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

7TH ANNUAL REPORT

TO THE

TEXAS WATER DEVELOPMENT BOARD

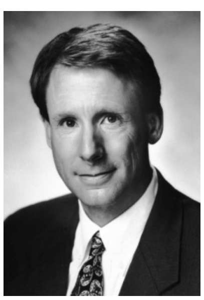
Texas Alliance For Water Conservation

TAWC

“Water is Our Future”

MAY 1, 2012

TEXAS ALLIANCE FOR WATER CONSERVATION PARTICIPANTS:



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 depend 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, chair-elect, 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 Manager serves in an *ex officio* capacity on the Producer Board. Meetings of the Producer Board of Directors are on an as need basis to carry out the responsibilities of the project and occur at least 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 2011 Participants

Texas Tech University
Rick Kellison, Project Director*
Dr. Vivien Gore Allen*
Mr. Philip Brown*
Dr. David Doerfert*
Dr. Phil Johnson*
Dr. Stephan Maas*
Dr. Eduardo Segarra*
Mr. Tom Sell*
Dr. Justin Weinheimer
Dr. Jeff Johnson
Ms. Samantha Borgstedt,
Communications Director
Ms. Angela Beikmann,*
Secretary/Bookkeeper

Texas AgriLife Extension
Dr. Steven Klose*
Mr. Jeff Pate*
Dr. Calvin Trostle*
Mr. Jay Yates*
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Gerald Crenwelge

USDA - Natural Resource Conservation Service
Mr. Monty Dollar (retired)*

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

Producer Board Chairman
Mr. Glenn Schur*

Graduate Research Assistants (past and present)
Rebekka Martin (completed 2005)
Pamela Miller (completed 2006)
Nithya Rajan (completed 2007)
Paul Braden (completed 2007)
Jurahee Jones (completed 2007)
Justin Weinheimer (completed 2008)
Katie Leigh (completed 2008)
Heather Jones (completed 2010)
Yue Li (completed 2011)
Lindsay Graber (completed 2011)
Song Cui (completed 2011)
Swetha Dorbala
Morgan Newsom
Jarrott Wilkinson
Rachel Oates
Cody Zilverberg
Jennifer Zavaleta
Nichole Sullivan
Lisa Fultz
Marko Davinic
Melissa Muharam

* Indicates Management Team member

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

BACKGROUND

The Texas High Plains currently generates a combined annual economic value of crops and livestock that exceeds $5.6 billion ($1.1 crops; $4.5 livestock; TASS, 2004) but is highly dependent on water from the Ogallala Aquifer. Ground water supplies are declining in this region (TWDB, 2007) while costs of energy required to pump water are escalating. Improved irrigation technologies including low energy precision application (LEPA) and sub-surface drip (SDI) irrigation have increased water use 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 fuels, 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. Increasing grain prices, fertilizer costs, and uncertain energy costs are driving changes in this region as well as increasing water scarcity.

Diversified systems that include both crops and livestock have long been known for complimentary effects that increase productivity. Research conducted at Texas Tech over the past ten years has shown that an integrated cotton/forage/beef cattle system, compared with a 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; 2007; 2008). At cotton yields average for irrigated cotton in the region, profitability was greater for the integrated system than a cotton monoculture. 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). This ongoing replicated research provided originally the information for designing the demonstration project and now provides the basis for interpretation of results from the demonstration project. Together, the demonstration sites coupled with the replicated research are providing a uniquely validated approach to discovery and implementation of solutions to preserving and protecting our water resource while offering viable agricultural solutions to the Texas High Plains and beyond.

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, the technology to accomplish, and the impact of water conservation on regional stability and economics. 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 work on this 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.

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. Due to recent developments results of this study assist area producers in meeting the requirements of the ground water districts new water restrictions and conservation rules being implemented. Currently this project is funded to include the production years 2005-2013.

Report of The First Seven Years

In the first year of any demonstration or research project, the data should be interpreted with caution. As systems are begun and data collection is initiated, there are also many factors that do not function as they will over more time when everything becomes a mature system with data gathering techniques well developed. For each added year of reporting, some data will be missing because there is only a partial years accounting or because some data are not yet complete. However, because 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.

Because this project uses existing farming systems that were already functioning at the beginning of the project, the startup time was minimized and even in the first year, interesting data emerged that had meaningful interpretations. These data become more robust and meaningful with each additional year's data.

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 are subject to change from year to year as producers strive to address changes in market opportunities, weather, commodity prices, and other factors that influence their decisions. This project allows us to measure, monitor, and document the effects of these decisions. As this project progresses, it is providing a valuable measure of changes in agricultural practices in this region and the information to interpret what is driving these changes.

Sites were picked originally 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 represent a range from monoculture cropping practices, integrated cropping systems, integrated crop and livestock systems, and all forage/livestock systems. Irrigation practices include subsurface drip, center pivot, furrow, and dryland systems.

It is important to recognize that these data and their interpretations are based on certain assumptions. These assumptions are critical to being able to compare information across the different sites involved in this demonstration project. These assumptions are necessary to avoid differences that would be unique to a particular producer or site that have nothing to do with understanding how these systems function. Thus, we have adopted certain constants across all systems such as pumping depth of wells to avoid variables that do not influence system behavior but would bias economic results. 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 the specific location. Actual economic returns for each site are also being calculated and made available to the individual producer but are not a part of this report.

ASSUMPTIONS OF DATA COLLECTION AND INTERPRETATION

1. Although actual depth to water in wells located among the 26 sites varies, a pumping depth of 260 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. 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. In 2009, prices of electricity decreased compared with the previous two years, reflecting the decline in crude oil prices.

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 ASSUMPTIONS (TERM DEFINITIONS ON PAGE 227)

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

Table 1. Electricity irrigation cost parameters for 2005, 2006, 2007, 2008, 2009, 2010 and 2011.

Item	2005	2006	2007	2008	2009	2010	2011
Gallons per minute (gpm)							
Gallons per minute (gpm)	450	450	450	450	450	450	450
Pumping lift (feet)	260	250	252	254	256	285	290
Discharge Pressure (psi)	15	15	15	15	15	15	15
Pump efficiency (%)	60	60	60	60	60	60	60
Motor Efficiency (%)	88	88	88	88	88	88	88
Electricity Cost per kWh	$0.085	$0.09	$0.11	$0.14	$0.081	$0.086	$0.090
Cost of Electricity per Ac. In.	$4.02	$4.26	$5.06	$6.60	$3.78	$4.42	$4.69
Cost of Maintenance and Repairs per Ac. In.	$2.05	$2.07	$2.13	$2.45	$3.37	$3.49	$4.15
Cost of Labor per Ac. In.	$0.75	$0.75	$0.80	$0.90	$0.90	$0.90	$0.90
Total Cost per Ac. In.	$6.82	$7.08	$7.99	$9.95	$8.05	$8.81	$9.74

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

Table 2. Commodity prices for 2005, 2006, 2007, 2008, 2009, 2010 and 2011.

Commodity	2005	2006	2007	2008	2009	2010	2011
Cotton lint ($/lb)	$0.54	$0.56	$0.58	$0.55	$0.56	$0.75	$0.90
Cotton seed ($/ton)	$100.00	$135.00	$155.00	$225.00	$175.00	$150.00	$340.00
Grain Sorghum – Grain ($/cwt)	$3.85	$6.10	$5.96	$7.90	$6.48	$9.51	$9.75
Corn – Grain ($/bu)	$2.89	$3.00	$3.69	$5.71	$3.96	$5.64	$5.64
Corn – Food ($/bu)	$3.48	$3.55	$4.20	$7.02	$5.00	$4.88	$7.50
Wheat – Grain ($/bu)	$2.89	$4.28	$4.28	$7.85	$5.30	$3.71	$5.75
Sorghum Silage ($/ton)	$20.19	$18.00	$18.00	$25.00	$24.00	$24.00	$24.00
Corn Silage ($/ton)	$20.12	$22.50	$25.00	$25.00	$42.90	$43.50	$43.50
Wheat Silage ($/ton)	$18.63	$22.89	$22.89	$29.80	$26.59	$26.59	$26.59
Oat Silage ($/ton)	-	$17.00	$17.00	-	$14.58	-	-
Millet Seed ($/lb)	$0.17	$0.17	$0.22	$0.25	-	$0.25	$0.25
Sunflowers ($/lb)	$0.21	$0.21	$0.21	$0.29	$0.27	-	-
Alfalfa ($/ton)	$130.00	$150.00	$150.00	$160.00	$160.00	$185.00	$350.00
Hay ($/ton)	$60.00	$60.00	$60.00	$60.00	$60.00	-	-
WWB Dahl Hay ($/ton)	$65.00	$65.00	$90.00	$90.00	-	$60.00	$200.00
Hay Grazer ($/ton)	-	$110.00	$110.00	$70.00	$110.00	$65.00	$65.00
Sideoats Seed ($/lb)	-	-	$6.52	$6.52	$3.90	$8.00	$5.70
Sideoats Hay ($/ton)	-	-	$64.00	$64.00	$70.00	$60.00	$220.00

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

4. Other variable and fixed costs are given for 2005 through 2011 in Table 3.

Table 3. Other variable and fixed costs for 2005, 2006, 2007, 2008, 2009, 2010 and 2011.

VARIABLE COSTS	2005	2006	2007	2008	2009	2010	2011
Boll weevil assessment: ($/ac)							
Irrigated cotton	$12.00	$12.00	$12.00	$1.50	$1.00	$1.00	$1.00
Dryland cotton	$6.00	$6.00	$6.00	$1.50	$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
Dryland cotton	$12.25	$12.25	$12.25	$12.25	$12.25	$12.25	$20.00
Irrigated corn	$15.00	$15.00	$15.00	$15.00	$15.00	$15.00	$15.00
Cotton harvest – strip and module ($/lint lb)	$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	$1.95
Bags, Ties, & Classing ($/480 lb bale)	$17.50	$19.30	$17.50	$18.50	$18.50	$18.50	$18.50

FIXED COSTS	2005	2006	2007	2008	2009	2010	2011
Irrigation system:							
Center Pivot system	$33.60	$33.60	$33.60	$33.60	$33.60	$40.00	$40.00
Drip system	$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
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
Irrigated corn silage, corn grain, and alfalfa.	$75.00	$75.00	$75.00	$100.00	$100.00	$140.00	$140.00
Dryland cropland	$15.00	$15.00	$15.00	$25.00	$25.00	$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.

WEATHER DATA

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 1 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 4, is the actual mean of precipitation recorded at the 26 sites during 2005 but begins in March when the sites were identified and equipped. Precipitation for January and February are amounts recorded at Halfway, TX; the nearest monitoring site.

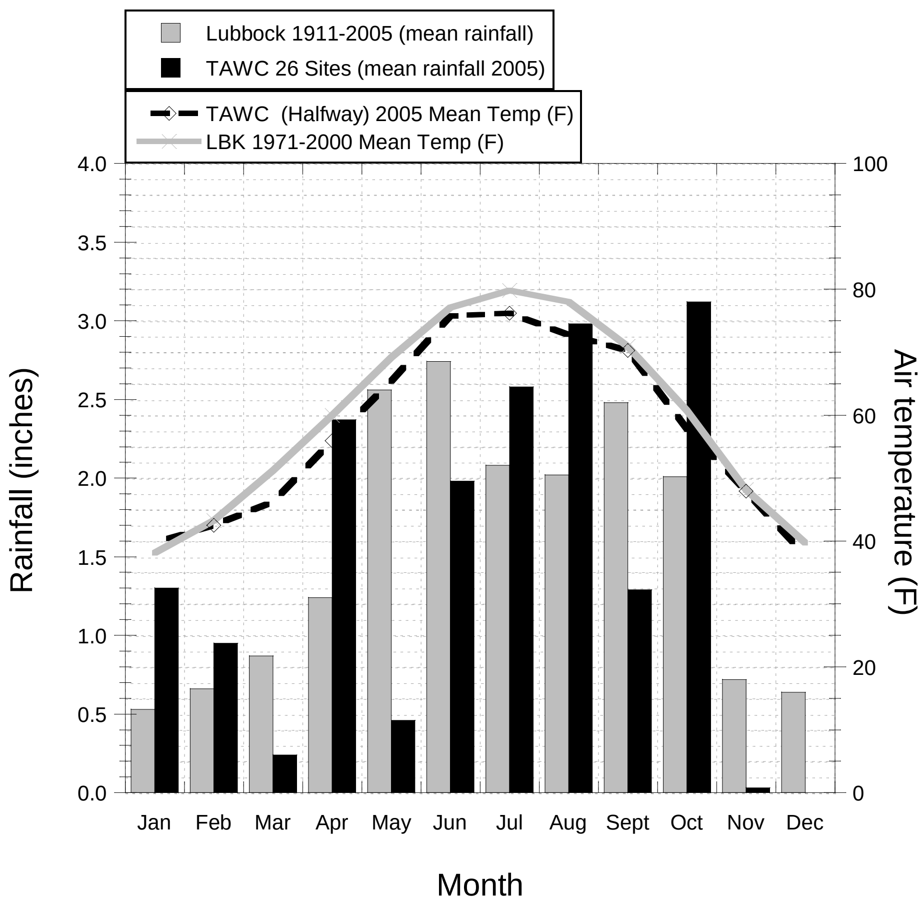

Figure 1. Temperature and precipitation for 2005 in the demonstration area compared with long term averages.

Table 4. 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
01	0	0	0.4	1.3	0.2	1.7	2.2	2.4	2	4.1	0	0	**14.3**
02	0	0	0.4	1.8	0.5	1.4	2.4	3.6	0.8	3.4	0	0	**14.3**
03	0	0	0.7	2	0.6	1.4	2.5	4	0.4	3.2	0	0	**14.8**
04	0	0	0.6	8	0.3	1.4	2.2	3.2	0.1	1	0	0	**16.8**
05	0	0	0.6	2.9	0.4	1.5	3.2	4.2	0.6	1.7	0	0	**15.1**
06	0	0	0.5	1.5	0.4	3	2.4	1	2	4.2	0	0	**15**
07	0	0	0.5	1.5	0.6	2.6	2.4	1.5	3.3	3	0	0	**15.4**
08	0	0	0	1.5	0.6	2.6	2.4	1.5	3.3	3	0	0	**14.9**
09	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**
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**
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**	**0.0**	**0.2**	**2.4**	**0.5**	**2.0**	**2.6**	**3.0**	**1.3**	**3.1**	**0.0**	**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 2 and Table 5, 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.

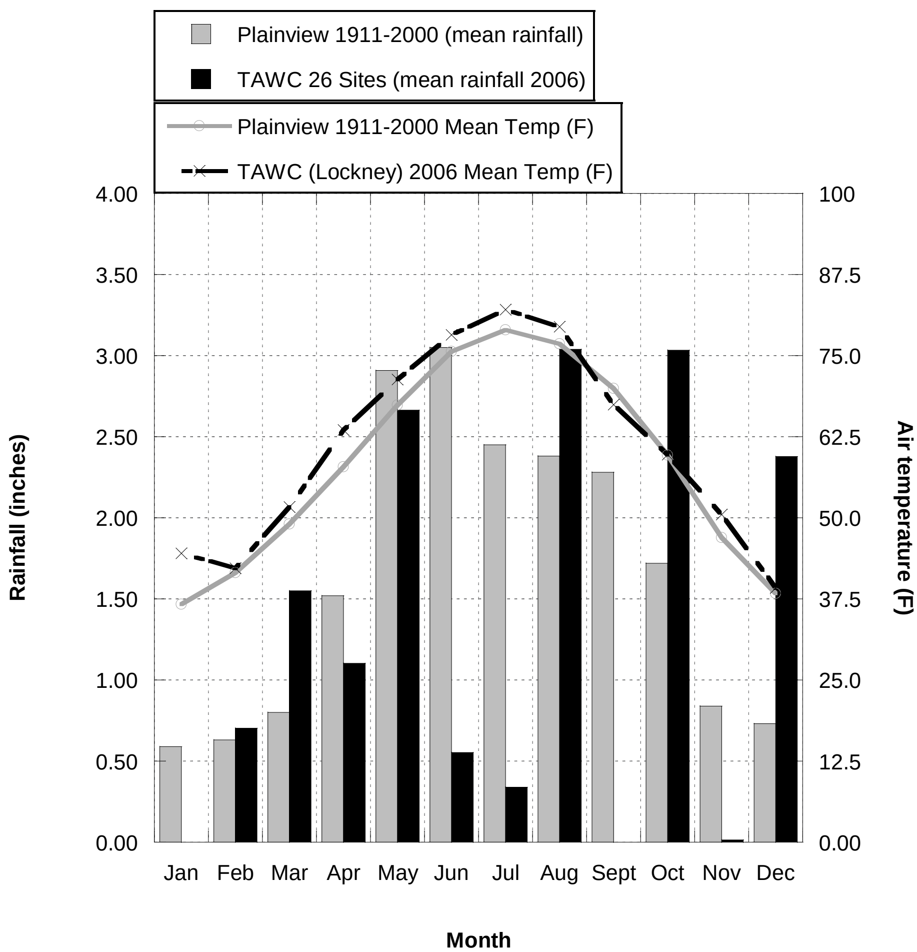

Figure 2. Temperature and precipitation for 2006 in the demonstration area compared with long term averages.

Table 5. 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
01	0	0.9	1.7	1.2	2.6	0.5	0.55	2.3	0	2.87	0	2.6	**15.22**
02	0	0.8	1.9	1.1	1.9	0.2	0	2.6	0	3.05	0	1.8	**13.35**
03	0	0.6	1.5	0.9	2.6	0.7	0.22	3	0	3.14	0	3.2	**15.86**
04	0	0.5	1.4	1.1	2.7	0.2	0.4	3.8	0	2.56	0	2.8	**15.46**
05	0	0.7	1.4	1.8	3.2	0.4	0.57	4	0	2.78	0	2.8	**17.65**
06	0	0.7	1.5	0.8	3	0.4	0.2	5.4	0	2.6	0	2.7	**17.3**
07	0	0.5	1.3	0.9	1.92	0.5	0.33	3.8	0	2.75	0	2.1	**14.1**
08	0	0.5	1.3	0.9	1.92	0.5	0.33	3	0	2.75	0	2.1	**13.3**
09	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**
12	0	0.8	1.4	0.8	2.2	0.9	0.2	1.9	0	3.3	0	2	**13.5**
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	**14.7**
15	0	1.4	2.2	1.4	2.8	0.4	0	2	0	4.4	0.1	2.6	**17.3**
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**	**0.7**	**1.6**	**1.1**	**2.7**	**0.6**	**0.3**	**3.0**	**0.0**	**3.0**	**0.0**	**2.4**	**15.40**

2007

Precipitation during 2007 totaled 27.2 inches (Table 6) 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 3). 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 3 and Table 6, 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.

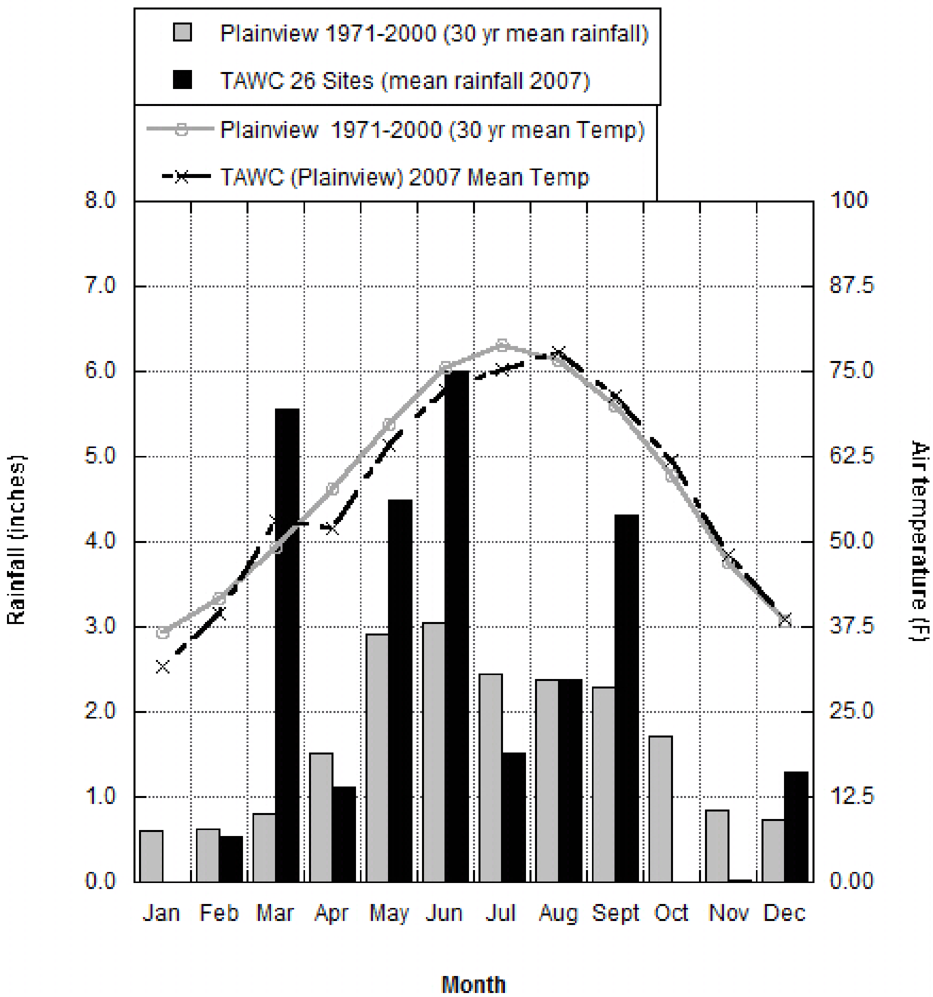

Figure 3. Temperature and precipitation for 2007 in the demonstration area compared with long term averages.

Table 6. 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
01	0	0.74	5.4	0.8	4.92	4.75	0.71	2.3	3.6	0	0	1.2	**24.42**
02	0	0.52	3.7	0.8	2.86	6.93	1.32	3	4.8	0	0	1.2	**25.13**
03	0	0.47	4.8	0.9	2.74	6.88	1.41	2.4	4.4	0	0	1	**25**
04	0	0.29	7.6	0.9	3.53	6.77	4	1.5	5	0	0	1	**30.59**
05	0	0.72	6	1.1	5.09	7.03	0.79	1.2	4.7	0	0	1.2	**27.83**
06	0	0.46	6	0.7	5.03	5.43	0.54	2	4.5	0	0	1.4	**26.06**
07	0	0.9	6.4	1	5.4	4.12	0.74	1.2	3.2	0	0	1.4	**24.36**
08	0	0.9	6.4	1	5.4	4.12	0.74	1.2	3.2	0	0	1.4	**24.36**
09	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	**27.4**
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	**23.8**
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**	**0.5**	**5.6**	**1.1**	**4.5**	**6.0**	**1.5**	**2.4**	**4.3**	**0.0**	**0.0**	**1.3**	**27.2**

2008

Precipitation during 2008, at 21.6 inches, was above average for the year (Table 7). However, the distribution of precipitation was unfavorable for most crops (Figure 4). 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 4).

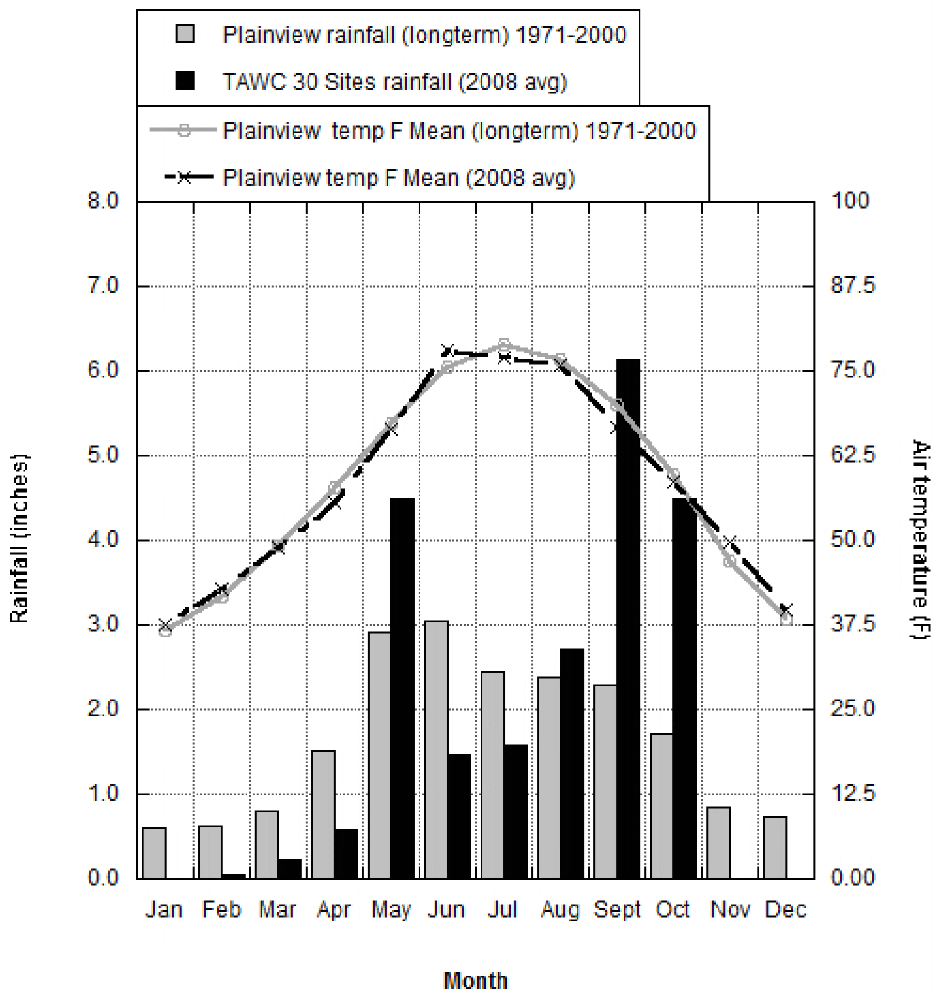

Figure 4. Temperature and precipitation for 2008 in the demonstration area compared with long term averages.

Table 7. 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**
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**
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**
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**
Average	**0.0**	**0.04**	**0.2**	**0.6**	**4.5**	**1.5**	**1.6**	**2.7**	**6.1**	**4.5**	**0.0**	**0.0**	**21.6**

2009

Precipitation during 2009 totaled 15.2 inches averaged across all sites. This was similar to precipitation in 2005, the first reporting year for this project. However, in 2005 above average winter moisture was received followed by precipitation in April that was nearly twice the long-term mean (Fig. 1; 2005). July, August, and October precipitation were also higher than normal in that year. In 2009, January began with very little precipitation that followed two months of no precipitation in the previous year (Fig. 4; 2008). 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.

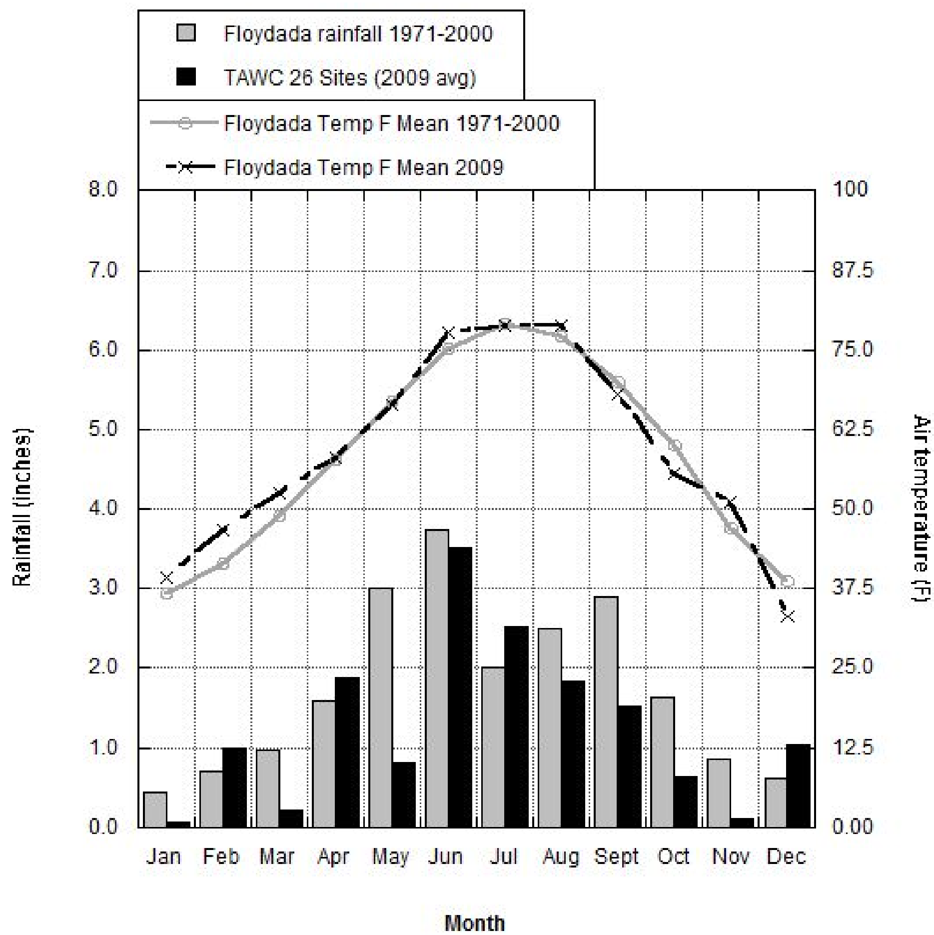

Figure 5. Temperature and precipitation for 2009 in the demonstration area compared with long term averages.

Table 8. 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 9 and illustrated in Figure 6. 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.

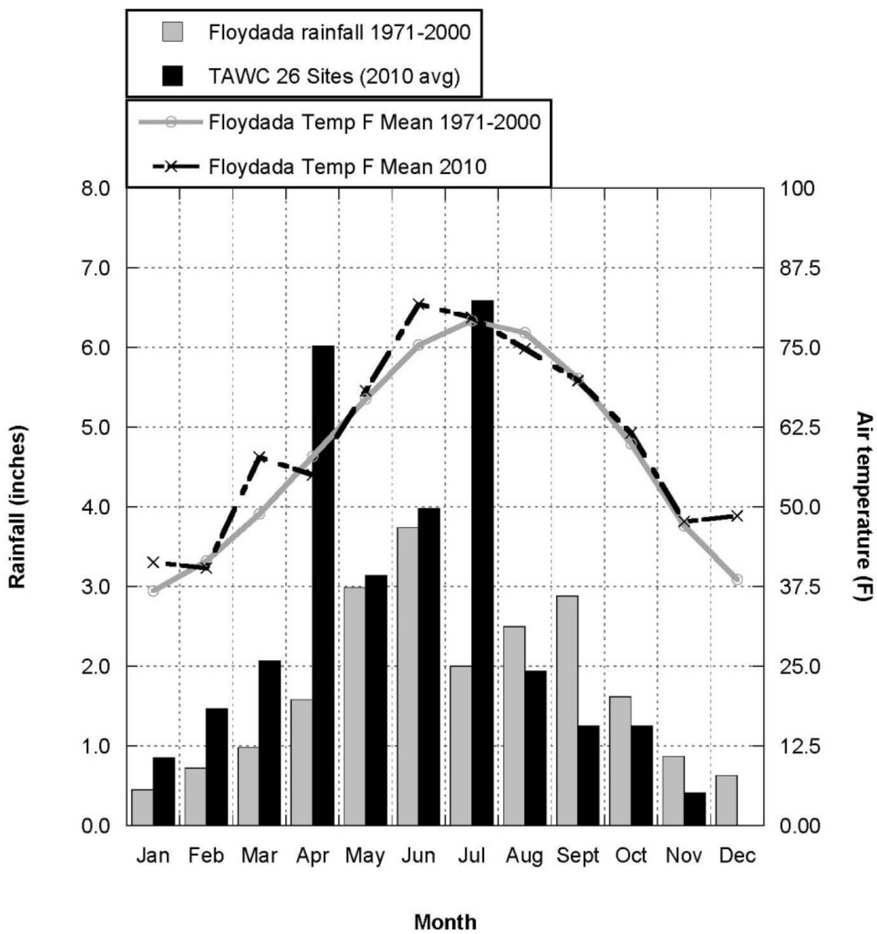

Figure 6. Temperature and precipitation for 2010 in the demonstration area compared with long term averages.

Table 9. 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 measured across the project, as indicated in Table 10 and illustrated in Figure 7. This was a year of historic drought and caused many fields to be abandoned. Virtually no rainfall was received during the normal growing season.

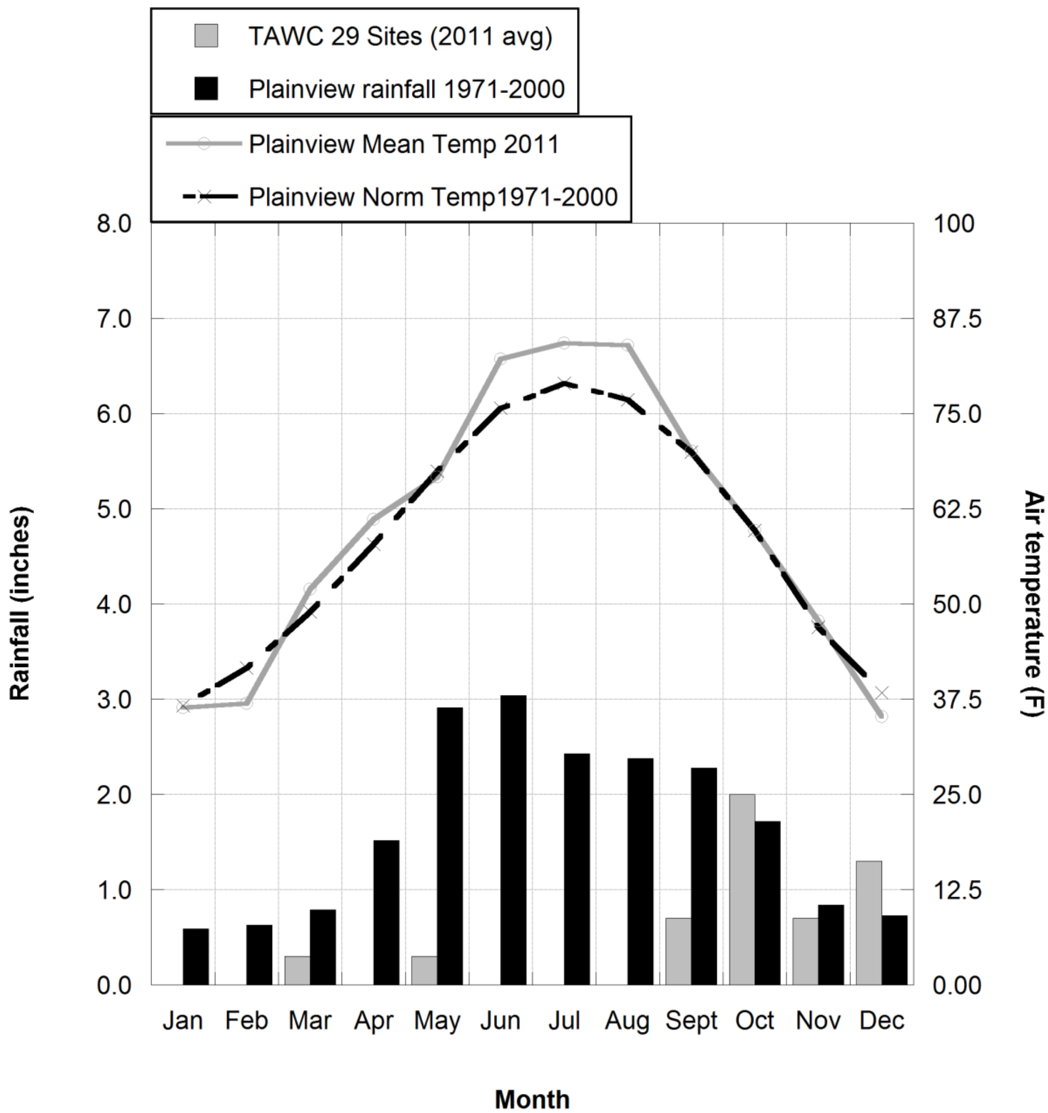

Figure 7. Temperature and precipitation for 2011 in the demonstration area compared with long term averages.

Table 10. 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

SUPPLEMENTARY GRANTS TO PROJECT

Grants Directly used and/or their % used within the TAWC project sites are noted in blue highlight. Other grants are considered complementary and outside of the TAWC project but were attempted or obtained through leveraging of the base platform the TeCSIS-TAWC (Texas Coalition for Sustainable Integrated Systems (Research component) and Texas Alliance for Water Conservation (Demonstration Sites) program represents and adds valuable information to this overall 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., & Akers, C. 2008. Developing Tomorrow's Water Conservation Researchers Today. Ogallala Aquifer Program Project. $28,000 (funded).

Doerfert, D.L., Meyers, Courtney. 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 3 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 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. & 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 (status pending).

Fultz, L. Assessment of soil C quality using mid-infrared diffuse reflectance spectrometry for alternative agroecosystems in the Southern High Plains. USDA-SSARE graduate student fellowship. $9,953 (not funded).

Davinic, Marko. Diversity and ecology of fungal communities in soil aggregates under integrated crop and livestock systems. USDA-SSARE graduate student fellowship. $10,000 (not funded).

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.,).

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).

DONATIONS TO PROJECT

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
Bamert 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

Lucia Barbato, TTU Center for Geospatial Technology. Donation for server support software for TAWC database. $10,000.00

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

VISITORS TO THE DEMONSTRATION PROJECT SITES

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+

Bloomberg News group	Dr. Mike Galyean	Larry Gambone
Jane Henry	David Henry	T.J. Martinez
Gilbert Mokry	Texas AgriLife agents	Dr. Sara Trojan
Comer Tuck	Voice of America group	

PRESENTATIONS

2005

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	

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	

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

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

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

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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	

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)	

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

Related Publications

Rajan, N., and S. J. Maas. 2007. Comparison of water use among crops in the Texas High Plains estimated using remote sensing. Abstracts, 2007 Water Research Symposium, Socorro, NM.

Rajan, N., and S. J. Maas. 2007. Calibrating aerial imagery for estimating crop ground cover. In R. R. Jensen, P. W. Mausel, and P. J. Hardin (ed.) Proc., 21st Biennial Workshop on Aerial Photog., Videography, and High Resolution Digital Imagery for Resource Assessment, Terre Haute, IN. 15-17 May. 2007. ASPRS, Bethesda, MD.

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Zilverberg, C., et al. Energy and carbon costs of integrated crop/livestock systems designed for reduced irrigation (in progress)

SITE DESCRIPTIONS

BACKGROUND

This project officially began with the announcement of the grant in September, 2004. However, it was February, 2005, before all of the contracts and budgets were finalized and actual field site selection could begin. By February, 2005, the Producer Board had been named and was functioning and the Management Team had been 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 8). Soil moisture monitoring points installed, maintained and measured by the High Plains Underground Water Conservation District No. 1 were purposely located in close proximity to these sites and GPS position coordinates were taken for each of these monitoring points. 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, 2006, 2007, 2008, 2009, 2010 and 2011 are given in Tables 11,12,13,14,15, 16 and 17. 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), 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 the information to fill gaps that occur due to the time it took to bring these 26 sites on-line but information in regard to water use is based on estimates as well as actual measurements during this first year and should be interpreted with caution. However, it provided useful information as we began this long-term project. It is also important to note that the first year of any project is unlikely to resemble closely any following year because of all the factors involved in start-up and calibration of measurement techniques. This is always the case. As we entered year 2, we were positioned to collect increasingly meaningful data and all sites were complete.

In year 2 (2006), Site No. 25 was lost to the project due to a change in ownership of the land. However, Site 27 was added, thus, the project continued to monitor 26 sites. Total acreage in 2006 was 4,230, a difference of about 60 acres between the two years. Crop and livestock enterprises on these sites and the acres committed to each use by site is given in Table 12.

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 the area in Site No. 1.

In year 4 (2008), 25 sites included 3,967 acres (Table 14). Sites 1, 13, 16, and 25 of the original sites had left the project with sites 28 and 29 added since the project began.

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 in the project.

In year 6 (2010), three additional sites were added as part of the implementation phase of the project. These three new sites intended to limit total irrigation for 2010 to no more than 15 acre inches. Crops grown include cotton, seed millet and corn. The original purpose of these added sites were to demonstrate successful production systems while restricting the total water applied to each system. With the addition of sites 31, 32, and 33, the project totaled 29 sites and increased the acreage from 3,991 acres to 4,272 acres in the project. These 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 and no longer discussed separately due to HPWD water restriction rules being implemented and the fore mentioned sites be treated identically to all other sites in the project. In addition, Site 5 was converted from a livestock only system to a standard cropping system and as a result the system acres were reduced from 626.4 to 487.6 acres dropping the grassland corners but maintaining the cropping system under the center pivot. System maps will be 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.

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 reflect completion and revisions made to previous year's 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 1-7 follow and are presented by site.

Texas Alliance for Water Conservation 2011

Scale: 1:120,000

System Acres

2	60.9	19	120.4
3	123.3	20	233.4
4	123.0	21	122.6
5	487.6	22	148.7
6	122.8	23	121.1
7	130.0	24	129.7
8	61.8	26	125.2
9	237.8	27	108.5
10	173.6	28	51.5
11	92.5	29	221.6
12	283.9	30	21.8
14	124.2	31	121.1
15	102.8	32	70.0
17	220.8	33	70.0
18	122.2		

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TAWC

Texas Alliance for Water Conservation

"Water is Our Future"

Agriculture Division
High Plains Underground
Water Conservation District No. 1

March 2011

Figure 8. System map index for 2011 (year 7).

Table 11. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 27 producer systems 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													
27	SDI	n/a														
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 12. Irrigation type and total acres, by site, of crops, forages and acres grazed by cattle in 27 producer systems 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												
25	DRY	n/a														
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 13. Irrigation type and total acres, by site, of crops, forages and acres grazed by cattle in 27 producer systems 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													
25	DRY	n/a														
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 14. Irrigation type and total acres, by site, of crops, forages and acres grazed by cattle in 25 producer systems 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 15. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 26 producer systems 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 16. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 26 producer systems 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**

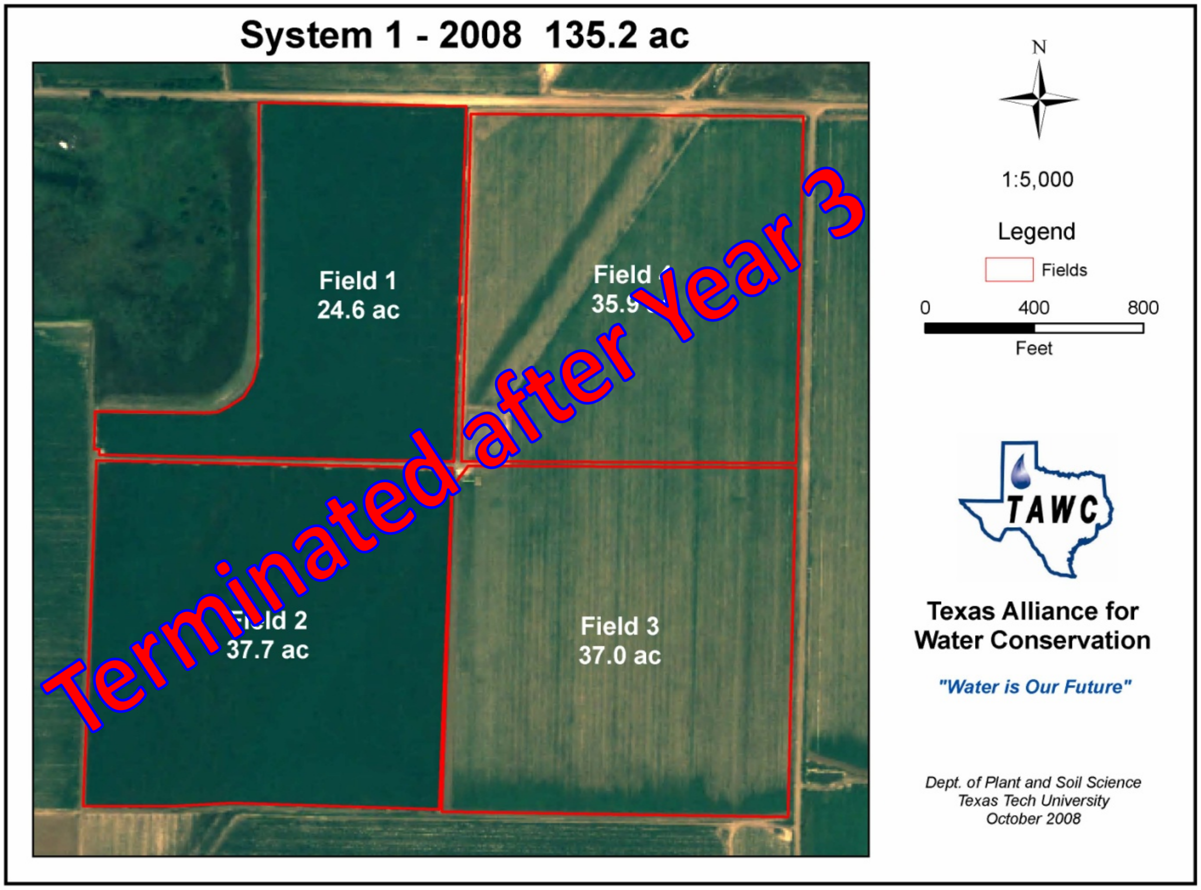
PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation

Table 17. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 29 producer systems 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



System 1 Description

Total system acres: 135.2

Field No. 1 Acres: 24.6
Major soil type: Estacado clay loam; 1 to 3% slope

Field No. 2 Acres: 37.7
Major soil type: Lofton clay loam, 0 to 1% slope
Pullman clay loam, 1 to 3% slope

Field No. 3 Acres: 37.0
Major soil type: Pullman clay loam, 0 to 1% slope

Field No. 4 Acres: 35.9
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Sub-surface 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

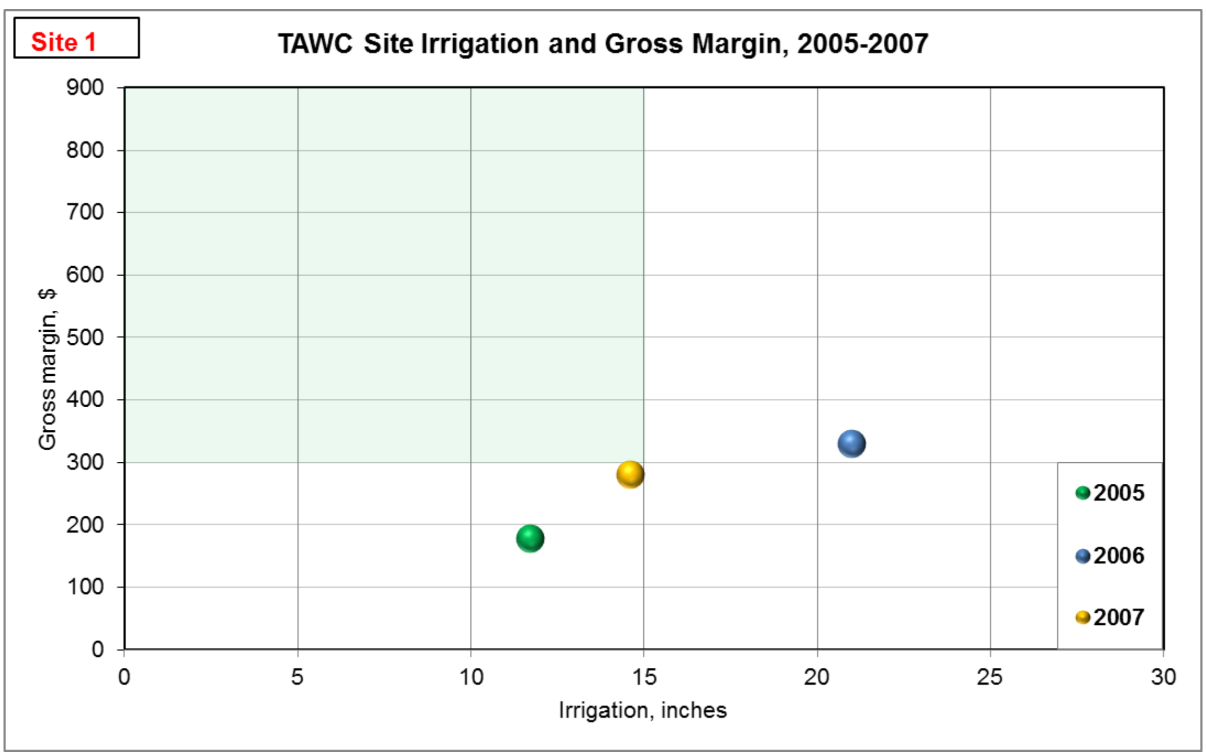
Number of wells: 2

Fuel source: Electric
Natural gas

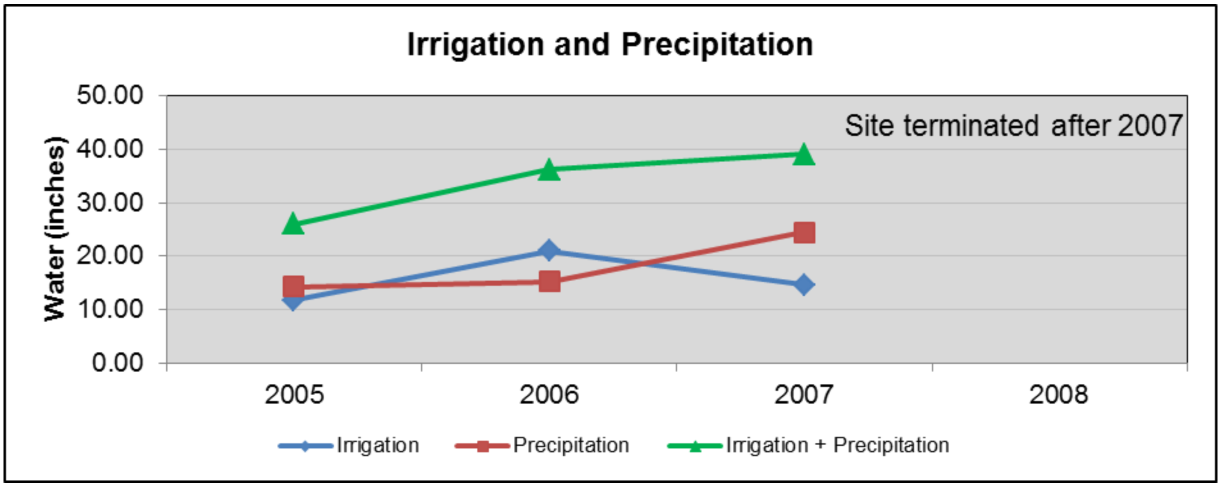
Comments: Drip irrigation cotton and corn system, conventional tillage with crops planted on forty-inch centers.

System 1

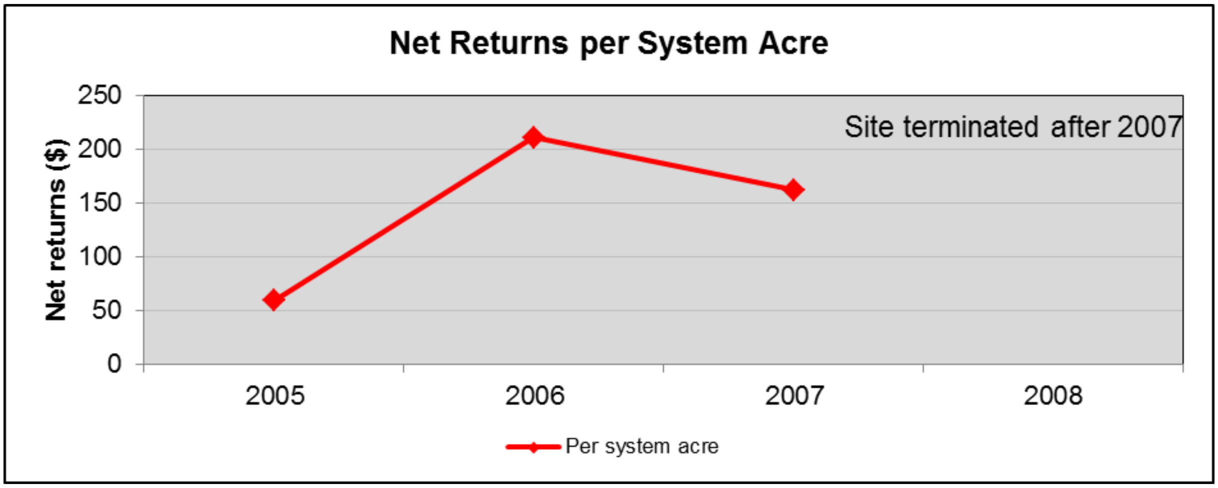
	Livestock	Field 1	Field 2	Field 3	Field 4
2005	None	Cotton	Cotton		
2006	None	Cotton	Cotton	Cotton	Cotton
2007	None	Cotton	Cotton	Cotton	Cotton
2008	Site terminated in 2008				
2009					
2010					
2011					



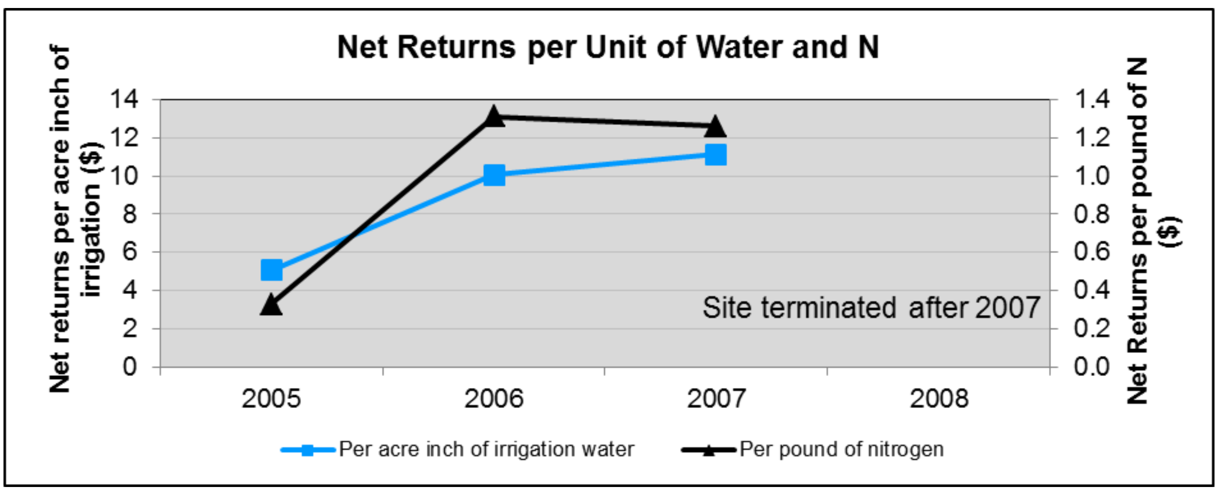
System 1



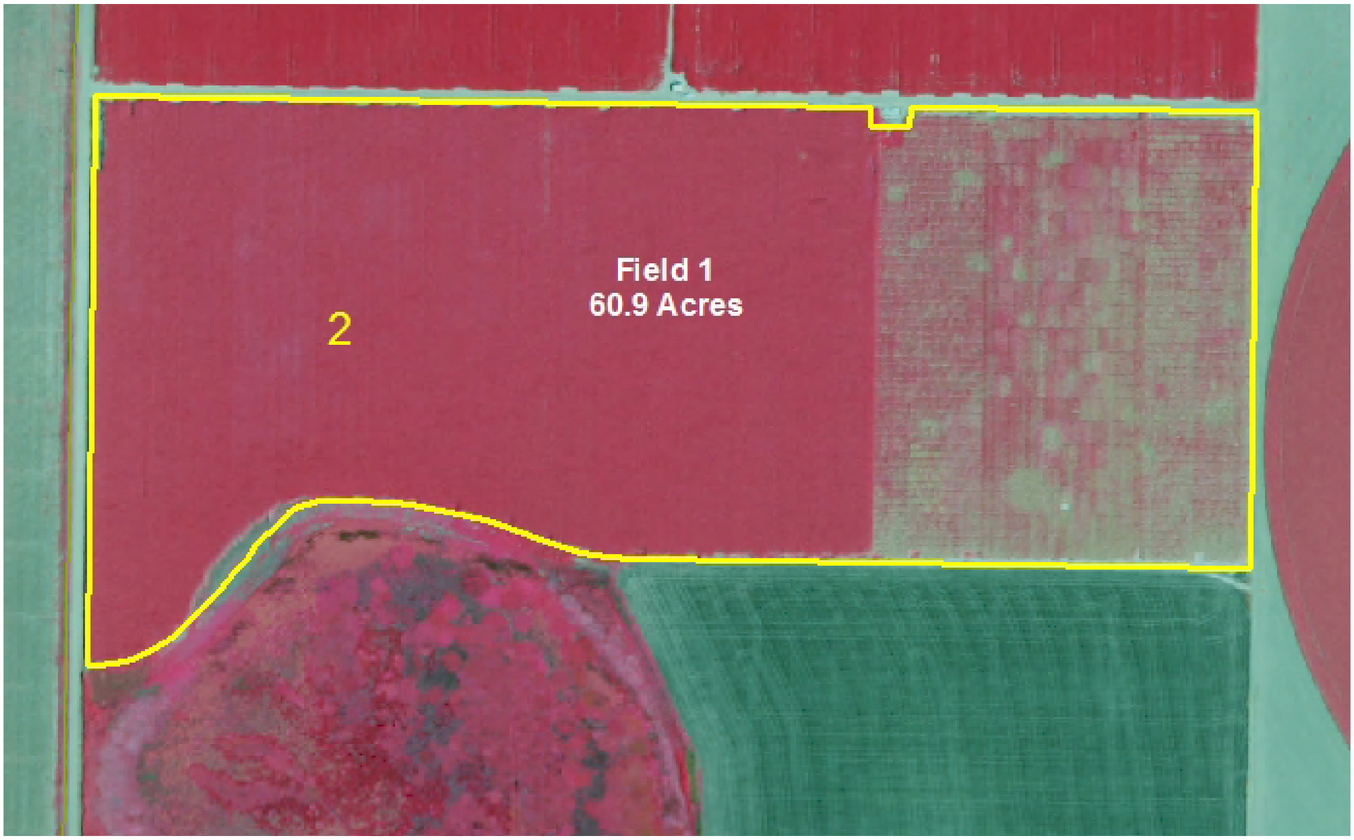
Irrigation and Precipitation
Water (inches)
50.00
40.00
30.00
20.00
10.00
0.00
Site terminated after 2007
2005
2006
2007
2008
Irrigation
Precipitation
Irrigation + Precipitation



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



System 2 Description

Total system acres: 60.9

Field No. 1 Acres: 60.9
Major soil type: Pullman clay loam, 0 to 1% slope
Olton clay loam, 1 to 3% slope

Irrigation

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

Pumping capacity, gal/min: 360

Number of wells: 2

Fuel source: Electric

System 2

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

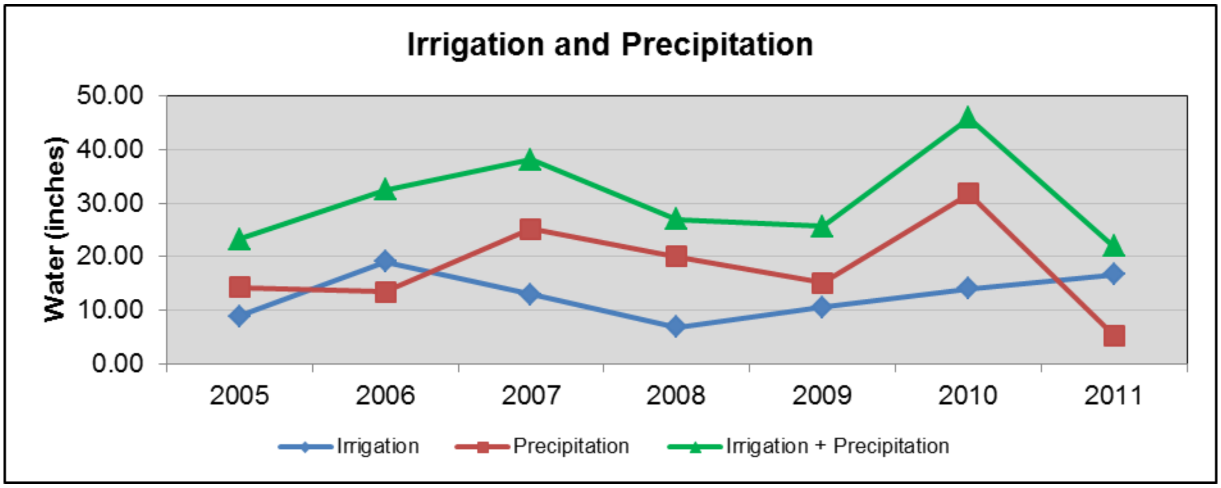
Comments: This drip site is planted on thirty-inch centers and has been planted to cotton or sunflowers.

