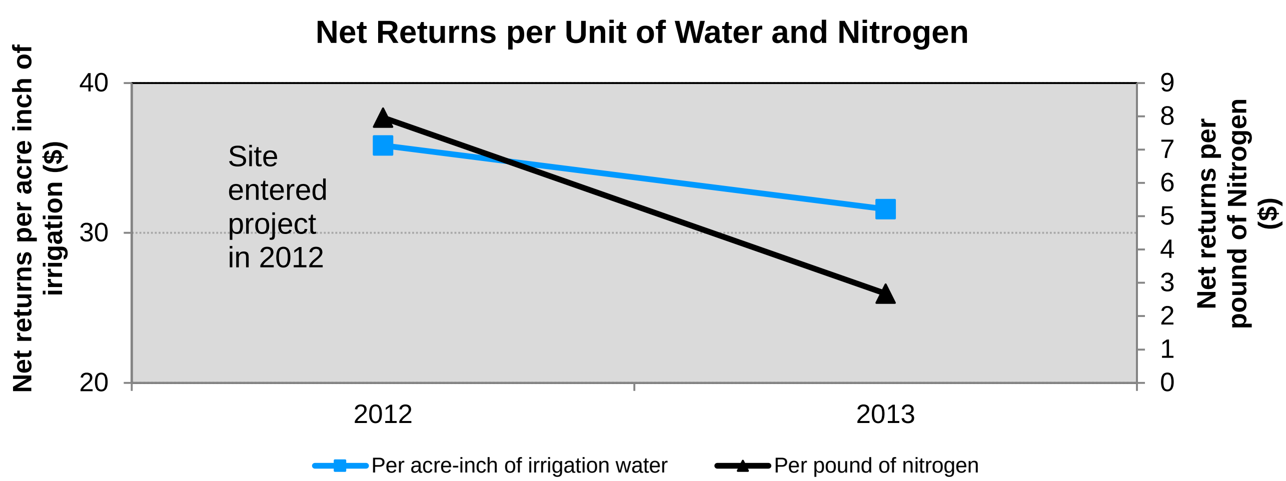
July sunflower

July corn

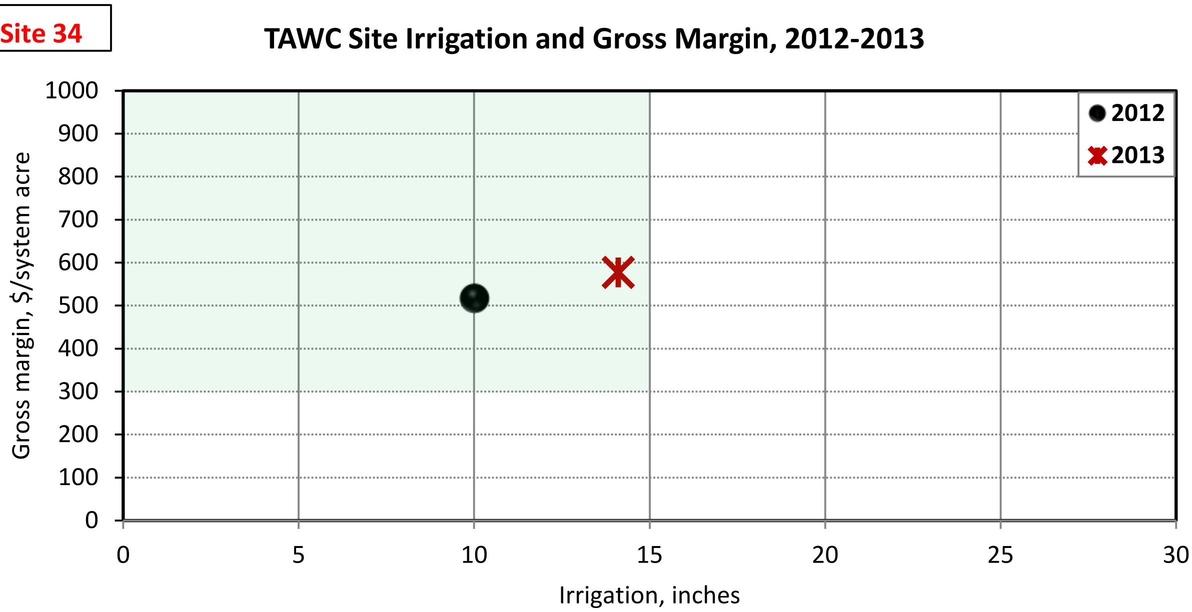
Site 34


Irrigation and Precipitation
Water (inches)
30
25
20
15
10
5
0
Site
entered
project
in 2012
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
500
400
300
200
100
0
Site
entered
project
in 2012
2012
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
40
30
20
Net returns per pound of Nitrogen ($)
9
8
7
6
5
4
3
2
1
0
Site
entered
project
in 2012
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen

Site 34

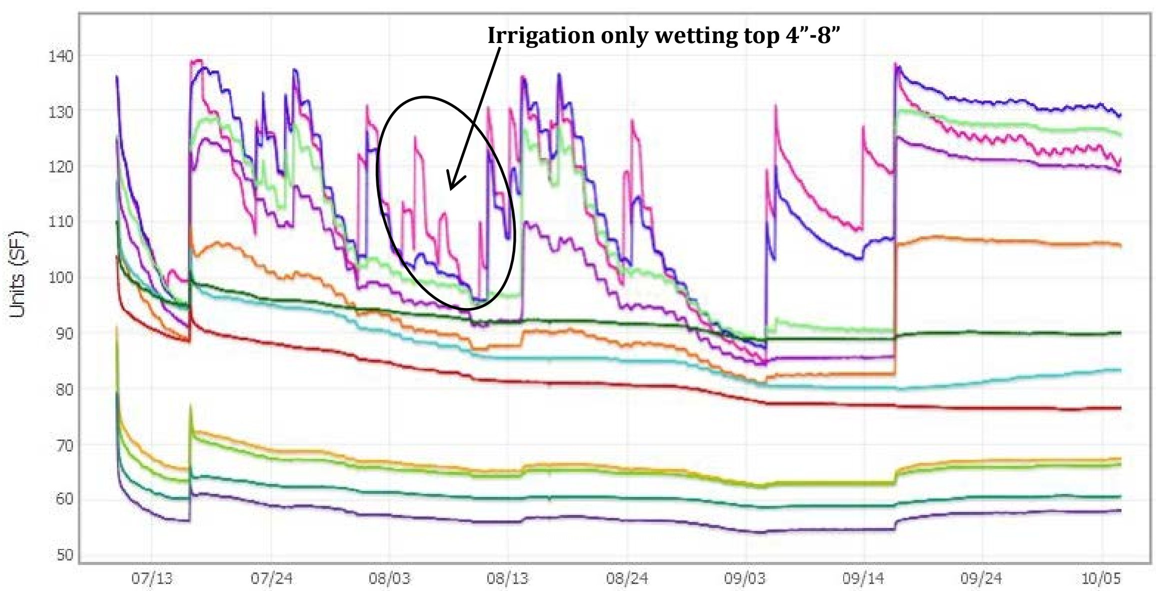


TAWC Site Irrigation and Gross Margin, 2012-2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2012
2013

AquaSpy

David Sloan, Principal Agronomist
Site 34 – Pivot, Corn (239 bu/ac)

The probe data from this site seem to indicate a much lower corn grain yield than the field average, so it is possible that the probe was located in a drier and lower yielding part of the field. The summary graph (above) shows that the site experienced significant deficit irrigation for a large part of the growing season – especially during peak demand in early August. The sensor graph (below) showed that irrigation was very frequent and very light, with many irrigations only wetting down to 4 inches. Root growth and water uptake was observed down to 48 inches but the majority of active water use was in the top 20 inches. I believe that the probe data do not truly reflect the yield obtained. There was either localized wetting patterns that caused the irrigation to soak in away from the probe, or there were lower yielding areas of the field.



SITE 35

DESCRIPTION

Total site acres: 229.2

Field No. 1 Acres: 82.8
Major soil type: PuA-Pullman clay loam, 0 to 1%
LoA-Lofton clay loam, 0 to 1%

Field No. 2 Acres: 54.1
Major soil type: PuA-Pullman clay loam, 0 to 1%

Field No. 3 Acres: 92.3
Major soil type: PuA-Pullman clay loam, 0 to 1%
LoA-Lofton clay loam, 0 to 1%

IRRIGATION

Type: Sub-surface Drip

Pumping capacity, gal/min: ?

Number of wells: 2

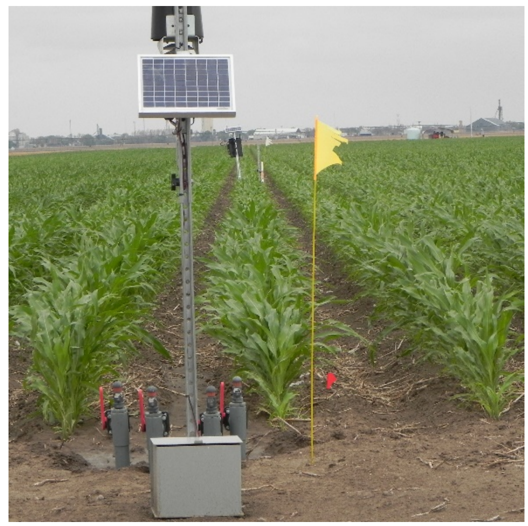
Fuel source: Electric

Site 35

	Livestock	Field 1	Field 2	Field 3
2013	None	Grain Sorghum	Corn	Cotton

Comments: This is a new drip site added in 2013.

Harvesting grain sorghum



Corn planted in 2013

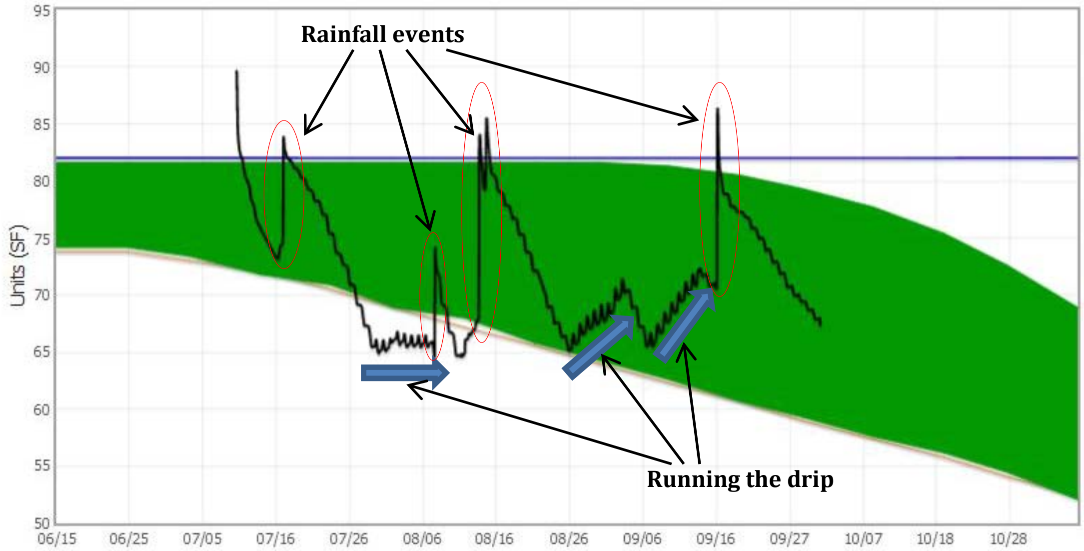
July cotton

Harvesting cotton

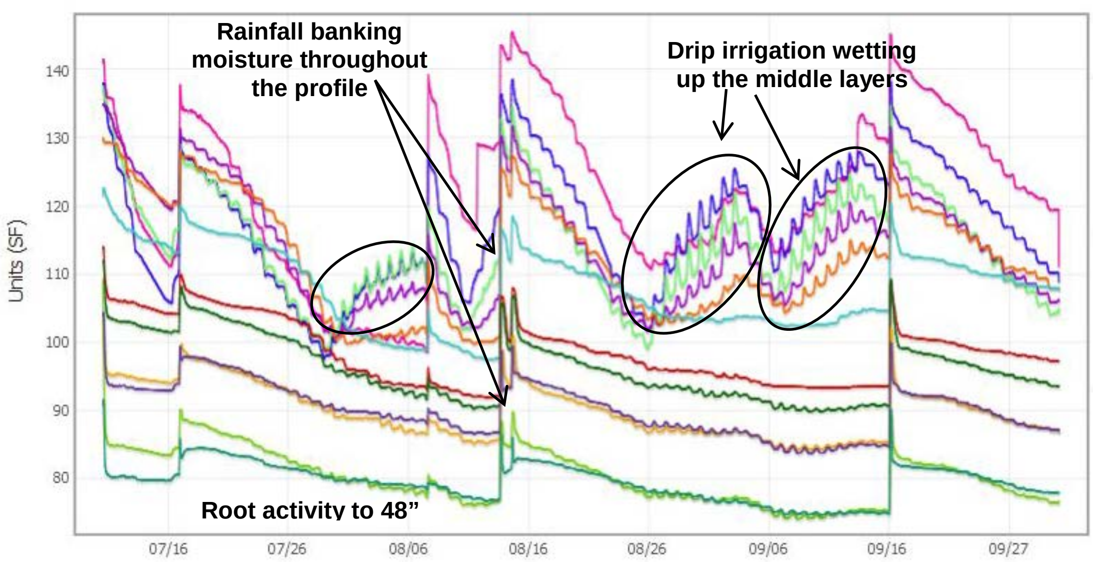
AquaSpy

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.



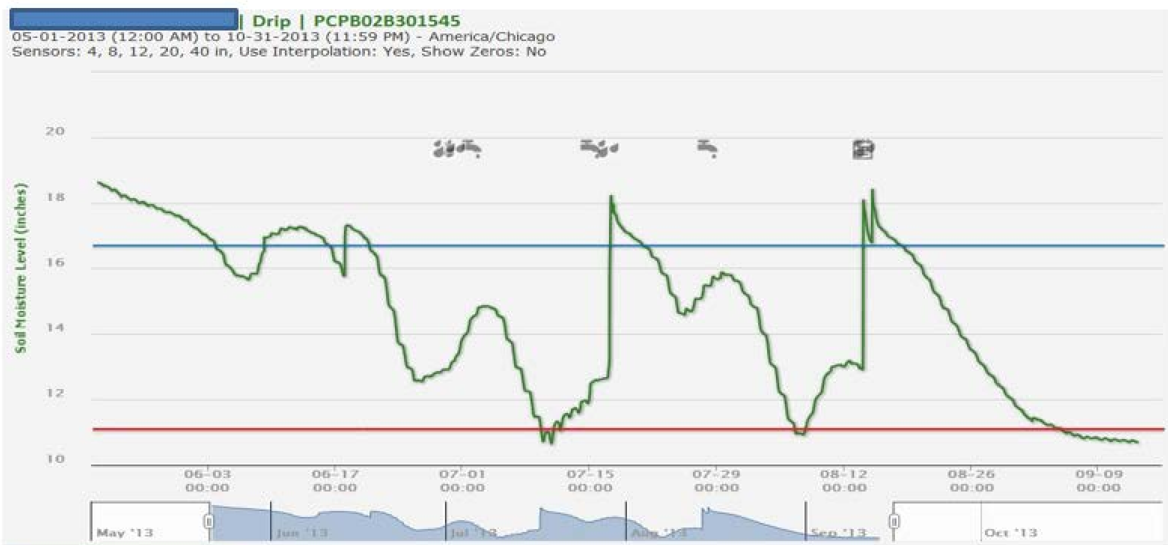
John Deere CropSense™

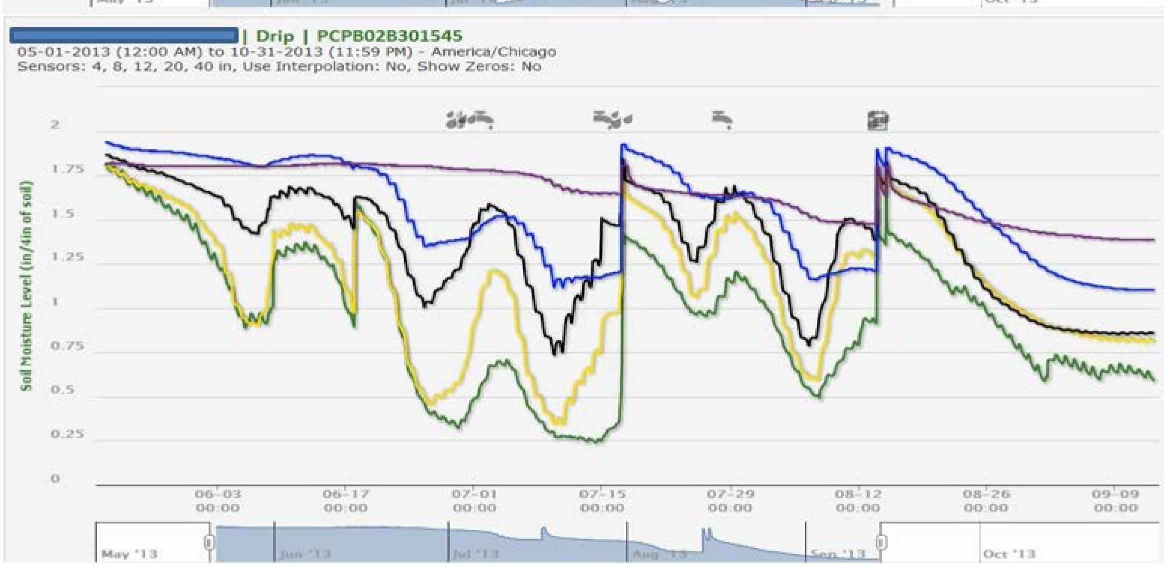
TAWC 2013 Grower Review

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 a very good irrigation pattern and management of rainfall over the season.



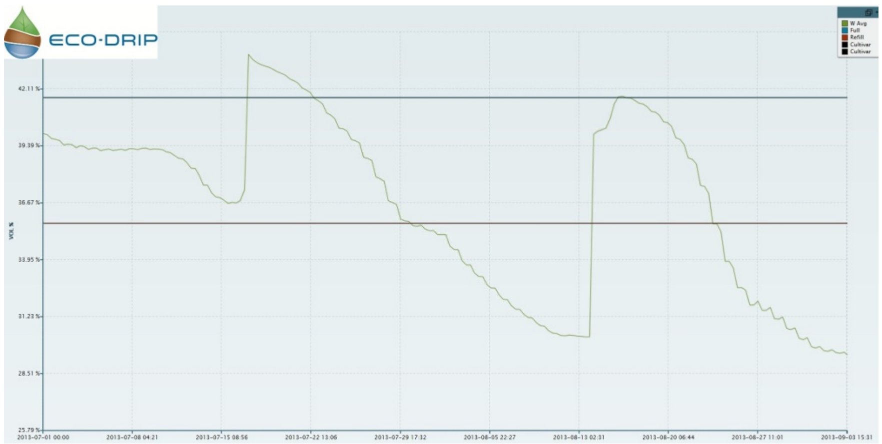


[*Eco-Drip*]

TAWC 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.

Smartfield

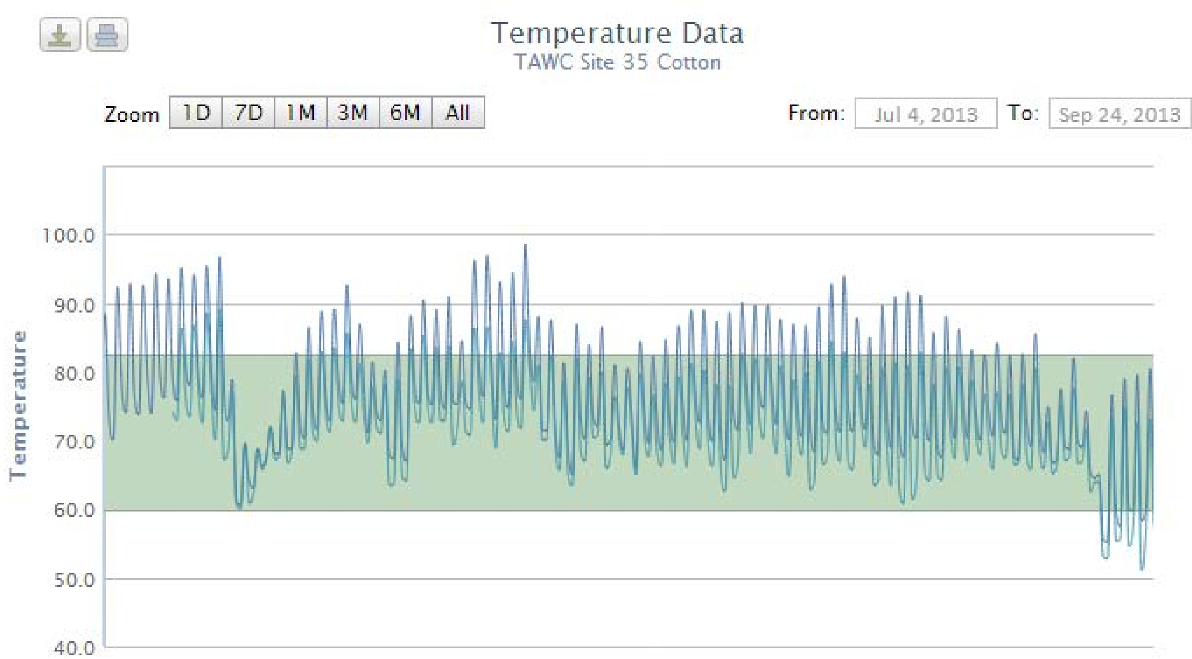
Tom Speed, VP Smartfield Agronomic Services

Site 35, Corn, Cotton, and Grain Sorghum

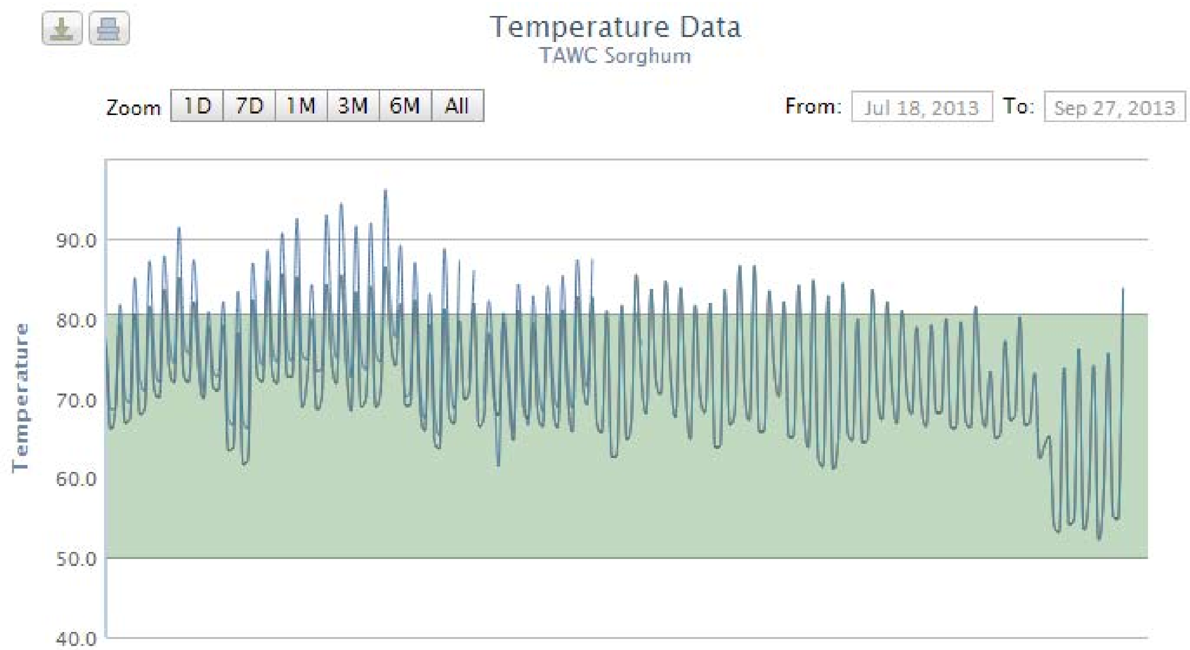
Smartfield technology and analytical services are based on the science of optimal plant canopy temperatures. The canopy temperature is a plant-based, direct measurement of plant health and plant production. Essential plant metabolic functions as well as photosynthetic rates are directly correlated with plant leaf temperatures.

Smartfield tools continuously and automatically capture and store the plant canopy temperature every 15 minutes. Weather variables such as ambient temperature, relative humidity, rainfall, solar radiation and wind speed are also recorded with Smartfield tools for the same time periods.

The canopy temperatures are used in Smartfield's proprietary algorithms to quantify and qualify the effect of plant stress on final production. Screenshots of the seasonal continuous canopy temperature data collected from the corn, sorghum and cotton sites are listed below:

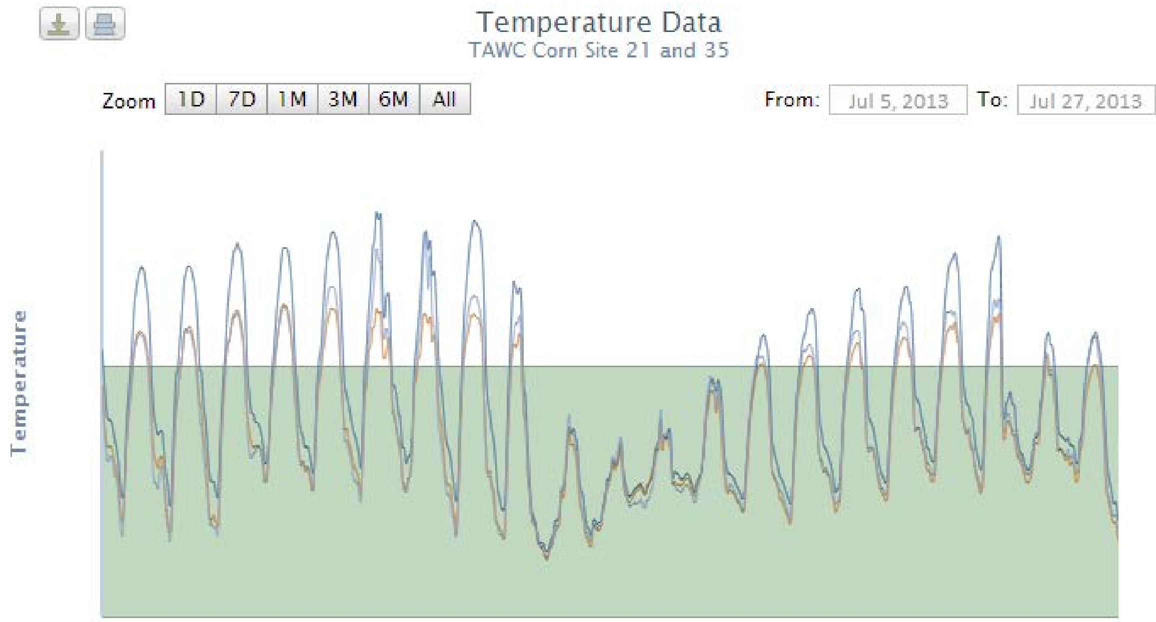


Canopy temperature monitoring for the cotton site began July 10 and continued through September 25. This captured the fruiting period through cutout, when yield potential is established. The darker blue line represents the daily ambient air temperature while the lighter blue line represents the cotton canopy temperature. While the optimal plant canopy temperature for cotton is 82° F, it can be noted the cotton canopy in this field stayed well below this mark. This relatively cool canopy temperature made it possible to achieve high yields (1891 lbs./acre); however, it also indicates that a little less water could have been applied. With continuous monitoring, a grower can follow the water status of the crop and irrigate when needed.



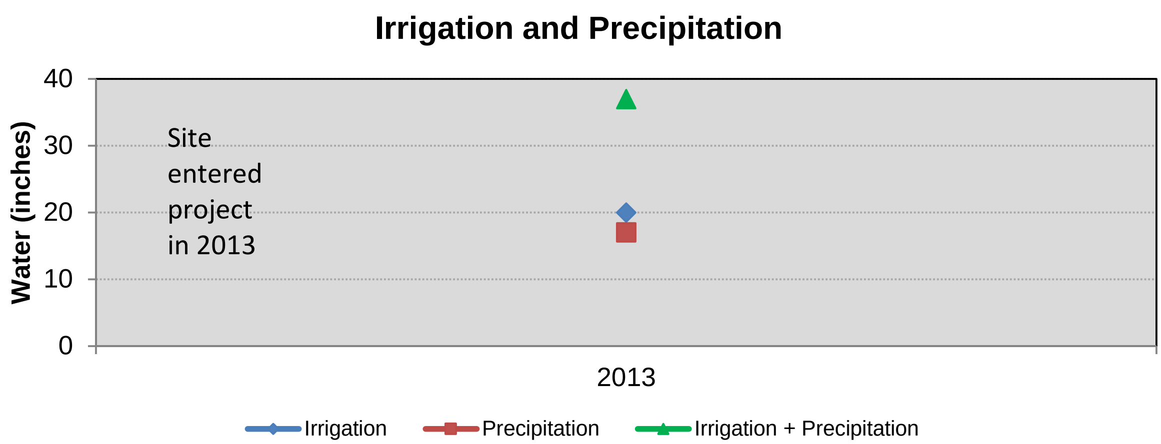
The sorghum field was monitored from July 10 through September 25 (above graph). Again, high yields (8816 lbs./acre) were achieved at this field due to low crop stress. It was noted that during the last week of August and the first week of September, crop canopy temperatures were slightly above optimal, which could have reduced yields just slightly.

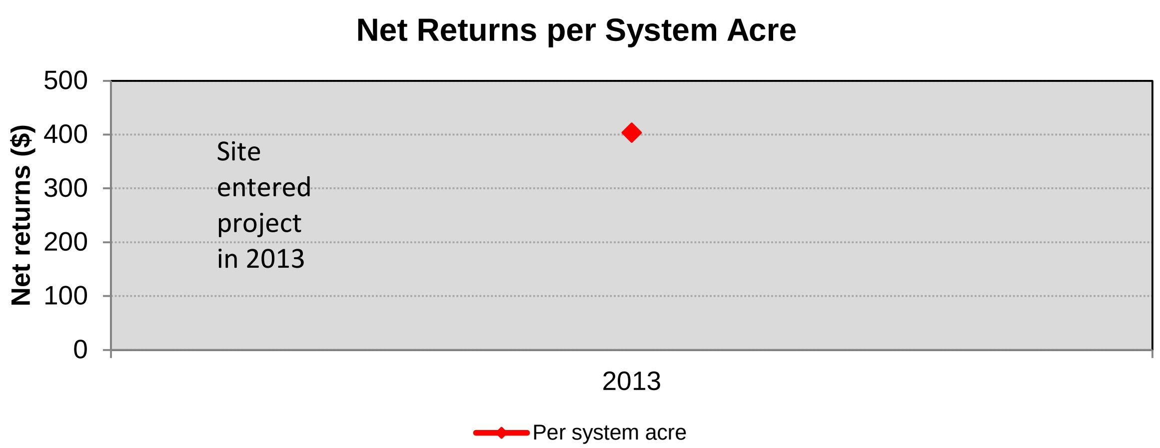
The screenshot below (page 189) shows canopy temperatures from the drip and pivot corn at the TAWC Lockney site. I have only shown the dates from July 5th through July 27th to highlight the subtle differences between the drip and the pivot. The blue line that reaches the highest levels each day is the ambient air temperature and the next lower blue line represents the canopy temperature from the pivot corn. The orange line represents the canopy temperatures from the drip corn. From the graph, one can note that during the first 4 days the canopy temperatures between the drip and pivot fields were very similar; however, after this point the pivot corn canopy temperatures usually reached about 2-3 degrees F higher. The higher canopy temperature in the pivot corn indicated slightly higher stress by the corn, which in turn contributed to approximately a 20 bushel/acre final yield difference.

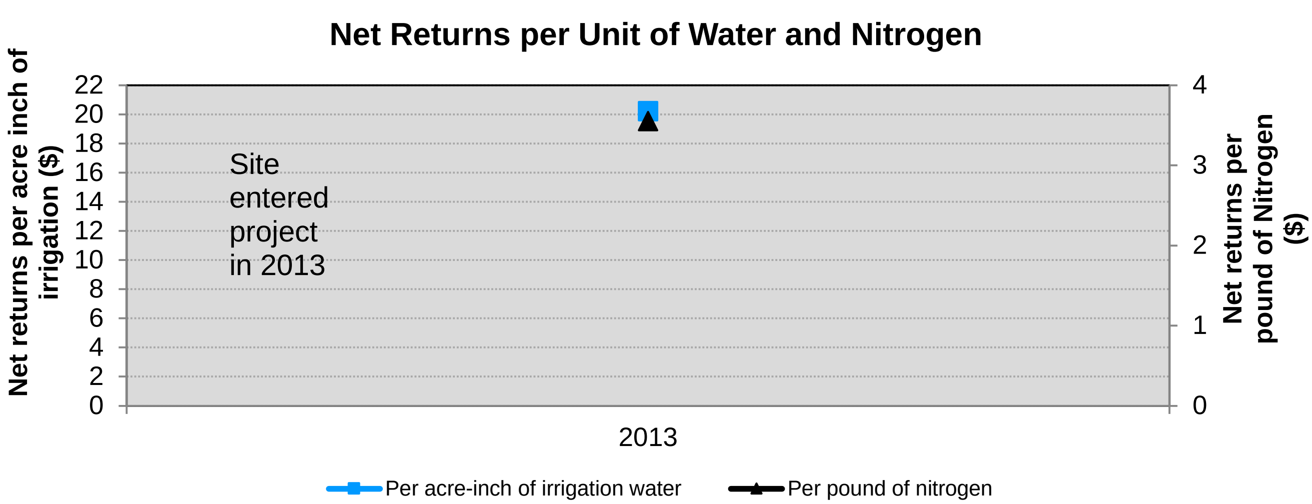


Growers can have better crop and water management insights by knowing the crop's physiological growth stage, ambient weather conditions combined with crop canopy temperatures. With this information a grower can determine what level of plant stress the crop is experiencing and can adjust his water management practices accordingly.

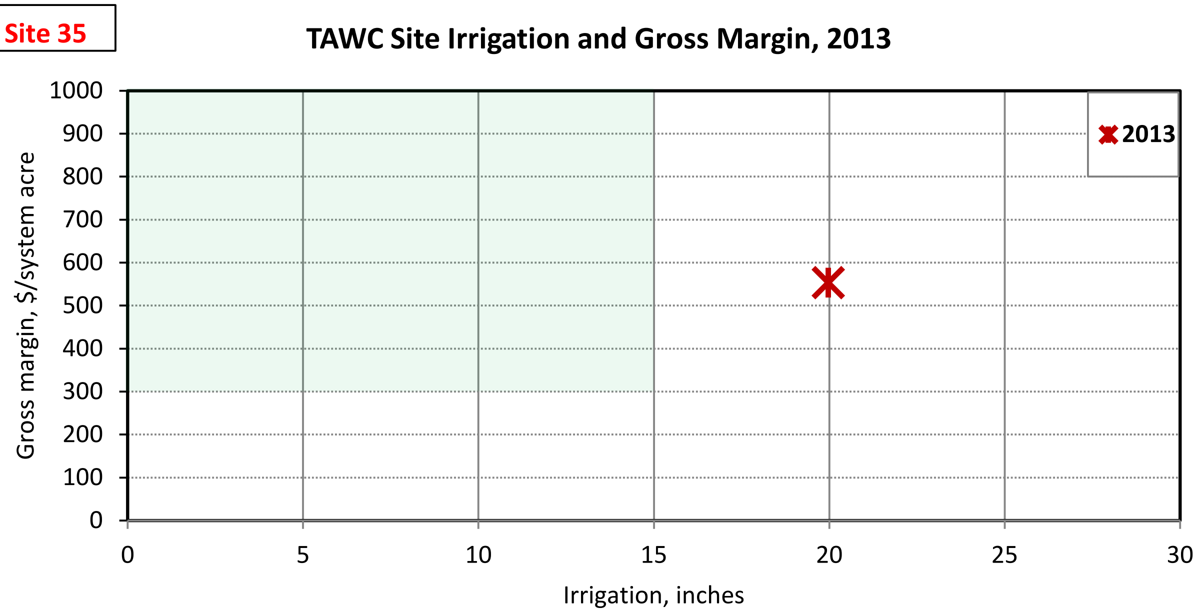
Site 35


Irrigation and Precipitation
Water (inches)
40
30
20
10
0
Site entered project in 2013
2013
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
500
400
300
200
100
0
Site entered project in 2013
2013
Per system acre


Net Returns per Unit of Water and Nitrogen
Net returns per acre inch of irrigation ($)
22
20
18
16
14
12
10
8
6
4
2
0
Site entered project in 2013
2013
Net returns per pound of Nitrogen ($)
4
3
2
1
0
Per acre-inch of irrigation water
Per pound of nitrogen

Site 35


TAWC Site Irrigation and Gross Margin, 2013
Gross margin, $/system acre
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Irrigation, inches
2013

Economic Summaries of Results from Monitoring Producer Sites in 2005-2013.

Economic assumptions of data collection and interpretation

1. Although actual depth to water in wells located among the producer sites varies, a pumping depth of 303 feet is assumed for all irrigation points. The actual depth to water influences costs and energy used to extract water but has nothing to do with the actual functions of the system to which this water is delivered. Thus, a uniform pumping depth is assumed.

2. All input costs and prices received for commodities sold are uniform and representative of the year and the region. Using an individual's actual costs for inputs would reflect the unique opportunities that an individual could have for purchasing in bulk or being unable to take advantage of such economies and would thus represent differences between individuals rather than the system. Likewise, prices received for commodities sold should represent the regional average to eliminate variation due to an individual's marketing skill.

3. Irrigation system costs are unique to the type of irrigation system. Therefore, annual fixed costs were calculated for each type of irrigation system taking into account the average cost of equipment and expected economic life.

4. Variable cost of irrigation across all systems was based on a center pivot system using electricity as the energy source. Variable costs are nearly constant across irrigation systems, according to Amosson et al. (2011)[2], so this assumption has negligible effect on the analysis. The estimated cost per acre-inch includes the cost of energy, repair and maintenance cost, and labor cost. The primary source of variation in variable cost from year to year is due to changes in the unit cost of energy and repair and maintenance costs.

5. Mechanical tillage operations for each individual site were accounted for with the cost of each field operation being based on typical custom rates for the region. Using custom rates avoids the variations among sites in the types of equipment owned and operated by individuals.

Economic Term Definitions

Gross Income – The total revenue received per acre from the sale of production

Variable Costs – Cash expenses for production inputs including interest on operating loans.

Gross Margin – Total revenue less total variable costs

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

[2] Amosson, L. et al. 2011. Economics of irrigation systems. Texas A&M AgriLife Extension Service. B-6113.

Net Returns – Gross margin less fixed costs.

Assumptions of energy costs, prices, fixed and variable costs (Tables 12-14)

1. Irrigation costs were based on a center pivot system using electricity as the energy source.

Table 12. Electricity irrigation cost parameters for 2005 through 2013.

Item	2005	2006	2007	2008	2009	2010	2011	2012	2013
Gallons per minute (gpm)	450	450	450	450	450	450	450	450	450
Pumping lift (feet)	260	250	252	254	256	285	290	300	303
Discharge Pressure (psi)	15	15	15	15	15	15	15	15	15
Pump efficiency (%)	60	60	60	60	60	60	60	60	60
Motor Efficiency (%)	88	88	88	88	88	88	88	88	88
Electricity Cost per kWh	$0.085	$0.085	$0.090	$0.110	$0.140	$0.081	$0.086	$0.100	$0.140
Cost of Electricity per Ac. In.	$4.02	$4.26	$5.06	$6.60	$3.78	$4.42	$4.69	$5.37	$8.26
Cost of Maint. & Repairs per Ac. In.	$2.05	$2.07	$2.13	$2.45	$3.37	$3.49	$4.15	$3.83	$3.87
Cost of Labor per Ac. In	$0.75	$0.75	$0.80	$0.90	$0.90	$0.90	$0.90	$1.00	$1.10
Total Cost per Ac. In.	$6.82	$7.08	$7.99	$9.95	$8.05	$8.81	$9.74	$10.20	$13.23

2. Commodity prices are reflective of the production year; however, prices were constant across sites.

Table 13. Commodity prices for 2005 through 2013.

Commodity	2005	2006	2007	2008	2009	2010	2011	2012	2013
Cotton lint ($/lb)	$0.54	$0.56	$0.58	$0.55	$0.56	$0.75	$0.90	$0.90	$0.80
Cotton seed ($/ton)	$100	$135	$155	$225	$175	$150	$340	$280	$260
Grain Sorghum – Grain ($/cwt)	$3.85	$6.10	$5.96	$7.90	$6.48	$9.51	$9.75	$13.10	$8.50
Grain Sorghum – Seed ($/lb)	-	-	-	-	-	-	-	$0.17	
Corn – Grain ($/bu)	$2.89	$3.00	$3.69	$5.71	$3.96	$5.64	$5.64	$6.00	$5.00
Corn – Food ($/bu)	$3.48	$3.55	$4.20	$7.02	$5.00	$4.88	$7.50	$7.50	$6.80
Barley ($/cwt)	-	-	-	-	-	-	-	$14.08	$14.08
Wheat – Grain ($/bu)	$2.89	$4.28	$4.28	$7.85	$5.30	$3.71	$5.75	$6.85	$6.85
Sorghum Silage ($/ton)	$20.19	$18.00	$18.00	$25.00	$24.00	$24.00	$24.00	$24.00	$24.00
Corn Silage ($/ton)	$20.12	$22.50	$25.00	$25.00	$42.90	$43.50	$43.50	$43.50	$45.00
Wheat Silage ($/ton)	$18.63	$22.89	$22.89	$29.80	$26.59	$26.59	$26.59	$26.59	$26.59
Oat Silage ($/ton) -	$17.00	$17.00	-	$14.58	-	-	-	$14.58	$14.58
Millet Seed ($/lb)	$0.17	$0.17	$0.22	$0.25	-	$0.25	$0.25	$0.25	$0.38
Sunflowers ($/lb)	$0.21	$0.21	$0.21	$0.29	$0.27	-	-	$0.39	$0.38
Alfalfa ($/ton)	$130	$150	$150	$160	$160	$185	$350	$350	$250
Hay ($/ton)	$60	$60	$60	$60	$60	-	-	$60	$60
WWB Dahl Hay ($/ton)	$65	$65	$90	$90	-	$60	$200	$200	$108
Hay Grazer ($/ton)	-	$110	$110	$70	$110	$65	$65	$125	$104
Sideoats Seed ($/lb)	-	-	$6.52	$6.52	$3.90	$8.00	$5.70	$5.70	$9.00
Sideoats Hay ($/ton)	-	-	$64	$64	$70	$60	$220	$220	$60
Triticale Silage ($/ton)	-	-	-	-	-	-	-	$45	$45
Triticale Forage ($/ton)	-	-	-	-	-	-	-	$24	$24

3. Fertilizer and chemical costs (herbicides, insecticides, growth regulators, and harvest aids) are reflective of the production year; however, prices were constant across sites for the product and formulation.