Pictures from Drought Year of 2011

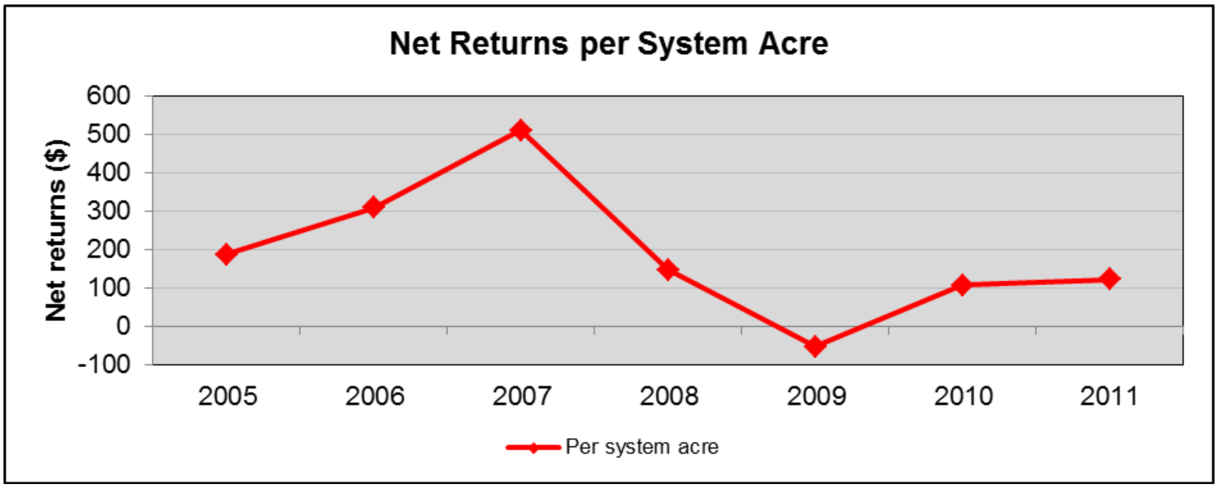
Field 1 July Corn over Drip Irrigation

Field 2 Fallowed field

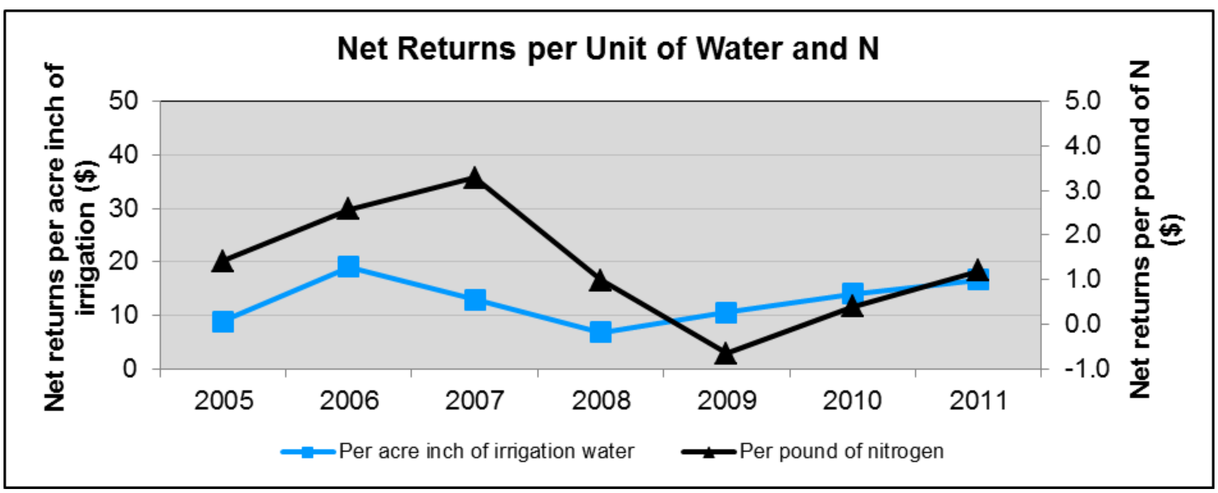
System 2



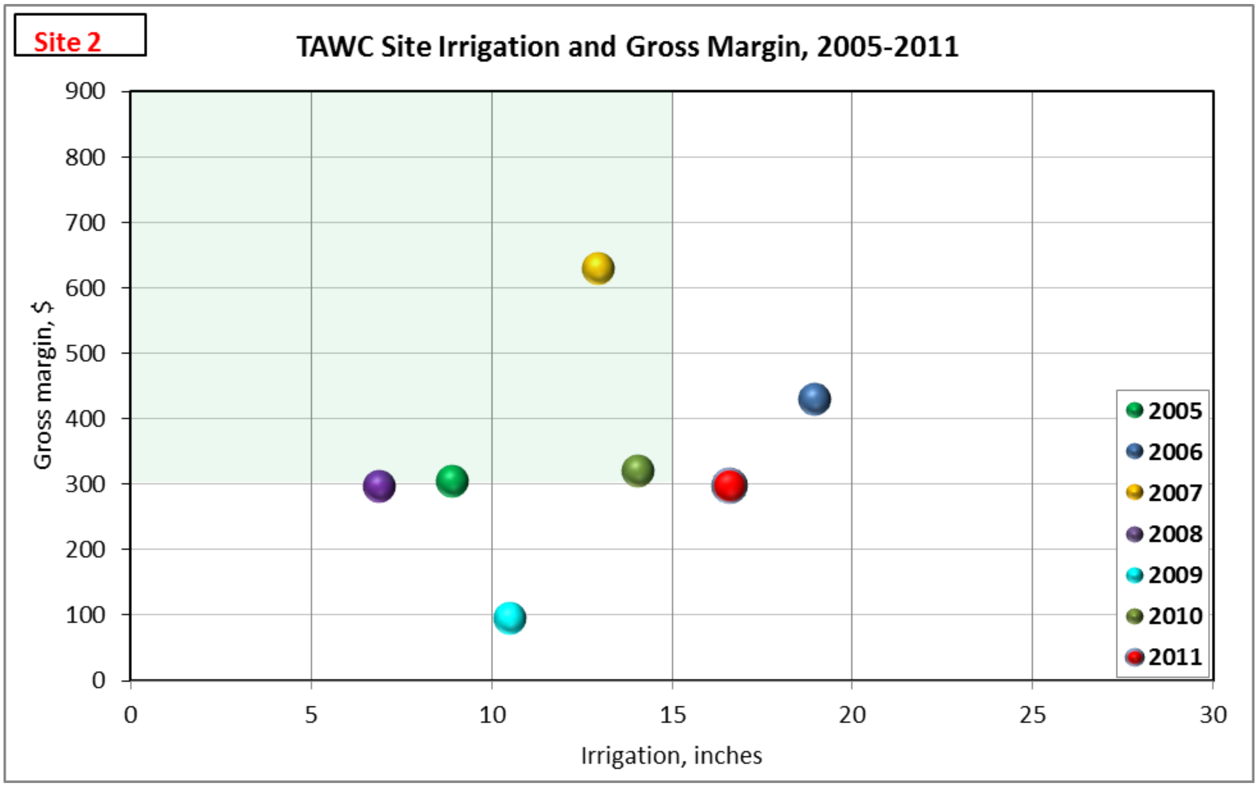
Irrigation and Precipitation
Water (inches)
50.00
40.00
30.00
20.00
10.00
0.00
2005
2006
2007
2008
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation

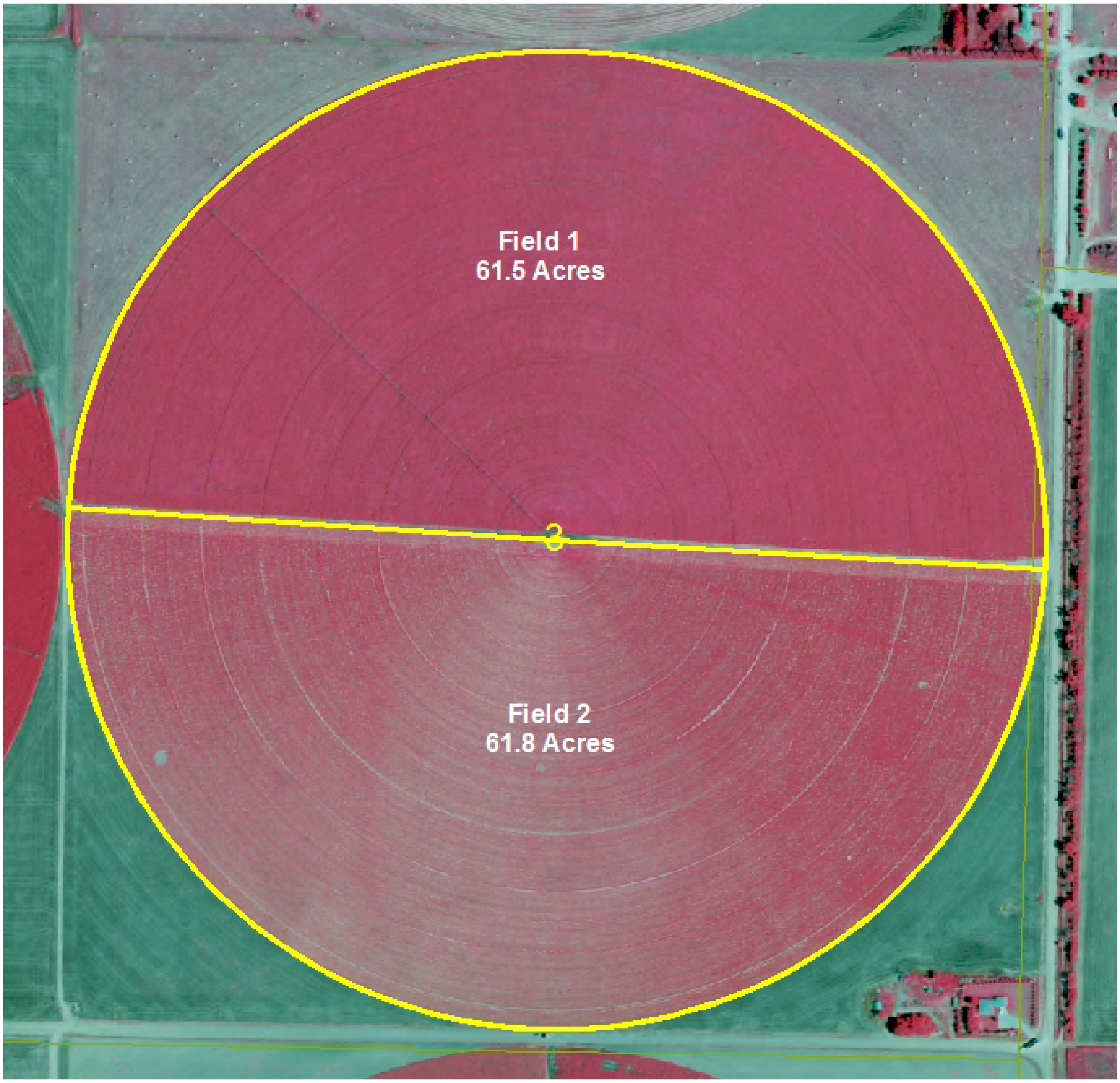


Net Returns per System Acre
Net returns ($)
600
500
400
300
200
100
0
-100
2005
2006
2007
2008
2009
2010
2011
Per system acre



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


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



System 3 Description

Total system acres:	123.3
Field No. 1 Acres:	61.5
Major soil type:	Pullman clay loam; 0 to 1% slope
Field No. 2 Acres:	61.8
Major soil type:	Pullman clay loam; 0 to 1% slope

Irrigation

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

System 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

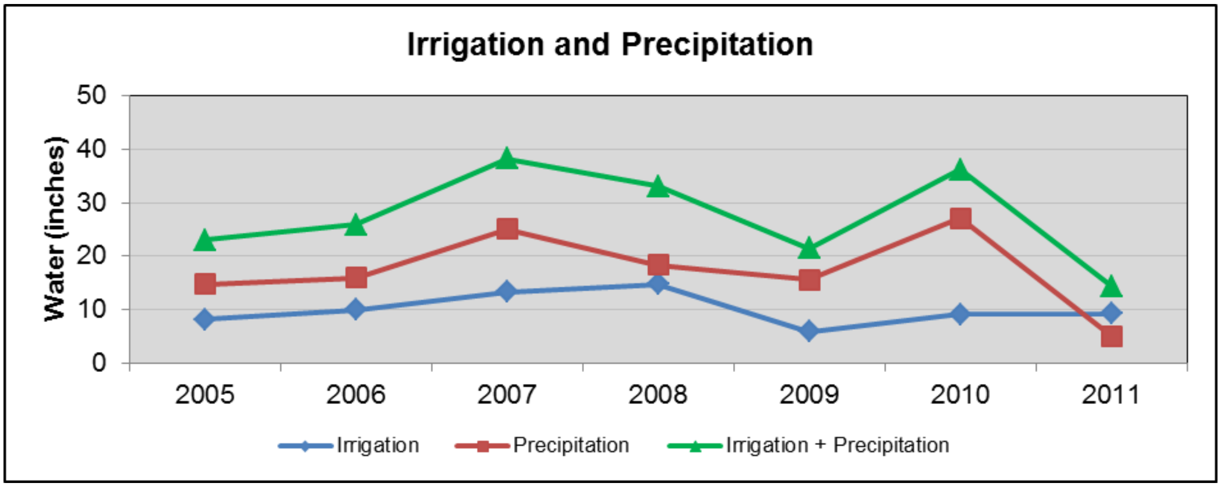
Comments: This is a pivot irrigated system using conventional tillage, and row crops are planted on forty-inch centers. Crops have included cotton, wheat and grain sorghum.

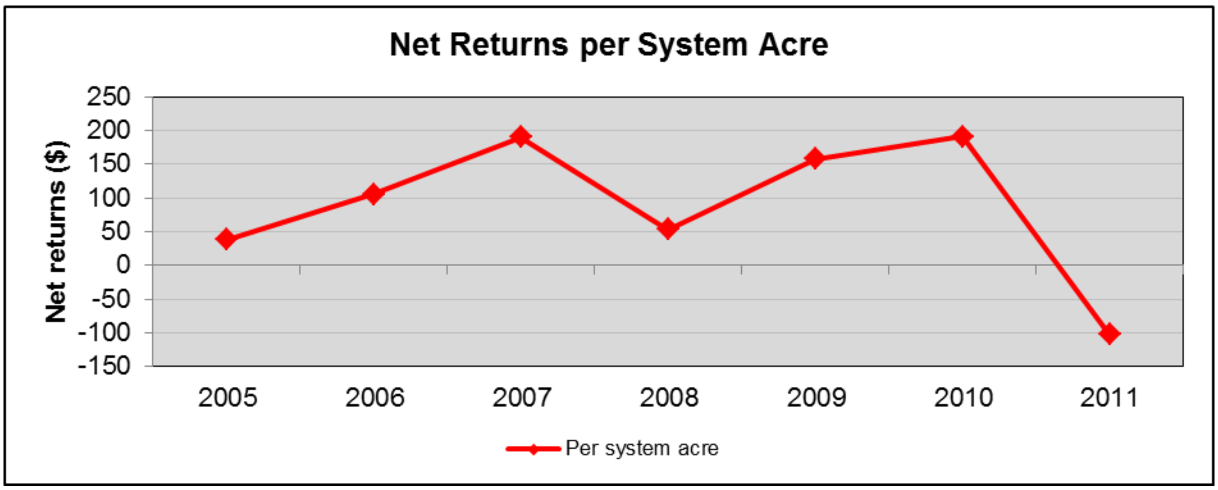
Pictures from Drought Year of 2011

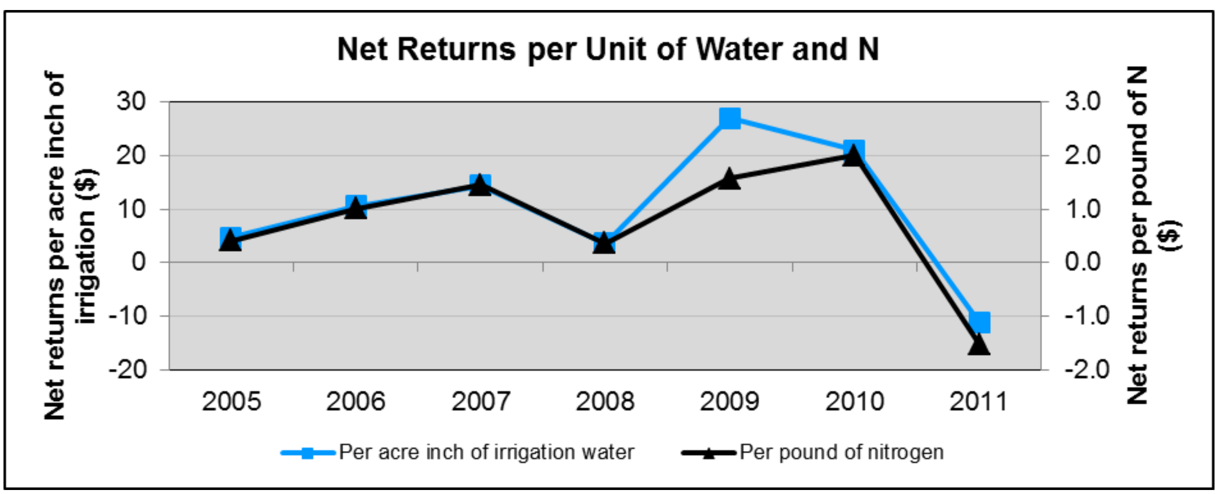
July Cotton

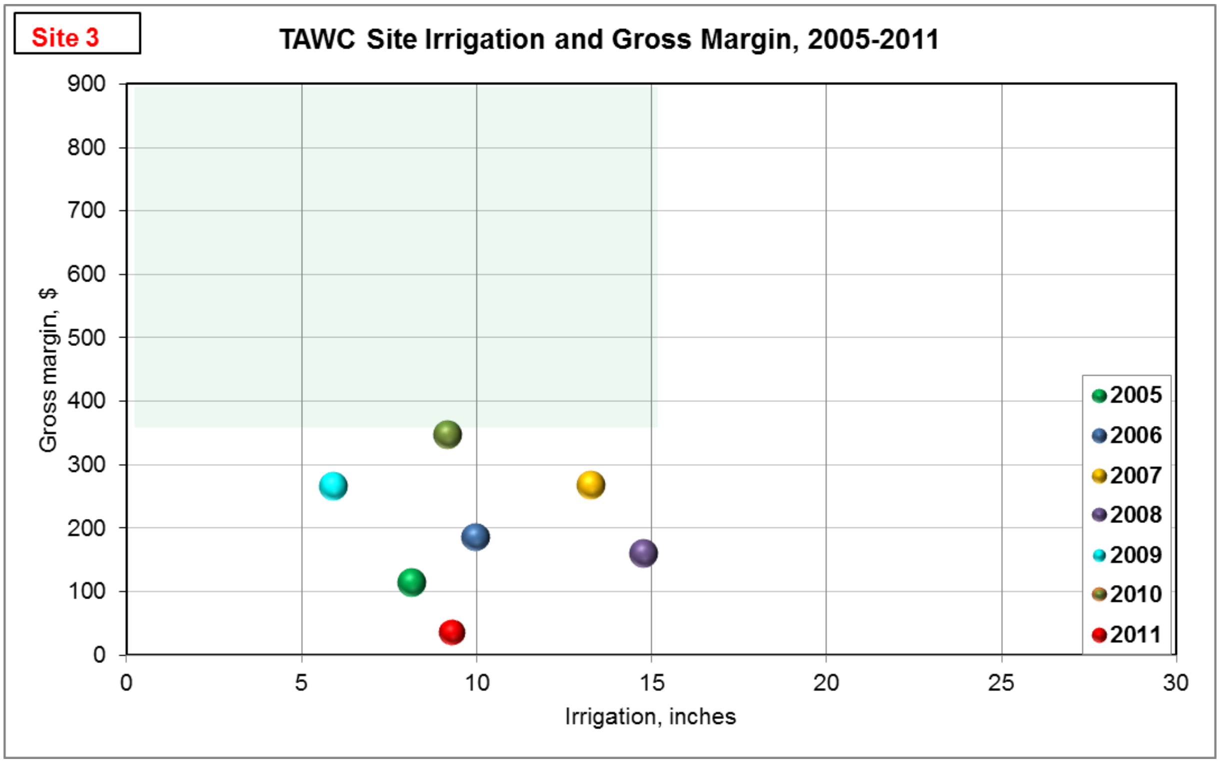
August Cotton

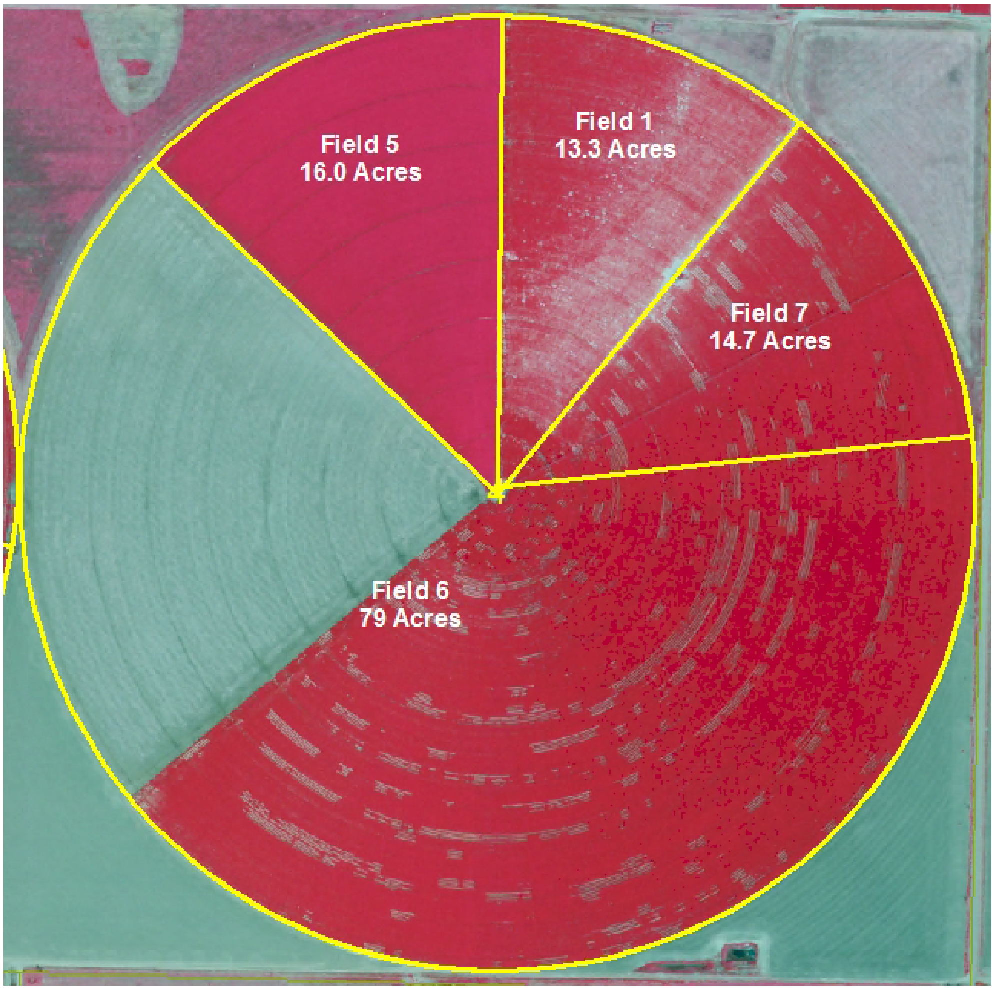
System 3


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


Net Returns per System Acre
Net returns ($)
250
200
150
100
50
0
-50
-100
-150
2005
2006
2007
2008
2009
2010
2011
Per system acre


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


Site 3
TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $
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



System 4 Description

Total system acres: 123.0

Field No. 1 Acres: 13.3
Major soil type: Estacado clay loam, 1 to 3% slope

Field No. 5 Acres: 16.0
Major soil type: Pullman clay loam, 0 to 1% slope

Field No. 6 Acres: 79.0
Major soil type: Pullman clay loam, 0 to 1% slope

Field No. 7 Acres: 14.7
Major soil type: Pullman clay loam, 0 to 1% slope

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 500

Number of wells: 3

Fuel source: 1 Natural gas
2 Electric

System 4

	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	Hay Grazer	Alfalfa		Cotton	Wheat

Comments: This pivot irrigated system uses strip tillage. Crops planted for 2011 include alfalfa, cotton, wheat, and forage sorghum. Forage sorghum and alfalfa were harvested for hay to be used in this producer's cow-calf program.

System 4 - [Pictures from Drought Year of 2011]

Swathed Haygrazer

Cotton

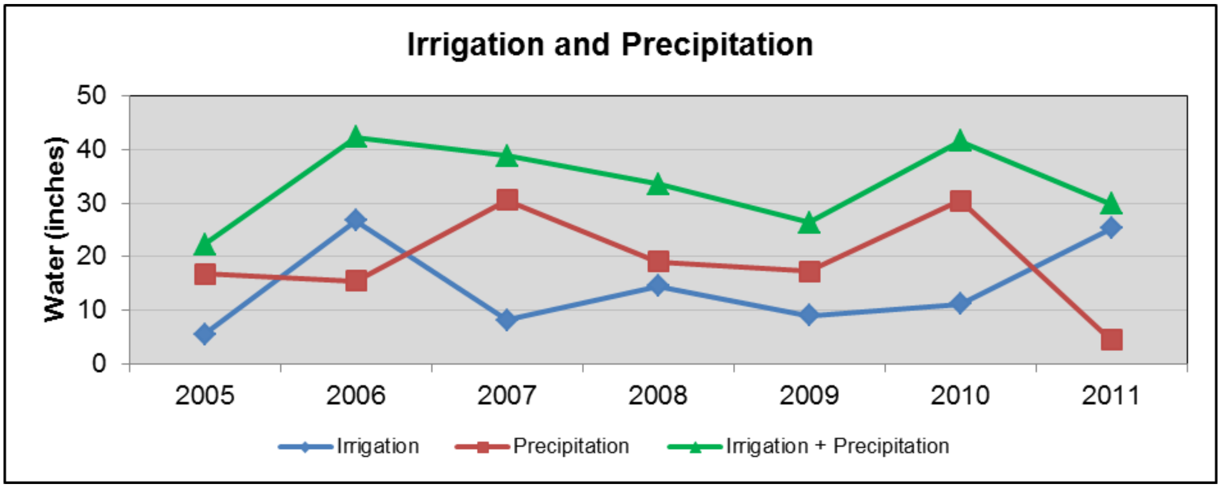
Alfalfa

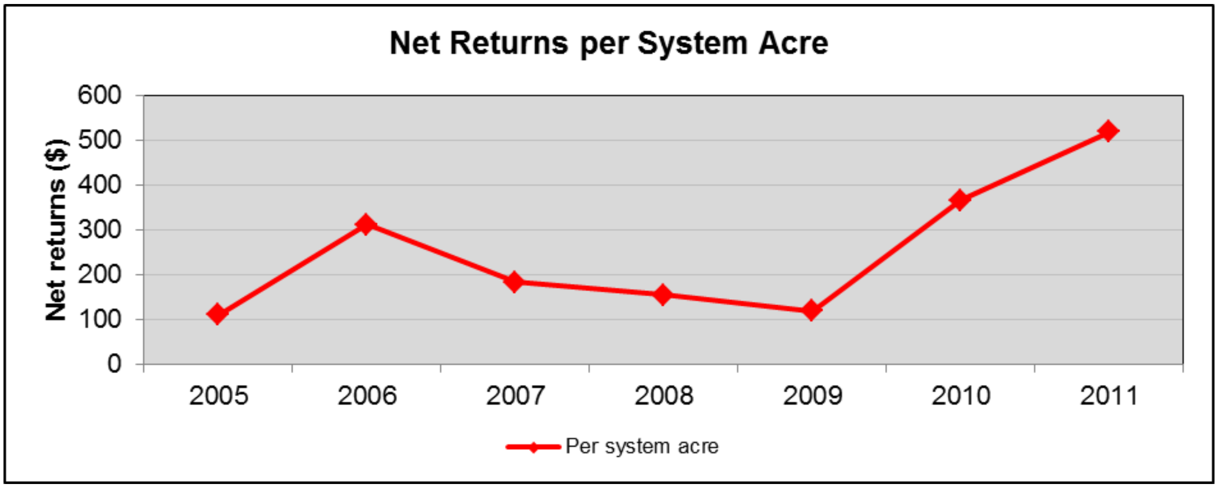
Cutting Hay

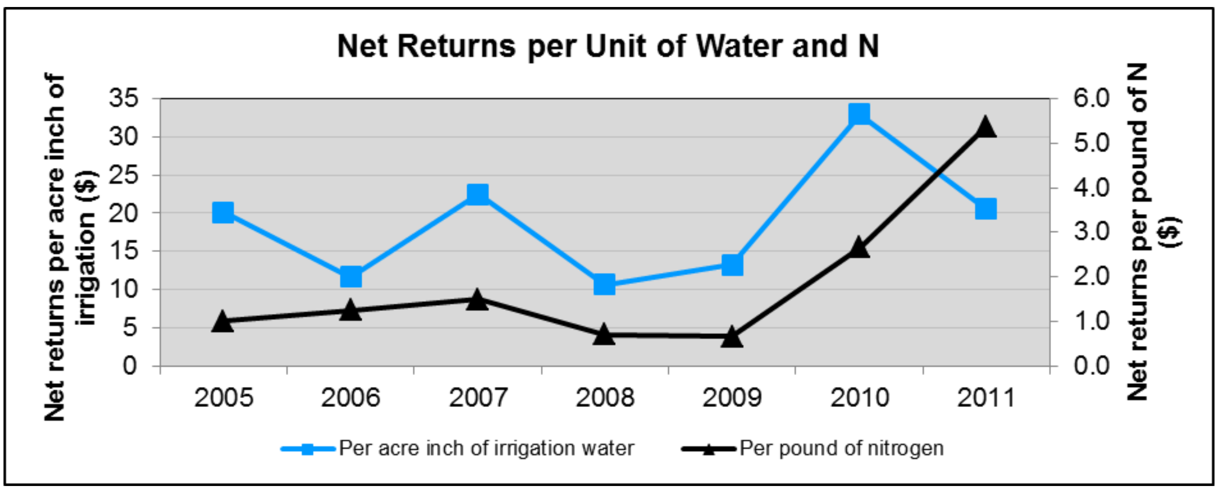
Evaluating the crop

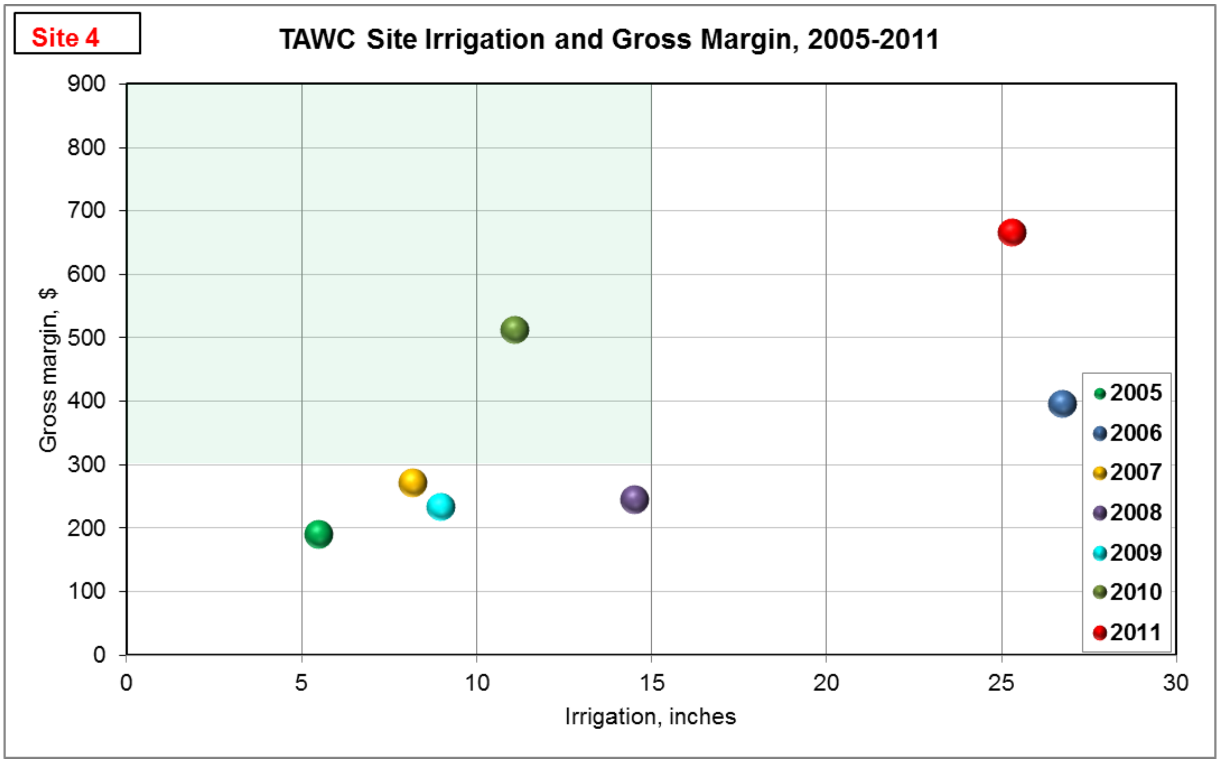
Drought stricken wheat

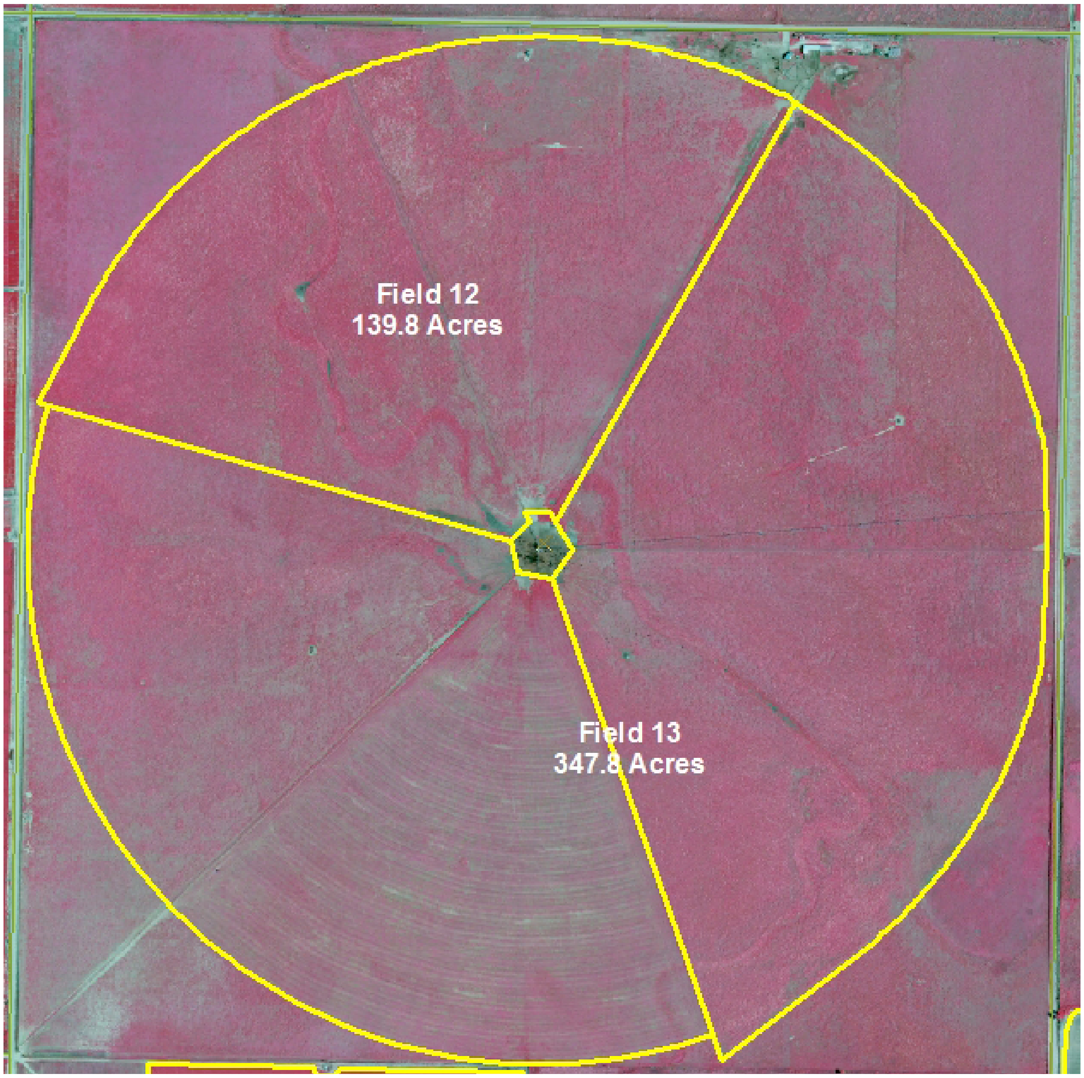
System 4


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
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
Per system acre


Net Returns per Unit of Water and N
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
Per acre inch of irrigation water
Per pound of nitrogen


Site 4
TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $
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



System 5 Description

Total system acres: 487.6
(487.6 irrigated)

IRRIGATED

Field No. 12 Acres: 139.8
Major soil type: Bippus loam, 0 to 1% slope
Mansker loam, 0 to 3 and 3 to 5% slope
Olton loam, 0 to 1% slope

Field No. 13 Acres: 347.8
Major soil type: Olton loam, 0 to 1% slope
Bippus loam, 0 to 1% slope
Mansker loam, 0 to 3% slope

Irrigation

Type: Center Pivot (MESA)

Pumping capacity, gal/min: 1100

Number of wells: 4

Fuel source: Electric

System 5 ***Crops - Irrigated***

	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		Fallowed	Cotton/abandoned				

System 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 2011 this site was converted from a commercial, spring calving cow-calf operation to a cotton system. All interior livestock fencing was removed. Only eighty acres of cotton was harvested with the balance leased for grazing.

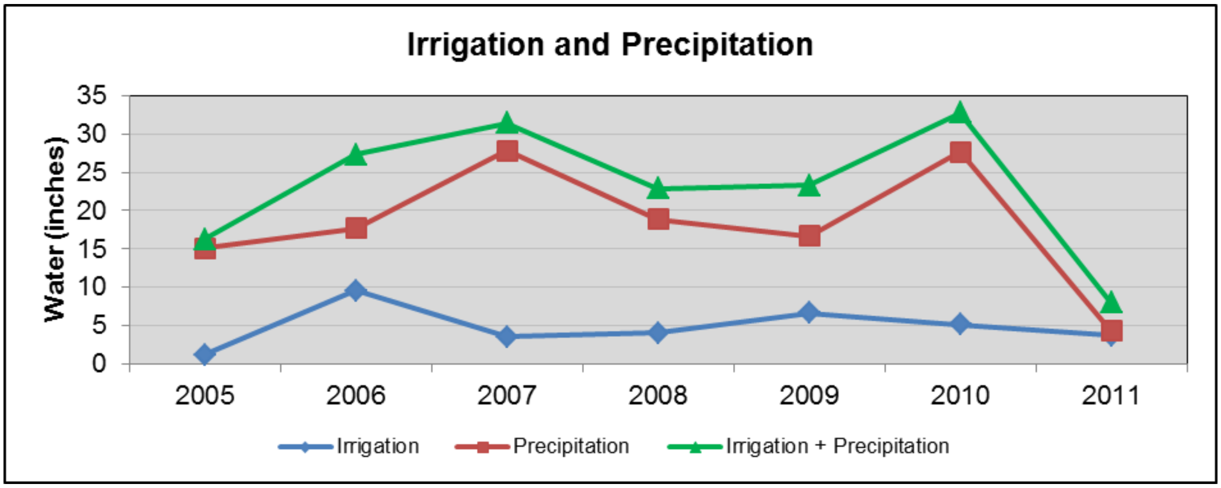
System 5 - [Pictures from Drought Year of 2011]

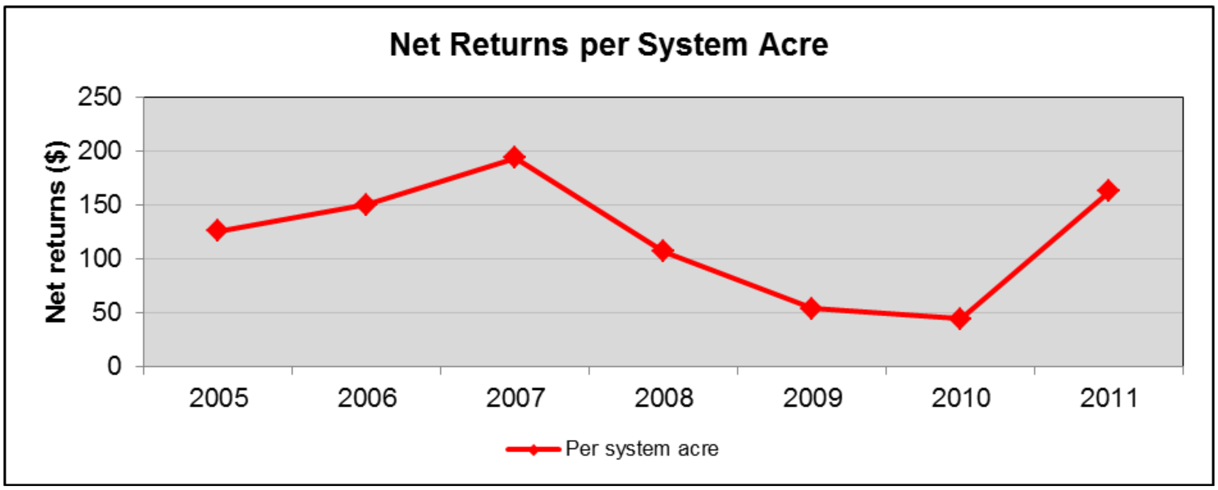
Desperate irrigation

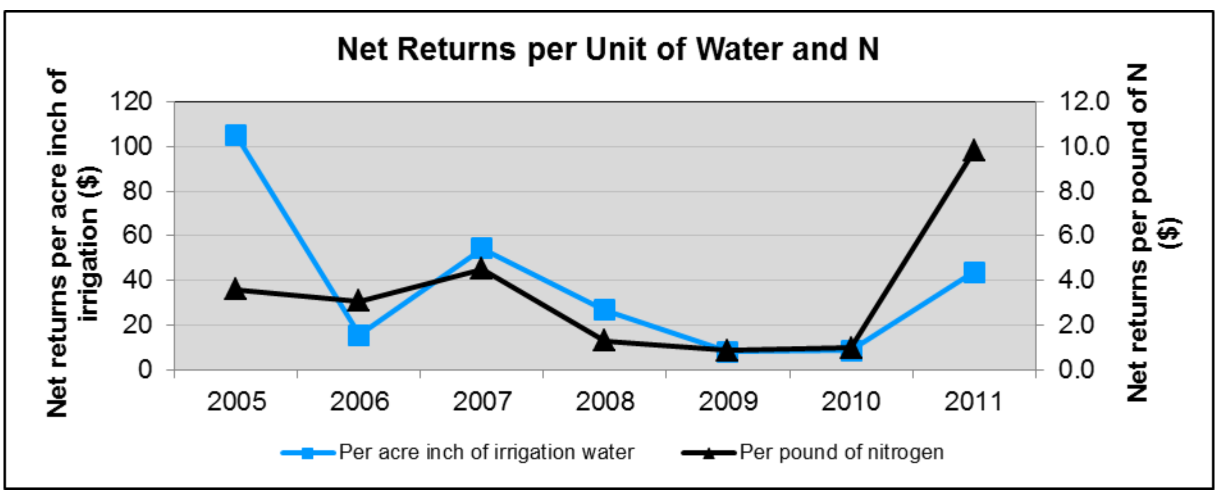
July cotton

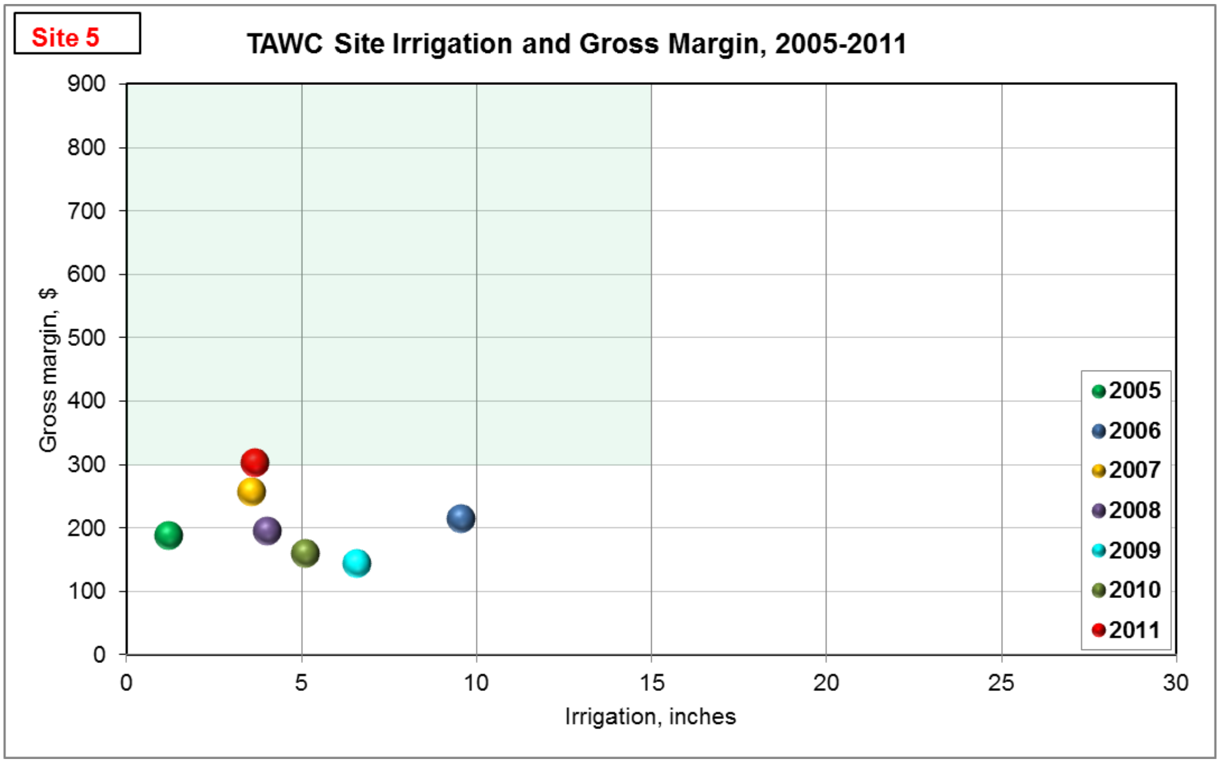
Late October - Cotton Crop Failure

System 5


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


Net Returns per System Acre
Net returns ($)
250
200
150
100
50
0
2005
2006
2007
2008
2009
2010
2011
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
120
100
80
60
40
20
0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
2010
2011
Per acre inch of irrigation water
Per pound of nitrogen


Site 5
TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $
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

System 6 Description

Total system acres: 122.8

Field No. 5 Acres:	32.1
Major soil type:	Pullman clay loam, 0 to 1% slope
Field No. 6 Acres:	29.8
Major soil type:	Pullman clay loam, 0 to 1% slope
Field No. 7 Acres:	31.2
Major soil type:	Pullman clay loam, 0 to 1% slope
Field No. 8 Acres:	29.7
Major soil type:	Pullman clay loam, 0 to 1% slope

Irrigation

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

System 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

Comments: In 2011 this site was planted to cotton and corn on forty-inch centers. The corn was abandoned because of the lack of rainfall.

System 6 - **Pictures from Drought Year of 2011**

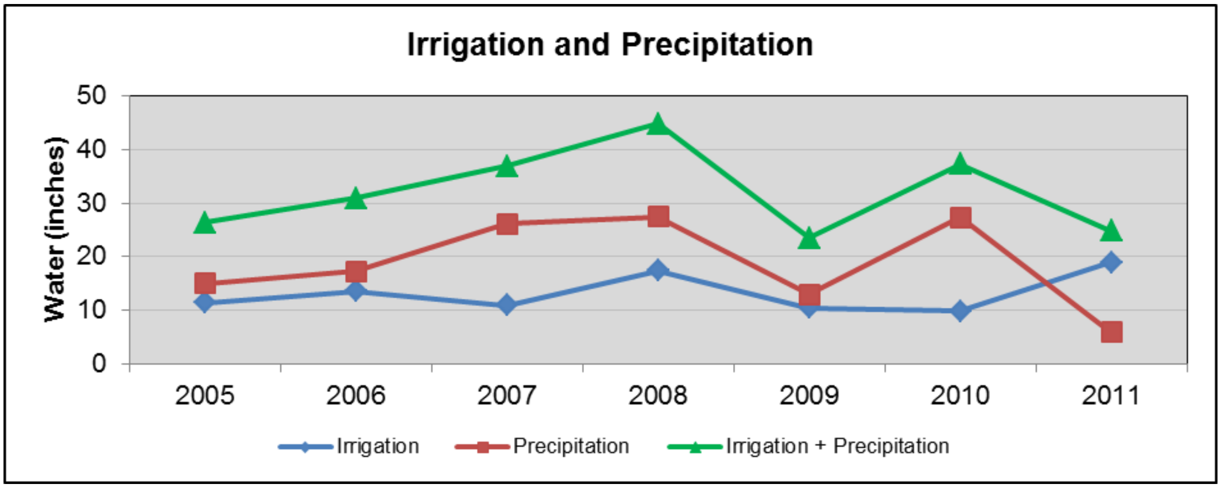
What to Do? Plant or Not?

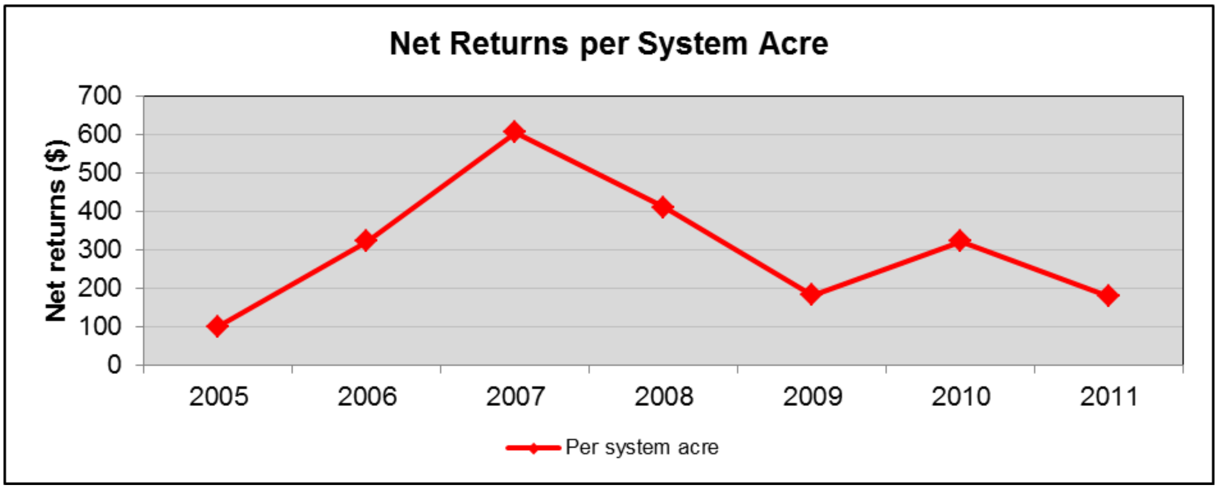
May Corn hurting for water

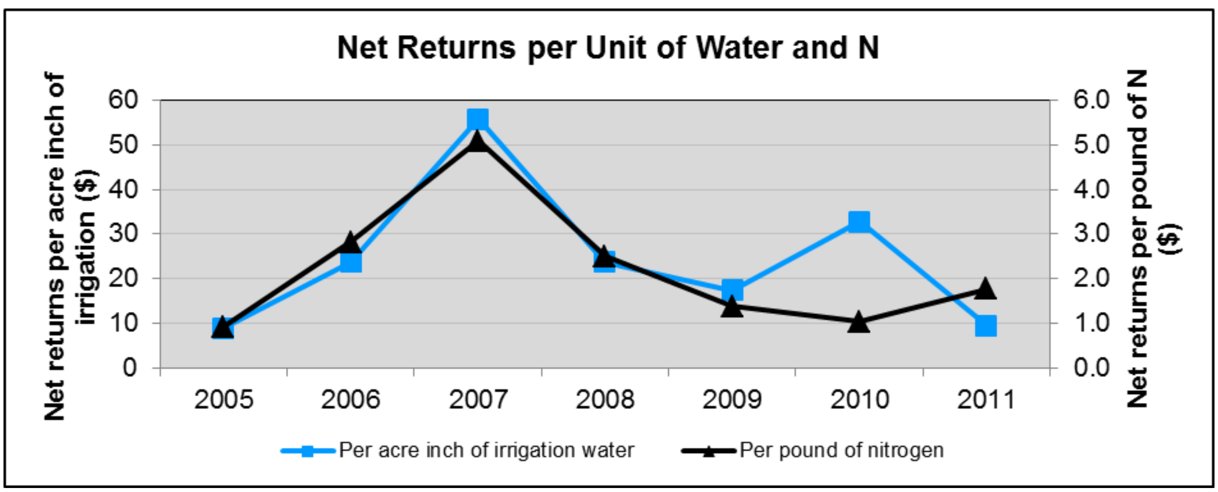
July 1- Cotton

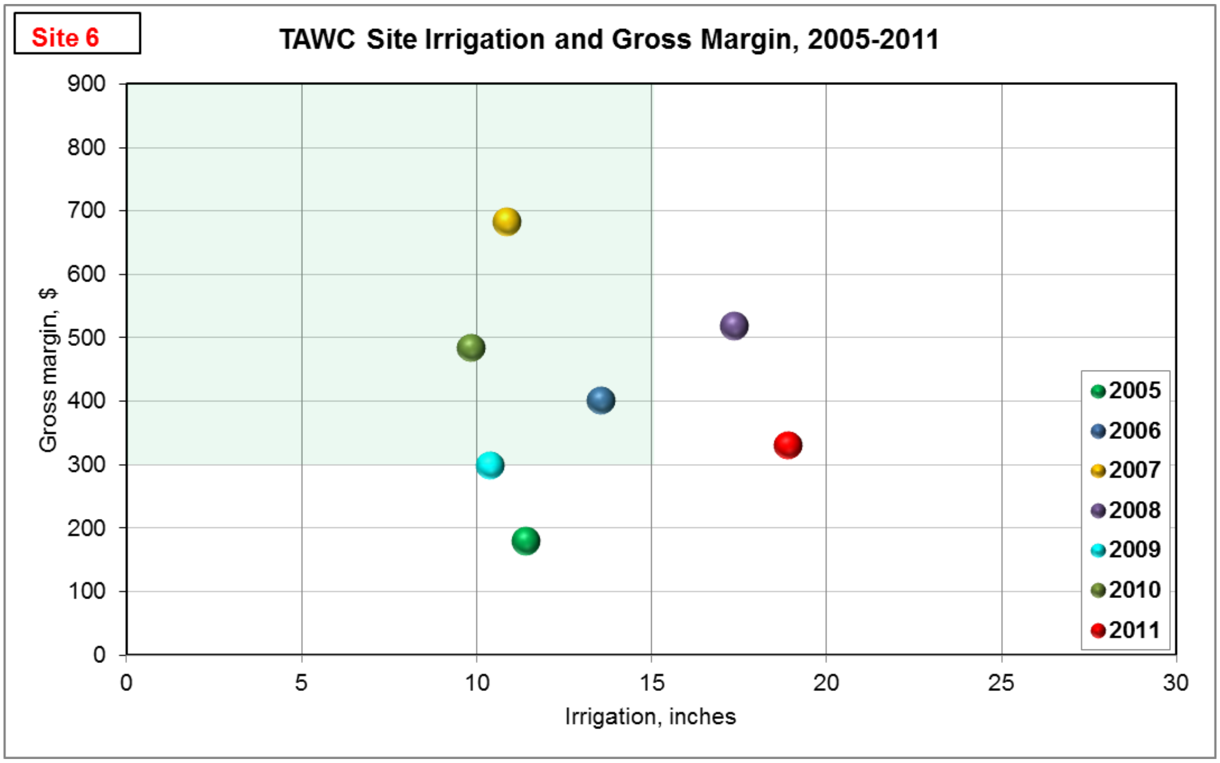
Corn burning in field

System 6

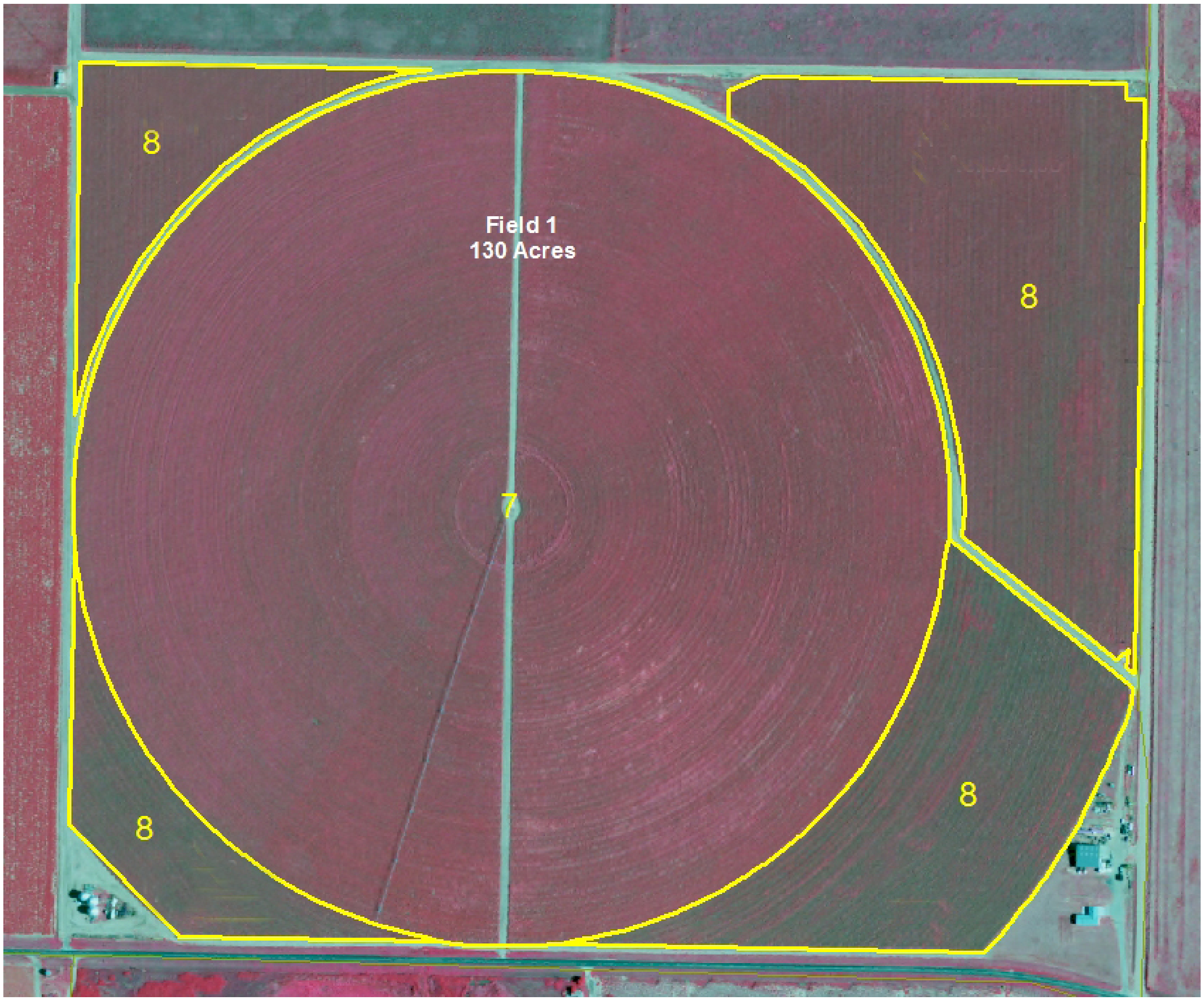

Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
700
600
500
400
300
200
100
0
2005
2006
2007
2008
2009
2010
2011
Per system acre


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



Site 6
TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $
Irrigation, inches
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
2005
2006
2007
2008
2009
2010
2011



System 7 Description

Total system acres: 130.0

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

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 500

Number of wells: 4

Fuel source: Electric

System 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

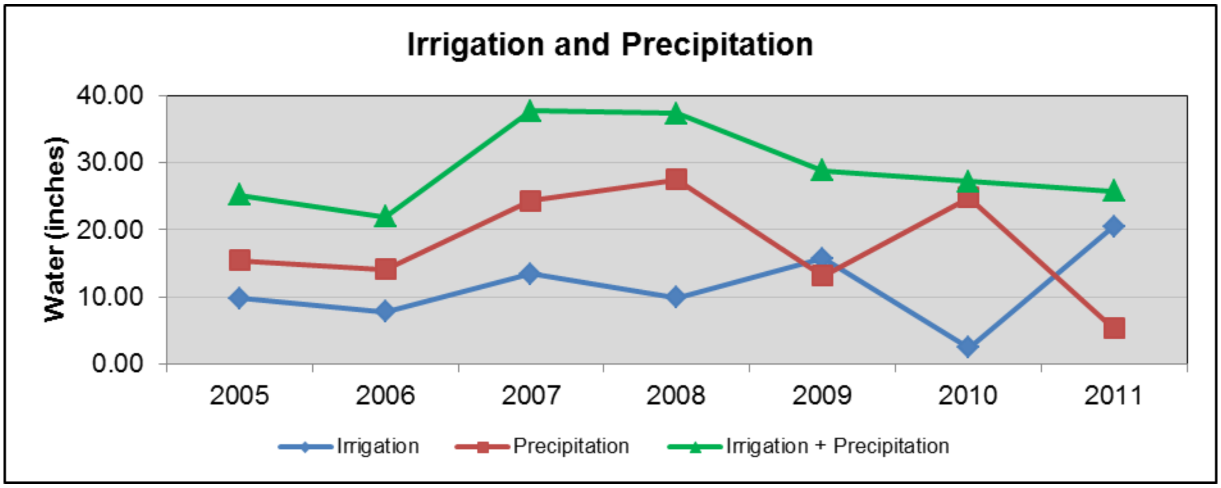
Comments: This is a pivot irrigated field of side-oats grama grown for seed production and the grass residue is round baled for hay and sold. This field was established to grass seventeen years ago.