4. Other variable and fixed costs are given for 2005 through 2013 in Table 14.

Table 14. Other variable and fixed costs for 2005 through 2013.

VARIABLE COSTS	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Boll weevil assessment: ($/ac)									
Irrigated cotton	$12.00	$12.00	$12.00	$1.50	$1.00	$1.00	$1.00	$1.00	$1.00
Dryland cotton	$6.00	$6.00	$6.00	$1.50	$1.00	$1.00	$1.00	$1.00	$1.00
Crop insurance: ($/ac)									
Irrigated cotton	$17.25	$17.25	$17.25	$20.00	$20.00	$20.00	$30.00	$30.00	$30.00
Dryland cotton	$12.25	$12.25	$12.25	$12.25	$12.25	$12.25	$20.00	$20.00	$20.00
Irrigated corn	$15.00	$15.00	$15.00	$15.00	$15.00	$15.00	$15.00	$15.00	$15.00
Irrigated corn silage	-	-	-	-	-	-	-	$11.00	$11.00
Irrigated Wheat	-	-	-	-	-	-	-	$5.00	$5.00
Irrigated Sorghum Grain	-	-	-	-	-	-	-	$2.00	$2.00
Dryland Sorghum Grain	-	-	-	-	-	-	-	$2.00	$2.00
Irrigated Sorghum Silage	-	-	-	-	-	-	-	$2.00	$2.00
Irrigated Sunflowers	-	-	-	-	-	-	-	$5.00	$5.00
Cotton harvest – strip and module ($/lint lb)	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08
Cotton ginning ($/cwt)	$1.95	$1.75	$1.75	$1.95	$1.95	$1.95	$1.95	$1.95	$2.10
Bags, Ties, & Classing ($/bale)	$17.50	$19.30	$17.50	$18.50	$18.50	$18.50	$18.50	$18.50	$18.50

FIXED COSTS	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Irrigation system:									
Center Pivot system	$33.60	$33.60	$33.60	$33.60	$33.60	$40.00	$40.00	$40.00	$40.00
Drip system	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00
Flood system	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00
Cash rent:									
Irrigated cotton, grain sorghum, sun-flowers, grass, pearl millet, and sorghum silage.	$45.00	$45.00	$45.00	$75.00	$75.00	$100.00	$100.00	$100.00	$100.00
Irrigated corn silage, corn grain, and alfalfa.	$75.00	$75.00	$75.00	$100.00	$100.00	$140.00	$140.00	$140.00	$140.00
Dryland cropland	$15.00	$15.00	$15.00	$25.00	$25.00	$30.00	$30.00	$30.00	$30.00

5. The custom tillage and harvest rates used for 2005 were based on rates reported in USDA-NASS, 2004 Texas Custom Rates Statistics, Bulletin 263, September 2005. The custom rates used for 2006 were 115% of the reported 2004 rates to reflect increased cost of operation due to rising fuel prices and other costs while 2007 rates were 120% of the 2006 rates. 2008 rates were calculated at 125% of 2007 due to a 25% rise in fuel prices. 2009 rates were unchanged from 2008, as fuel prices stabilized. 2010 rates were estimated based on the most recent survey from Texas AgriLife Extension Service. 2011 rates were increased approximately 39% from 2010 rates to adjust for increased fuel expenses of 26% and increased expenses for repairs and maintenance. 2013 rates were unchanged from 2012 and 2011.

Table 15. Summary of results from monitoring 26 producer sites in 2005 (Year 1).

System	Site No.	Acres	Irrigation Type[1]	System Inches	$/system Acre	$/inch water
Monoculture systems						
Cotton	1	61	SDI	11.7	84.02	7.19
Cotton	2	68	SDI	8.9	186.94	21
Cotton	14	125	CP	6.8	120.9	17.91
Cotton	16	145	CP	7.6	123.68	16.38
Cotton	21	123	CP	6.8	122.51	18.15
Cotton	11	95	Fur	9.2	4.39	0.48
Cotton	15	98	Fur	4.6	62.65	13.62
Multi-crop systems						
Cotton/grain sorghum	3	125	CP	8.3	37.79	4.66
Cotton/grain sorghum	18	120	CP	5.9	16.75	2.84
Cotton/grain sorghum	25	179	DL	0	67.58	na
Cotton/forage sorghum	12	250	DL	0	36	na
Cotton/pearlmillet	19	120	CP	9.5	186.97	19.12
Cotton/corn	22	148	CP	15.3	166.63	10.9
Cotton/corn	24	129	CP	14.7	149.87	9.96
Cotton/corn	26	123	CP	10.5	192.44	18.34
Cotton/sunflowers	23	110	CP	5.4	270.62	47.07
Cotton/alfalfa	4	123	CP	5.5	110.44	19.06
Cotton/wheat	13	315	DL	0	47.37	na
Cotton/corn silage/grass	17	223	CP	10.5	188.44	17.91
Corn/wheat/sorghum silages	20	220	CP	21.5	-48.6	-2.16
Crop-Livestock systems						
Cotton/wheat/stocker cattle	6	123	CP	11.4	162.63	9.04
Cotton/grass/stocker cattle	9	237	CP	6.5	298.14	46.17
Cotton/grass/cattle	10	175	CP	8.5	187.72	22.06
Forage/beef cow-calf	5	630	CP	1.23	125.89	93.34
Forage/Grass seed	7	61	SDI	9.8	425.32	37.81
Forage/Grass seed	8	130	CP	11.3	346.9	35.56

[1]SDI – Subsurface drip irrigation; CP – center pivot; Fur – furrow irrigation; DL – dryland

Table 16. Summary of results from monitoring 26 producer sites in 2006 (Year 2).

System	Site No.	Acres	Irrigation type[1]	System inches	$/system acre	$/inch water	Gross margin per inch irrigation
Monoculture systems							
Cotton	1	135	SDI	21	225.9	10.76	15.77
Cotton	2	61	SDI	19	308.71	16.25	22.56
Cotton	27	46	SDI	18	417.99	23.22	29.89
Cotton	3	123	CP	10	105.79	10.58	18.44
Cotton	6	123	CP	13.6	321.79	23.64	29.42
Cotton	14	124	CP	6.2	44.81	7.2	19.84
Cotton	16	143	CP	12.2	71.08	5.81	8.43
Cotton	11	93	Fur	16.9	88.18	5.22	9.37
Multi-crop systems							
Cotton/grain sorghum	15	96	Fur	11.2	161.89	14.51	20.78
Cotton/forage sorghum	12	284	DL	0	-13.72	na	na
Cotton/forage sorghum/oats	18	122	CP	12	-32.31	-2.69	3.86
Cotton/pearlmillet	19	120	CP	9.8	95.28	9.77	17.83
Cotton/corn	22	149	CP	22	285.98	12.98	16.55
Cotton/corn	24	130	CP	19.4	68.17	3.51	8.34
Cotton/corn	26	123	CP	16	243.32	15.22	21.08
Cotton/corn	23	105	CP	14.8	127.39	8.59	13.9
Cotton/alfalfa/wheat/ forage sorghum	4	123	CP	26.7	312.33	11.69	14.75
Cotton/wheat	13	320	DL	0	-33.56	na	na
Corn/triticale/sorghum silages	20	233	CP	21.9	242.79	10.49	15.17
Crop-Livestock systems							
Cotton/stocker cattle	21	123	CP	16.4	94.94	5.79	10.22
Cotton/grass/stocker cattle	9	237	CP	10.6	63.29	6.26	13.87
Cotton/corn silage/wheat/cattle	17	221	CP	13	242.21	14.89	20.64
Forage/beef cow-calf	5	628	CP	9.6	150.46	15.62	22.31
Forage/beef cow-calf	10	174	CP	16.1	217.71	13.52	18.4
Forage/Grass seed	7	130	CP	7.8	687.36	88.69	98.83
Forage/Grass seed	8	62	SDI	10.1	376.36	48.56	64.05

[1]SDI – Subsurface drip irrigation; CP – center pivot; Fur – furrow irrigation; DL – dryland

Table 17. Summary of results from monitoring 26 producer sites during 2007 (Year 3).

System	Site No.	Acres	Irrigation Type[1]	System inches	$/system acre	$/inch water	Gross margin per inch irrigation
Monoculture systems							
Cotton	1	135	SDI	14.60	162.40	11.12	19.34
Cotton	2	61	SDI	12.94	511.33	39.52	48.79
Cotton	6	123	CP	10.86	605.78	55.78	63.02
Cotton	11	93	Fur	14.67	163.58	11.15	15.92
Cotton	14	124	CP	8.63	217.38	25.19	34.30
Cotton	22	149	CP	11.86	551.33	46.49	53.11
Corn	23	105	CP	10.89	325.69	29.91	37.12
Corn	24	130	CP	15.34	373.92	24.38	31.46
Perennial grass: seed and hay	7	130	CP	13.39	392.59	29.32	35.19
Perennial grass: seed and hay	8	62	SDI	15.67	292.63	18.67	26.33
Multi-crop systems							
Cotton/grain sorghum/wheat	3	123	CP	13.25	190.53	14.38	20.31
Cotton/grain sorghum	12	284	DL	0.00	265.71	Dryland	Dryland
Cotton/wheat	13	320	DL	0.00	105.79	Dryland	Dryland
Cotton/grain sorghum	15	96	Fur	10.50	191.68	18.26	24.92
Grain sorghum/wheat	18	122	CP	5.34	13.91	2.60	13.62
Cotton/pearlmillet	19	121	CP	7.57	318.61	42.10	52.49
Corn/sorghum/triticale silages	20	233	CP	24.27	371.14	15.29	19.76
Corn/perr. grass: seed and hay	21	123	CP	8.35	231.60	27.75	37.16
Corn silage	27	62	SDI	13.00	194.40	14.95	24.18
Crop-Livestock systems							
Wheat: cow-calf, grain/cotton/alfalfa hay	4	123	CP	8.18	183.72	22.47	33.30
Perennial grass: cow-calf, hay	5	628	CP	3.56	193.81	54.38	72.45
Perr. grass, rye: stocker cattle/grain sorghum	9	237	CP	4.19	48.89	11.65	30.00
Perennial grass: cow-calf, hay/corn silage	10	174	CP	6.80	27.84	4.09	14.74
Perennial grass: cow-calf, seed, hay/cotton/wheat for grazing	17	221	CP	8.31	181.48	21.83	33.06
Pearlmillet: seed, grazing/corn	26	123	CP	11.34	378.61	33.39	41.65

[1]SDI – Subsurface drip irrigation; CP – center pivot; Fur – furrow irrigation; DL – dryland

Table 18. Summary of results from monitoring 25 producer sites during 2008 (Year 4).

System	Site No.	Acres	Irrigation Type[1]	System inches	$/system acre	$/inch water	Gross margin per inch irrigation
Monoculture Systems							
Sunflowers	2	60.9	SDI	6.89	147.83	21.46	43.23
Perennial grass: seed and hay	7	130.0	CP	9.88	295.43	29.90	40.89
Perennial grass: seed and hay	8	61.8	SDI	6.65	314.74	47.33	69.89
Cotton	14	124.2	CP	8.97	-2.12	-0.24	11.87
Corn	22	148.7	CP	24.75	720.10	29.09	34.49
Corn	24	129.8	CP	24.70	513.54	20.79	26.20
Corn	28	51.5	SDI	8.20	591.15	72.09	93.43
Multi-crop systems							
Cotton/Wheat/Grain sorghum	3	123.3	CP	14.75	53.79	3.65	11.01
Cotton/Corn	6	122.9	CP	17.35	411.02	23.68	29.94
Cotton/Grain sorghum	11	92.5	Fur	10.86	176.14	16.22	25.43
Sorghum silage/fallow wheat	12	283.9	DL	0.00	-17.89	Dryland	Dryland
Cotton/Wheat	15	95.5	Fur/SDI	11.22	132.15	11.78	21.57
Cotton/Wheat silage/Grain sorghum hay & silage	18	122.2	CP	10.67	186.42	17.47	27.64
Cotton/Seed millet	19	120.4	CP	7.01	121.40	17.33	32.83
Wheat grain/Grain sorghum grain & silage/hay	20	233.4	CP	27.61	513.56	18.60	22.54
Barley seed/forage sorghum hay/perr. Grass: seed & hay	21	122.7	CP	10.13	387.20	38.24	48.96
Cotton/Sunflowers	23	105.1	CP	14.93	-50.54	-3.38	4.60
Cotton/Corn grain	27	108.5	SDI	20.69	291.15	14.07	22.01
Cotton/Wheat/fallow	29	221.6	DL	0.00	34.06	Dryland	Dryland
Crop-Livestock systems							
Wheat: cow-calf, grain/cotton/alfalfa hay	4	123.1	CP	14.51	154.85	10.68	17.00
Perennial grass: cow-calf, hay	5	628	CP	4.02	107.14	26.65	49.02
Perennial Grass: stocker cattle/Cotton	9	237.8	CP	7.26	11.63	1.60	16.25
Perennial grass: cow-calf, hay/Grass seed/Corn	10	173.6	CP	14.67	64.80	4.42	0.00
Perennial grass: cow-calf, seed, hay/cotton/wheat for grazing	17	220.8	CP	15.00	309.34	20.62	28.68
Pearlmillet: seed, Grain sorghum/Corn: grazing, hay	26	125.2	CP	14.65	279.69	19.09	27.36

[1]SDI – Subsurface drip irrigation; CP – center pivot; Fur – furrow irrigation; DL – dryland

Table 19. Summary of results from monitoring 26 producer sites during 2009 (Year 5).

System	Site No.	Acres	Irrigation Type[1]	System inches	$/system acre	$/inch water	Gross margin per inch irrigation
Monoculture Systems							
Cotton	2	60.9	SDI	10.50	-52.29	-4.98	9.31
Perennial grass: seed and hay	7	129.9	CP	15.70	597.23	38.04	44.96
Perennial grass: seed and hay	8	61.8	SDI	13.80	365.46	26.48	37.35
Cotton	15	102.8	Fur/SDI	12.96	72.15	5.57	12.39
Cotton	22	148.7	CP	14.73	56.35	3.83	11.20
Cotton	28	51.5	SDI	10.89	187.72	17.24	31.01
Sunflower	30	21.8	SDI	9.25	8.13	0.88	17.10
Multi-crop systems							
Cotton/Grain Sorghum	3	123.3	CP	5.89	158.51	26.91	45.35
Cotton/Corn	6	122.9	CP	10.43	182.14	17.52	28.49
Cotton/Rye	9	237.8	CP	3.17	-11.71	-3.69	30.52
Cotton/Grain Sorghum	11	92.5	Fur	13.24	53.67	4.05	11.60
Sorghum silage/Wheat	12	283.9	DL	0.00	-8.81	Dryland	Dryland
Wheat grain/Cotton	14	124.2	CP	10.57	37.15	3.52	13.79
Wheat grain/Cotton	18	122.2	CP	3.53	44.88	12.71	43.47
Wheat grain/Cotton	19	120.3	CP	5.26	-4.88	-0.93	19.71
Corn silage/Cotton	20	233.3	CP	23.75	552.08	23.25	28.35
Wheat grain/Hay/perennial grass	21	122.6	CP	17.75	79.79	4.50	10.61
Oats/Wheat/Sorghum – all silage	23	105.2	CP	15.67	53.80	3.43	10.36
Corn/Sunflower	24	129.7	CP	13.09	172.53	13.18	22.42
Corn/Cotton	27	108.5	SDI	23.00	218.72	9.51	16.63
Wheat grain/Cotton	29	221.6	DL	0.00	73.79	Dryland	Dryland
Crop-Livestock systems							
Wheat/haygrazer; contract grazing, grain sorghum/cotton/alfalfa hay	4	123.1	CP	9.03	119.85	13.28	25.67
Perennial grass: cow-calf, hay	5	626.4	CP	6.60	53.76	8.15	21.79
Perennial grass: contract grazing, /Cotton	10	173.6	CP	6.04	-83.25	-13.79	4.20
Perennial grass: contract grazing, /sunflower/dahl for seed and grazing	17	220.8	CP	7.09	71.37	10.07	25.39
Corn/Sunflower, contract grazing	26	125.2	CP	14.99	316.22	21.09	29.16

[1]SDI – Subsurface drip irrigation; CP – center pivot; Fur – furrow irrigation; DL – dryland

Table 20. Summary of results from monitoring 26 producer sites during 2010 (Year 6).

System	Site No.	Acres	Irrigation Type[1]	System inches	$/system acre	$/inch water	Gross margin per inch irrigation
Monoculture systems							
Corn	2	60.9	SDI	14.04	107.81	7.68	22.99
Perennial grass: seed and hay	7	130	CP	2.37	460.56	194.33	253.40
Perennial grass: seed and hay	8	61.8	SDI	3.25	498.82	153.48	207.33
Cotton	15	102.8	Fur/SDI	3.98	489.46	122.85	166.77
Corn	22	148.7	CP	16.10	370.88	23.04	34.22
Corn	24	129.7	CP	17.90	271.50	15.17	25.22
Cotton	28	51.5	SDI	6.24	298.35	47.81	75.86
Corn	30	21.8	SDI	11.90	563.63	47.36	65.43
Multi-crop systems							
Cotton/Grain Sorghum/Wheat	3	123.3	CP	9.15	191.55	20.93	38.10
Alfalfa/Cotton/Wheat/Hay	4	123	CP	11.11	365.89	32.92	45.99
Cotton/Corn	6	122.8	CP	9.88	323.38	32.72	48.88
Cotton/Grain Sorghum	11	92.5	Fur	4.41	6,9,10	38.93	67.25
	12	283.9	DL	0.00	0.00	Dryland	Dryland
Wheat grain/Cotton	14	124.2	CP	4.30	73.13	17.02	49.59
Wheat grain/Cotton	18	122.2	CP	1.11	78.24	70.66	197.11
Wheat grain/Cotton	19	120.3	CP	4.31	134.55	31.21	63.69
Corn/Trit Silage/Cotton	20	233.4	CP	16.69	817.74	49.01	59.80
Cotton/Corn	21	122.6	CP	10.45	246.09	23.54	38.85
Trit/Corn Silage	23	121.1	CP	20.70	-7.64	-0.37	8.33
Corn Silage/Cotton	27	108.5	SDI	14.70	565.29	38.46	51.59
Grain Sorghum/Cotton	29	221.6	DL	0.00	235.29	Dryland	Dryland
Crop-Livestock systems							
Perennial grass: cow-calf, Hay	5	628	CP	5.15	44.47	8.63	31.08
Perennial grass: contract grazing, /Cotton	9	237.8	CP	2.19	129.12	58.98	122.93
Perennial grass: contract grazing, /Corn	10	173.6	CP	12.00	140.43	25.32	57.36
Perennial grass: contract grazing, /Corn	17	220.8	CP	8.94	6.82	0.76	18.62
Wheat/Cotton/Corn, contract grazing	26	125.2	CP	10.73	416.76	38.85	53.75

[1]SDI – Subsurface drip irrigation; CP – center pivot; Fur – furrow irrigation; DL – dryland

Table 21. Summary of results from monitoring 29 producer sites during 2011 (Year 7).

System	Site No.	Acres	Irrigation Type[1]	System inches	$/system acre	$/inch water	Gross margin per inch irrigation
Monoculture systems							
Cotton	2	60.9	SDI	16.61	122.37	7.37	17.90
Cotton	3	123.3	CP/MESA	9.30	-102.89	-11.07	3.99
Perennial grass: seed and hay	7	130	CP/LESA	20.50	370.64	18.08	24.91
Perennial grass: seed and hay	8	61.8	SDI	20.04	93.50	4.67	13.40
Cotton	12	283.9	DL	0.00	230.29	Dryland	Dryland
Cotton	14	124.2	CP/MESA	17.80	-226.26	-12.71	-4.85
Cotton	19	120.3	CP/LEPA	19.90	141.92	7.13	14.17
Cotton	22	148.7	CP/LEPA	25.20	538.44	21.37	26.92
Cotton	28	51.5	SDI	18.80	319.90	17.02	26.32
Cotton	29	221.6	DL	0.00	194.89	Dryland	Dryland
Fallow	30	21.8	SDI	0.00	-215.00	Fallow	Fallow
Corn	32	70	CP/LEPA	37.00	-866.35	-23.41	-18.55
Corn	33	70	CP/LEPA	12.00	-67.05	-5.59	9.41
Multi-crop systems							
Alfalfa/Cotton/Wheat /Haygraze	4	123	CP/LEPA	25.32	519.67	20.53	26.26
Cotton/fallow	5	487.6	CP/LESA	3.71	162.53	43.82	81.56
Cotton/Corn	6	122.8	CP/LESA	18.94	179.82	9.49	17.40
Cotton/Grain Sorghum	11	92.5	Fur	27.80	-81.18	-2.92	1.58
Corn/Cotton	15	102.8	SDI	19.31	346.96	17.97	27.95
Wheat grain/Cotton	18	122.2	CP/MESA	0.93	31.02	33.35	183.89
Corn/Trit Silage/Cotton	20	233.4	CP/LEPA	52.08	250.23	4.80	8.26
Cotton/Corn	21	122.6	CP/LEPA	17.91	157.78	8.81	17.75
Trit/Corn Silage	23	121.1	CP/LESA	33.85	112.64	3.33	8.65
Corn grain/Cotton	24	129.7	CP/LESA	26.54	537.36	20.25	26.27
Corn/Cotton	26	125.2	CP/LESA	16.57	433.62	26.16	35.81
Corn Silage/Cotton	27	108.5	SDI	38.20	229.80	6.02	11.17
Cotton/Seed millet	31	121	CP/LEPA	27.90	12.26	0.44	5.46
Crop-Livestock systems							
Perennial grass: contract grazing, /Cotton	9	237.8	CP/MESA	8.45	72.39	8.56	25.12
Perennial grass: contract grazing, /Cotton	10	173.6	CP/LESA	30.02	592.02	19.72	24.38
Perennial grass: contract grazing, /Cotton	17	220.8	CP/MESA	22.00	116.96	5.32	11.68

[1]SDI – Subsurface drip irrigation; CP – center pivot; Fur – furrow irrigation; DL – dryland

Table 22. Summary of results from monitoring 29 producer sites during 2012 (Year 8).

System	Site No.	Acres	Irrigation Type[1]	System inches	$/system acre	$/inch water	Gross margin per inch irrigation
Monoculture systems							
Cotton	3	123.3	CP/MESA	8.40	822.71	97.93	114.60
Cotton/fallow	5	484.1	CP/LESA	10.53	-55.06	-5.23	5.71
Corn grain/fallow	6	122.7	CP/LESA	17.29	-76.28	-4.41	2.52
Perennial grass: seed and hay	7	130	CP/LESA	20.60	696.38	33.80	40.60
Perennial grass: seed and hay	8	61.8	SDI	17.30	712.46	41.18	51.30
Cotton (No Data)	12	283.8	DL	0.00	0.00	Dryland	Dryland
Cotton/fallow	19	120.4	CP/LEPA	7.33	177.03	24.16	40.50
Cotton	22	148.7	CP/LEPA	19.50	918.83	47.12	54.30
Cotton	30	21.8	SDI	13.60	-53.60	-3.94	8.93
Corn grain	33	70	CP/LEPA	18.70	-298.65	-15.97	-6.34
Multi-crop systems							
Cotton/Corn grain	2	60	SDI	12.06	545.42	45.23	61.73
Alfalfa/Cotton/Wheat/ Seed Sorghum	4	123	CP/LEPA	15.54	320.03	20.59	26.24
Cotton (failed)/Grain Sorghum	11	92.5	Fur	12.00	463.87	38.66	49.07
Cotton/Wheat	14	124.1	CP/MESA	6.51	-99.71	-15.31	6.19
Cotton (failed)/Grain Sorghum	15	101.1	SDI	27.43	591.80	21.57	27.95
Perennial grass: contract grazing, /Cotton/Corn g.	17	220.7	CP/MESA	17.40	890.46	51.18	59.23
Wheat/Cotton (No Data)	18	122.2	CP/MESA	0.00	0.00	0.00	0.00
Corn/Trit Silage/Cotton	20	233.3	CP/LEPA	29.53	609.85	20.66	26.08
Wheat/Haygrazer/Cott on	21	122.6	CP/LEPA	19.41	542.88	27.97	35.19
Corn grain/Cotton	24	129.7	CP/LESA	19.94	788.27	39.53	47.55
Sunflowers/Cotton	26	125.1	CP/LESA	14.95	235.53	15.75	25.12
Corn Silage/Cotton	27	108.4	SDI	16.98	953.77	56.17	66.40
Cotton (hail)/Corn grain	28	51.5	SDI	19.6	-138.03	-7.04	1.89
Cotton/Grain Sorghum	29	221.6	DL	0.00	9.39	Dryland	Dryland
Cotton/Seed millet	31	121.9	CP/LEPA	20.36	167.05	8.21	15.08
Cotton (hail)/Corn grain	32	70	CP/LEPA	21.50	194.39	9.04	17.41
Cotton (hail)/Corn grain	34	726.6	CP/LESA	10.00	358.39	35.84	51.84
Crop-Livestock systems							
Perennial grass: contract grazing, /Cotton	9	237.8	CP/MESA	11.46	391.18	34.14	46.35
Perennial grass: contract grazing, /Cotton	10	173.6	CP/LESA	23.02	29.08	1.26	8.22

[1]SDI – Subsurface drip irrigation; CP – center pivot; Fur – furrow irrigation; DL – dryland

Table 23. Summary of results from monitoring 29 producer sites during 2013 (Year 9).

System	Site No.	Acres	Irrigation Type[1]	System inches	$/system acre	$/inch water	Gross p irr
Monoculture systems							
Perennial grass: seed/hay	7	130	CP/LESA	10.3	403.68	39.19	
Perennial grass: seed/hay	8	61.8	SDI	14.1	983.54	69.75	
Cotton	11	92.5	FUR	12.0	-18.10	-1.51	
Cotton – No Data	12	283.8	DL	0	0.00	Dryland	
Cotton (2 in 2 out)	14	124.1	CP/LESA	7.5	371.85	49.58	
Cotton	15	101.1	SDI	17.65	858.11	48.62	
Fallowed	18	122.2	CP/MESA	0	0.00	0.00	
Cotton (2 in 2 out)	19	120.3	CP/LEPA	12.0	199.93	16.66	
Cotton	22	148.7	CP/LEPA	24.5	424.35	17.32	
Cotton	28	51.4	SDI	17.5	163.36	9.33	
Cotton (failed, collected ins.)	29	221.6	DL	0	3.79	Dryland	
Corn	30	21.8	SDI	13	-30.84	-2.37	
Corn	32	70	CP/LEPA	20.6	196.45	9.54	
Corn	33	70	CP/LEPA	26.8	188.99	7.05	
Multi-crop systems							
Cotton/Corn grain	2	59.9	SDI	21.0	262.95	12.54	
Cotton/Grain Sorghum	3	123.3	CP/MEPA	16.2	334.56	20.59	
Wheat/Millet/Cotton/Sunflower	5	484.1	CP/LESA	10.3	454.87	44.37	
Wheat/Cotton	6	122.7	CP/LESA	17.0	149.62	8.78	
Dahl/Corn/Sunflower	17	220.7	CP/MESA	12.2	118.60	9.76	
Trit silage/Corn silage/Cotton	20	233.3	CP/LEPA	27.3	704.25	25.78	
Wheat/Haygrazer/Corn	21	122.6	CP/LEPA	19.9	286.14	14.38	
Corn grain/Sunflower	24	129.7	CP/LESA	17.2	392.45	22.78	
Wheat/Corn	26	125.1	CP/LESA	11.9	157.18	13.20	
Corn Silage/Cotton	27	108.4	SDI	36.3	673.31	18.55	
Cotton/Seed millet	31	121.9	CP/LEPA	20.0	469.53	23.52	
Corn/Sunflower	34	726.6	CP/LESA	14.1	445.30	31.58	
Grain Sorghum/Corn/Cotton	35	229.3	SDI	20.0	403.82	20.22	
Crop-Livestock systems							
Alfalfa/Cotton/Wheat/Seed Sorghum	4	122.9	CP/LEPA	18.3	420.87	23.05	
Perennial grass: contract grazing/cotton	9	237.7	CP/MESA	8.7	277.95	31.89	
Perennial grass: contract grazing/cotton	10	173.6	CP/LESA	18.5	242.86	13.14	

[1]SDI – Subsurface drip irrigation; CP – center pivot; FUR – furrow irrigation; DL – dryland

Table 24. Overall summary of crop production, irrigation, and economic returns within all production sites in Hale and Floyd Counties during 2005-2013.

Item			2005	2006	2007	2008	2009	2010	2011	2012	2013	Crop Year Average
Mean Yields, per acre (only includes sites producing these crops, includes dryland) {Yield averages across harvested fields within sites}												
	Cotton											
		Lint, lbs	1,117 (22) [1]	1,379 (20)	1,518 (13)	1,265 (11)	1,223 (16)	1,261 (15)	1,166 (19)	1,299 (16)	1,470 (19)	1,300
		Seed, tons	0.80 (22)	0.95 (20)	1.02 (13)	0.86 (11)	0.81 (16)	0.83 (15)	0.77 (19)	0.92 (16)	1.0 (19)	0.9
	Corn											
		Grain, lbs	12,729 (3)	8,814 (4)	12,229 (4)	10,829 (8)	12,613 (4)	12,685 (10)	6,766 (4)	7,475 (7)	11,982 (9)	10,680
		Silage, tons	30.9 (2)	28.3 (3)	27.3 (3)	-	38.3 (1)	31 (2)	20.5 (3)	6.3 (4)	32 (5)	26.8
	Sorghum											
		Grain, lbs	4,147 (3)	2,987 (1)	6,459 (4)	6,345 (5)	6,907 (3)	4,556 (3)	1,196 (1)	6,358 (2)	8,124 (3)	5,231
		Silage, tons	26.0 (1)	20.4 (2)	25.0 (1)	11.3 (2)	9.975 (2)	-	-	-	-	18.5
		Seed, lbs	-	-	-	3,507 (1)	-	-	-	3,396 (1)	-	3,438
	Wheat											
		Grain, lbs	2,034 (1)	-	2,613 (5)	4,182 (5)	2,061 (6)	2,860 (6)	3,060 (1)	2,052 (3)	798 (3)	2,458
		Silage, tons	16.1 (1)	7.0 (1)	-	7.5 (1)	3.71 (1)	-	-	-	-	8.6
		Hay, tons	-	-	-	-	2.5 (1)	-	-	-	0.5 (2)	1.5
	Oat											
		Silage, tons	-	4.9 (1)	-	-	12.5 (1)	-	-	-	-	8.7
		Hay, tons	-	1.8 (1)	-	-	-	-	-	-	-	1.8
	Barley											
		Grain, lbs	-	-	-	3,133 (1)	-	-	-	-	-	3,133
		Hay, tons	-	-	-	5.5 (1)	-	-	-	-	-	5.5
	Triticale											
		Hay, tons	-	-	-	-	-	-	3(1)	-	-	3.0
		Silage, tons	-	21.3 (1)	17.5 (1)	-	-	13 (2)	2.5(2)	12 (1)	-	13.3
	Sunflower											
		Seed, lbs	-	-	-	1,916 (2)	2,274 (4)	-	-	1903 (1)	2,635 (4)	2,182
	Pearl millet for seed											
		Seed, lbs	3,876 (1)	2,488 (1)	4,002 (2)	2,097 (2)	-	-	1,800(1)	2,014 (1)	3,600 (3)	2,840
	Perennial forage											
	Dahl											
		Seed, PLS lbs	-	-	-	30 (1)	83.14 (1)	-	-	62.8 (1)	-	58.6
		Hay, tons	-	-	-	2.5 (1)	-	-	-	-	-	2.5
	SideOats											
		Seed, PLS lbs	313 (2)	268 (2)	183.5 (3)	192.9 (3)	362 (3)	212.5 (2)	200.75 (2)	267 (2)	315 (2)	257
		Hay, tons	3.6 (2)	2.1 (2)	1.46 (3)	1.66 (3)	1.83 (3)	1.1 (2)	0.5 (2)	1.9 (2)	1.4 (2)	1.7
	Other											
		Hay, tons	-	-	-	0.11 (1)	4.3 (1)	2.4 (1)	-	-	-	2.3

Table 24. continued

Item			2005	2006	2007	2008	2009	2010	2011	2012	2013	Crop Year Average
	Alfalfa											
		Hay, tons	8.3 (1)	9.18 (1)	4.90 (1)	12.0 (1)	9.95 (1)	9.0 (1)	10.6 (1)	8.4 (1)	9.5 (1)	9.1
	Annual forage											
	Forage Sorghum											
		Hay, tons	-	-	-	-	-	-	6.8 (1)	1.9 (2)	1.7 (1)	3.5
Precipitation, inches (including all sites)			15.0	15.4	27.3	21.7	15.7	28.9	5.3	10.0	13.2	16.9
Irrigation applied, inches (not including dryland)												
	By System											
Total irrigation water (system average)			9.2 (26)	14.8 (26)	11.0 (25)	13.3 (23)	11.5 (24)	9.2 (24)	20.9 (27)	16.0 (26)	16.6 (28)	13.6
	By Crop (Primary Crop)											
	Cotton		8.7 (19)	14.3 (19)	11.3 (11)	12.2 (10)	12.5 (15)	7.4 (15)	23.2 (19)	14.8 (16)	18.4 (17)	13.6
	Corn grain		17.4 (3)	21.0 (4)	12.5 (4)	21.7 (8)	19.2 (4)	12.8 (10)	27.1 (4)	22.1 (7)	22.0 (9)	19.5
	Corn silage		18.0 (2)	24.0 (3)	12.6 (3)	-	24.3 (1)	18 (2)	34.7 (3)	22.5 (4)	25.8 (4)	22.5
	Sorghum grain		7.5 (1)	4.2(1)	6.6 (4)	13.8 (5)	9.4 (3)	6.13(2)	27.8 (1)	19.7 (2)	16.9 (3)	12.3
	Sorghum silage		15.0 (1)	12.5 (2)	13.5 (1)	11.5 (1)	15.7 (1)	-	-	-	-	13.6
	Wheat grain		-	-	5.3 (3)	7.68 (4)	5.7 (5)	2.6 (6)	11.3 (1)	4.7 (3)	8.1 (3)	6.5
	Wheat silage		7.5 (1)	16.3 (1)	-	5.5 (1)	15.7 (1)	-	-	-	-	11.3
	Oat silage		-	4.3 (1)	-	-	15.7 (1)	-	-	-	-	10.0
	Oat hay		-	4.9 (1)	-	-	-	-	-	-	-	4.9
	Triticale silage		-	10.0 (1)	12.9 (1)	-	-	6.9 (2)	17.8 (2)	19.6 (1)	-	13.4
	Barley grain		-	-	-	12.8 (1)	-	-	-	-	-	12.8
	Small Grain (grazing)		0.5 (3)	0.8 (2)	0.8 (3)	-	-	-	-	-	3.9 (1)	1.5
	Small Grain (grains)		-	-	5.3 (3)	8.7 (5)	5.7 (5)	2.6 (6)	11.3 (1)	4.7 (3)	8.1 (3)	6.6
	Small Grain (silage)		7.5 (1)	10.2 (3)	12.9 (1)	5.5 (1)	15.7 (2)	6.9 (2)	17.8 (2)	19.6 (1)	-	12.0
	Small Grain (hay)		-	4.9 (1)	-	-	-	-	-	-	8.3(2)	6.6
	Small Grain (all uses)		5.2 (5)	7.3 (10)	7.4(11)	8.2 (6)	8.6 (7)	3.7 (8)	15.6 (3)	8.4 (4)	7.5 (6)	8.0
	Sunflower seed		-	-	-	9.6 (2)	8.9 (4)	-	-	15.1 (1)	12.3 (5)	11.5
	Millet seed		-	-	-	9.6 (2)	-	-	29.4 (1)	22.0 (1)	18.3 (3)	19.8
	Dahl											
	hay		-	-	-	4.65 (1)	-	-	-	-	-	4.7
	seed					9.4 (1)	8.9 (1)	-	-	8.2 (1)	-	8.8
	grazing						4.1 (1)	4.6 (3)	8.9 (2)	22.7 (1)	5.6 (2)	9.2
	Sideoats											
	seed		-	-	-	8.0 (3)	15.3 (3)	2.8 (2)	20.3 (2)	18.9 (2)	12.2 (2)	12.9
	Bermuda											
	grazing		-	-	-	6.2 (1)	5.3 (1)	0 (1)	17.1 (1)	12.0 (1)	-	8.1

Table 24. continued

Item		2005	2006	2007	2008	2009	2010	2011	2012	2013	Crop Year Average
	Other Perennials/Annuals										
	hay	-	-	-	4.02 (1)	-	8.5 (1)	-	13.9 (2)	3.6 (1)	7.5
	grazing	-	-	-	5.5 (1)	6.6 (1)	5.1 (1)	-	-	0 (1)	4.3
	Perennial grasses (grouped)										
	Seed	-	-	-	8.35 (4)	13.7 (4)	2.8 (2)	-	8.2 (1)	12.2 (2)	9.1
	Grazing	-	-	-	5.85 (2)	5.3 (3)	3.8 (5)	11.6 (3)	10.8 (1)	3.7 (3)	6.8
	Hay	-	-	-	4.33(2)	-	-	-	13.9 (2)	3.6 (1)	7.3
	All Uses	6.5 (6)	8.8 (6)	7.1 (7)	6.7 (8)	10.1 (7)	3.5 (7)	11.6 (3)	11.7 (2)	6.5 (6)	8.1
	Alfalfa	10.3 (1)	34.5 (1)	10.6 (1)	15.6 (1)	18.6 (1)	15.6 (1)	44.1 (1)	28.3 (1)	31.6 (1)	23.2
Income and Expense, $/system acre											
	Projected returns	660.53	773.82	840.02	890.37	745.82	961.87	951.66	1,063.98	1,171.08	895.50
	Costs										
	Total variable costs (all sites)	444.88	504.91	498.48	548.53	507.69	537.14	658.68	578.28	709.95	554.30
	Total fixed costs (all sites)	77.57	81.81	81.77	111.98	110.65	153.55	149.98	135.53	137.19	115.6
	Total all costs (all sites)	522.45	586.72	580.25	660.51	618.34	690.69	808.67	713.80	846.87	669.80
	Gross margin										
	Per system acre (all sites)	215.66	268.91	341.54	341.84	238.13	424.74	313.83	469.92	454.90	341.10
	Per acre inch irrigation water (irrigated only)	33.51	22.53	34.01	31.17	22.95	71.51	24.77	32.73	30.54	33.7
	Net returns over all costs										
	Per system acre (all sites)	138.09	187.10	259.77	229.86	127.48	271.19	163.85	334.39	317.98	225.50
	Per acre inch of irrigation water (irrigated only)	21.58	15.88	24.99	20.89	9.99	43.71	10.16	22.89	21.33	21.3
	Per pound of nitrogen (all sites)	1.62	0.81	2.34	1.48	0.87	2.40	1.92	2.51	2.46	1.8
	[1] Numbers in parenthesis refer to the number of sites in the mean.										

Reports by Specific Task

TASK 2: ADMINISTRATION AND SUPPORT

Annual Report ending February 28, 2014

2.1: Project Director: Rick Kellison, Project Director (TTU)

In the TAWC demonstration area 2013 irrigated crop yields were a pleasant surprise after two and a half of the driest years on record. Dryland crops were a disaster again in 2013. We received two timely, significant rainfall events in July and August that produced, with supplemental irrigation, some of the best cotton and grain yields ever. Producers are also learning how to reduce planted acres to match available irrigation supply.

A water database workshop was held on April 26, 2013 at the High Plains Water District office in Lubbock. Along with TAWC other presentations were made by North Plains Groundwater Conservation District, High Plains Underground Water Conservation District, and Texas Tech University. The objective of this meeting was to share information about various databases being collected by each group and how this information could be best used and shared. Dr. Dick Ridgway acted as facilitator in this planning meeting.

The Lubbock Gin Show was held on April 4 where I worked with Samantha Borgstedt, Dr. David Doerfert, and Jeff Pate to man the TAWC booth. While at the gin show I had the opportunity to meet with Curtis Griffith (City Bank) and Brent Crossland (Bayer Crop Science) to discuss the dissemination of the planning and irrigation management tools to area producers. In April, Samantha Borgstedt and I met several times to finalize plans for the summer Field Walks. We developed a calendar for the different speakers to discuss their topics during radio segments on KFLP and KDDD stations. On May 22, the first of five Field Walks was held at the Eddie Teeter Farm. Dr. Dan Krieg (professor emeritus Texas Tech) and Mr. Bob Glodt (agricultural consultant) were our featured speakers. Their topics included daily crop water demands, water holding capacities of various soil types, critical stages of growth for corn and cotton, and management approaches to be more effective with irrigation applied, such as staggered planting dates.

TAWC hosted three Field Walks at the Eddie Teeter Farm (sites 21 and 35) in June and July. Dr. Krieg and Mr. Glodt made presentations at each Field Walk along with representatives from Smart Field, AquaSpy, John Deere Crop Sense, and Eco-Drip Aqua Check. Dr. Krieg and Mr. Glodt focused their presentations on water and crop nutrition demands at various growth stages for cotton, corn and grain sorghum. At each Field Walk, soils were hand-probed with a soil corer to estimate soil moisture content at 1, 2, and 3-foot depths. These estimates were then compared to calculations from the TAWC ET online tool (Irrigation Scheduler) and to the in-field soil moisture capacitance probes. Several producers noticed how close the ET program tracked with the actual hand-probe estimates and commented that this gave them additional confidence in the technologies being demonstrated.

On August 13 I made a presentation about TAWC to the board of directors of the High Plains Underground Water Conservation District. Four of the five board members have served less than one year, and the new board members were anxious to gain more information about the demonstration project. I presented results of TAWC phase I (2005-2012) and plans for phase II, including the role that the water district had played up to this point. The board voted unanimously to support TAWC in phase II and to be more involved in supporting the outreach component. TAWC looks forward to working with the High Plains Water District in the future as we both have the goal to aid producers in their water conservation efforts.

TAWC hosted its annual summer field day on August 15 at Muncy, Texas. We had approximately seventy-five in attendance, and KFLP Radio broadcast the presentations live over both of their radio stations. Our keynote speaker was Tim Lust, National Grain Sorghum Association. For the first time we were unable to make field visits because of a great and timely rainfall event.

Todd Neely with DTN News visited some of the demonstration sites on July 29. He used that visit to prepare a story about the how TAWC aided producers with their water conservations efforts. On June 6, I hosted Dr. Merri Lisa Trigilio and her film crew who were doing a film documentary on the Ogallala aquifer.

On September 19, I had the opportunity to make oral and poster presentations at the 22nd International Grassland Conference in Sydney, Australia. This was a great opportunity to meet and exchange ideas with people from around the world and a once in a lifetime opportunity for me. Dr. Calvin Trostle and I hosted a class from Wayland Baptist University on September 26, where I explained the TAWC project. This was an interesting meeting in that the majority of these young students had no background in agriculture. The questions and comments were much different from usual.

I attended the Amarillo Farm Show and Commodity Classic on December 4 and 5 where I helped man the TAWC booth. Eddie Teeter, TAWC producer, cooperator, and board member received the Blue Legacy Award. Eddie has been a great asset to TAWC's water conservation efforts. While at the farm show, some of the members of the TAWC management team met to discuss the possibility of partnering with the High Plains Agricultural Crop Consultants (HPACC) at their annual meeting in Lubbock in 2014. HPACC agreed to allow TAWC to make several presentations at their March 4, 2014, annual meeting. This would give TAWC the opportunity to discuss our online planning and management tools, irrigation conservation strategies, conduct a consultant and producer panel, and an explanation by High Plains Water District of their proposed pumping policy.

On January 7 I made three TAWC presentations to producers attending the Sorghum U meetings in Levelland, Texas. This meeting had good producer attendance with considerable interest in the TAWC demonstration project. On January 16t, TWDB director Bech Bruun allowed us to explain the scope of the TAWC project to him and members of his staff. This presentation lead to an opportunity to make the same presentation to the TWDB and staff at their meeting in Lubbock on February 24, 2014.

Presentations this year: (Presentations added to 2013 Presentations list on page 10)

04-26-2013	High Plains Water District database meeting	Lubbock, Texas
07-19-2013	Texas Southwestern Cattle Raisers Association	Lubbock, Texas
08-13-2013	High Plains Water District board of directors	Lubbock, Texas
09-19-2013	International Grassland Conference	Sydney, Australia
09-26-2013	Wayland Baptist University class	Lockney, Texas
10-02-2013	Congressman Frank Lucas	Lubbock, Texas
10-07-2013	TAIA Annual Meeting	Dumas, Texas
10-09-2013	Congressman Mike Conway	Lubbock, Texas
10-10-2013	TAWC Field Walk	Lockney, Texas
01-07-2014	Sorghum U	Levelland, Texas
01-16-2014	TWDB Director Bech Bruun & staff	Lubbock, Texas
01-28-2014	Randall County Producers	Canyon, Texas
02-12-2014	Texas Panhandle-High Plains Water Symposium	Amarillo, Texas
02-24-2014	TWDB Work Session	Lubbock, Texas

Tours this year:

04-30-2013	Dr. Chuck West & Dr. Sara Trojan
07-20-2013	Todd Neely DTN
09-07-2013	Dr. Steve Fraze & Dr. Rudy Ritz

We have held our monthly management team meetings this year and I have made regular sites visits.

2.2: Administrative Coordinator: Christy Barbee, Unit Coordinator (TTU)

Year 9 main objectives for the secretarial/administrative and bookkeeping support role for the TAWC Project include the following:

Accurate Accounting of All Expenses for the Project Included monthly reconciliation of accounts with TTU accounting system, quarterly reconciliation of subcontractors' invoices, preparation of itemized quarterly reimbursement requests, and preparation of Task and Expense Budget and Cost Sharing reported for Year 9 of the project.   Budget was balanced for this annual report and assistance was given preparing the annual report to completion.

Administrative Support for Special Events   Continued to assist Communications Director and Project Director with special events by processing purchase orders, procurement card orders and travel.

Ongoing Administrative Support Daily administrative tasks included correspondence through print, telephone and e-mail; completed various clerical documents such as mileage logs, purchase orders, cost transfers, travel applications, human resource forms, and pay payroll paperwork; and other duties as requested or assigned.

Five monthly Management Team meetings have been attended and all minutes have been transcribed, distributed, and archived.

TAWC producer binders were assembled for the TAWC producer to categorize their records. These binders greatly assist the research team in acquiring useful data for this annual report and other communications.

A lot of the focus during 2013 was on making sure Task leaders spent out money in accordance with grant specifications. Also, a lot of time was spent with the Task leaders preparing the budgets and statement of work for Phase II of TAWC.

TASK 3: FARM ASSISTANCE PROGRAM

Annual Report ending February 28, 2014

Principal Investigator(s): Dr. Steve Klose, Jeff Pate and Jay Yates (AgriLife-Extension)

Texas AgriLife Extension Service, FARM Assistance Subcontract with Texas Tech University

Year 9 progress regarding Task 3 has occurred in several areas ranging from collaborating in project coordination and data organization to data collection and communication, as well as providing additional services to the area producers in conjunction with the TAWC project. A brief summary of specific activities and results follows:

Project Collaboration

A primary activity of initiating the FARM Assistance task included collaborating with the entire project management team and coordinating the FARM Assistance analysis process into the overall project concepts, goals, and objectives. The assessment and communication of individual producer's financial viability remains crucial to the evaluation and demonstration of water conserving practices. Through AgriLife Extension participation in management team meetings and other planning sessions, collaboration activities include early development of project plans, conceptualizing data organization and needs, and contributions to promotional activities and materials.

Farm Field Records

AgriLife Extension has taken the lead in the area of data retrieval in that FARM Assistance staff is meeting with producers multiple times each year to obtain field records and entering those records into the database. AgriLife Extension assisted many of the project participants individually with the completion of their individual site demonstration records (farm field records). Extension faculty have completed the collection, organization, and sharing of site records for all of the 2013 site demonstrations.

FARM Assistance Strategic Analysis Service

FARM Assistance service is continuing to be made available to the project producers. The complete farm analysis requires little extra time from the participant, and the confidentiality of personal data is protected. Extension faculty have completed whole farm strategic analysis for several producers in the past, and continues to seek other participants committed to the analysis. Ongoing phone contacts, e-mails, and personal visits with project participants promote this additional service to participants.

FARM Assistance Site Analysis

While the whole farm analysis offered to demonstrators as a service is helpful to both the individual as well as the long-term capacities of the project, the essential analysis of the financial performance of the individual sites continues. FARM Assistance faculty completed and submitted economic projections and analysis of each site based on 2012 demonstration data. These projections will serve as a baseline to for future site and whole farm strategic analysis, as well as providing a demonstration of each site's financial feasibility and profitability. Each producer in the project received a copy of the analysis for their site based on the 2012 data. This analysis can be used by each producer to establish some economic goals for the future. 2013 analysis will be completed this summer, as yield data has only recently been finalized for the 2013 crop.

Economic Study Papers

Farm Assistance members completed a study poster utilizing the economic data on a site within the TAWC project. The paper examined the profitability of irrigated cotton grown during the extreme drought conditions of 2011and 2013 comparing LESA vs. LEPA. The results of this paper were presented at the Beltwide Cotton Conference held in New Orleans, Louisiana in January, 2013.

Continuing Cooperation

Farm Assistance members also continue to cooperate with the Texas Tech Agriculture Economics Department by furnishing data and consulting in the creation of annual budgets. These budgets will later be used by FARM Assistance members to conduct site analysis for each farm in the TAWC project.

Conservation Innovation Grant

Nine additional sites operated by six producers have been selected. Beginning in 2012, data were collected from these sites, as well as the 29 existing sites in the TAWC project. All of these sites were furnished with soil moisture monitoring equipment, as water metering devices, and center pivot monitors. FARM Assistance members assisted in training producers in the use and interpretation of data from each of these devices.

Other Presentations

Farm Assistance members made a presentation to County Extension Agents in District 2 concerning the use of irrigation management tools that were developed by the TAWC These tools were developed for producers in the Texas High Plains, but proved to be useful to producers outside of this area. A similar presentation was made to the Texas 4-H Agriculture Ambassadors. FARM Assistance members also traveled to St. Louis, Missouri to give a presentation to executives at Monsanto concerning work done by the TAWC.

Field Walks

Five Field Walks were held in throughout the growing season at one site. The purpose of these Field Walks were to make producers aware of irrigation timing practices using various soil moisture probes. These probes were located on-site and allowed attendees to see them in operation during various stages of growth of corn, cotton, and grain sorghum. The participation was so encouraging that similar events are planned for 2014.

Field Days

Two Field Days were held in the TAWC project during the 2013 growing season. The Summer Field Day was held August 15 and the Winter Field Day was held January 17. Both meetings were held at the Unity Center in Muncy, Texas The purpose of these meetings were to allow producers outside of the project to see what takes place within the project, as well as allow producers to hear about the latest research and policy that could have an impact on their operation . Personnel from AgriLife Extension, AgriLife Research, Farm Assistance, the High Plains Water District, and Texas Tech University were involved.

TASK 4: ECONOMIC ANALYSIS

Annual Report ending February 28, 2014

Principal Investigator(s): Dr. Phillip Johnson and Donna Mitchell

The primary objectives of Task 4 are to compile and develop field level economic data, analyze the economic and agronomic potential of each site and system, and evaluate relationships within each system relative to economic viability and efficiency. In conjunction with Texas AgriLife Extension, field level records of inputs, practices and production are used to develop enterprise budgets for each site. The records and enterprise budgets provide the base data for evaluation of the economics of irrigation technologies, cropping strategies, and enterprise options. All expenses and revenues are accounted for within the budgeting process. In addition to an economic evaluation of each site, energy and carbon audits are compiled and evaluated.

Major achievements for 2013:

- 2013 represented the ninth year of economic data collection from the project sites. Data for the 2013 production year was collected and enterprise budgets were generated.
- TAWC cooperated with the National Cotton Council in a pilot project for the Fieldprint Calculator which is being developed by Field-to-Market – The Keystone Alliance for Sustainable Agriculture. The Fieldprint Calculator estimates the sustainability footprint for crop production. TAWC site information for 2007 through 2011 was entered into the calculator. The results from the Fieldprint Calculator were reported in a paper presented at the 2014 Beltwide Cotton Conference.

Journal articles related to the TAWC in 2013: (Placed in Journal Article section, page 21)

- Johnson, P., C.J. Zilverberg, V.G. Allen, J. Weinheimer, C.P. Brown, R. Kellison, and E. Segarra. 2013. Integrating cotton and beef production in the Texas Southern High Plains: III. An economic evaluation. *Agronomy Journal* 105:929-937.
- Weinheimer, J., P. Johnson, D. Mitchell, J. Johnson, and R. Kellison. 2013. Texas High Plains Imitative for Strategic and Innovative Irrigation Management and Conservation. *Journal of Contemporary Water Research & Education.* August 2013; 151:43-49.

Abstracts related to the TAWC in 2013: (Non-refereed paper section, page 21)

- Mitchell, D., P. Johnson, V. Allen, and C. Zilverberg. 2013. Integrating Cotton and Beef Production in the Texas Southern High Plains: A Simulation Approach. Presented at the annual meeting of the Southern Agricultural Economics Association, February 2-5, 2013, Orlando, FL. http://ageconsearch.umn.edu/bitstream/143053/2/SAEA%202013%20Paper%20.pdf

- Mitchell, D., and P. Johnson. 2013. Economic Impacts of the 2011 Drought on the Southern High Plains. Presented at the annual meeting of the American Agricultural Economics Association, August 4-6, 2013, Washington, DC. http://ageconsearch.umn.edu/bitstream/149625/2/AAEA_DMposter.pdf

Presentations related to the TAWC in 2013: (Listed in Presentations section, p. 10)

- Johnson, P. 2013. Data Plans for the Initiative for Strategic and Innovative Irrigation Management and Conservation. Presented at the Water Management and Conservation: Database Workshop. April 26, 2013. Lubbock, TX.

Fieldprint Calculator: A Measurement of Agricultural Sustainability in the Texas High Plains[3]

K. Stokes, P. Johnson -Texas Tech University, Lubbock, TX
B. Robertson - National Cotton Council, Cordova, TN
B. Underwood – Natural Resources Conservation Service, Lubbock, TX

Abstract

Sustainability of agricultural production is an important issue with regard to the marketing of agricultural products in today's world. Recently, numerous companies and organizations within the Keystone Alliance for Sustainable Agriculture began efforts to encourage sustainable practices in crop production. The Fieldprint Calculator is a tool—designed by Field to Market, the Keystone Alliance for Sustainable Agriculture—that computes the sustainability levels of a producer's operations and aids in evaluating potential changes that may improve sustainability in the future. The objective of this study was to analyze the Fieldprint Calculator's data output for fields in the Texas Cotton Pilot program sponsored by the National Cotton Council on sites in the Texas Alliance for Water Conservation project in the Texas High Plains region. A sustainability index was created from the data, and the sites were evaluated across a time period of five years, 2007 to 2011. Analysis indicated that the method of irrigation appears to be an important factor in sustainability, and the level of output is important in the calculations of four of the calculator's sustainability metrics. Further studies should determine the relevance of some of the calculator's metrics to different regions and determine the producers' profitability relative to sustainability.

Background

The sustainability of agricultural production has become an important issue for a diverse group of stakeholder in agriculture. These stakeholders represent agricultural producers, processors, marketing agents, food and fiber companies, retailers, commodity organizations, agricultural input suppliers and manufacturers, conservation organizations, and universities. The Fieldprint Calculator is a tool designed by Field to Market, the Keystone Alliance for Sustainable Agriculture, that aids in encouraging sustainable production practices by allowing producers to evaluate their sustainability metrics, determine the sustainability level of their farming practices, and evaluate changes that may improve sustainability in the future. The National Cotton Council (NCC), as a member of the Keystone Alliance, initiated two projects, in Louisiana and Texas, to evaluate the Fieldprint Calculator in measuring economic and environmental production metrics. The sustainability footprint generated by the Fieldprint Calculator is based on seven metrics—land use, irrigation water use, energy use, greenhouse gas emissions, soil conservation, soil carbon, and water quality—which are used to determine areas that are efficient or need improvement to produce at the highest levels of sustainability as possible. The NCC partnered with the Texas Alliance for Water Conservation (TAWC) project in the Texas High Plains region to evaluate cotton production fields using data 2007 – 2011.

[3] 2014 Beltwide Cotton Conferences Proceedings, pg. 406-412. Selected for presentation. January 4-7, 2014, New Orleans, LA. National Cotton Council and the Cotton Foundation.

Methods
The TAWC is an on-farm demonstration project that compares crop production practices, technologies, and systems with the goal of improving water management to increase water use efficiency and maintain or increase profitability. Project sites represent field level, commercial production managed by cooperating producers located in Hale and Floyd counties of Texas. Extensive data was collected on each site, including tillage practices, fertilization, pest control, irrigation, growth regulators, harvest aids, and output. This data is available for the five year period, 2007 to 2011. For this study, a total of 22 grower sites were evaluated, consisting of approximately 6000 planted acres of cotton representing 107 observations. If a site had multiple fields, the fields were considered observations and combined to give an average for the site. Farming operations included practices from no-till to conventional tillage, and irrigation methods used were subsurface drip, center pivot, or furrow. The availability of five years of input and production data allowed for the comparison of the sustainability profile for specific fields across time. For this analysis, only observations from irrigated fields that were harvested were used to compare the sustainability effects of different production practices.

The Fieldprint Calculator was used to evaluate each observation representing a given site for each year the site was in cotton production. The Fieldprint Calculator computes seven metrics: land use (ac/lb), irrigation water use (in/lb), energy use (gallons of diesel/lb), greenhouse gas emissions (lbs of CO_2 /lb), soil conservation (tons of soil loss as % of T), soil carbon index, and water quality index. Figure 14 is an example of the spider-web graph that the Fieldprint Calculator generates to represent a producer's sustainability "footprint" and shows the effect each metric has on sustainability for a particular field in a given year. The graph displays a blue area representing the individual producer, and the green, orange, and red lines represent the national, state, and county averages, respectively.

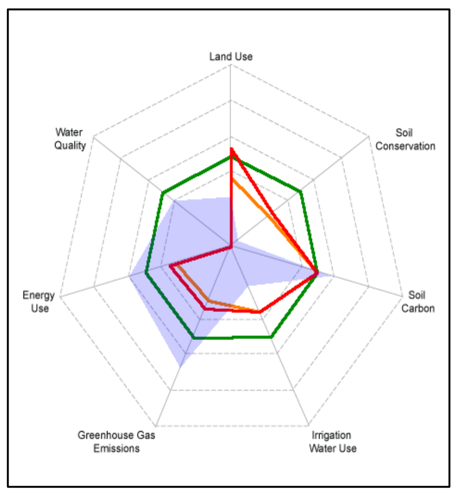


Figure 14. Sustainability footprint using a spider-web graph of the Fieldprint Calculator metrics.

The Fieldprint Calculator expresses cotton yield on a lint equivalent basis. Cotton is a commodity with joint products, lint and seed, therefore, the calculator expresses seed yield in terms of lint yield based on percent revenue from each product and combines this equivalent yield with the actual lint yield to calculate the lint equivalent yield (LEY). Many of the calculations for the sustainability metrics within the Fieldprint Calculator are given on a per pound of LEY basis.

When computing the sustainability metrics, the Fieldprint Calculator expresses the metrics as a per unit of output measurement rather than a per acre measurement. Land use and irrigation water use are measured as acres per pound of LEY and inches per pound of LEY, respectively. Energy use is expressed in two forms, BTUs per pound of LEY and gallons of diesel equivalent per pound of LEY (only gallons of diesel per pound of LEY measurement are used in this analysis). Greenhouse gas emission (GHG) is measured as pounds of CO_2 per pound of LEY. The soil conservation metric is expressed as soil erosion as a percent of the soil loss T value. Simply stated, the soil loss T-value is the "tolerable erosion," meaning it is the amount of soil that a particular piece of land afford can lose through a combination of wind and water erosion in a given year and maintain productivity. For the soil carbon and water quality, the calculator produces an index of measurement.

The sustainability metrics are expressed such that the smaller the value the more sustainable the production practices. Therefore, the goal for producers is to shrink each field's "footprint." In order to compare sites in this study for various production practices, an index was constructed for each sustainability metric based on the mean value of the metric for all observations. For example, the land use metric is expressed as acres per pound of LEY. An index value for each individual observation was constructed by dividing by the average of acres per pound of LEY for all observations and multiplying by 100. An overall index, that includes all metrics, was constructed for each observation by calculating the average of the metric index values; therefore, each metric was given equal weight in the overall index. The smaller the overall index value the smaller the field's sustainability "footprint." The water quality index was not considered in this study.

Results/Discussion

Figure 15 shows the sustainability metric indices for each of the 22 sites evaluated. These results show that for some sites there is considerable variation in the level of the various sustainability metrics. Figure 16 shows the overall index value of the sustainability metrics for each site. Eight sites were above the base value of 100 and 14 sites were below the base value. Of the sites above the base value, four sites were more than 10 index points above the base value, and four sites were between one and eight index points above the base value.

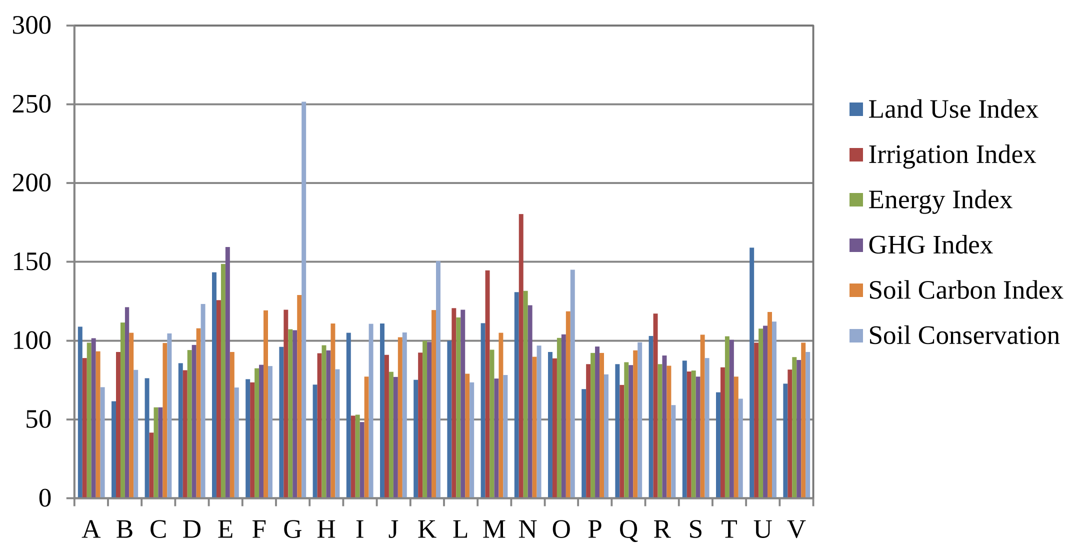


Figure 15. Values of sustainability metric indices for each site.

A comparison was made between three sites, A, N, and P, representing the center pivot, furrow, and subsurface drip irrigation methods, respectively. These sites were chosen because they had multiple observations across the five years, and a similar soil type, Pullman clay loam. The significant difference between the sites is the irrigation method.

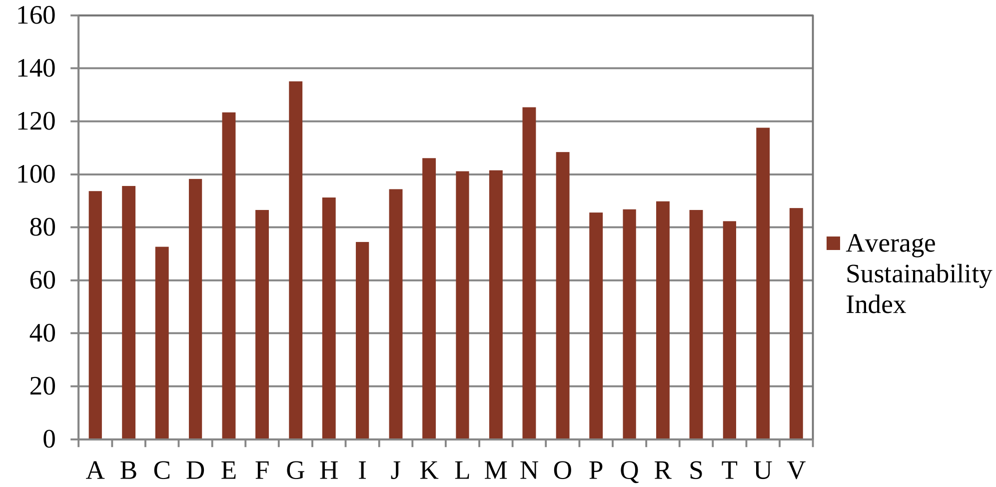


Figure 16. Average sustainability index for each site.

Site A has a center pivot system using the LEPA method of irrigation. There were seven observations over the five years, 2007 – 2011, from two fields. The average LEY was 1317 lbs/acre and the average irrigation rate was 10.5 inches. The overall average sustainability index value was 93.6. Figure 17 shows the average index values of the various metrics for Site A. Land use and GHG emissions were the only metrics above the base value.

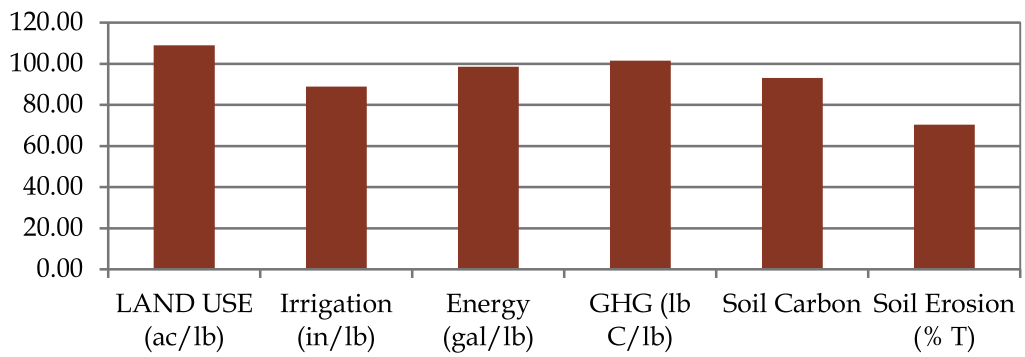


Figure 17. Sustainability metric index values for Site A.

Site N was furrow irrigated and had 12 observations over the five years, 2007 – 2011, from three fields. The average LEY was 1185 lbs/acre and the average irrigation rate was 15.0 inches. The overall average sustainability index value was 125.3. Figure 18 shows the average index values of the various metrics for Site N. Four of the six sustainability metrics were above the base value - land use, irrigation, energy, and GHG emissions.

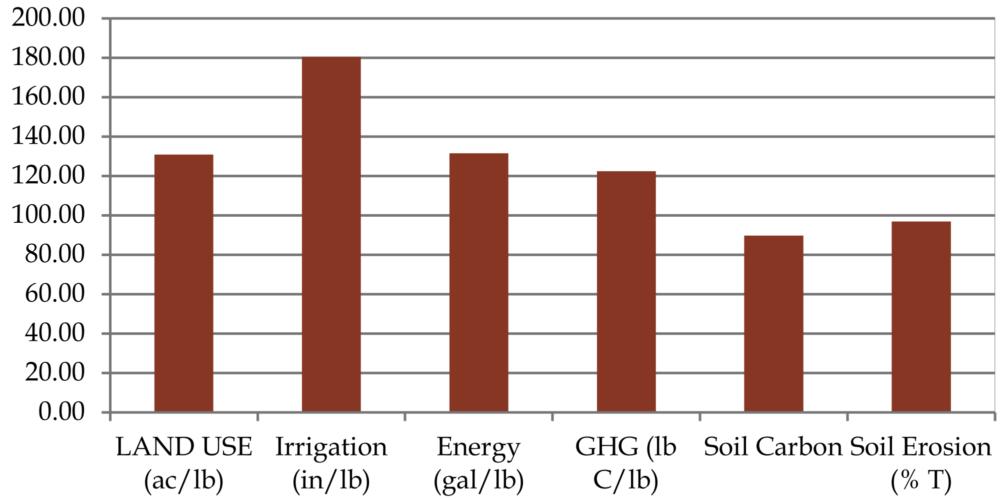


Figure 18. Sustainability metrics index values for Site N.

Site P was irrigated using subsurface drip and had five observations over the five years, 2007 – 2011, from one field. The average LEY was 2037 lbs/acre and the average irrigation rate was 19.0 inches. The overall average sustainability index value was 85.6. Figure 19 shows the average index values of the various metrics for Site P. All sustainability metrics were below the base value. When looking at the average sustainability index of these 3 sites, site P overall had a smaller index value than sites A and N.

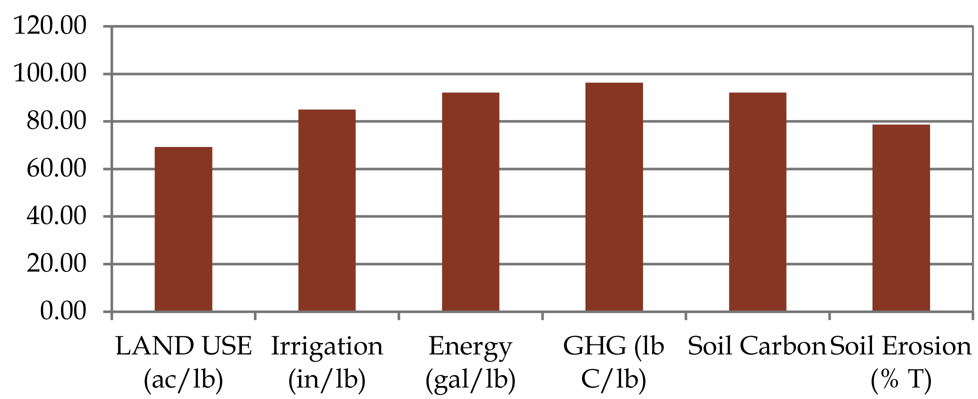


Figure 19. Sustainability metrics index values for Site P.

The level of output is an important factor in the calculation of four of the seven Fieldprint Calculator metrics: land use, irrigation water use, energy use, and GHG emissions. This means that the higher the output relative to the metric, the more sustainable the field is going to appear.

Figures 20 through 22 show the annual index values for sites A, N and P, respectively. A comparison of the annual indices of the four metrics for each of the sites may show a trend in a particular metric over time. The metrics for Site A (Figure 20) and Site P (Figure 22) were relatively stable across years with the exception of 2011 which was an extreme drought year. However for Site N (Figure 21) the metrics steadily increased from 2008 to 2011.These sites represent center pivot, subsurface drip, and furrow irrigation systems. Thus implying, the method of irrigation may have had an impact on the overall sustainability. However, this impact is related to the level of output, given that these four metrics are expressed in terms of output. This can be seen for the 2011 year when drought lowered yields; thus, the metric values increased significantly. Also seen in Figures 20 through 22, there is a high correlation between energy use and GHG emissions. Energy use and GHG emissions result mainly from energy used in tillage operations, irrigation, and the manufacture of fertilizers and chemicals.

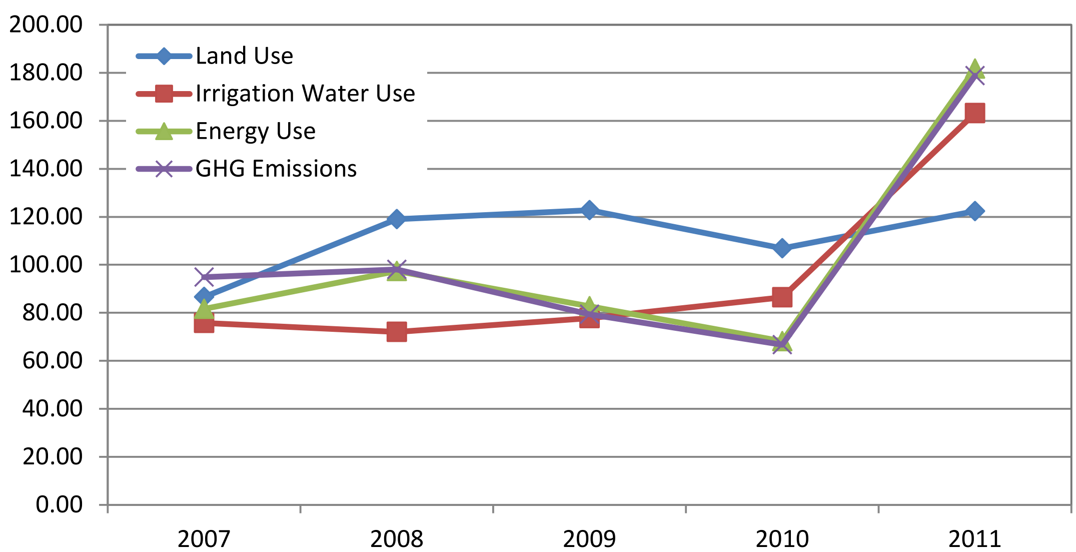


Figure 20. Annual metric indices for Site A.

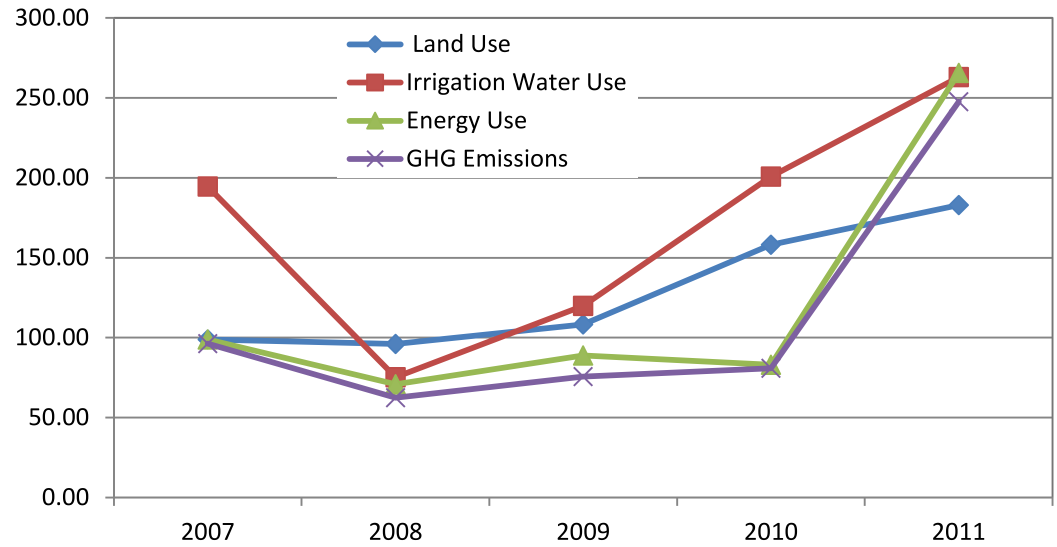


Figure 21. Annual metric indices for Site N.

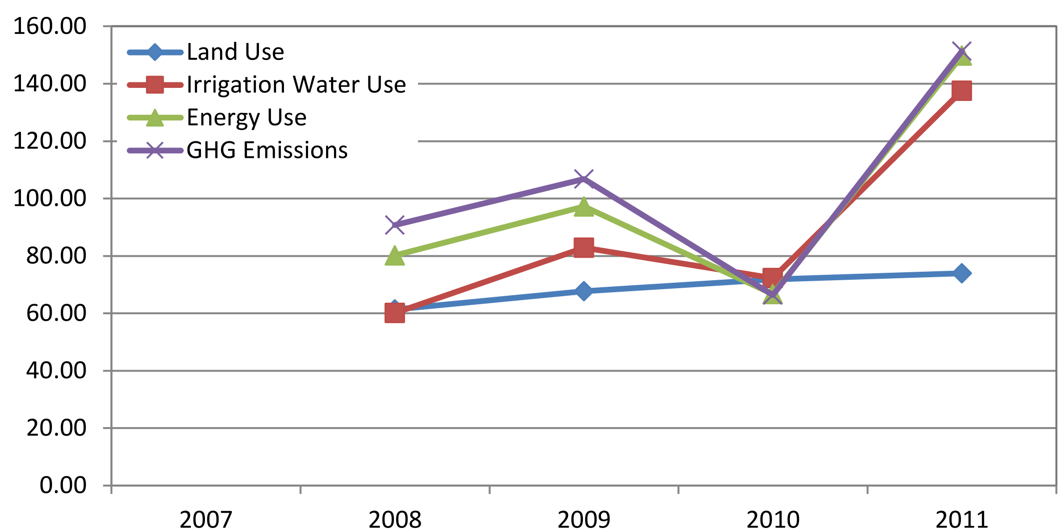


Figure 22. Annual metric indices for Site P.

The Fieldprint Calculator computes the soil conservation metric based on estimated soil erosion from water; however, in the Texas High Plains region wind erosion is the main source of soil erosion. The index calculated in this study expressed the estimated soil erosion as a percent of the tolerable soil loss (T-value) for a given soil type; however, given that wind erosion was not included the value for the soil conservation metric may be under estimated. The soil carbon index is the estimated change on soil carbon based in the crop produced and the tillage practices used.

Conclusion/Comments

The objectives of this study were to understand the metrics produced by the Fieldprint Calculator and how these related to cotton production in the Texas High Plains region. Indices of the various sustainability metrics were constructed to allow for comparison of certain production practices across 22 field level sites. The results indicate that that the method of irrigation appears to be a factor in sustainability and that the level of output is important in the calculations of several of the metrics.

This study provided an indication of the level and variability of the metrics from the Fieldprint Calculator for the Texas High Plains region. There was an indication that irrigation methods may influence the level of certain metrics. In particular, the furrow irrigated site had an overall greater sustainability "footprint" compared to the center pivot and subsurface drip sites.

Future studies should address whether particular metrics, such as the water quality metric, is relevant to this region. The soil conservation metric needs to consider wind erosion to fully capture the effects of erosion in the region. Analysis of the weighting of the metrics in the overall index should be considered. In this study the mean value of each metric was used as the base level of the index. However, the index could be constructed on a fixed value that is feasible for the region. Also, it is important to determine and compare profitability relative to sustainability.

TASK 5: PLANT WATER USE AND WATER USE EFFICIENCY

Annual Report ending February 28, 2014

Principal Investigator(s): Drs. Steve Maas and Nithya Rajan

Several major areas of investigation were pursued during 2013. These are summarized in the following sections.

Irrigation System Efficiency

The 2-year study funded separately by TWDB for auditing irrigation systems in TAWC was completed in 2013. During this project, 14 center pivot irrigated fields were identified for conducting standard irrigation audits. These represent most of the center pivot fields in the TAWC project. In addition, data were collected from two subsurface drip (SSD) irrigated fields for estimating irrigation efficiency. Characteristics of these fields are summarized in Table 25.

Table 25. TAWC fields observed in the project.

TAWC Field Number	Irrigation Type	Field Size (ac)	Maximum Pumping Rate (gpm)*
03	MESA	123.3	450
04	LESA	123	500
06	LESA	122.7	500
07	LESA	130	500
09	MESA	237.8	900
10	LESA	173.6	800
14	LEPA	124.1	300
17	MESA	220.7	900
18**	LEPA	122.2	250
19	LEPA	120.4	400
20	LEPA	233.3	1000
21	LEPA	122.6	500
22	LEPA	148.7	800
31	LEPA, LESA***	123	500
02	SSD	60	360
15	SSD	101.1	290

* Reported by producer to TAWC
** Only outer 3 spans (6-8) were applying irrigation at time of audit. Results omitted from further analysis.
*** One span (5) was set up as LESA for comparison with LEPA.

For all center pivot fields, direct measurements of emitter flow rate were made for the entire center pivot system. Emitter flow rates were measured by placing an emitter into a plastic container and measuring the time it took for the water level to rise to a specified mark. The time was measured with a stop watch. By knowing the volume of water in the portion of the jug up to the mark, the flow rate of the emitter could be calculated. Three containers were used for fields in the project. Choice of container depended on the size of the emitter and it flow rate. Fields with relatively small emitters and modest flow rates (such as those for LEPA or LESA) were measured using either of two plastic jugs (see

Figure 23). The first had a mark at 1225 ml (0.32 gal), while the other had a mark at 1250 ml (0.33 gal). For larger, high-output emitters (such as MESA), a large plastic bucket was used. This bucket had a mark at 2500 ml (0.66 gal). As shown in Figure 23, two people were involved in making the measurements-- one to handle the container and call out the starting and stopping times for filling to the mark, and the other to time the filling and record the measurements. It normally took approximately 2 hours to measure all the emitters on an 8-span center pivot system using this method. Larger fields took proportionately longer. Standard practice in many irrigation auditing efforts has been to determine the variation in emitter output along the length of the pivot system by catching the water at the soil surface below the emitters using catch cans. However, this is only an indirect estimate of emitter flow rate. The procedure used in this study provides more accurate direct measurements of emitter flow rates.

The SSD fields could not be audited in the conventional manner, since the emitters are buried in the soil and are inaccessible for measurement. SSD fields in the study were scouted on foot to detect malfunctioning emitters or leaks in the subsurface drip lines. These could be detected by the presence of wet surface soil. Plugged emitters could not be visually detected.

Emitter flow rate data for the center pivot fields in Table 25 were graphed with the flow rate (gal/min) of each emitter plotted versus its respective position along the length of the center pivot. This was done to evaluate two characteristics of the irrigation system: *proper nozzle selection* and *emitter uniformity*. Proper nozzle selection was evaluated by comparing the observed trend in emitter flow rates versus the theoretical trend in emitter flow rates determined from characteristics of the irrigation system. Emitter uniformity was evaluated by constructing confidence limits about the regression line and determining how many individual emitters had flow rates outside the confidence limits compared to how many individual emitters had flow rates within the confidence limits. The ratio of these two numbers, expressed as a percentage, is an indicator of overall emitter uniformity for the irrigation system. The upper and lower confidence limits about the regression were established based on the standard deviation calculated for the flow rate data for each field. The upper confidence limit is equal to the regression plus two standard deviations. The lower confidence limit is equal to the regression minus two standard deviations. Points in the graphs lying above or below the pair of confidence limits can be considered as “outliers” and represent flow rate values significantly different from the general trend, accounting for random measurement error.

Results of evaluating nozzle selection and emitter uniformity were analyzed between individual systems, and average values for the three main center pivot irrigation systems in this study (MESA, LESA and LEPA) were compared to provide cross-system evaluations. Values of total flow (Q_p) and percent uniformity for each field are summarized in Table 26.

Table 26. Total flow (Q_p) and emitter uniformity for the center pivot fields in the project.

Field	Q_p (gal/min)	Uniformity (%)	Field	Q_p (gal/min)	Uniformity (%)	Field	Q_p (gal/min)	Uniformity (%)
03	327.4	95.9	10	526.1	97.4	21	427.3	96.8
04	468.2	96.4	14	230.2	95.6*	22	839.2	97.6
06	409.2	98.4	17	590.5	96.3	31	543.2	95.7
07	420.0	97.0	19	147.1	98.9*			
09	633.8	96.8	20	854.0	96.7			

* Intentionally skipped emitters were not included in the calculation of uniformity.