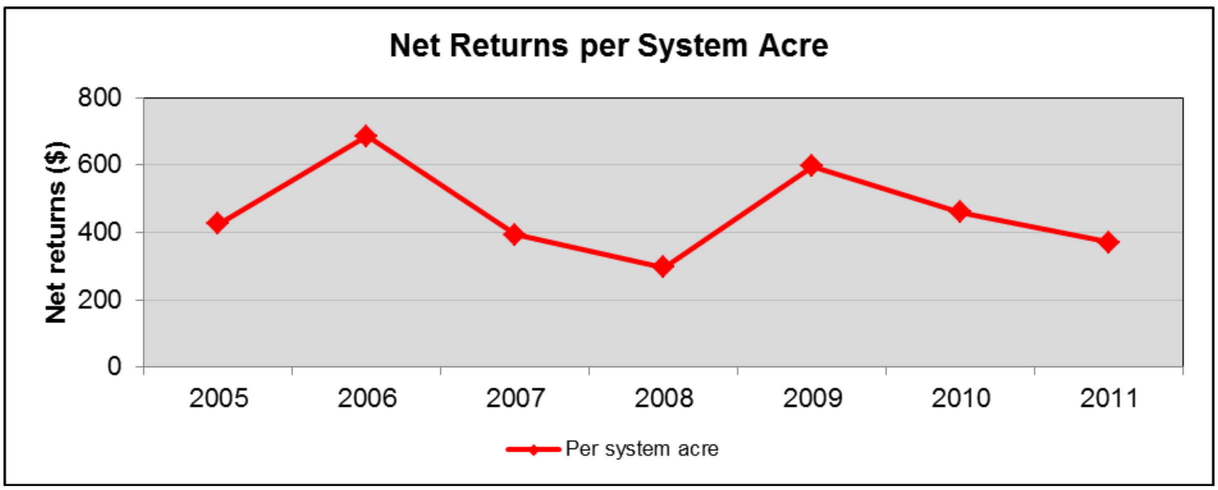
Pictures from Drought Year of 2011

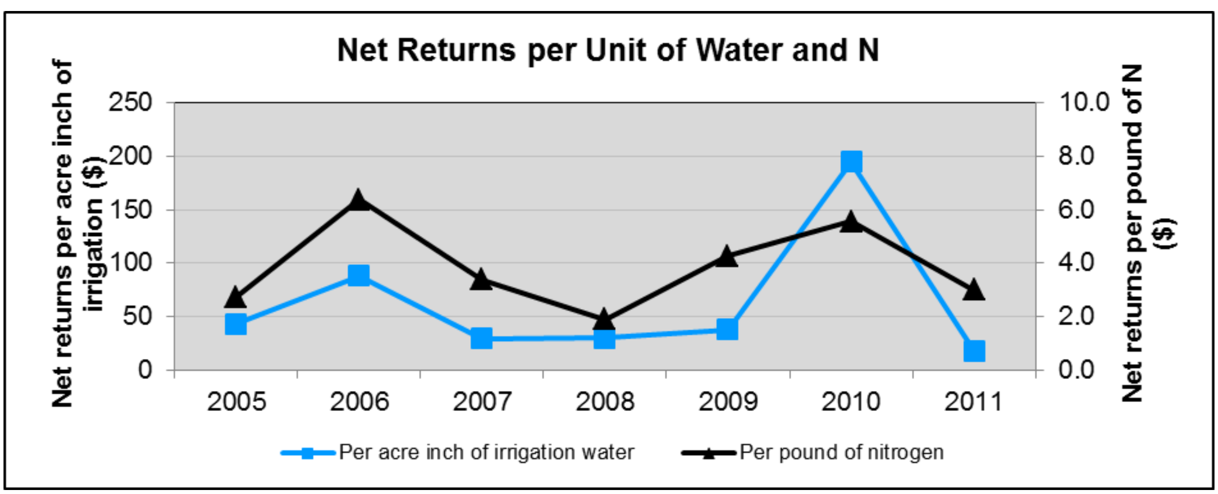
Sideoats grama in field

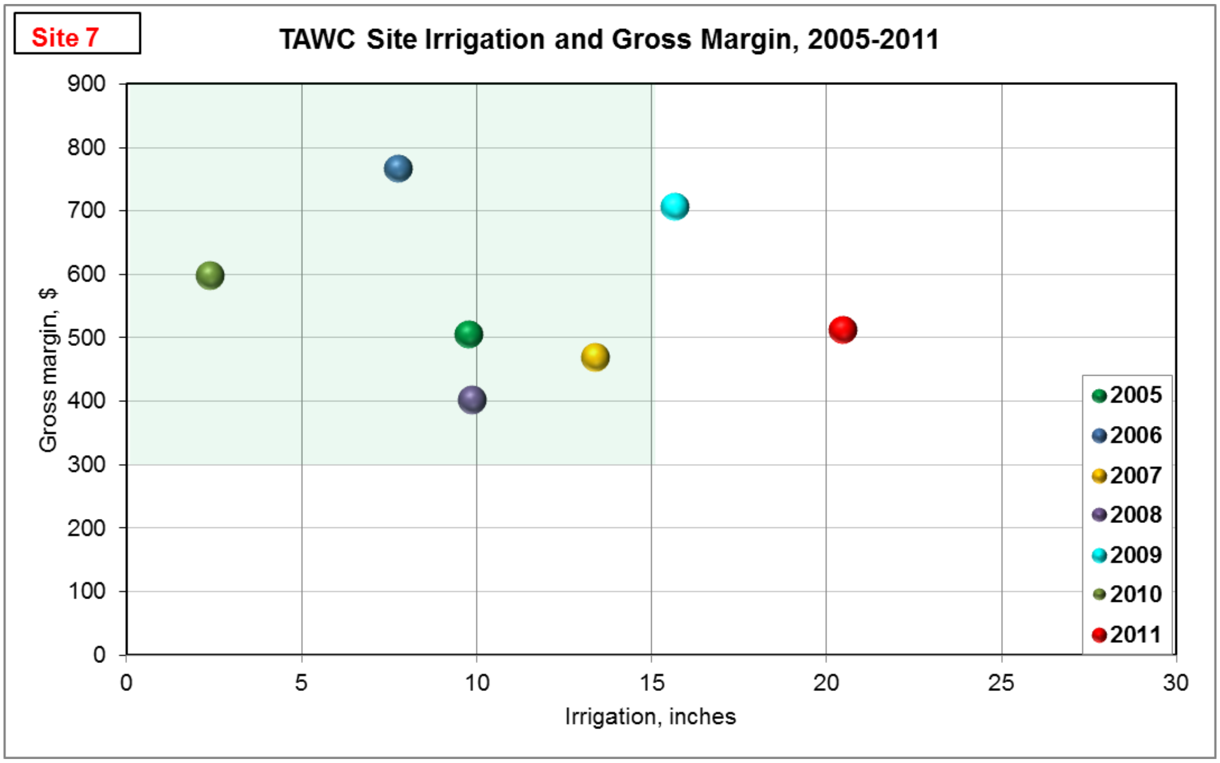
Harvesting Hay

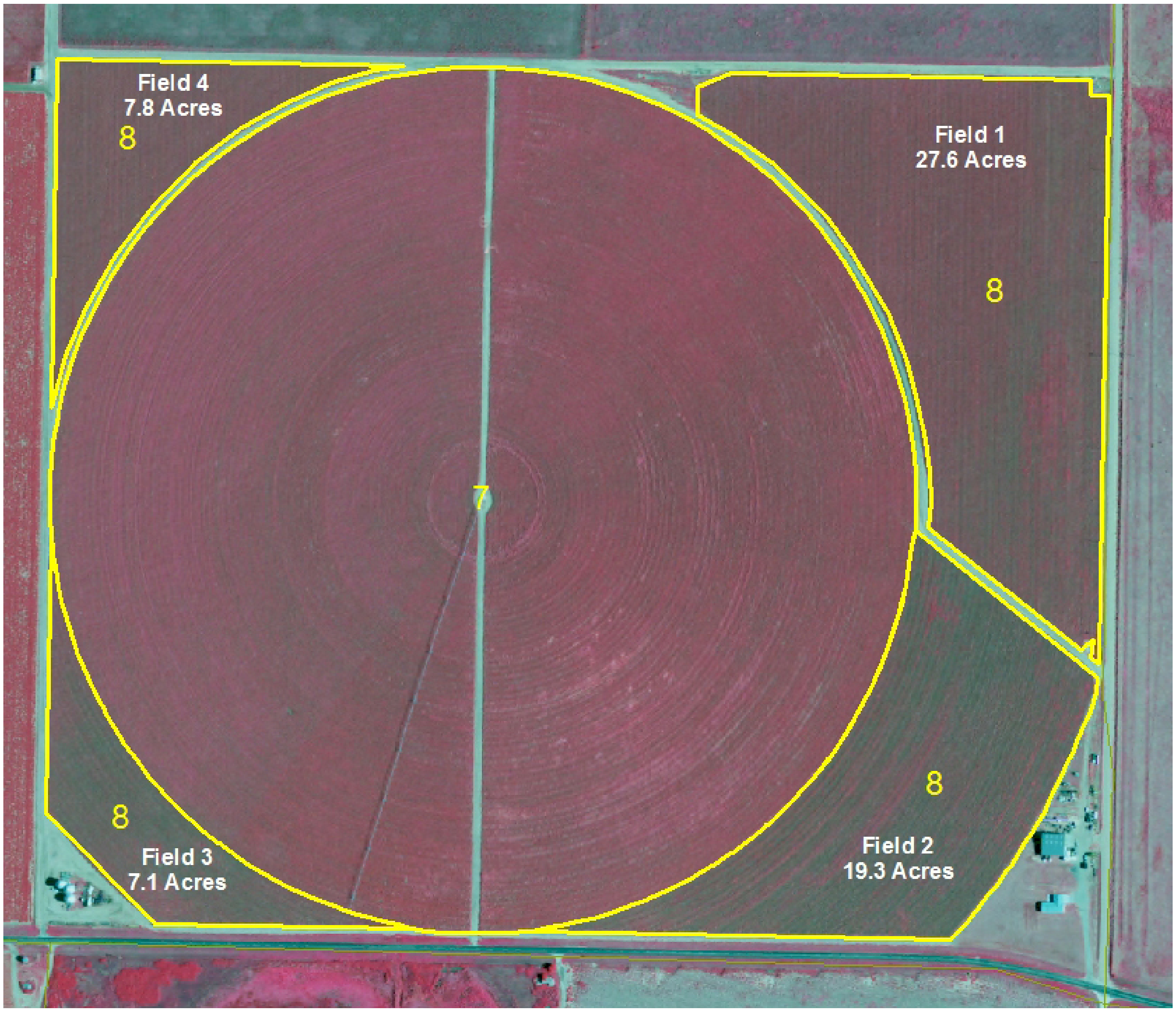
System 7


Irrigation and Precipitation
Water (inches)
40.00
30.00
20.00
10.00
0.00
2005
2006
2007
2008
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation


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


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


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



System 8 Description

Total system acres:	61.8
Field No. 1 Acres:	27.6
Major soil type:	Pullman clay loam, 0 to 1% slope
Field No. 2 Acres:	19.3
Major soil type:	Pullman clay loam, 0 to 1% slope
Field No. 3 Acres:	7.1
Major soil type:	Pullman clay loam, 0 to 1% slope
Field No. 4 Acres:	7.8
Major soil type:	Pullman clay loam, 0 to 1% slope

Irrigation

Type:	Sub-surface Drip (SDI)
Pumping capacity, gal/min:	360
Number of wells:	4
Fuel source:	Electric

System 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

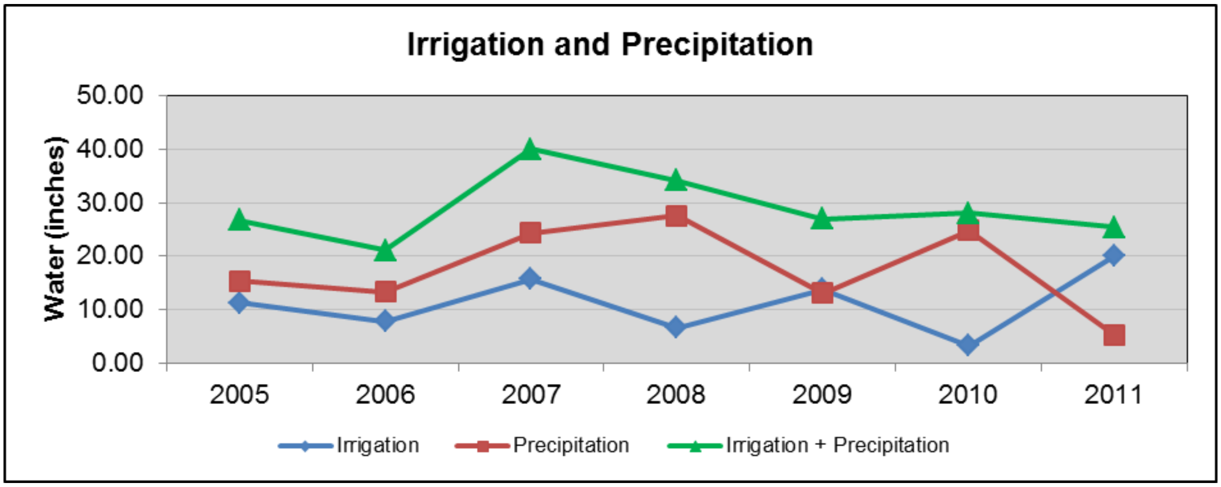
Comments: This is a drip irrigated field of side-oats grama grown for seed production and the grass residue is round baled for hay and sold. These four fields were put into drip irrigation eight years ago. Prior to the installation of drip these fields were furrow irrigated.

Pictures from Drought Year of 2011

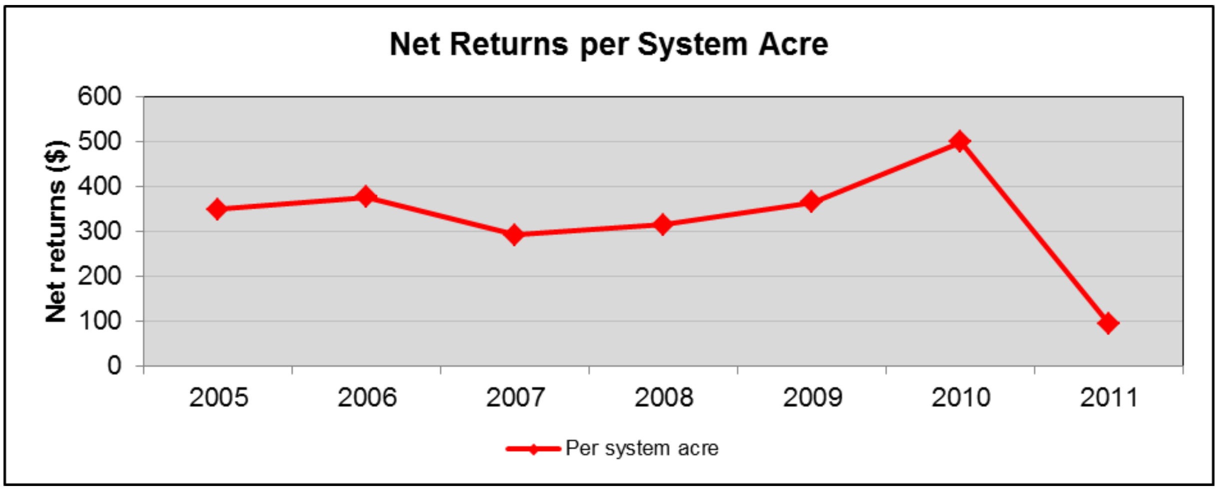
Sideoats awaiting harvest

Round baled sideoats grama

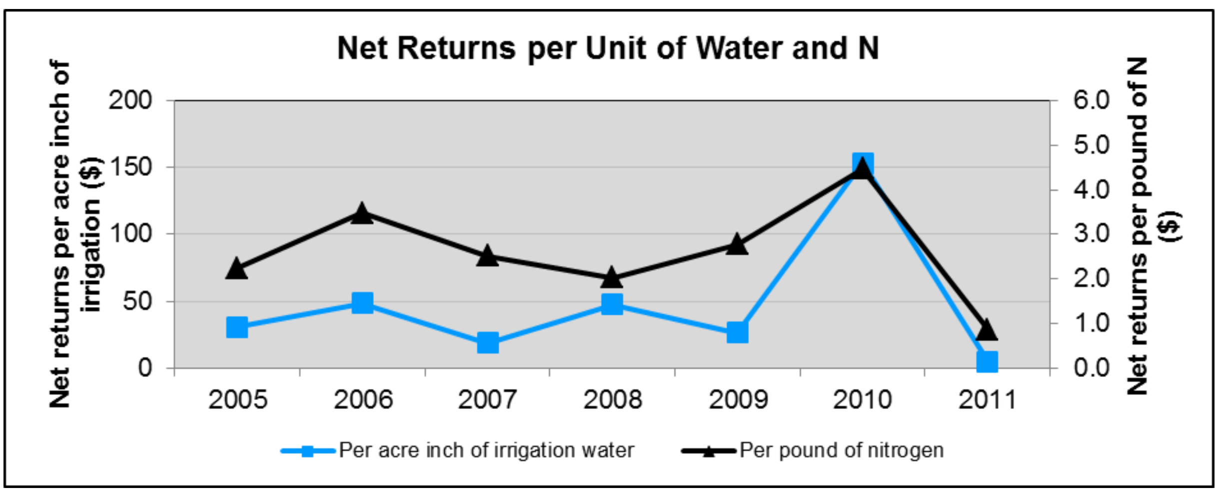
System 8



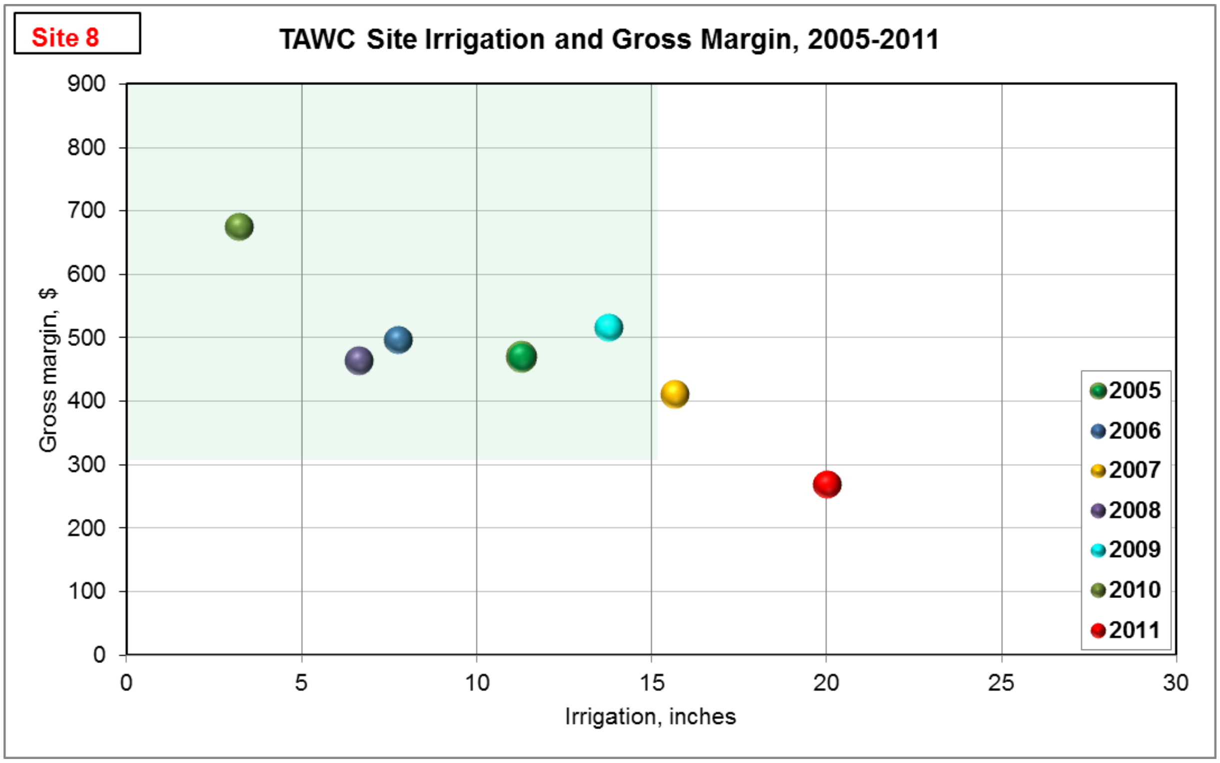
Irrigation and Precipitation
Water (inches)
50.00
40.00
30.00
20.00
10.00
0.00
2005
2006
2007
2008
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation

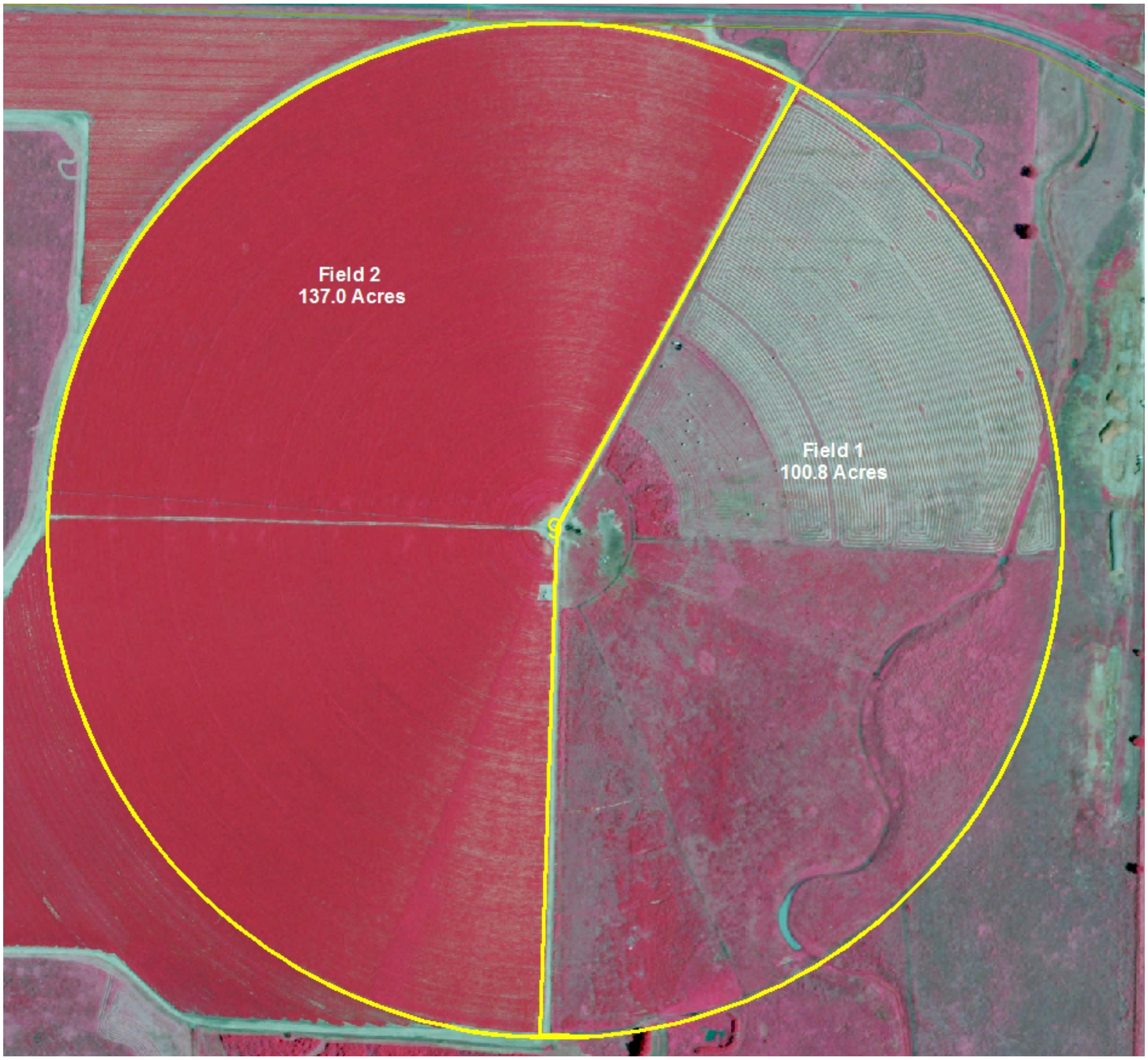


Net Returns per System Acre
Net returns ($)
600
500
400
300
200
100
0
2005
2006
2007
2008
2009
2010
2011
Per system acre



Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
200
150
100
50
0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
2010
2011
Per acre inch of irrigation water
Per pound of nitrogen


Site 8
TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $
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



System 9 Description

Total system acres: 237.8

Field No. 1 Acres: 100.8
Major soil type: Mixed shallow soils

Field No. 2 Acres: 137.0
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (MESA)
Pumping capacity, gal/min: 900

Number of wells: 4

Fuel source: 2 Natural gas
2 Diesel

System 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

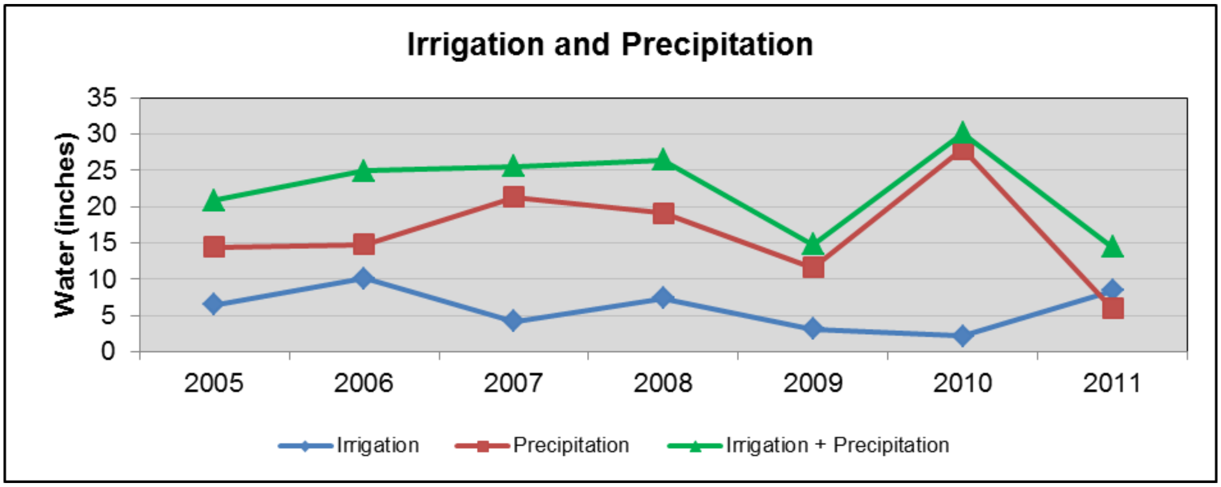
Comments: This site was returned to conventional tillage after eleven years of no-till production. Field 1 is predominantly kleingrass and used for cow-calf production. Field 2 was planted to cotton on forty-inch centers.

Pictures from Drought Year of 2011

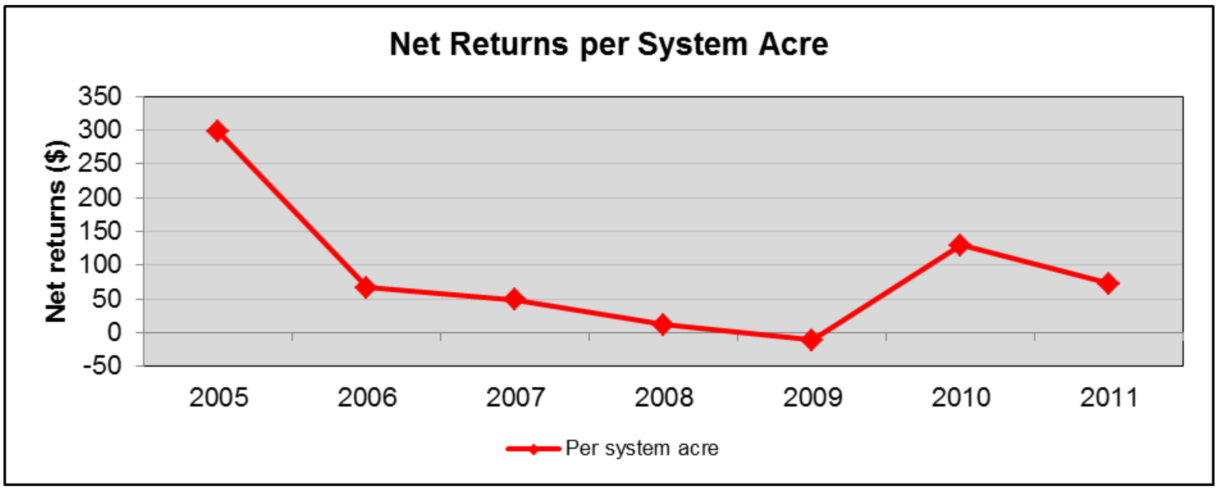
Animals grazing in the background

Cotton ready for harvest

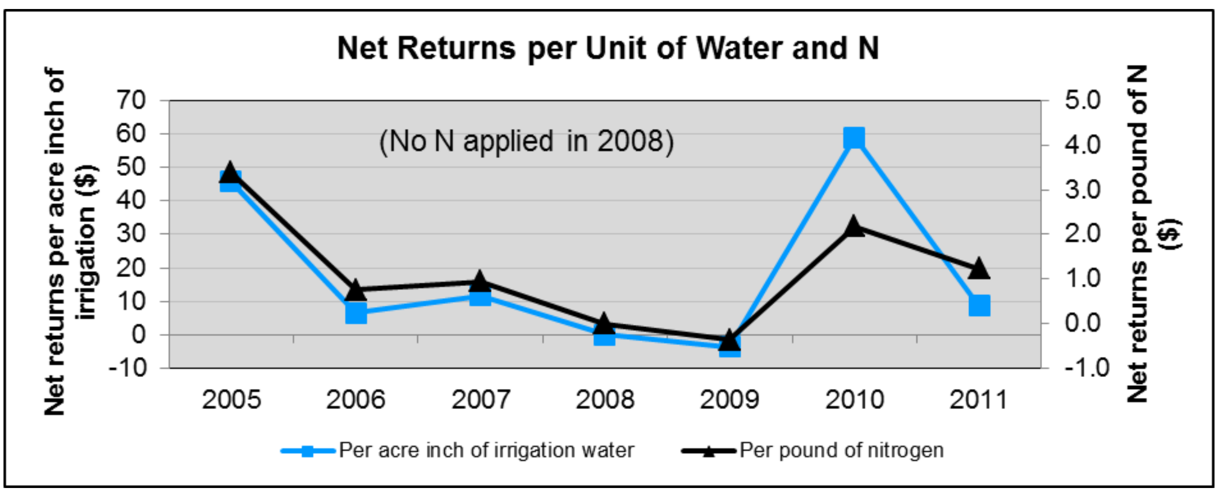
System 9



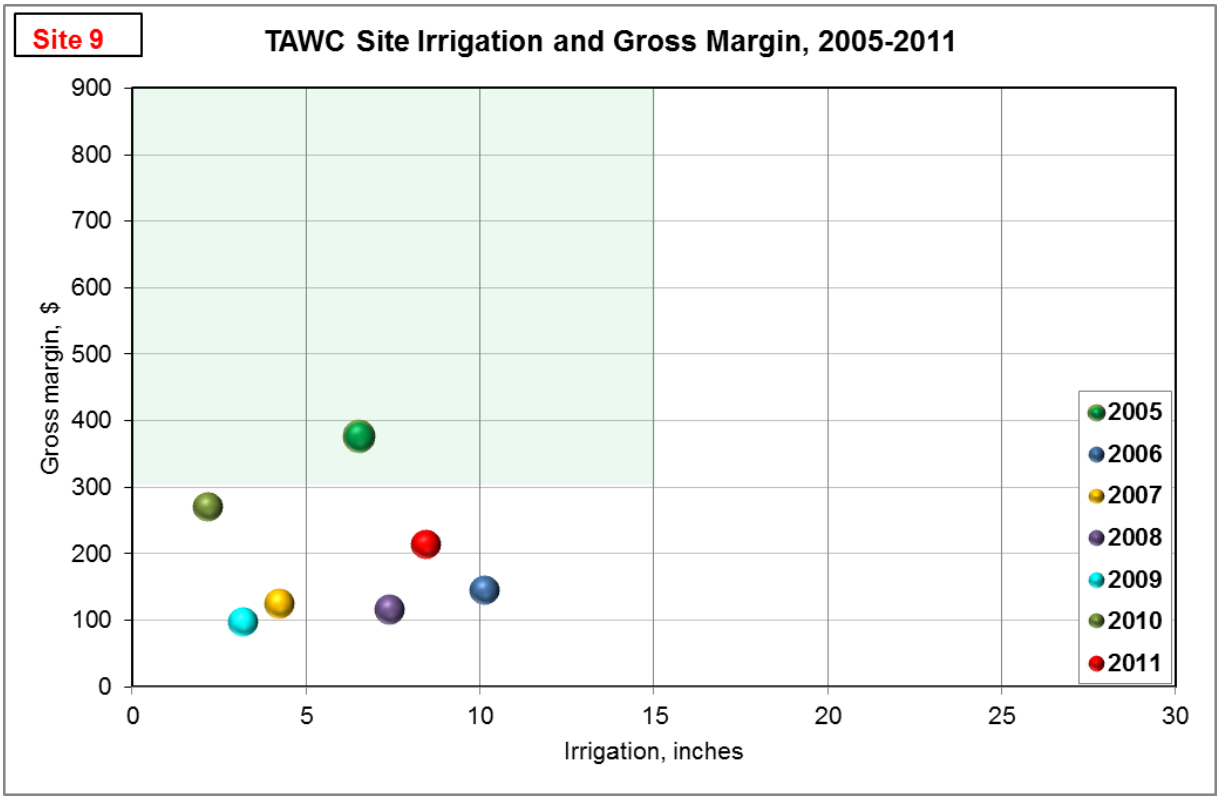
Irrigation and Precipitation
Water (inches)
35
30
25
20
15
10
5
0
2005
2006
2007
2008
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation

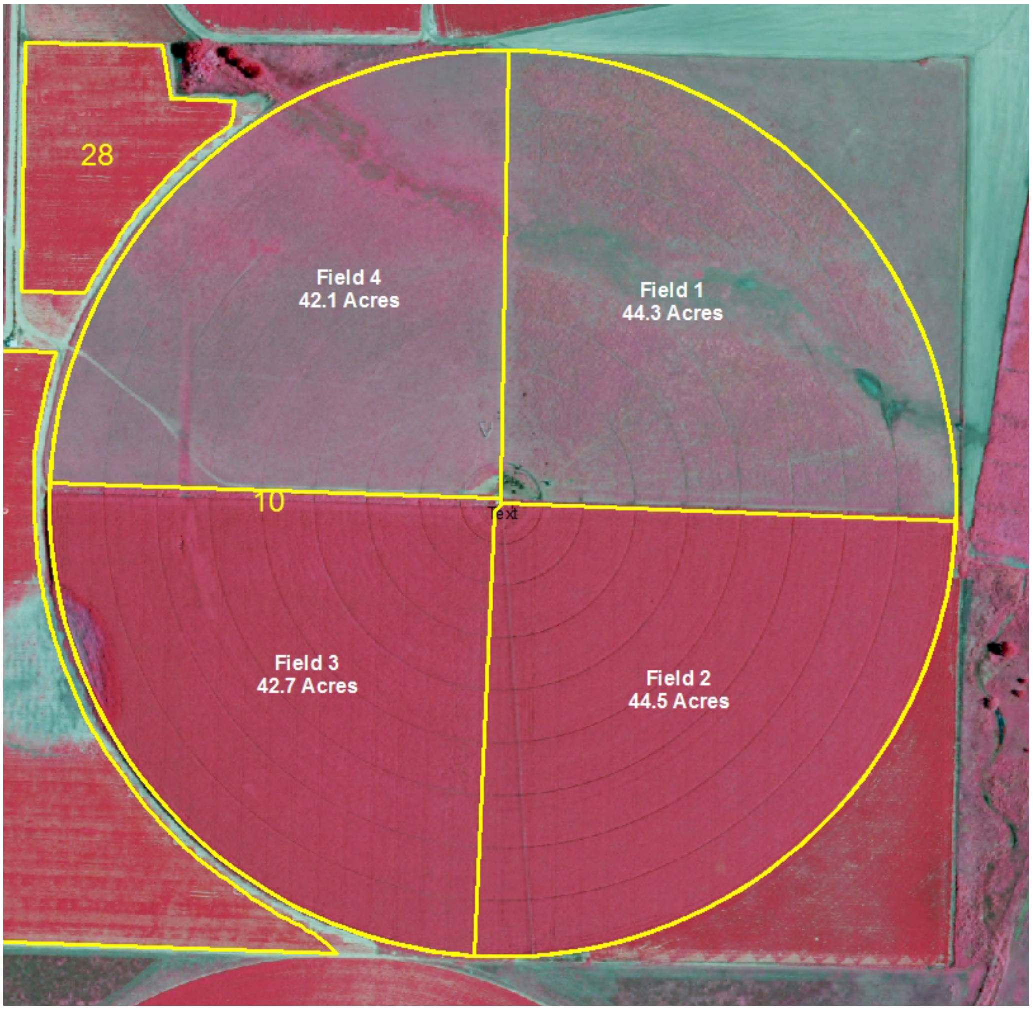


Net Returns per System Acre
Net returns ($)
350
300
250
200
150
100
50
0
-50
2005
2006
2007
2008
2009
2010
2011
Per system acre



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


Site 9
TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $
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



System 10 Description

Total system acres: 173.6

Field No. 1 Acres: 44.3
Major soil type: Pullman clay loam; 0 to 1% slope
Lofton clay loam; 0 to 1% slope
Estacado clay loam; 0 to 1% slope

Field No. 2 Acres: 44.5
Major soil type: Pullman clay loam; 0 to 1% slope
Estacado clay loam; 0 to 1% slope

Field No. 3 Acres: 42.7
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 4 Acres: 42.1
Major soil type: Pullman clay loam; 0 to 1 and 1 to 3% slope
Lofton clay loam; 0 to 1% slope

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

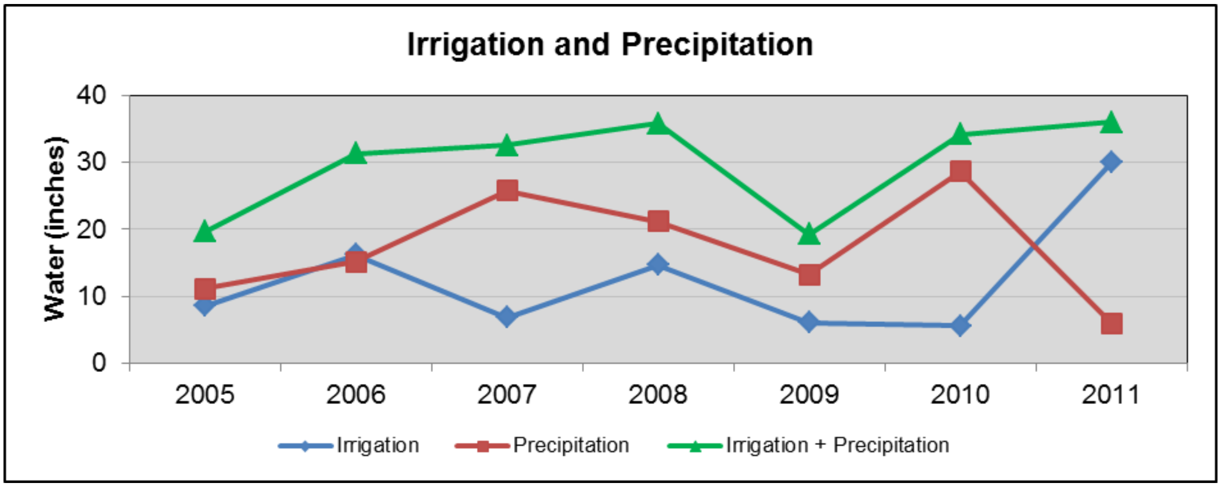
Comments: This is a two cell, pivot irrigated row crop, improved forage, cow-calf system. Old-world bluestem and Bermuda grass are used in rotation for livestock grazing. One-half of this system was planted to cotton on forty-inch centers for 2011.

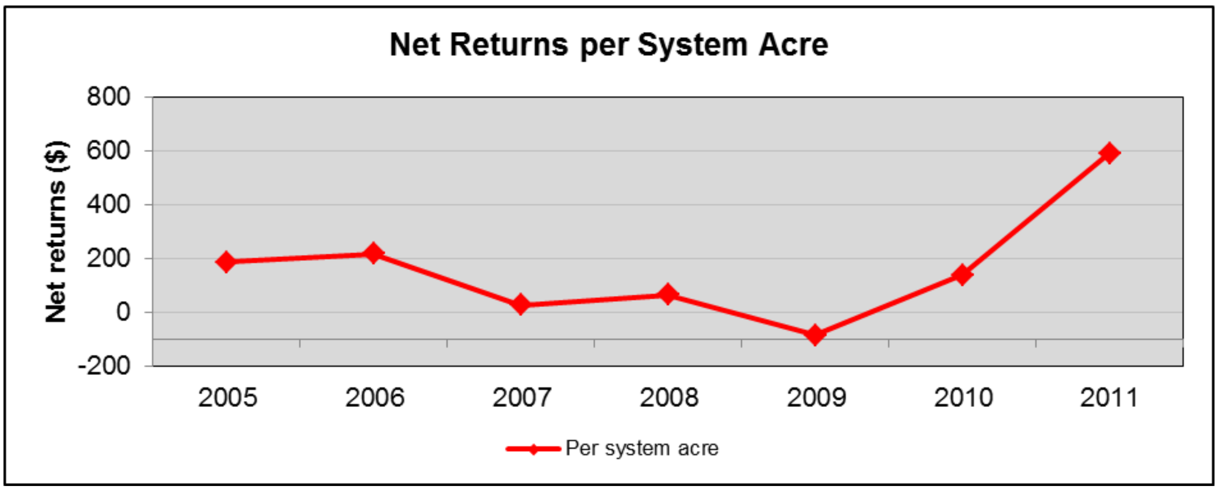
Pictures from Drought Year of 2011

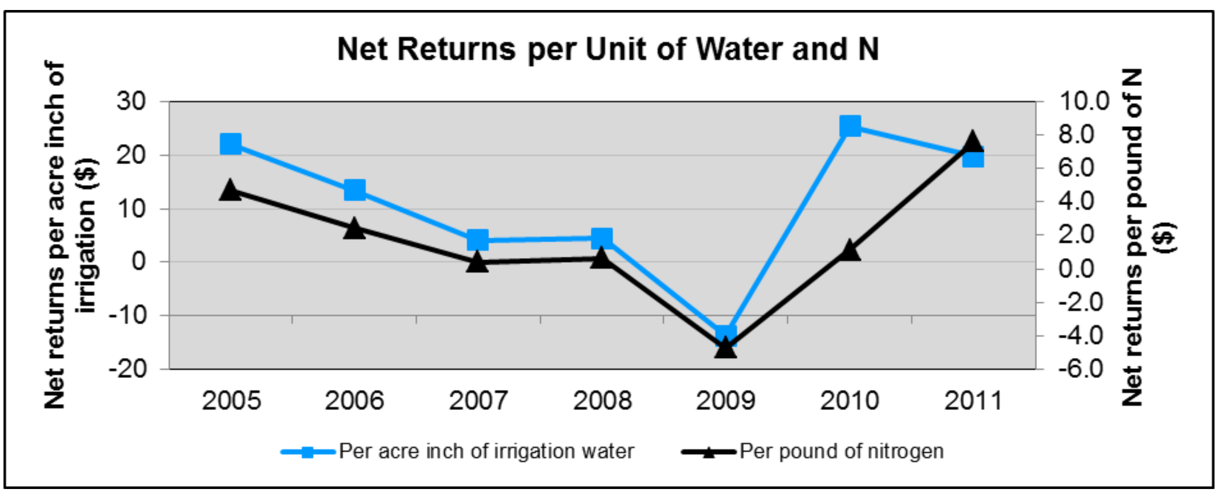
Excellent cotton harvest in dry year

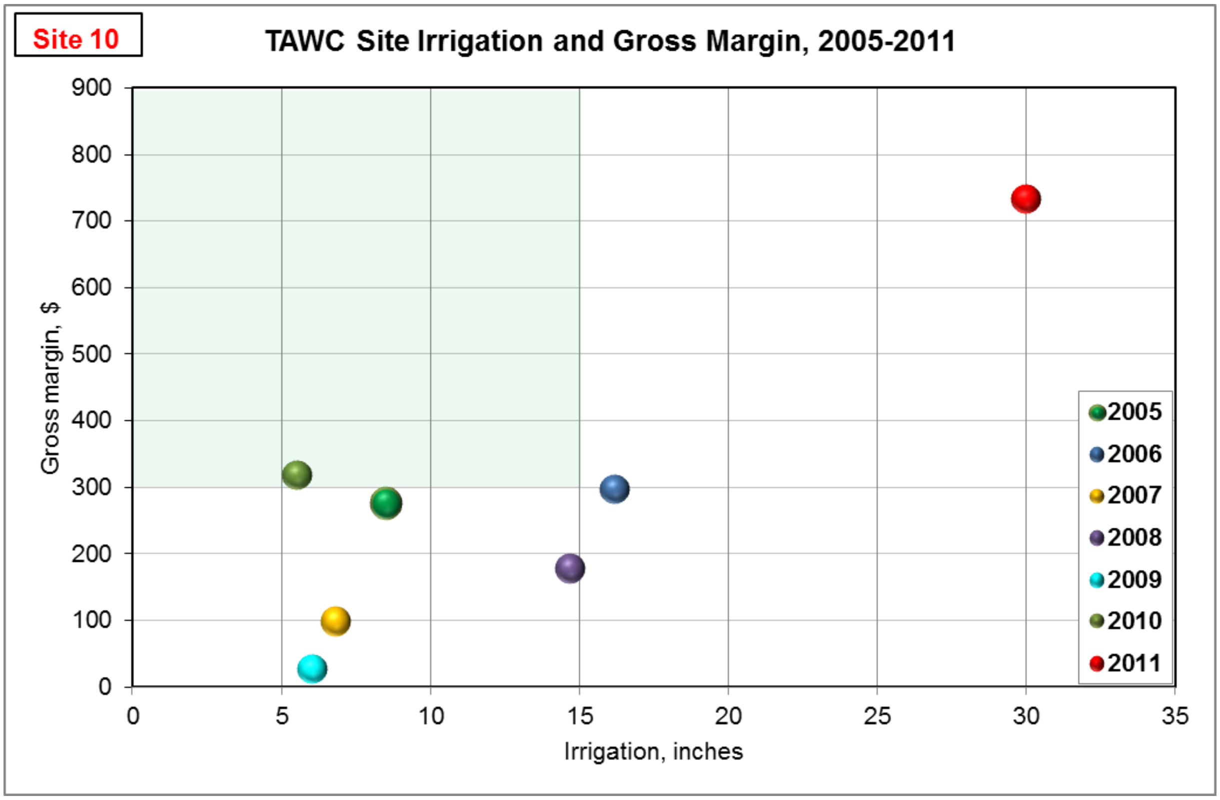
Cattle supplementation

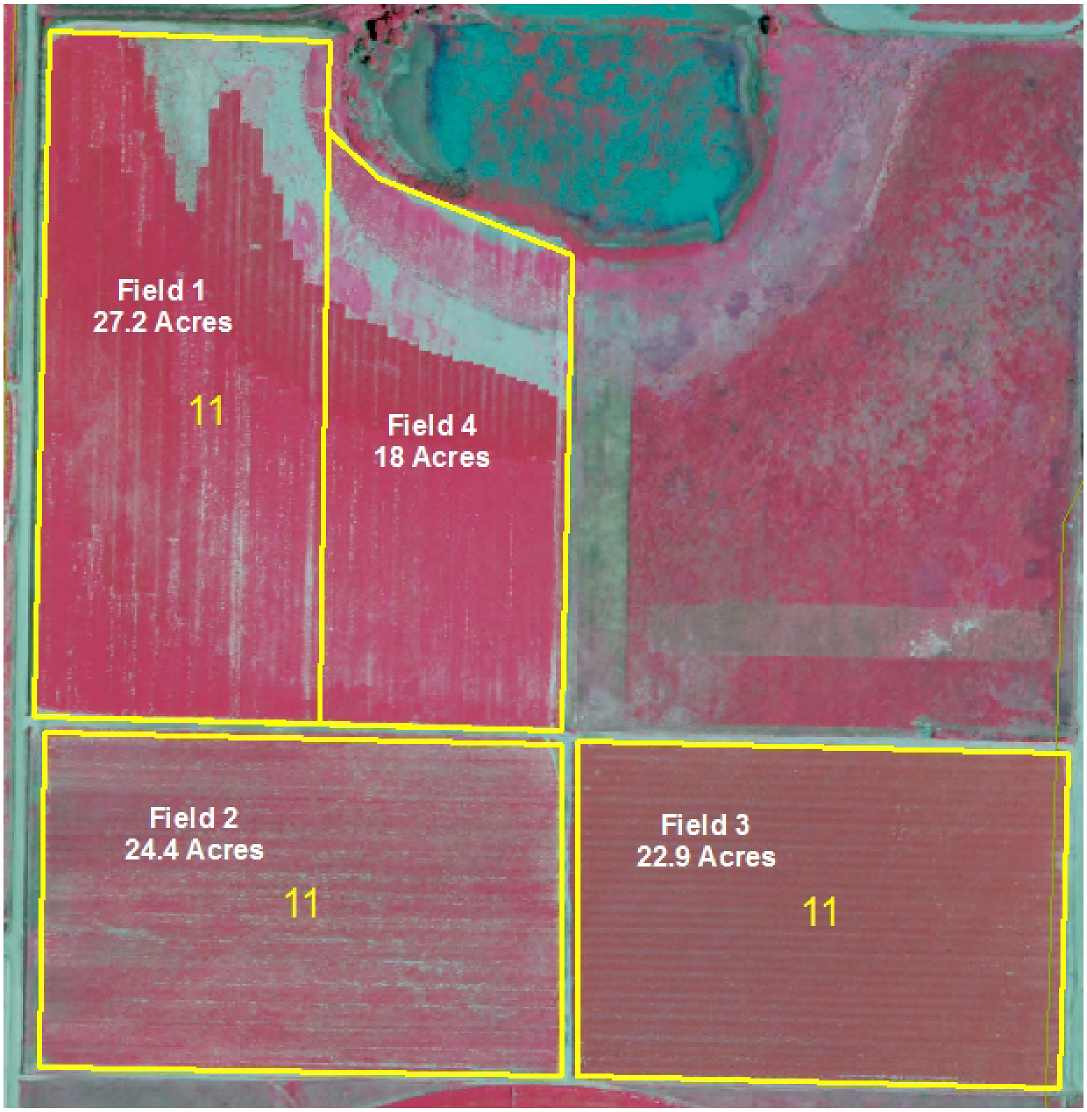
System 10


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


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


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


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



System 11 Description

Total system acres: 92.5

Field No. 1 Acres: 45.2
Major soil type: Lofton clay loam; 0 to 1% slope
Olton clay loam; 1 to 3% slope

Field No. 2 Acres: 24.4
Major soil type: Pullman clay loam; 0 to 3% slope

Field No. 3 Acres: 22.9
Major soil type: Pullman clay loam; 0 to 3% slope

Field No. 4 Acres: 18.0
Major soil type: Pullman clay loam; 0 to 3% slope

Irrigation

Type: Furrow

Pumping capacity, gal/min: 490

Number of wells: 1

Fuel source: Electric

System 11

	Livestock	Field 1	Field 2	Field 3	Field 4
2005	None	Cotton following Wheat cover crop	Cotton	Cotton	
2006	None	Cotton	Cotton	Cotton	
2007	None	Cotton	Cotton	Cotton	
2008	None	Grain Sorghum	Cotton	Cotton	
2009	None	Cotton	Grain sorghum	Cotton	
2010	None	Cotton	Cotton	Grain Sorghum	
2011	None	Cotton	Cotton	Cotton	Grain Sorghum

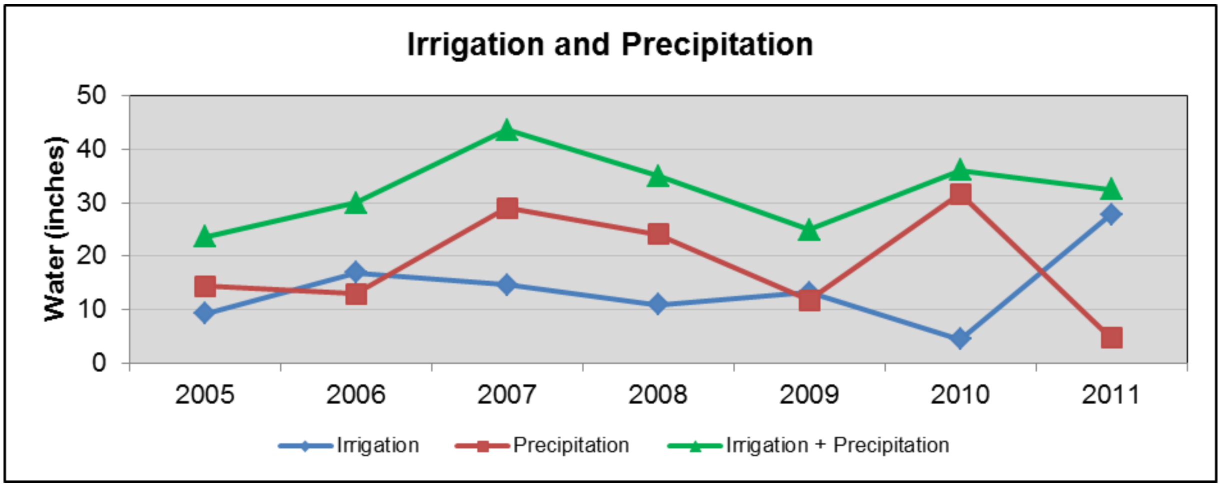
Comments: This is a furrow irrigated cotton and grain sorghum system using conventional tillage and planted on forty-inch centers.

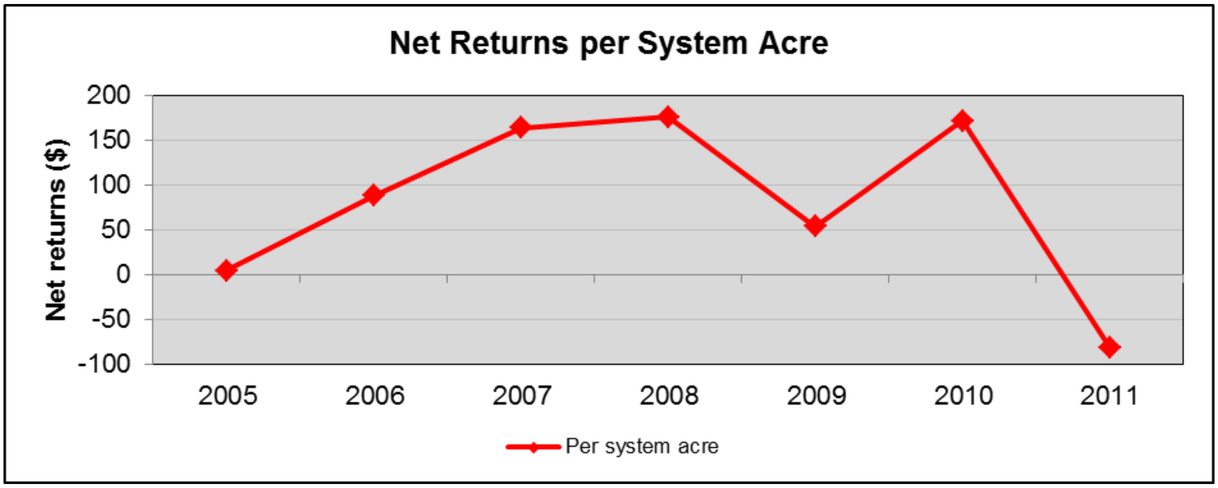
Pictures from Drought Year of 2011

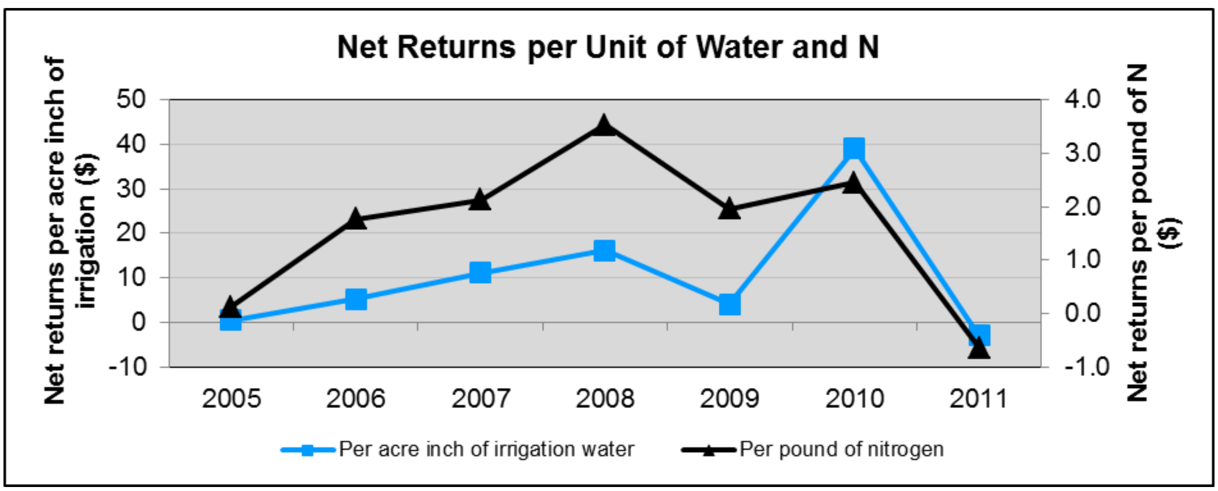
Cotton so-far-so good

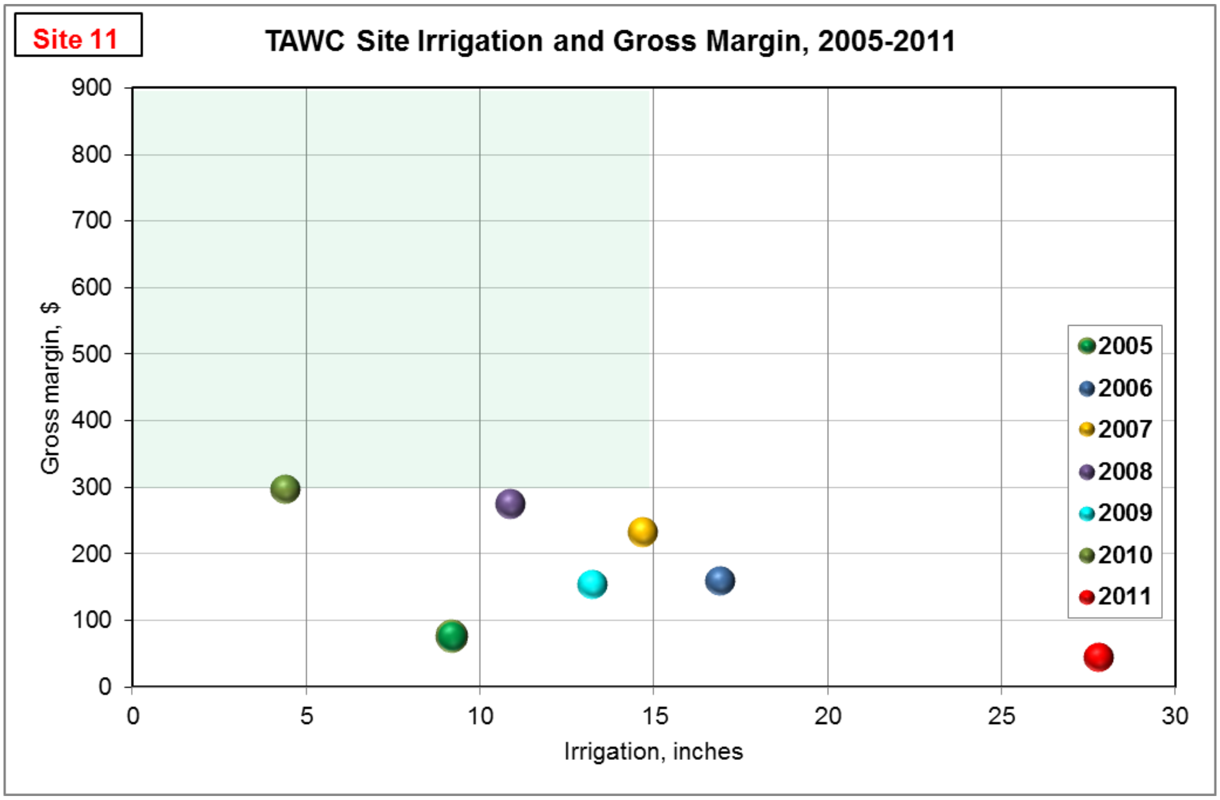
Grain Sorghum needing water

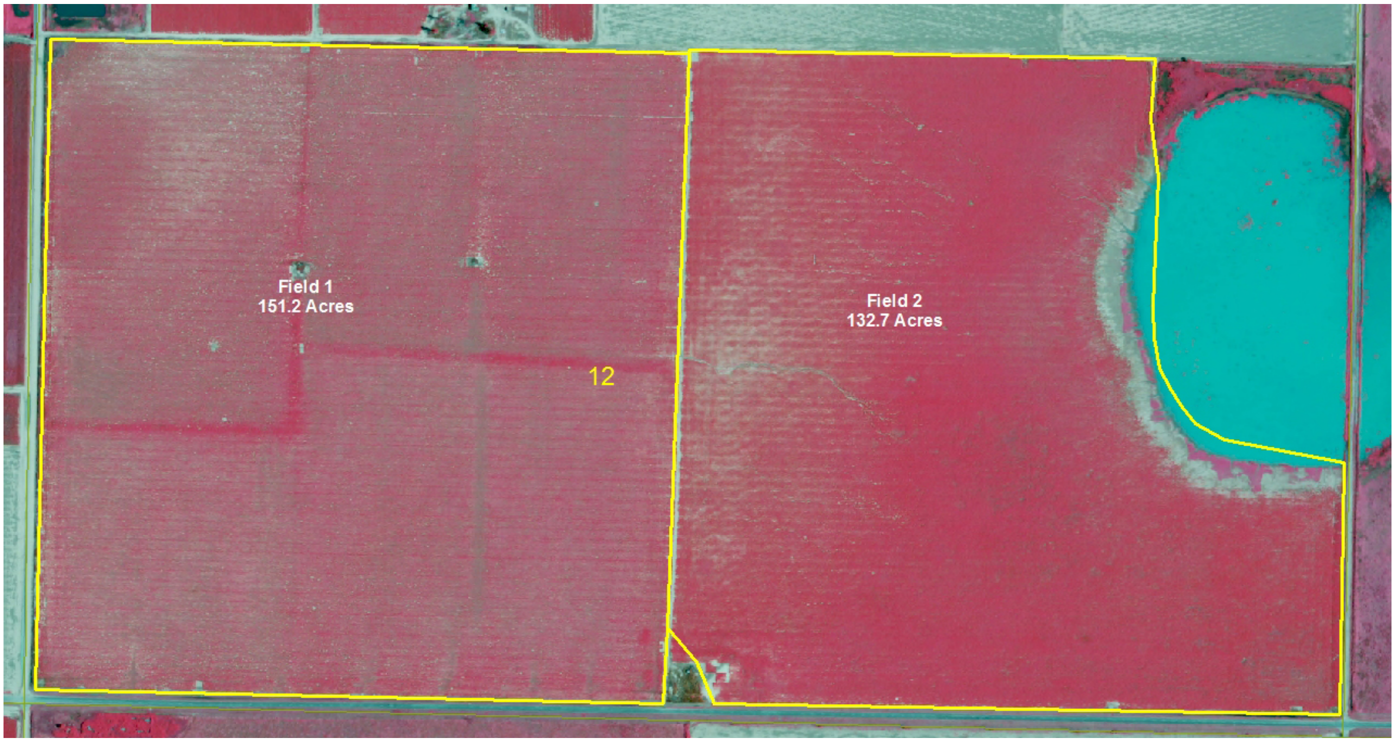
System 11


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


Net Returns per System Acre
Net returns ($)
200
150
100
50
0
-50
-100
2005
2006
2007
2008
2009
2010
2011
Per system acre


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


Site 11
TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $
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



System 12 Description

Total system acres:	283.9
Field No. 1 Acres:	151.2
Major soil type:	Pullman clay loam; 0 to 1% slope
Field No. 2 Acres:	132.7
Major soil type:	Pullman clay loam; 0 to 1% slope

Irrigation

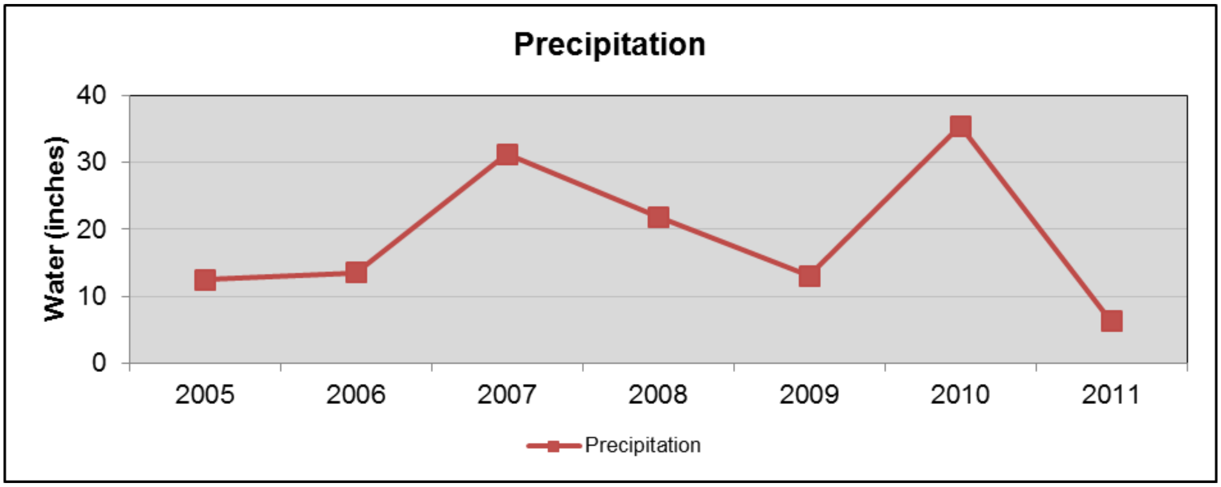
Type:	Dryland
Pumping capacity, gal/min:	na
Number of wells:	na
Fuel source:	na

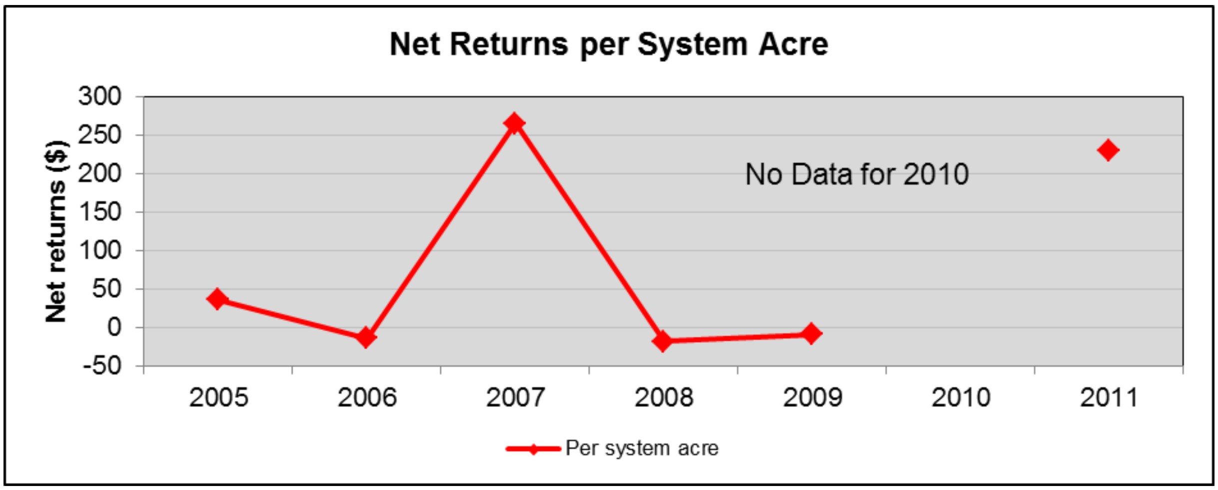
System 12 – Dryland Site

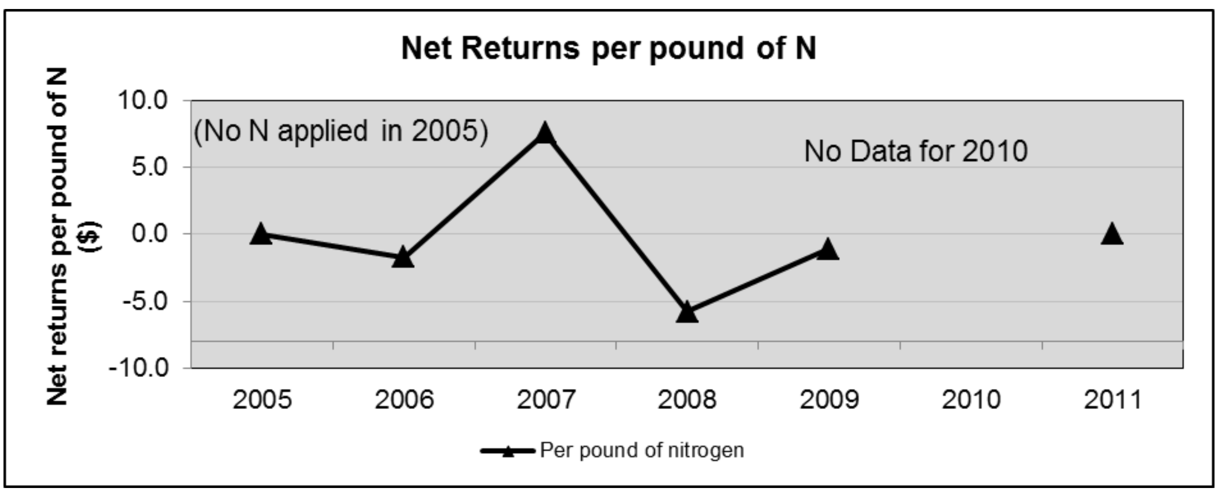
	Livestock	Field 1	Field 2
2005	None	Cotton following Wheat cover crop	Forage Sorghum for cover following Wheat
2006	None	Wheat for grain	Cotton following previous year cover of Forage Sorghum
2007	None	Cotton	Grain Sorghum following Wheat cover crop
2008	None	Grain Sorghum for silage	Fallow, volunteer Wheat for cover crop
2009	None	Grain Sorghum for silage	Fallow
2010	None	Cotton	Cotton
2011	None	Cotton	Cotton

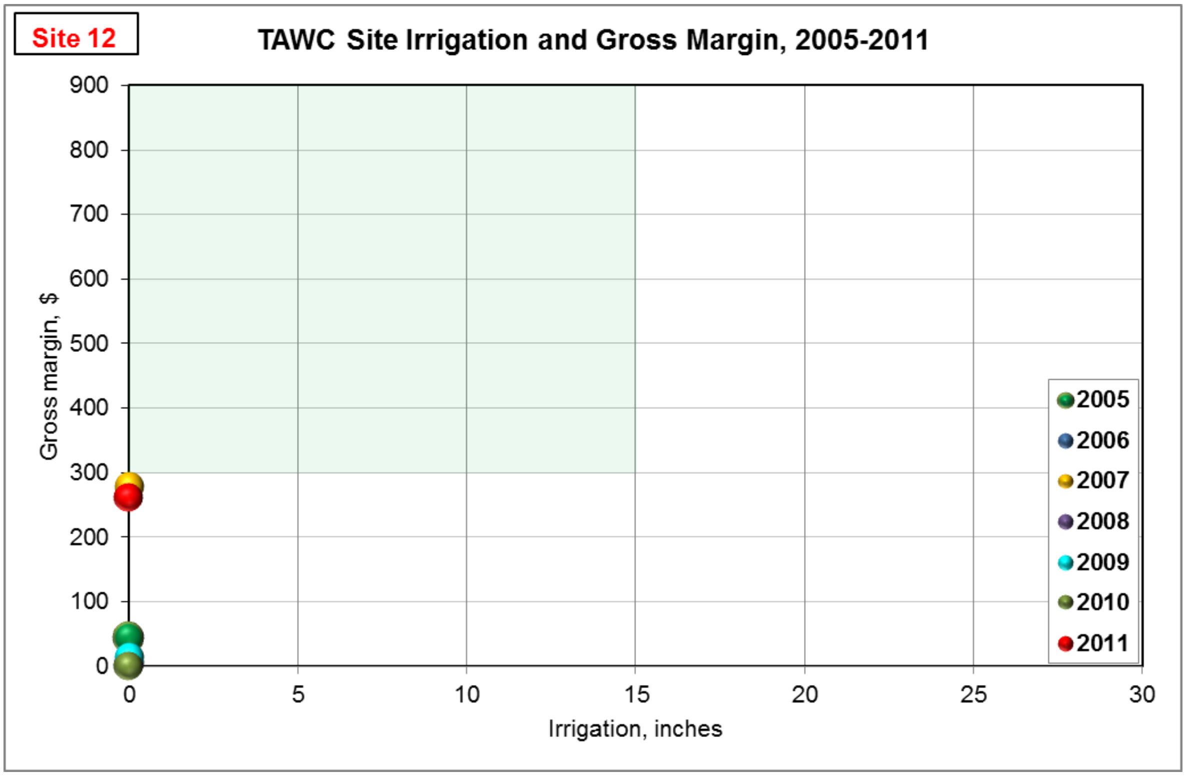
Comments: This dryland system uses cotton, grain sorghum and wheat in rotation. Was planted to cotton in 2011 but never emerged.