Although not typically a part of traditional irrigation system audits, it was decided that an attempt would be made in this project to evaluate the application efficiencies of various irrigation types. *Application efficiency* (E_a) is considered to represent how much of the irrigation water emitted by the system makes it into and remains within the root zone so that it is available for uptake by crop plants. Estimates of the application efficiency for various irrigation systems in the TAWC project are summarized in Table 27.

Table 27. Summary of application efficiencies (E_a) for various center pivot irrigation systems.

Type	Irrigation Amount (in)	E_a (%)			
		Bare Soil (GC = 0)	Partial Canopy* (GC = 50%)	Full Canopy** (GC = 100%)	Average
MESA	1	65.0	61.0	61.6	62.5
	2	82.5	69.8	61.6	71.3
LESA	1	65.0	71.1	78.5	71.5
	2	82.5	79.9	78.5	80.3
LEPA	1	82.5	91.3	~ 100	91.3
	2	91.8	95.6	~ 100	95.8

* MESA: corn with LAI = 3; LESA and LEPA: cotton or grain sorghum with LAI = 1.5
** MESA: corn with LAI = 6; LESA and LEPA: cotton or grain sorghum with LAI = 3

From the results in Table 27, we should expect application efficiencies in the general range of 60-70% for MESA systems, 70-80% for LESA systems, and greater than 90% for LEPA systems. These values are in qualitative agreement with estimates reported from other studies. Note that the application efficiency increased when the applied water increased from 1 to 2 inches. This is because, when more water is applied, a greater fraction penetrates into the root zone and proportionally less is lost through evaporation. These results assume that the irrigation systems are well-maintained without significant mechanical problems, such as leaking delivery pipes. They also assume that the ground in the field is approximately level. Use of high irrigation rates (greater than 2 in) could reduce these values due to run-off from the field and deep percolation.

The application efficiency for subsurface drip (SSD) irrigation systems is around 100%. This is because the irrigation water is applied below the soil surface with SSD systems. Thus, there is little opportunity for surface evaporation or interception of water by the plant canopy. The main factors that might reduce E_a for SSD systems are deep percolation due to over-irrigation, leaks in the system due to damaged drip lines, or plugged drip emitters resulting from poor maintenance of the system.

In summary, one can rank the general application efficiencies of the various irrigation systems as follows,

SSD > LEPA > LESA > MESA

As indicated by the comparison of irrigation systems in Table 28, substantial annual water savings could be realized by switching from MESA or LESA to LEPA or SSD, assuming the choice of crop allowed it. A producer that applies a certain amount of water using a less efficient irrigation system could potentially see an effective increase in water applied if a more efficient irrigation system had been used, simply because a larger percentage of the applied water makes it into the rooting zone (and not lost to soil evaporation or evaporation from plant surfaces) if a more efficient system is used. So, switching to a more efficient irrigation system is like getting "extra" water to apply to the crop, even though the basic irrigation rate stays the same. This situation is illustrated in Tables 28-31. These show the increase in water that would be available for use by the crop if the producer switched to a more efficient irrigation system. Results are presented for situations where the producer would be applying 10, 12, 14 and 16 inches of water with their current system.

Table 28. Potential increase in water (inches) available for use by the crop from a 10-in irrigation if the producer switches from a less efficient system (left column) to a more efficient system.

Current System applying 10 in	**Switch To ...**			
	MESA	**LESA**	**LEPA**	**SSD**
MESA	0	1.35	3.99	4.65
LESA	-	0	2.33	2.91
LEPA	-	-	0	0.47
SSD	-	-	-	0

Table 29. Potential increase in water (inches) available for use by the crop from a 12-in irrigation if the producer switches from a less efficient system (left column) to a more efficient system.

Current System applying 12 in	**Switch To ...**			
	MESA	**LESA**	**LEPA**	**SSD**
MESA	0	1.62	4.79	5.58
LESA	-	0	2.80	3.49
LEPA	-	-	0	0.56
SSD	-	-	-	0

Table 30. Potential increase in water (inches) available for use by the crop from a 14-in irrigation if the producer switches from a less efficient system (left column) to a more efficient system.

Current System applying 14 in	Switch To ...			
	MESA	LESA	LEPA	SSD
MESA	0	1.89	5.59	6.51
LESA	-	0	3.25	4.07
LEPA	-	-	0	0.66
SSD	-	-	-	0

Table 31. Potential increase in water (inches) available for use by the crop from a 16-in irrigation if the producer switches from a less efficient system (left column) to a more efficient system.

Current System applying 16 in	Switch To ...			
	MESA	LESA	LEPA	SSD
MESA	0	2.16	6.38	7.44
LESA	-	0	3.73	4.66
LEPA	-	-	0	0.75
SSD	-	-	-	0

For example, Table 28 suggests that if a producer were applying a 10-inch irrigation to a crop using a MESA system, switching to a LESA system would make an additional 1.35 inches of the original 10-inch irrigation available for use by the crop. Switching to a LEPA system would make an additional 3.99 inches of the original 10-inch irrigation available for use by the crop. The big difference between the values for switching to a LEPA system over switching to a LESA system reflect the marked increase in application efficiency between LESA to LEPA (Table 27). These values are based on average application efficiencies for MESA, LESA, LEPA and SSD irrigation systems of 66.9, 75.9, 93.6, and 98.0 percent, respectively. Actual values might vary from those presented in Tables 28-31, but these results are useful in illustrating the relative gains to be made by switching from less efficient to more efficient irrigation systems.

It might not be possible for some producers to realize the kinds of gains shown in Tables 28-31 without changing crops. For example, MESA systems are typically used for irrigating corn, due to the height of the crop canopy. In this situation, it might not be feasible to switch from MESA to LESA or LEPA. From a practical point of view, the biggest gains in water conservation (associated with irrigation type) that could be realized in the Texas High Plains would result from producers switching from LESA to LEPA. Field studies conducted as part of the TAWC project have demonstrated that a higher cotton yield can be achieved under LEPA as compared to LESA using the same basic irrigation rate. This suggesting that the water applied by the LEPA system was more effective in producing yield (i.e., a greater percentage of it was available to grow the crop, as indicated by the results in Tables 28-31). Switching from LESA to LEPA emitters is a relatively easy task, so these improvements are feasible. As available water resources continue to dwindle, it is likely that more producers in the Texas High Plains might be making this change.

Remote Sensing of Soil Moisture

A major objective of Task 5 over the preceding few years has been the development and testing of the "Next-Generation TAWC Irrigation Scheduling Tool". This tool uses satellite remote sensing to establish crop coefficients that are specific to individual fields. It is intended to eventually replace the existing irrigation scheduling tool currently available from the TAWC Solutions webpage. Development and testing of the Next-Generation TAWC Irrigation Scheduling Tool has been described in previous TAWC Annual Reports.

The Next-Generation Tool is capable of making irrigation recommendations based on modeling the changes in soil moisture for a field over the growing season. For such a system, it would be of great value to have periodic measurements of the actual amount of soil moisture in the field to use as a check (and possibly to provide real-time calibration) of the accuracy of the soil moisture modeling. Conceivably, such measurements could come from *in situ* soil moisture monitors (like the John Deere or AquaSpy capacitance probes) placed in the field. However, many producers might not want to spend the money to have these sensors placed in their fields. A second method for providing this information at no cost to the producer would be of great benefit.

Primarily through the work of Ms. Sanaz Shafian, a PhD graduate student funded by TAWC under the direction of Dr. Maas, a method for estimating the soil moisture in individual fields using satellite remote sensing has been developed. This method makes use of remote sensing image data in the red, near-infrared, and thermal infrared spectral bands. Suitable image data can be obtained at no cost from the Landsat-7 and Landsat-8 satellites that are currently operational. Data from these satellites are also used in other parts of the Next-Generation Irrigation Scheduling Tool.

This method for estimating soil moisture is based on the development of a new index, the "Perpendicular Soil Moisture Index" or PSMI. PSMI is evaluated by plotting values of crop ground cover (GC) estimated using satellite image data in the red and near-infrared spectral bands versus corresponding values of surface temperature expressed as digital counts (DC) in the thermal infrared spectral band. The result is a distribution of points in which the position of a point is related to its soil moisture (Figure 23). PSMI measures the distance that a point (pixel) lies in this distribution relative the wet and dry edges of the distribution. PSMI includes a correction for crop ground cover.

A field study was conducted to collect data to test the relationship between PSMI and soil moisture. The study was conducted during 2012 and 2013 in 19 TAWC fields. The study involved the acquisition and analysis of multispectral satellite imagery for evaluating PSMI and measurement of volumetric soil water content for comparison with the corresponding PSMI values. Landsat-7 Enhanced Thematic Mapper (ETM+) or Landsat-8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) imagery containing the study site was acquired on 11 dates during the 2012 and 2013 growing seasons. Each image, located according to the Landsat World Reference System (WRS-2) along Path 30 at Row 36, was obtained from the U.S. Geological Survey (USGS) Earth Explorer website. Pixel data extracted from the red and near-infrared spectral bands were used to estimate GC using the scatterplot-based procedure developed by Drs. Maas and Rajan.

In situ measurements of volumetric soil water content were made for the 19 fields in the study. In 11 of the fields, we installed CS616 time domain reflectometry (TDR) probes at the start of the study. These were installed to measure the water content of the soil in a layer approximately 5 to 25 cm below the surface. Data were continuously recorded using either CR10X or CR1000 data loggers. In an additional 8 fields, volumetric soil water content was measured with commercially available capacitance probes installed by two companies as part of the Texas Alliance for Water Conservation (TAWC) Demonstration Project. These were either John Deere Field Connect soil moisture probes or AquaSpy Soil Moisture Probes. Both systems measure soil moisture at various depths in the soil down to 150 cm. For this study, measurements in the upper portion of the soil profile roughly corresponding to the soil layer in which the CS616 TDR probes were installed were used. Data from these probes was accessed from websites set up to monitor soil moisture in the fields as part of the TAWC project. Measurements of volumetric soil water content were extracted from the data records for each field that corresponded to the dates and times of the satellite image acquisitions.

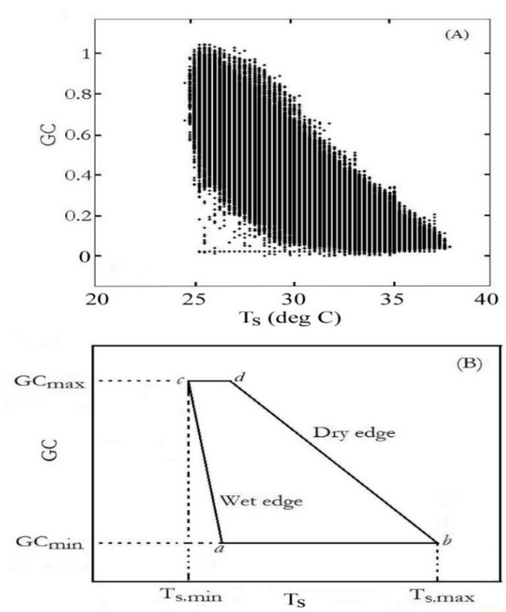


Figure 23. Ground cover (GC) plotted versus surface temperature ($\mathbf{T_s}$); (A) Actual distribution of GC versus T_s for pixels in a Landsat-7 image of an agricultural region; (B) Diagrammatic representation of features of the distribution of $\mathbf{T_s}$-GC space. Points *a* – *d* indicate the vertices of the trapezoidal representation of the distribution of points.

Figure 24 shows values of volumetric soil water content from measurements in the 19 study fields plotted versus corresponding values of PSMI calculated from multispectral satellite image data. The solid line in the figure represents the simple linear regression placed through the points. This regression has the following equation,

$$VWC = 0.81 - 1.04\ (PSMI)$$

in which VWC is volumetric water content and PSMI is the average value of the index for a field. PSMI explains 70% of the variation in VWC for the data set with an RMSE of 0.003. These results show that PSMI is highly correlated with soil moisture conditions in the field over a substantial range of soil moisture conditions (0.25 to 0.6 in Figure 24), with greater values of soil moisture values associated with lower values of PSMI. While this relationship is purely statistical, it shows that remotely sensed quantities such as GC and TIR can be useful indicators of field conditions that are of interest to agronomists and producers, like soil moisture, but are often difficult or cost-prohibitive to directly measure over agricultural regions.

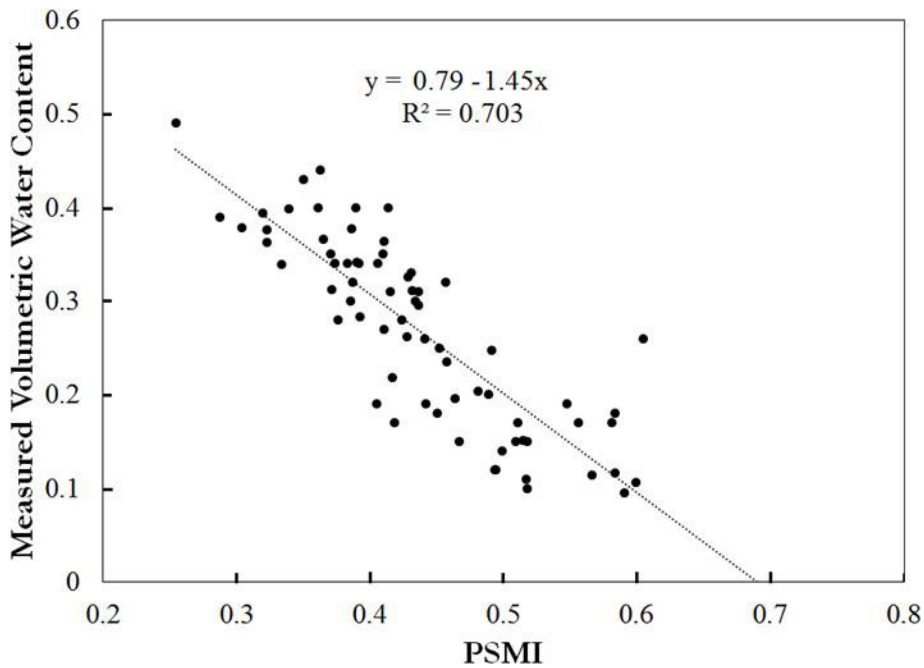


Figure 24. Simple linear regression between field measurements of volumetric soil water content and corresponding values of PSMI calculated from multispectral satellite image data.

As an example of the utility of PMSI in assessing the spatial variation in field conditions across an agricultural region, Figures 25A and 25B show maps of PSMI calculated on a pixel-by-pixel basis for a 976 km^2 portion of the TAWC project on two separate dates. Figure 25A was constructed from Landsat-8 multispectral image data acquired on 4 August 2013, while Figure 25B was constructed from Landsat-8 multispectral image data acquired on 21 September 2013. In the figures, PSMI is color-coded to emphasize its variation across the landscape, and non-agricultural features (urban areas, water bodies, clouds, and cloud shadows) have been masked in black. The information provided by PSMI is consistent with the known soil moisture conditions across the region. For the 4 August image (Figure 25A), PSMI is relatively low (indicated by green) in most of the irrigated fields, indicating that they are actively being irrigated– this is consistent with farming practices in the region at this time of peak crop growth. Surrounding dryland (non-irrigated) fields and pastures exhibit relatively high values of PSMI (indicated by orange and red), indicating less soil moisture under strictly rainfed conditions. For the 21 September image (Figure 25B), most irrigation has been terminated so PSMI is higher in most of the fields that previously were irrigated. Image products such as these could be useful in monitoring regional soil moisture or drought conditions, and could provide input or calibration information for running crop growth models.

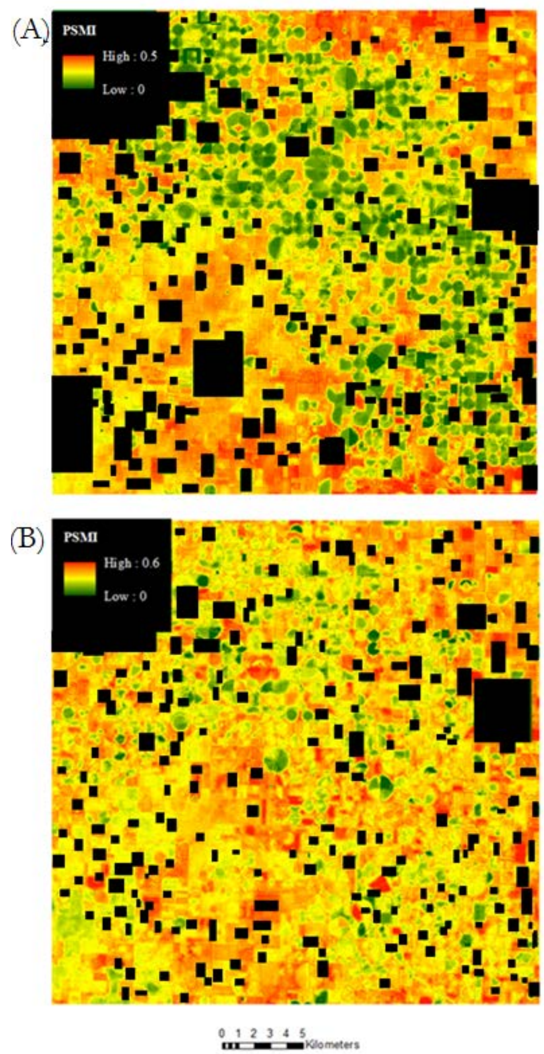


Figure 25. PSMI maps constructed for two dates for a portion of the Texas High Plains; (A) PSMI map for 4 August 2013; (B) PSMI map for 21 September 2013. Green indicates low values of PSMI (high moisture), while orange and red indicates high values of PSMI (low moisture). Urban areas, water bodies, clouds and cloud shadows are masked in black.

Publications and Presentations related to TAWC

(Added to Presentations/Publications/In Press, pages 20-21)

Rajan, N., and S. Maas. Spectral crop coefficient for estimating crop water use. Agricultural Water Management. (In Review)

Rajan, N., and S. Maas. Mega-drought effects on evapotranspiration and energy balance of a pasture in the Southern High Plains. Agronomy Journal. (In Press)

Cui, S, N. Rajan, and S. Maas. An automated soil line identification method using relevance vector machine. Remote Sensing Letters. (In Press)

Rajan, N., S. Maas and S. Cui. 2013. Extreme drought effects on carbon dynamics of a semi-arid pasture. Agronomy Journal 105(6): 1749-1760.

Rajan, N., S. Maas and G. Ritchie. Field evaluation of a remote sensing based irrigation scheduling tool. Abstracts, 2013 Beltwide Cotton Conference, January 7-10, San Antonio, TX.

Maas, S., and N. Rajan. Remote sensing based water management from the watershed to the field level. Abstracts, Workshop "Beyond Diagnostics: Insights and Recommendations from Remote Sensing." CIMMYT and the Gates Foundation, 14-15 December 2013, Mexico City. (Invited)

Shafian, S., and S. Maas. Remote sensing based soil moisture detection. Abstracts, Workshop "Beyond Diagnostics: Insights and Recommendations from Remote Sensing." CIMMYT and the Gates Foundation, 14-15 December 2013, Mexico City. (Invited)

TASK 6: COMMUNICATIONS AND OUTREACH

Annual Report ending February 28, 2014

Principal Investigator(s): Samantha Borgstedt (TTU), Dr. Steve Fraze, Dr. Rudy Ritz

We are satisfied with our progress towards achieving our goals in outreach and communications. Activities this quarter toward achieving the objectives include:

March – May 2013

- Samantha Borgstedt updated the project's Twitter and Facebook accounts regularly with new tweets/postings.
- A TAWC-related research proposal that included Dr. David Doerfert was submitted to USDA AFRI Climate Change: Change Mitigation and Adaptation in Agriculture research area focused on the potential impact of various winter cover crops on soil moisture.
- Borgstedt and Harkey staffed the TAWC booth for the Texas Ginners Annual Meeting and Trade Show (April 4-5, 2013) where they distributed project materials and shared the water management guide and TAWC online tools with attendees. A meeting was held during the Gin Show with Dr. Dan Krieg with several TAWC project members to plan the Summer Field Walks.
- Before the Field Walks we make a flyer detailing the date, time, location and topics to be discussed. This is emailed to our contacts, including extension agents who hang them up and disseminate how they wish. Rick Kellison also post these flyers at producer hang-outs throughout our project area. Borgstedt appeared with Eddie Griffiths on Fox Talk 950, Tony St. James on 900AM KFLP and 800AM KDDD, and Todd Waylyn on 1090AM KKYN to advertise our field day.
- We have mailed out 2,519 save-the-date postcards listing all the dates of the TAWC Summer Field Walks and Field Day. It also lists where and when they can listen to TAWC Field Talk on 900AM KFLP and 800AM KDDD, as well as our new web address, www.tawc.us. In addition, 200 cards were distributed at area cotton gins, coffee shops, extension offices, and other locations where producer gather.
- The first of our TAWC Summer Field Walks was held May 22nd at TAWC Site 21 on Eddie Teeter's Farm. Participants examined corn planted on drip and LEPA center pivot irrigation. About 25 were in attendance. Rick Kellison kicked off the field walk by talking about the TAWC project and its purpose as well as the TAWC tools. Dr. Dan Krieg and Bob Glodt explained evapotranspiration and discussed best irrigation management practices depending on ET rate, plant stress level, and plant growth stage. Bob Glodt also demonstrated how to use and read a soil moisture probe.
- We began a radio segment called TAWC Field Talk on 900AM KFLP and 800AM KDDD which runs at 12:30 and 3:00pm. Each day the segment features a county extension agent, researcher, producer, commodity group leader, technology expert or consultant to talk about current issues related to agriculture production in West Texas. We also report the daily and 5-day cumulative ET each day. These segments run from May

through August. The radio station estimates that we reach between 1,000 to 1,200 listeners per day. TAWC Field Talk segments are sponsored by Hurst Farm Supply, Bayer Crop Science, DuPont Pioneer, and the Initiative for Strategic and Innovative Irrigation Management and Conservation.

- The project purchased the domain www.tawc.us and installed *Google Analytics* to track audience views of our web-based information. Moving forward, we will be using this address on handouts and emails.
- An evaluation conducted by Dr. Doerfert involving interviews with TAWC producers sought answers to questions posed by TWDB. As part of that questionnaire, data were collected to complete a social network analysis to determine the interpersonal communications patterns that may exist within the project.
- Dr. David Doerfert completed an award application to American Water Resources Association (AWRA) for integrated water management projects. The TAWC project was selected as the national winner. Dr. Doerfert accepted the award at AWRA's annual meeting in Portland in November 2013.
- Dr. Doerfert submitted a manuscript to the AWRA for possible presentation at the national meeting in November.

June - August 2013

- Samantha Borgstedt updated the project's Twitter and Facebook accounts regularly with new tweets/postings.
- Pictures of each TAWC site were taken by graduate assistant Kelly Harkey and Borgstedt during the quarter to document progress through the growing season.
- Borgstedt and Harkey produced 65 radio segments lasting 3 minutes each in June, July and August. These segments featured producers, commodity leaders, irrigation technology experts, researchers, consultants and county extension agents.
- Borgstedt and Harkey also tracked and recorded the daily and five day cumulative daily maximum crop water demand for each of these 65 days. This, along with the 3 minute segments, ran twice a day, 7 days a week on 900AM KFLP (Lubbock) and 800AM KDDD (Amarillo).
- Borgstedt went on AM radio stations in Plainview, Lubbock and Floydada 11 times to advertise these Field Walks. Email, social media, flyers and save-the-date cards were also used as advertisement.
- Three Field Walks were held on June 12, July 10 and July 31 at TAWC site 21. Dr. Dan Krieg and Bob Glodt spoke about irrigation needs of corn, grain sorghum and cotton during each of the walks. Each of these three crops were planted on site 21 and reports of the crop's daily ET, rainfall events and irrigation events tracked by the TAWC Solutions site with the results being distributed and explained to attendees. Representatives from John Deere, Eco-Drip, AquaSpy and SmartField were also at each Crop Walk and explained their technologies to the crowd. Each Field Walk was

attended by approximately 30 producers, researchers, consultants and county extension agents.

- Radio advertisements for the Field Day ran for two weeks prior on Fox Talk 950AM, KFLP 900AM and KDDD 800AM. Samantha Borgstedt and Rick Kellison went on these stations as well as Plainview's KKYN 106.9AM to advertise the Field Day. Email, flyers, save the date cards and social media were also used.
- On August 15 we held our Annual TAWC Field Day at the Floyd County Unity Center in Muncy, Texas. This was attended by 76 people. Lubbock's Fox Channel 34 recorded the beginning of the Field Day and interviewed several of its speakers (http://www.myfoxlubbock.com/content/agdaylubbock/story/recent-rainfall-crops-drought/23GuFNT7-0GWMB8mcSFq7g.cspx). Reporters from Hereford and Floydada also attended and ran pieces in their newspapers about it. Live radio coverage was provided by 900AM KFLP and 800 AM KDDD. Segments from Field Day speakers continued to run on these station's Ag Business Report for several days.
- An evaluation conducted in December-February by Dr. David Doerfert involving interviews with TAWC producers. Data were collected to complete a social network analysis to determine the interpersonal communications patterns that may exist within the project.
- The TAWC project was selected as the national winner of the American Water Resources Association (AWRA) integrated water management project of the year. Dr. Doerfert will accept the award at AWRA's annual meeting in Portland in November 2013.
- A manuscript of the social network analysis research was accepted for presentation at the AWRA national meeting in November. This was a peer-reviewed process.
- On July 8th, Doerfert presented on the TAWC project and related agricultural water management research to the Roscoe ISD Advisory Board meeting.
- While attending the Agricultural Media Summit, Doerfert was interviewed by The Daily News of Batavia, NY about water use in agriculture and West Texas. http://m.thedailynewsonline.com/mobile/article_9380f962-fd85-11e2-9987-0019bb2963f4.html

September - November 2013

- Dr. David Doerfert announced that he will leave TAWC project prior to the start of Phase II funding in 2014. He will conclude the majority of his work in December 2013 with the exception of supervising the thesis research of Kelly Harkey which is focused on using Google Analytics to examine TAWC website activity (will conclude in May 2014). Drs. Steve Fraze (Task 6 overall management), Courtney Meyers (communications-related task management), and Rudy Ritz (education-related task management) from the Department of Agricultural Education & Communications have joined the project with Doerfert's departure.

- Samantha Borgstedt updated the project's Twitter and Facebook accounts regularly with new tweets/postings.
- Borgstedt and Harkey produced radio segments for each week during the quarter. This work included setting up the interviews, recording and editing the interview, and uploading the final segment. These interviews aired every Wednesday at 12:20 pm and 3:20 pm on 900 AM KFLP and 800 AM KDDD. These segments featured producers, commodity leaders, irrigation technology experts, researchers, consultants and county extension agents.
- Conducted final crop walk on September 11th at TAWC site 21. Dr. Dan Krieg and Bob Glodt spoke about the remaining needs for grain sorghum and cotton during the walk. Representatives from John Deere, Eco-Drip, AquaSpy and SmartField were also at each Crop Walk and explained their technologies to the crowd. The Crop Walk was attended by 17 area producers, researchers, consultants and county extension agents.
- Two posters were accepted through a peer-review process and presented at the 2013 American Association for Agricultural Education (AAAE) Western Region Meeting held in Lubbock, TX September 23-25, 2013. The APA citations and recognition received are:
    - Hill, N. & Doerfert, D. (2013). Using NodeXL for social network analysis and adoption-related research. Poster presented at the 2013 American Association for Agricultural Education (AAAE) Western Region Meeting, Lubbock, TX. Poster received 3rd place Innovation Idea Poster Award.
    - Hill, N. & Doerfert, D. (2013). Identifying the information exchange patterns that exist within an agriculture production demonstration project through the use of social network analysis (SNA). Poster presented at the 2013 American Association for Agricultural Education (AAAE) Western Region Meeting, Lubbock, TX. Poster received 5th place Research Poster Award.
- Dr. Doerfert presented a poster on the TAWC project at the Engagement Scholarship Conference that was held on the Texas Tech campus October 8-9, 2013. This was a peer-reviewed process. The APA citation would be: Doerfert, D. (2013). The Texas Alliance for Water Conservation: An integrated water resources management project. Poster presented at the 2013 Engagement Scholarship Conference, Lubbock, TX.
- A Grass Trail Research Day was conducted on October 10th next to TAWC site 21. Dr. Calvin Trostle spoke about the results of the research and how this can facilitate pasture development. The event was attended by 17 area producers, researchers, consultants and county extension agents.
- Using evaluation data collected in December-February by Dr. David Doerfert and graduate assistants Nellie Hill and Kelly Harkey, Nellie Hill completed a social network analysis to determine the interpersonal communications patterns that may exist within the project. This research served as her master's thesis titled A Social Network Analysis of Texas Alliance for Water Conservation Producers. The thesis was successfully defended on October 10th and shared with the TAWC Management Team during their November meeting. The abstract for her thesis is:

Networks of relationships form the foundation of our social lives. Understanding and utilizing these connections can help practitioners and researchers more effectively and efficiently disseminate information and innovations within a group. The Texas Alliance for Water Conservation is concerned with identifying the best practices and new technologies for water management in West Texas. The project also desires to share knowledge beyond the currently involved members to other producers in the region. This study sought to describe the interpersonal relations of the TAWC Demonstration Project producers through social network analysis. Semi-structured interviews were conducted with TAWC producers in order to describe producers and their interpersonal connections in terms of relations and typology. NodeXL for Microsoft Excel, QDA Miner, and WordStat software tools were used for data analysis. Results indicated TAWC producers are diverse in their attributes, both personally and in their farming operations. Analysis revealed a change agent and several opinion leaders within the TAWC producer network. Furthermore, the knowledge developed through the TAWC has reach beyond the TAWC producers. The study results will facilitate further social network analysis of the population and guide further information and innovation dissemination to the TAWC producer network.

- A manuscript of the social network analysis research was presented at the AWRA national meeting November 4, 2013. This was a peer-reviewed process and the APA citation would be:
    - Hill, N., Doerfert, D., & Harkey, K. (2013). Social network analysis of West Texas farmers: Potential impact in disseminating research results and best practices. Paper presented at the 2013 American Water Resources Association (AWRA) Annual Water Resources Conference, Portland, OR.
- The TAWC project was selected as the national winner of the American Water Resources Association (AWRA) Integrated Water Resources Management Project of the Year. Dr. Doerfert accepted the award at AWRA's annual meeting in Portland in November 6, 2013.
- In November, Borgstedt and Harkey prepared materials and folders for use in the TAWC booth at the 2013 Amarillo Farm & Ranch Show (December 3-5, 2013).
- For his contributions to the success of the TAWC project, producer Eddie Teeter was nominated and will receive the Save Texas Water Blue Legacy Award in Agriculture from the Water Conservation Advisory Council during the 2013 Amarillo Farm & Ranch Show. According to the council, award winners were selected based on their demonstrated willingness and commitment to incorporate water conservation practices into their operations as well as their leadership in furthering water conservation in their communities or within the industry.
- Borgstedt and Harkey began plans for 2014 TAWC Winter Meeting to be held in conjunction with High Plains Association of Crop Consultants annual meeting.

December 2013- March 2014

- Samantha Borgstedt and graduate assistant Kelly Harkey staffed an information booth at the 2013 Amarillo Farm & Ranch Show December 1, 2013. Project materials were distributed to attendees and the TAWC tools and water management guide were shared.
- Samantha Borgstedt submitted the Blue Legacy Award application for TAWC producer Eddie Teeter. He won the award and received it during the Texas Commodity Symposium held during the Amarillo Farm and Ranch Show. This is the third year in a row for the TAWC or one of its producers to win the Blue Legacy Award.
- Samantha Borgstedt produced a press release about Teeter's receiving the Blue Legacy Award. This was picked up by several local newspapers and Fox 34 television's Ag Talk did a special segment on Teeter.
- Kelly Harkey continued with interviews and producing radio segments airing on AM radio stations KFLP and KDDD. These segments run each Wednesday at 12:20pm and 3:20pm reaching over 1,000 listeners.
- The majority of time and resources spent during this quarter were on planning the joint meeting between the High Plains Association of Crop Consultants HPACC and TAWC. This meeting was held on March 4, 2014, and TAWC was responsible for the majority of the all-day program.
- Planning was also done for the TAWC Cotton Irrigation Short Course. This is a series of meetings held every Tuesday (March 11, 18, 25, April 1, 8). These meetings will be held at the Plainview Country Club from 7:30am – 8:30am and focus on irrigation management and use of the TAWC online tools. Bob Glodt, Dan Krieg and Jim Bordovsky will all be guest presenters during these meetings and producers from the Texas High Plains area will be invited to attend.
- Samantha Borgstedt joined Rick Kellison and Jeff Pate to meet with TAWC producers and photograph sites and equipment. These photos will be used for future outreach materials.
- Preparations have begun for the Texas Ginners Annual Meeting and Trade Show (April 3-4, 2014). Samantha Borgstedt, Kelly Harkey, Rudy Ritz and Mallory Newsom will staff the TAWC booth where they will distribute project materials and share the water management guide and TAWC online tools with attendees.

TASK 7: PRODUCER ASSESSMENT OF OPERATION

Annual Report ending February 28, 2014

Principal Investigator(s): Dr. Calvin Trostle (Texas A&M AgriLife Extension)

Support to Producers

Visited with eight producers during 2013 about their operations as part of the ongoing producer assessment of their needs and what crop information they would like to have for their operation. Numerous research and Extension reports were provided as needed in the TAWC area.

Common questions among producers continued to be irrigation strategies in 2013 using split pivot irrigation scenarios (see the base information, updated for 2013, at http://lubbock.tamu.edu/files/2013/03/Texas-South-Plains-Irrigation-Strategies-2013.pdf) whereby producers are choosing two different crops to spread water use (and demand) rather than require irrigation on a full circle at one time. Then as the drought deepened its grip information was sought on how different crops respond to drought and what to do about water intensive crops that were failing.

Field Demonstrations

Lockney Grass & Irrigation Trials

This trial completed data collection in 2012 and is no longer irrigated. Two field tours were held at the site in 2013. The Oct. 10 meeting with TAWC was attended by over 40 producers, seed company staff, and landowners to review for the final time the data and the persistence from this variety trial. Due to gradual contamination from adjacent grasses, we believed this might be the last opportunity to review the grasses. The meeting lasted almost two hours and included TAWC speaker Dr. Chuck West; Dr. Ted McCollum, AgriLife Extension beef cattle specialist, Amarillo; and Nick Bamert, Bamert Seed Company (grass), Muleshoe. An additional Sept. 26 tour hosted Wayland Baptist University's Dr. Harold Grover, professor of biology, and 11 students from his environmental ecology glass. This site discussion was approximately 2.5 hours.

Opportunities to Expand TAWC Objectives

Project awareness: Commented on project on seven different radio programs, answered producer phone calls, and information and the approach that the TAWC project is taking has helped shape other programs and Extension activities in the Texas South Plains.

Educational Outreach

Participated in two TAWC educational meetings in the region as well as two county Extension meetings covering the TAWC demonstration area in 2013. These included the Hale Co. crops conference and the Floyd-Crosby crops conference.

Support to Overall Project

Activities include attending five monthly management team meetings and/or producer advisory board meetings.

TASK 8: INTEGRATED CROP/FORAGE/LIVESTOCK SYSTEMS AND ANIMAL PRODUCTION EVALUATION

Annual Report ending February 28, 2013

Principal Investigator(s): Dr. Charles West, Phil Brown (TTU)

Preparing the budgets, subcontracts, and statement of work for Phase II of TAWC (2014-2020) was a major occupation in 2013. Editing, submitting, and revising manuscripts for publication was also a major focus in 2013 as Dr. Chuck West succeeded Dr. Vivien Allen in leading Task 8. During this transition period Dr. Vivien Allen has remained part-time and continued work on completing publications derived from our over-all research effort. The following papers with references have been published and/or accepted for publication:

1. Cui, S., V.G. Allen, C.P. Brown, and D.B. Wester. 2013. Growth and nutritive value of three old world bluestems and three legumes in the semiarid Texas High Plains. Crop Sci. 53:1-12.

2. Johnson, P., J. Zilverberg, V.G. Allen, J. Weinheimer, C.P. Brown, R. Kellison, and E. Segarra. 2013. Integrating cotton and beef production in the Texas Southern High Plains: III. An economic evaluation. Agron. J. 105:929–937.

3. Davinic, M., J. Moore-Kucera, V. Acosta-Martinez, J. Zak, and V. Allen. 2013. Soil fungal groups' distribution and saprophytic functionality as affected by grazing and vegetation components of integrated cropping-livestock agroecosystems. Appl. Soil Ecol. 66:61-70.

4. Li, Y., V.G. Allen, F. Hou, J. Chen, and C.P. Brown. 2013. Li, Y., V.G. Allen, F. Hou, J. Chen, and C.P. Brown. 2013. Steers grazing a rye cover crop influence growth of rye and no-till cotton. Agron. J. 105:1571-1580.

5. Li, Y., V.G. Allen, J. Chen, F. Hou, C.P. Brown, and P. Green. 2013. Allelopathic influence of a wheat or rye cover crop on growth and yield of no-till cotton. Agron. J. 105:1581-1587.

6. Fultz, L.M., J. Moore-Kucera, T.M. Zobeck, V. Acosta-Martínez, and V.G. Allen. 2013. Soil aggregate-carbon pools after 13 years under a semi-arid integrated crop-livestock agroecosystem. Soil Sci. Soc. Am. J. 77:1659-1666. doi:10.2136/sssaj2012.0423.

7. Fultz, L.M., J. Moore-Kucera, T.M. Zobeck, V. Acosta-Martinez, and V.G. Allen. 2013. Organic carbon dynamics and soil stability in five semiarid agroecosystems. Agric. Ecosystems Environ. 181:231-240. doi:10.1016/j.agee.2013.10.004.

8. Zilverberg, C.J., C.P. Brown, P.E. Green, M.L. Galyean, and V.G. Allen. 2014. Integrated crop–livestock systems in the Texas High Plains: Productivity and water use. Agron. J. 106:831-843.

9. Cui, S., C.J. Zilverberg, V.G. Allen, C.P. Brown , J. Moore-Kucera, D.B. Wester, M. Mirik, S. Chaudhuri, and N. Phillips. Carbon and nitrogen responses of three old world bluestems to nitrogen fertilization or inclusion of a legume. Field Crops Res. (In press).

Another task was led by Dr. West was providing leadership to the forage research project known as TeCSIS. This consisted of planning and submitting a grant proposal to the USDA-Southern SARE program that included four producer cooperators, some of whom are participants in the TAWC program. The title was "Transitioning Texas High Plains agriculture toward low water use with integrated pastures and livestock". The objective was to demonstrate and evaluate the conversion of land used for annual crops in the Texas High Plains to pastureland for the purpose of reducing whole-farm irrigation use and enhancing soil sustainability without sacrificing agricultural profitability. The proposal was not funded in 2013, but is being revised and resubmitted in 2014.

TASK 9: EQUIPMENT, SITE INSTRUMENTATION AND DATA COLLECTION FOR WATER MONITORING

Annual Report ending February 28, 2014
Principal Investigator(s): Jason Coleman and Keith Whitworth (HPWCD #1)

The year 2013 was a year of transition for the High Plains Underground Water Conservation District No. 1. General Manager Jim Conkwright retired June 30, 2013, after 12 years of service. Gerald Crenwelge, Soil Scientist and Field Data Coordinator, retired August 31, 2013. The Water District Board of Directors hired Jason Coleman to be the general manager, effective September 3, 2013. Long time district employee Keith Whitworth was promoted to the district's Field Technician supervisor. Through all these transitions, the district staff continued to monitor monthly rainfall and soil moisture levels in the TAWC Project. This was another dry year. The average rainfall within the TAWC Project area was 12.1 inches from March 1, 2013 thru February 28, 2014. Soil moisture values were collected at planting and after harvest for use in calculating the Total Crop Water. This is the Water District's contribution to the data necessary to determine the Potential Irrigation Conserved.

Water Use Efficiency Summary: Philip Brown, Texas Alliance for Water Conservation
Total Water Use Efficiency (WUE)

Table 32 lists the information related to the irrigation efficiency. Data presented include **site**, **field**, **crop**, special harvest **status**, **irrigation type** and **acres** for each location within the project area. **Season rainfall** is based on individual sites and represents an estimated 70% effective rainfall in inches received during the growing season (planting to harvest). **In-season irrigation,** reported in inches is the total amount of irrigation applied between planting and harvest for each individual site's crop. **Soil moisture contribution to WUE,** (inches) is the estimated plant available soil moisture provided from pre-plant irrigation and/or rainfall and is the calculated difference based on a beginning and end of season Neutron probe measurement obtained by the High Plains Underground Water Conservation District No. 1. Due to the labor intensive effort required for this type of measurement, only a limited number of fields were measured. In an attempt to compensate for the missing information a median soil moisture value was derived for the missing data and used to calculate a more complete data set across all sites. **Total crop water supplied** is a sum total of 70% effective rainfall, in-season irrigation and soil moisture contribution. **ET crop water demand** is the average crop water demand in inches required for individual crops at 100% ET based on crop-specific water coefficients and experience and history with other crops lacking these derived crop water-use coefficients. Percent **Crop water demand provided by rainfall (70% effective), irrigation,** and **soil moisture** are the percentage of crop water demand supplied by each individual factor. **Crop water demand provided by total crop water (%)** includes all of these factors combined. **Total irrigation potentially conserved in acre-feet** is the total amount of water estimated to have been conserved over **total crop water demand** at 100% of crop ET.

Our data indicates that soil moisture contributed only an estimated 10% to the season total crop water demand. Historically, producers have “banked” or stored water in pre-season irrigation applications with the expectation that this water will be present and available at planting. However, the lack of site-specific information on soil water holding capacity and management practices can result in major losses due to watering too early and in excess of soil capacity. A better measure of this pre-season water is being studied, but greater awareness of pre-watering practices and soil-specific management is indicated.

Assuming no water applied has no potential water savings, estimated sum total irrigation potentially conserved across the TAWC project sites totals 309.6 acre-feet or 3,715 acre inches for the 2013 growing season. On average across all sites and irrigation systems, irrigation alone provided 59% of the total crop water demand with 29% provided by rainfall and another 10% by soil moisture. This sums to approximately 98% of the crop water demand provided by total crop water. While this does not total 100%, it is unrealistic to believe we have accounted for all water used and/or lost due to evaporation and drainage through the soil profile throughout the whole season. It is of interest to note there were numerous sites supplying greater than 100% of total crop water demand with values ranging from 100 to 164%, and for one site, irrigation alone provided 127% of the total crop water. Sub-surface drip (SDI) and low energy precision application (LEPA) while the most efficient irrigation systems available supplied on average 113% and 94% crop water demand provided by total crop water. This indicates excessive water application for SDI and leaves room for improvement for LEPA. Many producers employ irrigation management strategies based on their experience with older less efficient pivot irrigation systems, however LEPA and particularly SDI systems require a unique management style since this water is applied sub-surface and/or in narrow bands to reduce surface evaporation. This improved efficiency may not be taken into account. Newer irrigation systems, while becoming more efficient, have resulted in more water being applied rather than less due to management rather than due to the system itself. It has been demonstrated in our area that deficit irrigation at 70% of total crop water demand provides an economically viable crop. Irrigating at this level, in addition to the average 30-50 % water contribution from rainfall and pre-soil moisture should meet 100% of total crop water demand in most years. If management strategies in 2013 for those fields in excess of 70% total crop water supplied by irrigation were limited to a maximum of 70%, then this would have resulted in twice the water saved with an additional 341 acre feet of water potentially conserved for a total of approximately 650 acre feet.

While it is impossible to predict how much and when specific rainfall may occur, predicting this rainfall and its timing is critical to a successful crop; however, taking advantage of this additional moisture when received is of extreme importance in achieving additional water savings and will rely on changing attitudes, improved management techniques, advanced technologies, management tools, and predictive models to achieve further reductions in our irrigated water use.

Table 32. Total water use efficiency (WUE) summary by various cropping and livestock systems across the TAWC sites (2013).

Year	Site	Field	Crop	Status	Irrigation type	Acres	Season rainfall (70% effective-inches)	In-season irrigation (inches)	Soil moisture contribution to WUE (inches)	Total crop water supplied (inches)	ET crop water demand (inches)	Crop water demand provided by rainfall (%)	Crop water demand provided by irrigation (%)	Crop water demand provided by soil moisture (%)	Crop water demand provided by total crop water (%)	Total irrigation potentially conserved (acre-feet)
2013	2	2	cotton		SDI	31.5	9.5	21.0	2.4	32.8	24.0	39%	88%	10%	137%	-23.1
2013	2	3	corn		SDI	28.4	9.5	21.0	6.7	37.1	33.0	29%	64%	20%	113%	-9.8
2013	3	1	cotton		MESA	61.5	4.1	12.1	2.4	18.5	24.0	17%	50%	10%	77%	28.1
2013	3	2	grain sorghum		MESA	61.8	4.1	8.4	1.4	13.9	22.0	18%	38%	7%	63%	41.7
2013	4	5	alfalfa		LEPA	16	7.3	31.6	1.1	40.0	40.0	18%	79%	3%	100%	0.0
2013	4	8	cotton		LEPA	50.5	7.6	12.5	3.0	23.1	24.0	32%	52%	13%	96%	4.0
2013	4	9	millet		LESA	29.6	7.3	14.7	0.3	22.3	20.0	36%	74%	1%	111%	-5.5
2013	4	10	wheat	grazed	LEPA	26.8	1.5	3.9	2.4	7.8	11.7	13%	33%	20%	67%	8.7
2013	4	10	forage sorghum	grazed	LEPA	26.8	7.5	6.4	2.4	16.2	16.3	46%	39%	14%	100%	0.0
2013	5	2	wheat		LESA	85.8	1.7	5.0	2.4	9.0	18.0	9%	28%	13%	50%	64.1
2013	5	3	millet		LESA	156	7.0	12.0	2.4	21.4	20.0	35%	60%	12%	107%	-17.6
2013	5	4	cotton		LESA	119.4	7.1	12.0	6.4	25.4	24.0	29%	50%	27%	106%	-14.2
2013	5	5	sunflowers		LESA	122.9	4.4	10.0	2.4	16.8	22.0	20%	45%	11%	76%	53.7
2013	6	9	cotton		LESA	60.6	9.0	18.6	7.0	34.6	24.0	38%	78%	29%	144%	-53.7
2013	6	10	wheat	hay	LESA	62.1	1.9	11.6	2.4	15.8	18.0	11%	64%	13%	88%	11.2
2013	7	1	sideoats		LESA	130	3.8	10.3	0.9	15.0	15.0	25%	69%	6%	100%	0.1
2013	7	1	sideoats	hay	LESA	130	5.0	0.0	2.4	7.4	15.0	na	na	na	na	na
2013	8	1-4	sideoats		SDI	61.8	3.8	14.1	-2.8	17.9	15.0	25%	94%	0%	119%	-14.8
2013	8	1-4	sideoats	hay	SDI	61.8	5.0	0.0	2.4	7.4	15.0	na	na	na	na	na
2013	9	1	grass	grazed	MESA	100.8	11.6	0.0	0.9	12.5	9.8	na	na	na	na	na
2013	9	3	cotton		MESA	77	11.6	8.2	2.4	22.1	24.0	48%	34%	10%	92%	12.2
2013	9	4	grain sorghum		MESA	59.9	10.5	12.1	3.8	26.4	22.0	48%	55%	17%	120%	-22.0

2013	10	1	Dahl	grazed	LESA	44.3	10.2	9.8	2.4	22.3	15.6	na	na	na	na	-24.7
2013	10	4	Cotton		LESA	42.1	10.2	15.2	0.9	26.4	24.0	43%	63%	4%	110%	-8.2
2013	10	5	Corn silage		LESA	87.2	9.1	19.0	-1.0	28.1	27.0	34%	70%	0%	104%	-8.0
2013	11	2	cotton		FUR	24.4	8.3	12.0	2.4	22.7	24.0	35%	50%	10%	95%	2.7
2013	11	3	cotton		FUR	22.9	8.3	12.0	3.6	23.9	24.0	35%	50%	15%	100%	0.2
2013	11	5	cotton		FUR	45.2	8.3	12.0	2.4	22.7	24.0	35%	50%	10%	95%	5.0
2013	12	1	cotton	abandon	DL	151.1	8.2	0.0	2.4	10.5	24.0	na	na	na	na	na
2013	12	2	cotton	abandon	DL	132.7	8.2	0.0	2.4	10.5	24.0	na	na	na	na	na
2013	14	4	cotton		LESA	124.1	7.4	4.0	3.4	14.7	24.0	31%	17%	14%	61%	96.1
2013	15	8	cotton		SDI	56.7	7.2	11.6	2.4	21.2	24.0	30%	48%	10%	88%	13.4
2013	15	9	cotton		SDI	44.4	7.2	10.8	4.4	22.4	24.0	30%	45%	18%	93%	6.0
2013	17	4	grass	grazed	MESA	111.8	8.5	1.4	2.6	12.4	9.8	na	na	na	na	-25.1
2013	17	5	corn		MESA	54.5	8.5	26.8	2.4	37.6	33.0	26%	81%	7%	114%	-21.0
2013	17	6	sunflowers		MESA	54.4	5.4	12.7	2.5	20.6	22.0	25%	58%	11%	94%	6.3
2013	18	1	fallow	fallow	MESA	61.5	5.0	0.0	-0.9	5.0	59.1	na	na	na	na	na
2013	18	2	fallow	fallow	MESA	60.7	5.0	0.0	2.4	7.3	59.1	na	na	na	na	na
2013	19	11	cotton		LEPA	120.3	9.2	9.0	2.2	20.4	24.0	39%	38%	9%	85%	35.7
2013	20	1	triticale silage		LEPA	117.6	3.9	5.6	2.4	11.8	24.0	16%	23%	10%	49%	119.6
2013	20	1	cotton		LEPA	115.7	10.2	20.2	-1.5	30.4	24.0	43%	84%	0%	127%	-61.9
2013	20	2	corn silage		LEPA	117.6	9.5	21.8	1.0	32.3	27.0	35%	81%	4%	120%	-51.7
2013	21	1	corn		LEPA	61.4	9.5	15.5	-0.2	25.0	33.0	29%	47%	0%	76%	40.8
2013	21	2	wheat		LEPA	61.2	2.2	14.5	2.4	19.1	18.0	12%	81%	13%	106%	-5.6
2013	21	2	forage sorghum		LEPA	61.2	7.2	3.3	2.4	12.9	25.0	29%	13%	9%	51%	61.9
2013	22	3	cotton		LEPA	148.7	8.5	21.5	-2.6	30.0	24.0	35%	90%	0%	125%	-74.0
2013	24	1	corn		LESA	65.1	7.4	20.7	-1.3	28.1	33.0	22%	63%	0%	85%	26.9
2013	24	2	sunflowers		LESA	65.1	5.8	8.7	5.7	20.2	22.0	26%	40%	26%	92%	9.8
2013	26	1	wheat		LESA	62.9	1.7	5.0	2.4	9.0	18.0	9%	28%	13%	50%	47.0
2013	26	2	corn		LESA	62.2	6.4	14.2	2.4	23.0	33.0	19%	43%	7%	70%	52.1
2013	27	1	corn silage		SDI	46.1	8.2	30.5	1.7	40.4	27.0	30%	113%	6%	150%	-51.4
2013	27	3	cotton		SDI	48.8	9.0	30.5	-1.1	39.5	24.0	37%	127%	0%	164%	-62.9
2013	27	4	corn silage		SDI	13.5	8.2	30.5	2.4	41.0	27.0	30%	113%	9%	152%	-15.8

Year	Site	Field	Crop	Status	Irrigation type	Acres	Season rainfall (70% effective-inches)	In-season irrigation (inches)	Soil moisture contribution to WUE (inches)	Total crop water supplied (inches)	ET crop water demand (inches)	Crop water demand provided by rainfall (%)	Crop water demand provided by irrigation (%)	Crop water demand provided by soil moisture (%)	Crop water demand provided by total crop water (%)	Total irrigation potentially conserved (acre-feet)
2013	28	1	cotton		SDI	51.4	10.3	17.5	2.4	30.1	24.0	43%	73%	10%	126%	-26.3
2013	29	1	cotton		DL	50.8	8.3	0.0	2.4	10.6	24.0	na	na	na	na	na
2013	29	2	cotton		DL	104.3	8.3	0.0	2.4	10.6	24.0	na	na	na	na	na
2013	29	3	cotton		DL	66.5	8.3	0.0	2.4	10.6	24.0	na	na	na	na	na
2013	30	1	corn		SDI	21.8	6.4	13.0	1.5	20.8	33.0	19%	39%	4%	63%	22.1
2013	31	1	millet		LEPA	66.8	7.3	20.0	2.4	29.6	20.0	36%	100%	12%	148%	-53.6
2013	31	2	cotton		LEPA	55.1	7.6	9.4	2.4	19.3	24.0	32%	39%	10%	80%	21.5
2013	32	1	corn silage		LEPA	70	4.6	16.3	2.4	23.3	27.0	17%	60%	9%	86%	21.8
2013	33	1	corn		LEPA	70	6.5	21.5	2.4	30.4	33.0	20%	65%	7%	92%	15.4
2013	34	1	corn		LESA	241.2	8.5	18.5	2.4	29.3	33.0	26%	56%	7%	89%	74.0
2013	34	2	sunflowers		LESA	242.1	9.0	9.6	2.4	21.0	22.0	41%	44%	11%	95%	20.6
2013	34	3	sunflowers		LESA	243.3	6.0	14.3	2.4	22.6	22.0	27%	65%	11%	103%	-12.2
2013	35	1	grain sorghum		SDI	82.8	9.1	9.2	2.4	20.7	22.0	41%	42%	11%	94%	9.3
2013	35	2	corn		SDI	54.2	9.2	16.7	2.4	28.2	33.0	28%	51%	7%	86%	21.6
2013	35	3	cotton		SDI	92.3	9.9	9.2	2.4	21.5	24.0	41%	38%	10%	90%	19.3
Average across all sites and irrigation types												**29%**	**59%**	**10 %**	**98%**	**5.3**
Average (MESA)												**30%**	**48%**	**11%**	**89%**	**14.6**
Average (LESA)												**26%**	**54%**	**12%**	**92%**	**13.0**
Average (LEPA)												**28%**	**58%**	**8%**	**94%**	**5.2**
Average (SDI)												**33%**	**72%**	**9%**	**113%**	**-8.6**
Average (FUR)												**35%**	**50%**	**11%**	**96%**	**2.6**
Sum total irrigation potentially conserved across all TAWC sites and irrigation types (acre-feet)																**309.6**

Crop Water Use Efficiency (WUE)

Table 33 lists the information related to the crop water use efficiency. Data presented include **site**, **field**, **crop**, special harvest **status**, **irrigation type**, **acres, harvest yield** (lbs/acre), **in-season irrigation** (inches) and **in-season total crop water supplied** (inches) which includes in-season irrigation, soil moisture and 70% in-season effective rainfall (planting to harvest) for each specific site, field and crop within the project area. Crop water use efficiency is presented in terms of **yield per inch of irrigation** water applied and the **yield per inch of total water** applied.

Categorization of the primary mode of irrigation system type by specific crops indicate improved management for specific irrigation systems may be needed. In terms of yield per acre inch of total water for cotton, Furrow (FUR) was the least efficient at 34 lbs lint/inch of irrigation as expected, however mid-elevation spray application (MESA) (91 lbs lint/inch) and sub-surface drip irrigation (SDI) (76 lbs lint/inch) were shown to be the most efficient followed by low-elevation spray application (LESA) (64 lbs lint/inch) and low-energy precision application (LEPA) (56 lbs lint/inch). In terms of amount of irrigation applied to the cotton FUR provided 12 inches of irrigation while MESA, LESA, LEPA and SDI provided 10, 13, 15 and 17 inches respectively over the growing season. This indicates the ability of these more efficient systems to provide a greater amount of total crop water demand but at the expense of water use efficiency for the crop when management leads to overwatering as indicated previously in the irrigation efficiency discussion for Table 32. A more thorough classification of the individual systems and the way they are being managed will be a focus in phase 2 of the TAWC project area.

For corn grain, average of irrigation applied by system was 27, 18, 19 and 17 inches for MESA, LESA, LEPA, and SDI respectively. In terms of water use efficiency as yield per inch of total water applied, yields were 360 (MESA), 480 (LESA), 431 (LEPA) and 379 lbs/inch (SDI). In this case, LESA was shown to be the most water use efficient for corn, followed by LEPA, SDI and finally MESA. There appears to be a “sweet” spot that balances water applied to yield per inch of irrigation, but proper management of these more efficient irrigation systems is critical if efficiency potential is to be achieved.

Sunflower, which is considered a more water use efficient crop per acre inch of total water yielded 143 and 127 lbs/inch of total water on MESA and LESA irrigation systems with each system applying 13 and 11 inches of total irrigation for both MESA and LESA respectively. Once again a reversal of expectations based on system efficiency. However, the MESA system applied 2 inches more total irrigation which may have offset the lower expected efficiency of the MESA system and resulted in a higher yield potential.

In the case of the perennial warm season grass ‘WW-B. Dahl’ old world bluestem [Bothriochloa bladhii (Retz) S.T. Blake] received just under 10 inches of total irrigation and was utilized for grazing animals. This was a single site equipped with a LESA irrigation system. Perennial warm season grasses have consistently shown less water use as compared to row crops as well as added environmental benefits (Allen et. al 2012).

The number of observations for each irrigation system type and crop varies and a more detailed analysis of crop water use efficiency needs to be made across all years for irrigation systems, crops and management practices to gain a clearer understanding of this efficiency and its related factors. If this holds true, an education focus through outreach needs to be irrigation management specific to the irrigation system being used in a particular operation if the irrigation systems potential for reducing water use is to be recognized.

Table 33. Crop water use efficiency (WUE) summary by various cropping and livestock systems across the TAWC sites (2013).

Year	Site	Field	Crop	Status	Irrigation type	Acres	Harvest yield (lbs/ac)	In-season irrigation (inches)	In-season total crop water supplied (inches)	Yield per inch of irrigation (lbs/inch)	Yield per inch of total water (lbs/inch)
2013	2	2	cotton		SDI	31.5	1877	21.0	32.8	89.4	57.2
2013	2	3	corn		SDI	28.4	11984	21.0	37.1	570.7	322.8
2013	3	1	cotton		MESA	61.5	2006	12.1	18.5	165.8	108.4
2013	3	2	grain sorghum		MESA	61.8	6100	8.4	13.9	726.2	438.8
2013	4	5	alfalfa		LEPA	16	18920	31.6	40.0	598.7	472.9
2013	4	8	cotton		LEPA	50.5	1548	12.5	23.1	123.8	67.1
2013	4	9	millet		LESA	29.6	3416	14.7	22.3	232.4	153.5
2013	4	10	wheat	grazed	LEPA	26.8	0	3.9	7.8	0.0	0.0
2013	4	10	forage sorghum	grazed	LEPA	26.8	0	6.4	16.2	0.0	0.0
2013	5	2	wheat		LESA	85.8	600	5.0	9.0	120.0	66.4
2013	5	3	millet		LESA	156	4000	12.0	21.4	333.3	187.4
2013	5	4	cotton		LESA	119.4	1297	12.0	25.4	108.1	51.0
2013	5	5	sunflowers		LESA	122.9	2294	10.0	16.8	229.4	136.9
2013	6	9	cotton		LESA	60.6	1693	18.6	34.6	91.0	48.9
2013	6	10	wheat	hay	LESA	62.1	1500	11.6	15.8	129.3	94.7
2013	7	1	sideoats		LESA	130	234	10.3	15.0	22.7	15.6
2013	7	1	sideoats	hay	LESA	130	1920	0.0	7.4	na	na
2013	8	1-4	sideoats		SDI	61.8	396	14.1	17.9	28.1	22.1
2013	8	1-4	sideoats	hay	SDI	61.8	3600	0.0	7.4	na	na
2013	9	1	grass	grazed	MESA	100.8		0.0	12.5	na	na
2013	9	3	cotton		MESA	77	1642	8.2	22.1	200.2	74.3
2013	9	4	grain sorghum		MESA	59.9	9456	12.1	26.4	781.5	358.2
2013	10	1	Dahl	grazed	LESA	44.3		9.8	22.3	na	na
2013	10	4	Cotton		LESA	42.1	1366	15.2	26.4	89.9	51.8
2013	10	5	Corn silage		LESA	87.2	18900	19.0	28.1	994.7	672.6
2013	11	2	cotton		FUR	24.4	861	12.0	22.7	71.8	38.0
2013	11	3	cotton		FUR	22.9	861	12.0	23.9	71.8	36.1
2013	11	5	cotton		FUR	45.2	665	12.0	22.7	55.4	29.3
2013	12	1	cotton	abandon	DL	151.1	0	0.0	10.5	na	na
2013	12	2	cotton	abandon	DL	132.7	0	0.0	10.5	na	na
2013	14	4	cotton		LESA	124.1	1506	4.0	14.7	376.5	102.4
2013	15	8	cotton		SDI	56.7	2175	11.6	21.2	187.5	102.8

Year	Site	Field	Crop	Status	Irrigation type	Acres	Harvest yield (lbs/ac)	In-season irrigation (inches)	In-season total crop water supplied (inches)	Yield per inch of irrigation (lbs/inch)	Yield per inch of total water (lbs/inch)
2013	15	9	cotton		SDI	44.4	2335	10.8	22.4	216.2	104.3
2013	17	4	grass	grazed	MESA	111.8		1.4	12.4	na	na
2013	17	5	corn		MESA	54.5	13552	26.8	37.6	505.7	360.2
2013	17	6	sunflowers		MESA	54.4	2950	12.7	20.6	232.3	143.1
2013	18	1	fallow	fallow	MESA	61.5	0	0.0	5.0	na	na
2013	18	2	fallow	fallow	MESA	60.7	0	0.0	7.3	na	na
2013	19	11	cotton		LEPA	120.3	1245	9.0	20.4	138.3	60.9
2013	20	1	triticale silage		LEPA	117.6	0	5.6	11.8	0.0	0.0
2013	20	1	cotton		LEPA	115.7	731	20.2	30.4	36.2	24.0
2013	20	2	corn silage		LEPA	117.6	25200	21.8	32.3	1156.0	780.7
2013	21	1	corn		LEPA	61.4	13409	15.5	25.0	865.1	535.9
2013	21	2	wheat		LEPA	61.2	1494	14.5	19.1	103.0	78.3
2013	21	2	forage sorghum		LEPA	61.2	206400	3.3	12.9	62545.5	16049.8
2013	22	3	cotton		LEPA	148.7	1736	21.5	30.0	80.7	57.9
2013	24	1	corn		LESA	65.1	12600	20.7	28.1	608.7	449.2
2013	24	2	sunflowers		LESA	65.1	2750	8.7	20.2	316.1	136.1
2013	26	1	wheat		LESA	62.9	900	5.0	9.0	180.0	99.7
2013	26	2	corn		LESA	62.2	12264	14.2	23.0	863.7	534.4
2013	27	1	corn silage		SDI	46.1	25200	30.5	40.4	826.2	623.9
2013	27	3	cotton		SDI	48.8	2454	30.5	39.5	80.5	62.2
2013	27	4	corn silage		SDI	13.5	25200	30.5	41.0	826.2	614.0
2013	28	1	cotton		SDI	51.4	1172	17.5	30.1	67.0	38.9
2013	29	1	cotton		DL	50.8	0	0.0	10.6	na	na
2013	29	2	cotton		DL	104.3	0	0.0	10.6	na	na
2013	29	3	cotton		DL	66.5	0	0.0	10.6	na	na
2013	30	1	corn		SDI	21.8	6300	13.0	20.8	484.6	302.3
2013	31	1	millet		LEPA	66.8	3384	20.0	29.6	169.2	114.2
2013	31	2	cotton		LEPA	55.1	1364	9.4	19.3	145.1	70.6
2013	32	1	corn silage		LEPA	70	17500	16.3	23.3	1073.6	752.0
2013	33	1	corn		LEPA	70	9912	21.5	30.4	461.0	326.5
2013	34	1	corn		LESA	241.2	13384	18.5	29.3	723.5	456.5
2013	34	2	sunflowers		LESA	242.1	2498	9.6	21.0	260.2	119.1
2013	34	3	sunflowers		LESA	243.3	2595	14.3	22.6	181.5	114.8
2013	35	1	grain sorghum		SDI	82.8	8816	9.2	20.7	958.3	426.9
2013	35	2	corn		SDI	54.2	14435	16.7	28.2	864.4	511.5
2013	35	3	cotton		SDI	92.3	1890	9.2	21.5	205.4	87.9

http://www.tawcsolutions.org

TAWC Solutions: Management Tools to aid Producers in conserving Water

Rick Kellison, Jeff Pate, Philip Brown

The **Texas Alliance for Water Conservation** released three web-based tools to aid producers at our February 2011 field day. Producers involved in the TAWC project had indicated the need for tools to aid them in making cropping decisions and managing these crops in season.

The **Irrigation Scheduling Tool** is a field level, crop specific ET tool to aid producers in irrigation management. The producer can customize this tool for beginning soil moisture, effective rainfall, effective irrigation application and percent ET replacement. Users can select from a list of local weather stations that supplies the correct weather information for each field. Once the decision is made on which crop a grower plants, this tool produces an in-season, check-book style water balance output to aid in irrigation applications.

The **TAWC Resource Allocation Analyzer** provide producers with a simple, comprehensive approach to planning and managing various cropping systems. The Resource Allocation Tool is an economic based optimization model that aids producers in making decisions about different cropping systems. Based on available irrigation water, projected cost of production and expected revenue, this model will aid producers in their decisions to plant various crops.

Because of implementation of new water policy by the High Plains Underground Water Conservation District, growers need a method to determine the amount of irrigation that they were allowed to apply to each irrigated acre. The **Contiguous Acre Calculator** allows growers to project specific levels of irrigation water to be applied to various delivery systems. The tool then calculates how much water can be banked for future use. Once the growing season is completed the producer can enter actual water applied and use it for record keeping.

Provided on the following pages are the usage instructions for each tool with more detail concerning each individual program as provided on our website.

TAWC ET
Irrigation Scheduling Tool

THE *TAWC SOLUTIONS IRRIGATION SCHEDULING TOOL* is intended as an aid to producers in determining a more refined irrigation schedule. This program utilizes weather information collected from the Texas Tech Mesonet along with specific producer input information to automatically calculate and update the soil water balance for a specific crop based on information provided by the user. Some key inputs include: crop type, planting date, site rainfall, irrigation, and other environmental and producer information. This provides a checkbook-style water balance register with which a producer can determine when and how much water to apply for an irrigation event based on tracking of the soil water balance available to the crop at any given growth stage during the growing season. The TAWC Solutions Irrigation Scheduling Tool is designed to help producers make the most out of their irrigation regime while being conscious of this precious natural resource.

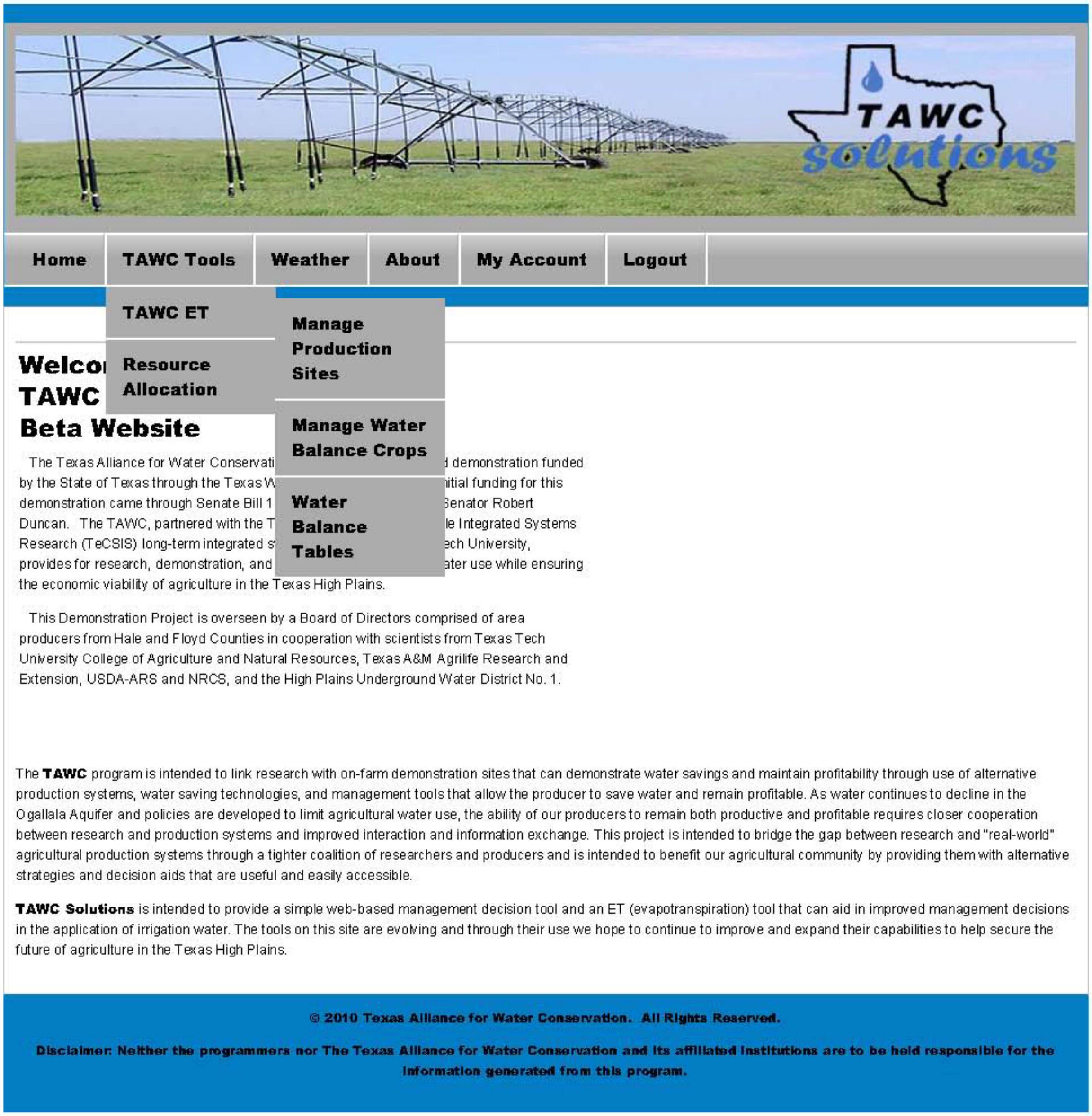
To utilize the **TAWC Solutions ET program** you must first create a User ID and Password by selecting **Request User ID/New Password** from the top of the TAWC Solutions homepage banner next to the logon prompts. Once this is completed, log into the site and place your mouse cursor over **TAWC Tools** from the Navigation menu at top and a drop down menu will appear with the following selections:

TAWC ET – Irrigation Scheduling Tool
Resource Allocation – Economic Decision Aid Tool

To begin, move your cursor over **TAWC Tools** then over **TAWC ET** on the main navigation menu and select **Manage Production Sites** from the side menu**.** A **Site** is considered a location and field is the irrigated field or crop for that location. There can be multiple fields per location (ie. pivot 1, pivot 2, drip 1 etc…).

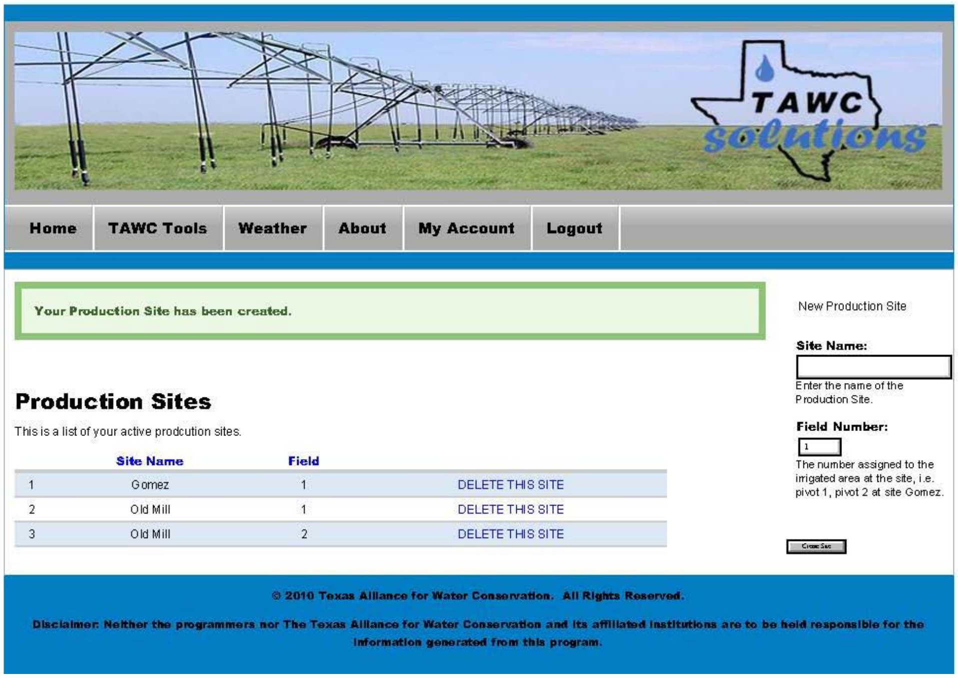
Illustrations and instructions for use of the program are presented on the following pages.

Screen 1



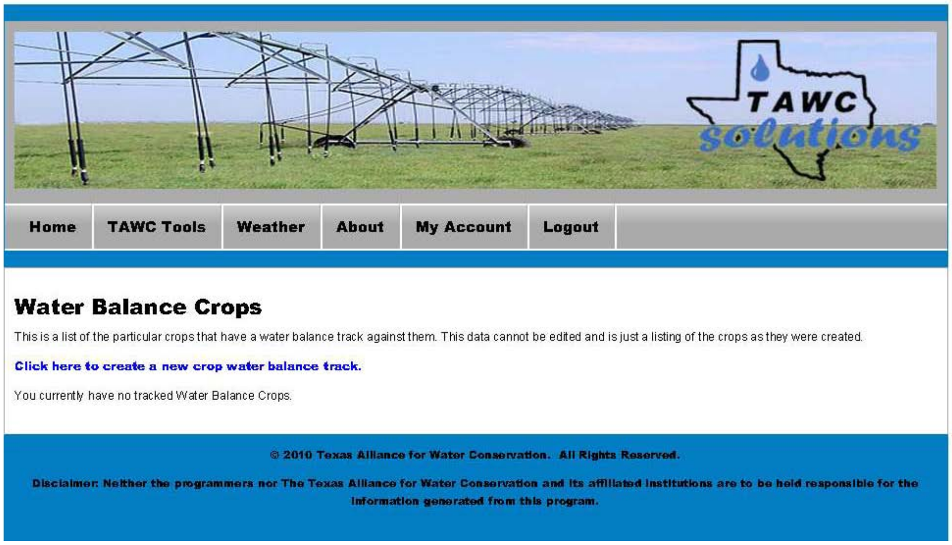
You will see a screen that states "There are no rows in this table." In the right column you have the option of entering a new site location name (i.e. Gomez) in the box. Enter the desired name and irrigated field number (ie. pivot 1) and click "**Create Site".** You will then see a green confirmation box stating **"Your Production Site has been created"** with the new site name and an option to delete the site if desired. You can then create additional site locations and irrigated fields for each location as appropriate. A maximum of 10 fields per site location can be created. You can return to this page and create and delete site locations and fields as needs evolve or a new cropping year begins.

Screen 2



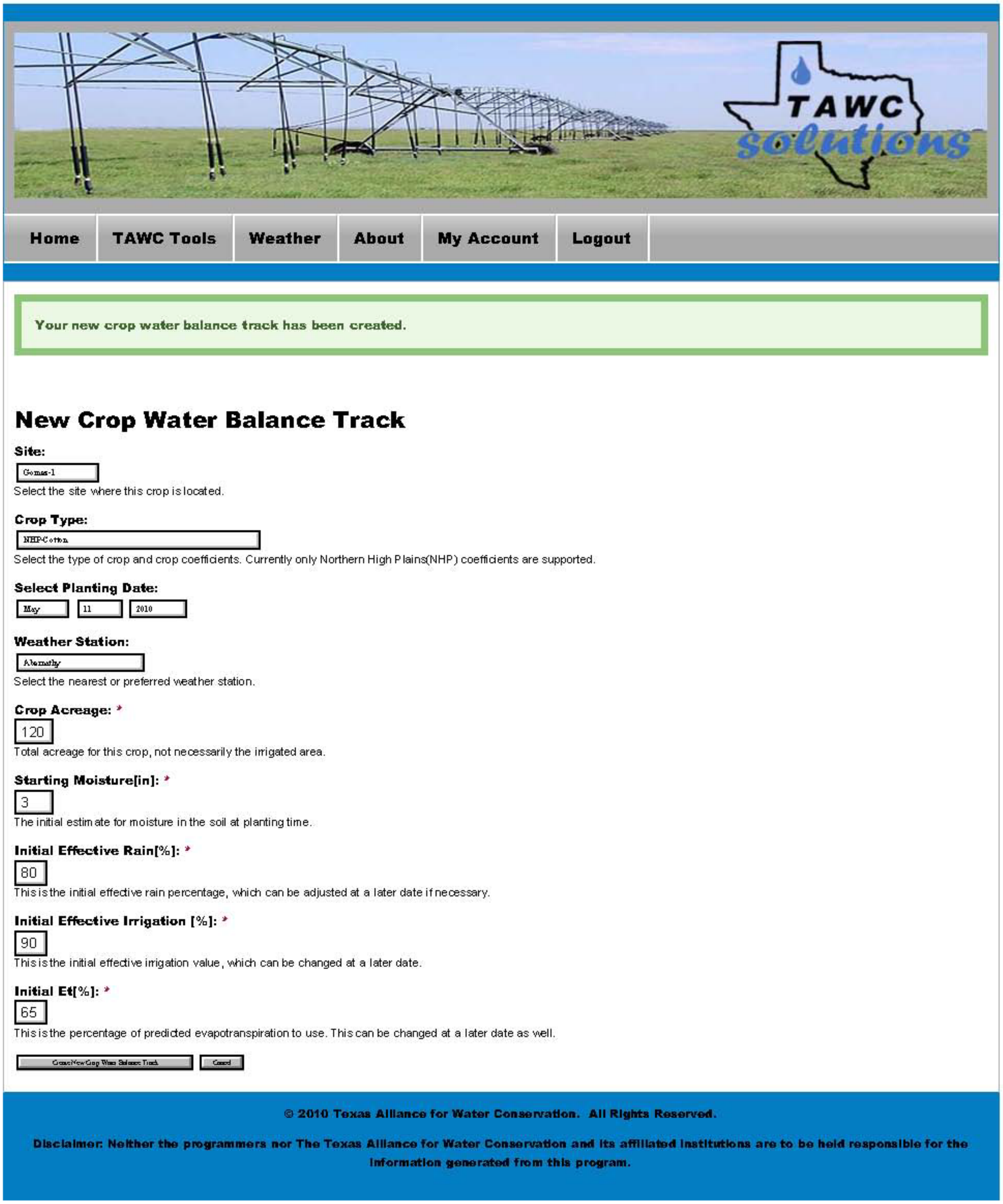
Return to **TAWC ET** on the navigation menu and select the next option "**Manage Water Balance Crops**", a new screen will appear with an option "Click here to create a new crop water balance track".

Screen 3



Click the text and a new **Crop Water Balance Track** information page will be presented. In the **Site** location box select a previously entered **Production Site** from the drop down menu and provide all requested information then select the "**Create New Crop Water Balance Track**" button at the bottom of the page. You will then see a new page with a green confirmation box stating that "**Your new crop water balance track has been created**".

Screen 4



Repeat this procedure for each **Production Site** and irrigation field created. Definitions for each input are provided on the next page.

The confirmation page will revert to default entries after clicking "Create New Crop Water Balance Track" for information requested and is not representative of the track just created.

Crop type: the appropriate crop being tracked for the specific site location and irrigation field.
Planting Date: date the irrigated crop is planted by selecting the appropriate month, day and year from the drop down menus.
Weather Station: select the closest weather station to the specific site location being tracked from the drop down menu list of stations from the Texas Tech Mesonet.
Crop Acreage: enter total field acres for a specific irrigated field.
Starting Moisture: an estimated soil profile water content in inches for your specific soil type based on soil probing to a depth of 3 feet within the field and is a number in 0.0 inches (i.e. 2.5 inches).
Initial Effective Rain: the % (in whole numbers) rain that you expect to normally capture in any given rain event for your specific soil type (this number can be changed for any given event in the Daily Measurements table (i.e. 85%).
Initial Effective Irrigation: the % (in whole numbers) of irrigation water that is expected to be absorbed by the soil profile at the site under a given irrigation method (i.e. Sprinkler – 90%, Drip – 95%, etc…).
Initial ET: the % of ET or evapotranspiration that you desire to water a given crop and can vary from 0 to 100 % depending of specific producer management desires and goals.

NEXT SELECT **"WATER BALANCE TABLES"** FROM THE **TAWC ET** MENU.

You are now presented with the "Check Book" style register for monitoring and adjusting various parameters as the season progresses. The **Daily Measurements** table should be populated with default settings for Effective Irrigation, Effective Rain, and Percent ET based on the information you provided in creating a **Water Track**. You may change the displayed Water Balance Crop being monitored from the left hand column by selecting the desired crop to monitor and the page will update to display that specific location field and crop information. The top of the Table has a **Crop Summary** which maintains current information for the Site location and field selected including **Last ET**, current soil **Moisture Balance**, **Growth Stage**, **Total Irrigation**, and **Total Rain** received since the start date. This allows a producer to get a quick overview of the current status of his operation for that specific location and field.

Below this summary is the **Daily Measurements** table and is a day by day record of measurements for the selected water balance crop. The selected **Water Balance Crop** can be changed by clicking on the list of water balance crops in the right hand column.

Screen 5

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Crop Summary

Site	Weather Station	Acreage	Type	Last Et	Moisture Balance	Growth Stage	Total Irrigation	Total Rain
Old Mill-1	Abernathy	120	Cotton	0.01	0.33	Strip	0.00	11.34

Select a Different Water Balance Crop

1	Gomez-1,Corn
2	Old Mill-2,Cotton

Daily Measurements

	Date	Effective Irrigation	Effective Rain	Percent Et	Irrigation	Rain	Daily Et	Moisture Balance	Growth Days	Growth Stage
0	2010-05-11	0.90	0.75	0.60	0.00	0.00	0	3	0	Planting Day
1	2010-05-12	0.90	0.75	0.60	0.00	0.00	0.01	2.99	1	-------
2	2010-05-13	0.90	0.75	0.60	0.00	0.00	0.01	2.98	2	-------
3	2010-05-14	0.90	0.75	0.60	0.00	1.03	0	3.75	3	-------
4	2010-05-15	0.90	0.75	0.60	0.00	0.01	0	3.76	4	-------
5	2010-05-16	0.90	0.75	0.60	0.00	0.00	0.01	3.75	5	-------
6	2010-05-17	0.90	0.75	0.60	0.00	0.54	0.01	4.15	6	-------
7	2010-05-18	0.90	0.75	0.60	0.00	0.00	0.01	4.14	7	-------
8	2010-05-19	0.90	0.75	0.60	0.00	0.00	0.01	4.13	8	-------
9	2010-05-20	0.90	0.75	0.60	0.00	0.00	0.01	4.12	9	-------
10	2010-05-21	0.90	0.75	0.60	0.00	0.00	0.01	4.11	10	Emerge
11	2010-05-22	0.90	0.75	0.60	0.00	0.00	0.02	4.09	11	-------
12	2010-05-23	0.90	0.75	0.60	0.00	0.00	0.01	4.08	12	-------
13	2010-05-24	0.90	0.75	0.60	0.00	0.03	0.02	4.08	13	-------
14	2010-05-25	0.90	0.75	0.60	0.00	0.00	0.01	4.07	14	-------
15	2010-05-26	0.90	0.75	0.60	0.00	0.08	0.02	4.11	15	-------
16	2010-05-27	0.90	0.75	0.60	0.00	0.00	0.01	4.1	16	-------

The only **Required** input for this table is for **Irrigation** events but through added user input and interaction with the program, ET can be more accurately calculated for a producer's specific crop. The **TAWC ET** program is intended to be simple, yet flexible by allowing the producer to tailor irrigation based on specific crop and environmental factors.