System 12 – Dryland Site

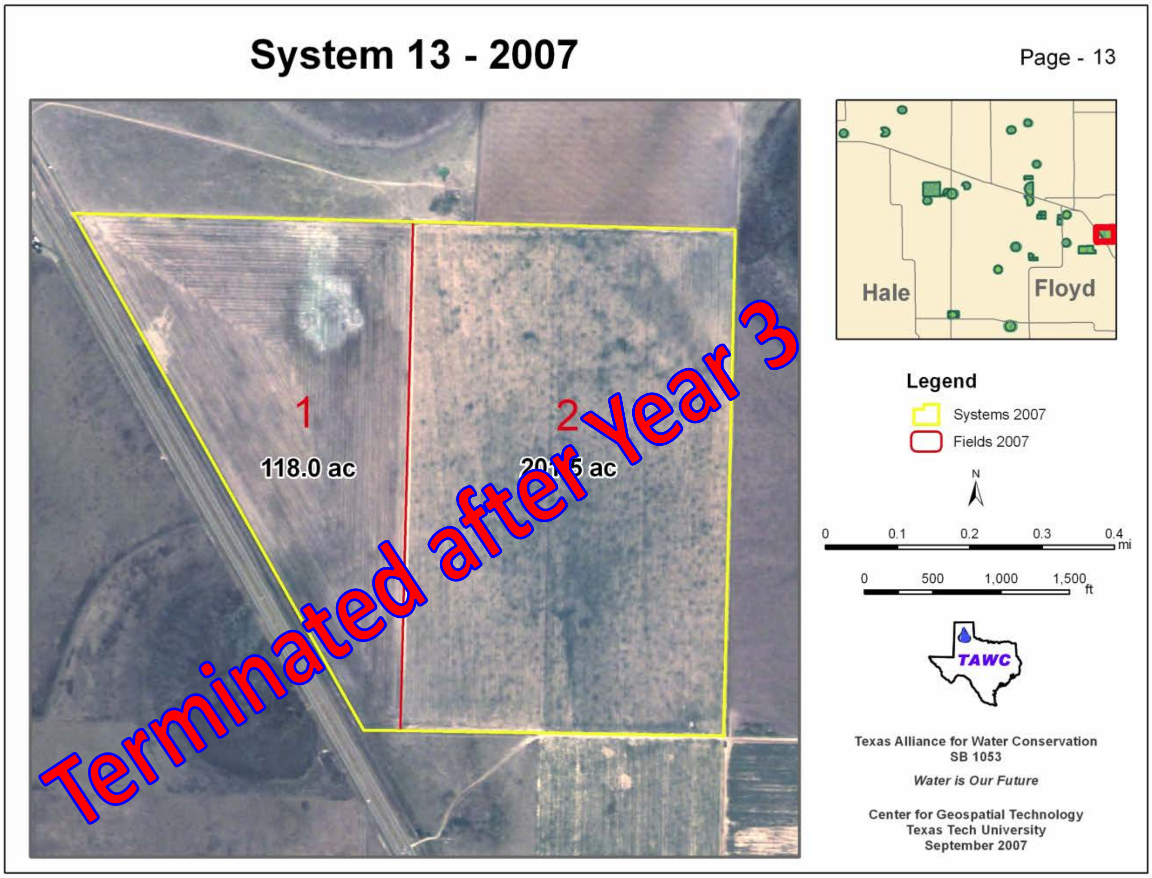








Dryland Site



System 13 Description

Total system 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:

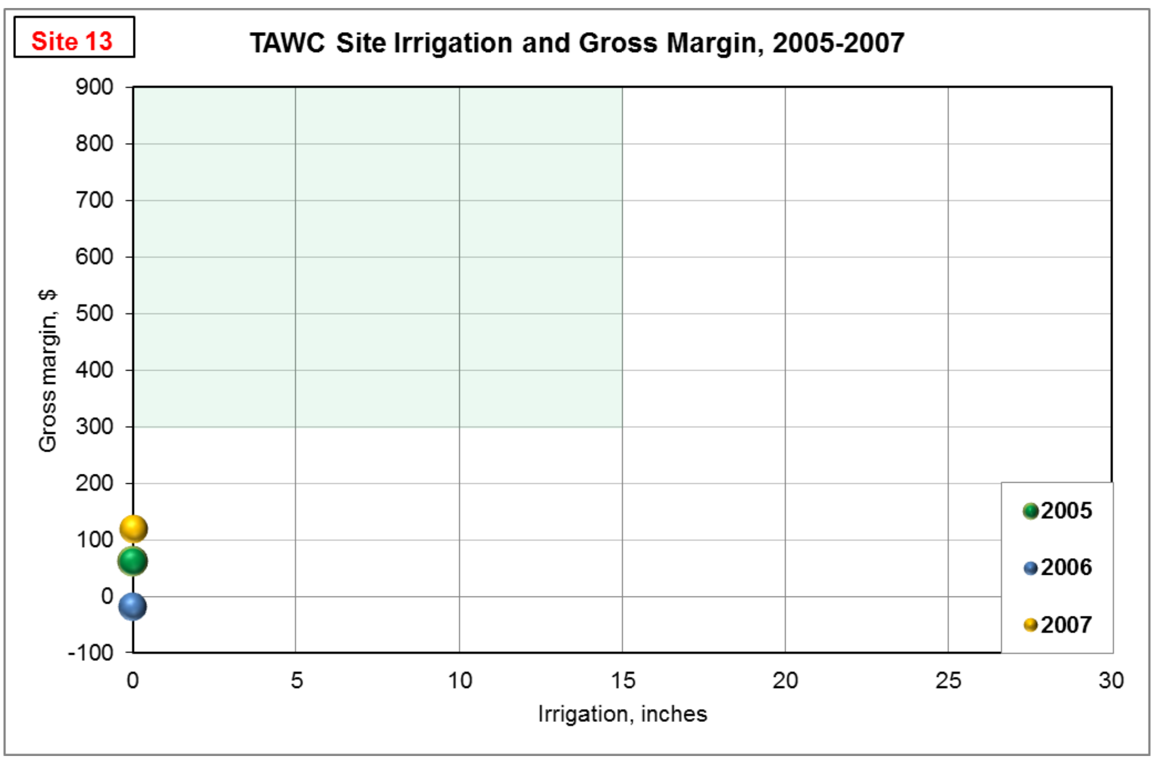
Number of wells:

Fuel source:

Comments: This dryland site uses cotton and small grains in rotation. Cotton is planted on forty-inch centers under limited tillage. Small grains are drilled after cotton harvest.

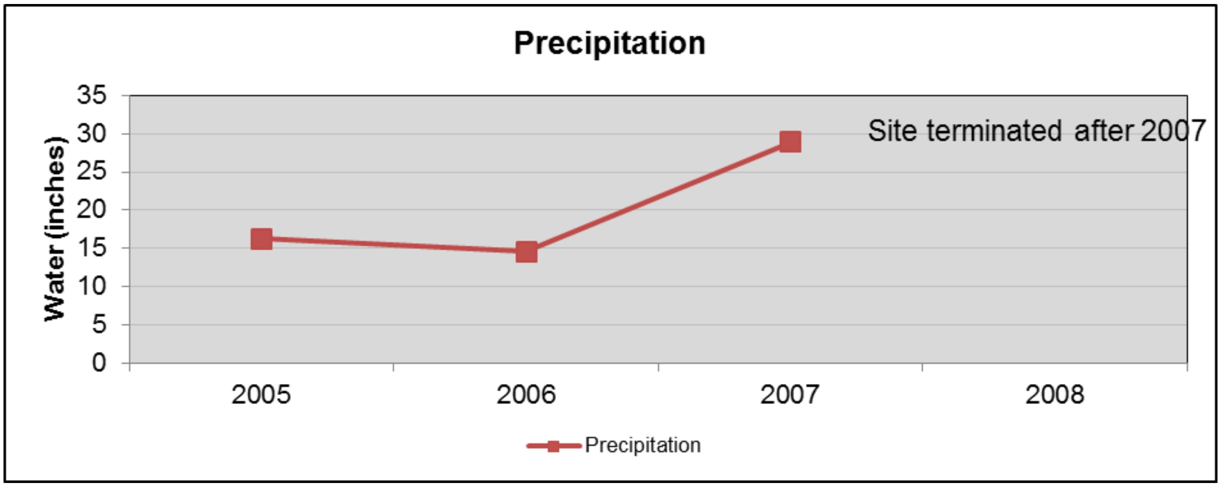
System 13-
Dryland Site

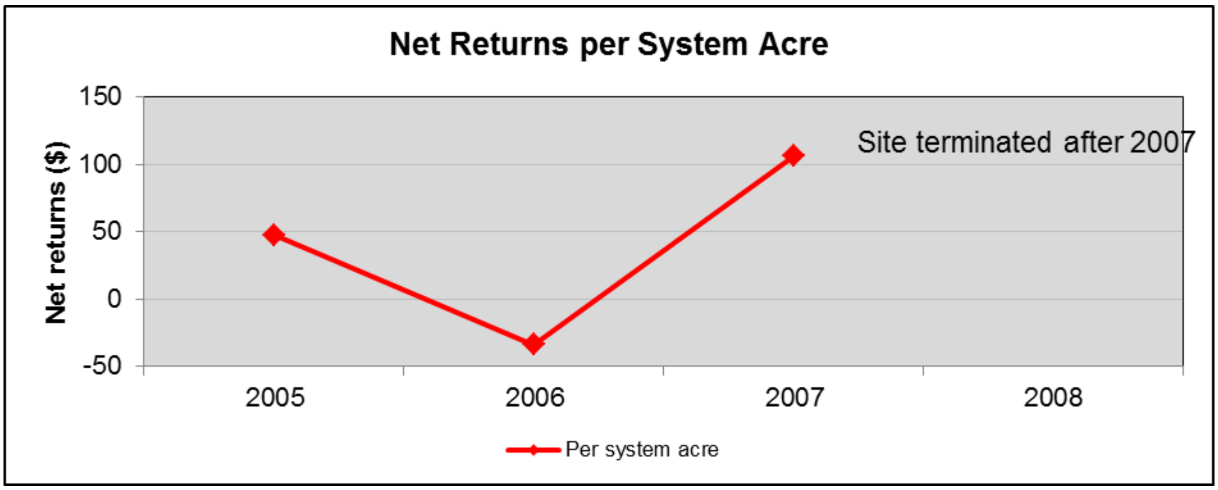
	Livestock	Field 1	Field 2
2005	None	Wheat for grain	Cotton following previous year's cover of Wheat stubble
2006	None	Cotton following previous year's cover of Wheat stubble	Wheat lost to drought
2007	None	Wheat for grain	Cotton following Wheat cover crop
2008	Site terminated for 2008		
2009			
2010			
2011			

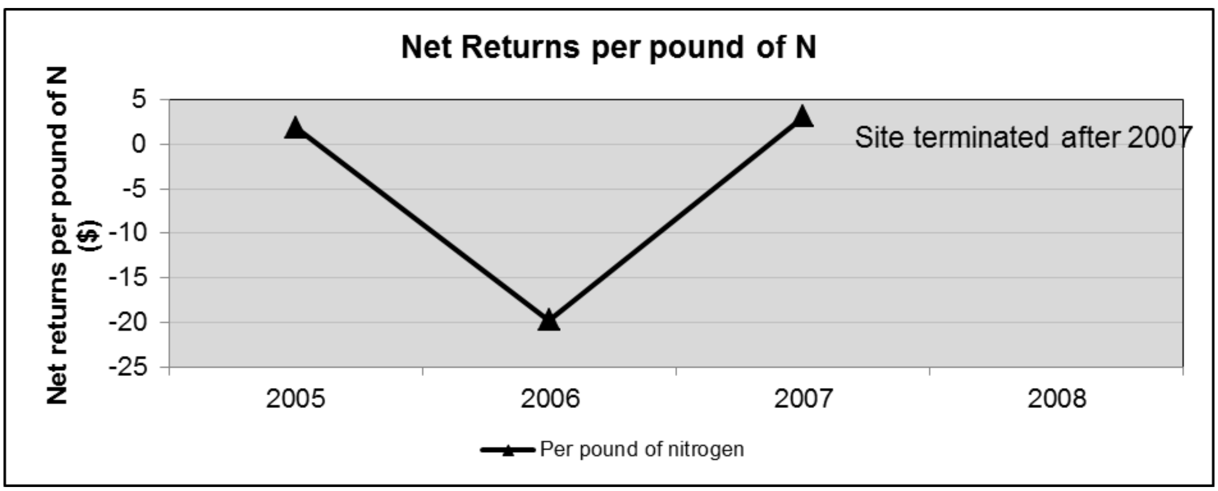


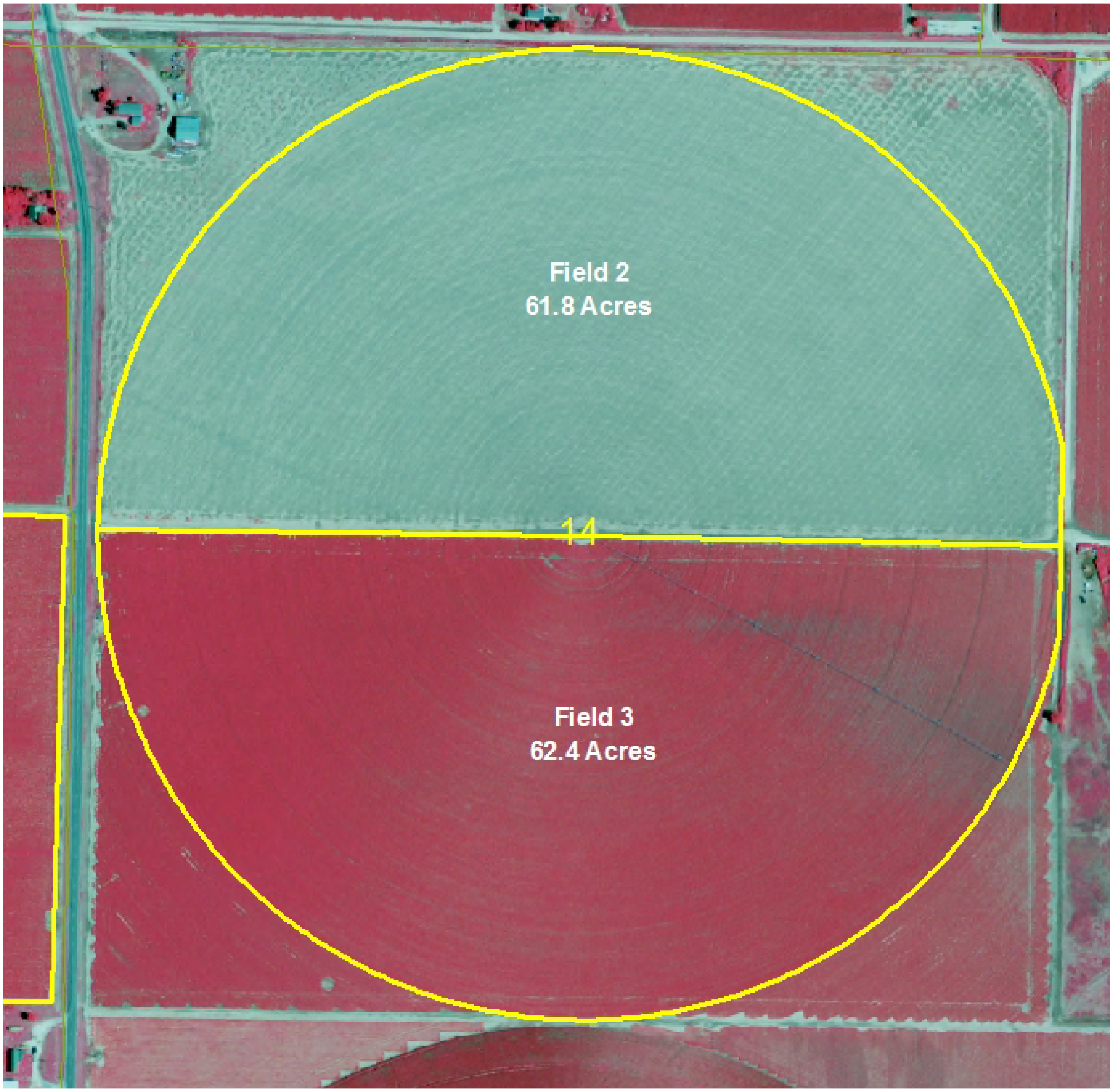
Dryland Site

System 13 – Dryland Site









System 14 Description

Total system acres:	124.2
Field No. 2 Acres:	61.8
Major soil type:	Pullman clay loam; 0 to 1% slope
Field No. 3 Acres:	62.4
Major soil type:	Pullman clay loan; 0 to 1% slope

Irrigation

Type:	Center Pivot (LEPA)
Pumping capacity, gal/min:	300
Number of wells:	3
Fuel source:	Electric

System 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

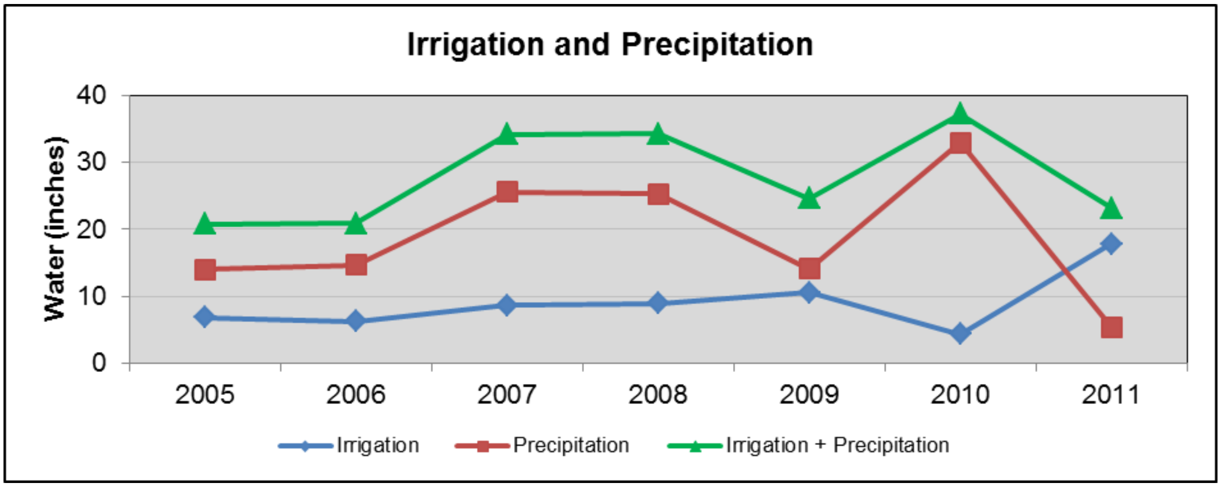
Comments: This is a pivot irrigated cotton and wheat rotation system with limited irrigation. This producer uses conventional tillage on forty-inch centers.

Pictures from Drought Year of 2011

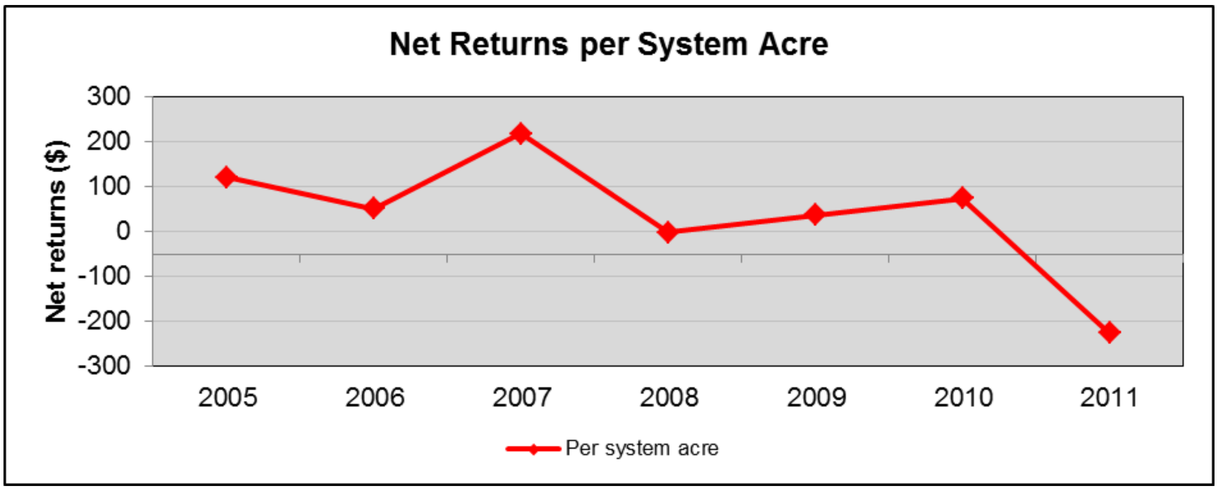
July cotton

September cotton harvest

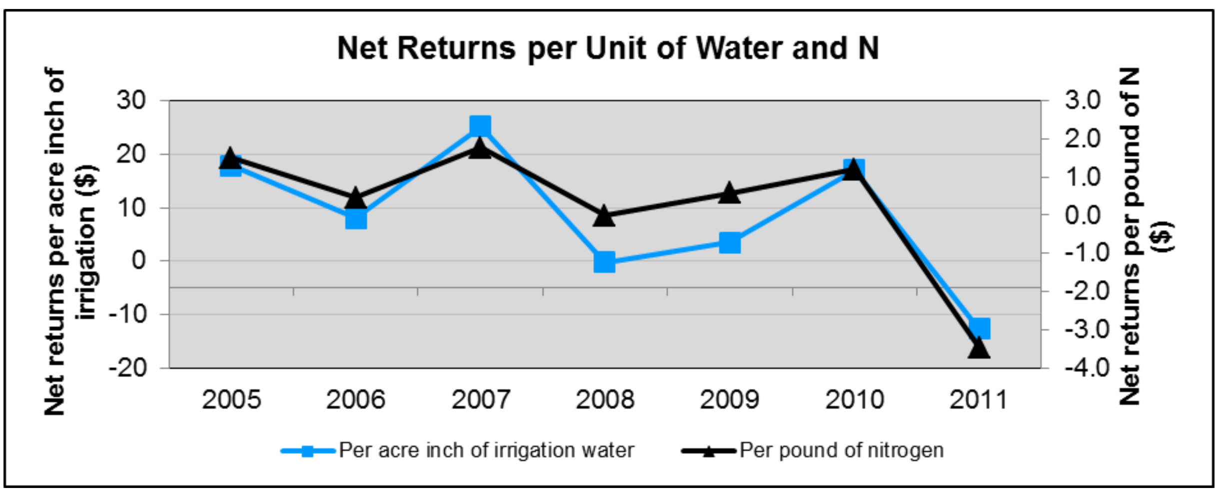
System 14



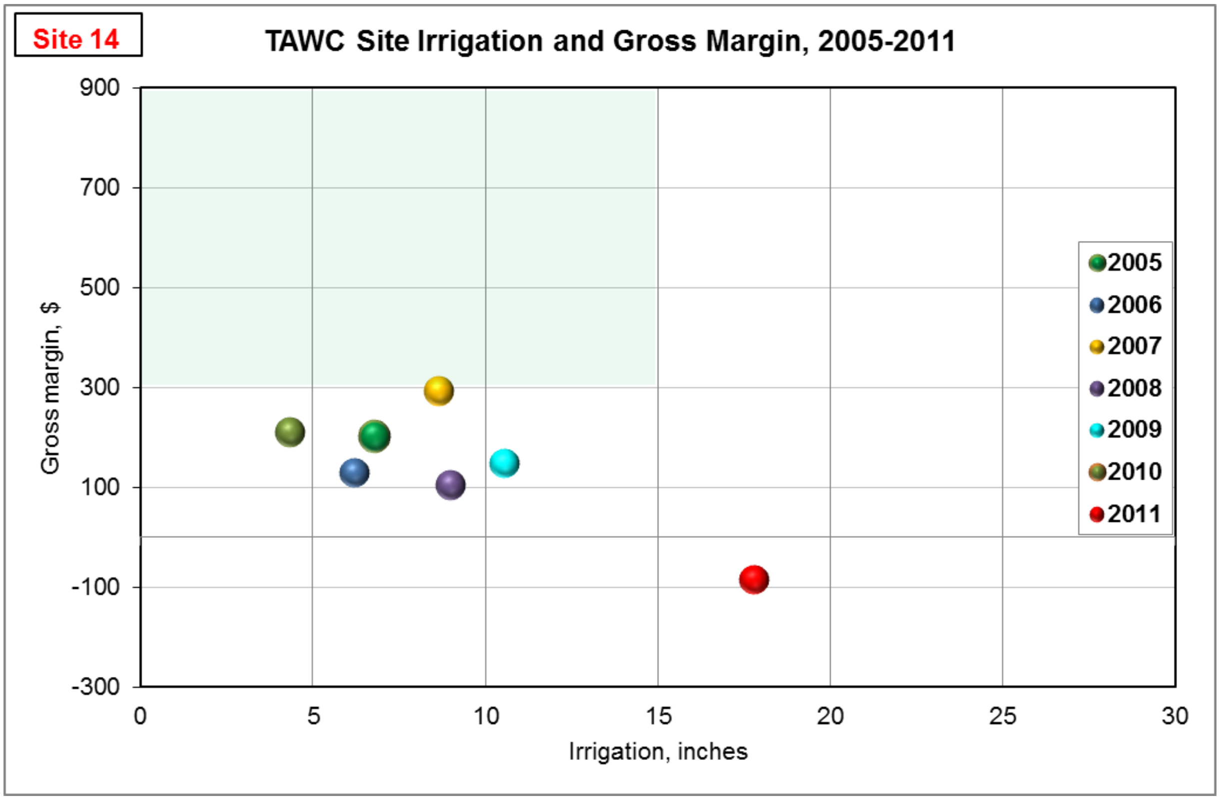
Irrigation and Precipitation
Water (inches)
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation



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



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



Site 14
TAWC Site Irrigation and Gross Margin, 2005-2011
900
700
500
300
100
-100
-300
Gross margin, $
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009
2010
2011

System 15 Description

Total system acres: 102.8

Field No. 8 Acres: 57.2
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 9 Acres: 45.6
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Furrow Field 8
Subsurface Drip Field 9

Pumping capacity, gal/min: 290

Number of wells: 1

Fuel source: Natural gas

System 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 Wheat 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

Comments: This has been a cotton, wheat and grain sorghum system in previous years. This year both corn and cotton were planted on forty-inch centers. In 2011 the furrow irrigated field was converted to drip irrigation.

Pictures from Drought Year of 2011

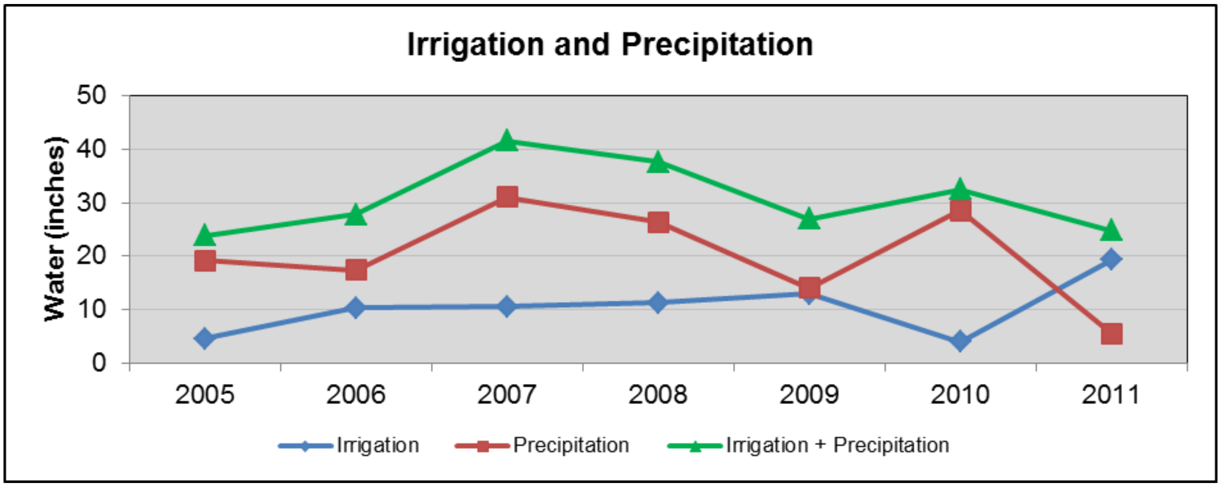
July corn over drip irrigation

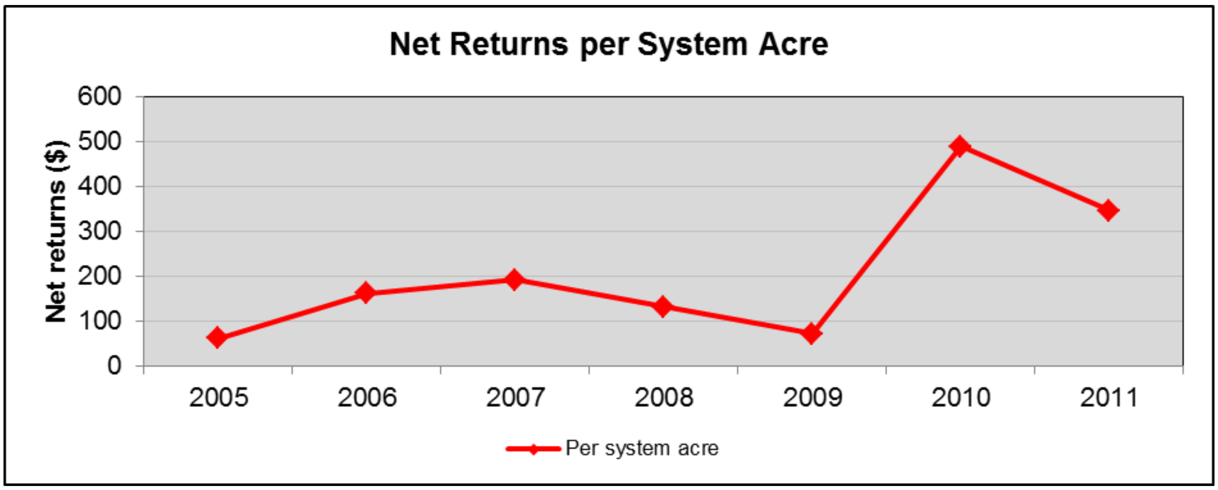
July cotton over drip irrigation

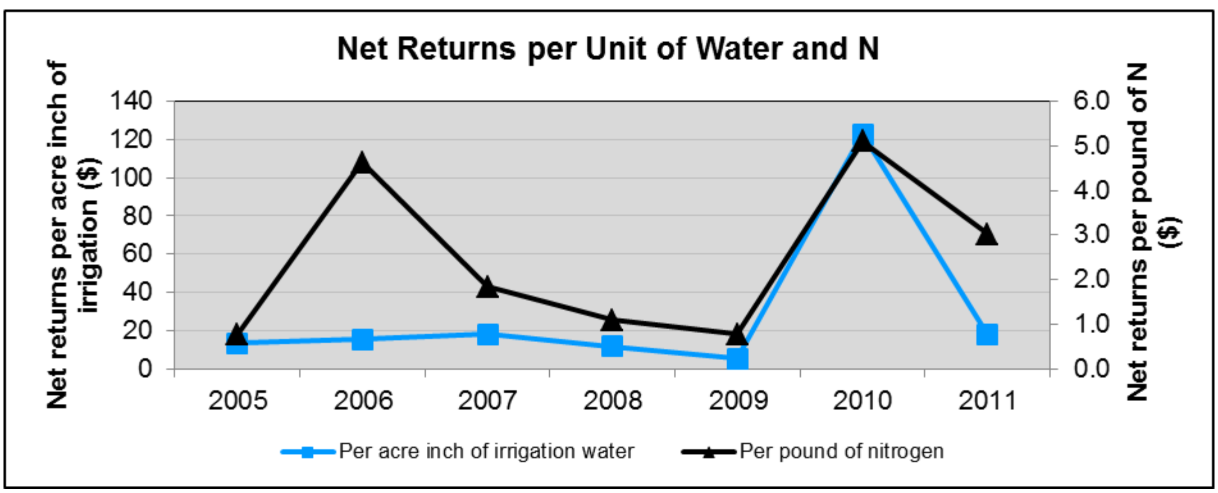
Furrow irrigation converted to drip

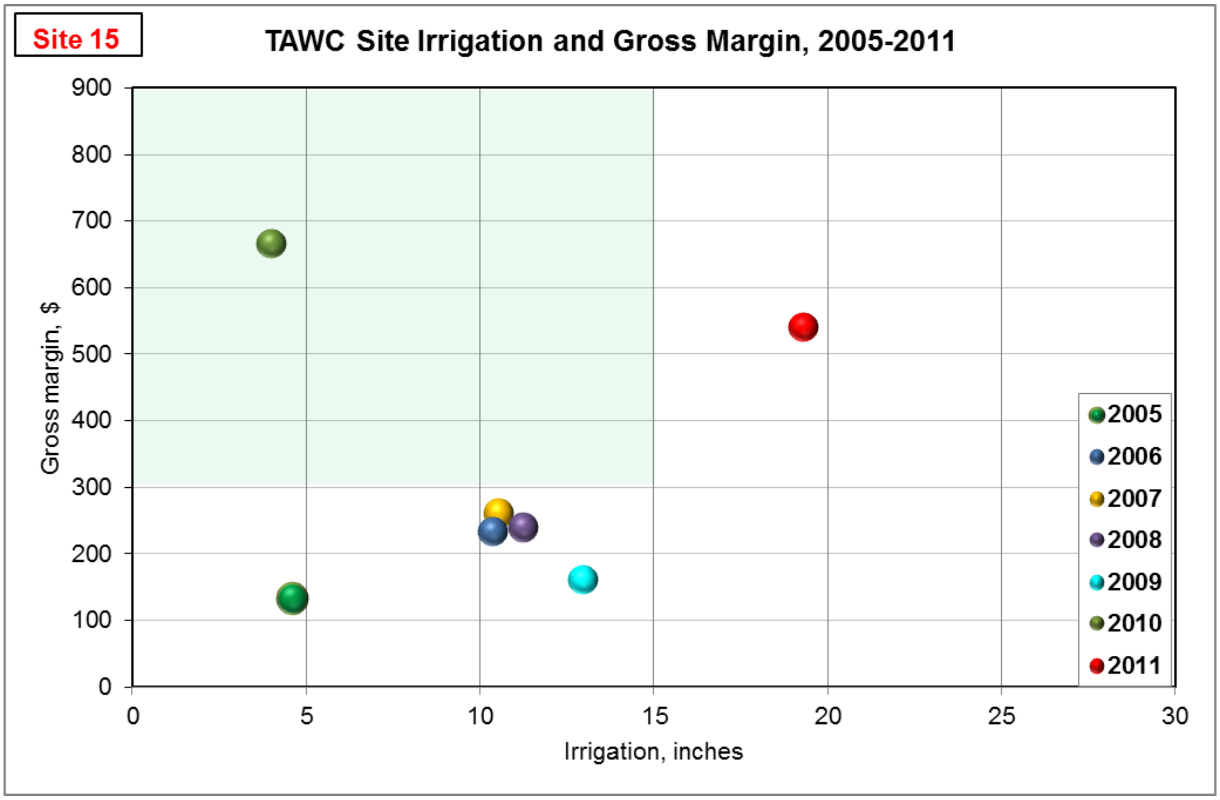
Corn grain harvest

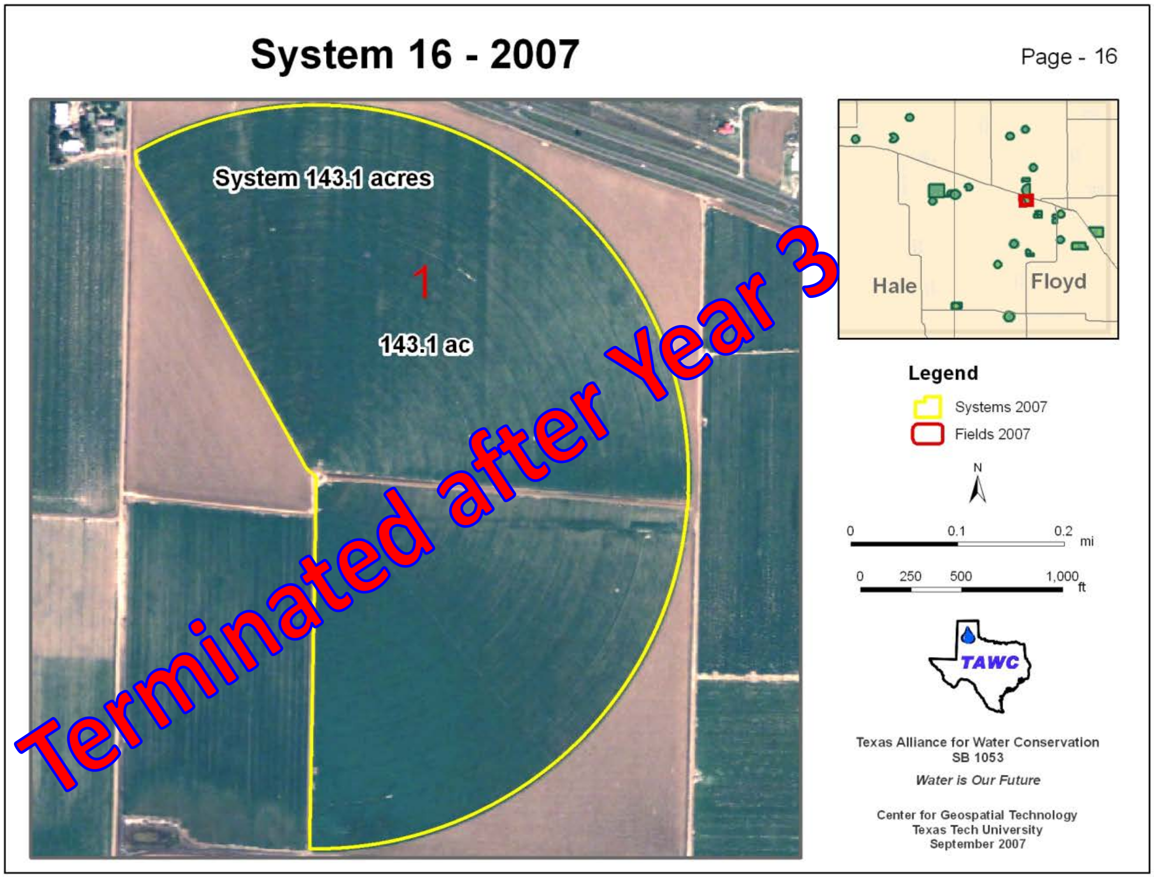
System 15


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


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


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


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



System 16 Description

Total system acres: 143.1

Field No. 1 Acres: 143.1
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 600

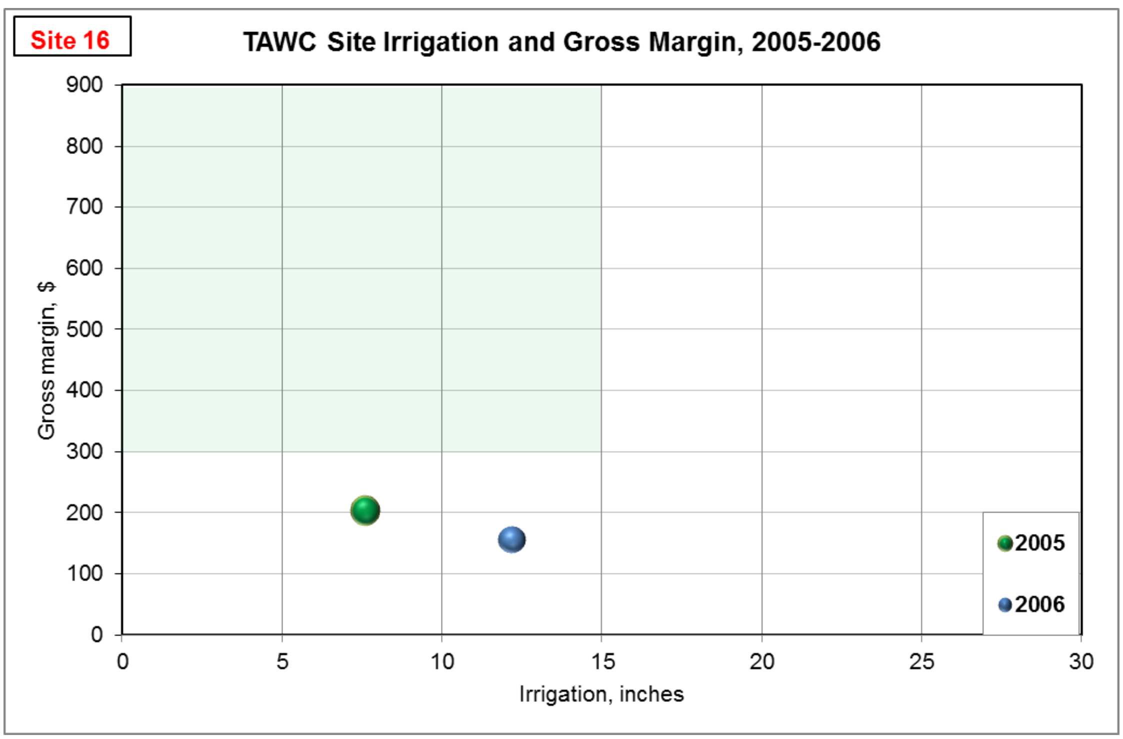
Number of wells: 3

Fuel source: Electric

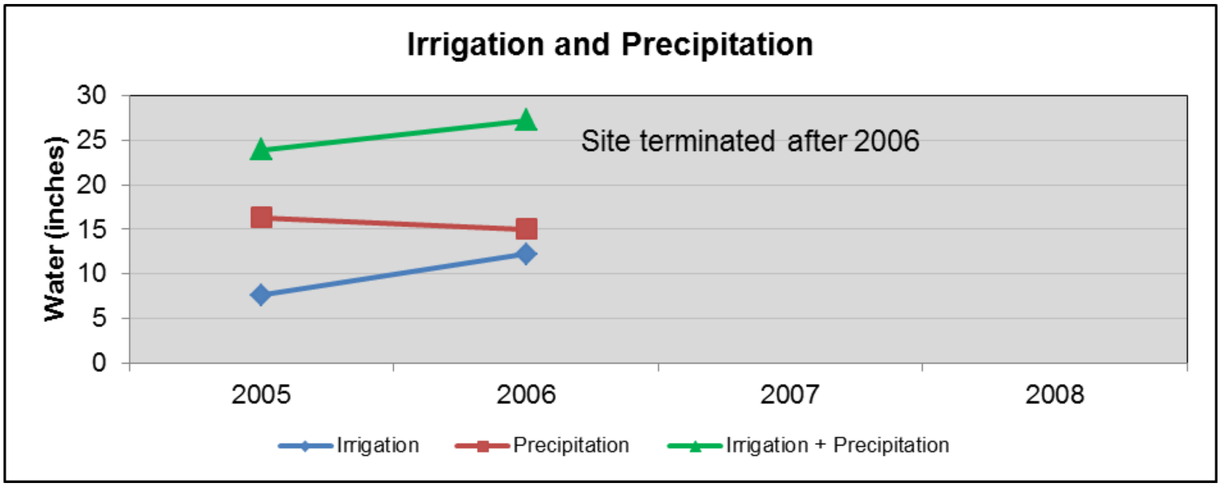
Comments: This pivot irrigated cotton site uses conventional tillage and plants on forty-inch centers.

System 16

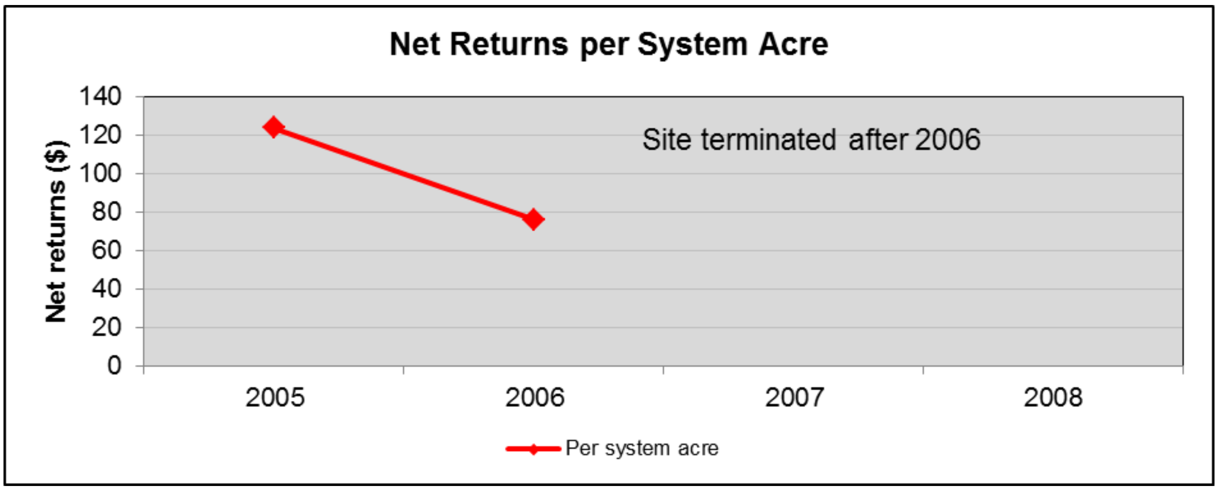
	Livestock	Field 1
2005	None	Cotton
2006	None	Cotton
2007	None	Cotton following Wheat cover crop
2008	Site terminated for 2008	
2009		
2010		
2011		



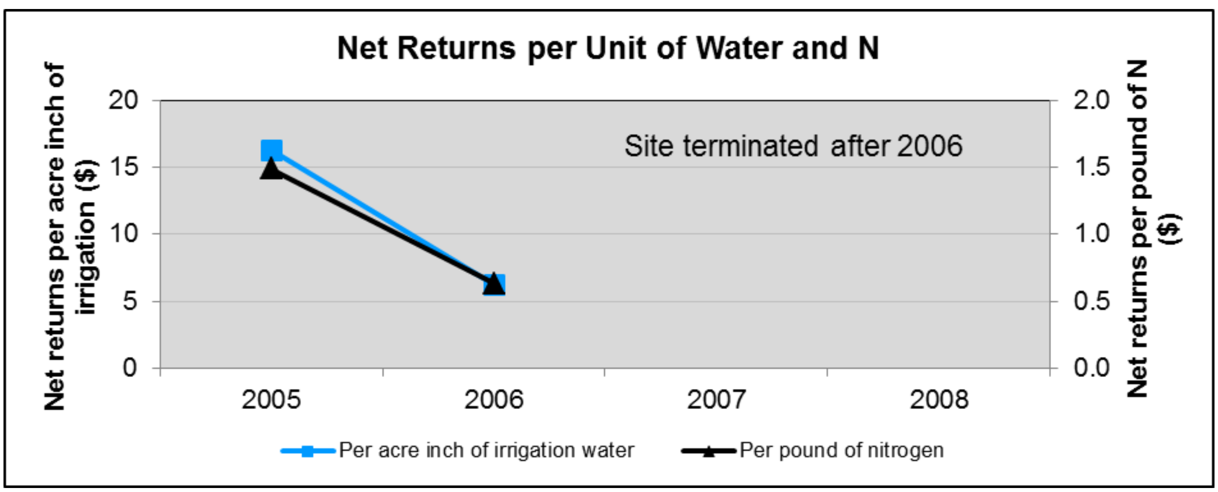
System 16



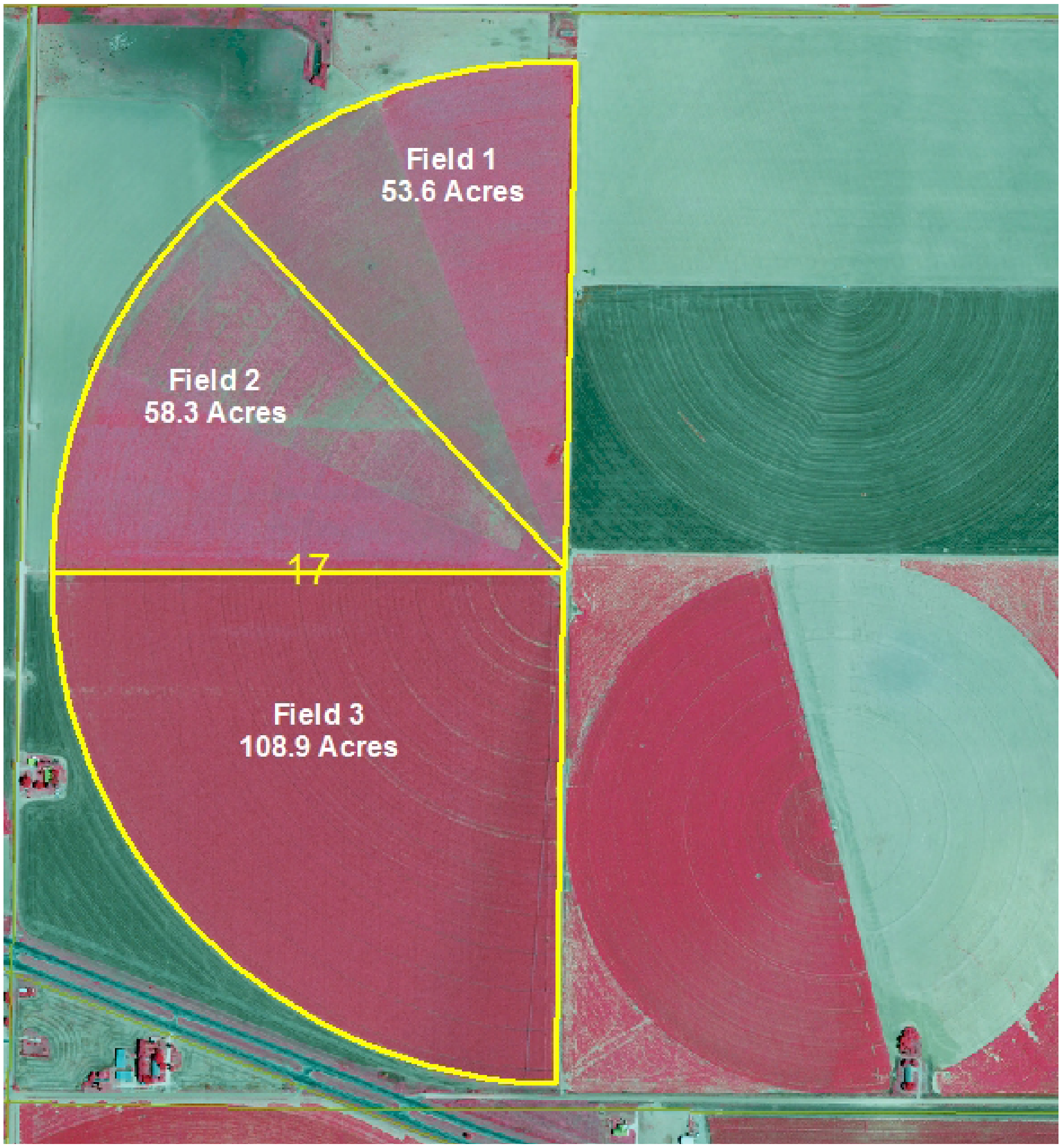
Irrigation and Precipitation
Water (inches)
30
25
20
15
10
5
0
Site terminated after 2006
2005
2006
2007
2008
Irrigation
Precipitation
Irrigation + Precipitation



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



System 17 Description

Total system acres:	220.8
Field No. 1 Acres:	53.6
Major soil type:	Pullman clay loam; 0 to 1% slope
Field No. 2 Acres:	58.3
Major soil type:	Pullman clay loam; 0 to 1% slope
Field No. 3 Acres:	108.9
Major soil type:	Pullman clay loam; 0 to 1% slope

Irrigation

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

System 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

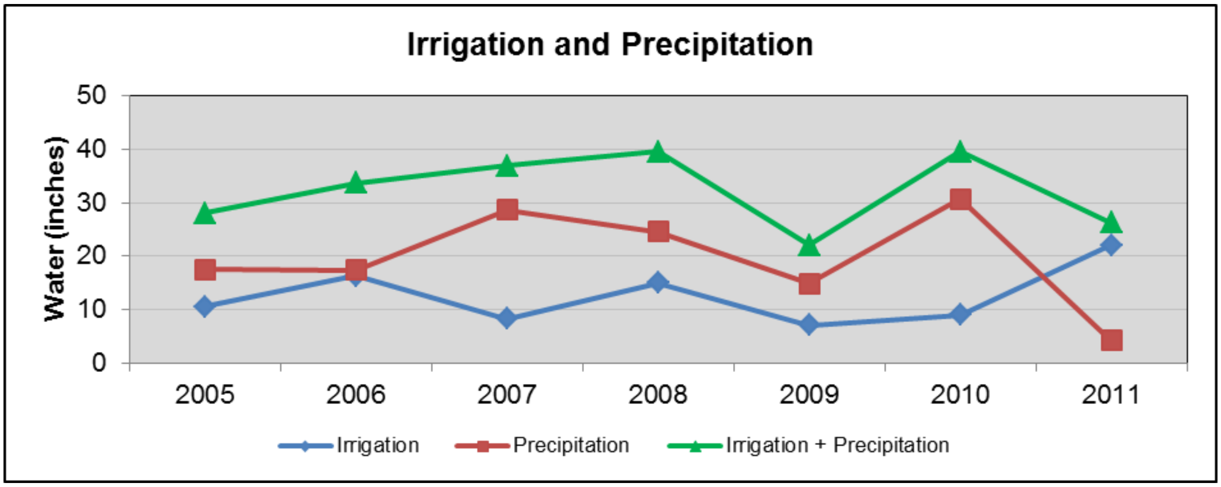
Comments: This pivot irrigated site has grown cotton, corn, sunflowers, and Old-World bluestem. Corn and sunflowers are planted on twenty-inch centers with cotton planted on thirty-inch centers. The Old-World bluestem is used for grazing and/or seed production. In 2011 all cows were sold due to the lack of available forage.