Columns displayed in a blue color may be manually adjusted at any time during the season. For example, if you click on a blue number in the column for **Effective Irrigation**, a data entry box will pop up allowing you to change the **Effective Irrigation** % for any specific date during the growing season. An option also exists that allows you to select a checkbox that will apply this new value to all subsequent dates in the table or leave the box unchecked and make the change to the current date only. This applies to **Effective Irrigation**, **Effective Rain** and **Percent ET** columns.

For the **Irrigation** and **Rain** columns the user may click on a blue number for any specific date and enter an irrigation or rainfall event that applies to his specific location. Rainfall will be recorded automatically on a daily basis from the nearest **Weather Station** selected by the user during the creation of a **Water BalanceTrack** unless overridden by that user through manual entry. This allows the producer to better control the conditions of the specific field being monitored by manually updating rainfall measured at the individual site and thus more representative of the sites conditions. **However, the user must manually input each Irrigation event by clicking the blue number and entering each irrigation event amount in inches.**

The **Growth Stage** column is filled with estimated growth stages of the crop based on planting date. These values may be adjusted by the producer to more accurately represent the stage of his crop maturity thereby adjusting the calculated ET value for the crops current and subsequent growth stages. This is accomplished by clicking the blue lines in the column and selecting the appropriate growth stage for the calendar date from the drop down menu in the pop up.

For example if you planted cotton on May 9 the estimated **Emerge** date is May 19, however if emergence occurred a day earlier or a day later the actual **Emerge** date can then be adjusted by clicking the blue lines on the appropriate day and selecting the correct growth stage from the drop down menu. This same logic is followed through the season for **1^{st} Square, 1^{st} Bloom, Max Bloom, 1^{st} Open, 25% Open, 50% Open, 95% Open, and Strip.** Adjusting these values to the actual date of occurrence adjusts the ET calculation to more appropriately reflect the plant requirements and potentially reduce water use. Adjustment of the plants growth stage is not a requirement but will allow the **ET calculation** to be more accurate for the crops individual stage of growth.

TAWC Resource Allocation Analyzer

THE ***TAWC RESOURCE ALLOCATION ANALYZER*** is an economic-based decision aid which utilizes economic variables provided by an individual agricultural producer to estimate options for cropping systems that maximize per acre profits, whether at the field or farm level. Utilizing information such as expected commodity prices, water availability, and enterprise options, irrigated agricultural producers can view cropping options that maximize their net returns per acre while accounting for irrigation demands and revenue potential. This user-friendly aid is designed to provide the agronomic planning options to maintain profitability and sustainability in irrigated row crop agriculture.

To operate the **TAWC Solutions Resource Analyzer** a User ID and Password must be created under **MY Account** in the Navigation menu. Once this is completed, log into the site and place the mouse cursor over **TAWC Tools** from the Navigation menu at top and a drop-down menu will appear with the following selections:

TAWC ET Irrigation Scheduling Tool
Resource Allocation

To begin, move your cursor over **TAWC Tools**, then click on **Resource Allocation** as seen in **Screen 1**. This will take you to **Screen 2**.

Screen 1

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TAWC ET

Resource Allocation

Welcor TAWC Beta Website

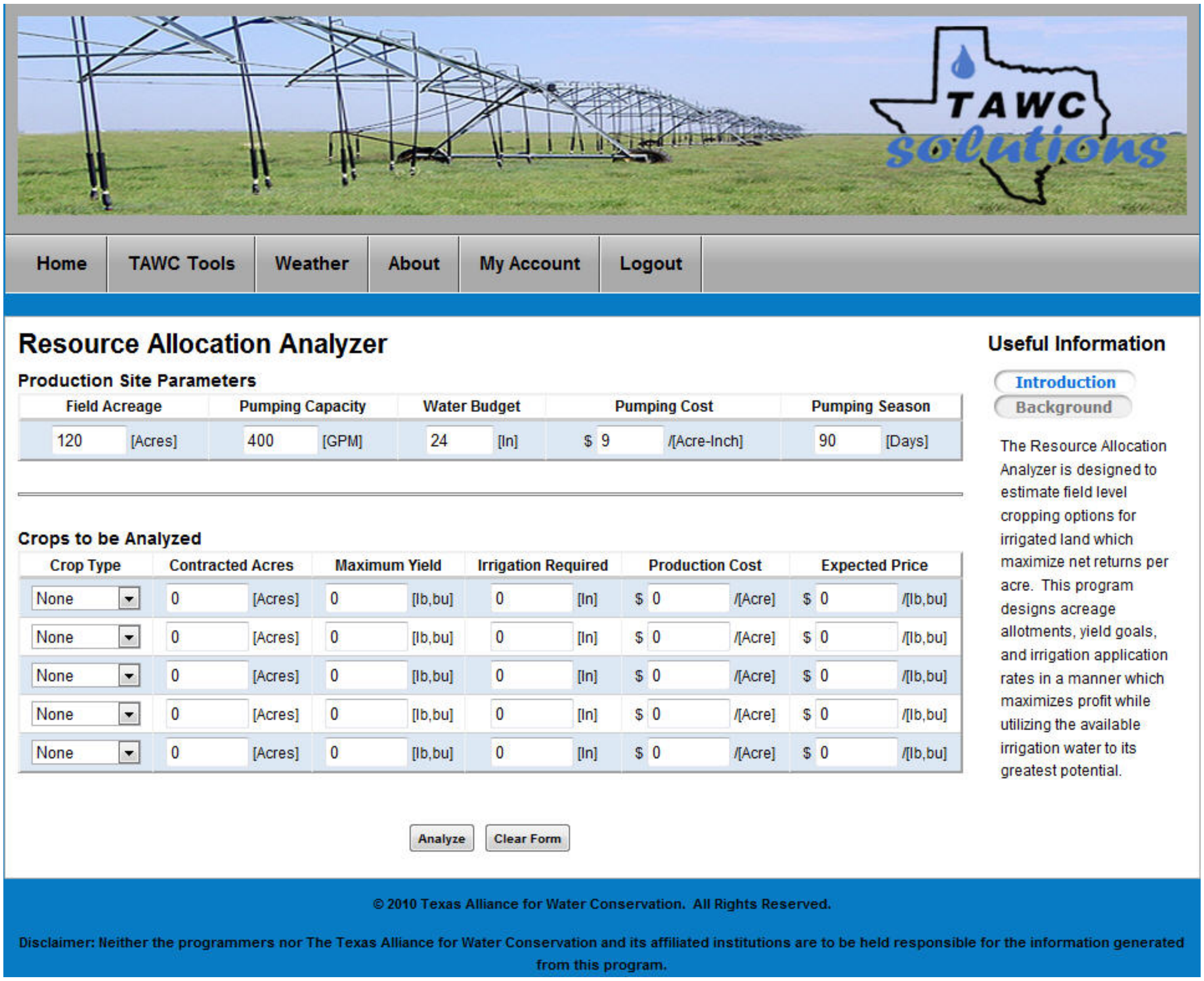
The Texas Alliance for Water Conservation (TAWC) is a producer-led demonstration funded by the State of Texas through the Texas Water Development Board. Initial funding for this demonstration came through Senate Bill 1053 that was sponsored by Senator Robert Duncan. The TAWC, partnered with the Texas Coalition for Sustainable Integrated Systems Research (TeCSIS) long-term integrated systems research at Texas Tech University, provides for research, demonstration, and implementation to reduce water use while ensuring the economic viability of agriculture in the Texas High Plains.

This Demonstration Project is overseen by a Board of Directors comprised of area producers from Hale and Floyd Counties in cooperation with scientists from Texas Tech University College of Agriculture and Natural Resources, Texas A&M Agrilife Research and Extension, USDA-ARS and NRCS, and the High Plains Underground Water District No. 1.

The **TAWC** program is intended to link research with on-farm demonstration sites that can demonstrate water savings and maintain profitability through use of alternative production systems, water saving technologies, and management tools that allow the producer to save water and remain profitable. As water continues to decline in the Ogallala Aquifer and policies are developed to limit agricultural water use, the ability of our producers to remain both productive and profitable requires closer cooperation between research and production systems and improved interaction and information exchange. This project is intended to bridge the gap between research and "real-world" agricultural production systems through a tighter coalition of researchers and producers and is intended to benefit our agricultural community by providing them with alternative strategies and decision aids that are useful and easily accessible.

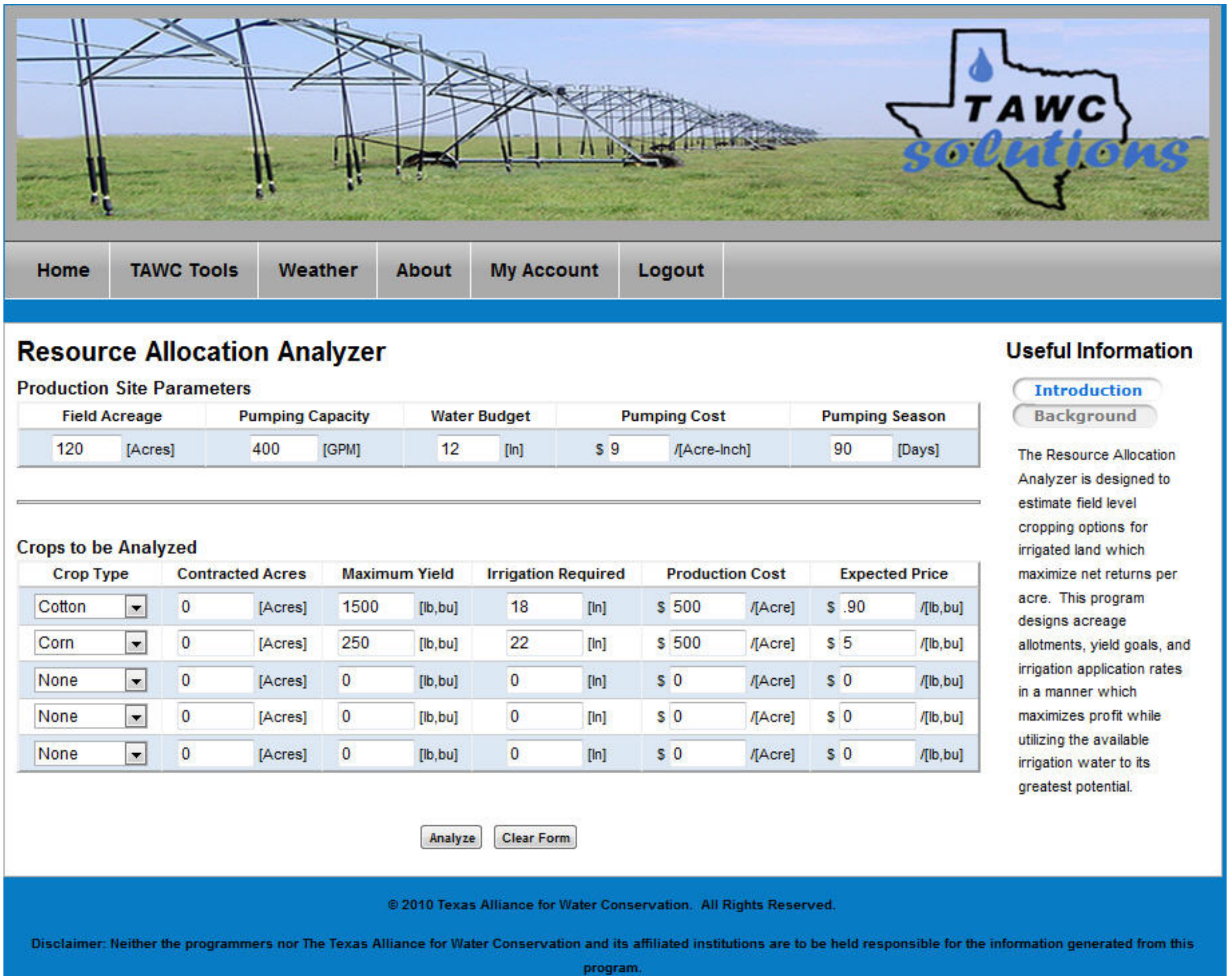
TAWC Solutions is intended to provide a simple web-based management decision tool and an ET (evapotranspiration) tool that can aid in improved management decisions in the application of irrigation water. The tools on this site are evolving and through their use we hope to continue to improve and expand their capabilities to help secure the future of agriculture in the Texas High Plains.

Screen 2



Screen 2 represents the platform from which the Resource Allocation Analyzer works. This is the only input screen for the program. Default values appear for the Production Site Parameters, but each field or cell can be modified if so desired. To start the process, select each production site parameter to fit the field or farm to analyze. For definitions of each parameter refer to the definitions on page 264 and 265 of this section. With the Production Site Parameters set, choose one of five crops to analyze. A single crop or up to a maximum of five can be chosen for the analysis. An example of selecting corn and cotton is illustrated in **Screen 3**.

Screen 3



TAWC solutions

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Resource Allocation Analyzer

Production Site Parameters

Field Acreage	Pumping Capacity	Water Budget	Pumping Cost	Pumping Season
120 [Acres]	400 [GPM]	12 [In]	$ 9 /[Acre-Inch]	90 [Days]

Crops to be Analyzed

Crop Type	Contracted Acres	Maximum Yield	Irrigation Required	Production Cost	Expected Price
Cotton	0 [Acres]	1500 [lb,bu]	18 [In]	$ 500 /[Acre]	$ .90 /[lb,bu]
Corn	0 [Acres]	250 [lb,bu]	22 [In]	$ 500 /[Acre]	$ 5 /[lb,bu]
None	0 [Acres]	0 [lb,bu]	0 [In]	$ 0 /[Acre]	$ 0 /[lb,bu]
None	0 [Acres]	0 [lb,bu]	0 [In]	$ 0 /[Acre]	$ 0 /[lb,bu]
None	0 [Acres]	0 [lb,bu]	0 [In]	$ 0 /[Acre]	$ 0 /[lb,bu]

Analyze | Clear Form

Useful Information

Introduction

Background

The Resource Allocation Analyzer is designed to estimate field level cropping options for irrigated land which maximize net returns per acre. This program designs acreage allotments, yield goals, and irrigation application rates in a manner which maximizes profit while utilizing the available irrigation water to its greatest potential.

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Disclaimer: Neither the programmers nor The Texas Alliance for Water Conservation and its affiliated institutions are to be held responsible for the information generated from this program.

Screen 4 illustrates the output from analyzing the crops and field parameters chosen in screen 3. The Maximum Profit Scenario indicates that the entire 120 acre field could be planted to cotton, with a yield goal of 1441 lbs receiving 13.9 acre inches of water. This option will produce the highest net returns for the field at $88,884. The next three scenarios offer alternatives which can be compared against the maximum profit scenario. Definitions and descriptions of the output screen can be seen on page 264 and 265 of this section. By using the Back button at the bottom of the page, alternative runs can be conducted by adding or deleting crop chooses and varying the production site parameters.

Screen 4

Resource Allocation Analyzer

Maximum Profit Scenario

	Crop Acreage [Acres]	Irrigation [Inches]	Yield per Acre [lbs,bu]	Cost per Acre	Return per Acre	Return per Crop	Total Irrigation [Acre-Inches]	Reduced Irrigation Demand [Acre-Inches]	Weighted Net Return	Net Return
Cotton	120	13.9	1,441	$557	$741	$88,884	1,669	491	$741	$88,884

Maximum Profit Scenario for Equal Acreage among crops not contracted

	Crop Acreage [Acres]	Irrigation [Inches]	Yield per Acre [lbs,bu]	Cost per Acre	Return per Acre	Return per Crop	Total Irrigation [Acre-Inches]	Reduced Irrigation Demand [Acre-Inches]	Weighted Net Return	Net Return
Cotton	60	13.9	1,441	$557	$741	$44,442	1,773	627	$686	$82,304
Corn	60	15.7	234	$540	$631	$37,862				

Alternative Scenario 1

	Crop Acreage [Acres]	Irrigation [Inches]	Yield per Acre [lbs,bu]	Cost per Acre	Return per Acre	Return per Crop	Total Irrigation [Acre-Inches]	Reduced Irrigation Demand [Acre-Inches]	Weighted Net Return	Net Return
Cotton	80	13.9	1,441	$557	$741	$59,256	1,738	582	$704	$84,497
Corn	40	15.7	234	$540	$631	$25,241				

Alternative Scenario 2

	Crop Acreage [Acres]	Irrigation [Inches]	Yield per Acre [lbs,bu]	Cost per Acre	Return per Acre	Return per Crop	Total Irrigation [Acre-Inches]	Reduced Irrigation Demand [Acre-Inches]	Weighted Net Return	Net Return
Cotton	61	13.9	1,441	$557	$741	$45,183	1,771	625	$687	$82,413
Corn	59	15.7	234	$540	$631	$37,231				

Back

Production Site Parameters and Input Value Descriptions

Field Acreage - enter the amount of acres to be analyzed.

Pumping Capacity - enter the Gross Pumping Capacity at the delivery system. This value is estimated in gallons per minute or GPM.

Water Budget - select a water budget in acre inches as it applies to your particular field. This cell can be used to evaluate crop options under restricted water scenarios. The water budget is defaulted at 24 acre-inches.

Pumping Cost - enter the per acre-inch pumping cost for the field being analyzed.

Pumping Season - enter the typical length of irrigated days. This is used in conjunction with the Pumping Capacity to estimate the total amount of water that could be applied to the field.

Crop Type - choose from the pull-down menu one of the five crops to be analyzed. (cotton, corn, sorghum, wheat, and sunflower). A maximum of five crops can be analyzed.

Contracted Acres - enter an acreage value in this column only if you have contracted a crop by acres. The will produce solutions that must have at least as many acres for a crop as entered into this column. For example if entered 60 acres of contracted corn on a 120 acre pivot, then the solution will solve such that at least 60 acres of corn will be in production, with the remaining water being allocated to another crop chosen.

Maximum Yield - enter the maximum yield for a chosen crop. This yield number should represent the realistic maximum yield which could be achieved on the field analyzed. For example, while genetics do allow for 2200 lbs of cotton to be produced, the field analyzed may have never produced more than 1500 lbs. In this case, 1500 lbs should be entered into the cell.

Production Cost - enter the total expenses incurred to produce the crop at the maximum yield, excluding pumping costs. Typically these expenses represent the total cash expenses such as seed, fertilizer, tillage operations, chemical applications, and other in-field operations.

Expected Price - enter the price which is expected to be received upon selling or marketing the crop.

Output Definitions and Descriptions

Maximum Profit Scenario – This result provides an optimal level of crops acres, irrigation levels, and yield goals which maximize the total net returns per acre. This outcome can be a single crop or a combination of several crops of chosen.

Maximum Profit Scenario for Equal Acreage – This scenario produces the optimal outcome for all of the crops selected in the input screen and divides them equally among the field or farm acres analyzed.

Alternative Scenario 1 - This scenario presents the optimal choice of crop acreages, irrigation levels, and yield goals that maximizes profit at 5% below the true maximum.

Alternative Scenario 1 - This scenario presents the optimal choice of crop acreages, irrigation levels, and yield goals that maximizes profit at 10% below the true maximum.

Crop Acreage – the optimal acres by crop that could be planted to maximize net returns.

Irrigation – the optimal amount of irrigation required to produce the yield goal generated.

Yield Goal per Acre – the yield goal which maximizes net returns at the given irrigation level.

Cost per Acre – the total per acre cost of production including irrigation, at the optimal yield goal and irrigation levels.

Return per Acre – the net return per acre per crop representing the total revenue less total expenses.

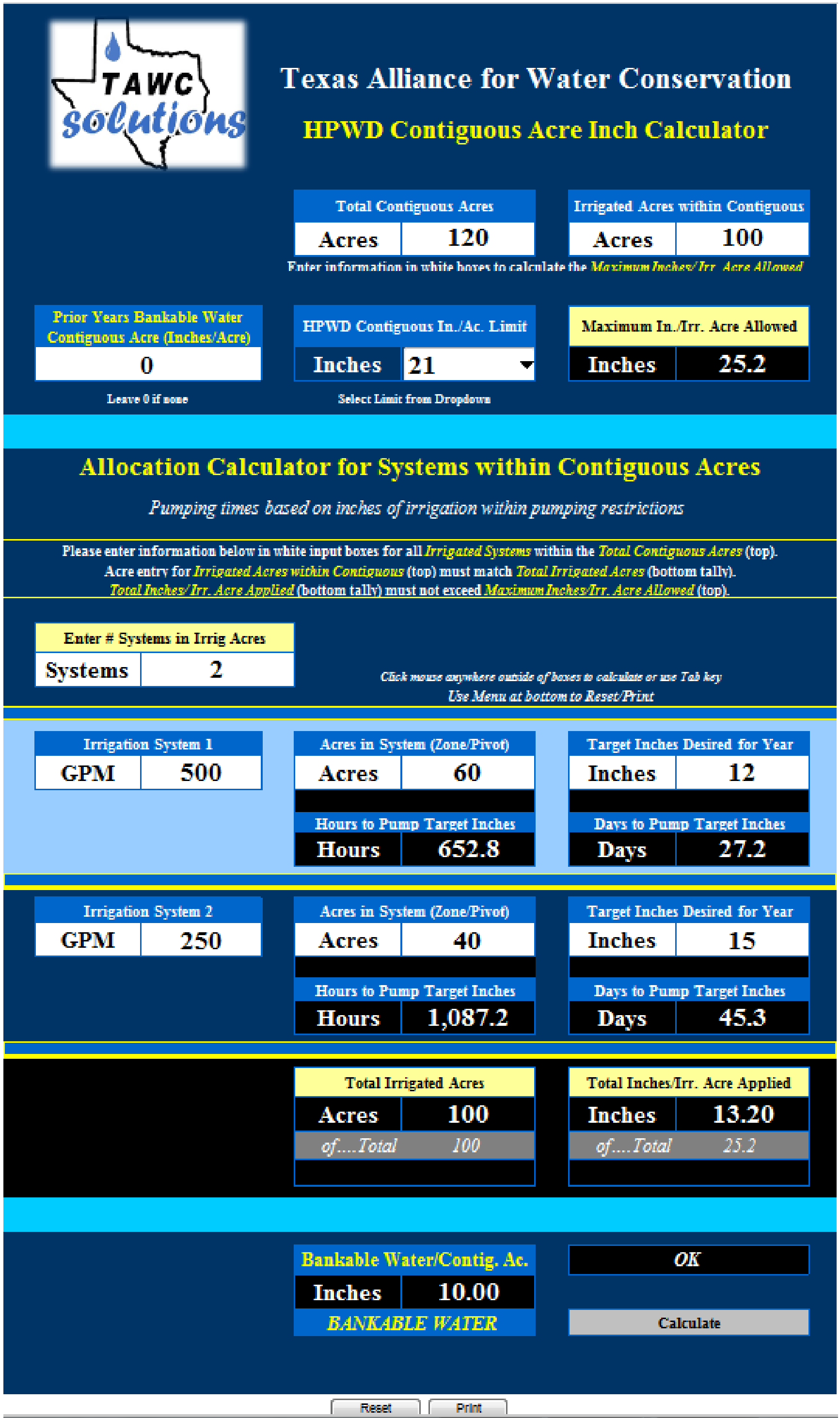
Return per Crop – the total net returns per crop summed over the optimal acreage

Total Irrigation – the total amount of optimal irrigation applied in acre-inches.

Reduced Irrigation Demand – the amount of irrigation water that was not applied by avoiding producing at the maximum yield but by producing at the optimal level of yield and irrigation which maximized returns.

Weighted Net Return - the weighted amount of returns per acre if multiple crops were within the optimal solution.

Net Return - the total net returns over the acreage analyzed.



TAWC Contiguous Acre Calculator

THE *TAWC CONTIGUOUS ACRE CALCULATOR* is a two-part tool.

The top portion of the calculator is intended to be used to aid producers in determining the maximum amount of water that may be applied per irrigated acre based on the High Plains Underground Water Conservation District (HPUWCD) guidelines (as of 2013) regarding water withdrawal from the Ogallala Aquifer. This tool allows the producer to enter the total contiguous acres as defined by HPWD and the total irrigated acres within the contiguous land area. Upon entering these two pieces of information, the producer can select from the current or future HPWD contiguous inches per acre limits from a drop down box (HPWD Contiguous In./Ac. Limit), and the maximum inches per irrigated acre allowed will be calculated based on the limit selected. This allows the producer to view how the future restrictions would affect the maximum inches per irrigated acre allowed. If the producer has banked water (water allowed but not used from one of the previous 3 years), he may enter this amount which will be added to the maximum inches per acre allowed for that crop production year.

The second or lower part of the calculator is a water allocation calculator for irrigated systems within the contiguous acres that enables the producer to distribute the maximum inches per acre allowed across irrigated systems within the contiguous land area. This portion of the calculator allows a producer to first enter the number of irrigation systems within a specific contiguous land area. This will expand data entry fields to the number of systems requested, allowing the producer to enter the GPM, irrigated acres within each zone or pivot, and target inches desired for each individual irrigated system. The producer may enter various scenarios for each system by varying the amount of inches of water, to view how the water may be distributed to maximize or minimize the designated water amount on any given system, as well as view any bankable or "carry forward water" remaining. If the calculator detects an error, such as maximum water allowed or number of irrigated acres exceeded, the program will give a "red flag" error notification, which will allow the producer to correct the offending issue. Once all data entry values have been entered correctly, "OK" will display at the bottom of the calculator and no red flag warnings will be visible. If there is any unused water remaining of the total allowed, this amount will display in the "Bankable Water/Contig. Ac." box at the bottom of the calculator.

Information obtained from this two-part tool includes the maximum inches/irrigated acre allowed, hours and days required to pump the target inches of water, bankable water for carry forward, and the ability to distribute the allowed water among irrigated systems based on the HPWD total acre inches allowed. In addition the producer may use the tool to try varying scenarios to distribute the allowed water based on the crops within each system.

> *We are continually striving to improve the accuracy, usability and performance of these programs. Through your feedback and assistance we can be proactive in addressing the needs of the Texas High Plains. This program has been created through the efforts of many involved in this project including Texas Tech University, Texas A&M AgriLife Research and Extension, USDA-ARS/NRCS, High Plains Underground Water District No. 1, Producers of Hale and Floyd Counties and the Texas Water Development Board.*

We must work together to solve the growing issues faced by agriculture today and tomorrow because 'Water Is Our Future'.

Budget

Table 34. Final task and expense budget for Phase I - years 1-9 of the demonstration project.

2005-358-014		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Final Year	
		(9/22/04 - 1/31/06)	(2/01/06 - 2/28/07)	(3/01/07 - 2/29/08)	(3/01/08 - 2/28/09)	(03/01/09 - 2/28/10)	03/01/10 - 2/28/11	03/01/11 - 2/29/12	03/01/12 - 2/28/13	03/01/13 - 4/30/14	
Task Budget	**Task Budget***	***revised***	***revised***								**Total Expenses**
1	4,537	4,537	0	0	0	0	0	0	0	0	4,537
2	2,561,960	216,966	335,319	317,317	299,727	249,163	299,550	296,282	249,082	371,233	2,631,949
3	675,402	21,112	33,833	80,984	61,455	56,239	28,122	46,033	145,566	200,675	674,017
4	610,565	52,409	40,940	46,329	53,602	64,124	43,569	117,206	118,858	60,525	597,564
5	376,568	42,428	40,534	47,506	38,721	51,158	27,835	29,231	45,096	55,092	377,601
6	568,773	54,531	75,387	71,106	60,257	39,595	60,473	52,444	56,865	97,256	567,913
7	306,020	37,014	22,801	30,516	25,841	11,497	14,302	34,398	87,024	13,269	262,197
8	334,692	44,629	43,089	41,243	43,927	42,084	42,984	37,157	38,169	5,948	339,229
9	623,288	145,078	39,011	35,656	82,844	52,423	65,785	32,971	76,416	110,886	627,160
10	162,970	0	0	0	0	0	86,736	55,871	0	0	142,607
TOTAL	6,224,775	618,702	630,914	670,657	666,374	566,283	669,355	701,594	817,075	914,885	6,224,775
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Final Year**	
Expense Budget	**Total Budget***	(09/22/04 - 01/31/06)	(02/01/06 - 02/28/07)	(3/01/07 - 2/29/08)	(3/01/08 - 2/28/09)	(03/01/09 - 2/28/10)	03/01/10 - 2/28/11	03/01/11 - 2/29/12	03/01/12 - 2/28/13	03/01/12 - 4/30/14	**Total Expenses**
Salary and Wages [1]	2,524,172	230,611	304,371	302,411	301,933	259,929	293,198	307,459	300,033	288,676	2,588,620
Fringe[2] (20% of Salary)	370,655	28,509	34,361	36,263	40,338	37,180	43,410	42,061	32,852	35,536	330,219
Insurance	186,600	13,634	26,529	25,302	25,942	21,508	23,294	24,918	17,554	25,126	204,096
Tuition and Fees	199,922	8,127	16,393	21,679	18,502	13,277	9,828	21,803	35,299	34,565	179,473
Travel	158,482	14,508	25,392	14,650	15,556	16,579	12,329	19,127	17,148	30,752	166,041
Capital Equipment	154,323	23,080	13,393	448	707	18,668	95,993	(146)	0	5,842	157,983
Expendable Supplies	105,455	14,277	16,100	12,205	18,288	8,614	4,802	8,265	21,058	73,705	163,314
Subcon	1,758,667	212,718	103,031	161,540	183,125	131,627	115,587	131,779	335,505	353,396	1,697,245
Technical/Computer	61,364	9,740	3,879	16,225	430	7,990	11,857	10,550	0	0	74,671
Communications	270,192	25,339	41,374	35,497	23,062	14,448	18,300	45,344	17,002	22,315	242,681
Reproduction (see comm)											0
Vehicle Insurance	2,000	0	397	235	187	194	114	130	222	0	1,479
Producer Compensation	57,450	0	0	0	0	0	0	39,225	0	0	39,225
Overhead	375,493	38,160	45,694	44,202	38,302	36,270	40,644	51,079	40,403	44,972	379,726
Profit											
TOTAL	6,224,775	618,702	630,914	670,657	666,374	566,283	669,355	701,594	817,075	914,885	6,224,775

Cost Sharing

Table 35. Final cost sharing figures for TTU, Texas A&M AgriLife, and HPUWCD for Phase I, Years 1-9 of the demonstration project.

Cost Sharing Balance Summary (estimated)

Budget	Total Cost Share Budgeted	*Actual Funds Contributed*	*Balance*
TTU		958,073.61	
TAMU		417,512.95	
HPUWCD		200,053.70	
TOTAL	1,300,000.00	1,575,640.26	(-275,640.26)

Expense Categories	Total Expense Budget	*Actual Funds Contributed*	*Balance*
Salary & Wages		350,471.81	
Overhead		607,601.80	
SubCon - TAMU		417,512.95	
$25,000/yr - HPUWCD		200,053.70	
TOTAL	1,300,000.00	1,575,640.26	(-275,640.26)

Appendix

Weather Data (2005-2012)

2005

The 2005 growing season was close to ideal in terms of temperatures and timing of precipitation. The precipitation and temperatures for this area are presented in Figure A1 along with the long-term means for this region. While hail events occurred in these counties during 2005, none of the specific sites in this project were measurably affected by such adverse weather events. Year 1, 2005, also followed a year of abnormally high precipitation. Thus, the 2005 growing season likely was influenced by residual soil moisture.

Precipitation for 2005, presented in Table A1, is the mean of precipitation recorded at the 26 sites during 2005, beginning in March when the sites were identified and equipped. Precipitation for January and February are amounts recorded at Halfway, TX; the nearest weather station.

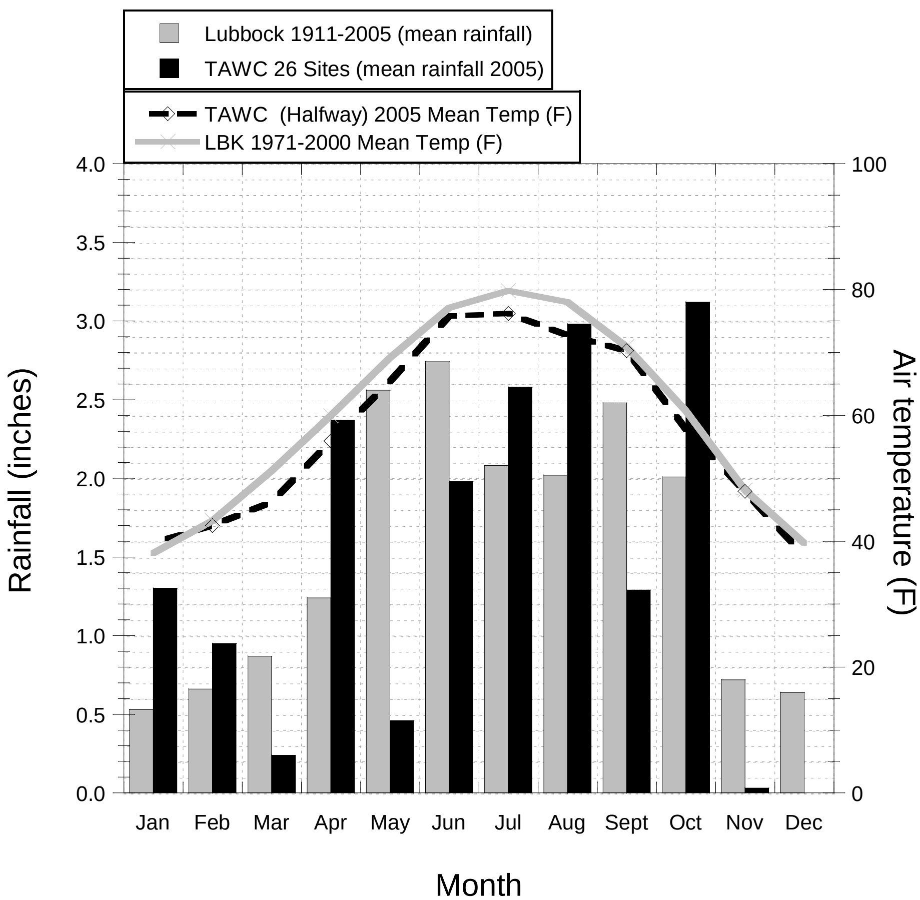


Figure A 1. Temperature and precipitation for 2005 in the demonstration area compared with long term averages.

Table A 1. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2005.

SITE	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1	0	0	0.4	1.3	0.2	1.7	2.2	2.4	2	4.1	0	0	**14.3**
2	0	0	0.4	1.8	0.5	1.4	2.4	3.6	0.8	3.4	0	0	**14.3**
3	0	0	0.7	2	0.6	1.4	2.5	4	0.4	3.2	0	0	**14.8**
4	0	0	0.6	8	0.3	1.4	2.2	3.2	0.1	1	0	0	**16.8**
5	0	0	0.6	2.9	0.4	1.5	3.2	4.2	0.6	1.7	0	0	**15.1**
6	0	0	0.5	1.5	0.4	3	2.4	1	2	4.2	0	0	**15.0**
7	0	0	0.5	1.5	0.6	2.6	2.4	1.5	3.3	3	0	0	**15.4**
8	0	0	0	1.5	0.6	2.6	2.4	1.5	3.3	3	0	0	**14.9**
9	0	0	0.5	1.5	0.5	2.6	2	1	3	3.3	0	0	**14.4**
10	0	0	0.4	1	0.2	2	1.8	1	1.6	3.1	0	0	**11.1**
11	0	0	0	1.2	0.4	3	2	1.7	1.8	4.3	0	0	**14.4**
12	0	0	0	0.7	0.4	3.2	2	2.2	1.2	2.8	0	0	**12.5**
13	0	0	0	1.7	0.4	3.4	3	2.6	1.2	4	0	0	**16.3**
14	0	0	0	1.3	0.5	1.8	3	2.2	2.2	3	0	0	**14.0**
15	0	0	0.4	1.3	0.5	2	3.6	4	2	5.4	0	0	**19.2**
16	0	0	0	1.4	0.4	2	3.2	3.4	1.8	4.1	0	0	**16.3**
17	0	0	0	2	0.5	2.2	3	3.6	1.6	4.6	0	0	**17.5**
18	0	0	0	4	0.9	1	2.8	4.8	0	3	0	0	**16.5**
19	0	0	0	3.2	0.5	1	2	4.6	0	2.6	0	0	**13.9**
20	0	0	0	2.8	0.4	1.6	3.4	4	0.8	2	0.4	0	**15.4**
21	0	0	0	1.2	0.6	2.5	2	2.5	2	4	0.3	0	**15.1**
22	0	0	0	5.8	0.3	1.6	2.6	4	0.2	0.6	0	0	**15.1**
23	0	0	0	3	0.3	1.2	2.9	3.6	0.5	0.9	0	0	**12.4**
24	0	0	0.8	4.8	0.3	1	2.9	4	0.4	0.8	0	0	**15.0**
25	0	0	0	2.3	0.9	2	2.4	3.4	0	7.4	0	0	**18.4**
26	0	0	0	2	0.4	1.7	2.8	3.4	0.7	1.7	0	0	**12.7**
Average	**0**	**0**	**0.2**	**2.4**	**0.5**	**2.0**	**2.6**	**3.0**	**1.3**	**3.1**	**0**	**0**	**15.0**

2006

The 2006 growing season was one of the hottest and driest seasons on record marked by the longest period of days with no measurable precipitation ever recorded for the Texas High Plains. Most dryland cotton was terminated. Rains came in late August and again in October delaying harvests in some cases. No significant hail damage was received within the demonstration sites.

Precipitation for 2006, presented in Figure A2 and Table A2, is the actual mean of precipitation recorded at the 26 sites during 2006 from January to December. The drought and high temperatures experienced during the 2006 growing season did influence system behavior and results. This emphasizes why it is crucial to continue this type of real-world demonstration and data collection over a number of years and sets of conditions.

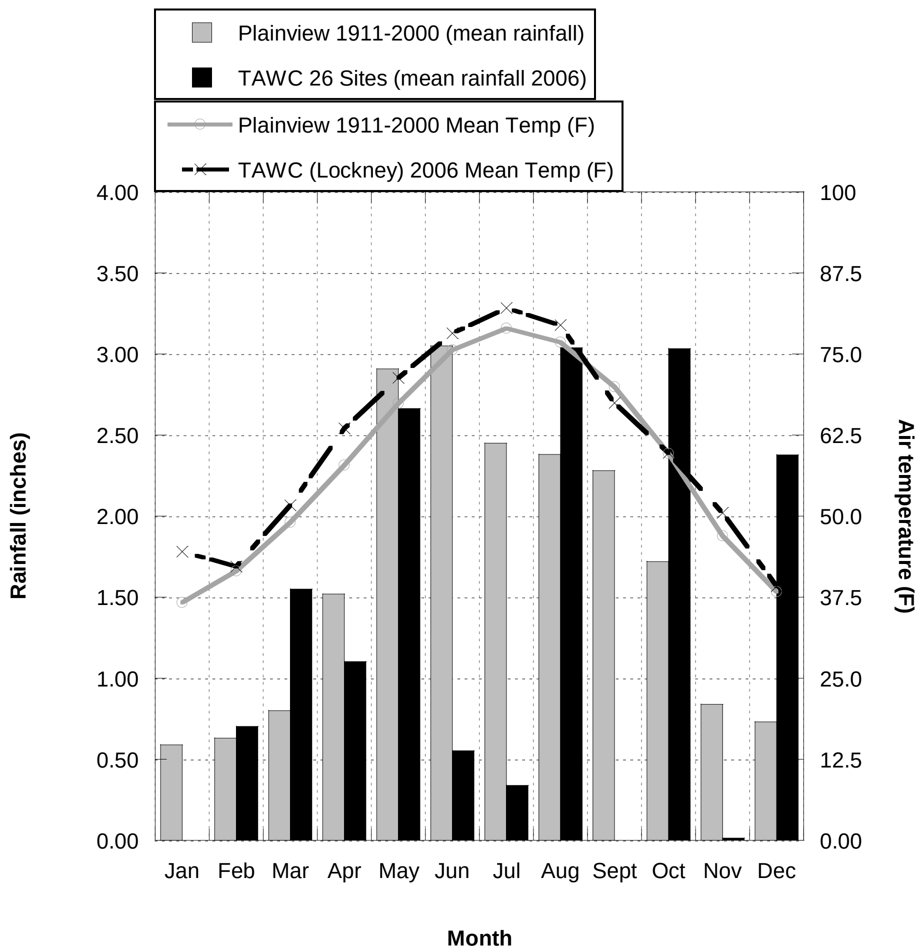


Figure A 2. Temperature and precipitation for 2006 in the demonstration area compared with long term averages.

Table A 2. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2006.