Pictures from Drought Year of 2011

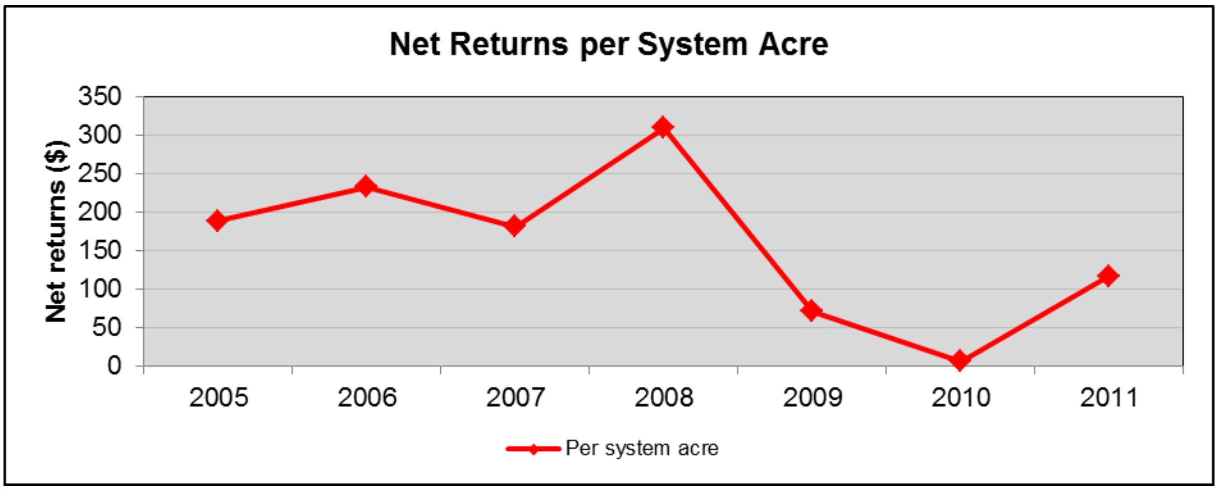
Cattle grazing dormant grass

June cotton

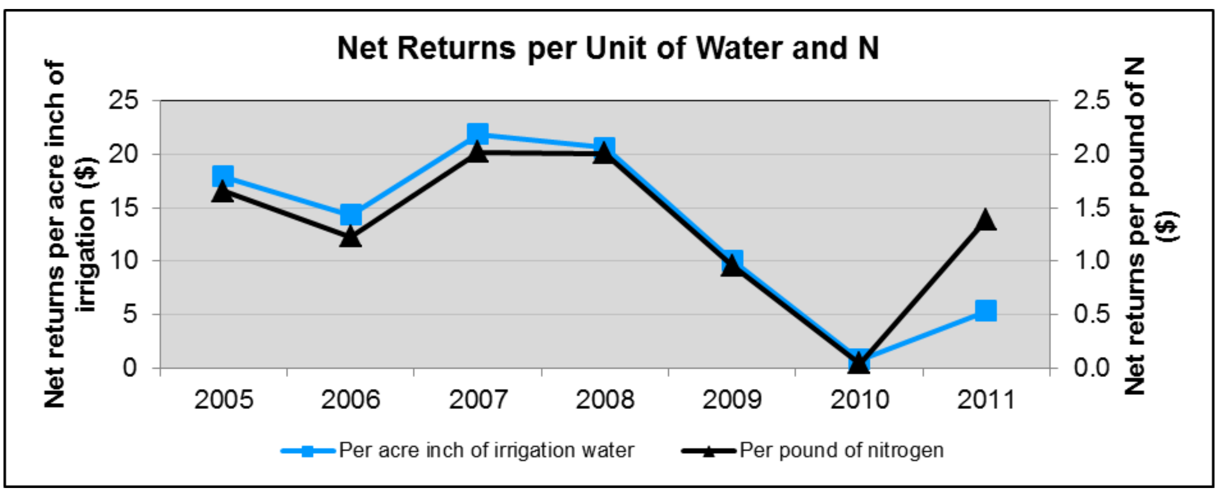
System 17



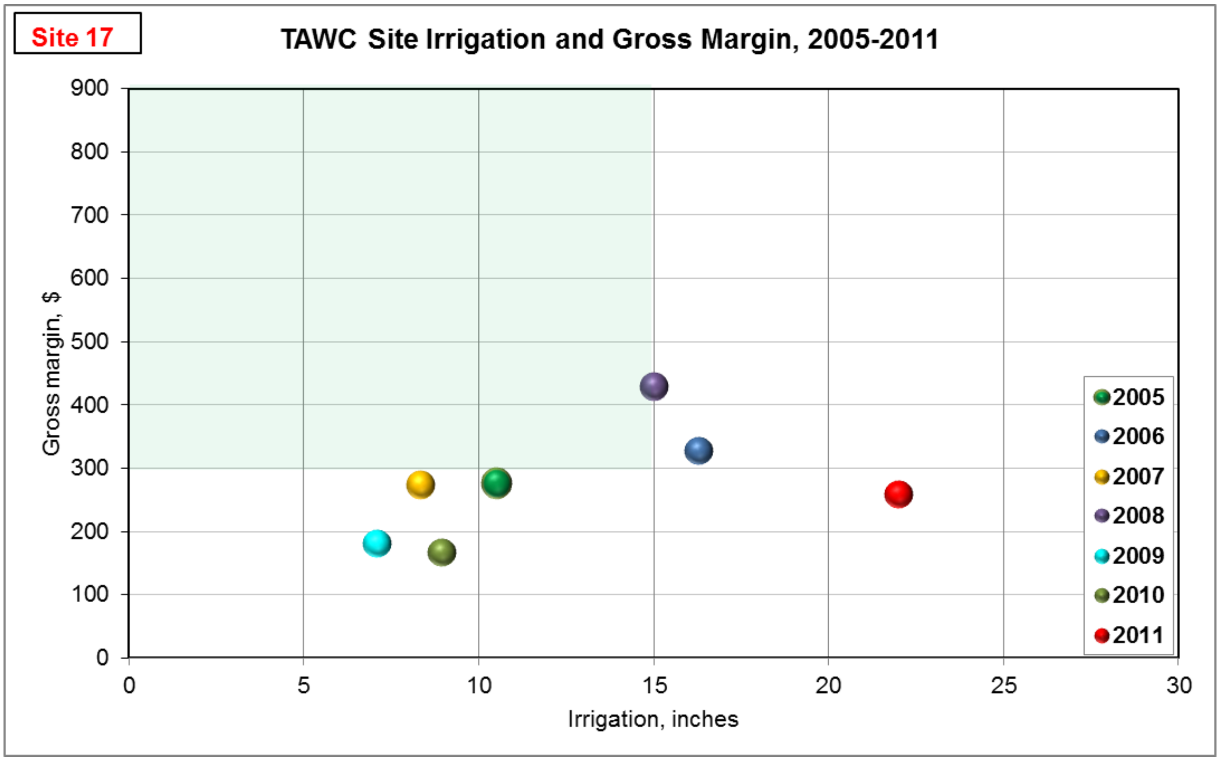
Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation

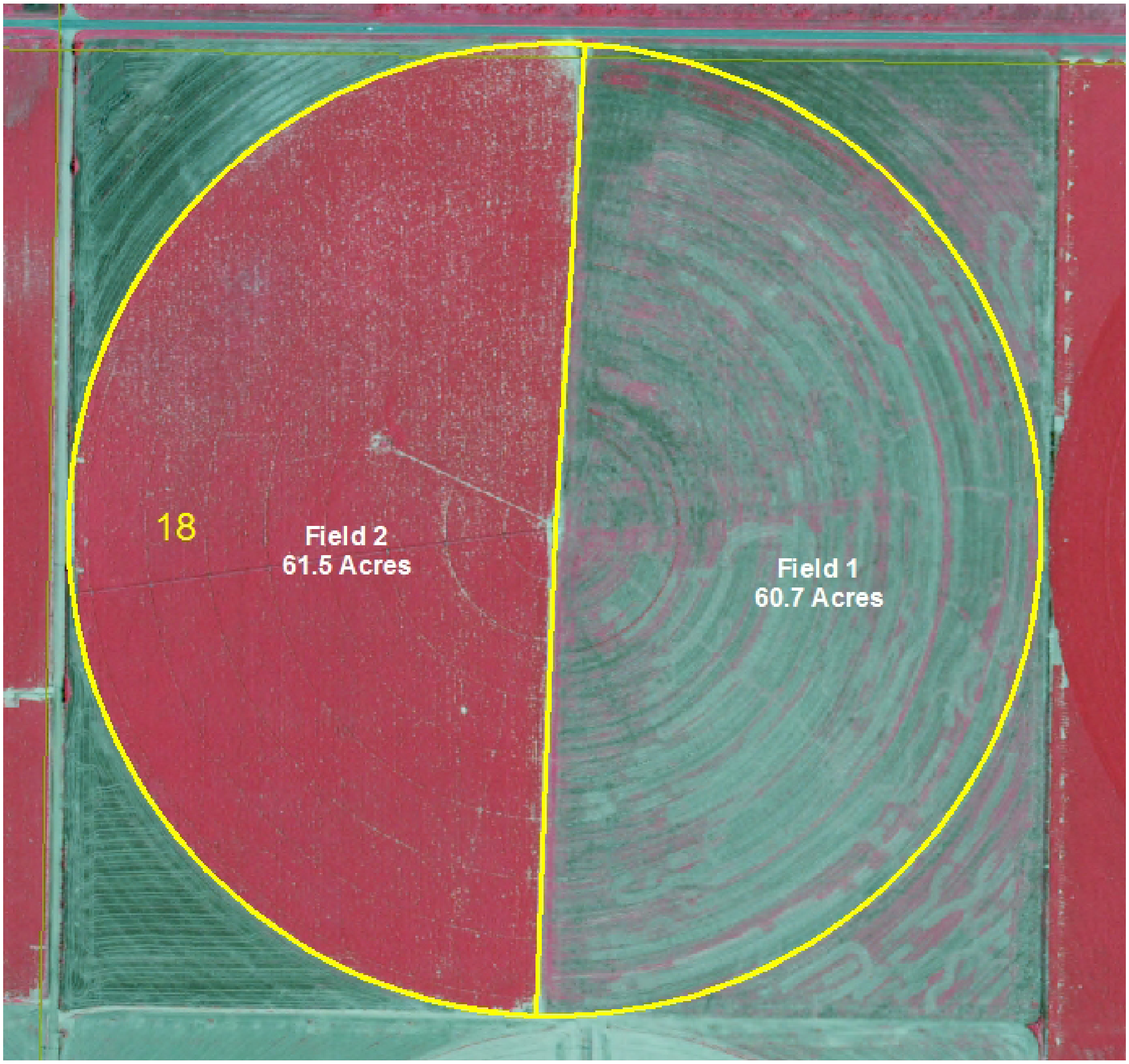


Net Returns per System Acre
Net returns ($)
350
300
250
200
150
100
50
0
2005
2006
2007
2008
2009
2010
2011
Per system acre



Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
25
20
15
10
5
0
2005
2006
2007
2008
2009
2010
2011
2.5
2.0
1.5
1.0
0.5
0.0
Net returns per pound of N ($)
Per acre inch of irrigation water
Per pound of nitrogen


Site 17
TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $
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



System 18 Description

Total system acres: 122.2

Field No. 1 Acres: 60.7
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 61.5
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (LEPA)

Pumping capacity, gal/min: 250

Number of wells: 3

Fuel source: Electric

System 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

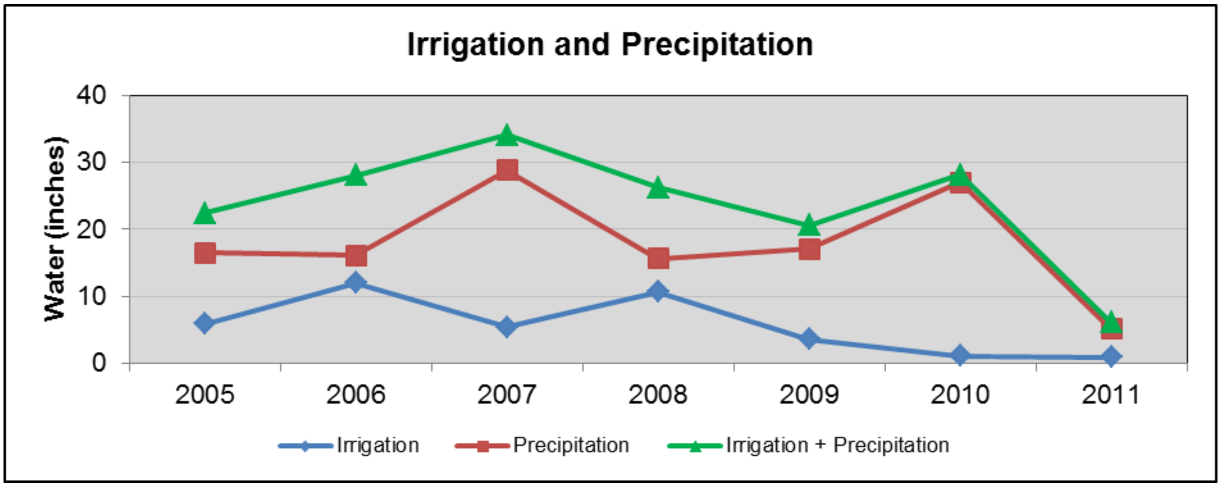
Comments: This is a pivot irrigated site with limited irrigation. Grain sorghum, cotton and wheat are planted on a rotational basis. This year wheat and cotton were abandoned.

Pictures from Drought Year of 2011

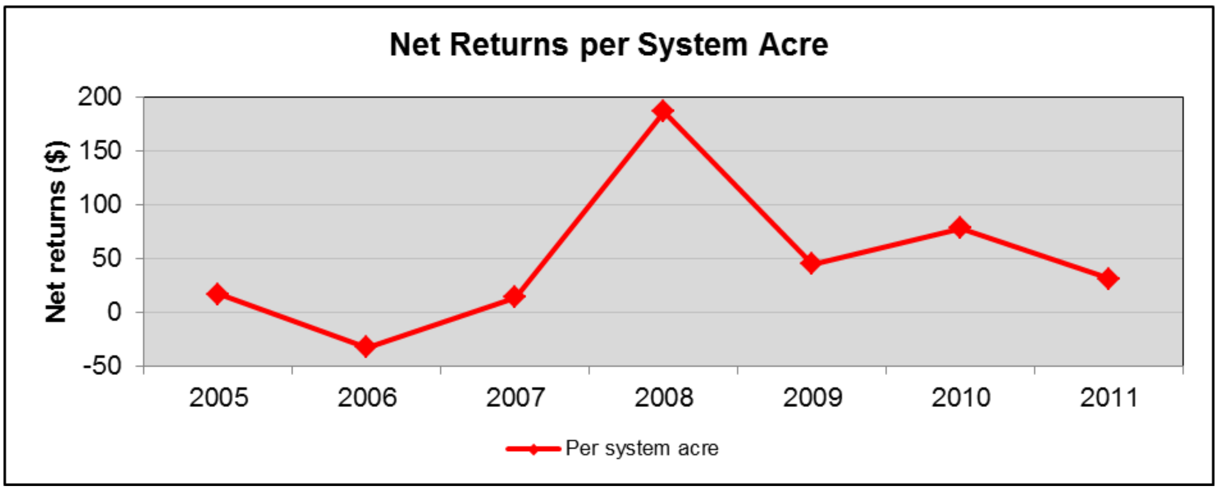
Abandoned cotton

Abandoned wheat

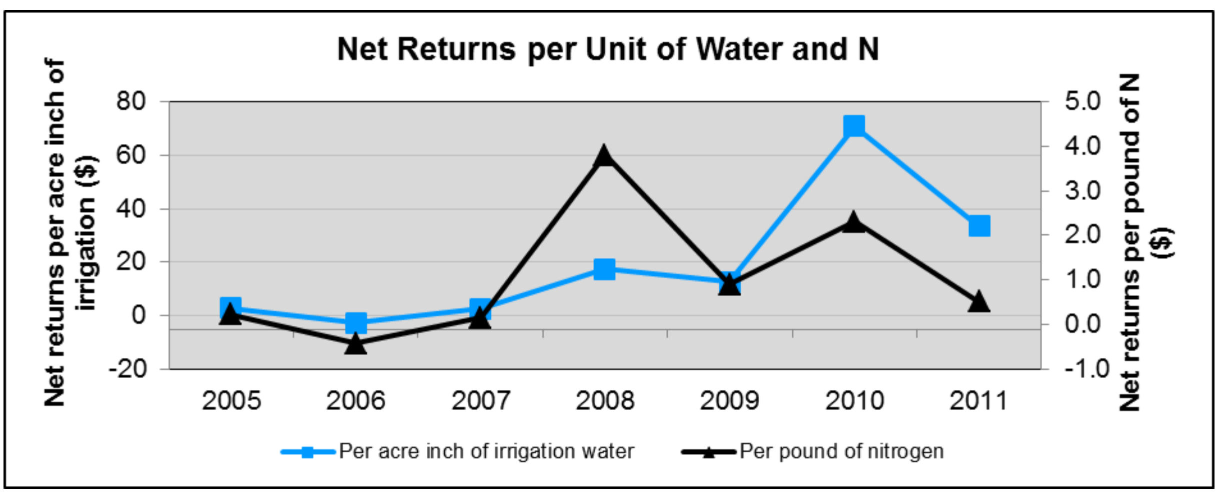
System 18



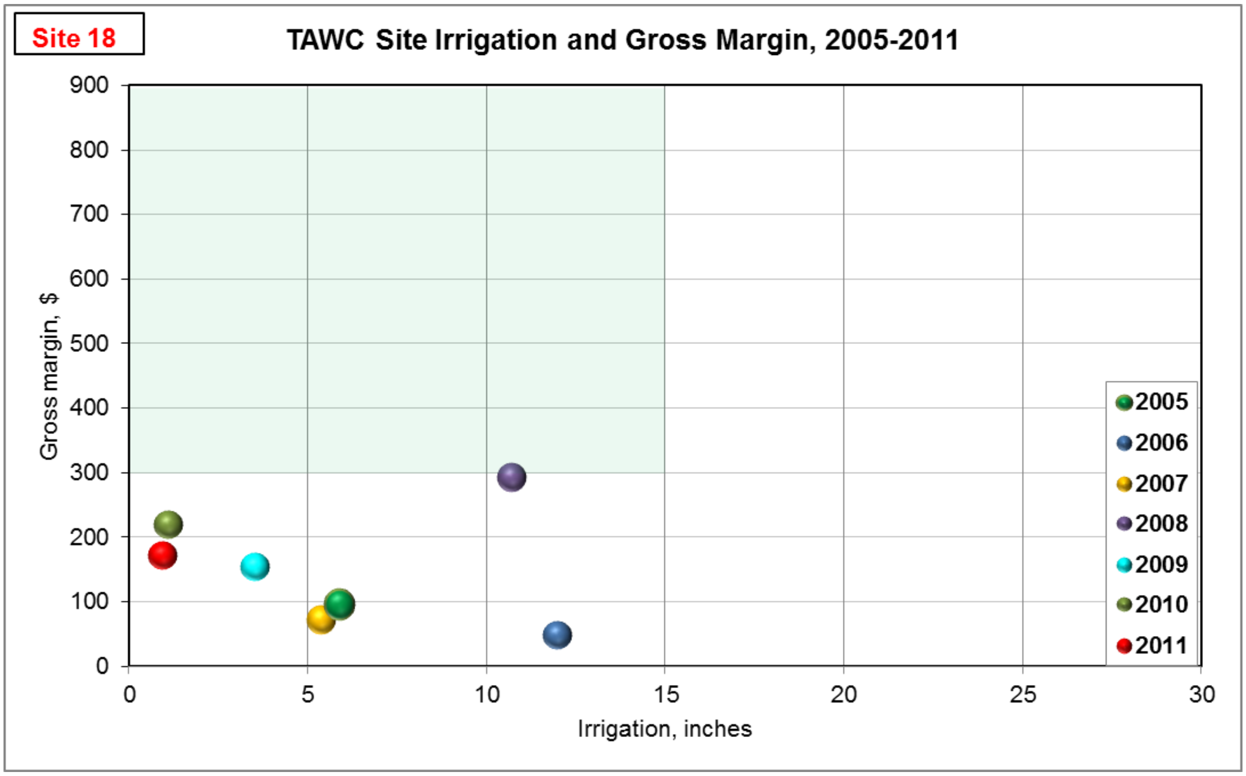
Irrigation and Precipitation
Water (inches)
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation

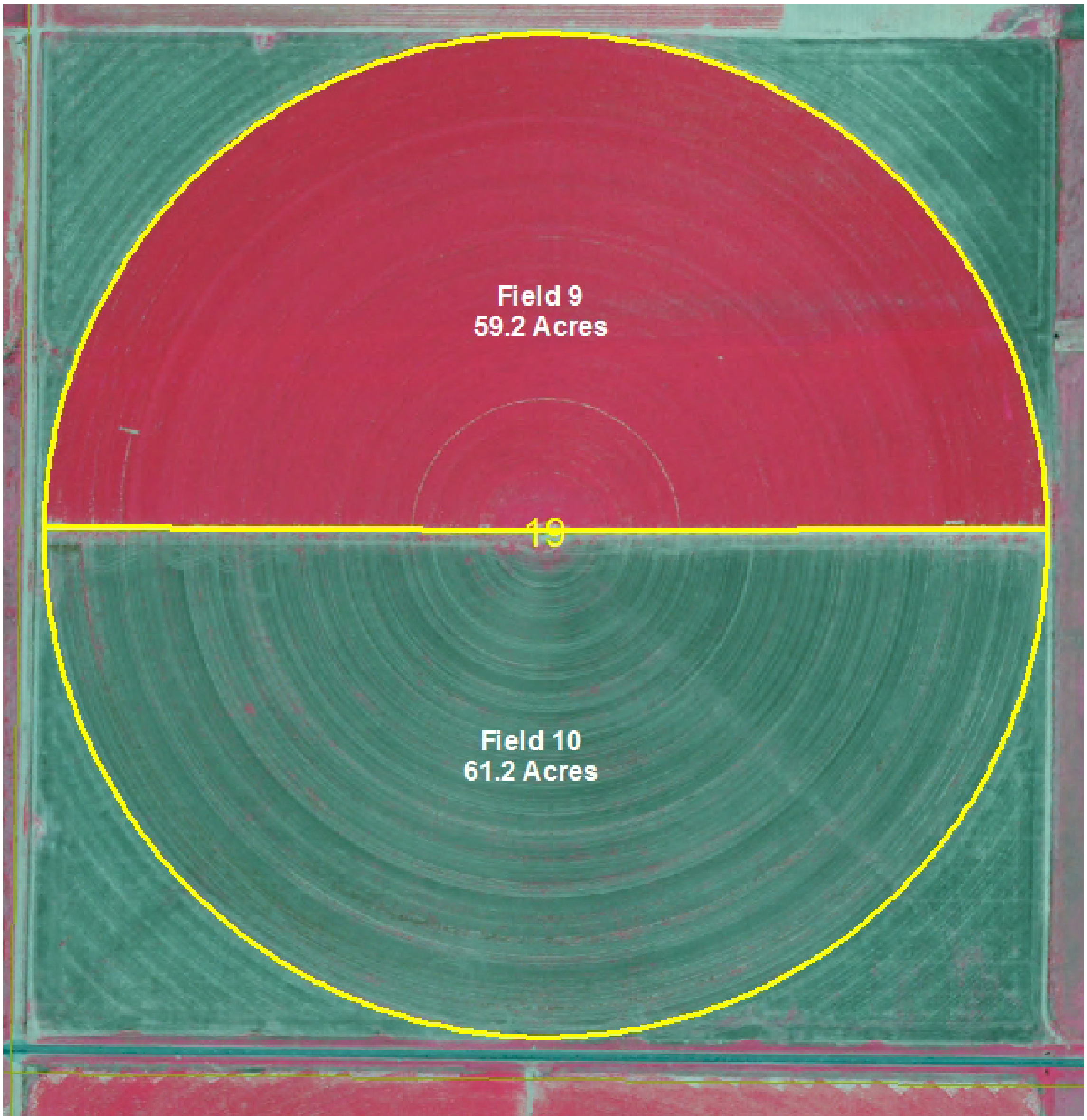


Net Returns per System Acre
Net returns ($)
200
150
100
50
0
-50
2005
2006
2007
2008
2009
2010
2011
Per system acre



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


Site 18
TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $
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



System 19 Description

Total system acres: 120.4

Field No. 9 Acres: 59.2
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 10 Acres: 61.2
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (LEPA)

Pumping capacity, gal/min: 400

Number of wells: 3

Fuel source: Electric

System 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

Comments: This is a pivot irrigated cotton and wheat site using conventional tillage. Cotton is planted on forty-inch centers.

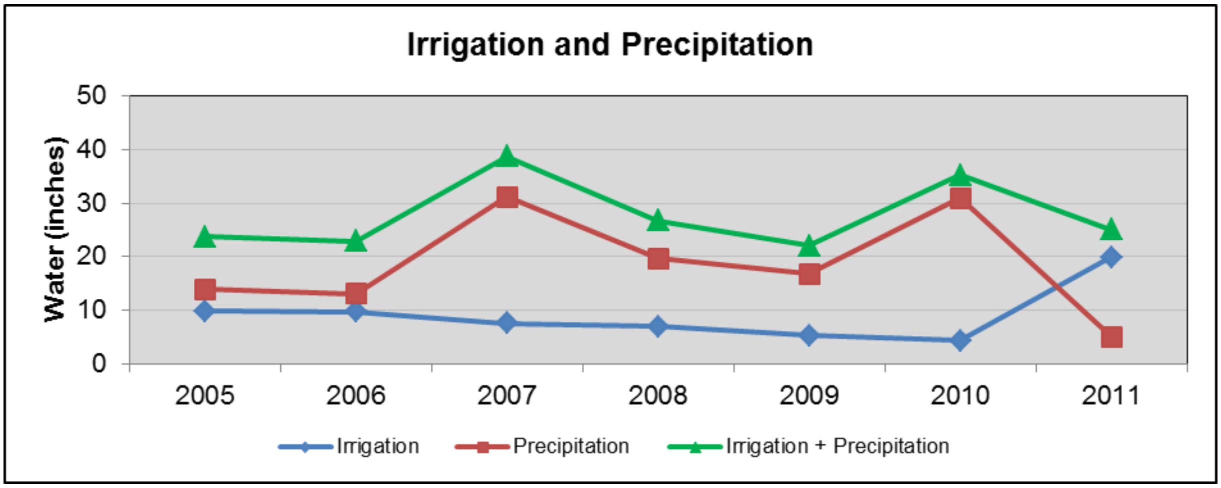
Pictures from Drought Year of 2011

June Cotton

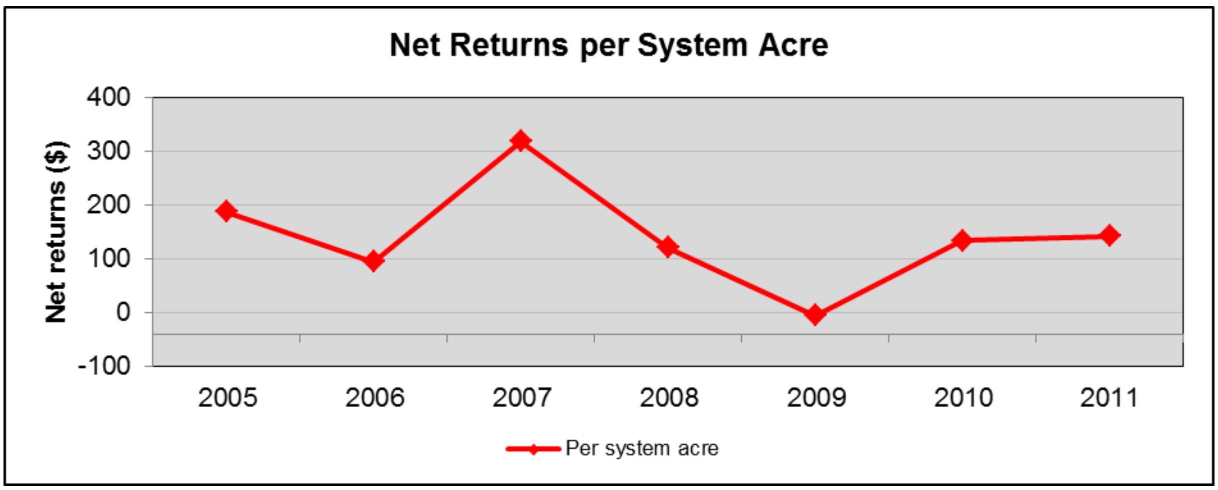
August cotton

Abandoned cotton field

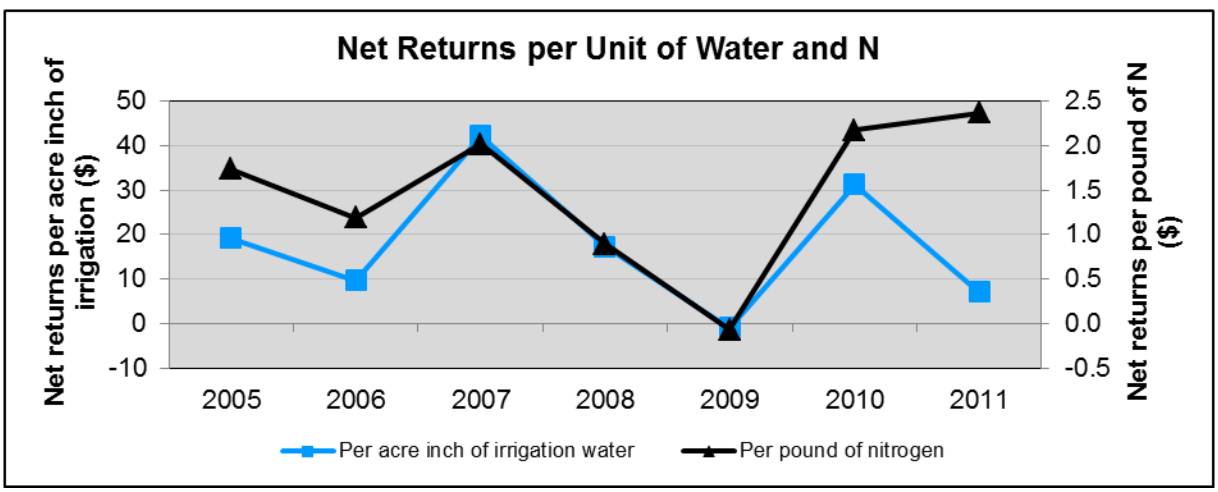
System 19



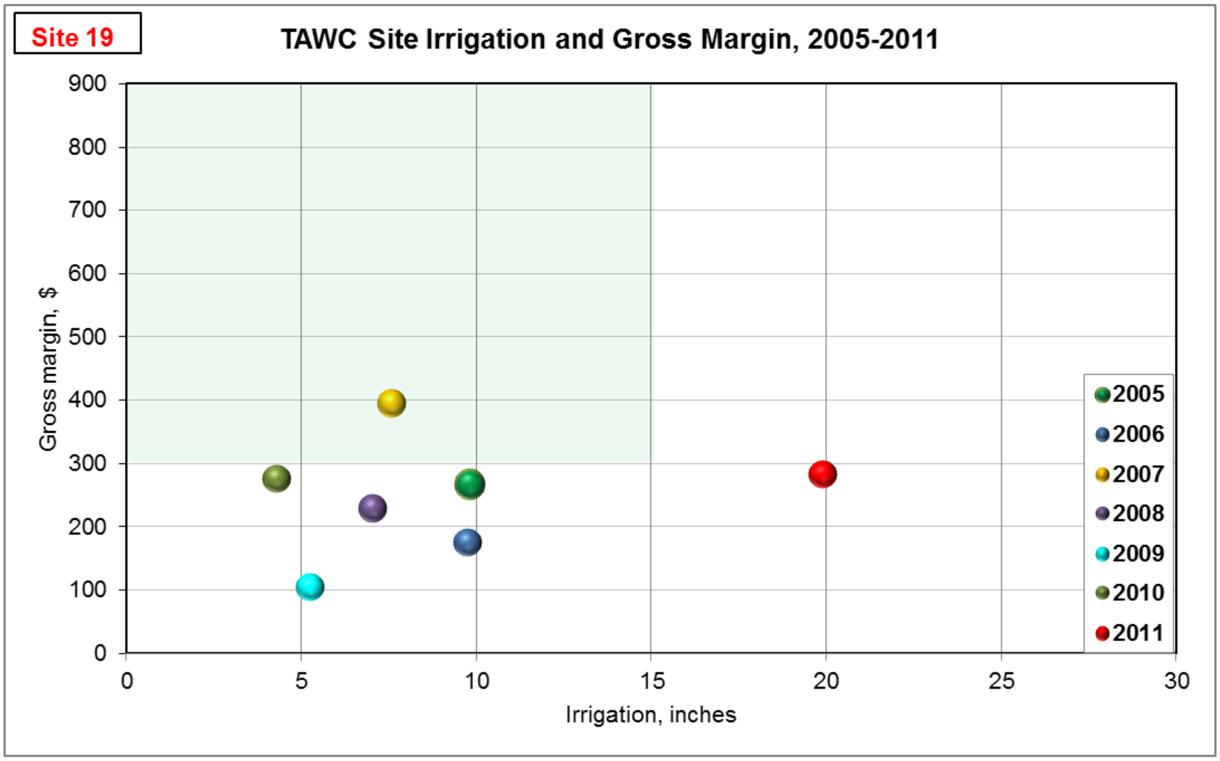
Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation

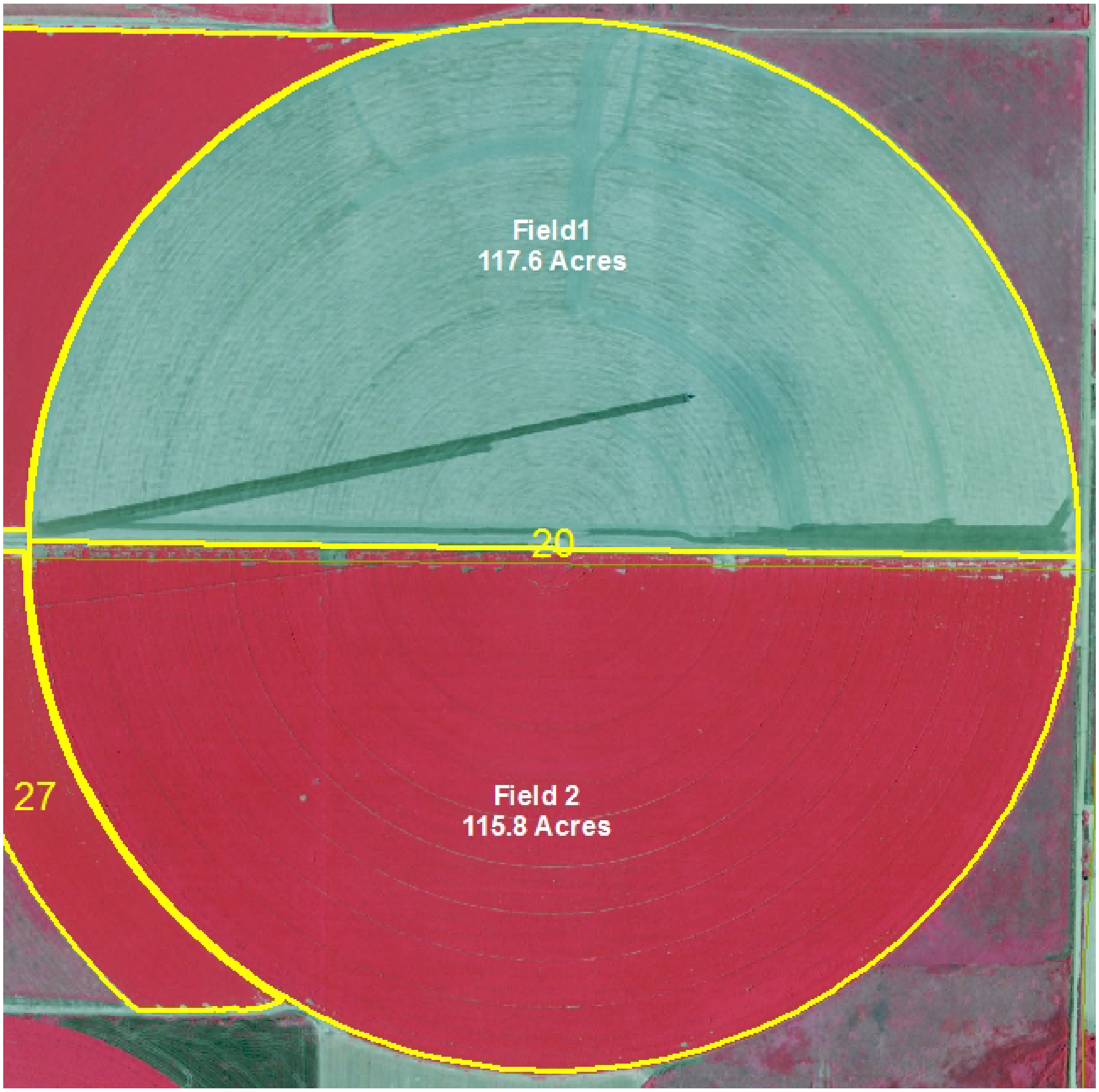


Net Returns per System Acre
Net returns ($)
400
300
200
100
0
-100
2005
2006
2007
2008
2009
2010
2011
Per system acre



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


Site 19
TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $
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



System 20 Description

Total system acres: 233.4

Field No. 1 Acres: 117.6
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 115.8
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (LEPA)

Pumping capacity, gal/min: 1000

Number of wells: 3

Fuel source: Electric

System 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

Comments: This site was planted to corn and triticale for silage. After triticale harvest cotton was planted no-till on forty-inch centers and corn was planted on forty-inch centers.

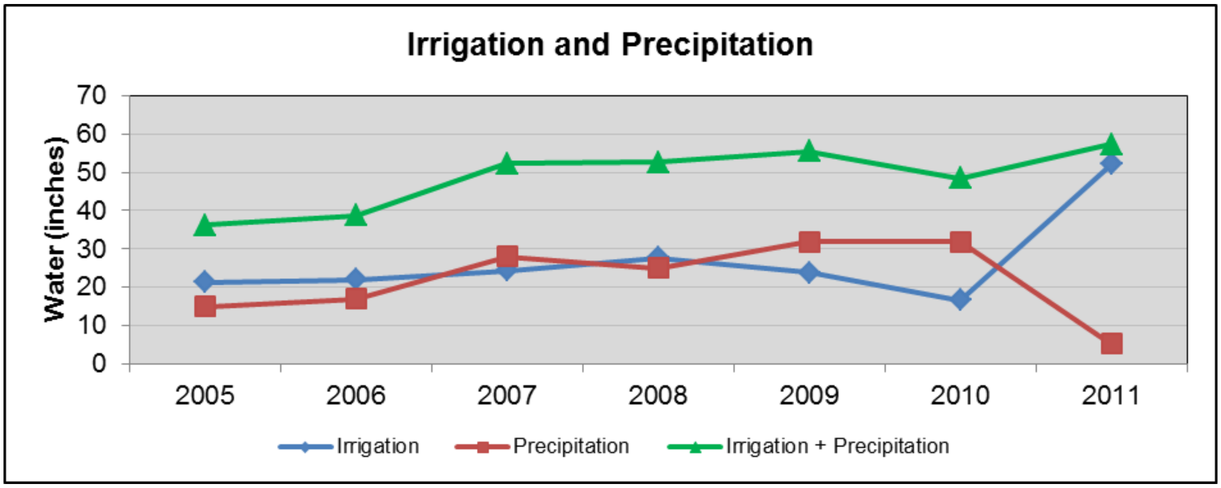
Pictures from Drought Year of 2011

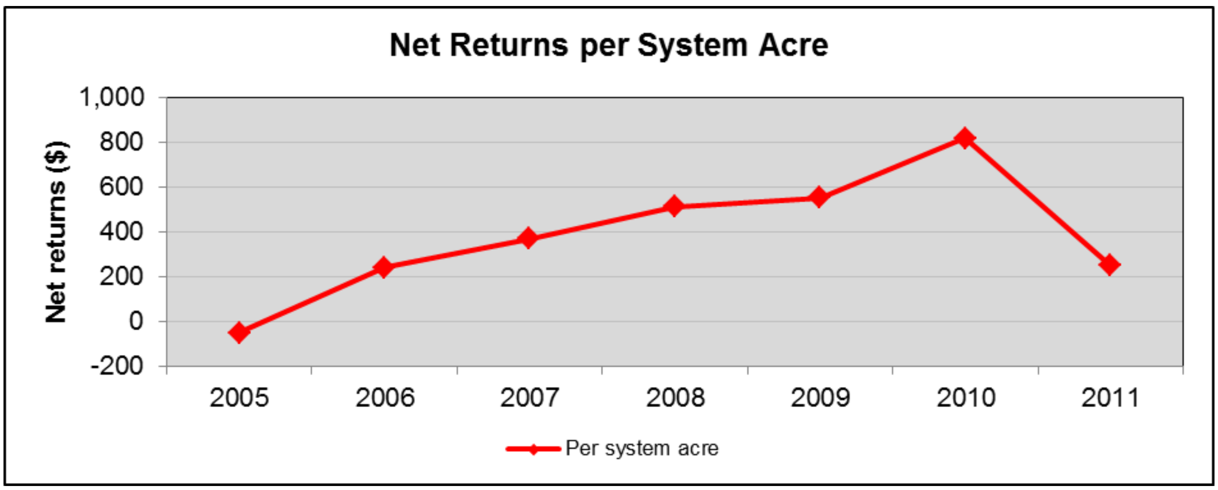
Triticale for silage

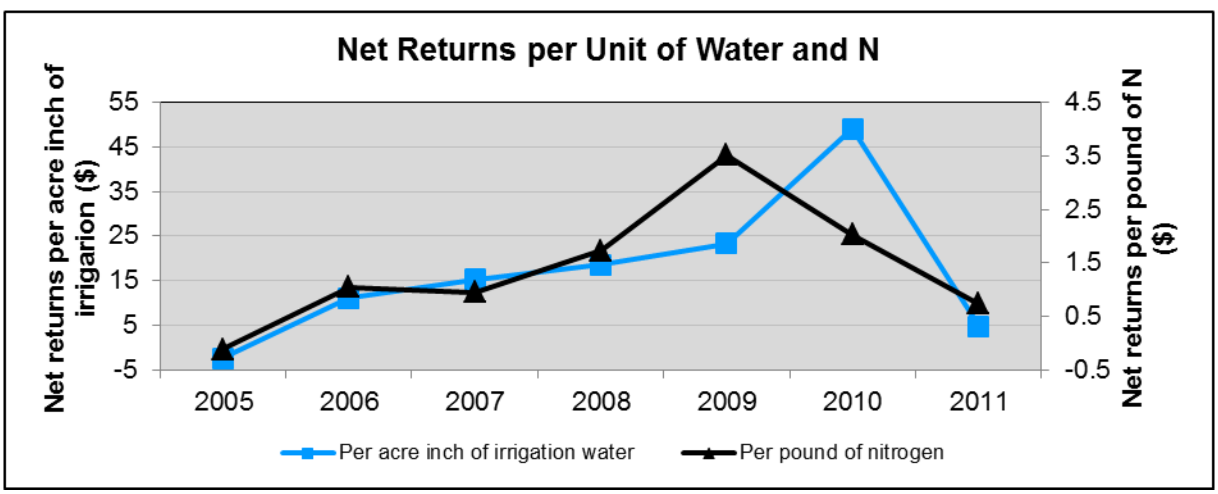
Cotton double crop

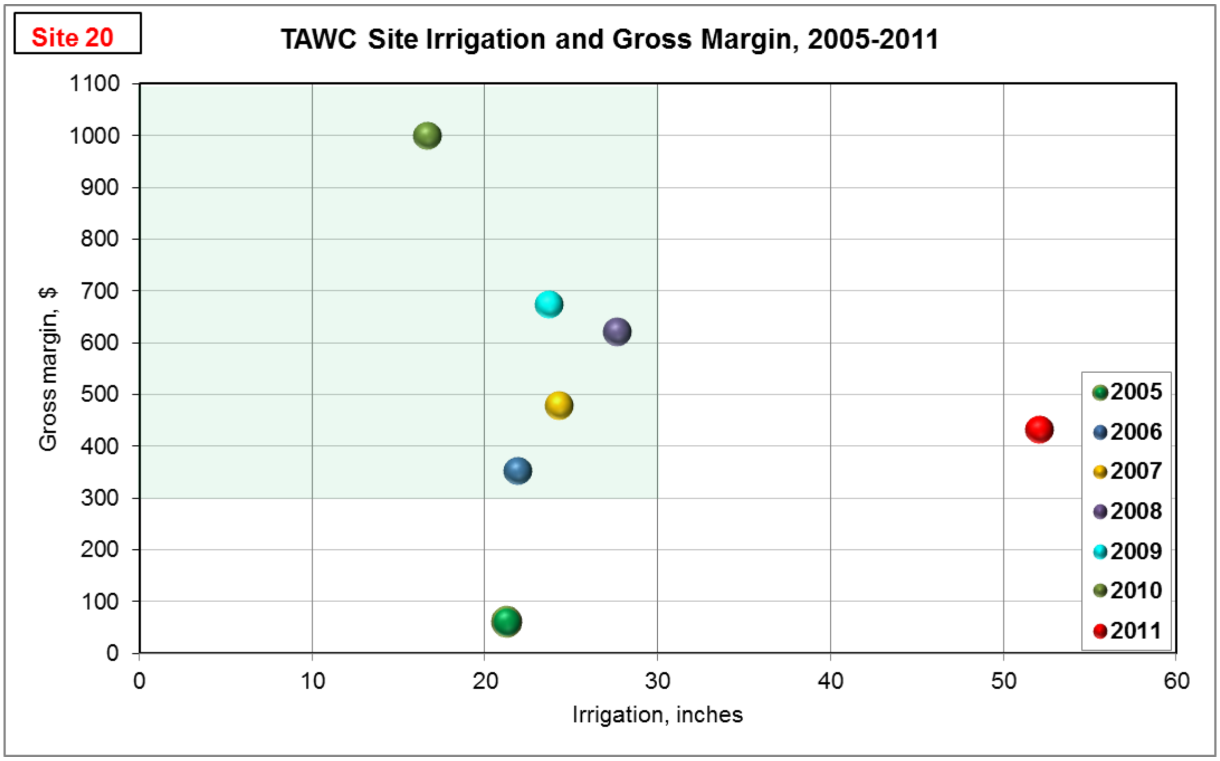
Making corn silage

System 20

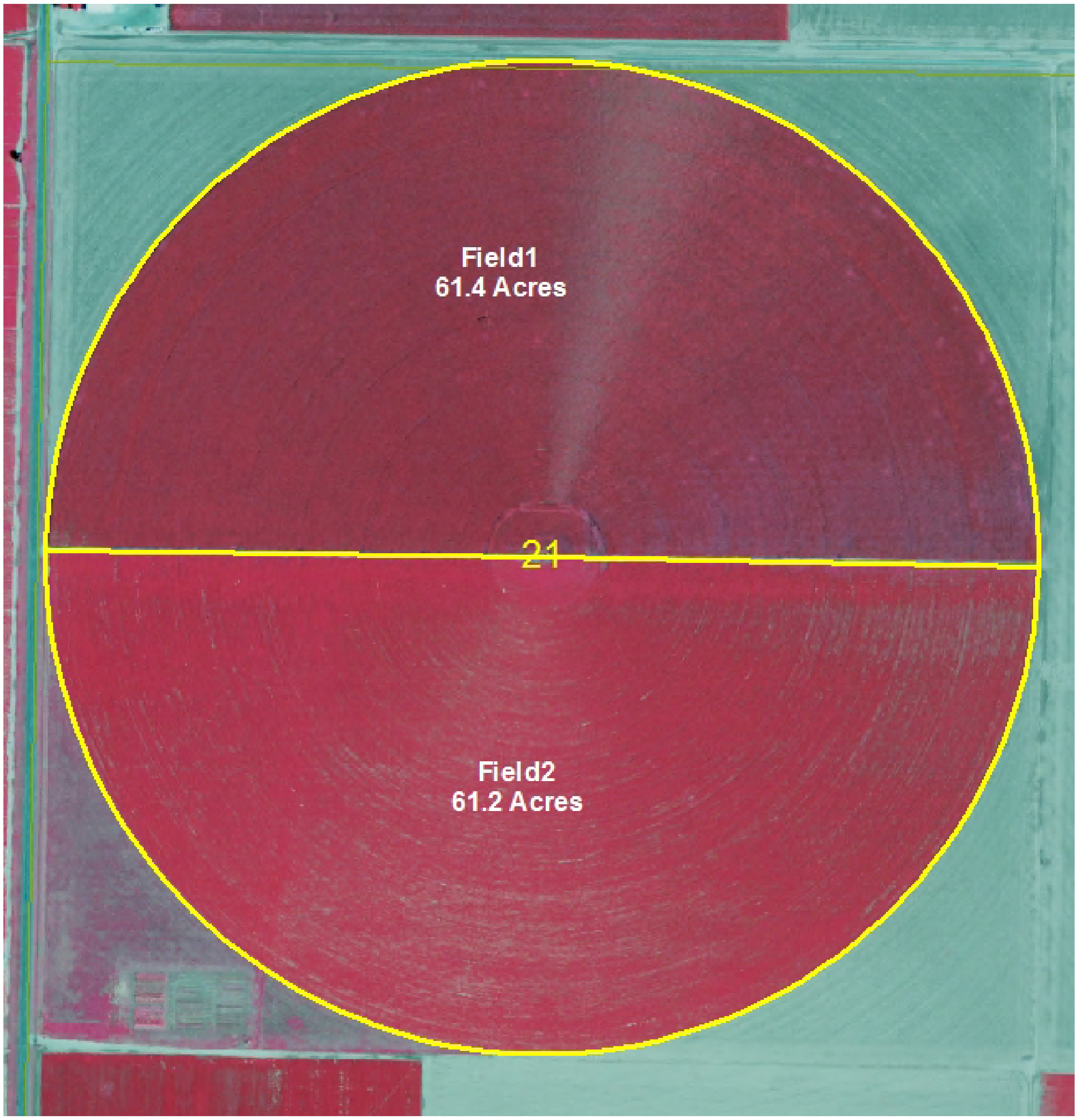

Irrigation and Precipitation
Water (inches)
70
60
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation


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


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



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



System 21 Description

Total system acres: 122.6

Field No. 1 Acres: 61.4
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 61.2
Major soil type: Pullman clay loam

Irrigation

Type: Center Pivot (LEPA)

Pumping capacity, gal/min: 500

Number of wells: 1

Fuel source: Electric

System 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

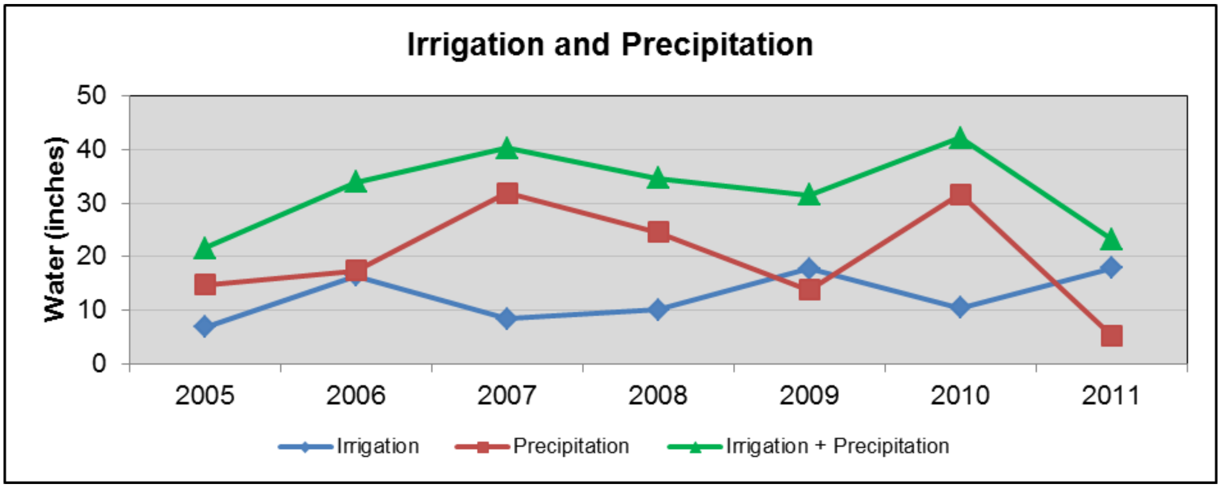
Comments: This is a pivot irrigated site with one-half planted to white food corn and one-half planted to cotton. Both crops are planted on forty-inch centers using conventional tillage. The corn was abandoned in mid June.

Pictures from Drought Year of 2011

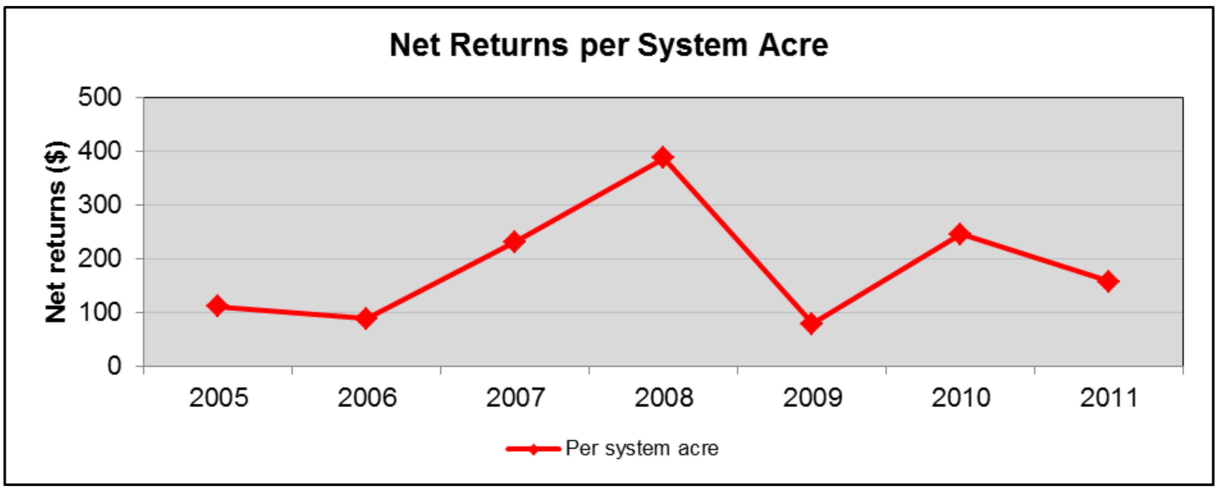
Cotton

Corn abandoned mid-June

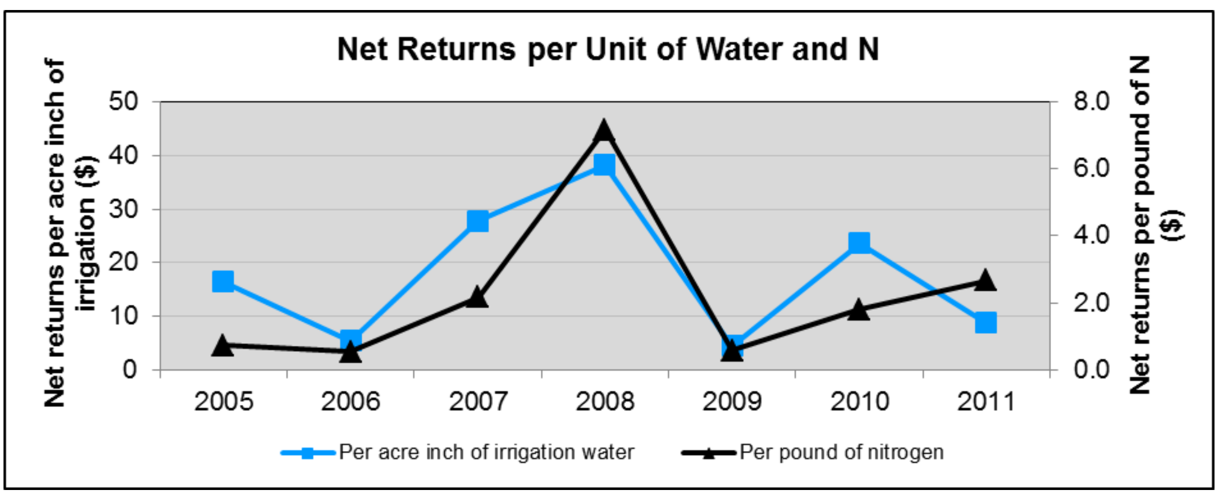
System 21



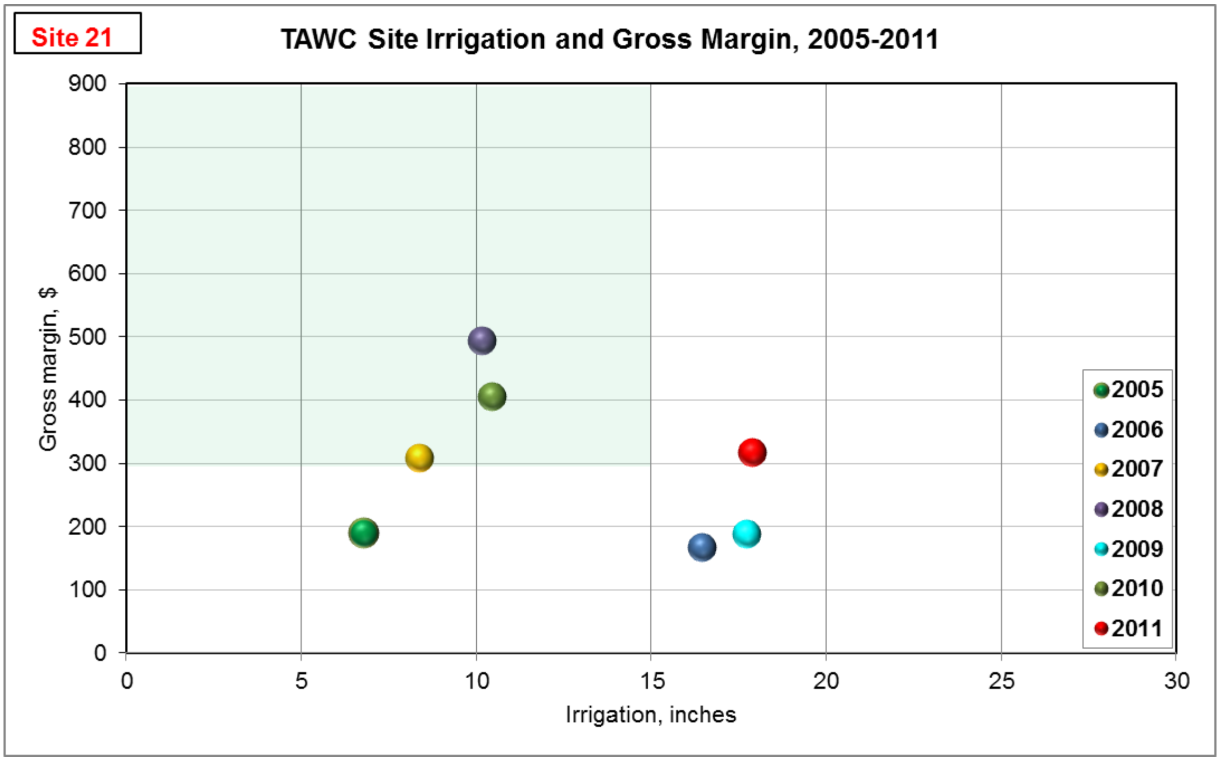
Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation



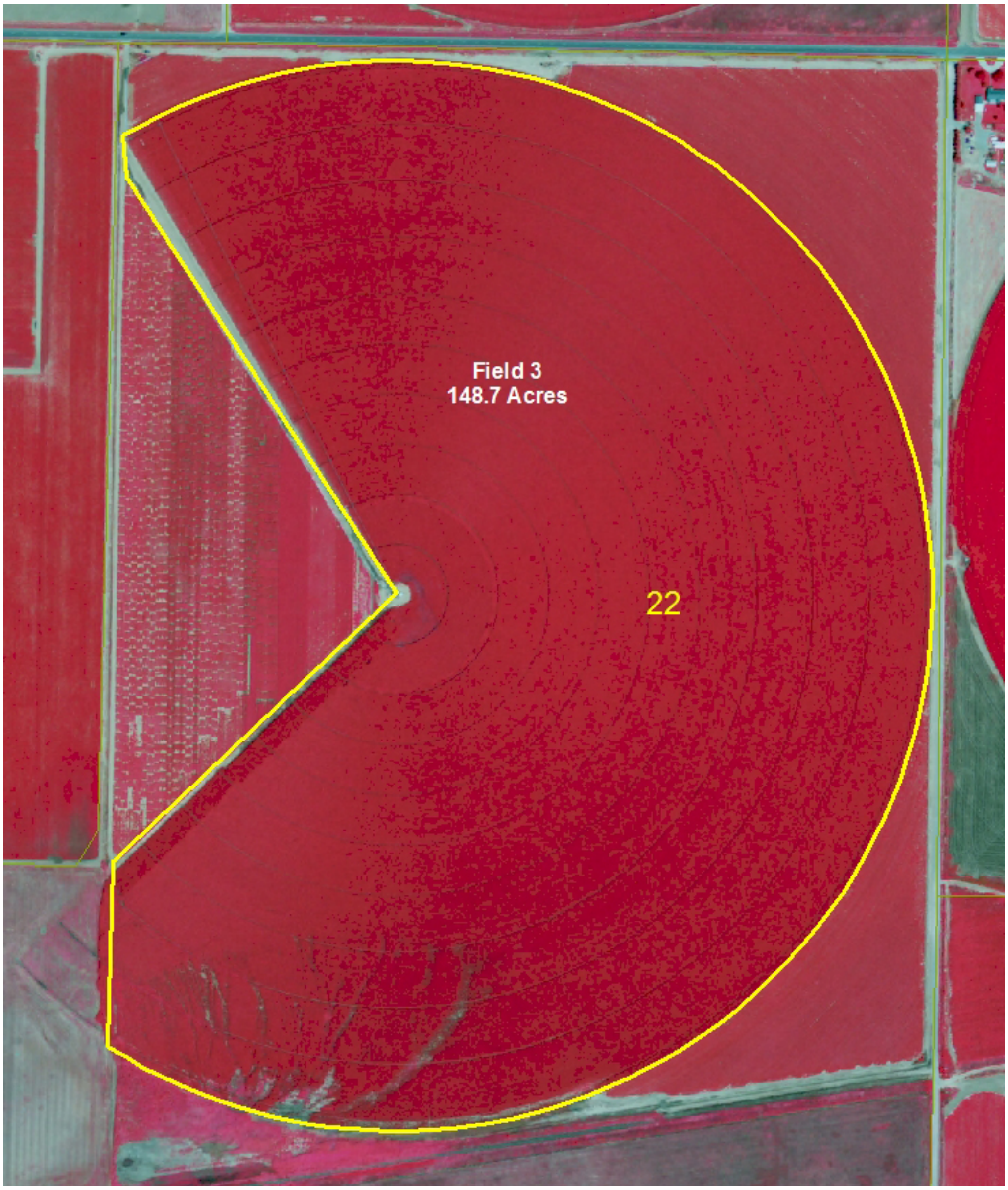
Net Returns per System Acre
Net returns ($)
500
400
300
200
100
0
2005
2006
2007
2008
2009
2010
2011
Per system acre



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



Site 21
TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $
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



System 22 Description

Total system acres: 148.7

Field No. 3 Acres: 148.7
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (LEPA)

Pumping capacity, gal/min: 800

Number of wells: 4

Fuel source: Electric

System 22

	Livestock	Field 1	Field 2	Field 3
2005	None	Corn for grain	Cotton	
2006	None	Cotton	Corn for grain	
2007	None	Cotton following Wheat cover crop	Cotton	
2008	None	Corn for grain	Corn for grain	
2009	None	Combined into Field 3		Cotton
2010	None			Corn
2011	None			Cotton

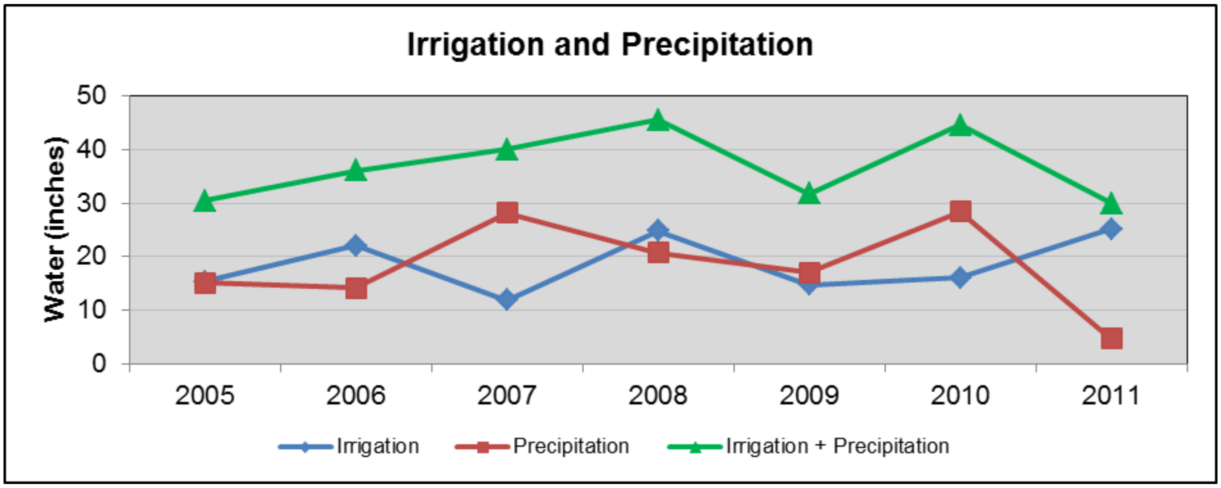
Comments: This is a pivot irrigated corn and cotton system. In 2011 both fields were planted to cotton on thirty-inch centers.

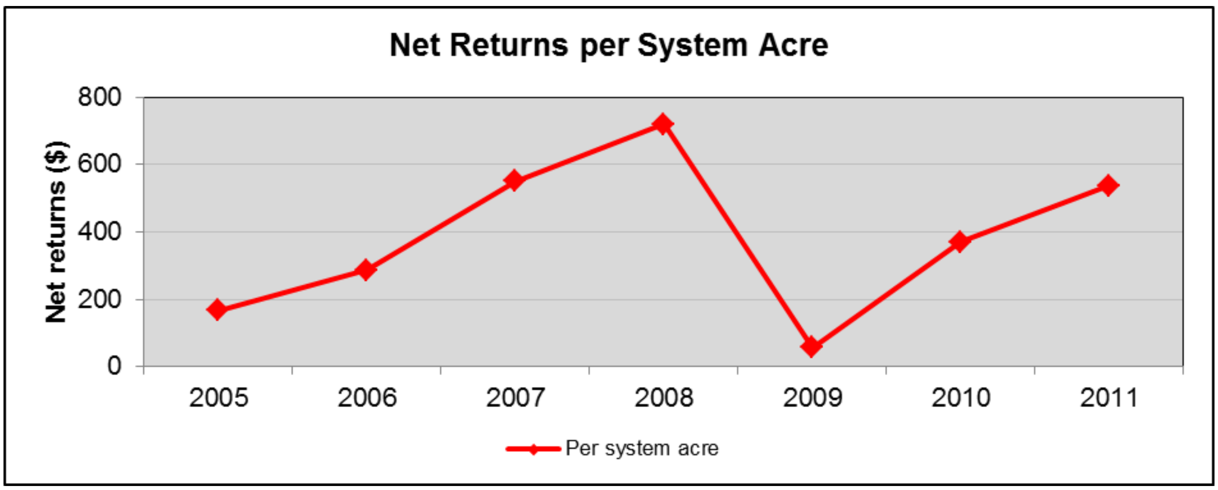
Pictures from Drought Year of 2011

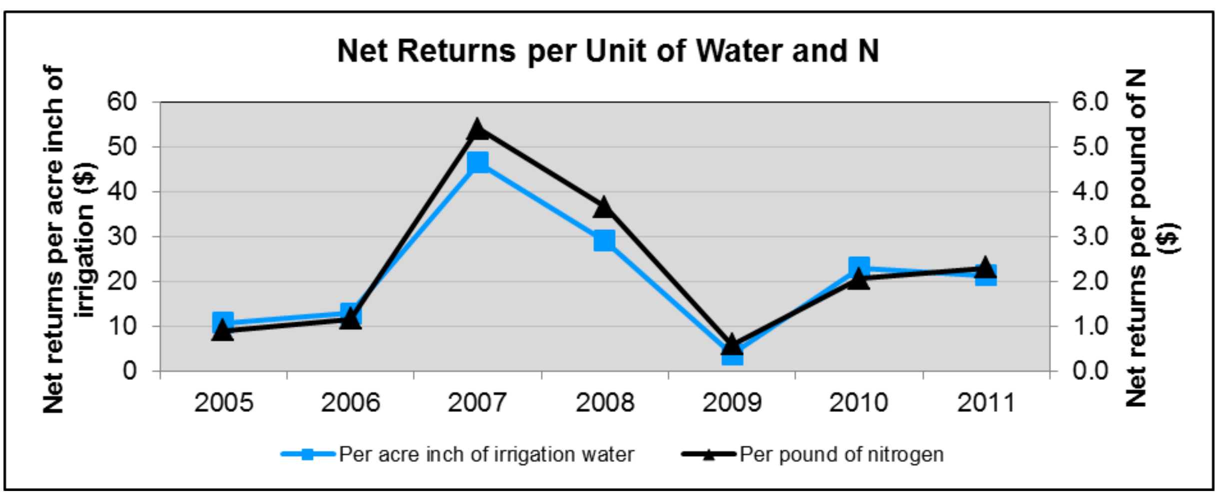
Planting prep

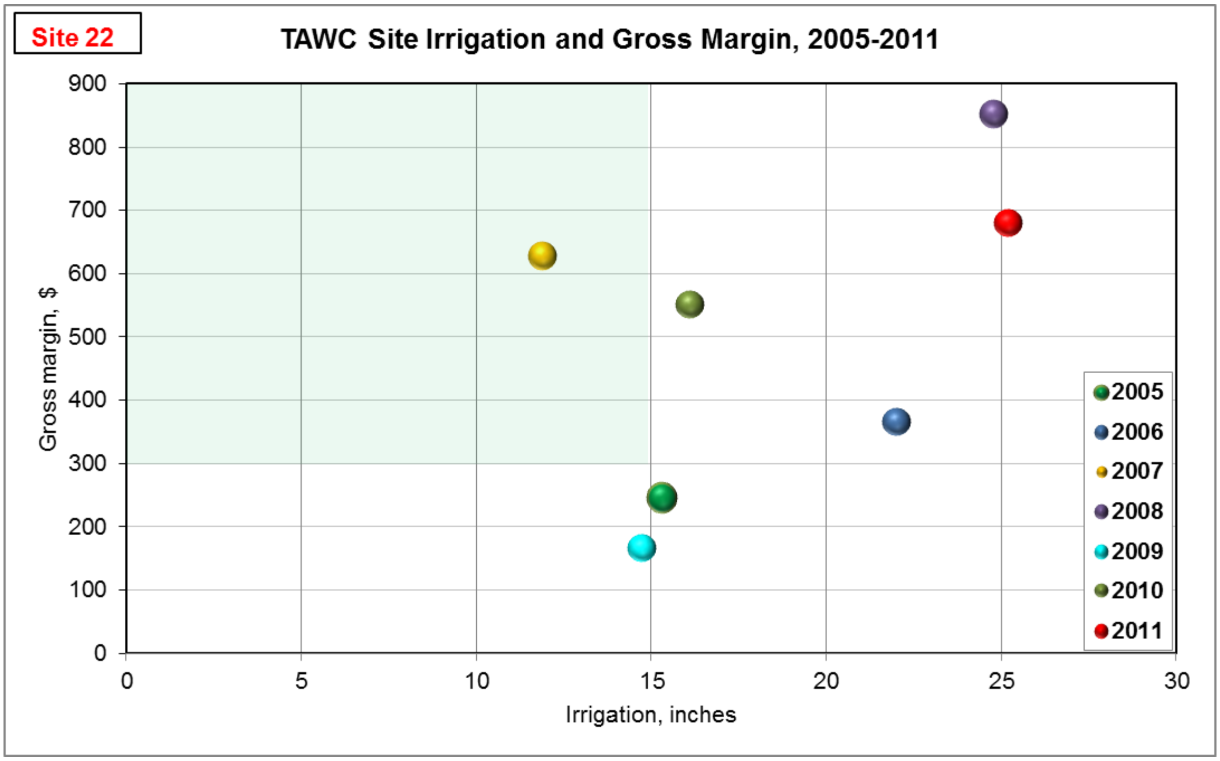
July cotton

System 22


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


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


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


Site 22
TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $
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

System 23 Description

Total system acres: 121.2

Field No. 6 Acres: 121.2
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 800

Number of wells: 2

Fuel source: Natural gas

System 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.

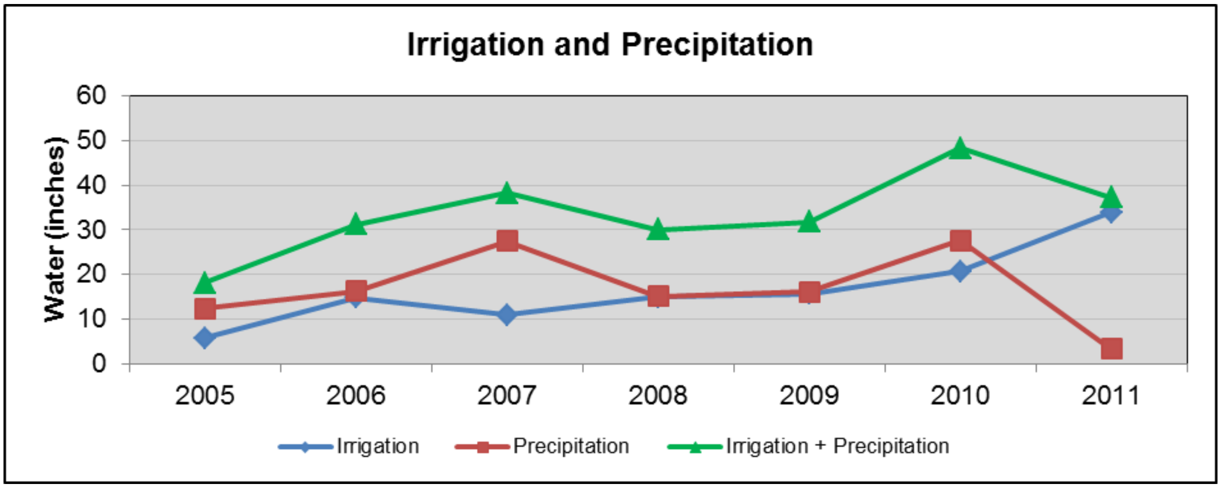
Pictures from Drought Year of 2011

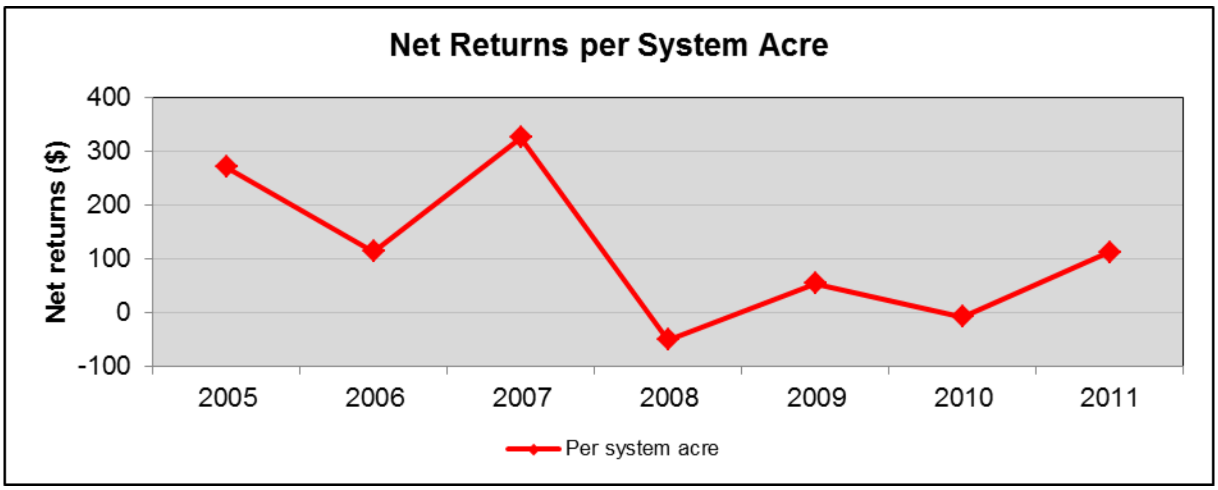
Triticale

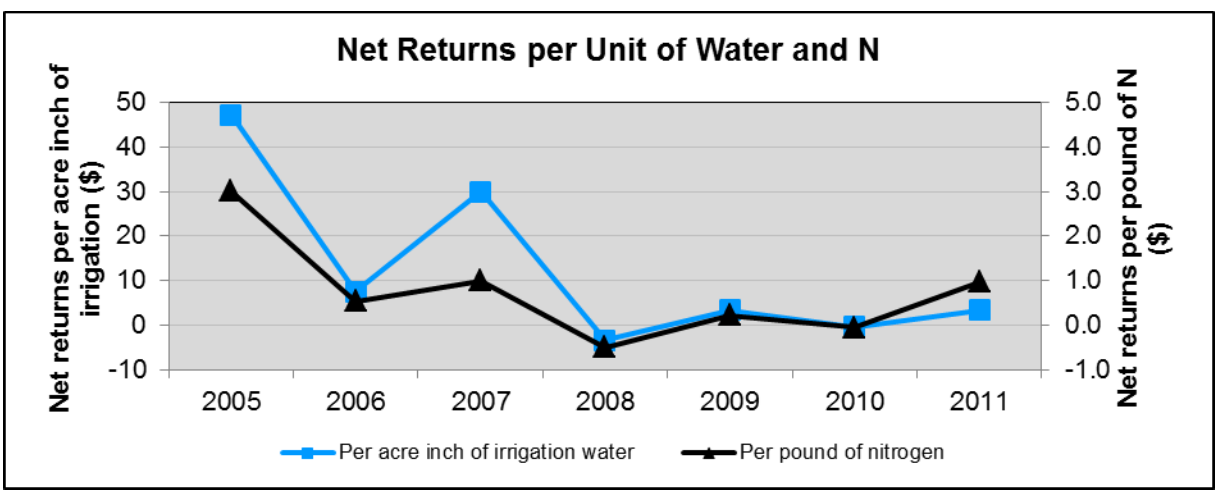
Corn planted into triticale residue

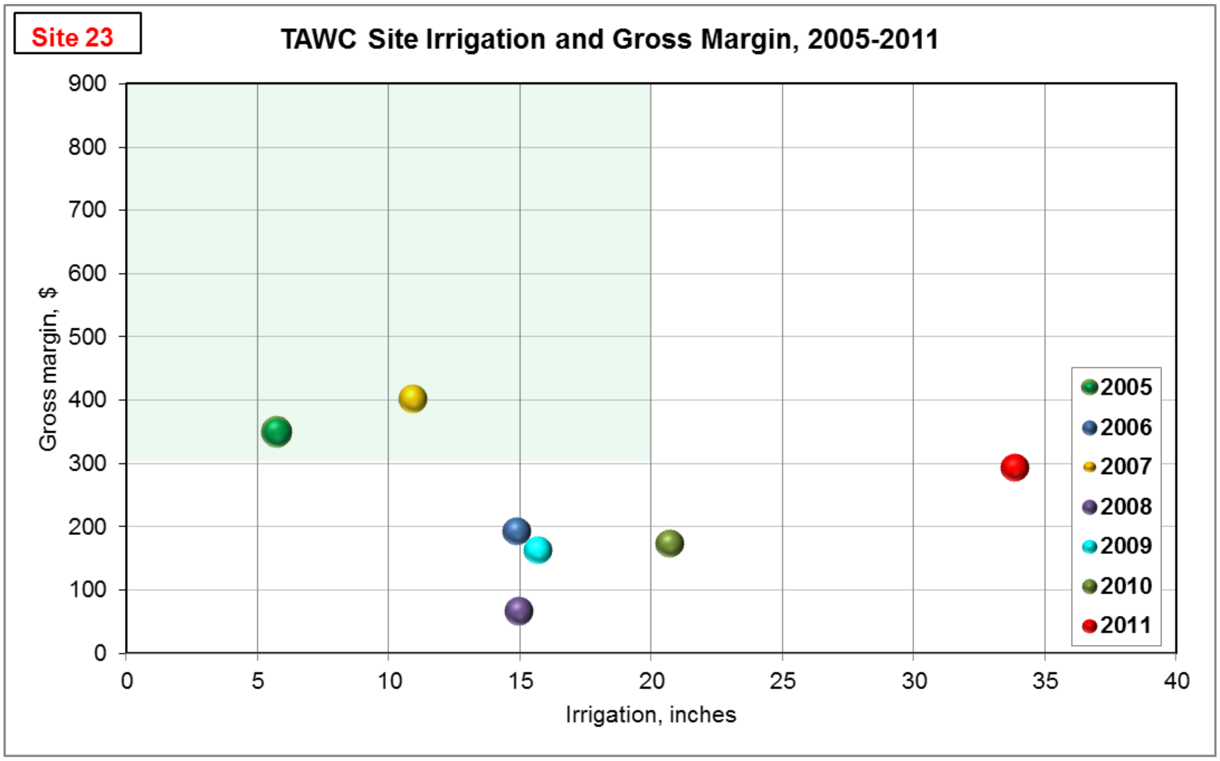
2011 Water battle

System 23

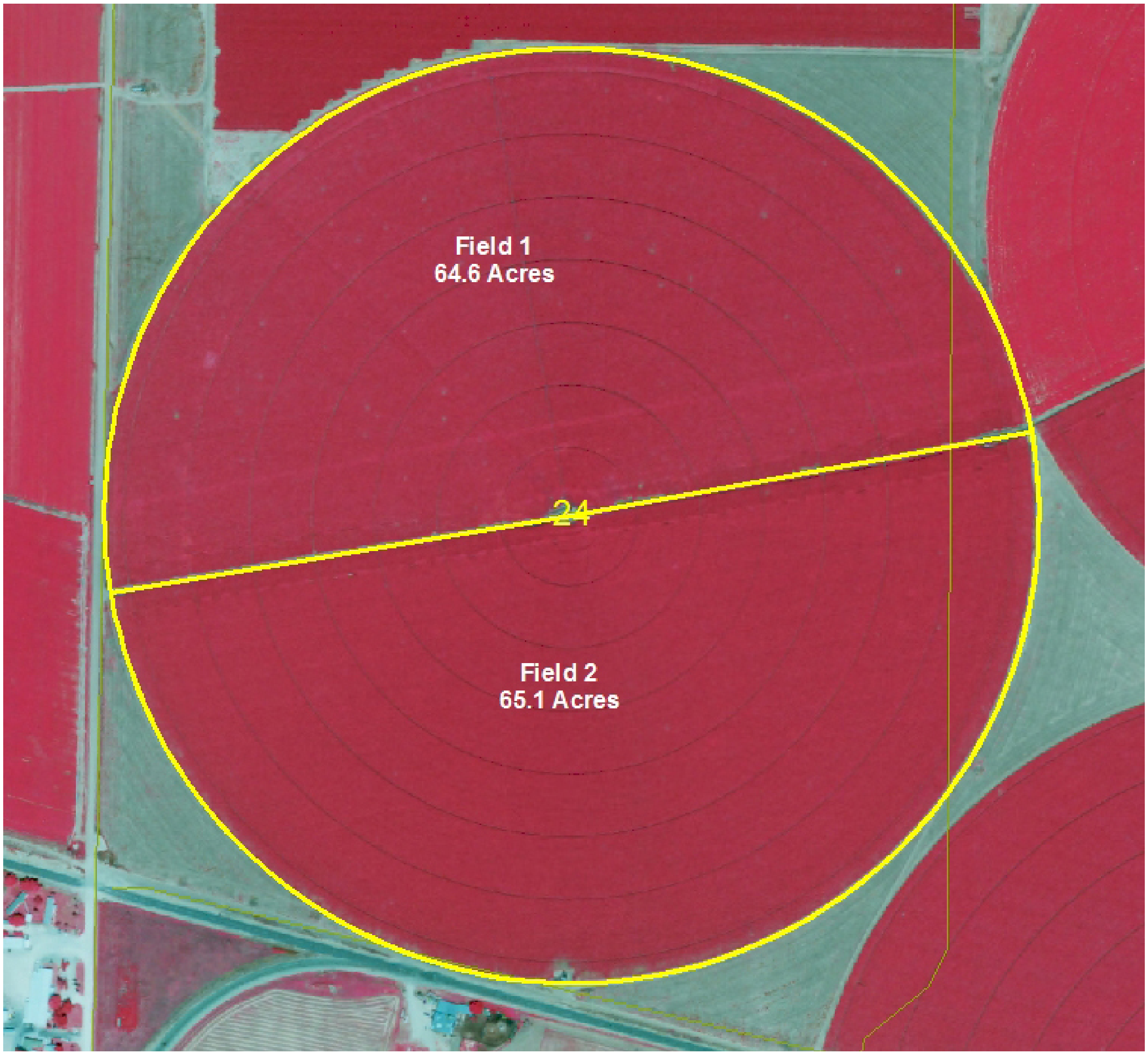

Irrigation and Precipitation
Water (inches)
0
10
20
30
40
50
60
2005
2006
2007
2008
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation


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


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
-10
0
10
20
30
40
50
Net returns per pound of N ($)
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
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, $
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



System 24 Description

Total system acres: 129.7

Field No. 1 Acres: 64.6
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 65.1
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 700

Number of wells: 1

Fuel source: Diesel

System 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

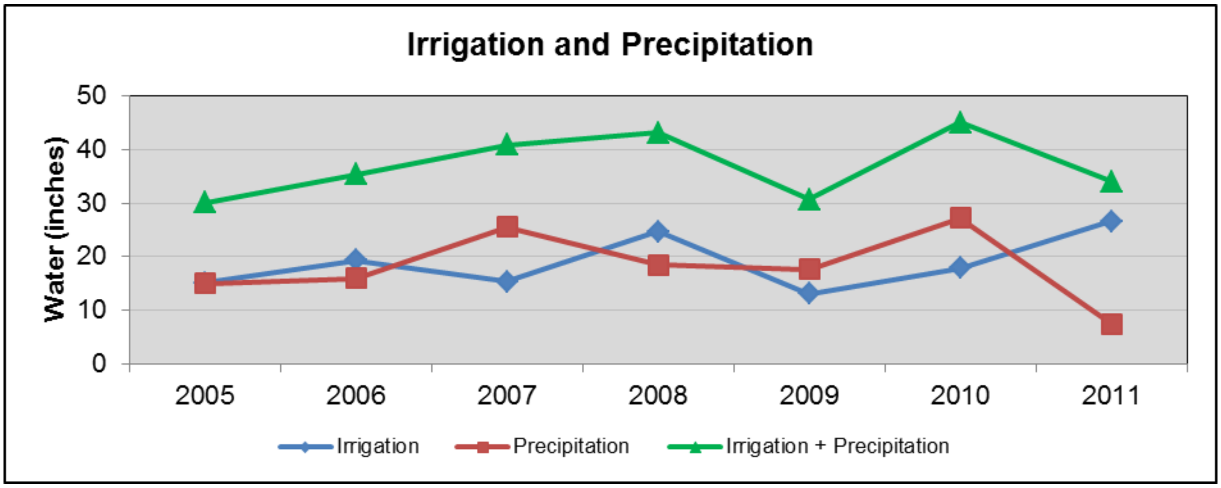
Comments: This has been a corn/cotton/sunflower pivot irrigated system using conventional tillage. In 2011 this system was planted to white food corn and cotton.

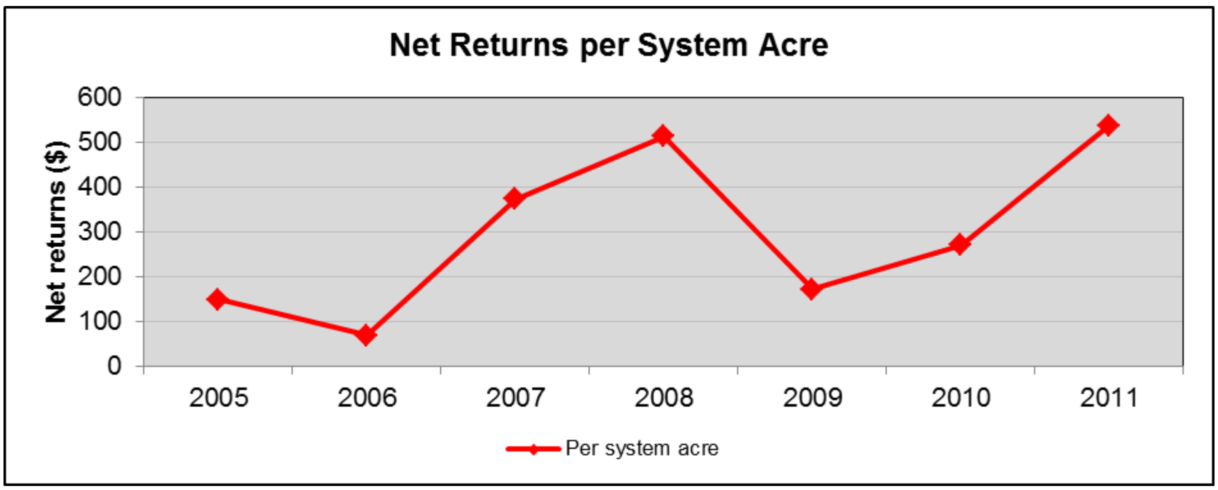
Pictures from Drought Year of 2011

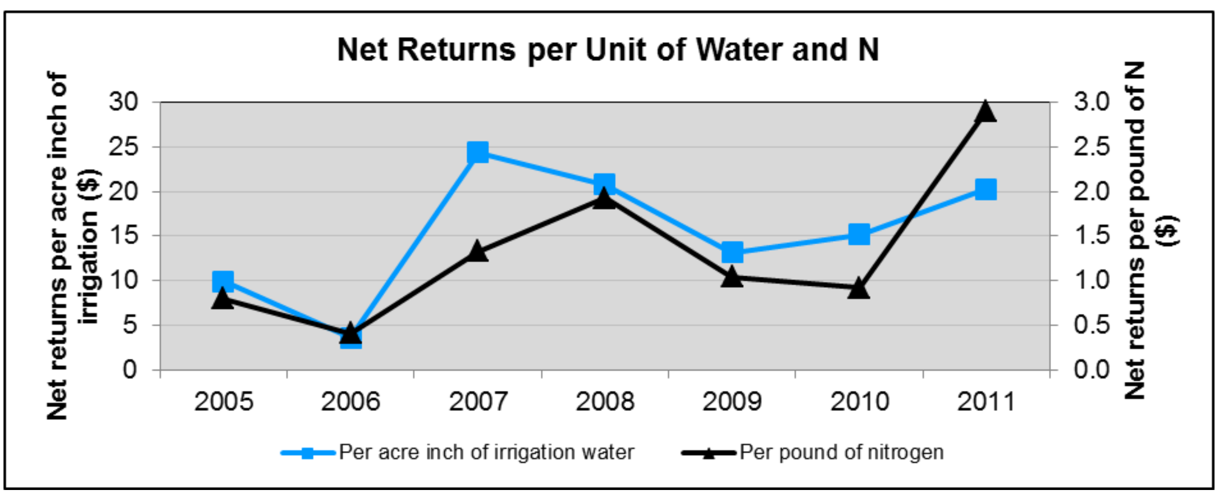
Corn harvest

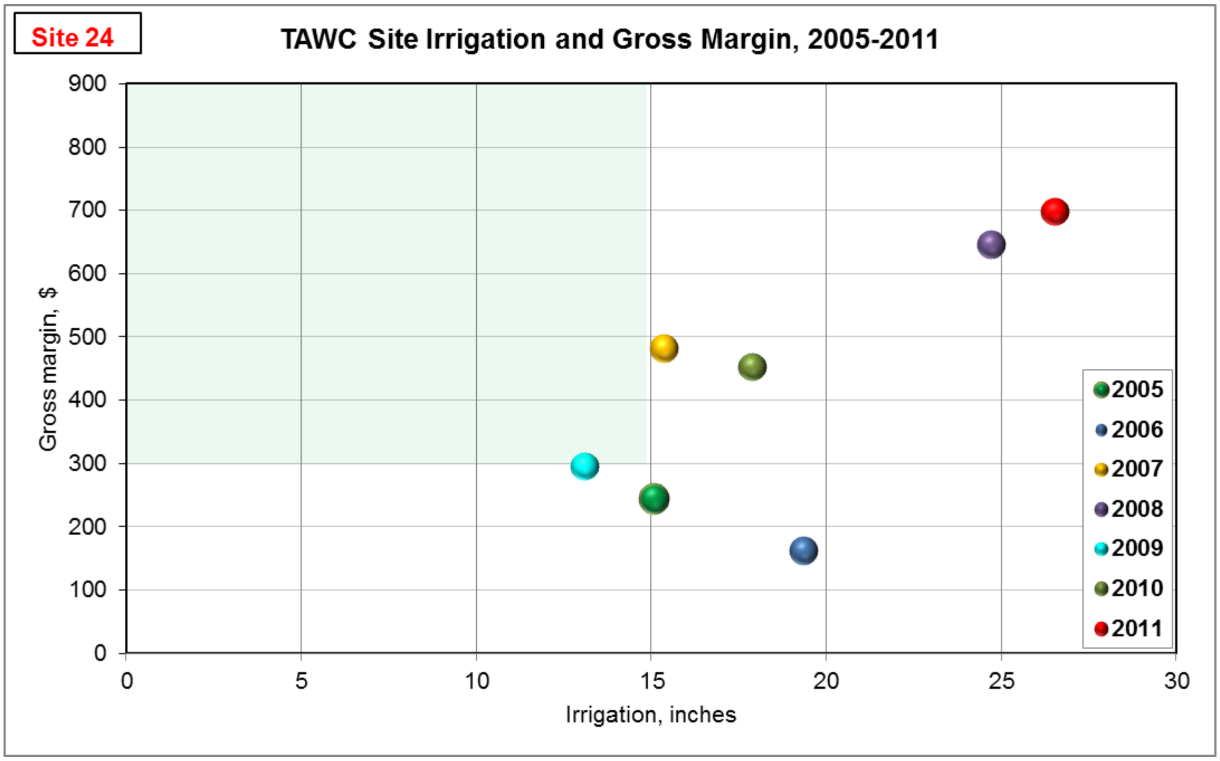
Cotton irrigation

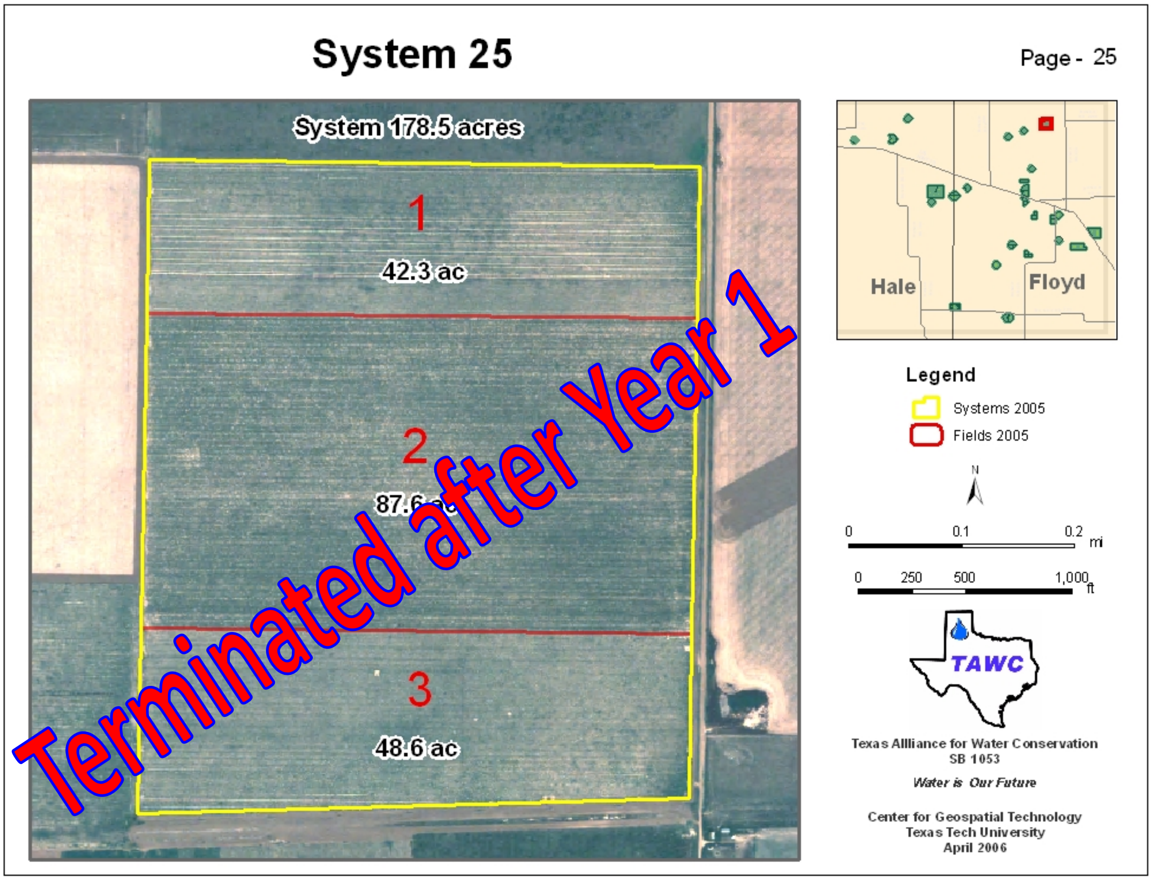
System 24


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
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
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
30
25
20
15
10
5
0
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
2010
2011
Per acre inch of irrigation water
Per pound of nitrogen


Site 24
TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $
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



System 25 Description

Total system acres: 178.5

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

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

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

Irrigation

Type: Dryland

Pumping capacity, gal/min:

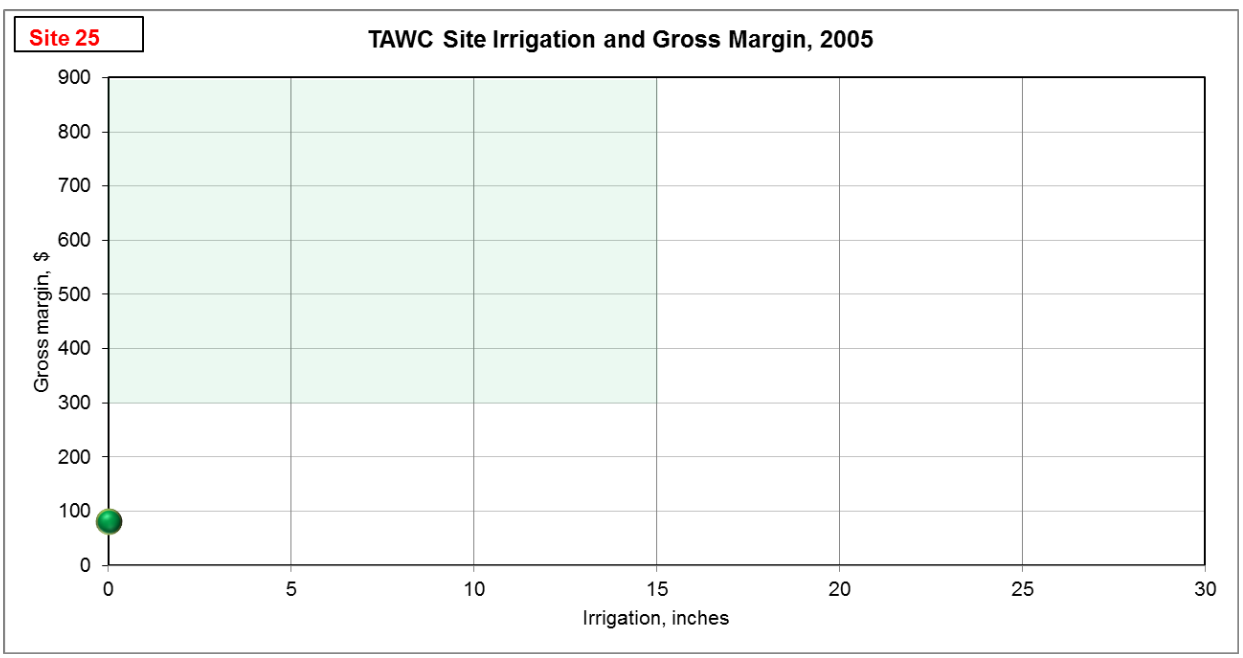
Number of wells:

Fuel source:

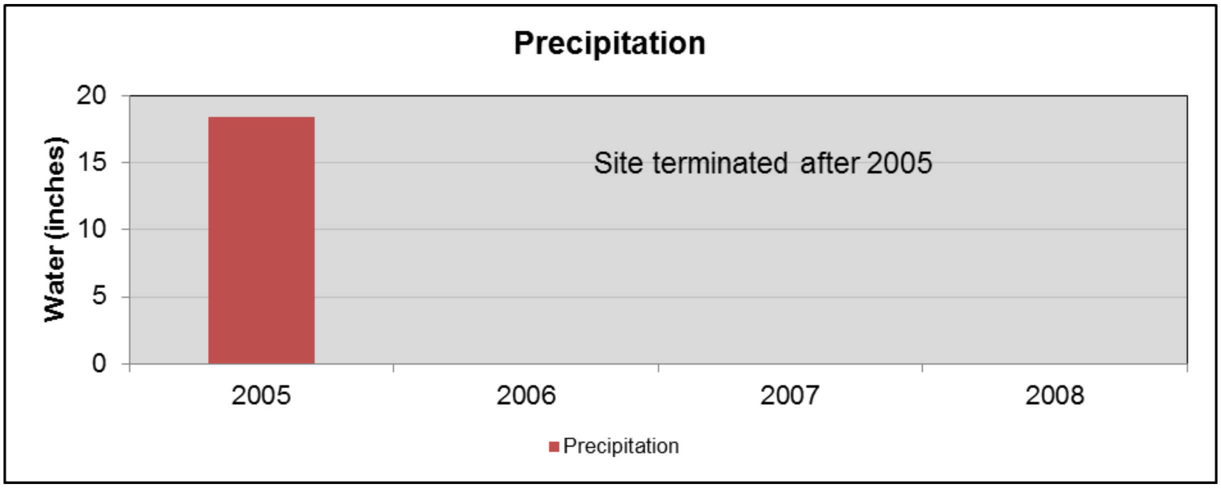
Comments: At this dryland site cotton and grain sorghum are grown in rotation. The cotton is planted in standing grain sorghum stalks. Cotton and grain sorghum are planted on forty-inch centers.

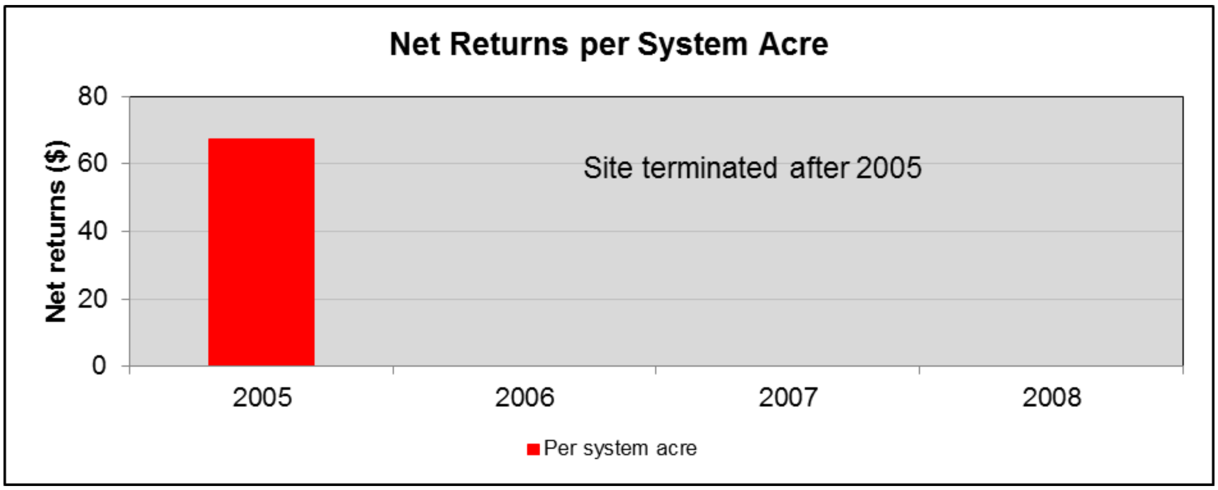
System 25 - Dryland

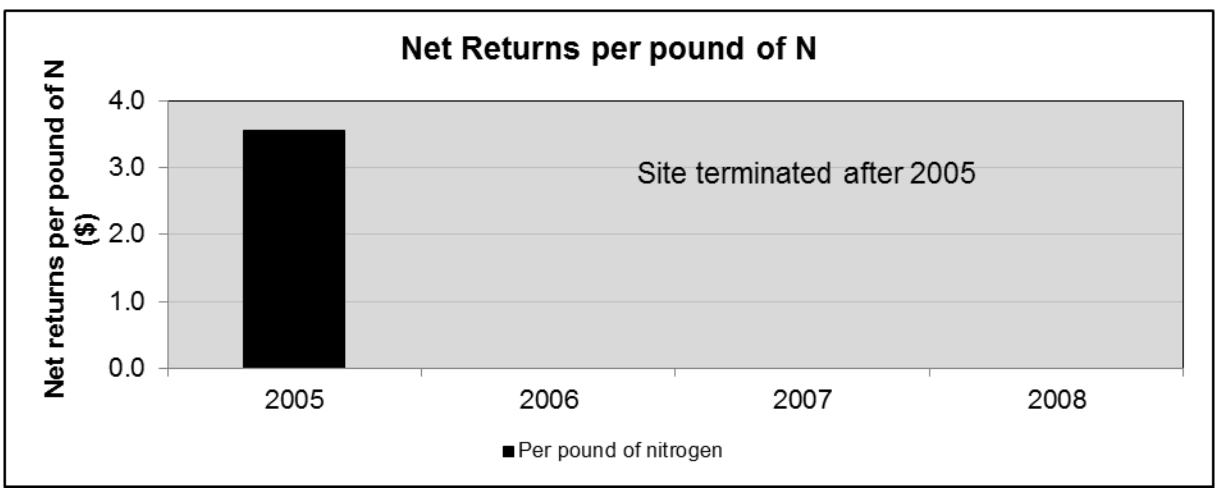
	Livestock	Field 1	Field 2	Field 3
2005	None	Cotton	Grain Sorghum	Cotton
2006	Site terminated in 2006			
2007				
2008				
2009				
2010				
2011				

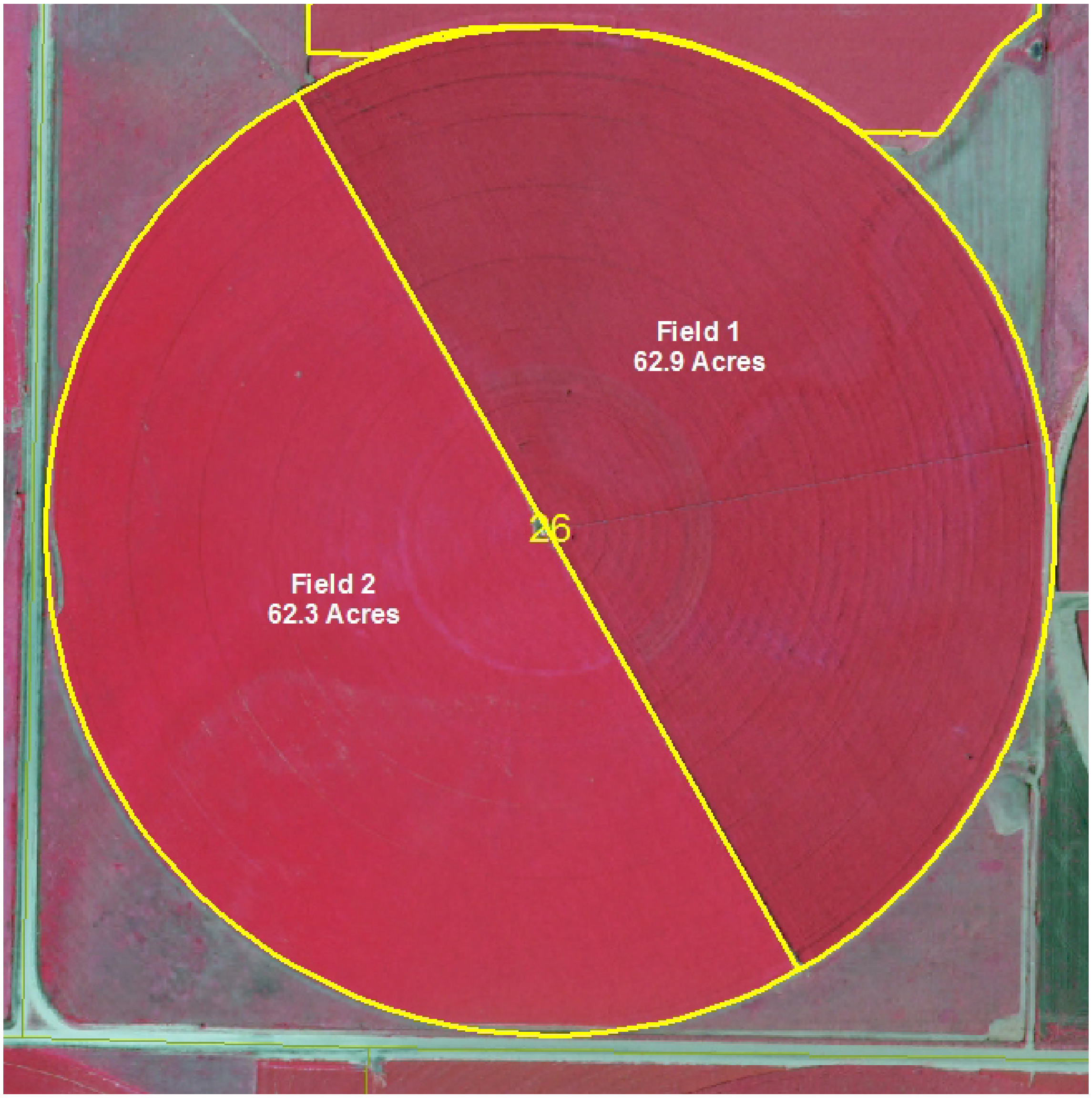


System 25 - Dryland









System 26 Description

Total system acres: 125.2

Field No. 1 Acres: 62.9
Major soil type: Bippus loam; 0 to 3% slope
Mansker loam; 3 to 5% slope

Field No. 2 Acres: 62.3
Major soil type: Bippus loam; 0 to 3% slope
Mansker loam; 3 to 5% slope

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 600

Number of wells: 2

Fuel source: 1 Electric
1 Diesel

System 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		

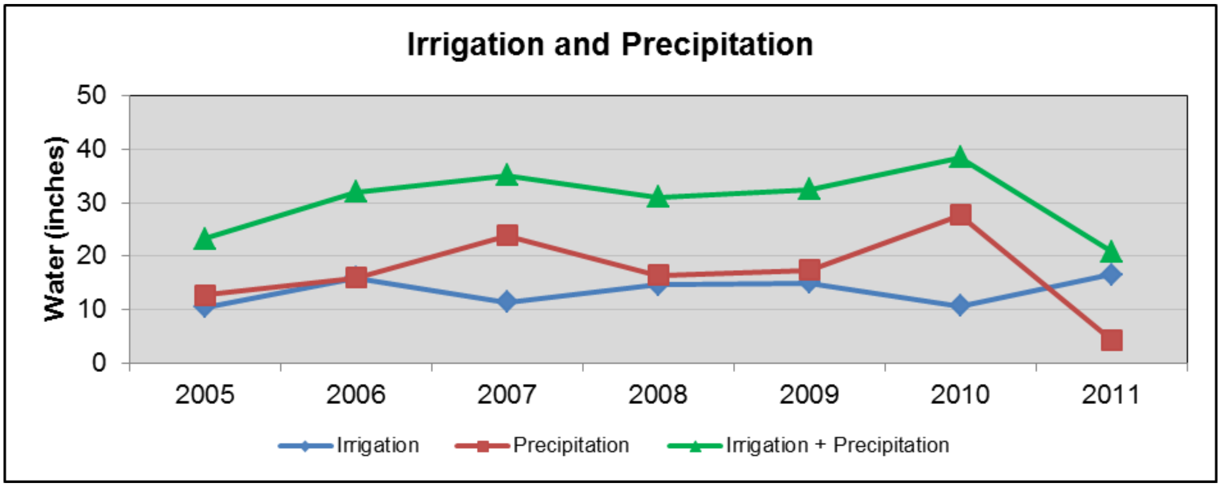
Comments: This was a cotton/corn system for 2011. This producer switched to a cotton picker and changed his row spacing to thirty-inch centers.

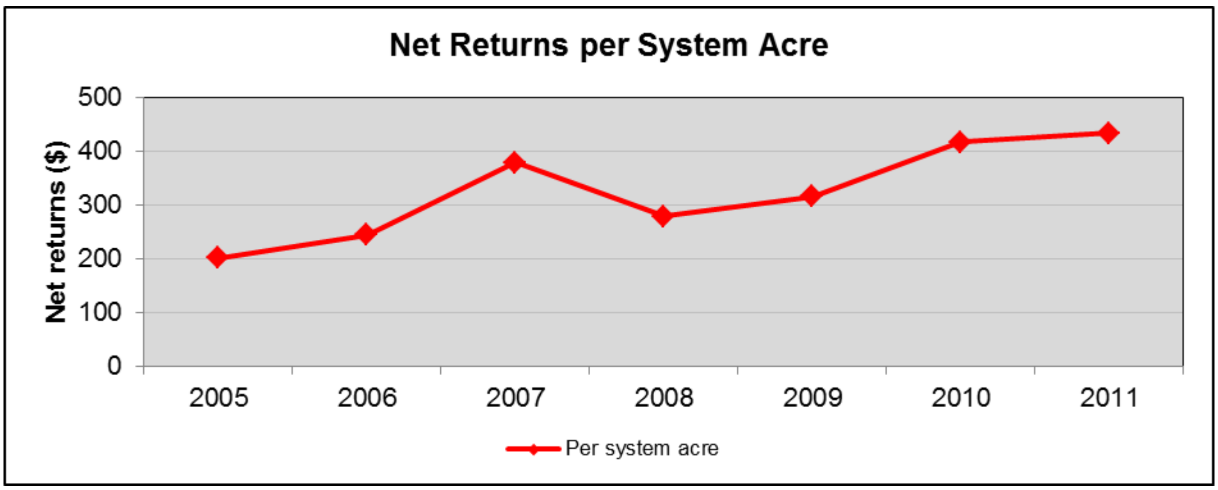
Pictures from Drought Year of 2011

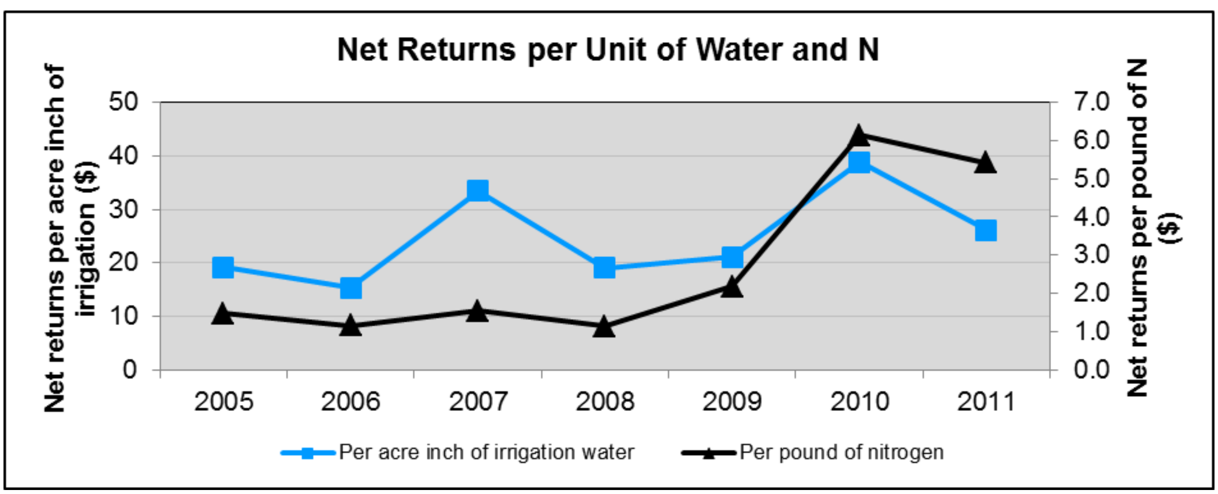
Cotton foreground/corn background

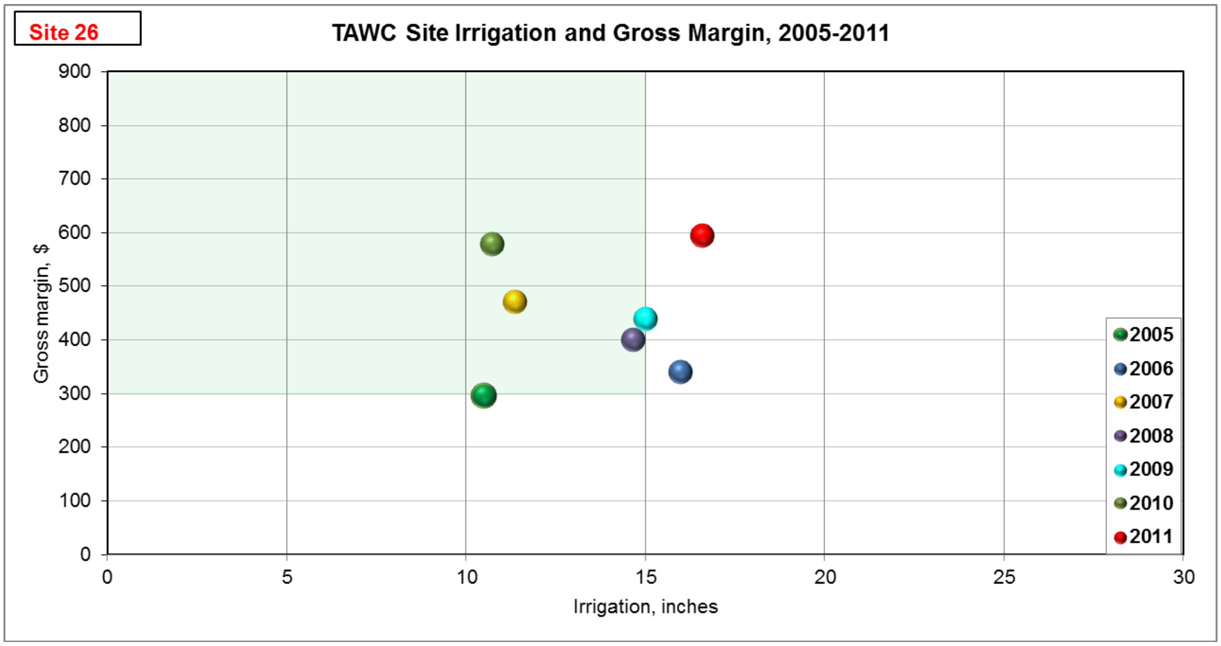
July corn

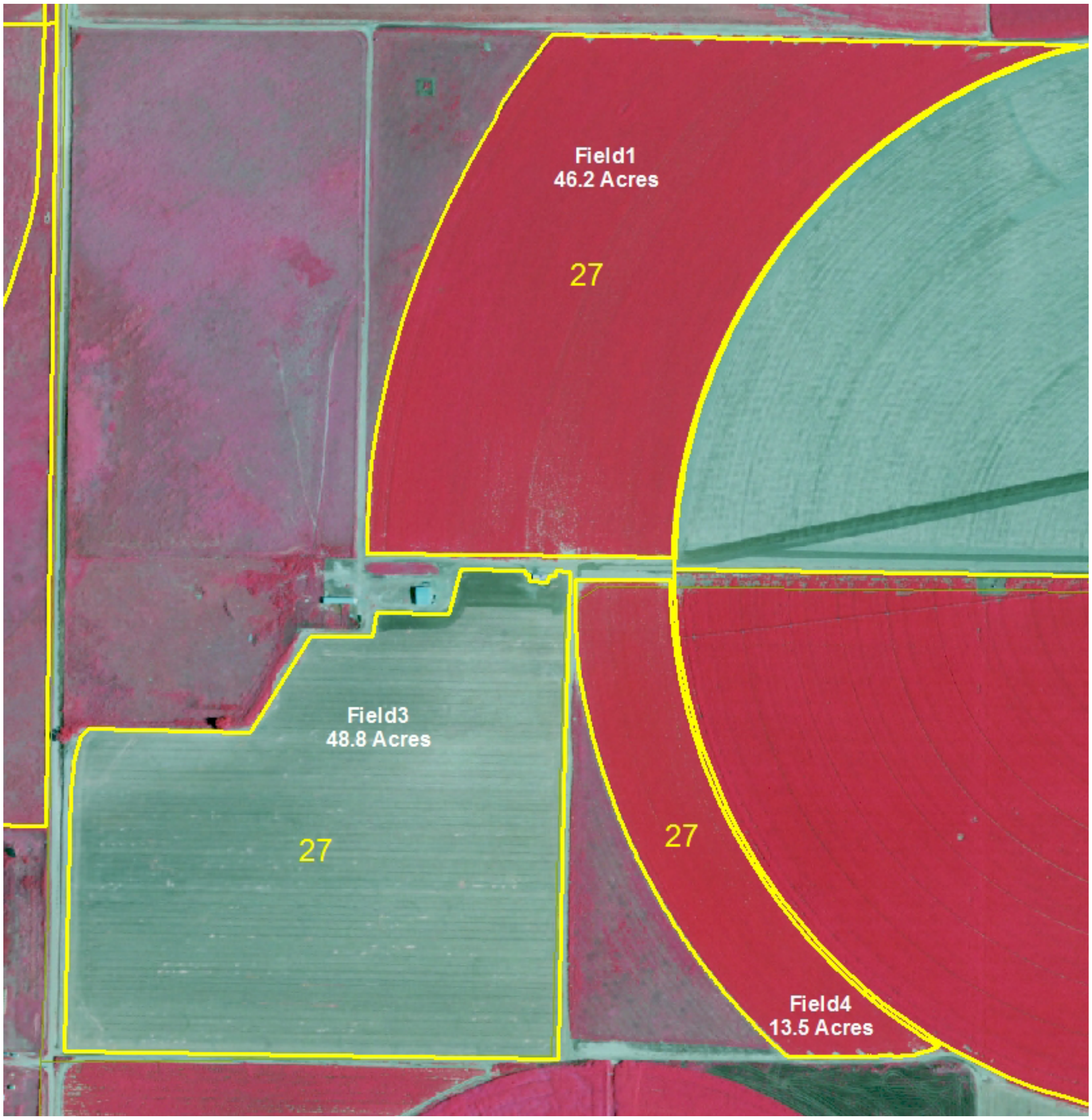
System 26


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


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


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


Site 26
TAWC Site Irrigation and Gross Margin, 2005-2011
Gross margin, $
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



System 27 Description

Total system acres: 108.5

Field No. 1 Acres: 46.2
Major soil type: Pullman clay loam; 0 to 1% slope

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

Field No. 4 Acres: 13.5
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

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

Number of wells: 2

Fuel source: Electric

System 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

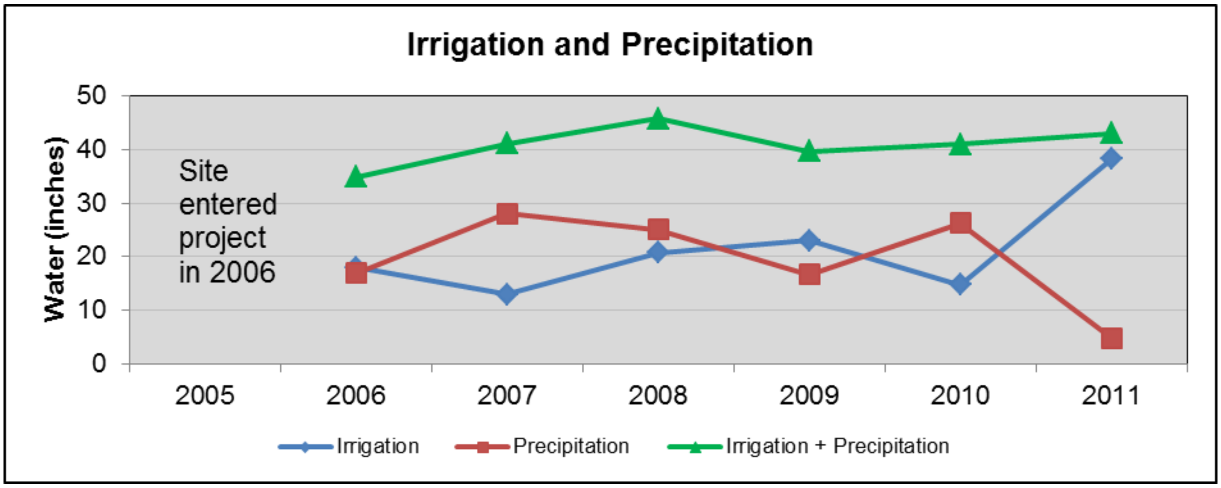
Comments: This is the fifth year for this cotton/corn drip irrigated site. Corn is planted on forty-inch centers with cotton planted also on forty-inch centers.

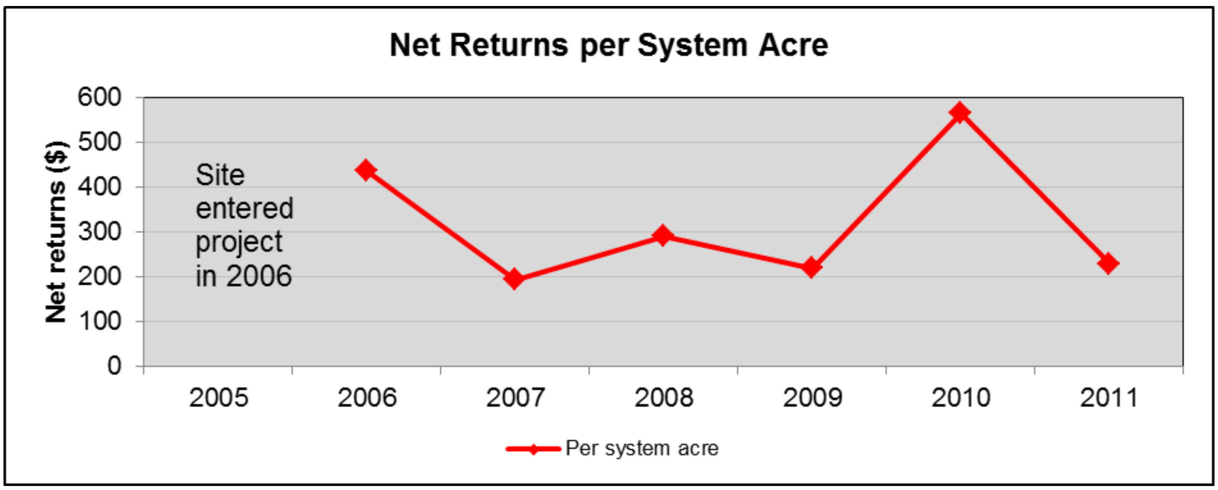
Pictures from Drought Year of 2011

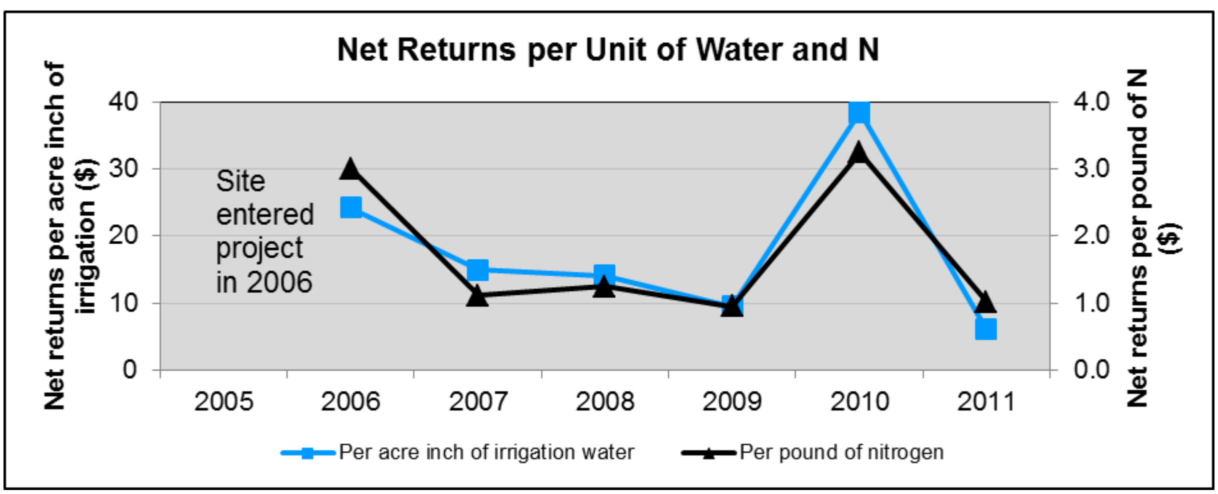
Corn

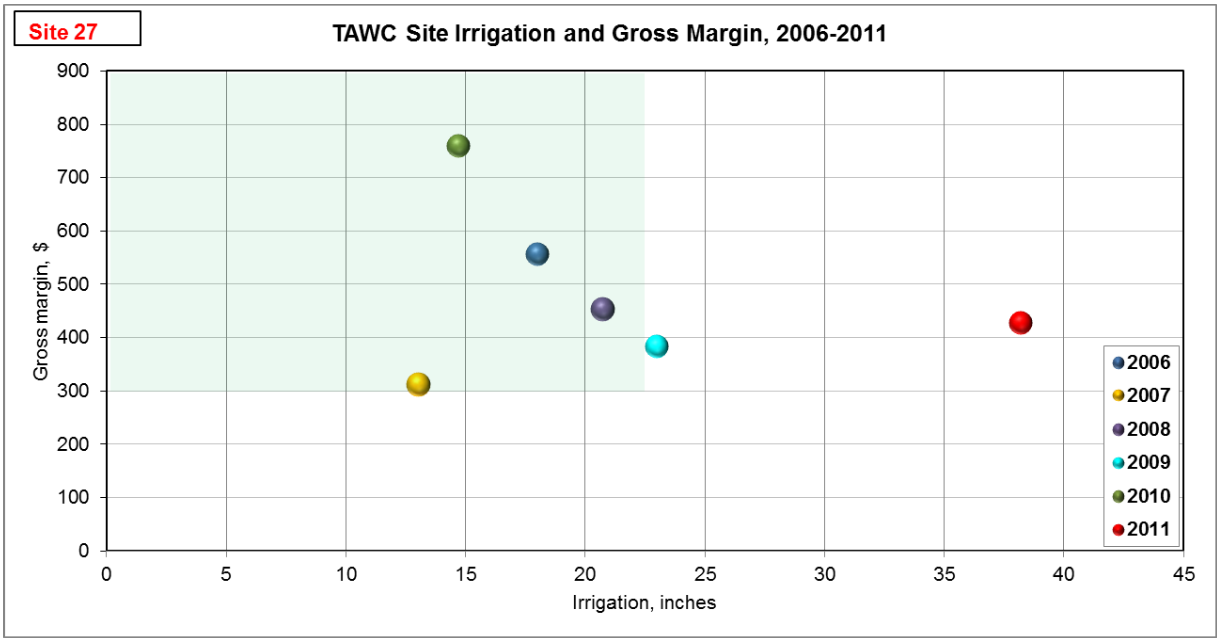
Cotton

System 27


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


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


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


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

System 28 Description

Total system acres: 51.5

Field No. 1 Acres: 51.5
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Sub-surface Drip (SDI)

Pumping capacity, gal/min: 300

Number of wells: 1

Fuel source: electric

System 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

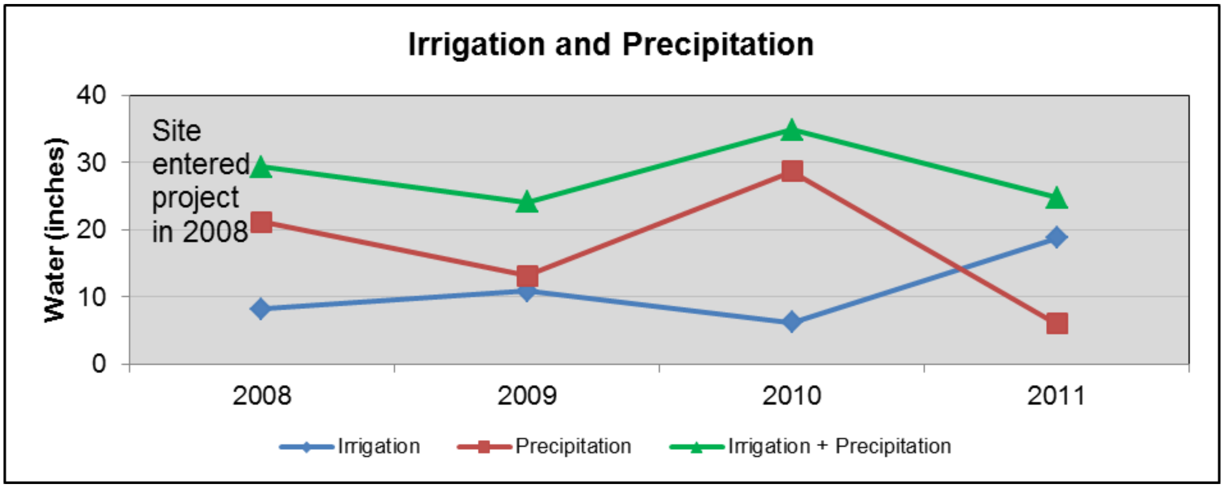
Comments: This is the fourth year for this drip irrigated site to be in the project. In 2011 this site was planted to cotton on forty-inch centers.