SITE	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1	0	0.9	1.7	1.2	2.6	0.5	0.55	2.3	0	2.87	0	2.6	**15.22**
2	0	0.8	1.9	1.1	1.9	0.2	0	2.6	0	3.05	0	1.8	**13.35**
3	0	0.6	1.5	0.9	2.6	0.7	0.22	3	0	3.14	0	3.2	**15.86**
4	0	0.5	1.4	1.1	2.7	0.2	0.4	3.8	0	2.56	0	2.8	**15.46**
5	0	0.7	1.4	1.8	3.2	0.4	0.57	4	0	2.78	0	2.8	**17.65**
6	0	0.7	1.5	0.8	3	0.4	0.2	5.4	0	2.6	0	2.7	**17.30**
7	0	0.5	1.3	0.9	1.92	0.5	0.33	3.8	0	2.75	0	2.1	**14.10**
8	0	0.5	1.3	0.9	1.92	0.5	0.33	3	0	2.75	0	2.1	**13.30**
9	0	0.6	1.5	0.8	1.82	0.5	0.12	3.8	0	3.28	0	2.4	**14.82**
10	0	0.6	1.5	1	3	0.4	0.11	3.1	0	2.8	0.1	2.4	**15.01**
11	0	0.5	0.7	0.4	2.5	0.4	0.1	3.5	0	3.3	0	1.6	**13.00**
12	0	0.8	1.4	0.8	2.2	0.9	0.2	1.9	0	3.3	0	2	**13.50**
13	0	1	1.8	0.8	2.2	1.1	0.1	2.7	0	3.05	0	1.8	**14.55**
14	0	0.8	1.8	1	2.8	0.3	0	1.6	0	3.8	0	2.6	**14.70**
15	0	1.4	2.2	1.4	2.8	0.4	0	2	0	4.4	0.1	2.6	**17.30**
16	0	1	2.2	1.3	2	0.8	0.2	2.6	0	2.69	0	2.2	**14.99**
17	0	0.8	2	1.3	2	1	0.3	3.3	0	3.38	0.1	3.2	**17.38**
18	0	0.7	1.2	1.2	1.8	1.1	0.74	2.6	0	3.11	0	3.6	**16.05**
19	0	0.6	1.3	1.1	1.3	1.4	0.75	1.2	0	3.11	0	2.3	**13.06**
20	0	0.6	1.4	1.3	3.8	0.4	0.55	4.07	0	2.56	0	2.2	**16.88**
21	0	0.9	2.6	1.4	2.8	0.4	0.73	2.2	0	3.54	0.1	2.7	**17.37**
22	0	0.6	1.5	1.3	3.8	0.3	0.22	1.8	0	2.66	0	1.9	**14.08**
23	0	0.4	0.9	1.1	3.8	0.2	0.55	3.6	0	3.7	0	2	**16.25**
24	0	0.5	1.6	1.2	4	0.7	0.12	2.8	0	2.64	0	2.3	**15.86**
26	0	0.7	1.3	1.3	3	0.3	0.86	4.3	0	2.49	0	1.7	**15.95**
27	0	0.6	1.4	1.3	3.8	0.4	0.55	4.07	0	2.56	0	2.2	**16.88**
Average	**0**	**0.7**	**1.6**	**1.1**	**2.7**	**0.6**	**0.3**	**3.0**	**0**	**3.0**	**0**	**2.4**	**15.40**

2007

Precipitation during 2007 totaled 27.2 inches (Table A3) and was well above the long-term mean (18.5 inches) for annual precipitation for this region. Furthermore, precipitation was generally well distributed over the growing season with early season rains providing needed moisture for crop establishment and early growth (Figure A3). Many producers took advantage of these rains and reduced irrigation until mid-season when rainfall declined. Growing conditions were excellent and there was little effect of damaging winds or hail at any of the sites. Temperatures were generally cooler than normal during the first half of the growing season but returned to normal levels by August. The lack of precipitation during October and November aided producers in harvesting crops.

Precipitation for 2007, presented in Figure A3 and Table A3, is the actual mean of precipitation recorded at the 26 sites during 2007 from January to December. Growing conditions during 2007 differed greatly from the hot dry weather encountered in 2006.

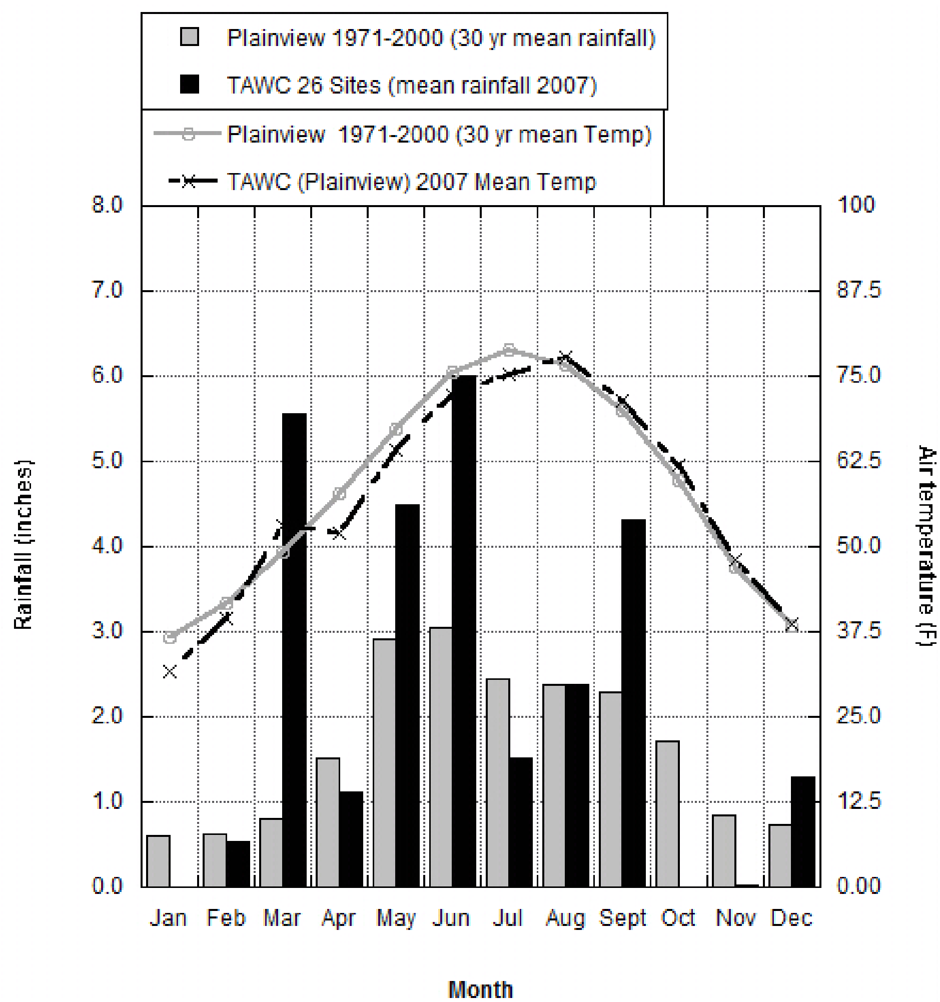


Figure A 3. Temperature and precipitation for 2007 in the demonstration area compared with long term averages.

Table A 3. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2007.

SITE	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1	0	0.74	5.4	0.8	4.92	4.75	0.71	2.3	3.6	0	0	1.2	**24.42**
2	0	0.52	3.7	0.8	2.86	6.93	1.32	3	4.8	0	0	1.2	**25.13**
3	0	0.47	4.8	0.9	2.74	6.88	1.41	2.4	4.4	0	0	1	**25.00**
4	0	0.29	7.6	0.9	3.53	6.77	4	1.5	5	0	0	1	**30.59**
5	0	0.72	6	1.1	5.09	7.03	0.79	1.2	4.7	0	0	1.2	**27.83**
6	0	0.46	6	0.7	5.03	5.43	0.54	2	4.5	0	0	1.4	**26.06**
7	0	0.9	6.4	1	5.4	4.12	0.74	1.2	3.2	0	0	1.4	**24.36**
8	0	0.9	6.4	1	5.4	4.12	0.74	1.2	3.2	0	0	1.4	**24.36**
9	0	0.42	4.8	0.6	5.13	4.05	0.75	1.6	3	0	0	1	**21.35**
10	0	0.41	4.8	0.6	4.62	6.62	0.81	2.2	4.5	0	0	1.2	**25.76**
11	0	0.41	4.6	1.5	4.74	6.8	1.2	3.4	5.3	0	0	1	**28.95**
12	0	0.41	6.7	1.3	5.3	6.6	1.6	3	5.3	0	0	1	**31.21**
13	0	0.41	5.5	0.6	5	7.1	2	3	4	0	0	1.3	**28.91**
14	0	0.52	6.2	0.9	5.29	3.79	0.71	2.6	3.8	0	0	1.8	**25.61**
15	0	0.52	6.75	4	5.29	4.25	0.71	2.5	4	0	0	3	**31.02**
16	0	0.45	5	1	3.6	5.65	0.85	2.5	4.2	0	0	1	**24.25**
17	0	0.67	5.3	1	3.85	7.27	1.5	3.2	4.6	0	0	1.2	**28.59**
18	0	0.52	5.8	1.9	4.54	5.61	2.22	3	4	0	0	1.2	**28.79**
19	0	0.55	4	1	4.7	7.7	2.8	3.9	4.5	0	0	2	**31.15**
20	0	0.41	5.6	0.8	4.06	7.24	1.15	3	4.8	0	0	1	**28.06**
21	0	0.52	7.4	2	5.3	5.28	1.17	3.4	5.4	0	0	1.4	**31.87**
22	0	0.34	6.2	0.9	3.9	6.88	3.17	1.8	4	0	0	1	**28.19**
23	0	0.4	4.6	0.7	4.65	7.86	2.19	2	4.5	0	0	0.5	**27.40**
24	0	0.91	5.4	0.9	3.22	3.47	3.94	1.7	4.2	0	0	1.8	**25.54**
26	0	0.48	4	0.8	4.76	6.45	1.31	1	3.8	0	0	1.2	**23.80**
27	0	0.41	5.6	0.8	4.06	7.24	1.15	3	4.8	0	0	1	**28.06**
Average	**0**	**0.5**	**5.6**	**1.1**	**4.5**	**6.0**	**1.5**	**2.4**	**4.3**	**0**	**0**	**1.3**	**27.20**

2008
Precipitation during 2008, at 21.6 inches, was above average for the year (Table A4). However, the distribution of precipitation was unfavorable for most crops (Figure A4). Beginning the previous autumn, little rain fell until December and then less than an inch of precipitation was received before May of 2008. Four inches was received in May, well above the average for that month. This was followed by below average rain during most of the growing season for crops. In September and October, too late for some crops and interfering with harvest for others, rain was more than twice the normal amounts for this region. Following the October precipitation, no more rain came during the remainder of the year. This drying period helped with harvest of some crops but the region entered the winter with below normal moisture.

Temperatures during 2008 were close to the long-term mean for the region (Figure A4).

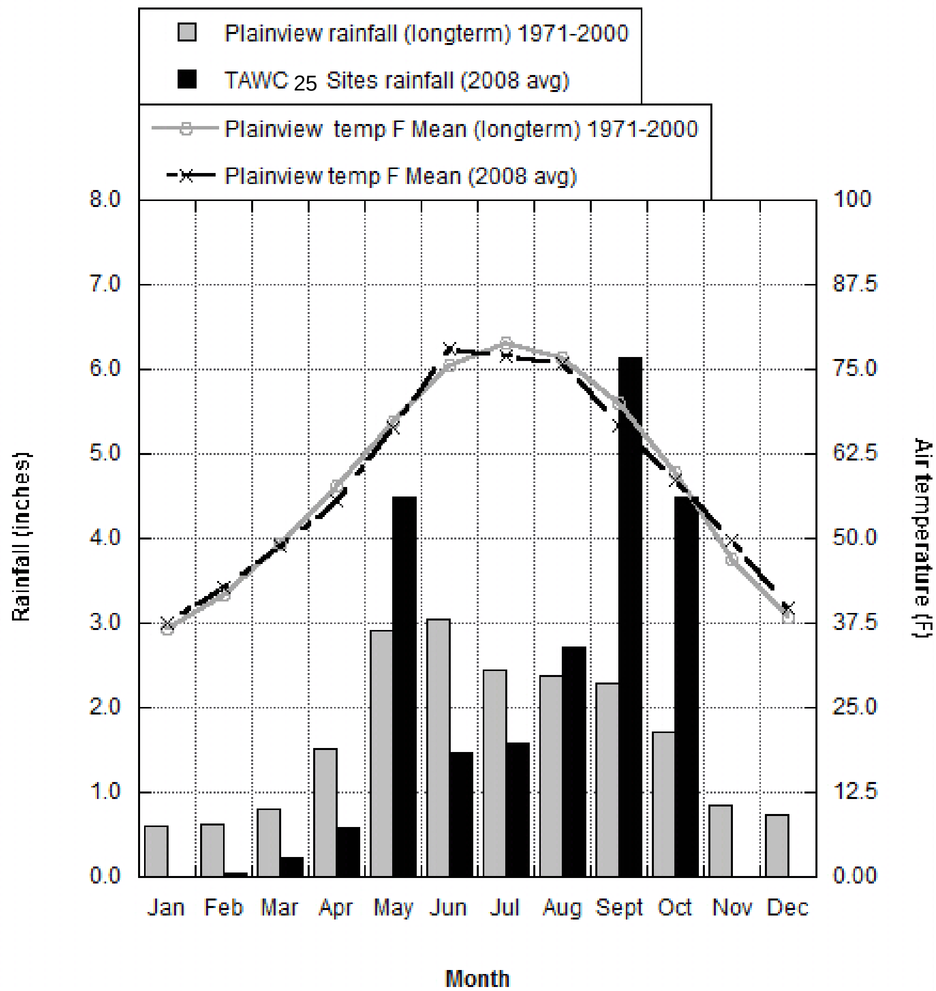


Figure A 4. Temperature and precipitation for 2008 in the demonstration area compared with long term averages.

Table A 4. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2008.

SITE	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
2	0	0	0.2	0.8	4.75	1.7	1	2.1	5.4	4.1	0	0	**20.1**
3	0	0	0.2	0.5	4.5	1.1	0.95	2	4.7	4.4	0	0	**18.4**
4	0	0	0.4	0.6	4	2.9	1.1	4.1	3	2.9	0	0	**19.0**
5	0	0	0	0.2	4	1.5	0.5	4.2	5	3.5	0	0	**18.9**
6	0	0	0.2	0.5	4.2	1.2	1.9	4	9.4	6	0	0	**27.4**
7	0	0	0	0.6	5.6	1.2	3.2	1.8	8.6	6.5	0	0	**27.5**
8	0	0	0	0.6	5.6	1.2	3.2	1.8	8.6	5.4	0	0	**26.4**
9	0	0	0	0.4	4.1	1	2.4	1.7	5.5	4	0	0	**19.1**
10	0	0	0	0.4	4.5	0.9	1	2.7	6.9	4.8	0	0	**21.2**
11	0	0	0.4	0.5	5.3	1.1	1.7	3.2	7.6	4.3	0	0	**24.1**
12	0	0	0.2	0.6	5	1.5	1.6	2.25	6.5	4.2	0	0	**21.9**
14	0	0.2	0.4	0.9	5	1.3	1.6	2.5	7.4	6	0	0	**25.3**
15	0	0.2	0.4	0.9	5	1.5	2.5	2.5	7.4	6	0	0	**26.4**
17	0	0	0.2	1.1	5	1.8	1.8	2.6	6.4	5.6	0	0	**24.5**
18	0	0.2	0.4	0.2	3.6	1.3	0.7	2.2	3	4	0	0	**15.6**
19	0	0.2	0.4	0.8	5	1	1.1	2.1	4.25	4.8	0	0	**19.7**
20	0	0	0.4	0.5	5	1.9	1.4	4.8	6.8	4.2	0	0	**25.0**
21	0	0.2	0.4	0.8	5	1.5	4	2.4	6	4.2	0	0	**24.5**
22	0	0	0.2	1	4.6	3	1.1	2.6	5	3.2	0	0	**20.7**
23	0	0	0.2	0.2	1.3	1.1	1	2.4	5.5	3.4	0	0	**15.1**
24	0	0	0.4	0.9	4.2	2.9	1.4	2.1	3.5	3	0	0	**18.4**
26	0	0	0.2	0.2	3.2	0.5	1.4	2.3	5.3	3.3	0	0	**16.4**
27	0	0	0.4	0.5	5	1.9	1.4	4.8	6.8	4.2	0	0	**25.0**
28	0	0	0	0.4	4.5	0.9	1	2.7	6.9	4.8	0	0	**21.2**
29	0	0	0	0.4	4	1	0.7	1.8	6.4	4.7	0	0	**19.0**
Average	**0**	**0.04**	**0.2**	**0.6**	**4.5**	**1.5**	**1.6**	**2.7**	**6.1**	**4.5**	**0**	**0**	**21.6**

2009

Precipitation during 2009 totaled 15.2 inches averaged across all sites (Table A5). This was similar to precipitation in 2005 (Table A1). However, in 2005 above-average winter moisture was received followed by precipitation in April that was nearly twice the long-term mean. July, August, and October precipitation were also higher than normal in that year (Figure A5). In 2009, January began with very little precipitation that followed two months of no precipitation in the previous year (Figure A4). Thus, the growing season began with limited soil moisture. March and May saw less than half of normal precipitation. While June and July were near of slightly above normal, August, September, October and November were all below normal. December precipitation was above normal and began a period of higher than normal moisture entering 2010.

Temperatures in February and March were above the long-term mean and peak summer temperatures were prolonged in 2009. However, by September, temperatures fell below normal creating a deficit in heat units needed to produce an optimum cotton crop.

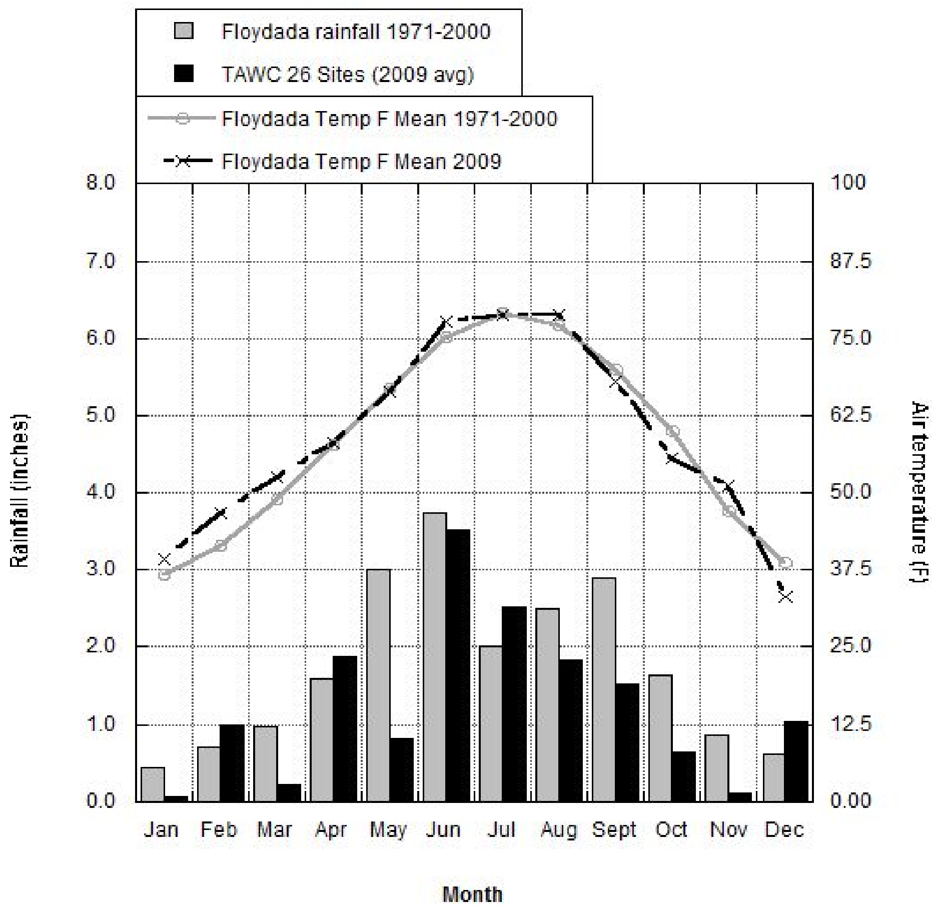


Figure A 5. Temperature and precipitation for 2009 in the demonstration area compared with long term averages.

Table A 5. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2009.

SITE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2	0.08	1.22	0.27	2.30	0.12	3.13	2.23	2.57	0.24	1.18	0.15	1.61	**15.10**
3	0.10	1.45	0.32	2.74	0.30	4.79	2.33	0.00	0.07	1.41	0.18	1.92	**15.60**
4	0.09	1.25	0.27	2.37	0.14	4.73	1.90	2.58	2.01	0.80	0.18	0.99	**17.30**
5	0.07	0.96	0.21	1.82	0.68	4.58	3.92	1.73	1.72	0.68	0.06	0.27	**16.70**
6	0.05	0.78	0.17	1.47	1.07	2.01	2.86	3.55	0.20	0.02	0.09	0.73	**13.00**
7	0.05	0.75	0.16	1.42	0.52	2.89	2.24	1.22	1.60	0.60	0.09	1.55	**13.10**
8	0.05	0.75	0.16	1.42	0.52	2.89	2.24	1.22	1.60	0.60	0.09	1.55	**13.10**
9	0.04	0.59	0.13	1.12	0.73	2.20	2.48	1.34	1.65	0.59	0.08	0.66	**11.60**
10	0.04	0.56	0.12	1.05	0.44	2.13	2.64	3.01	2.18	0.41	0.06	0.56	**13.20**
11	0.04	0.63	0.14	1.18	0.86	2.56	2.21	1.25	1.31	0.61	0.08	0.83	**11.70**
14	0.12	1.80	0.39	3.41	1.10	0.81	4.21	0.67	0.02	0.00	0.14	1.41	**14.10**
15	0.09	1.33	0.29	2.52	1.50	0.84	1.25	0.16	2.79	1.30	0.16	1.77	**14.00**
17	0.04	0.64	0.14	1.21	0.51	2.88	1.90	2.88	3.41	0.55	0.05	0.69	**14.90**
18	0.08	1.14	0.25	2.16	0.66	6.25	1.50	1.63	2.26	0.35	0.09	0.75	**17.10**
19	0.07	0.95	0.21	1.80	0.85	5.41	2.31	2.53	1.89	0.00	0.12	0.66	**16.80**
20	0.06	0.84	0.18	1.59	0.37	3.87	2.43	3.41	2.09	0.37	0.11	0.89	**16.20**
21	0.06	0.80	0.18	1.52	0.58	2.70	1.43	3.35	1.83	0.51	0.08	0.77	**13.80**
22	0.11	1.56	0.34	2.95	1.01	3.75	0.98	1.86	2.05	0.96	0.24	1.19	**17.00**
23	0.09	1.26	0.28	2.38	0.76	4.84	1.29	1.59	1.96	0.75	0.00	0.91	**16.10**
24	0.08	1.19	0.26	2.25	1.31	6.82	2.38	1.73	0.28	0.66	0.12	0.51	**17.60**
26	0.08	1.09	0.24	2.06	1.91	4.21	4.61	0.99	0.19	0.63	0.12	1.29	**17.40**
27	0.06	0.89	0.19	1.68	1.22	3.64	3.14	1.78	1.86	0.86	0.11	1.18	**16.60**
28	0.05	0.71	0.15	1.33	0.97	2.89	2.49	1.41	1.48	0.69	0.09	0.94	**13.20**
29	0.13	0.45	0.44	0.94	0.41	2.9	3.26	2.35	2.82	0.75	0.22	1.41	**16.08**
30	0.08	1.09	0.24	2.06	1.91	4.21	4.61	0.99	0.19	0.63	0.12	1.29	**17.40**
Average	**0.07**	**0.99**	**0.23**	**1.87**	**0.82**	**3.52**	**2.51**	**1.83**	**1.51**	**0.64**	**0.11**	**1.05**	15.15

2010

The project sites and the region received above average rainfall for the 2010 calendar year with an average of 28.9 inches measured across the project, as indicated in Table A6 and illustrated in Figure A6. Much of this rainfall came in the late winter and early spring/summer months, with above average rainfall from January through July, and significant rainfall amounts in the months of April and July. Temperatures for the year were slightly above average during the late fall and early spring months across the TAWC sites, allowing for increased soil temperatures at planting, further stabilizing the germination and early growth stages of the upcoming crops. An average of 6.0 inches fell on the project sites in April and 6.5 inches in July which when combined with the favorable conditions of the previous three months, provided ideal conditions for the 2010 summer growing season. The abnormally high rainfall continued in July and October allowing for summer crops to receive needed moisture during the final stages of production. This record high rainfall allowed some producers to achieve record yields, specifically on cotton and corn, while maintaining or decreasing their irrigation use from previous years of the project.

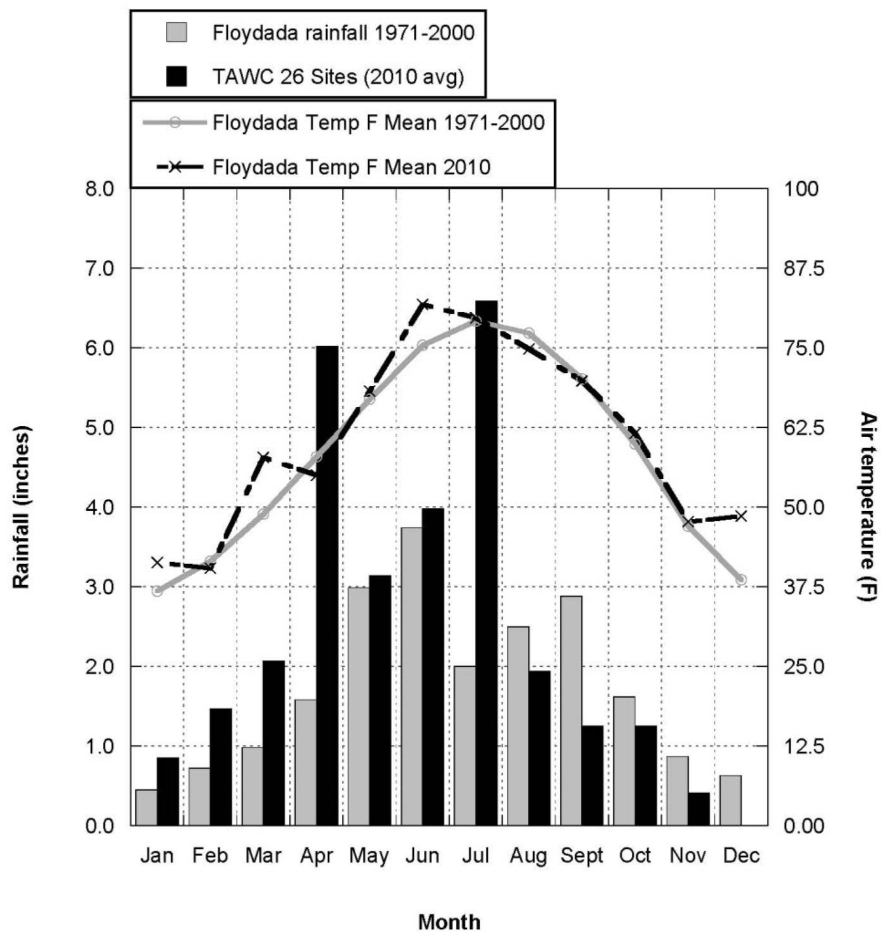


Figure A 6. Temperature and precipitation for 2010 in the demonstration area compared with long term averages.

Table A 6. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2010.

SITE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2	1.5	1.1	2.0	6.2	2.0	7.0	7.8	1.2	1.6	1.4	0.0	0.0	31.8
3	0.8	1.4	1.9	5.0	2.2	4.7	5.8	1.4	2.0	1.8	0.2	0.0	27.1
4	0.6	1.3	2.1	5.2	4.6	2.2	10.0	1.4	0.4	2.0	0.6	0.0	30.4
5	0.8	1.4	1.9	5.0	3.2	3.6	8.0	2.3	0.6	0.6	0.4	0.0	27.7
6	0.5	1.4	1.9	5.4	3.4	4.8	5.4	2.4	1.2	0.6	0.4	0.0	27.4
7	0.8	1.5	2.5	6.0	2.8	1.6	5.0	2.3	1.5	0.6	0.3	0.0	24.8
8	0.8	1.5	2.5	6.0	2.8	1.6	5.0	2.3	1.5	0.6	0.3	0.0	24.8
9	0.5	1.5	2.2	7.0	4.6	2.8	4.4	2.2	1.6	0.8	0.4	0.0	28.0
10	0.8	1.6	2.2	7.7	4.2	3.4	4.4	1.8	1.2	1.0	0.4	0.0	28.7
11	0.8	1.6	2.2	9.1	5.4	4.0	4.4	1.7	1.2	0.9	0.4	0.0	31.6
12	0.8	1.5	2.1	7.4	3.8	4.2	7.6	3.4	2.8	1.2	0.6	0.0	35.4
14	0.8	1.5	2.1	7.7	4.0	5.1	6.0	2.2	2.0	1.2	0.4	0.0	33.0
15	0.8	1.5	2.1	6.2	2.0	5.8	5.2	1.7	1.4	1.4	0.4	0.0	28.5
17	0.8	1.6	2.0	5.2	2.8	6.6	7.2	1.2	1.6	1.2	0.4	0.0	30.6
18	0.8	1.3	2.0	7.3	1.6	6.6	4.6	1.6	0.1	1.0	0.2	0.0	27.1
19	0.7	1.3	2.0	7.6	2.2	5.4	6.2	2.4	0.8	2.0	0.4	0.0	30.9
20	0.8	1.4	1.9	6.3	3.2	4.4	9.0	2.3	0.8	1.2	0.6	0.0	31.8
21	0.8	1.5	2.1	6.2	2.7	4.6	7.4	2.2	2.4	1.2	0.6	0.0	31.7
22	1.4	1.8	2.1	4.1	3.4	3.6	8.4	0.8	0.2	2.0	0.6	0.0	28.4
23	1.4	1.4	2.1	5.4	2.6	4.4	7.0	2.1	0.4	0.5	0.4	0.0	27.6
24	1.4	1.8	2.1	3.8	3.6	1.6	7.5	1.5	0.7	2.6	0.6	0.0	27.2
26	0.8	1.4	1.9	5.0	3.2	3.6	8.0	2.3	0.6	0.6	0.4	0.0	27.7
27	0.8	1.4	1.9	5.0	2.2	3.0	7.0	2.3	0.8	1.4	0.6	0.0	26.3
28	0.8	1.6	2.2	7.7	4.2	3.4	4.4	1.8	1.2	1.0	0.4	0.0	28.7
29	0.8	1.5	2.1	6.2	1.8	6.0	7.4	1.7	4.0	1.4	0.4	0.0	33.3
30	0.8	1.4	1.9	5.0	3.2	3.6	8.0	2.3	0.6	0.6	0.4	0.0	27.7
31	1.4	1.8	2.1	3.8	3.6	1.6	7.5	1.5	0.7	2.6	0.6	0.0	27.2
32	0.8	1.5	2.1	6.2	2.7	2.4	6.0	1.7	1.1	1.6	0.3	0.0	26.4
33	0.8	1.5	2.1	6.2	2.7	2.4	6.0	1.7	1.1	1.6	0.3	0.0	26.4
Average	**0.9**	**1.5**	**2.1**	**6.0**	**3.1**	**3.9**	**6.6**	**1.9**	**1.2**	**1.3**	**0.4**	**0.0**	**28.9**

2011

The project sites and the region received below average rainfall for the 2011 calendar year with an average of 5.3 inches (Figure A7 and Table A7), compared with a long term average of 18.5 inches. This was the worst drought the Texas High Plains had seen since the 1930's in that virtually no rainfall was received during the normal growing season. Several fields within sites recorded zero crop yields in 2011 because irrigation was insufficient to produce yields high enough to merit the harvest costs.

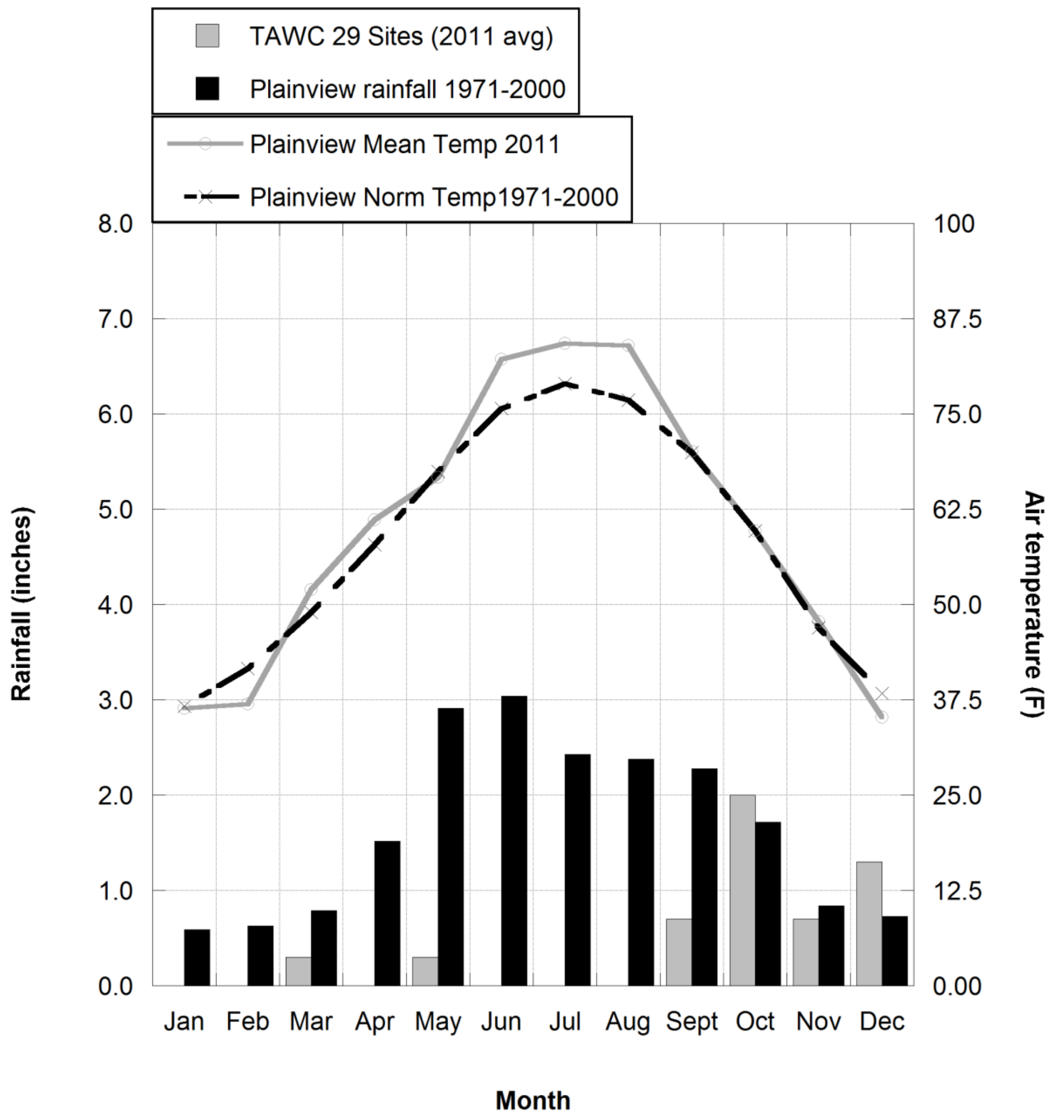


Figure A 7. Temperature and precipitation for 2011 in the demonstration area compared with long term averages.

Table A 7. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2011.

SITE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	1.0	2.2	0.6	1.3	**5.3**
3	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.4	2.0	0.8	0.8	0.9	**5.1**
4	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.4	2.4	0.3	0.8	**4.5**
5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.6	1.7	0.4	1.1	**4.3**
6	0.0	0.1	0.6	0.0	0.4	0.0	0.0	0.0	0.6	2.1	1.0	1.1	**5.9**
7	0.0	0.0	1.0	0.0	0.3	0.0	0.0	0.0	0.6	1.7	0.9	0.8	**5.3**
8	0.0	0.0	1.0	0.0	0.3	0.0	0.0	0.0	0.6	1.7	0.9	0.8	**5.3**
9	0.0	0.0	0.4	0.0	0.6	0.0	0.0	0.0	0.7	2.2	1.0	1.2	**6.0**
10	0.0	0.0	0.4	0.0	0.5	0.0	0.0	0.0	0.6	2.0	1.0	1.5	**6.0**
11	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.6	1.8	1.0	1.0	**4.7**
12	0.0	0.1	0.4	0.0	0.3	0.0	0.0	0.2	0.7	2.2	1.2	1.1	**6.2**
14	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.8	2.0	1.0	1.2	**5.4**
15	0.0	0.1	0.0	0.0	0.4	0.0	0.0	0.0	0.8	2.0	1.0	1.2	**5.5**
17	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.6	2.0	0.6	0.8	**4.2**
18	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.6	2.5	0.5	1.4	**5.1**
19	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.6	2.5	0.5	1.4	**5.1**
20	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.2	0.8	1.9	0.6	1.4	**5.3**
21	0.0	0.0	0.6	0.1	0.4	0.0	0.0	0.0	0.4	1.8	0.9	1.1	**5.3**
22	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.9	2.1	0.3	0.8	**4.7**
23	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.4	1.4	0.1	1.4	**3.4**
24	0.0	0.0	0.6	0.0	0.1	0.0	0.0	0.0	0.9	3.0	0.1	2.8	**7.5**
26	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.6	1.7	0.4	1.1	**4.3**
27	0.0	0.0	0.0	0.1	0.5	0.0	0.0	0.0	1.0	1.6	0.4	1.2	**4.8**
28	0.0	0.0	0.4	0.0	0.5	0.0	0.0	0.0	0.6	2.0	1.0	1.5	**6.0**
29	0.0	0.1	0.0	0.0	1.0	0.0	0.0	0.0	0.4	2.2	0.8	1.4	**5.9**
30	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.6	1.7	0.4	1.1	**4.3**
31	0.0	0.0	0.6	0.0	0.1	0.0	0.0	0.0	0.9	3.0	0.1	2.8	**7.5**
32	0.0	0.1	0.0	0.0	0.4	0.0	0.0	0.0	0.8	2.0	1.0	1.2	**5.5**
33	0.0	0.1	0.0	0.0	0.4	0.0	0.0	0.0	0.8	2.0	1.0	1.2	**5.5**
Average	**0.0**	**0.0**	**0.3**	**0.0**	**0.3**	**0.0**	**0.0**	**0.0**	**0.7**	**2.0**	**0.7**	**1.3**	5.3

2012

The project sites and the region again received below average rainfall for the 2012 calendar year, with an average of 10.0 inches measured across the project (Figure A8 and Table A8). Slightly above average rainfall was received in the months of March, June and September. Mean temperatures ran slightly above normal early in the season, but were close to normal during the growing season.

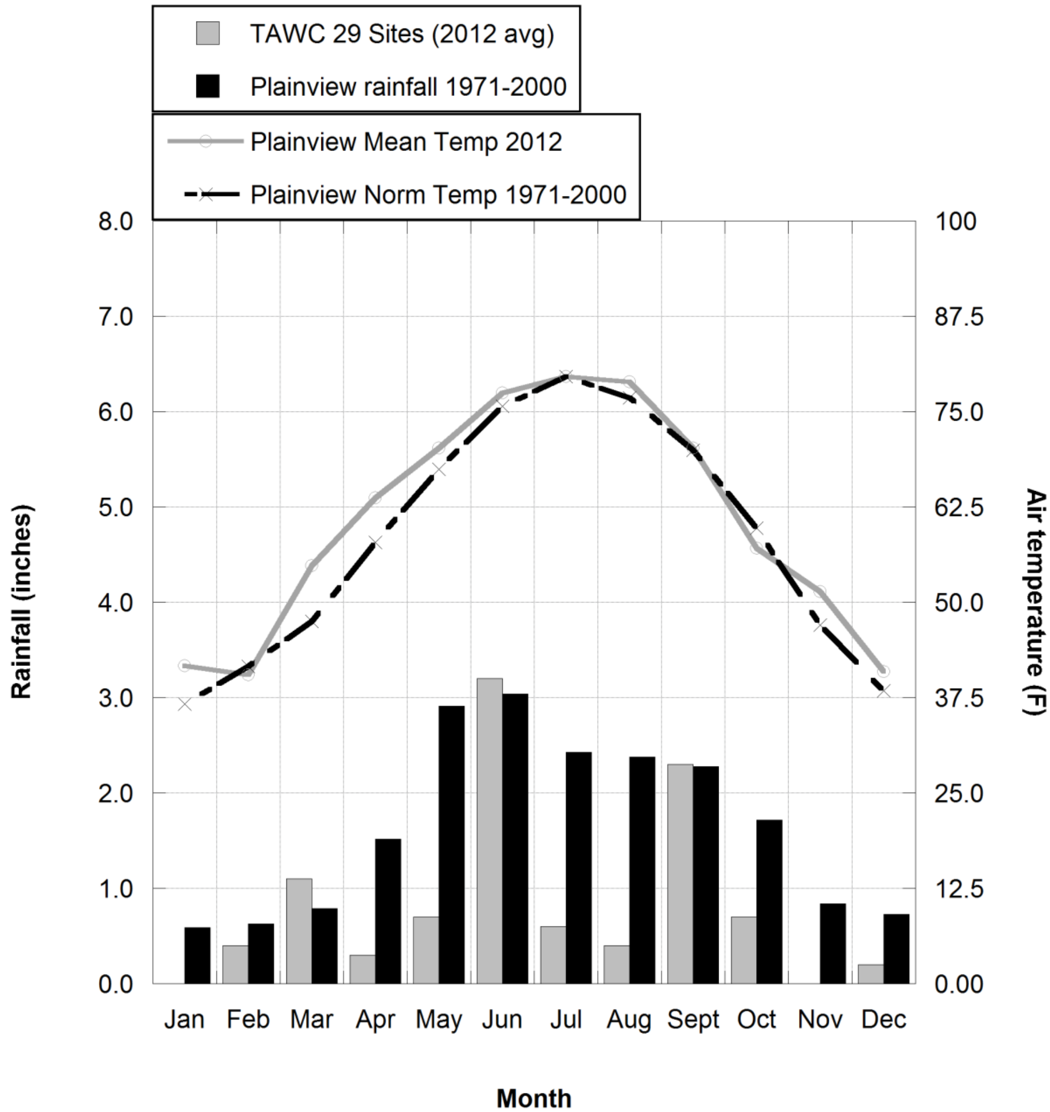


Figure A 8. Temperature and precipitation for 2012 in the demonstration area compared with long term averages.

Table A 8. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2012.