Pictures from Drought Year of 2011

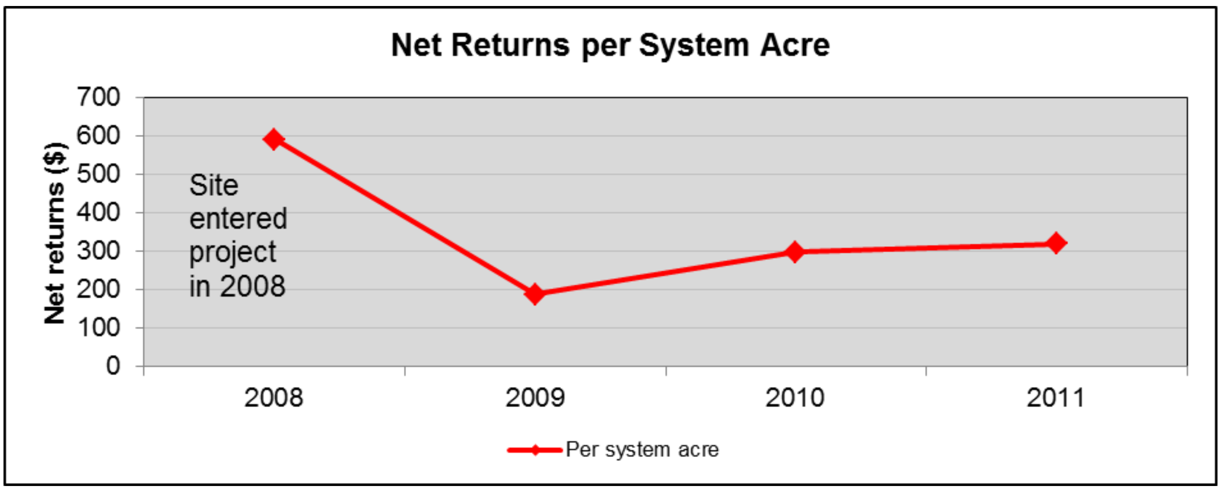
July Cotton

October Cotton

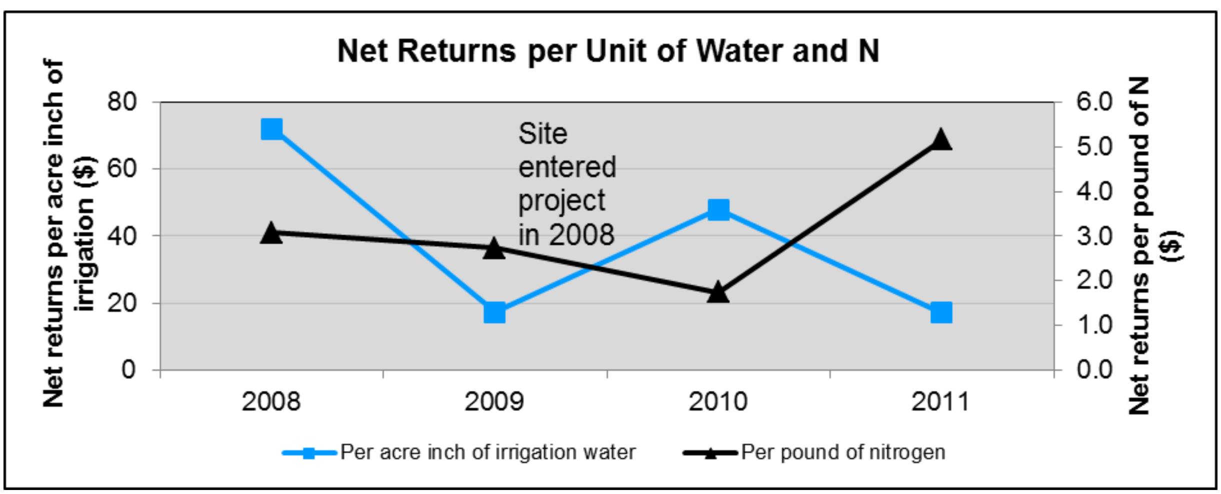
System 28



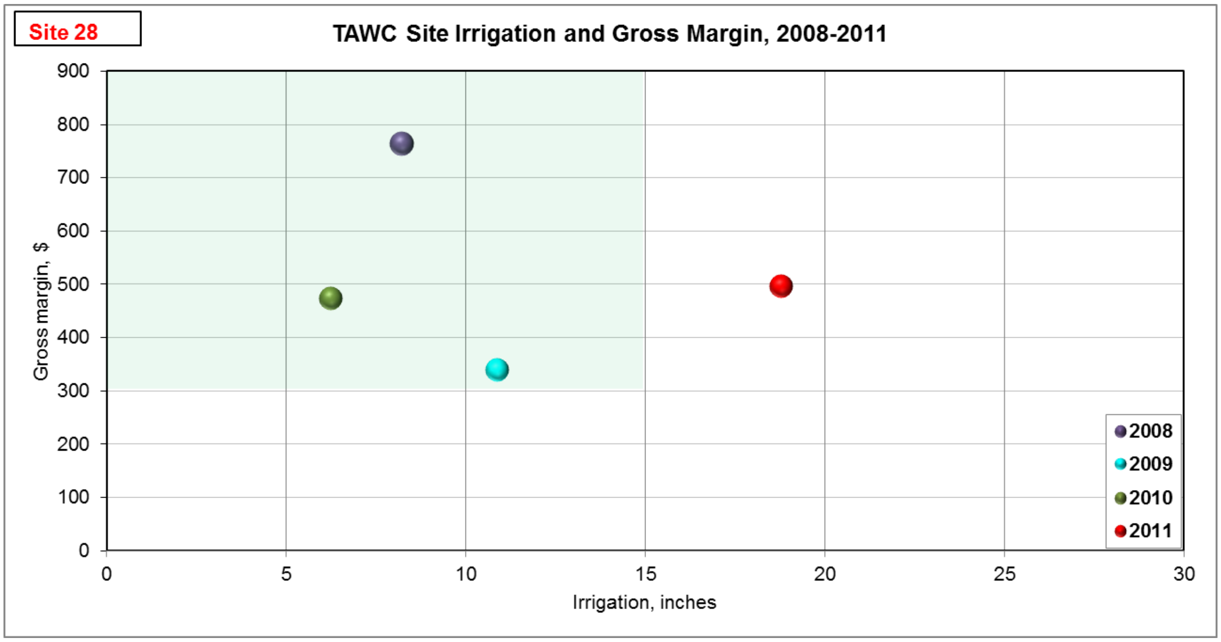
Irrigation and Precipitation
Water (inches)
40
30
20
10
0
Site entered project in 2008
2008
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation

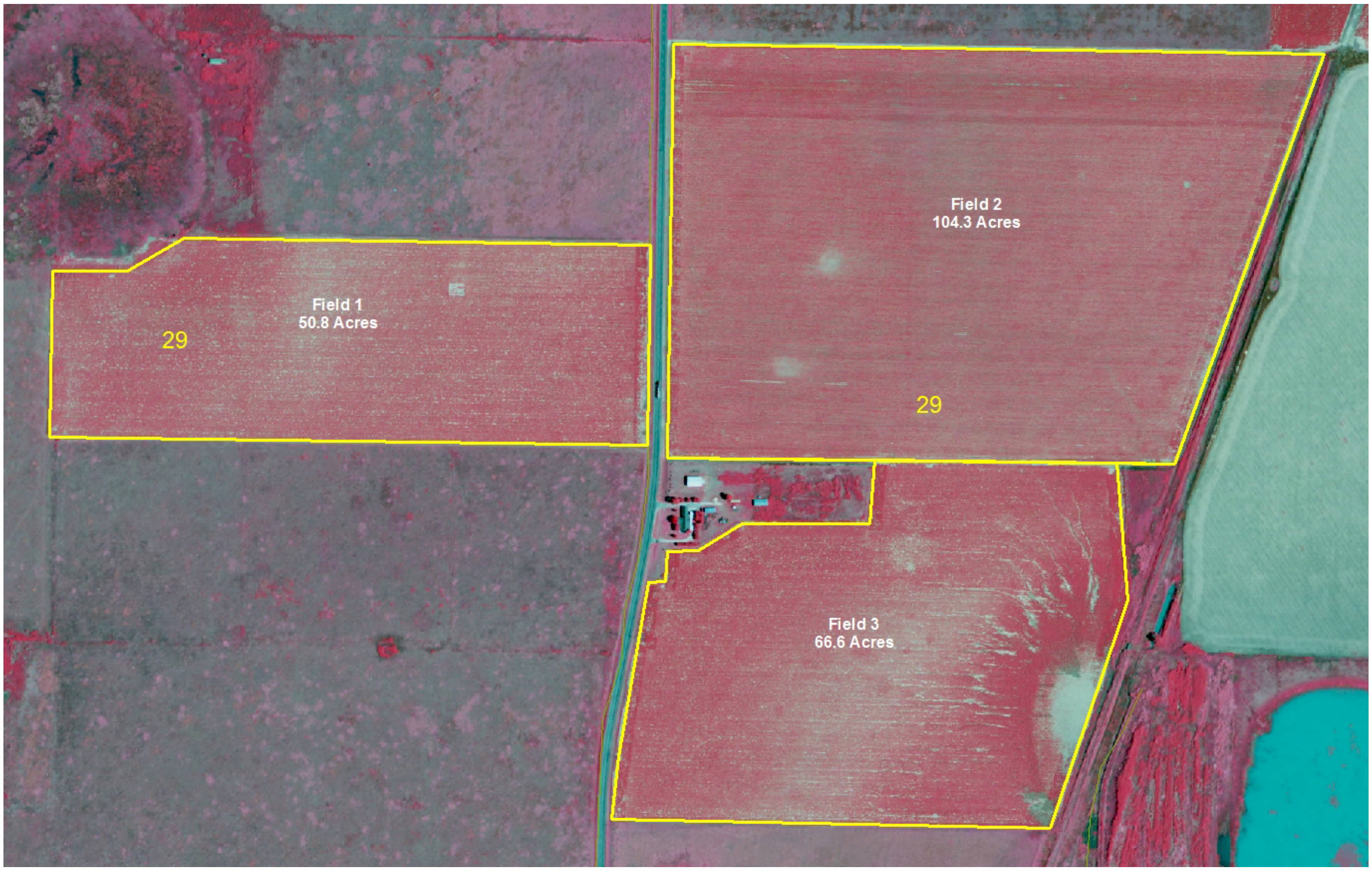


Net Returns per System Acre
Net returns ($)
700
600
500
400
300
200
100
0
Site entered project in 2008
2008
2009
2010
2011
Per system acre



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


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



System 29 Description

Total system acres: 221.7

Field No. 1 Acres: 50.8
Major soil type: Pullman clay loam; 0 to 1% slope

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

Field No. 3 Acres: 65.6
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Dryland

Pumping capacity, gal/min: na

Number of wells: na

Fuel source: na

System 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

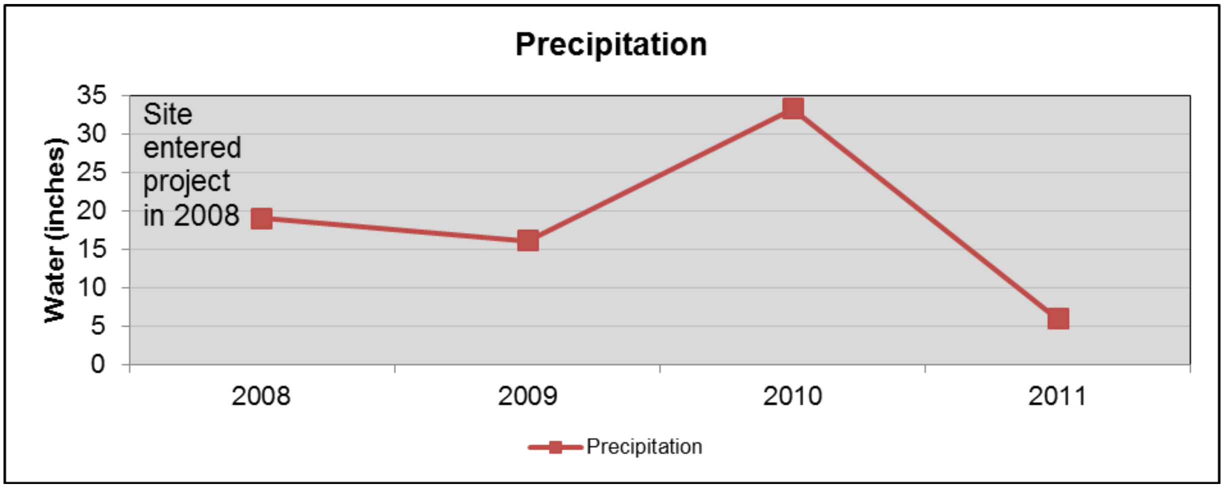
Comments: This is a conventional till dryland site using cotton and grain sorghum in rotation. Cotton and grain sorghum are planted on forty-inch centers. All fields in this system were failed in 2011 because of lack of any emergence.

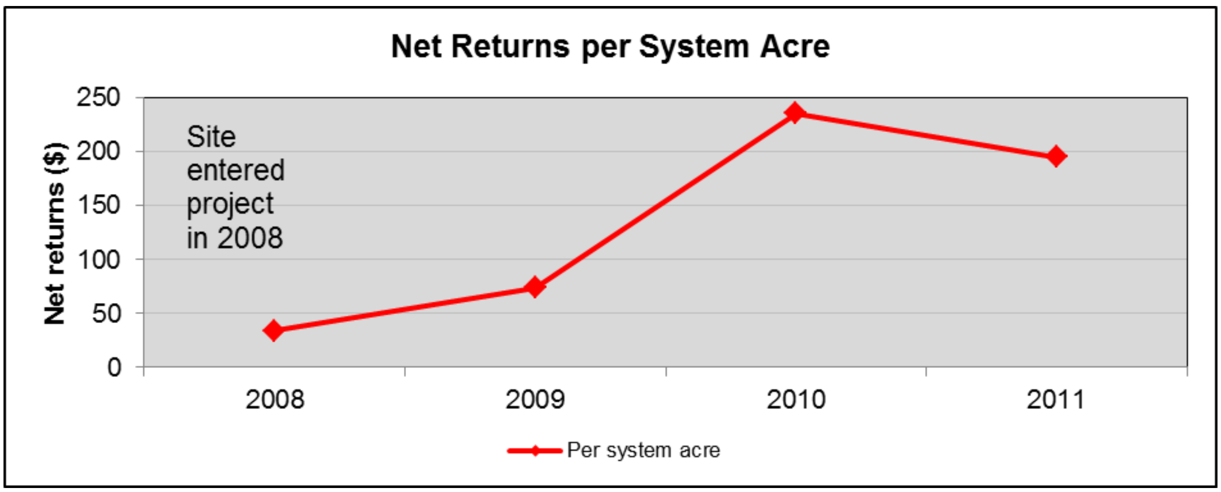
Pictures from Drought Year of 2011

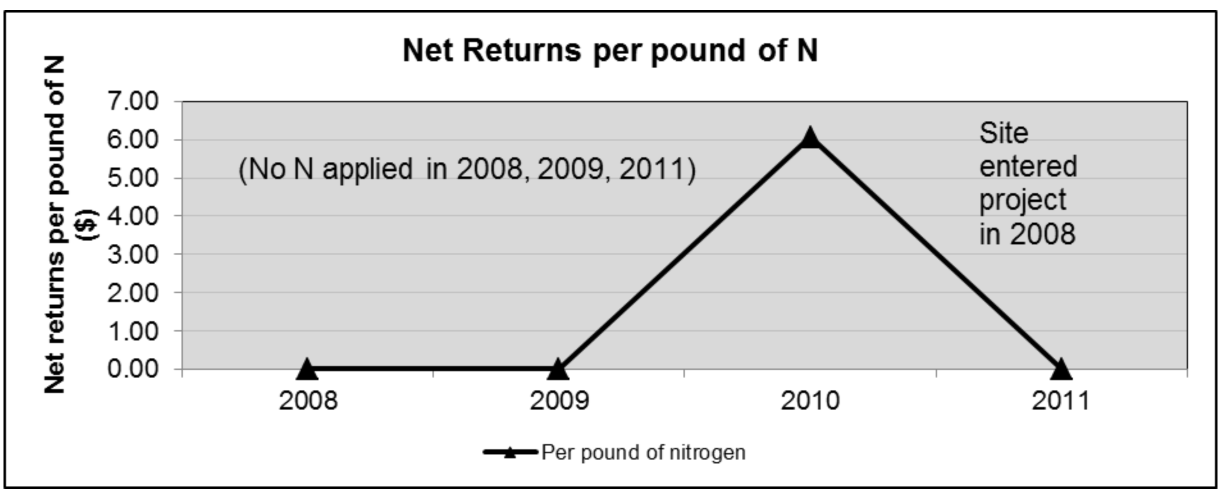
Abandoned cotton field

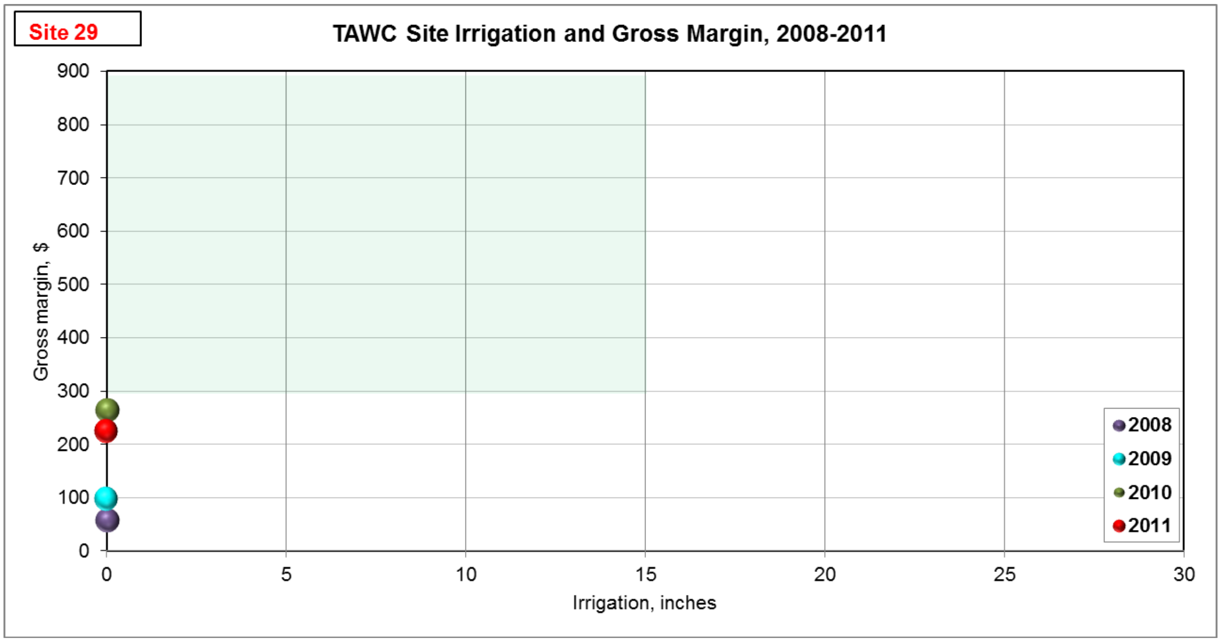
Abandoned cotton field

System 29 – Dryland Site

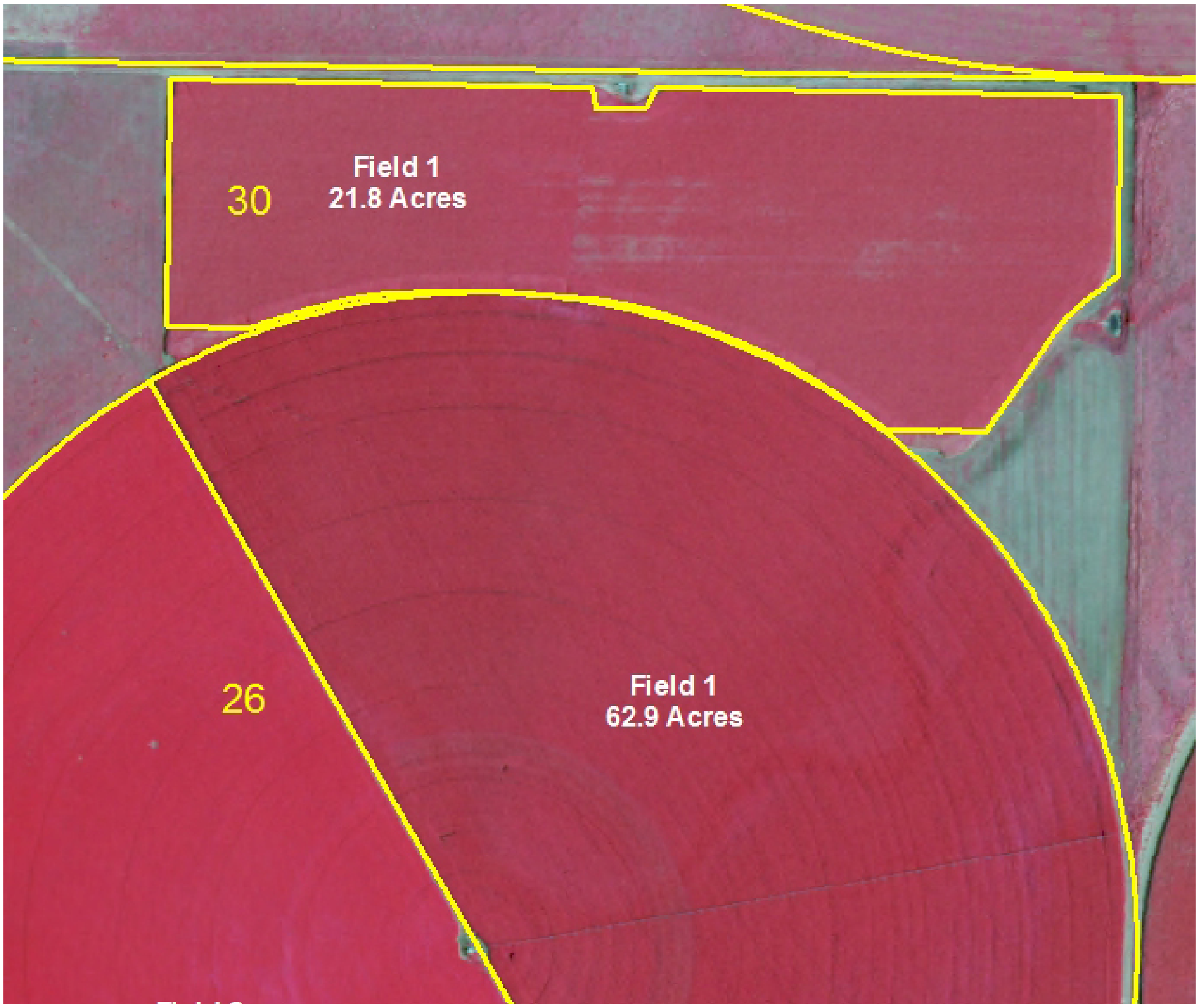








Dryland Site



System 30 Description

Total system acres: 21.8

Field No. 1 Acres: 21.8
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Sub-surface Drip (SDI)

Pumping capacity, gal/min: 150

Number of wells: 1

Fuel source: Electric

System 30

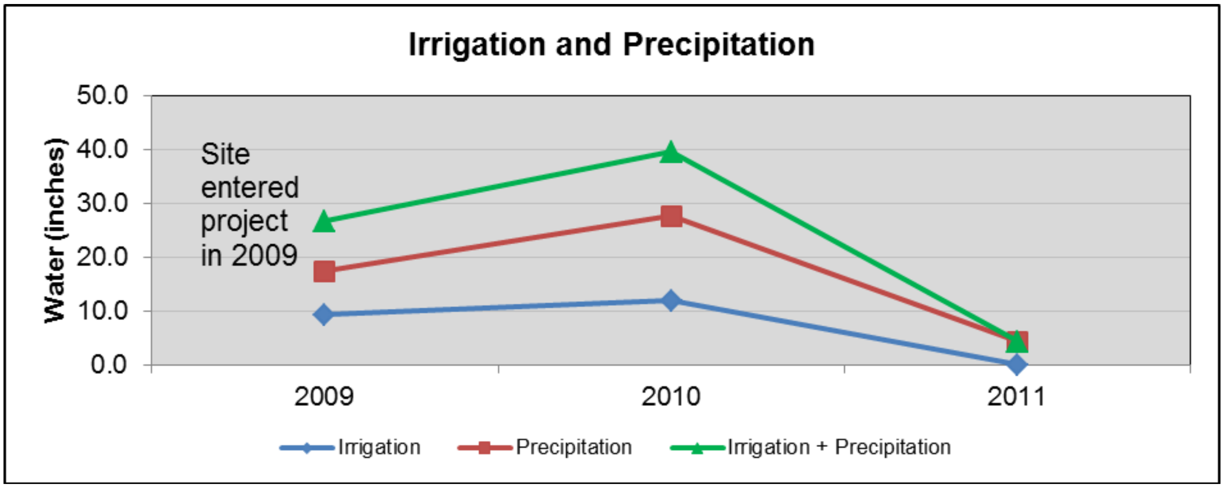
	Livestock	Field 1
2005	Entered project in Year 5	
2006		
2007		
2008		
2009	None	Sunflowers
2010	None	Corn
2011	None	Not planted

Comments: This site is was not planted in 2011.

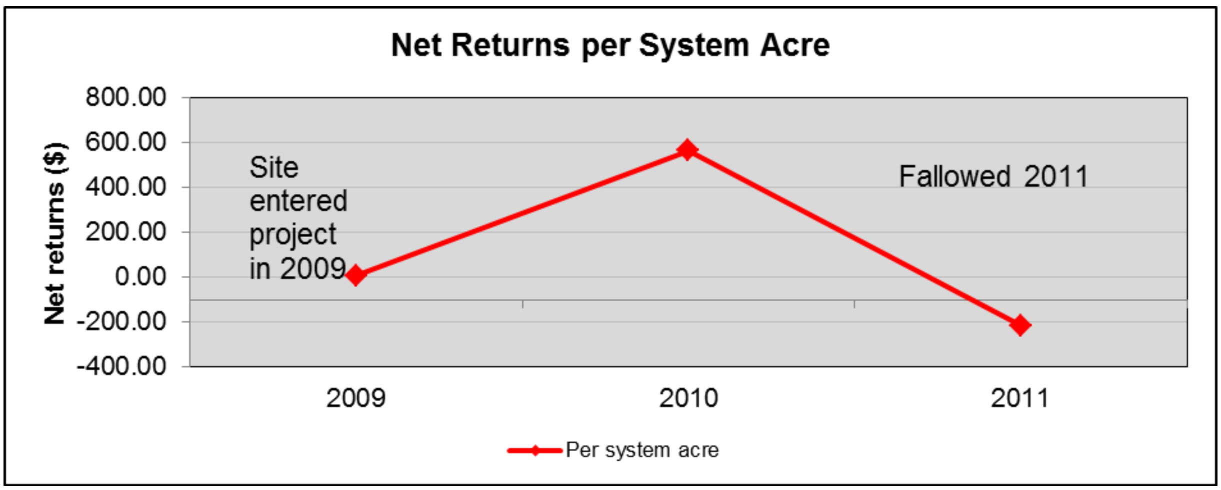
Pictures from Drought Year of 2011

Fallowed in 2011

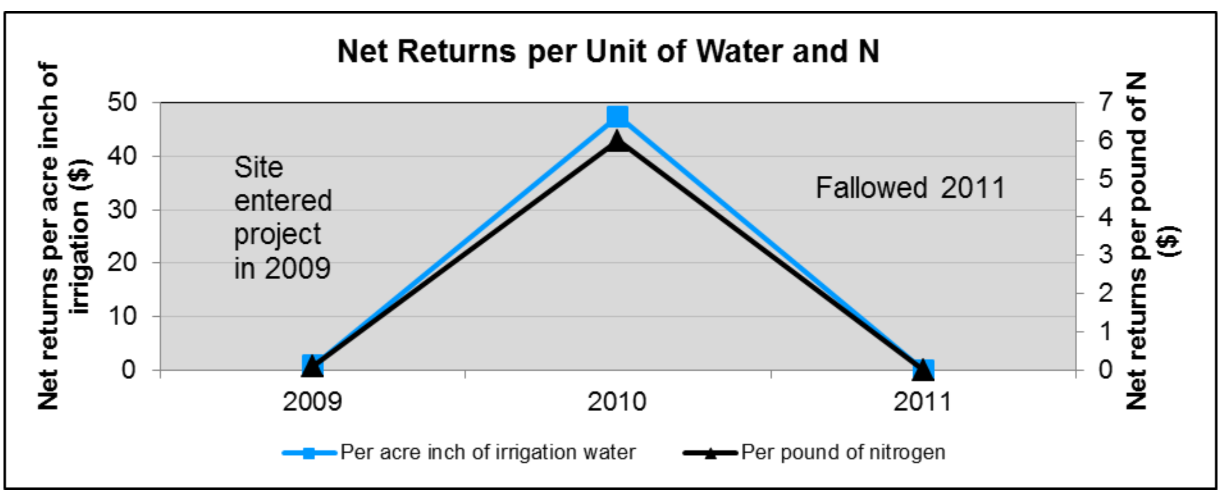
System 30



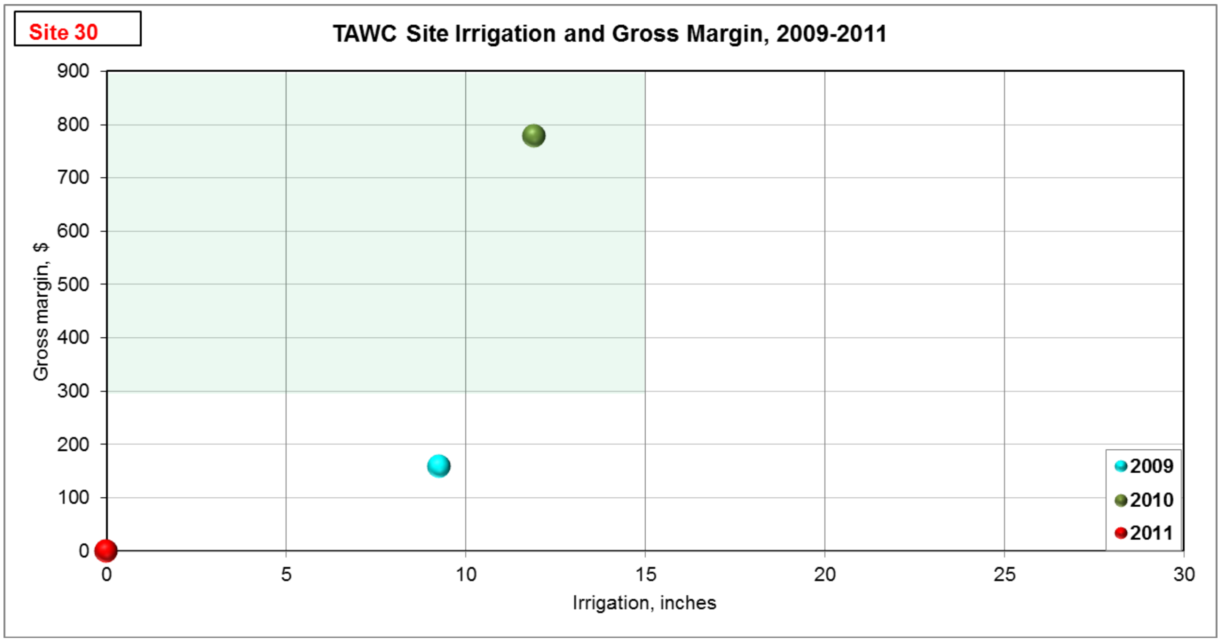
Irrigation and Precipitation
Water (inches)
50.0
40.0
30.0
20.0
10.0
0.0
Site
entered
project
in 2009
2009
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation

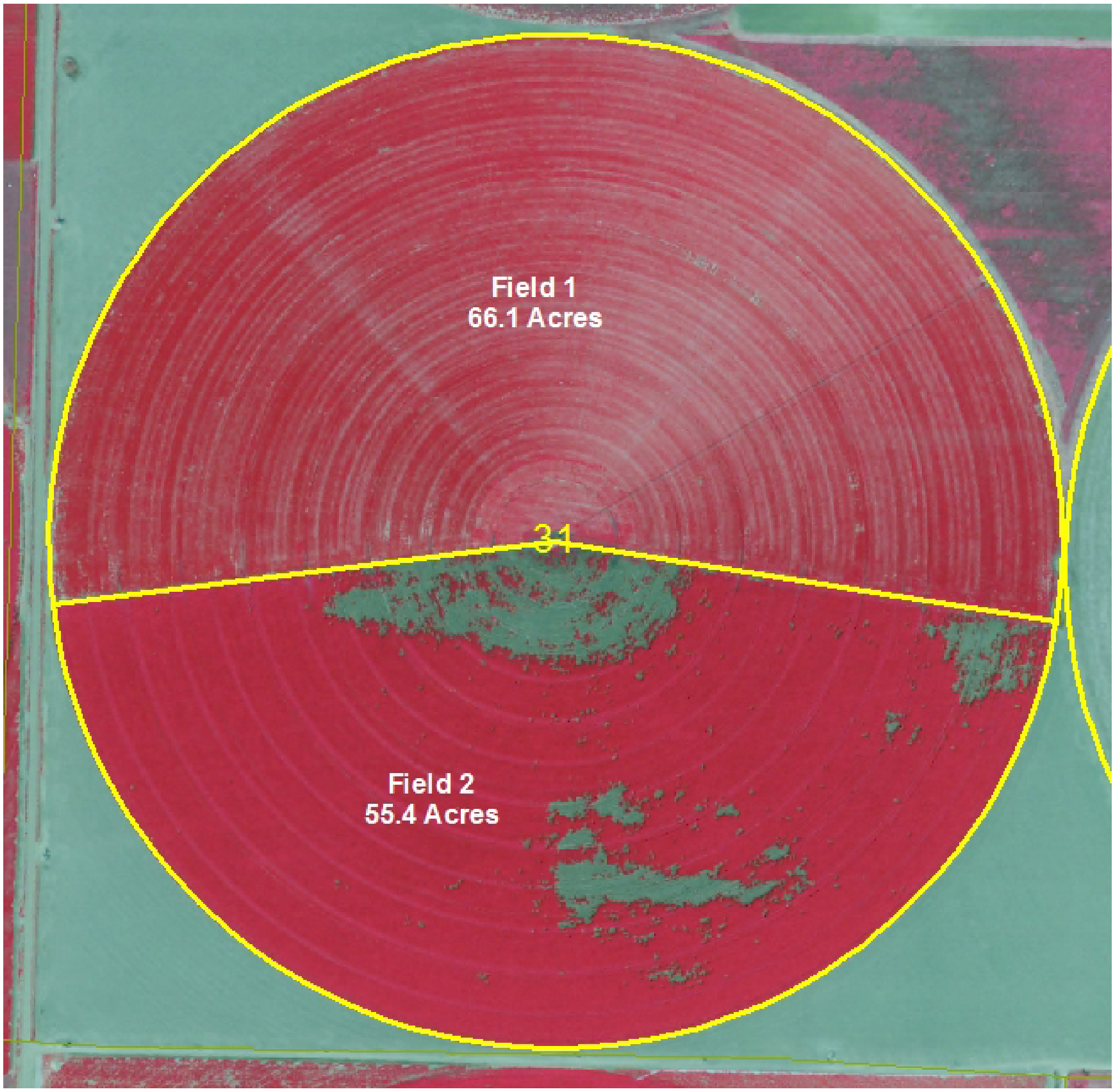


Net Returns per System Acre
Net returns ($)
800.00
600.00
400.00
200.00
0.00
-200.00
-400.00
Site
entered
project
in 2009
Fallowed 2011
2009
2010
2011
Per system acre



Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
50
40
30
20
10
0
7
6
5
4
3
2
1
0
Net returns per pound of N ($)
Site
entered
project
in 2009
Fallowed 2011
2009
2010
2011
Per acre inch of irrigation water
Per pound of nitrogen


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



System 31 Description

Total system acres:	121.5
Field No. 1 Acres:	66.1
Major soil type:	Pullman clay loam, 0 to 1% slope
Field No. 2 Acres:	55.4
Major soil type:	Pullman clay loam, 0 to 1% slope

Irrigation

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

System 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

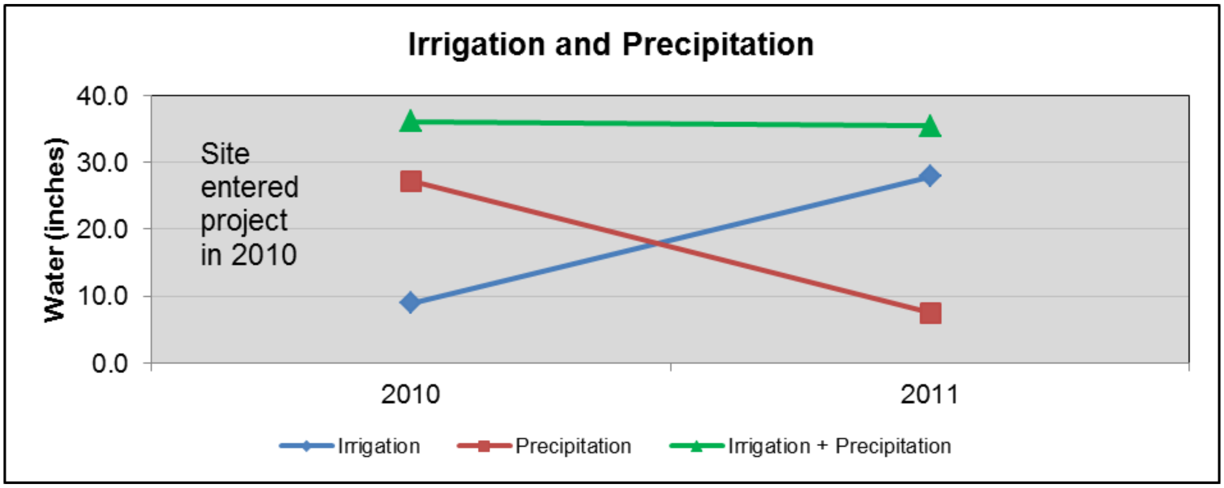
Comments: This is a pivot irrigated site which was planted to cotton and seed millet in 2010. Both crops were planted on forty-inch centers using conventional tillage.

Pictures from Drought Year of 2011

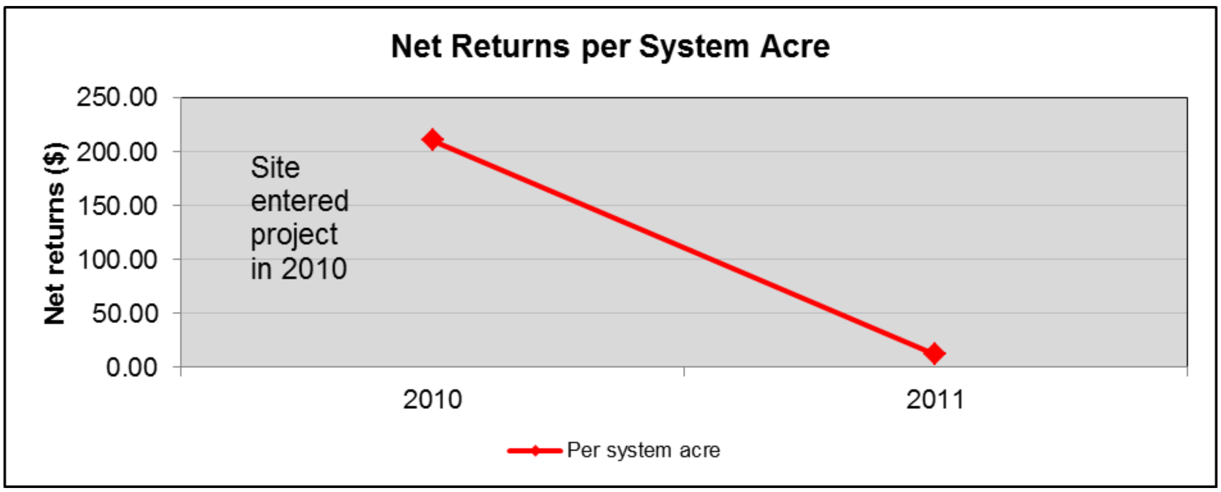
Seed millet

Cotton

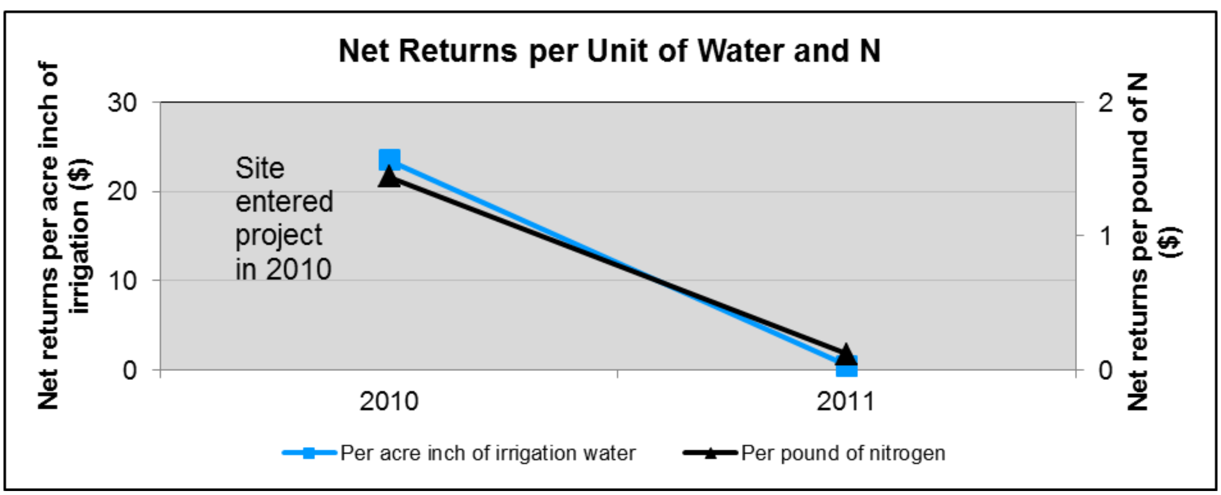
System 31



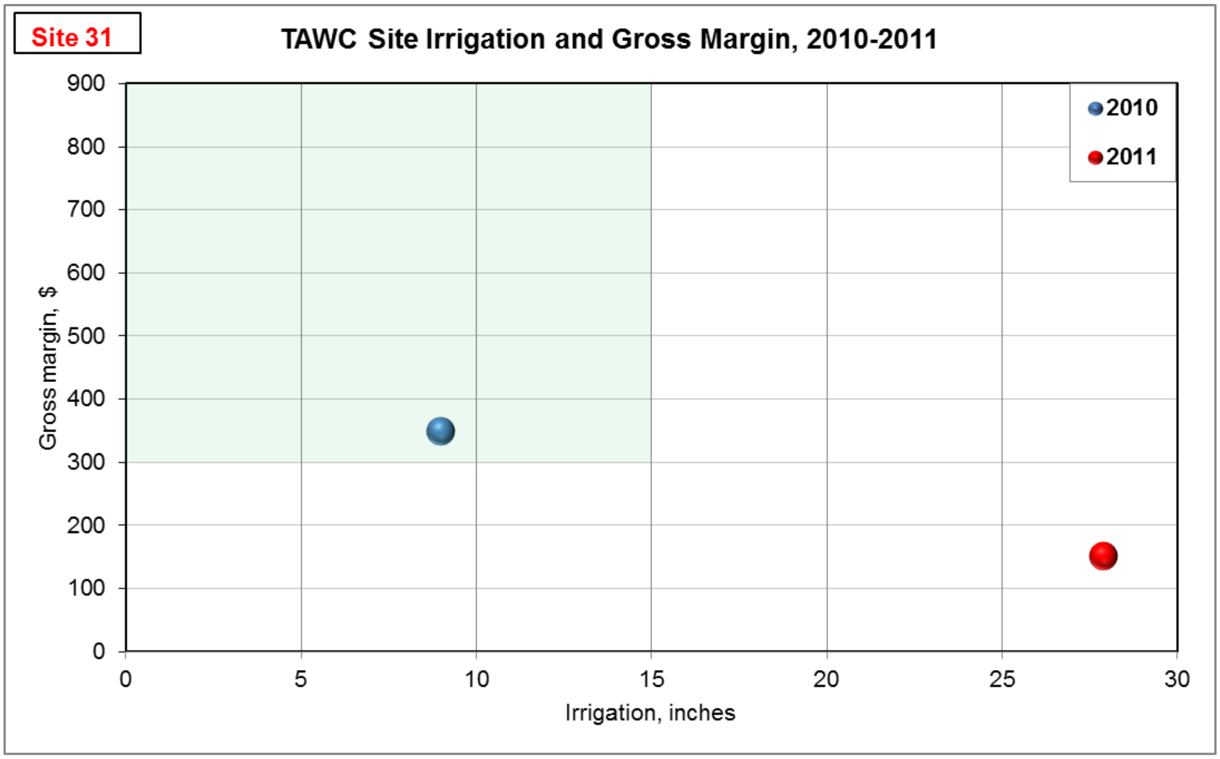
Irrigation and Precipitation
Water (inches)
40.0
30.0
20.0
10.0
0.0
Site
entered
project
in 2010
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation

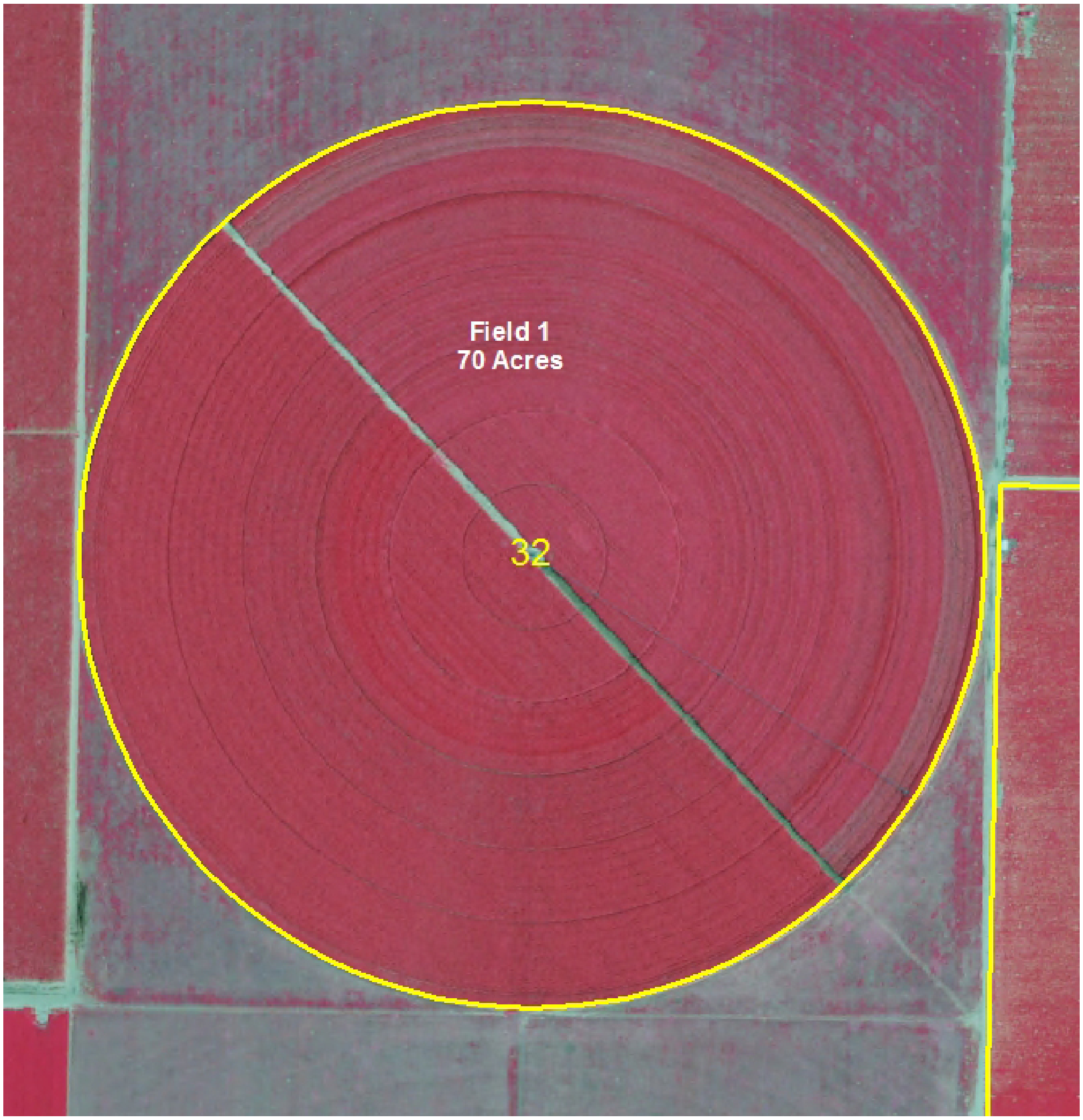


Net Returns per System Acre
Net returns ($)
250.00
200.00
150.00
100.00
50.00
0.00
Site
entered
project
in 2010
2010
2011
Per system acre



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


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



System 32 Description

Total system acres: 70.0

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

Irrigation

Type: Center pivot

Pumping capacity, gal/min: 350

Number of wells: 2

Fuel source: Electric

System 32

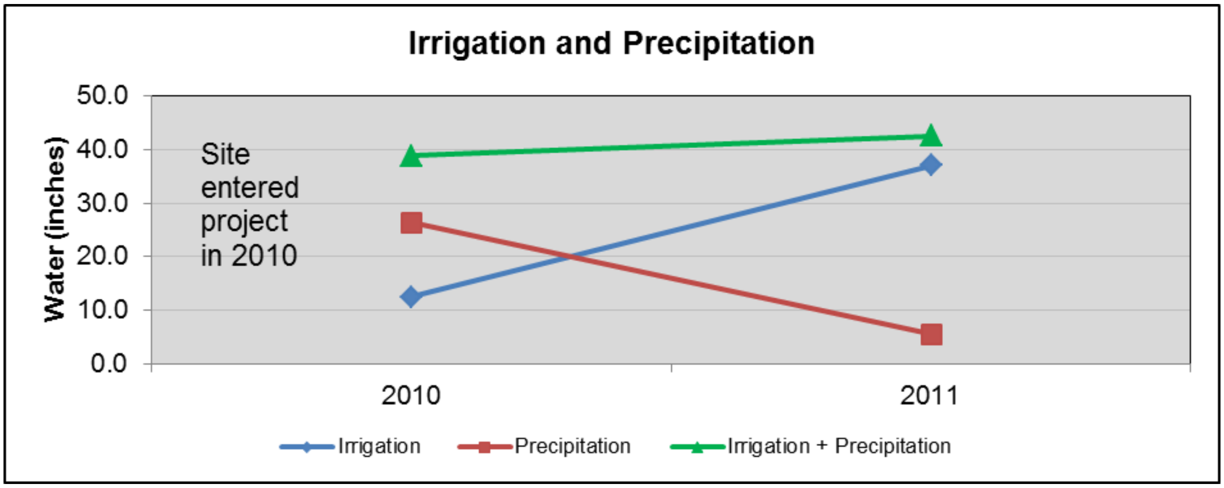
	Livestock	Field 1
2005	Entered project in Year 6	
2006		
2007		
2008		
2009		
2010	None	Corn
2011	None	Corn

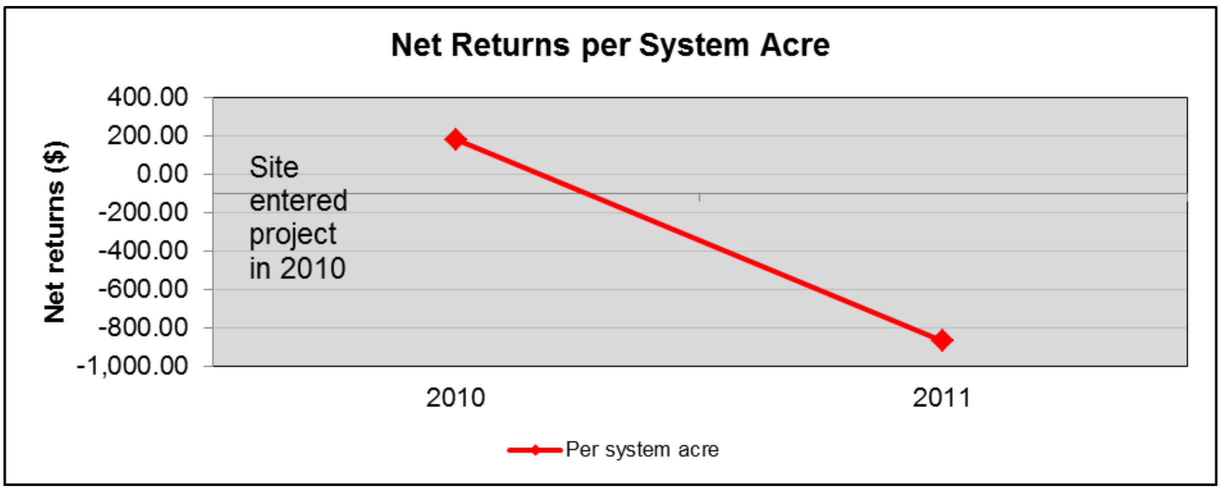
Comments: This is a pivot irrigated site which was planted to corn on forty-inch centers for 2011.

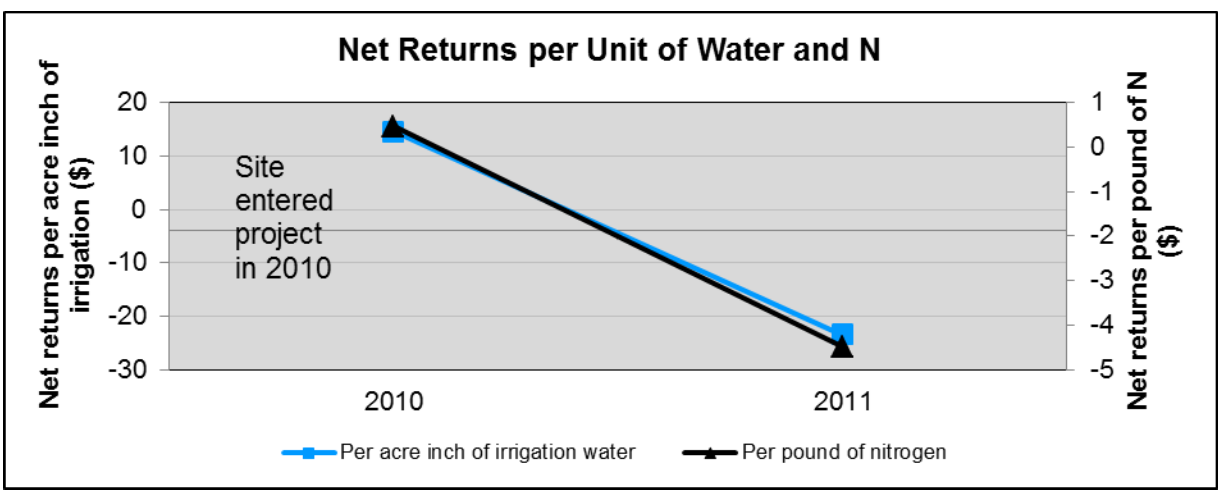
Pictures from Drought Year of 2011

Corn

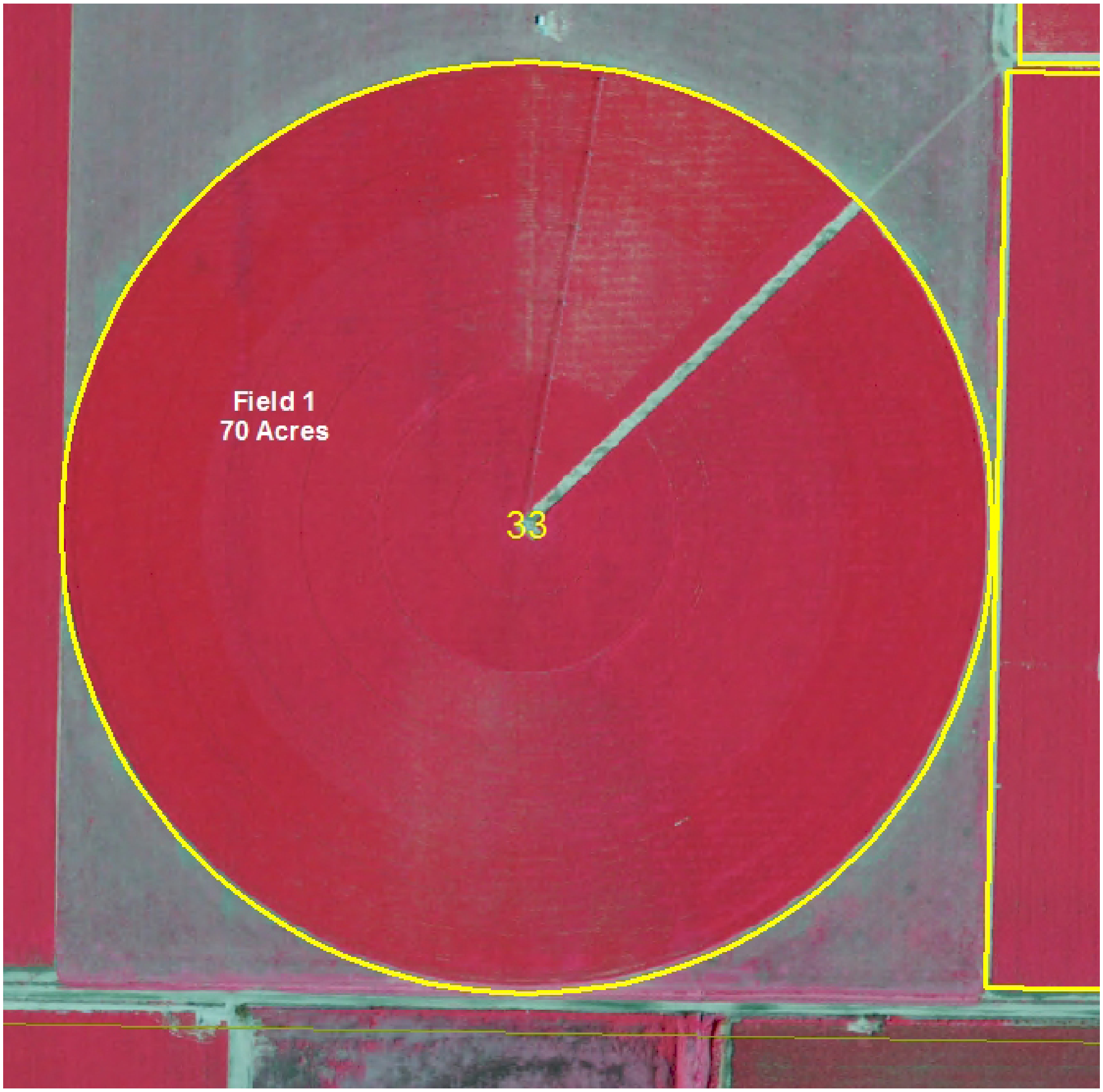
System 32


Irrigation and Precipitation
Water (inches)
50.0
40.0
30.0
20.0
10.0
0.0
Site entered project in 2010
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
400.00
200.00
0.00
-200.00
-400.00
-600.00
-800.00
-1,000.00
Site entered project in 2010
2010
2011
Per system acre


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


Site 32
TAWC Site Irrigation and Gross Margin, 2010-2011
900
700
500
300
100
-100
-300
-500
-700
-900
Gross margin, $
0
5
10
15
20
25
30
35
40
Irrigation, inches
2010
2011



System 33 Description

Total system acres: 70.0

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

Irrigation

Type: Center pivot

Pumping capacity, gal/min: 350

Number of wells: 2

Fuel source: Electric

System 33

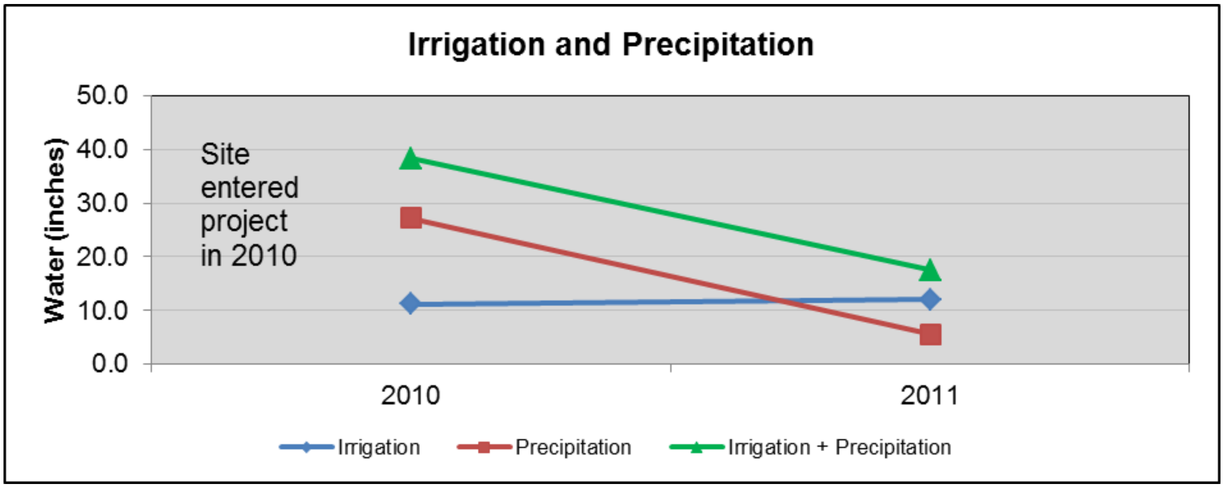
	Livestock	Field 1
2005	Entered project in Year 6	
2006		
2007		
2008		
2009		
2010	None	Cotton
2011	None	Corn

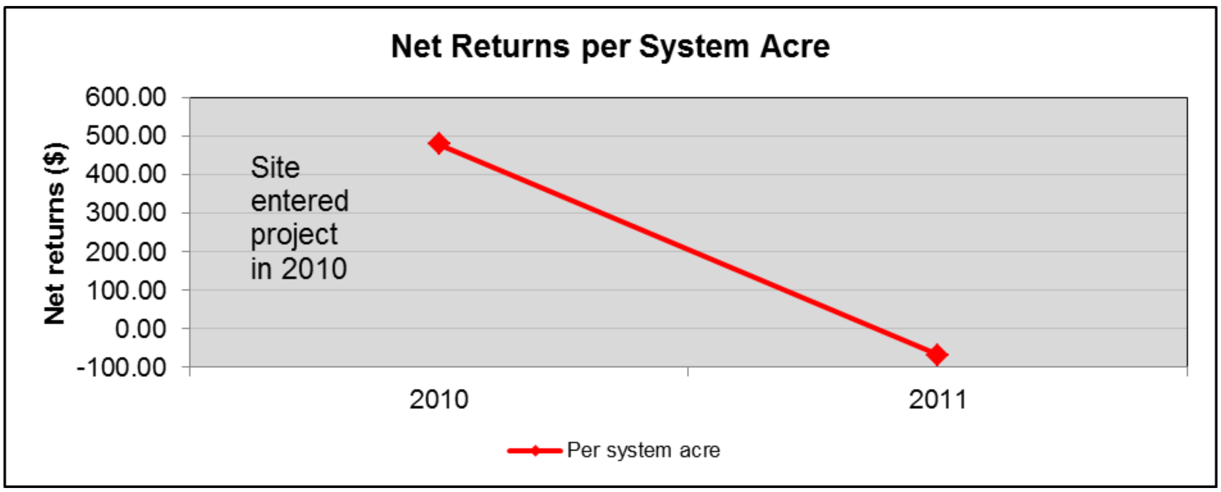
Comments: In 2011 this site was planted to corn on forty-inch centers using conventional tillage. The corn was abandoned in mid-June because of dry conditions.