SITE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2	0.0	0.5	1.0	0.7	1.0	3.3	0.8	0.6	2.0	0.6	0.0	0.2	10.7
3	0.0	0.4	1.2	0.8	0.6	0.7	0.4	0.6	1.4	0.7	0.0	0.0	6.8
4	0.0	0.5	1.2	0.0	1.6	2.9	0.5	0.4	3.3	0.8	0.0	0.2	11.3
5	0.0	0.6	0.8	0.0	0.4	2.9	1.0	0.2	2.8	1.5	0.0	0.0	10.2
6	0.0	0.3	0.0	0.0	0.0	3.7	0.6	0.3	2.0	0.1	0.0	0.4	7.3
7	0.0	0.2	1.0	0.4	0.3	5.2	0.1	0.4	2.2	0.2	0.0	0.2	10.2
8	0.0	0.3	1.0	0.4	0.3	5.2	0.1	0.4	2.2	0.2	0.0	0.2	10.3
9	0.0	0.3	1.0	0.4	0.4	4.9	1.4	0.4	4.2	0.5	0.0	0.2	13.7
10	0.0	0.6	1.4	0.2	0.6	3.4	0.4	0.2	2.2	0.2	0.0	0.3	9.5
11	0.0	0.4	2.0	0.2	0.8	4.2	0.1	0.2	2.6	0.2	0.0	0.2	10.9
12	0.0	0.5	1.9	0.4	0.9	2.5	0.2	0.1	1.9	0.4	0.0	0.3	9.1
14	0.0	0.4	1.8	0.1	0.6	3.3	0.2	0.4	2.2	0.4	0.0	0.3	9.7
15	0.0	0.4	1.8	0.1	0.7	2.9	0.2	0.4	2.2	0.2	0.0	0.4	9.3
17	0.0	0.4	1.0	0.7	1.0	2.7	0.7	0.4	2.4	0.5	0.0	0.2	10.0
18	0.0	0.3	0.5	0.0	0.8	2.6	0.2	0.8	2.4	1.0	0.0	0.1	8.7
19	0.0	0.4	1.0	1.2	1.2	3.3	0.4	1.0	2.8	1.0	0.0	0.2	12.5
20	0.0	0.4	1.2	0.2	0.4	3.4	1.4	1.0	2.4	1.0	0.0	0.4	11.8
21	0.0	0.5	1.5	0.2	0.8	2.9	0.2	0.1	2.1	0.5	0.0	0.1	8.9
22	0.0	0.6	1.0	0.0	1.0	3.4	1.2	0.5	3.1	0.8	0.0	0.1	11.7
24	0.0	0.2	2.0	1.5	0.7	4.0	3.0	0.3	1.8	3.6	0.0	0.1	17.2
26	0.0	0.6	0.8	0.0	0.4	2.9	1.0	0.2	2.8	1.5	0.0	0.0	10.2
27	0.0	0.5	1.0	0.0	0.5	2.7	1.4	0.9	2.2	1.8	0.0	0.1	11.1
28	0.0	0.6	1.4	0.2	0.6	3.4	0.4	0.2	2.2	0.2	0.0	0.3	9.5
29	0.0	0.4	1.3	0.2	1.4	2.8	0.4	1.2	2.0	0.4	0.0	0.3	10.4
30	0.0	0.6	0.8	0.0	0.4	2.9	1.0	0.2	2.8	1.5	0.0	0.0	10.2
31	0.0	0.5	1.2	0.0	1.6	2.9	0.5	0.4	3.3	0.8	0.0	0.2	11.3
32	0.0	0.4	0.0	0.0	0.7	2.9	0.0	0.0	0.0	0.2	0.0	0.4	4.6
33	0.0	0.4	0.0	0.0	0.7	2.9	0.0	0.0	0.0	0.2	0.0	0.4	4.6
34	0.0	0.3	0.0	0.0	0.0	3.2	0.7	0.6	2.4	0.1	0.0	0.2	7.5
Average	0.0	0.4	1.1	0.3	0.7	3.2	0.6	0.4	2.3	0.7	0.0	0.2	10.0

Supplementary Grants To Project (2005-2012)

Grants directly used or partially used within the TAWC project sites are listed. Other grants and grant requests are considered complementary and outside of the TAWC project, but were obtained or attempted through leveraging of the base platform of the Texas Coalition for Sustainable Integrated Systems and Texas Alliance for Water Conservation (TeCSIS) program, and therefore represents added value to the overall TAWC effort.

2006

Allen, V. G., Song Cui, and P. Brown. 2006. Finding a Forage Legume that can Save Water and Energy and Provide Better Nutrition for Livestock in West Texas. High Plains Underground Water Conservation District No. 1. $10,000 (funded).

2007

Trostle, C.L., R. Kellison, L. Redmon, S. Bradbury. 2007. Adaptation, productivity, & water use efficiency of warm-season perennial grasses in the Texas High Plains. Texas Coalition, Grazing Lands Conservation Initiative, a program in which Texas State Natural Resource Conservation Service is a member. $3,500 (funded).

Li, Yue and V.G. Allen. 2007. Allelopathic effects of small grain cover crops on cotton plant growth and yields. USDA-SARE. Amount requested, $10,000 (funded).

Allen, V.G. and multiple co-authors. Crop-livestock systems for sustainable High Plains Agriculture. 2007. Submitted to the USDA-SARE program, Southeast Region, $200,000 (funded).

2008

Doerfert, D. L., Baker, M., and Akers, C. 2008. Developing Tomorrow's Water Conservation Researchers Today. Ogallala Aquifer Program Project. $28,000 (funded).

Doerfert, D.L., Meyers, C.. 2008. Encouraging Texas agriscience teachers to infuse water management and conservation-related topics into their local curriculum. Ogallala Aquifer Initiative. $61,720 (funded).

Request for federal funding through the Red Book initiatives of CASNR - $3.5 million. Received letters of support from Senator Robert Duncan, mayors of three cities in Hale and Floyd Counties, Glenn Schur, Curtis Griffith, Harry Hamilton, Mickey Black, and the Texas Department of Agriculture.

Prepared request for $10 million through the stimulus monies at the request of the CASNR Dean's office.

2009

Texas High Plains: A Candidate Site for Long-Term Agroecosystems Research. USDA-CSREES 'proof of concept' grant. $199,937 (funded).

Building a Sustainable Future for Agriculture. USDA-SARE planning grant, $15,000 (funded).

Maas, S., A. Kemanian, & J. Angerer. 2009. Pre-proposal was submitted to Texas AgriLife Research for funding research on irrigation scheduling to be conducted at the TAWC project site.

Maas, S., N. Rajan, A.C. Correa, & K. Rainwater. 2009. Proposal was submitted to USGS through TWRI to investigate possible water conservation through satellite-based irrigation scheduling.

Doerfert, D. 2009. Proposal was submitted to USDA ARS Ogallala Aquifer Initiative.

2010

Kucera, J.M., V. Acosta-Martinez, V. Allen. 2010. Integrated Crop and Livestock Systems for Enhanced Soil C Sequestration and Biodiversity in Texas High Plains. Southern SARE grant. $159,999 (funded with ~15% applied directly to TAWC project sites).

Calvin Trostle, Rick Kellison, Jackie Smith. 2010. Perennial Grasses for the Texas South Plains: Species Productivity and Irrigation Response, $10,664 (2 years).

2011

Johnson, P., D. Doerfert, S. Maas, R. Kellison & J. Weinheimer. 2011. The Texas High Plains Initiative for Strategic and Innovative Irrigation Management and Conservation. USDA-NRCS Conservation Innovation Grant. Joint proposal with North Plains Groundwater Conservation District. $499,848 (funded).

Allen, V. 2011. Long-Term Agroecosystems Research and Adoption in the Texas Southern High Plains. Southern SARE grant. $110,000 (funded).

Maas, S. 2011. Auditing Irrigation Systems in the Texas High Plains. Texas Water Development Board. $101,049 (funded).

Maas, S. and co-authors. 2011. Development of a Farm-Scale Irrigation Management Decision-Support Tool to Facilitate Water Conservation in the Southern High Plains. USDA-NIFA. $500,000 requested.

Trostle, C. 2011. Dryland reduced Tillage/No Tillage Cropping Sequences for the Texas South Plains. $4,133 (funded from Texas State Support Committee, Cotton, Inc.,).

2012

Allen, V. 2012. Long-Term Agroecosystems Research and Adoption in the Texas Southern High Plains. Southern SARE grant. $110,000 (continued funding).

Trojan, S. and co-authors. 2012. Adapting to drought and dwindling groundwater supply by integrating cattle grazing into High Plains row-cropping systems. USDA-NRCS Conservation Innovation Grant. $348,847 requested.

Trostle, C. 2012. Dryland reduced tillage/no tillage cropping sequences for the Texas South Plains. $8,500 (funded from Texas Grain Sorghum Association).

Trostle, C. 2012. Dryland reduced tillage/no tillage cropping sequences for the Texas South Plains. $35,500 (funded from USDA Ogallala Aquifer Project).

West, C. 2012. Calibration and validation of ALMANAC model for growth curves of warm-season grasses under limited water supply. USDA-ARS USDA Ogallala Aquifer Project. $76,395 (funded).

Donations to Project (2005-2012)

2005

City Bank, Lubbock, TX. 2003 GMC Yukon XL. Appraised value $16,500.

2008

July 31, 2008 Field Day sponsors:

Coffey Forage Seeds, Inc.	$500.00
Agricultural Workers Mutual Auto Insurance Co.	$250.00
City Bank	$250.00
Accent Engineering & Logistics, Inc.	$100.00
Bammert Seed Co.	$100.00
Floyd County Supply	$100.00
Plainview Ag Distributors, Inc.	$100.00
Production-Plus+	$100.00

2010

February 3, 2010 Field Day sponsors:

Grain Sorghum Producers	$250.00
D&J Gin, Inc.	$250.00
Ronnie Aston/Pioneer	$500.00
Floyd County Supply	$200.00
Lubbock County	$250.00
City Bank	$250.00
High Plains Underground Water Conservation District	$250.00

August 10, 2010 Field Day sponsors:

Ted Young/Ronnie Aston	$250.00
Netafim USA	$200.00
Smartfield Inc.	$500.00
Floyd County Soil & Water Conservation District #104	$150.00
Grain Sorghum Producers	$500.00

2011

February 24, 2011 Field Day sponsors:

Texas Corn Producers Board	$500.00
West Texas Guar, Inc.	$500.00
Texas Grain Sorghum Producers	$500.00
Happy State Bank	$500.00

August 4, 2011 Field Day sponsors:

Texas Corn Producers Board	$500.00
City Bank	$500.00
Texas Grain Sorghum Producers	$500.00
AquaSpy, Inc.	$250.00
NetaFim USA	$200.00
Panhandle-Plains Land Bank Association, FLCA	$ 50.00

2012

August 4, 2012 Field Day sponsors:

Texas Corn Producers Board	$500.00
City Bank	$500.00
Texas Grain Sorghum Producers	$500.00
AquaSpy, Inc.	$250.00
NetaFim USA	$200.00
Panhandle-Plains Land Bank Association, FLCA	$ 50.00

January 17, 2013 Field Day sponsors:

Texas Corn Producers Board	$500.00
Plains Cotton Growers	$250.00
Grain Sorghum Producers	$250.00
Ronnie Aston	$500.00
Ag Tech	$250.00
Diversified Sub-Surface Irrigation	$500.00

Visitors to the Demonstration Project Sites (2005-2012)

2005

Total Number of Visitors 190

2006

Total Number of Visitors 282

2007

Total Number of Visitors 36

2008

Total Number of Visitors 53

2009

Total Number of Visitors 33

2010

Total Number of Visitors 14 +

2011

Total Number of Visitors 11 +

2012

Total Number of Visitors 15 +

Presentations (2005-2012)

2005

Date	Presentation	Spokesperson
1-Mar	Radio interview (KRFE)	Allen
17-Mar	Radio interview	Kellison
17-May	Radio interview (KFLP)	Kellison
21-Jul	Presentation to Floyd County Ag Comm.	Kellison
17-Aug	Presentation to South Plains Association of Soil & Water Conservation Districts	Kellison
13-Sep	Presentation at Floyd County NRCS FY2006 EQIP meeting	Kellison
28-Sep	Presentation at Floyd County Ag Tour	Kellison/Trostle/Allen
20-Oct	Presentation to Houston Livestock and Rodeo group	Allen/Baker
3-Nov	Cotton Profitability Workshop	Pate/Yates
10-Nov	Presentation to Regional Water Planning Committee	Kellison
16-Nov	Television interview (KCBD)	Kellison
18-Nov	Presentation to CASNR Water Group	Kellison/Doerfert
1-Dec	Radio interview (KRFE)	Kellison
9-Dec	Radio interview (AgriTALK – nationally syndicated)	Kellison
15-Dec	Presentation at Olton Grain Coop Winter Agronomy meeting	Kellison

2006

Date	Presentation	Spokesperson(s)
24-26 Jan	Lubbock Southwest Farm & Ranch Classic	Kellison
6-Feb	Southern Region AAAE Conference: The *value of water: Educational programming to maximize profitability and decrease water consumption* (poster presentation), Charlotte, NC	M. Norton/Doerfert
7-Feb	Radio Interview	Kellison/Baker
2-Mar	South Plains Irrigation Management Workshop	Trostle/Kellison/Orr
30-Mar	Forage Conference	Kellison/Allen/Trostle
19-Apr	Floydada Rotary Club	Kellison
20-Apr	Western Region AAAE Conference: *Conservation outreach communications: A framework for structuring conservation outreach campaigns* (poster presentation), Boise, ID	M. Couts/Doerfert
27-Apr	ICASALS Holden Lecture: *New Directions in Groundwater Management for the Texas High Plains*	Conkwright
18-May	Annual National AAAE Conference: *The value of water: Educational programming to maximize profitability and decrease water consumption* (poster presentation), Charlotte, NC	M. Norton/Doerfert
18-May	Annual National AAAE Conference: *Conservation outreach communications: A framework for structuring conservation outreach campaigns* (poster presentation), Charlotte, NC	M. Couts/Doerfert
15-Jun	Field Day @ New Deal Research Farm	Kellison/Allen/Cradduck/Doerfert
21-Jul	Summer Annual Forage Workshop	Trostle
27-Jul	National Organization of Professional Hispanic NRCS Employees annual training meeting, Orlando, FL	Cradduck (on behalf of Kellison)
11-Aug	2006 Hale County Field Day	Kellison
12-Sep	Texas Ag Industries Association Lubbock Regional Meeting	Doerfert (on behalf of Kellison)
11-Oct	TAWC Producer meeting	Kellison/Pate/Klose/Johnson
2-Nov	Texas Ag Industries Association Dumas Regional Meeting	Kellison
10-Nov	34th Annual Banker's Ag Credit Conference	Kellison
14-Nov	Interview w/Alphaeus Media	Kellison
28-Nov	Amarillo Farm & Ranch Show	Doerfert
8-Dec	2006 Olton Grain COOP Annual Agronomy Meeting	Kellison/Trostle
12-Dec	Swisher County Ag Day	Kellison/Yates
12-Dec	2006 Alfalfa and Forages Clinic, Colorado State University	Allen

2007

Date	Presentation	Spokesperson(s)
11-Jan	Management Team meeting (Dr. Jeff Jordan, Advisory Council in attendance)	
23—25 Jan	2007 Southwest Farm & Ranch Classic, Lubbock, TX	Kellison/Doerfert
6-Feb	Cow/Calf Beef Producer Meeting at Floyd County Unity Center	Allen
8-Feb	Management Team meeting	
13-Feb	Grower meeting, Clarendon, TX	Kellison
26-Feb	Silage workshop, Dimmitt, TX	
8-Mar	Management Team meeting	
21-Mar	Silage Workshop, Plainview, TX	Kellison/Trostle
22-Mar	Silage Workshop, Clovis, NM	Kellison/Trostle
30-Mar	Annual Report review meeting w/Comer Tuck, Lubbock, TX	
2-Apr	TAWC Producer meeting, Lockney, TX	
11-Apr	Texas Tech Cotton Economics Institute Research/Extension Symposium	Johnson
12-Apr	Management Team meeting	
21-Apr	State FFA Agricultural Communications Contest, Lubbock, TX (100 high school students)(mock press conf. based on TAWC info)	Johnson
7-May	The Lubbock Round Table meeting	Kellison
9-May	Area 7 FFA Convention, Texas State University, San Marcos, TX (distributed 200 DVD and info sheets)	Baker
10-May	Management Team meeting	
12-May	RoundTable meeting, Lubbock Club	Allen
15—17-May	21st Biennial Workshop on Aerial Photog., Videography, and High Resolution Digital Imagery for Resource Assessment: *Calibrating aerial imagery for estimating crop ground cover,* Terre Haute, IN	Rajan
30-May	Rotary Club (about 100 present)	Allen
7-Jun	Lubbock Economic Development Association	Baker
14-Jun	Management Team meeting	
18-Jun	Meeting with Senator Robert Duncan	Kellison
10-Jul	Management Team meeting	
24—26-Jul	Universities Council on Water Resources (UCOWR)/National Institutes for Water Resources (NIWR) Annual Conference: *Political and civic engagement of agriculture producers who operate in selected Idaho and Texas counties dependent on irrigation*, Boise, ID	Doerfert
30-Jul—3-Aug	Texas Vocational Agriculture Teachers' Association Annual Conference, Arlington, TX (distributed 100 DVDs)	Doerfert
9-Aug	Management Team meeting	

Date	Presentation	Spokesperson(s)
10-Aug	Texas South Plains Perennial Grass Workshop, Teeter Farm & Muncy Unity Center	Kellison/Trostle
13—15-Aug	International Symposium on Integrated Crop-Livestock Systems conference, Universidade Federal do Parana in Curitiba, Brazil	(Presentation made on behalf of Allen)
13—14-Aug	2007 Water Research Symposium: *Comparison of water use among crops in the Texas High Plains estimated using remote sensing,* Socorro, NM	Rajan
14—17-Aug	Educational training of new doctoral students, Texas Tech campus, Lubbock, TX (distributed 17 DVDs)	Doerfert
23-Aug	Cattle Feeds and Mixing Program	
12-Sep	West Texas Ag Chem Conference	Kellison
18-Sep	Floyd County Farm Tour	Trostle
20-Sep	Management Team meeting	
1-Oct	Plant & Soil Science Departmental Seminar: *Overview and Initial Progress of the Texas Alliance for Water Conservation Project*	Kellison
8-Oct	Plant & Soil Science Departmental Seminar: *Estimating ground cover of field crops using multispectral medium, resolution satellite, and high resolution aerial imagery*	Rajan
11-Oct	Management Team meeting	
4—8-Nov	American Society of Agronomy Annual meetings: *Using remote sensing and crop models to compare water use of cotton under different irrigation systems* (poster presentation), New Orleans, LA	Rajan
4—8-Nov	American Society of Agronomy Annual meetings: *Assessing the crop water use of silage corn and forage sorghum using remote sensing and crop modeling*, New Orleans, LA	Rajan
7—9-Nov	National Water Resources Association Annual Conference, Albuquerque, NM	Bruce Rigler (HPUWCD #1)
8-Nov	Management Team meeting (Comer Tuck in attendance)	
12—15-Nov	American Water Resources Association annual meeting: *Considering conservation outreach through the framework of behavioral economics: a review of literature* (poster presentations), Albuquerque, NM	M. Findley/Doerfert
12—15-Nov	American Water Resources Association annual meeting: Ho*w do we value water? A multi-state perspective* (poster presentation), Albuquerque, NM	L. Edgar/Doerfert
16-Nov	Water Conservation Advisory Council meeting, Austin, TX	Allen
19-Nov	Plant & Soil Science Departmental Seminar: *Finding the legume species for West Texas which can improve forage quality and reduce water consumption*	Cui
27—29-Nov	Amarillo Farm Show, Amarillo, TX	Doerfert/Leigh/Kellison
2—4-Dec	Texas Water Summit, San Antonio, TX	Allen
13-Dec	Management Team meeting	

2008

Date	**Presentation**	**Spokesperson(s)**
8-11-Jan	Beltwide Cotton Conference Proceedings: *Energy Analysis of Cotton Production in the Southern High Plains of Texas,* Nashville, TN	Johnson/Weinheimer
10-Jan	Management Team meeting	
1-Feb	Southwest Farm and Ranch Classic, Lubbock	Kellison
14-Feb	Management Team meeting (Weinheimer presentation)	
14-Feb	TAWC Producer Board meeting	Kellison
5-Mar	Floydada Rotary Club	Kellison
13-Mar	Management Team meeting	
25-Mar	National SARE Conference: New American Farm Conference: *Systems Research in Action,* Kansas City, MO	Allen
27-Mar	Media training for TAWC Producer Board	Doerfert/Kellison
Apr	Agricultural Economics Seminar: *Transitions in Agriculture,* Texas Tech University	Weinheimer
10-Apr	Management Team meeting	
5-May	Pasture and Forage Land Synthesis Workshop: *Integrated forage-livestock systems research*, Beltsville, MD	Allen
8-May	Management Team meeting	
9-Jun	Walking tour of New Deal Research farm	Allen/Kellison/Li/Cui/Cradduck
10-12-Jun	Forage Training Seminar: *Agriculture and land use changes in the Texas High Plains*, Cropland Genetics, Amarillo	Allen
12-Jun	Management Team meeting	
14-Jul	Ralls producers	Kellison
14-Jul	Water and the AgriScience Fair Teacher and Student Workshops	Kellison/Brown/Cradduck
15-Jul	Pioneer Hybrids Research Directors	Kellison
20-23-July	9th International Conference on Precision Agriculture, Denver, CO	Rajan
31-Jul	TAWC Field Day	all
8-Aug	TAWC Producer Board meeting	
12-Aug	Pioneer Hybrids Field Day	Kellison
9-Sep	Texas Ag Industries Association, Lubbock regional meeting	Allen
11-Sep	Management Team meeting	
16-Sep	Mark Long, TDA President, Ben Dora Dairies, Amherst, TX	Kellison/Trostle/ Cradduck
5-9-Oct	American Society of Agronomy Annual meeting, Houston	Rajan
8-Oct	American Society of Agronomy Annual meeting, Houston	Maas
15-Oct	State Energy Conservation Office (SECO) meeting	
Date	**Presentation**	**Spokesperson(s)**

16-Oct	Management Team meeting	
17-Oct	Thesis defense: *A Qualitative Investigation of the Factors that Influence Crop Planting and Water Management in West Texas*.	Leigh
20-Oct	Farming with Grass conference, Soil and Water Conservation Society, Oklahoma City, OK	Allen
23-Oct	Thesis defense: *Farm Level Financial Impacts of Water Policy on the Southern Ogallala Aquifer*	Weinheimer
13-Nov	Management Team meeting (Weinheimer presentation)	
17-20-Nov	American Water Resources Association Conference: *Farm-based water management research shared through a community of practice model*, New Orleans, LA	Leigh
17-20-Nov	American Water Resources Association Conference: *The critical role of the community coordinator in facilitating an agriculture water management and conservation community of practice*, New Orleans, LA	Wilkinson
17-20-Nov	American Water Resources Association Conference: *An exploratory analysis of the ruralpolitan population and their attitudes toward water management and conservation* (poster presentation), New Orleans, LA	Newsom
17-20-Nov	American Water Resources Association Conference: *Developing tomorrow's water researchers today* (poster presentation), New Orleans, LA	C. Williams
19-Nov	TTU GIS Open House	Barbato
Dec	Panhandle Groundwater District: *Farm Level Financial Impacts of Water Policy on the Southern Ogallala Aquifer,* White Deer, TX	Johnson/Weinheimer
2-4-Dec	Amarillo Farm Show	Doerfert
3-Dec	Dr. Todd Bilby, Ellen Jordan, Nicholas Kenny, Dr. Amosson (discussion of water/crops/cattle), Amarillo	Kellison
6-Dec	Lubbock RoundTable	Kellison
6-7-Dec	Meeting regarding multi-institutional proposal to target a future USDA RFP on water management, Dallas	Doerfert
11-Dec	Management Team meeting	
12-Dec	Olton CO-OP Producer meeting	Kellison
19-Dec	TAWC Producer meeting	Kellison/Schur/ Cradduck/Weinheimer

2009

Date	Presentation	Spokesperson
15-Jan	Management Team meeting	
21-Jan	Caprock Crop Conference	Kellison
27-29 -Jan	Southwest Farm & Ranch Classic (TAWC booth), Lubbock	Doerfert/Jones/Wilkinson/ Williams
27-Jan	Southwest Farm & Ranch Classic: *Managing Wheat for Grain*, Lubbock	Trostle
27-Jan	Southwest Farm & Ranch Classic: *2009 Planting Decisions – Grain Sorghum and Other Alternatives*, Lubbock	Trostle
28-Jan	Southwest Farm & Ranch Classic: *Profitability Workshop*, Lubbock	Yates/Pate
Feb	Floyd County crop meetings, Muncy	Trostle
Feb	Hale County crop meetings, Plainview	Trostle
12-Feb	Management Team meeting	
17-Feb	Crops Profitability workshops, AgriLife Extension and Research Center, Lubbock	Yates/Trostle
5-Mar	Crops Profitability workshops, AgriLife Extension and Research Center, Lubbock	Yates/Trostle
12-Mar	Management Team meeting	
1-Apr	Texas Tech Cotton Economics Institute Research Institutes 9th Annual Symposium (CERI): *Water Policy Impacts on High Plains Cropping Patterns and Representative Farm Performance*, Lubbock	Johnson/Weinheimer
9-Apr	Management Team meeting	
15-Apr	Texas Tech Forage Class	Kellison
21-Apr	Presentation to High Plains Underground Water District Board of Directors	Kellison
14-May	Management Team meeting	
27-May	Consortium for Irrigation Research and Education conference, Amarillo	Kellison
11-Jun	Management Team meeting	
22-24-Jun	Joint Meeting of the Western Society of Crop Science and Western Society of Soil Science: *Evaluation of the bare soil line from reflectance measurements on seven dissimilar soils* (poster presentation), Ft. Collins, CO	Rajan
26-Jun	Western Agricultural Economics Association: *Economics of State Level Water Conservation Goals*, Kauai, HI	Weinheimer/Johnson
7-Jul	Universities Council of Water Resources: *Water Policy in the Southern High Plains: A Farm Level Analysis*, Chicago, IL	Weinheimer/Johnson
9-Jul	Management Team meeting	
27-31 –Jul	Texas Agriscience Educator Summer Conference, Lubbock	Doerfert/Jones
6-Aug	Management Team meeting	
17-19–Aug	TAWC NRCS/Congressional tour and presentations, Lubbock, New Deal & Muncy	TAWC participants
27-Aug	Panhandle Association of Soil and Water Conservation Districts	Kellison
10-Sep	Management Team meeting	
8-Oct	Management Team meeting	
9-Oct	Presentation to visiting group from Colombia, TTU campus, Lubbock	Kellison

Date	Presentation	Spokesperson(s)
13-Oct	Briscoe County Field day, Silverton, TX	Kellison
1-5-Nov	Annual Meetings of the American Society of Agronomy, oral presentations: *Evapotranspiration of Irrigated and Dryland Cotton Fields Determined Using Eddy Covariance and Penman-Monteith Methods,* and *Relation Between Soil Surface Resistance and Soil Surface Reflectance,* poster presentation: *Variable Rate Nitrogen Application in Cotton Using Commercially Available Satellite and Aircraft Imagery,"* Pittsburgh, PA	Maas/Rajan
10-12-Nov	Cotton Incorporated Precision Agriculture Workshop: *Biomass Indices*, Austin, TX	Rajan/Maas
12-Nov	Management Team meeting	
Dec	United Farm Industries Board of Directors: *Irrigated Agriculture,* Lubbock	Johnson/Weinheimer
Dec	Fox 34 TV interview, Ramar Communications, Lubbock	Allen
1-3-Dec	Amarillo Farm Show, Amarillo	Doerfert/Jones/Oates/ Kellison
3-Dec	Management Team meeting	
10-Dec	TAWC Producer Board meeting, Lockney	Kellison/Weinheimer/Maas
14-Dec	Round Table meeting with Todd Staples, Lubbock, TX	Kellison
12-18 –Dec	Fall meeting, American Geophysical Union: *Vegetation cover mapping at multiple scales using MODIS, Landsat, RapidEye, and Aircraft imageries in the Texas High Plains,* San Francisco, CA	Rajan/Maas

2010

Date	Presentation	Spokesperson(s)
4-7-Jan	Beltwide Cotton Conference: *Energy and Carbon: Considerations for High Plains Cotton*, New Orleans, LA	Yates/Weinheimer
14-Jan	TAWC Management Team meeting	
3-Feb	TAWC Farmer Field Day, Muncy, TX	TAWC participants
6-9-Feb	Southern Agricultural and Applied Economics Association annual meeting: *Macroeconomic Impacts on Water Use in Agriculture*, Orlando, FL	Weinheimer
9-11-Feb	Southwest Farm & Ranch Classic (TAWC booth), Lubbock	Doerfert/Jones/Frederick
10-Feb	Southwest Farm & Ranch Classic, Lubbock	Kellison/Yates/Trostle/Maas
11-Feb	TAWC Management Team meeting	
9-March	TAWC Producer Board Meeting, Lockney	TAWC participants
11-March	TAWC Management Team meeting	
31-March	Texas Tech Forage Class	Kellison
8-April	TAWC Management Team meeting	
13-April	Matador Land & Cattle Co., Matador, TX	Kellison
13-May	TAWC Management Team meeting	
10-June	TAWC Management Team meeting	
30-June	TAWC Grower Technical Working Group meeting, Lockney	Glodt/Kellison
8-July	TAWC Management Team meeting	
9-July	Southwest Council on Agriculture annual meeting, Lubbock	Doerfert/Sell/Kellison
15-July	Universities Council on Water Resources (UCOWR): *Texas Alliance for Water Conservation: An Integrated Approach to Water Conservation*, Seattle, WA	Weinheimer
25-27-July	American Agricultural Economics Association annual meeting: *Carbon Footprint: A New Farm Management Consideration on the Southern High Plains,* Denver, CO	Weinheimer
27-July	Tour for Cotton Incorporated group, TAWC Sites	Kellison/Maas
August	Ag Talk on FOX950 am radio show	Weinheimer
10-Aug	TAWC Field day, Muncy, TX	TAWC participants
12-Aug	TAWC Management Team meeting	
30-Aug	Tour/interviews for SARE film crew, TTU campus, New Deal and TAWC Sites	TAWC participants
9-Sept	TAWC Management Team meeting	
14-Sept	Floyd County Farm Tour, Floydada, TX	Kellison
14-Oct	TAWC Management Team meeting	
27-Oct	Texas Agricultural Lifetime Leadership Class XII	Kellison

Date	**Presentation**	**Spokesperson(s)**
31-Oct—3-Nov	Annual Meetings of the American Society of Agronomy: *Carbon fluxes from continuous cotton and pasture for grazing in the Texas High Plains,* Long Beach, CA	Rajan/Maas
31-Oct—3-Nov	Annual Meetings of the American Society of Agronomy: *Closure of surface energy balance for agricultural fields determined from eddy covariance measurements,* Long Beach, CA	Maas/Rajan
8-Nov	Fox News interview	Kellison
8-Nov	Fox 950 am radio interview	Doerfert
9-Nov	Texas Ag Industries Association Regional Meeting, Dumas, TX	Kellison
18-Nov	TAWC Management Team meeting	
19-Nov	North Plains Water District meeting, Amarillo, TX	Kellison/Schur
1-3-Dec	Amarillo Farm & Ranch Show (TAWC booth), Amarillo	Doerfert/Zavaleta/Graber
9-Dec	TAWC Management Team meeting	
12-18-Dec	American Geophysical Union fall meeting: *Vegetation cover mapping at multiple scales using MODIS, Landsat, RapidEye, and Aircraft imageries in the Texas High Plains*, San Francisco, CA	Rajan/Maas

2011

Date	Presentation	Spokesperson(s)
13-Jan	High Plains Irrigation Conference	Kellison
13-Jan	TAWC Management Team meeting	
18-Jan	Fox Talk 950 AM radio interview	Doerfert/Graber/Sullivan
24-Jan	Wilbur-Ellis Company	Kellison
25-Jan	Caprock Crop Conference	Kellison
4-Feb	KJTV-Fox 34 Ag Day news program: *TAWC rep discusses optimal irrigation, Field Day preview*, Lubbock, TX	Glodt
6-8-Feb	American Society of Agronomy Southern Regional Meeting: *Seasonal Ground Cover for Crops in The Texas High Plains*, Corpus Christi, TX	Maas/Rajan
7-Feb	KJTV-Fox 34 Ag Day news program: *Risk management specialist gives best marketing options for your crop*, Lubbock, TX	Yates
8-Feb	KJTV-Fox 34 Ag Day news program: *Producer Glenn Schur shares his water conservation tips*, Lubbock, TX	Schur
8-10-Feb	Southwest Farm & Ranch Classic (TAWC booth), Lubbock, TX	Doerfert/Graber/Sullivan
9-Feb	Southwest Farm & Ranch Classic: *Managing Warm Season Annual Forages on the South Plains*, Lubbock, TX	Trostle
9-Feb	KJTV-Fox 34 Ag Day news program: *Rep of the HPWD discusses possible water restrictions*, Lubbock, TX	Carmon McCain
10-Feb	Hale County Crops meeting, Plainview, TX	Trostle
17-Feb	TAWC Management Team meeting	
23-Feb	Pioneer Hybrids	Kellison
24-Feb	2011 Production Agriculture Planning Workshop, Muncy, TX	TAWC participants
25-Feb	KJTV-Fox 34 Ag Day news program: *Producers gain knowledge about water conservation at TAWC Field Day*, Lubbock, TX	Doerfert
4-Mar	Texas Tech Forage class	Kellison
10-Mar	TAWC Management Team meeting (Maas presentation)	
30-Mar	West Texas Mesonet (Wes Burgett), TTU Reese Center, Lubbock, TX	Kellison/Brown/Maas/Rajan /Weinheimer
31-Mar—1-Apr	Texas Cotton Ginners Show (TAWC booth), Lubbock, TX	Doerfert/Graber/Sullivan
13-Apr	USDA-ARS/Ogallala Aquifer project (David Brauer), Lubbock, TX	Kellison/TAWC participants
13-Apr	KJTV-Fox 34 Ag Day news program: *TAWC introduces solution tools for producers*, Lubbock, TX	Weinheimer
14-Apr	TAWC Management Team meeting	

Date	**Presentation**	**Spokesperson(s)**
18-Apr	KJTV-Fox 34 Ag Day news program: *Cotton overwhelmingly king this year on South Plains*, Lubbock, TX	Boyd Jackson
18-Apr	KJTV-Fox 34 Ag Day news program: *Specialty, rotation crops not popular this growing season*, Lubbock, TX	Trostle
12-May	TAWC Management Team meeting	
17-May	KJTV-Fox 34 Ag Day news program: *Tools available to maximize irrigation efficiency*, Lubbock, TX	Kellison
18-May	Floydada Rotary Club, Floydada, TX	Kellison
9-Jun	TAWC Management Team meeting	
29-Jun—2-Jul	Joint meetings of the Western Agricultural Economics Association/Canadian Agricultural Economics Society: *Evaluating the Implications of Regional Water Management Strategies: A Comparison of County and Farm Level Analysis,* Banff, Alberta, Canada	Weinheimer
12-14-Jul	UCOWR/NIWR Conference: *Texas Alliance for Water Conservation: An Innovative Approach to Water Conservation: An Overview,* Boulder, CO	Kellison
12-14-Jul	UCOWR/NIWR Conference: *Sunflowers as an Alternative Irrigated Crop on the Southern High Plains*, Boulder, CO	Pate
12-14-Jul	UCOWR/NIWR Conference: *Economic Considerations for Water Conservation: The Texas Alliance for Water Conservation,* Boulder, CO	Weinheimer
12-14-Jul	UCOWR/NIWR Conference: *Determining Crop Water Use in the Texas Alliance for Water Conservation Project*, Boulder, CO	Maas
12-14-Jul	UCOWR/NIWR Conference: *What We Know About Disseminating Water Management Information to Various Stakeholders*, Boulder, CO	Doerfert
12-14-Jul	UCOWR/NIWR Conference: *Assessment of Improved Pasture Alternatives on Texas Alliance for Water Conservation,* Boulder, CO	Kellison
12-14-Jul	UCOWR/NIWR Conference: *Integrating forages and grazing animals to reduce agricultural water use*, Boulder, CO	Brown
21-Jul	TAWC Management Team meeting	
4-Aug	KXDJ-FM news radio interview	Weinheimer
4-Aug	TAWC Field Day, Muncy, TX	TAWC participants
11-Aug	TAWC Management Team meeting	
1-Sep	KJTV-Fox 34 Ag Day news program: *High Plains producers struggling to conserve water in drought*, Lubbock, TX	Boyd Jackson
5-Sep	KJTV-Fox 34 Ag Day news program: *New ideas, concepts emerging from surviving historic drought,* Lubbock, TX	Kellison
8-Sep	TAWC Management Team meeting (Brown presentation)	
29-Sep	Texas & Southwestern Cattle Raiser Association Fall meeting, Lubbock, TX	Kellison
13-Oct	TAWC Management Team meeting (Maas presentation)	

Date	Presentation	Spokesperson(s)
16-19-Oct	Annual Meetings of the American Society of Agronomy: *Satellite-based irrigation scheduling*, San Antonio, TX	Maas/Rajan
16-19-Oct	Annual Meetings of the American Society of Agronomy: *Comparison of carbon, water and energy fluxes between grassland and agricultural ecosystems*, San Antonio, TX	Maas/Rajan
16-19-Oct	Annual Meetings of the Soil Science Society of America: *CO2 and N2O Fluxes in Integrated Crop Livestock Systems* (poster presentation), San Antonio, TX	Lisa Fultz/Marko Davinic/Jennifer Moore-Kucera
16-19-Oct	Annual Meetings of the Soil Science Society of America: *Dynamics of Soil Aggregation and Carbon in Long-Term Integrated Crop-Livestock Agroeceosystems in the Southern High Plains* (poster presentation), San Antonio, TX	Lisa Fultz/Marko Davinic/Jennifer Moore-Kucera
16-19-Oct	Annual Meetings of the Soil Science Society of America: *Long-Term Integrated Crop-Livestock Agroecosystems and the Effect on Soil Carbon* (poster presentation), San Antonio, TX.	Lisa Fultz/Marko Davinic/Jennifer Moore-Kucera
16-19-Oct	Annual Meetings of the Soil Science Society of America: *Soil Microbial Dynamics in Alternative Cropping Systems to Monoculture Cotton in the Southern High Plains*, San Antonio, TX.	Marko Davinic/Lisa Fultz/Jennifer Moore-Kucera
16-19-Oct	Annual Meetings of the Soil Science Society of America: *Soil Fungal Community and Functional Diversity Assessments of Agroecosystems in the Southern High Plains*, San Antonio, TX.	Marko Davinic/Lisa Fultz/Jennifer Moore-Kucera
16-19-Oct	Annual Meetings of the Soil Science Society of America: *Aggregate Stratification Assessment of Soil Bacterial Communities and Organic Matter Composition: Coupling Pyrosequencing and Mid-Infrared Spectroscopy Techniques*, San Antonio, TX.	Marko Davinic/Lisa Fultz/Jennifer Moore-Kucera
6-10-Nov	47th Annual American Water Resources Association: *The Use of Communication Channels Including Social Media Technology by Agricultural Producers and Stakeholders in the State of Texas*, Albuquerque, NM	Doerfert/Graber
6-10-Nov	47th Annual American Water Resources Association: *What We Know About Disseminating Water Management Information to Various Stakeholders*, Albuquerque, NM	Doerfert, et al.
6-10-Nov	47th Annual American Water Resources Association: *The Water Management and Conservation Instructional Needs of Texas Agriculture Science Teachers*, Albuquerque, NM	Doerfert/Sullivan
6-10-Nov	47th Annual American Water Resources Association: *The Attitudes and Opinions of Agricultural Producers Toward Sustainable Agriculture on the High Plains of Texas*, Albuquerque, NM	Doerfert, et al.
6-10-Nov	47th Annual American Water Resources Association: *The Issues That Matter Most to Agricultural Stakeholders: A Framework for Future Research* (poster presentation), Albuquerque, NM	Sullivan/Doerfert, et al.
10-Nov	TAWC Management Team meeting	
18-Nov	39th Annual Bankers Agricultural Credit Conference, Lubbock, TX	Kellison
22-Nov	KJTV 950 AM AgTalk radio interview	Trostle
29-Nov—1-Dec	Amarillo Farm Show (TAWC booth), Amarillo, TX	Doerfert/Graber/Sullivan/Kellison /Borgstedt
7-Dec	Plainview Lions Club, Plainview, TX	Kellison
8-Dec	TAWC Management Team meeting	
13-Dec	Channel Bio Water Summit (TAWC booth), Amarillo, TX	Borgstedt/Sullivan/Graber

2012

Date	Presentation	Spokesperson(s)
6-Mar	Lubbock Kiwanis Club	Kellison
7-Mar	Monthly Management Team Meeting	Kellison
23-Mar	New Mexico Ag Bankers Conference	Kellison, Klose
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
19-June	Lloyd Author Farm	Kellison
20-June	Blake Davis Farm	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
27-28-Nov	Amarillo Farm & Ranch Show	Borgstedt/Doerfert/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

Date	Presentation	Spokesperson(s)
3-Jan	KFLP Radio	Kellison
7-9-Jan	Beltwide Cotton Conference	Doerfert
15-Jan	Fox 950 AM	Doerfert
4-Feb	Texas Seed Trade Association	Kellison
14-Feb	Monthly Management Team meeting	Kellison
21-Mar	Monthly Management Team meeting	Kellison
29-30-Mar	Texas Gin Association Convention	Borgstedt/Doerfert
11-Apr	Monthly Management Team meeting	Kellison

Related Non-Refereed Publications (2005-2012)

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Doerfert, D., V. Allen, W. Cradduck, and R. Kellison. 2007. Forage sorghum production in the Southern Plains Region. Texas Alliance for Water Conservation, Summary of Research. Vol. 1, No. 1. Texas Tech Univ., Lubbock, TX.

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Rajan, N., and S. J. Maas. 2008. Comparison of PVI and NDVI for estimating crop ground cover for precision agriculture applications. In Proc., 9th International Conference on Precision agriculture. 20-23 July, Denver, CO. (CD-ROM)

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Weinheimer, J., N. Rajan, P. Johnson, and S.J. Maas. 2010. Carbon footprint: A new farm management consideration in the Southern High Plains. Selected paper, Agricultural & Applied Economics Association Annual Meeting. July 25-27, Denver, CO.

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Rajan, N., M. Roy, S. J. Maas and F.M. Padilla. 2012. Soil background effects on reflectance-based estimates of leaf area index of cotton. Abstracts, Annual Meetings, Amer. Soc. Agronomy. October, Cincinnati, OH. (abstract) CD-ROM.

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