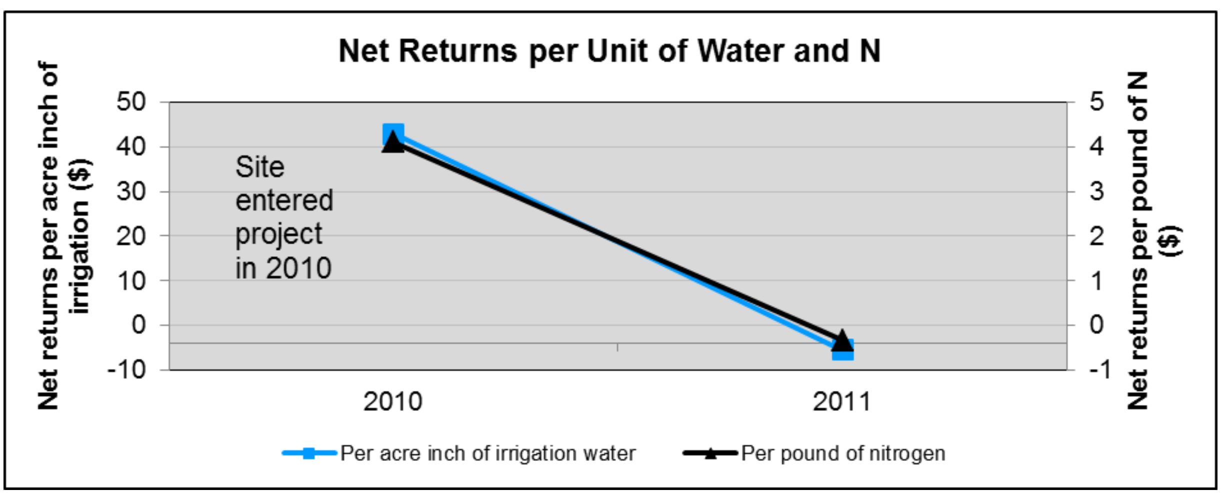
Pictures from Drought Year of 2011

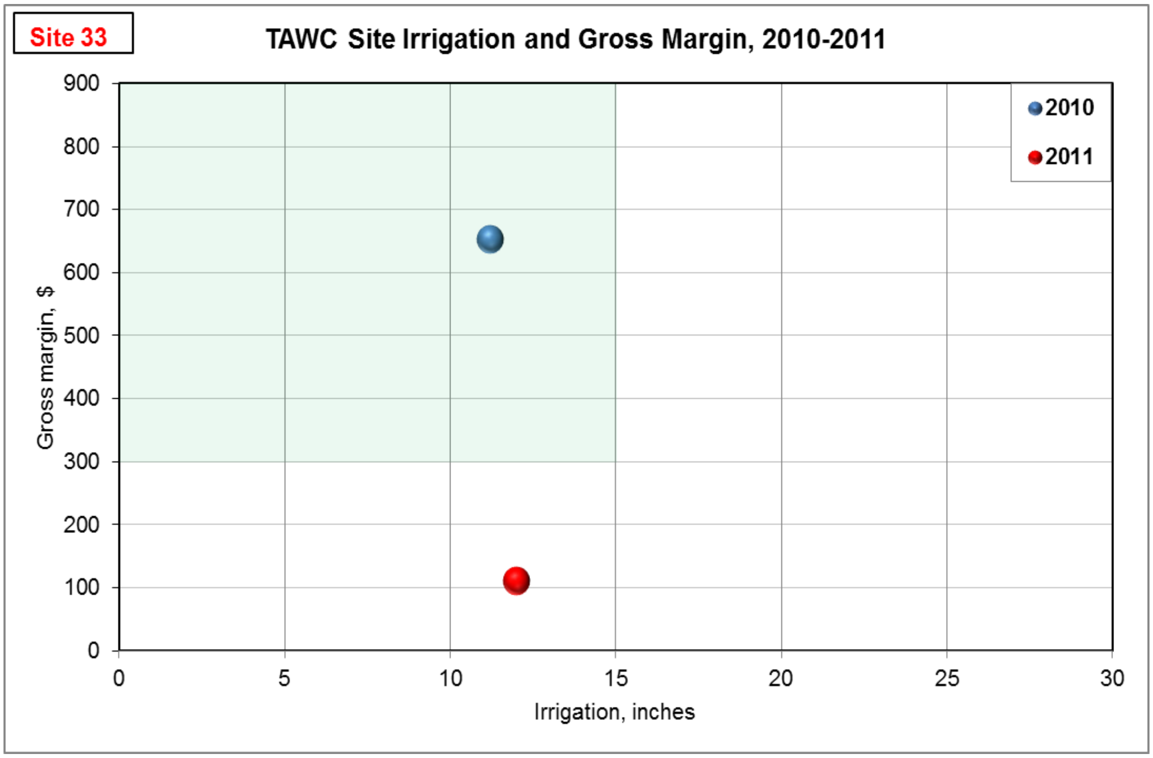
May corn abandoned mid-June

System 33


Irrigation and Precipitation
Water (inches)
50.0
40.0
30.0
20.0
10.0
0.0
Site entered project in 2010
2010
2011
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
600.00
500.00
400.00
300.00
200.00
100.00
0.00
-100.00
Site entered project in 2010
2010
2011
Per system acre


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


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

OVERALL SUMMARY OF YEARS 1 through 7

With 7 years completed of this study, trends and patterns are emerging and information is multiplying. Each individual year is highly influenced by weather, and availability of irrigation water, and by commodity prices and anticipated values for crops and livestock. Amount and distribution of precipitation and irrigation water to buffer inadequate precipitation are key factors in this environment. During the first 6 years of this study, precipitation ranged from a low of 15.0 inches (2005) to a high of 28.9 inches (2010), averaging 20.7 inches (2005-2010) which is slightly higher than the long-term mean (18.5 inches) for the region. (Table 25, pg. 217). These years were generally favorable to crop production although unfavorable distribution of precipitation caused additional irrigation water use in some years and delayed crop harvests in other years. During 2011, the 7th year of this study, a total of 5.3 inches was received over the demonstration sites (Fig. 9 and Fig. 10). The 2011 year was the driest on record for the Texas high plains exceeding the dust bowl of the 1930's and all other drought events over the years that records have been kept. Consequently, irrigation applied (mean of all sites) exceeded all other years in this project (Fig. 9 and 10). This lack of precipitation, and ultimately the inability for most sites to provide sufficient irrigation water, had a devastating effect on agriculture and will likely influence producer decisions into 2012 and perhaps beyond.

The 2011 drought was preceded by a year of unusually high precipitation (TAWC, 2011), thus, the current year's drought was initially buffered somewhat by favorable soil moisture as the growing season began. With no continuing precipitation, this initial moisture was quickly depleted. In 2011, the two dryland sites (sites 12 and 29) planted cotton that never emerged and fields were abandoned. Many irrigated sites also abandoned at least part of planted acres in order to focus available irrigation more effectively on fewer acres. Averaged over all crop-land acres in the Demonstration, about 33% was either fallowed or abandoned (Table 17, pg. 62). Although some corn was taken to harvest, yields were decreased. Corn yields for 2011 averaged 6,766 lbs grain/acre and reached only 58% of the average yield of the previous 6 years. By comparison, cotton lint yields for all harvested sites in 2011 averaged 1,166 pounds per acre which was about 90% of the average yields during the previous 6 years. Note that these yield numbers reflect only acres harvested and do not include those abandoned.

Corn demands more water than cotton or forage crops (Table 25, pg. 217) and earlier in the growing season than most crops. Some of the cotton was abandoned at harvest with yields too low to warrant further costs. The drought of 2011 significantly impacted all crop production on the TAWC sites and in this year of extreme moisture deficit, insurance played a dramatic and sometimes variable role in farm profitability. Multi-peril insurance played a significant role in the farmer's ability to recoup initial input cost as many fields in the TAWC were either abandoned or produced very low yields. Insurance indemnity payments within the crop budgets were handled one of two ways. If the farmer's record book indicated what his insurance indemnity payment was this value was incorporated into the budgeting process. If this value was not available or the producer did not know his particular insurance payment, the indemnity was estimated. This was

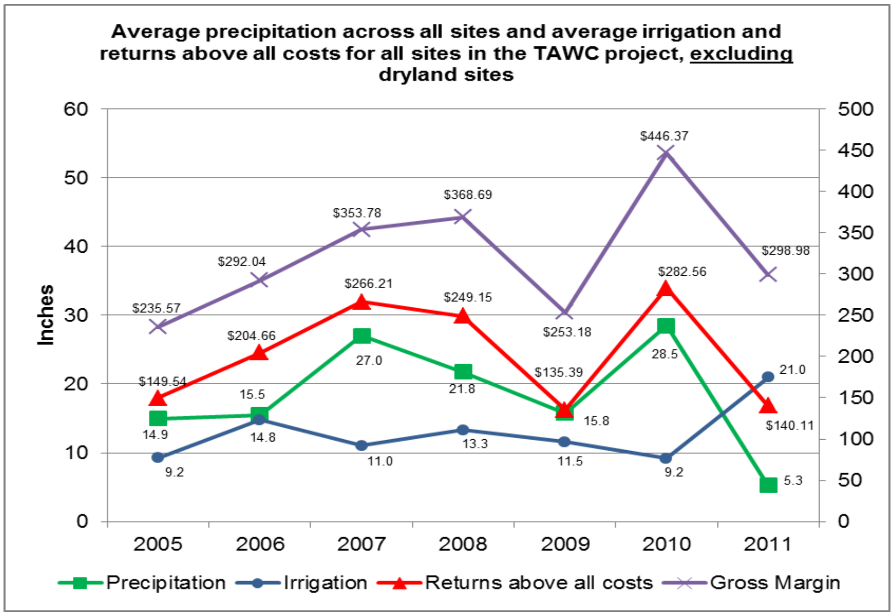


Figure 9. Average precipitation, irrigation, returns above all costs, and gross margin for irrigated sites in the TAWC Project (excludes dryland sites).

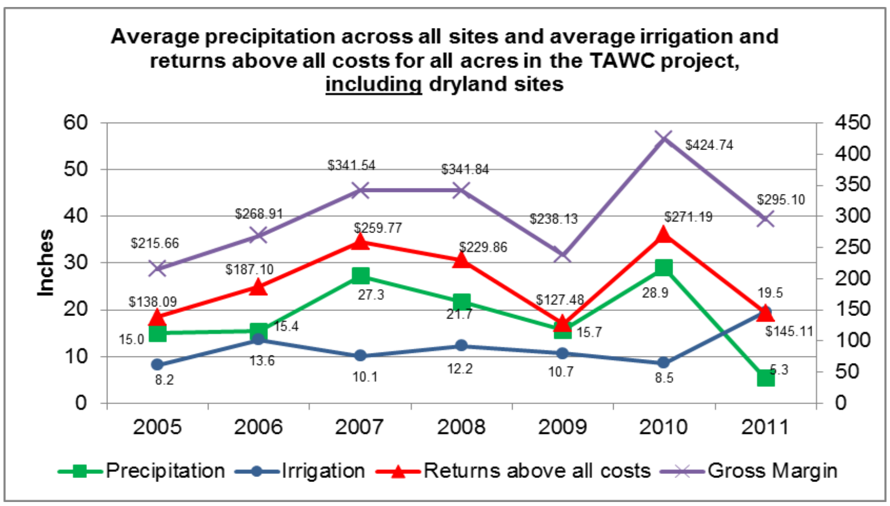


Figure 10. Average precipitation, irrigation, returns above all costs, and gross margin for all sites in the TAWC Project (includes dryland sites).

done by using average county yields to simulate a farms T yield (or trigger yield), a 65% coverage level was assumed for all grain and fiber crops, and a 2011 harvest price was used as the payment price. If the producer indicted any residual crop upon 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 9 and 10 show precipitation, irrigation applied, returns above all costs of production, and gross margin for irrigated sites alone (Fig. 9) and for all sites including the dryland sites (Fig. 10). Average total irrigation applied on the irrigated sites during the first 6 years was 11.5 inches. This mean irrigation level would comply with current and projected future pumping regulations for this region. Because of the drought in 2011, average irrigation applied to irrigated systems in this project increased to about 21 inches (Table 25 pg. 217; Fig. 9). Under current regulations, this increase could be absorbed into a 3-year average use especially because 2010 was a year of favorable moisture and only 9.2 inches of irrigation water was applied (Table 25 pg. 217; Fig. 9). Thus, the mean of these two years would remain within water-use restriction levels. If the drought continues, however, maximum levels of water use will quickly exceed the target 3-year mean levels for irrigation water use (currently at 21 acre inches/year). To the date of this report, the drought in west Texas continues.

When all systems, including the non-irrigated systems, are included in these means, average irrigation water applied per system acre declined from 21 inches to 19.5 inches pointing out the importance of inclusion of non-irrigated acres within a producers overall system in assessing water use. As water availability declines, two basic strategies can be used: either use less water per acre which means further improvements in water use efficiencies, or apply available water to fewer acres. Both approaches have merit depending on the crop, management strategies available, and the distribution of precipitation within any given year. Choice of crop species and/or genetics and the management approach are under the control of the producer. Distribution of precipitation is not under the control of producers and is a factor to which there can only be a retrospective response.

Total returns above all costs of production in 2011 ($124.31/system acre), including both irrigated and dryland systems, were similar to profitability recorded in 2005 and in 2009 (Fig. 10). Profitability in 2005 and 2009 were negatively impacted by high production costs vs. values of crops and livestock. Profitability in 2011 reflected reduction in livestock numbers, and losses in crops but also reflected insurance payments. If insurance payments were removed from this number, profitability in 2011 would be much lower. Additionally, most producers in the project utilize some form of forward contracting within their operation and were impacted by crop losses during 2011.

Each season producers in the TAWC project make their own decisions with regard to enterprise selection and production practices. Over the duration of the project, enterprise levels have varied based on the decisions producers make each year. The main factors in enterprise selection have been per acre profitability and water available for irrigation. Figures 11 and 12 show the acres and sites, respectively, that were devoted to cotton, corn, sorghum, perennial forages, cattle, small grains, and other crops within the producer systems

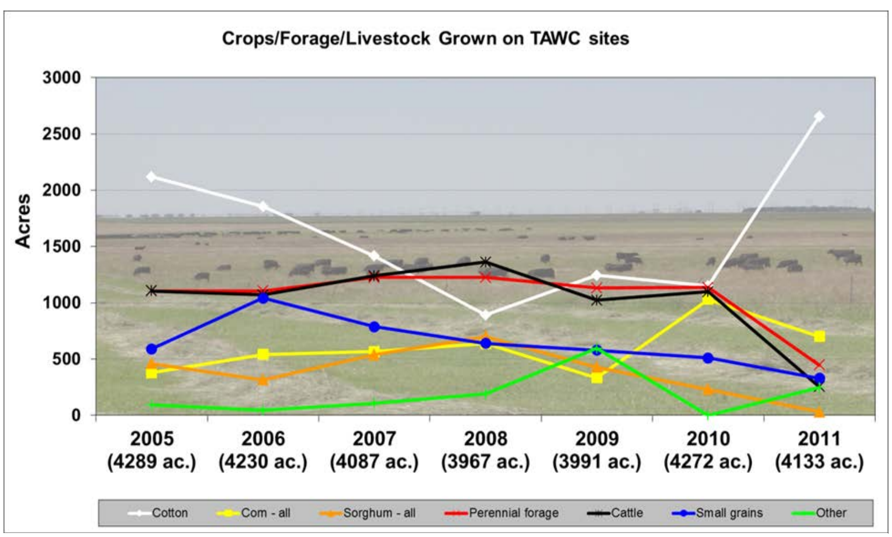


Figure 11. Number of acres that include cotton, corn, sorghum, perennial forages, cattle, small grains and other crops within the producer systems located in Hale and Floyd Counties.

located in Hale and Floyd Counties. (The total of enterprise acres exceeds total acres in the project in any given year due to double cropping and multi-use for livestock.) In 2011, irrigated acres in cotton increased to the highest level during the 7 years of this project. This increase largely reflected anticipated profitability and increasing concerns regarding amounts of water available for irrigating crops with higher water demands. Perennial forages had been relatively stable during the project but in 2011, Site 5 was converted to a conventional cropping system. This site had been devoted entirely to perennial grass and a cow-calf operation, thus, its conversion negatively impacted the total number of perennial grass acres and livestock numbers in the demonstration project. It should be noted that all perennial forage acres in the TAWC Project are production acres for grazing, hay, and/or grass seed production. No acres are in the Conservation Reserve Program. Sorghum and small grain acres declined as well with an increase in acres devoted to specialty crops. After a significant increase in corn acres in 2010, these acres also declined in 2011.

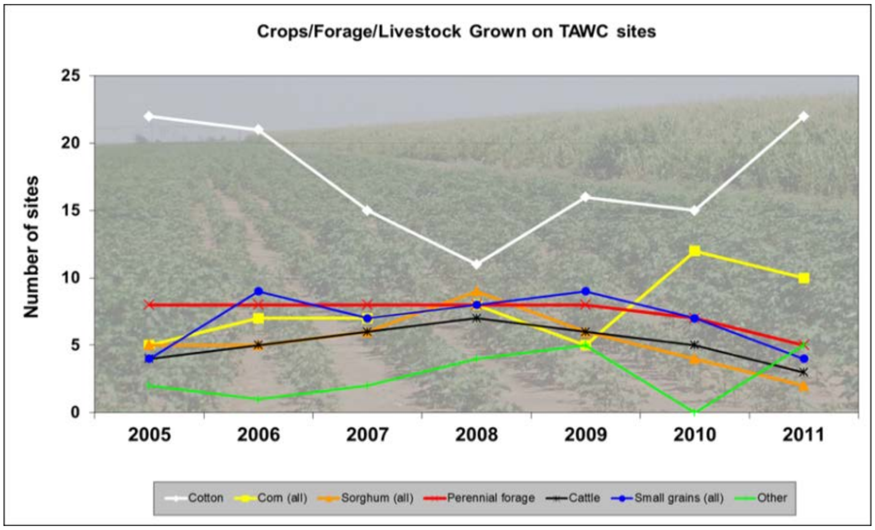


Figure 12. Number of systems (sites) that include cotton, corn, sorghum, perennial forages, cattle, small grains and other crops within the producer systems located in Hale and Floyd Counties.

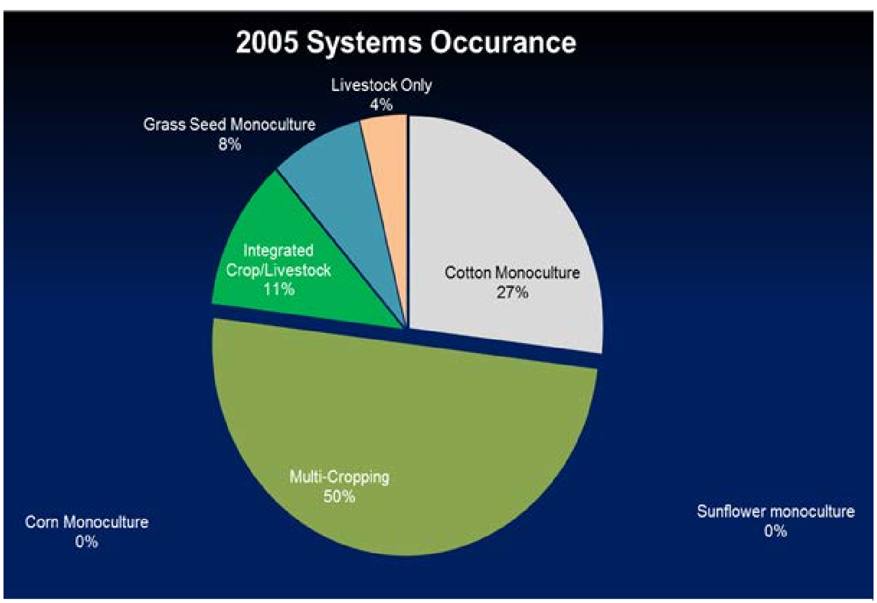


Figure 13. 2005 systems occurrence withing the TAWC project sites in Hale and Floyd Counties.

Production systems within the TAWC have proven to be very dynamic in their makeup, adjusting through the life of the project to various market and climatic factors. As shown in Figure 13, 50% of the total land in the project was devoted to multi-cropping systems in 2005 while 27% was in cotton monoculture systems. There were no corn or sunflower monoculture systems initially and 11% of the area was in integrated crop/livestock systems. Grass seed monoculture and livestock (cow-calf) systems accounted for the remaining 12%. When examined by year in previous reports, these acreages have shifted significantly over the past 6 years but in 2011, with a few exceptions, these numbers returned to a distribution that was more similar to that seen in 2005. As shown in Figure 14, in 2011 multi-cropping system acres declined to 46%; however, cotton monoculture acres increased to 29% while corn monoculture acres were 7%. Integrated livestock systems accounted for 11% of the area and no sites were devoted exclusively to forage-livestock operations.

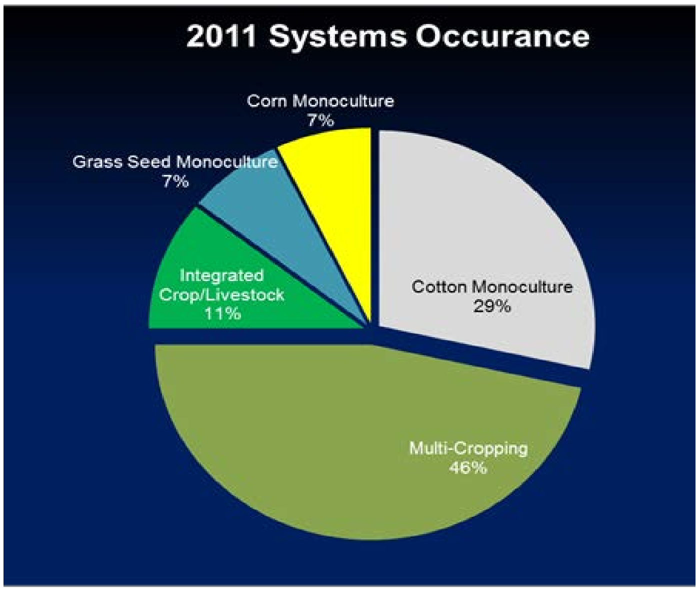


Figure 14. 2011 systems occurrence withing the TAWC project sites in Hale and Floyd Counties.

Land use by producers is dynamic and reflects all of the factors that influence their decisions including decisions to terminate leases, sell property, or to retire. Averaged over the 7 years of the project, cotton monocultures accounted for 21% of the systems, integrated crop/livestock systems were 15% of the systems, corn monocultures were 7%, and multi-cropping systems were 45% of the systems (Fig. 15).

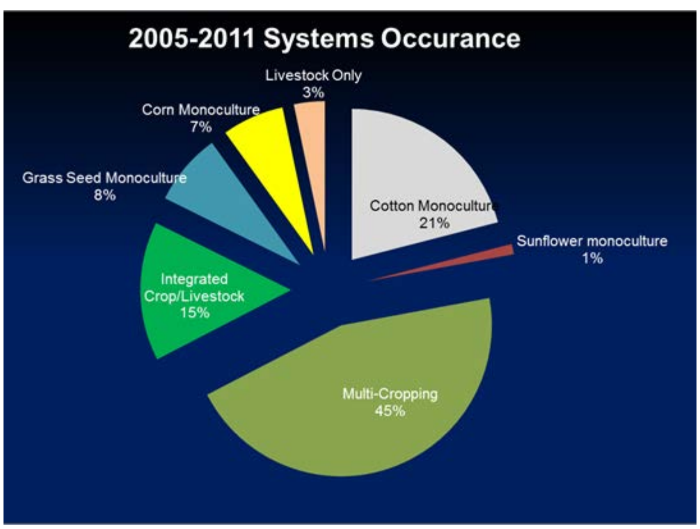


Figure 15. 2005-2011 systems occurrence withing the TAWC project sites in Hale and Floyd Counties.

Water Use and Profitability

With seven years of data, patterns are emerging in terms of total water use vs. profitability. This is important because of the basic need to conserve the water resource and the arrival of regulation of water use. To examine systems for meeting criteria of limited water use while maintaining profitability, we arbitrarily selected a maximum of 15 acre inches of irrigation water and a minimum of $300 per acre gross margin as a desired target area for system performance. Please note that these levels were selected only to begin this process and do not represent either the anticipated pumping limitation or the minimum amount of revenue required for agricultural operations to remain economically viable. This is simply a starting point to understand what these limits may ultimately be and to see if a pattern in systems emerges for meeting these criteria.

Average irrigation over all systems in 2010 was 8.5 acre inches (Fig. 10). In 2010, a year of favorable precipitation, 14 of the 26 sites were within the 15 acre inch water limit while generating at least $300 per acre gross margin. This is the most sites to meet the criteria for any year of the project. These sites included a diversification of system types, for example: Site 8 (drip irrigated sideoats grama for seed production), Site 15 (a furrow/drip irrigated monoculture cotton system), Site 27 (a drip-irrigated corn silage/cotton multi-crop system), and Site 26 (a center pivot-irrigated wheat/corn/cotton & contract grazing integrated crop-livestock system). The high proportion of sites that met the criteria in 2010 can be attributed to the high precipitation which reduced the need for irrigation and increased commodity prices. If we reduce the minimum gross margin target to $200 per acre and the irrigation limit to 10 acre inches, 13 systems fell in this range in 2010. Again, this represented a range of systems including the two grass seed production systems, two cotton monocultures, two integrated crop/livestock systems, and seven multi-cropping systems. All of the multi-cropping systems that met these criteria included cotton in the system, but the remainder of these seven systems varied including grain sorghum, corn, wheat for grain or as a cover crop. For the two integrated crop/livestock systems, one included cotton while the other included corn as the crop. Individual profitability of the component parts of systems determines the overall system profitability, thus, selection of system components is critical to meeting objectives. Such selection, however, is based on experience and knowledge of the producer and is vulnerable to unpredictable changes in commodity and input prices as well as the vagrancies of weather.

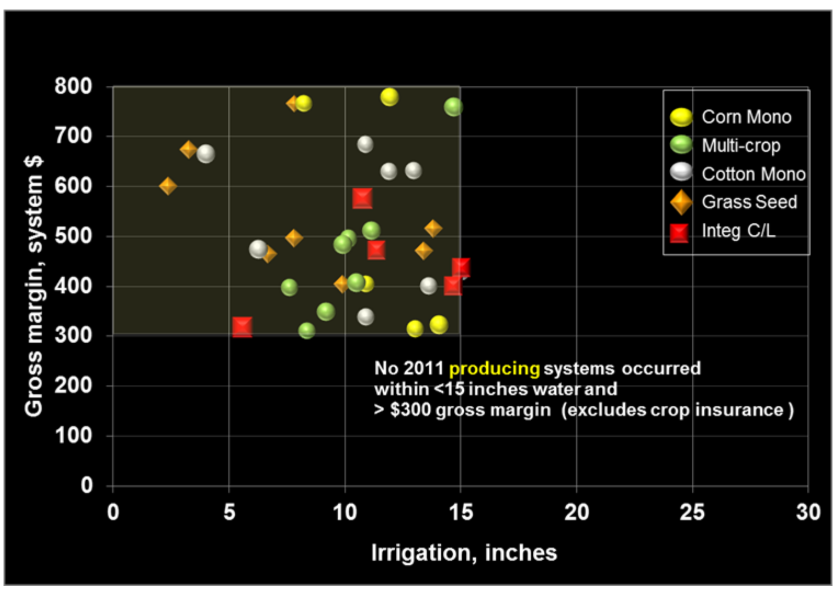


Figure 16. From 2005-2011 systems occurring within a maximum of 15 inches irrigation and greater than $300 Gross Margin on the TAWC Project sites in Hale and Floyd Counties.

In 2011, a year of severe moisture deficit, no producing systems met the criteria for at least $300/acre gross margin while using 15 or less inches of irrigation water (Fig. 16). This is based on systems that harvested crops and not on systems that depended on insurance payments as income.

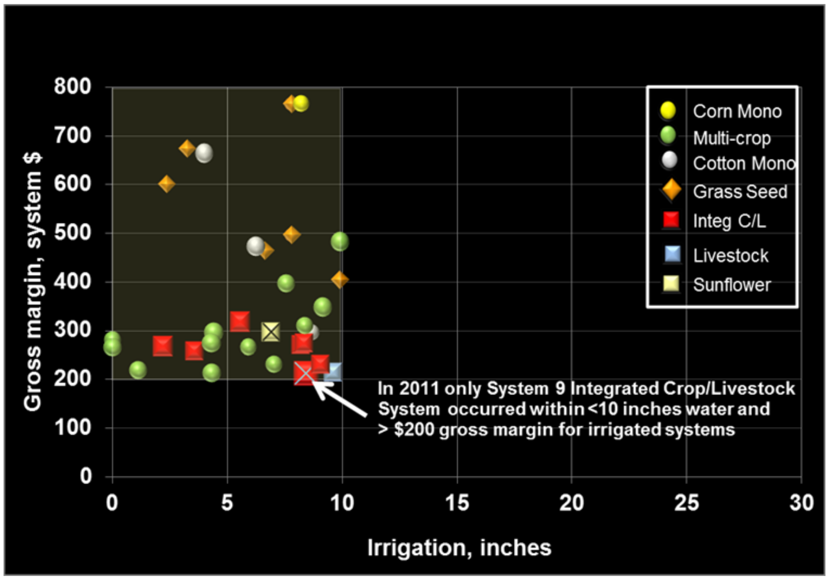


Figure 17. From 2005-2011 systems occurring within a maximum of 10 inches irrigation and greater than $200 Gross Margin on the TAWC Project sites in Hale and Floyd Counties.

When the minimum gross margin was lowered to $200/system acre and irrigation maximum was set at 10 inches, System 9 was the only system that met these criteria (Fig. 17). System 9 is a 2-paddock integrated crop-livestock system that produces stocker cattle on perennial pasture (predominantly kleinegrass) and cotton planted on 40-inch centers. This site had been in no-till cultivation for 11 years but was returned to conventional tillage in 2008.

2011 Project Year

During the first 6 years, grass seed production consistently had the highest average net returns per system acre. In 2011, the integrated crop-livestock systems had the highest average net returns per acre (Fig. 18) followed closely by grass seed and multi-cropping

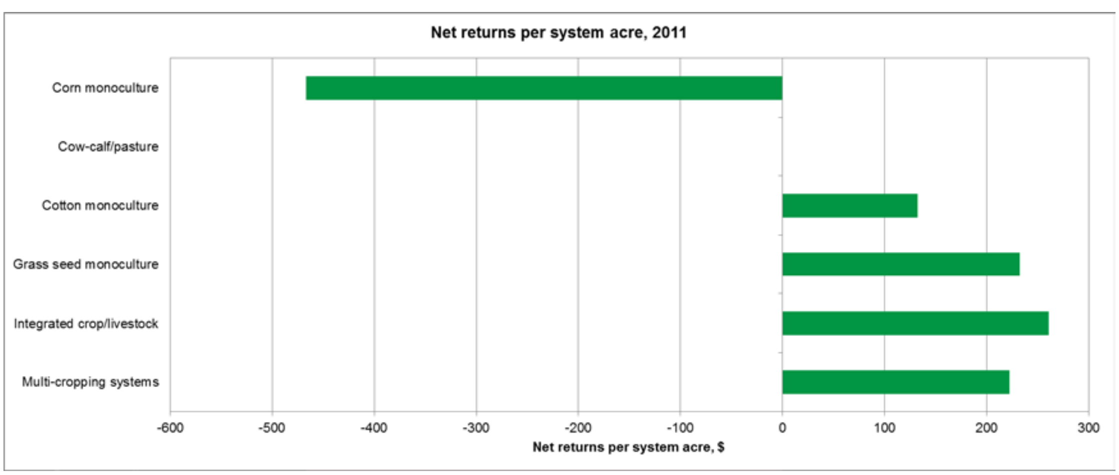


Figure 18. Net returns per system acre, 2011.

systems. Cotton monocultures returned less than half of the net returns per acre than the three previous systems while corn monocultures lost nearly $500/acre.

When these systems were examined in terms of net returns per inch of irrigation water, corn again was negative with cotton positive but less than one fourth the net returns per acre inch of water generated by the other systems examined (Fig. 19). Multi-cropping systems had the highest return per inch of irrigation water followed by integrated crop-livestock systems and grass seed production which were similar.

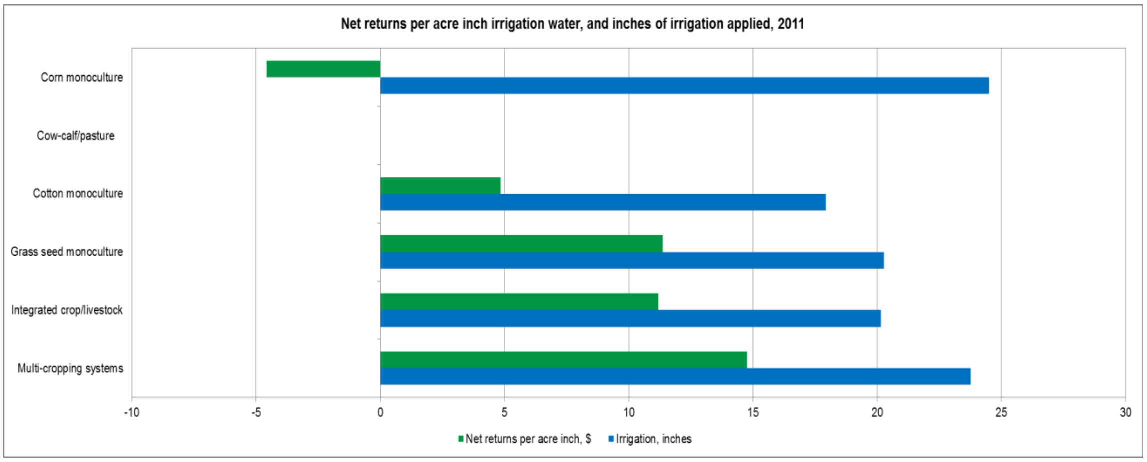


Figure 19. Net returns per acre inch irrigation water, and inches of irrigation applied, 2011.

Looked at differently, multi-cropping systems and monoculture corn were irrigated in 2011 with the highest amounts of water (Fig. 20; about 24 inches). Grass seed and integrated crop-livestock systems were similar in the amounts of irrigation water (about 20 inches) applied and used about 4 inches less than corn and multi-cropping systems.

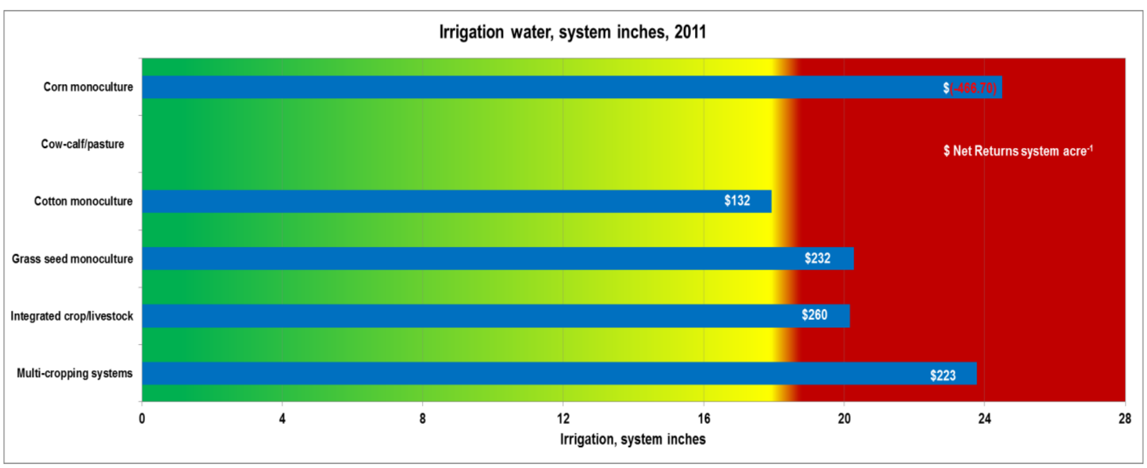


Figure 20. Irrigation water, system inches, 2011.

The lowest amount of irrigation was applied to monoculture cotton at about 18 inches.

As observed in previous years, corn monocultures had the highest application rates of nitrogen fertilizer at slightly less than 200 pounds/acre (Fig. 21). The lowest N applied was to the integrated crop-livestock systems at about 75 lbs/acre. Because of the role of

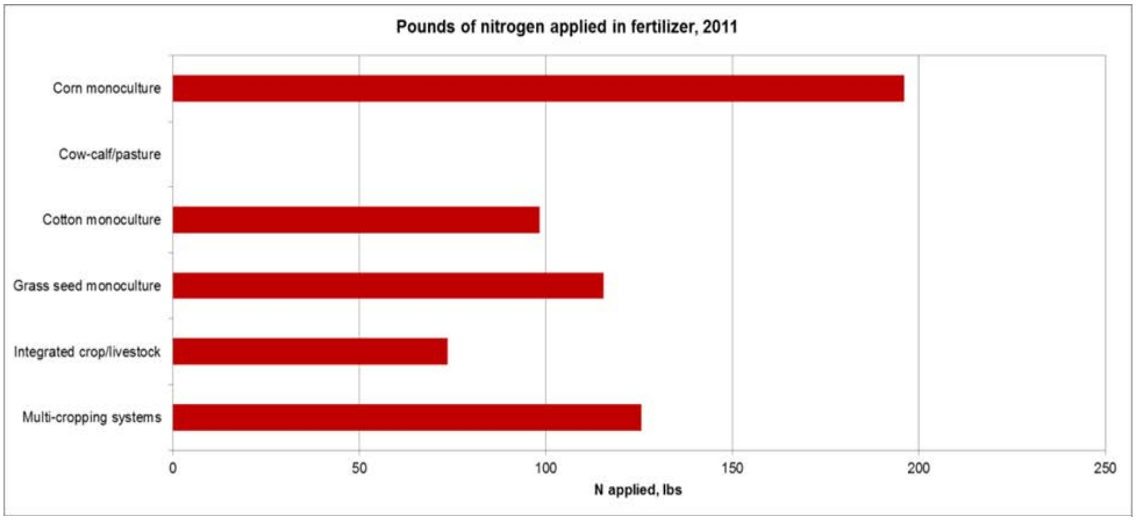


Figure 21. Pounds of nitrogen applied in fertilizer, 2011.

fertilizer N in the release of nitrous oxide, this feature takes on added significance in addition to the costs of the fertilizer per se. Nitrous oxide is both ozone depleting and a greenhouse gas.

Project years 1 through 7

Average net returns per acre over the seven years of the project (2005-2011) indicates that grass seed monocultures were the most profitable systems at almost $400 per acre (Fig. 22). These systems also had the highest net returns per unit of irrigation water

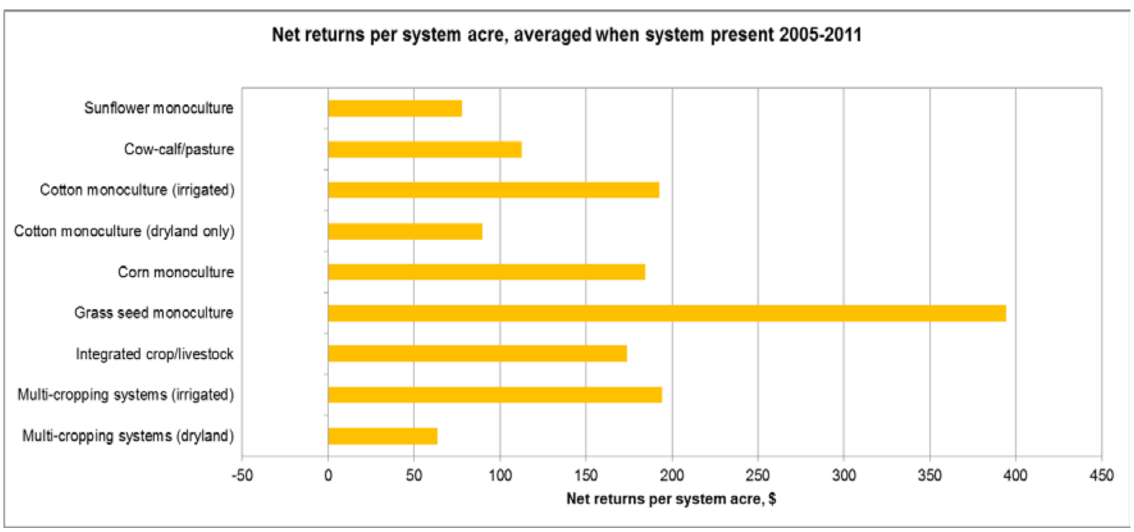


Figure 22. Net returns per system acre, average of 2005-2011.

applied but were similar to cotton in terms of total irrigation water used (Fig. 23). The 7 years of this project now cover a wide range of climatic and economic swings. It is interesting that grass-seed appear more buffered against these variations than any of the other systems. In 2010, a year of exceptional moisture, net returns/acre for grass seed averaged about $420/acre and in 2011, the year that set the new record for low precipitation, profitability for this crop was only about $20 less per acre. Irrigated cotton monocultures, corn monocultures, integrated crop-livestock systems, and multi-cropping systems responded differently to variations in precipitation and economics across these 7 years (see previous annual reports) but when averaged across all of this variation, there was little difference in net returns among the systems ($170 to 190/acre; Fig. 22). The integrated crop-livestock systems and the multi-cropping systems were nearly identical in net returns per system acre but irrigated water use was lower for the integrated crop-livestock system (Fig. 23). Irrigated cotton used about the same amount of irrigation

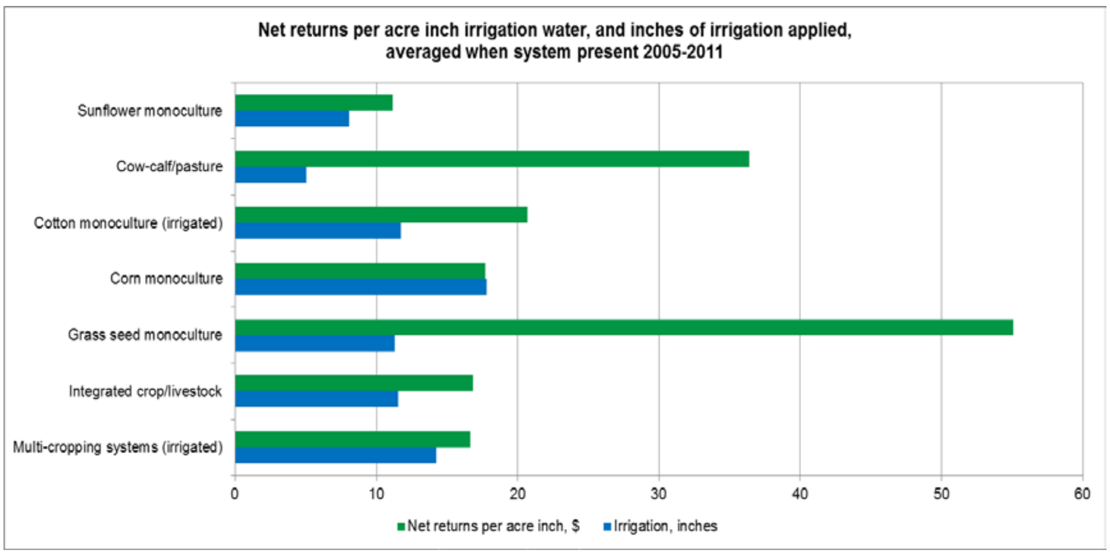


Figure 23. Net returns per acre inch of irrigation water, and inches of irrigation applied, average of 2005-2011.

water as did grass seed and the integrated crop-livestock systems. Net returns per unit of irrigation were higher for cotton than for the integrated systems but were much lower compared with grass seed. Corn monocultures were not present in some of the earlier years of this project and thus reflect fewer years in their means. The drought of 2011 hit this crop particularly hard and with fewer years in the mean, the effects of the drought have a proportionally greater effect on this crop. The perennial forage, cow-calf system, present until 2011 averaged about $110/acre net returns but had the second highest net returns per inch of irrigation water applied and the lowest total amount of irrigation water used (Fig. 23). As water continues to decline, this system would appear to be among the choices for sustainability of water use and profitability. Sunflowers represent a specialty crop in this region and required less irrigation water than any system type with the exception of the cow-calf system. However, returns per unit of water invested were also relatively low. Dryland systems have always had the lowest average net returns but on average, they were minimally profitable.

On an individual crop basis and averaged over all years, corn and alfalfa used the highest amounts of irrigation water (Table 25). Cotton and sorghum for silage were the second highest consumers of irrigation water. Sorghum for grain production used less water than sorghum for silage. Perennial grasses and small grains (all uses) were irrigated with the least amount of supplemental water. Based on water projected to be available for irrigation and anticipated regulations, alfalfa and corn if grown, will be a part of an overall system where the other system components are either fallowed, dryland production or in a low water requiring crop such as a perennial warm-season grass. As expected, dryland systems used the least N per system acre (Fig. 24). Without supplemental water, responses to higher N rates would not be expected. Cow-calf perennial grass pastures systems were the second lowest users of N fertilizer. Based on

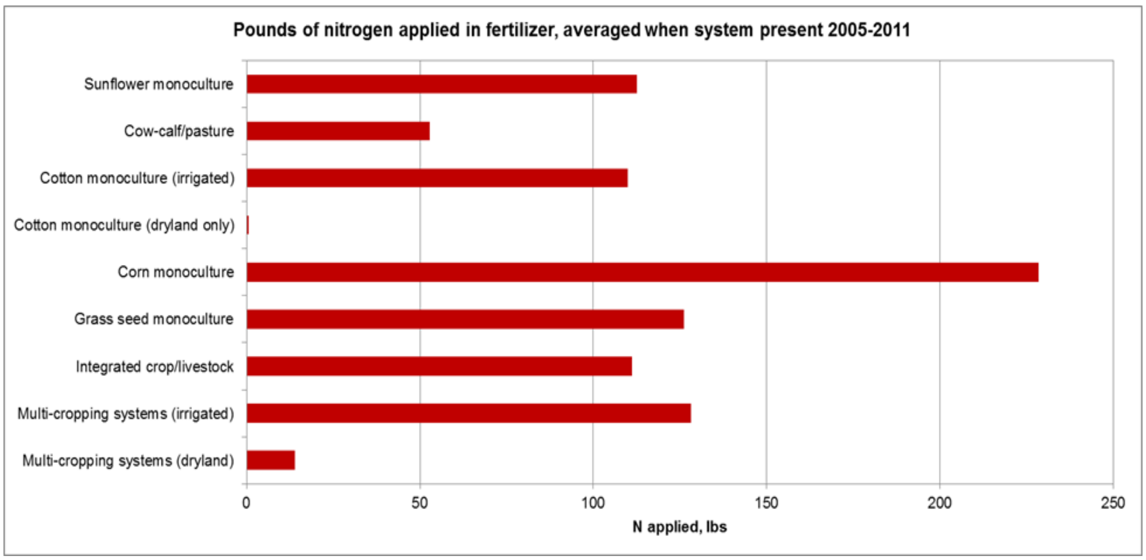


Figure 24. Pounds of nitrogen applied in fertilizer, average of 2005-2011.

warm-season grasses, 50 to 60 lbs of N/acre annually is generally considered adequate. Corn monocultures represented the other extreme with about 225 lbs N/acre annually. All other systems ranged from about 110 to 130 lbs/acre.

Discussion

Over the 7 years of the project we have been able to observe a number of system configurations under varied environmental conditions, irrigation regimes, and market conditions. It has not been surprising that management is the key to how these systems behave under the extreme year to year differences in economic opportunities and environmental conditions experienced in this region. Producers must make strategic and tactical production decisions within their operations to maintain economic viability and utilize available resources wisely. Strategic decisions relate to enterprise selection, whether it is year to year crop selection or more long- term planning. Perennial grass plantings for grass seed production, integrating livestock into an operation, or the selection of irrigation system types and technologies are examples of observed strategic decisions. Tactical decisions relate to enterprise management within the growing season, such as variety selection, fertility, and irrigation scheduling.

There are a number of irrigation management technologies such as Smart Crop, Aqua Spy and Net Irrigate that are available to irrigated producers to aid specifically in the tactical decision process. We have been able to provide 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 the producers that have used these technologies has been invaluable and has helped us formulate tools to address the short-term and long-term irrigation management challenges facing the region.

Two management tools were developed and made available to producers in the region through the TAWC Solutions web site (**http://www.tawcsolutions.com**) in early 2011. The Water Allocation Tool is an economic-based decision aid which utilizes economic variables provided by individual producers to estimate options for cropping systems which maximize per acre profits. This tool can be used by producers to make strategic cropping decisions that consider enterprise market conditions and limitations they may have regarding water availability, whether from structural limitations due to the aquifer or irrigation systems, or from policy limitations imposed by regulatory agencies. The Irrigation Scheduling Tool is intended as an in-season tactical aid to assist producers in determining a more refined irrigation schedule utilizing weather information, rainfall, irrigation applications, irrigation efficiency, and ET estimates. This tool is designed to assist producers in making growing season decisions to manage their available irrigation to meet crop moisture demands. The tool gives producers the ability to assess information to help manage irrigation on a field by field basis utilizing ET estimates that are based on weather data from the Texas Tech Mesonet, which is an extensive network of over 60 weather stations throughout the region. These tools are free of charge to the producer and are currently available on the TAWC website.

The dissemination of results and information from the project through various outreach efforts is an important part of the project. Continuing activities as in previous years, field days were held in February and August in 2011 at Muncy, TX. These field days allow 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 as well as other data aspects of the project. The February field day was devoted to a more in-depth discussion of results and analysis from the project as well as demonstration of the TAWC Solutions Tools. 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.

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 our water resource is critical to the continued economic success of agriculture in the region. Producers face many challenges, whether they are from “mother nature” or regulatory policy. The information we are deriving from this project will assist producers in meeting these challenges and allow the region to continue to be a leader in agricultural production.

Table 18. Summary of results from monitoring 27 producer sites during 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 19. Summary of results from monitoring 27 producer sites during 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 20. Summary of results from monitoring 27 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 21. 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 22. 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 23. 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 24. 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 25. Overall summary of crop production, irrigation, and economic returns within all production sites in Hale and Floyd Counties during 2005, 2006, 2007, 2008, 2009, 2010 and 2011.

Item		2005	2006	2007	2008	2009	2010	2011	Crop year Average
Mean Yields, per acre (only includes sites producing these crops, includes dryland) {Yield averages across harvested fields within sites for 2011}									
Cotton									
	Lint, lbs	1,117 (22) [1]	1,379 (20)	1,518 (13)	1,265 (11)	1,223 (16)	1,261 (15)	1166 (19)	1,275.57
	Seed, tons	0.80 (22)	0.95 (20)	1.02 (13)	0.86 (11)	0.81 (16)	0.83 (15)	0.77 (19)	0.86
Corn									
	Grain, lbs	12,729 (3)	8,814 (4)	12,229 (4)	10,829 (8)	12,613 (4)	12,685 (10)	6,766 (4)	10,952.14
	Silage, tons	30.9 (2)	28.3 (3)	27.3 (3)	-	38.3 (1)	31 (2)	20.5 (3)	29.38
Sorghum									
	Grain, lbs	4,147 (3)	2,987 (1)	6,459 (4)	6,345 (5)	6,907 (3)	4,556 (3)	1,196 (1)	4,656.71
	Silage, tons	26.0 (1)	20.4 (2)	25.0 (1)	11.3 (2)	9.975 (2)	-	-	18.54
	Seed, lbs	-	-	-	3507 (1)	-	-	-	3,507.00
Wheat									
	Grain, lbs	2,034 (1)	-	2,613 (5)	4,182 (5)	2,061 (6)	2,860 (6)	3,060 (1)	2,801.67
	Silage, tons	16.1 (1)	7.0 (1)	-	7.5 (1)	3.71 (1)	-	-	8.58
	Hay, tons	-	-	-	-	2.5 (1)	-	-	2.50
Oat									
	Silage, tons	-	4.9 (1)	-	-	12.5 (1)	-	-	8.70
	Hay, tons	-	1.8 (1)	-	-	-	-	-	1.80
Barley									
	Grain, lbs	-	-	-	3,133 (1)	-	-	-	3,133.00
	Hay, tons	-	-	-	5.5 (1)	-	-	-	5.50
Triticale									
	Hay, tons	-	-	-	-	-	-	3(1)	3.00
	Silage, tons	-	21.3 (1)	17.5 (1)	-	-	13 (2)	2.5(2)	13.58
Sunflower									
	Seed, lbs	-	-	-	1,916 (2)	2,274 (4)	-	-	2,095.00
Pearl millet for seed									
	Seed, lbs	3,876 (1)	2,488 (1)	4,002 (2)	2,097 (2)	-	-	1,800(1)	2,852.60
Perennial forage									
Dahl									
	Seed, PLS lbs	-	-	-	30 (1)	83.14 (1)	-	-	56.57
	Hay, tons	-	-	-	2.5 (1)	-	-	-	2.50
SideOats									
	Seed, PLS lbs	313 (2)	268 (2)	96 (5)	192.9 (4)	362 (3)	212.5 (2)	200.75 (2)	235.02
	Hay, tons	-	-	-	1.66 (3)	1.83 (3)	1.1 (2)	0.5 (2)	1.27
Other									
	Hay, tons	-	-	-	0.11 (1)	4.3 (1)	2.4 (1)	-	2.27
Alfalfa									
	Hay, tons	8.3 (1)	9.18 (1)	4.90 (1)	12.0 (1)	9.95 (1)	9.0 (1)	10.6 (1)	9.13
Annual forage									
Forage Sorghum									
	Hay, tons	-	-	-	-	-	-	6.8 (1)	6.80
Precipitation, inches (including all sites)		15.0	15.4	27.3	21.7	15.7	28.9	5.3	18.46
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)	20.99 (27)	12.86
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)	12.80
Corn grain		17.4 (3)	21.0 (4)	12.5 (4)	21.7 (8)	19.2 (4)	12.8 (10)	27.1 (4)	18.81
Corn silage		18.0 (2)	24.0 (3)	12.6 (3)	-	24.3 (1)	18 (2)	34.7 (3)	21.93
Sorghum grain		7.5 (1)	4.2(1)	6.6 (4)	13.8 (5)	9.4 (3)	6.13(2)	27.8 (1)	10.56
Sorghum silage		15.0 (1)	12.5 (2)	13.5 (1)	11.5 (1)	15.7 (1)	-	-	13.64
Wheat grain		-	-	5.3 (3)	7.68 (4)	5.7 (5)	2.6 (6)	11.3 (1)	6.52
Wheat silage		7.5 (1)	16.3 (1)	-	5.5 (1)	15.7 (1)	-	-	11.25
Oat silage		-	4.3 (1)	-	-	15.7 (1)	-	-	10.00
Oat hay		-	4.9 (1)	-	-	-	-	-	4.90
Triticale silage		-	10.0 (1)	12.9 (1)	-	-	6.9 (2)	17.8 (2)	11.90
Barley grain		-	-	-	12.8 (1)	-	-	-	12.80
Small Grain (grazing)		0.5 (3)	0.8 (2)	0.8 (3)	-	-	-	-	0.70
Small Grain (grains)		-	-	5.3 (3)	8.7 (5)	5.7 (5)	2.6 (6)	11.3 (1)	6.72
Small Grain (silage)		7.5 (1)	10.2 (3)	12.9 (1)	5.5 (1)	15.7 (2)	6.9 (2)	17.8 (2)	10.93
Small Grain (hay)		-	4.9 (1)	-	-	-	-	-	4.90
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)	8.00
Sunflower seed		-	-	-	9.6 (2)	8.9 (4)	-	-	9.25
Millet seed		-	-	-	9.6 (2)	-	-	29.4 (1)	19.50
Dahl									
hay		-	-	-	4.65 (1)	-	-	-	4.65
seed					9.4 (1)	8.9 (1)	-	-	9.15
grazing						4.1 (1)	4.6 (3)	8.9 (2)	5.87
Sideoats									
seed		-	-	-	8.0 (3)	15.3 (3)	2.8 (2)	20.3 (2)	11.60
Bermuda									
grazing		-	-	-	6.2 (1)	5.3 (1)	0 (1)	17.1 (1)	7.15
Other Perennials/Annuals									
hay		-	-	-	4.02 (1)	-	8.5 (1)	-	6.26
grazing		-	-	-	5.5 (1)	6.6 (1)	5.1 (1)	-	5.73
Perennial grasses (grouped)									
Seed		-	-	-	8.35 (4)	13.7 (4)	2.8 (2)	-	8.28
Grazing		-	-	-	5.85 (2)	5.3 (3)	3.8 (5)	11.6 (3)	6.64
Hay		-	-	-	4.33(2)	-	-	-	4.33
All Uses		6.5 (6)	8.8 (6)	7.1 (7)	6.7 (8)	10.1 (7)	3.5 (7)	11.6 (3)	7.76
Alfalfa		10.3 (1)	34.5 (1)	10.6 (1)	15.6 (1)	18.6 (1)	15.6 (1)	44.1 (1)	21.33
Income and Expense, $/system acre									
Projected returns		660.53	773.82	840.02	890.37	745.82	961.87	951.66	832.01
Costs									
	Total variable costs (all sites)	444.88	504.91	498.48	548.53	507.69	537.14	677.42	531.29
	Total fixed costs (all sites)	77.57	81.81	81.77	111.98	110.65	153.55	149.98	109.61
	Total all costs (all sites)	522.45	586.72	580.25	660.51	618.34	690.69	827.40	640.91
Gross margin									
	Per system acre (all sites)	215.66	268.91	341.54	341.84	238.13	424.74	295.10	303.70
	Per acre inch irrigation water (irrigated only)	33.50	22.53	34.01	31.17	22.95	71.51	24.11	34.25
Net returns over all costs									
	Per system acre (all sites)	138.09	187.10	259.77	229.86	127.48	271.19	145.11	194.09
	Per acre inch of irrigation water (irrigated only)	21.57	15.88	24.99	20.89	9.99	43.71	9.56	20.94
	Per pound of nitrogen (all sites)	1.62	0.81	2.34	1.48	0.87	2.40	1.82	1.62

[1] Numbers in parenthesis refer to the number of sites in the mean.

Reports by Specific Task

Task 2: Project Administration

2.1 Project Director: Rick Kellison.

It's difficult to adequately describe 2011. Just to say 2011 was the driest year in recorded history doesn't really do it justice. We will be feeling the effects for many years to come. After experiencing the timely rains of 2010 in conjunction with record cotton prices and very good grain and cattle prices, producers were very optimistic and excited about the possibilities for 2011. Because of this optimism, some producers continued to add additional inputs, such as irrigation and fertilizer. These producers were thinking that the growing season would get better and they would get some rainfall, but it never happened. The dry land crops were a complete disaster. Some irrigated acres were abandoned, while others made excellent yields. Of course, these varied results were based on the amount of irrigation available and timely management decisions.

Even with the poor growing season I believe that 2011 was a good year for TAWC. We rolled out our planning and management tools at our February field day. We have had good response from both producers and industry. Pioneer Hybrids allowed us to make presentations at four of their field days and Monsanto asked us to share our information at their winter consultants meeting. We were also asked to make presentations at the Lubbock Bankers Conference and the New Mexico Ag Bankers Conference. We are being included at several AgriLife producer field days.

On April 13th, Dr. David Doerfert, Dr. Steve Maas, Dr. Justin Weinheimer, Dr. Phil Johnson, and myself made a presentation for Dr. David Brauer with the Agriculture Research Service. He was interested in the TAWC project and the tools that we had developed.

After consulting with our producers and management team members the decision was made to go forward with our annual summer field day. Based on the adverse growing conditions we were experiencing, I believe our field day was a success with over eighty people in attendance.

On July 12th and 13th eight of our management team traveled to Boulder, Colorado to make presentations about the TAWC project to The University Council on Water Resources. We felt that this was a unique opportunity to showcase TAWC, our results and management tools.

On August 1st Justin Weinheimer and I met with Senator Robert Duncan and Sarah Clifton. The purpose of this meeting was to give Senator Duncan an update on the project and discuss future direction. Senator Duncan indicated that he was pleased with the progress and especially the management tools.

On September 13th we hosted Bloomberg News from New York and on September 27th Voice of America from Washington, D.C. Both groups toured some of the TAWC demonstration sites and interviewed some of the producers. We were able to show different methods of irrigation delivery and how these pratices would have a positive impact on water conservation and crop yields.

On October 4th, Dr. David Doerfert and I met with David Gibson, Texas Corn Growers Association. The purpose of this meeting was to discuss the development of a web-based water management guide for producers. The initial version was shown to producers at the Amarillo Farm Show. Mr. Gibson indicated that the Corn Growers Association was in full support of our efforts and would aid us in this effort.

Dr. Justin Weinheimer and I met with Senator Robert Duncan on October 25th. The purpose was to discuss various ways we might secure additional funding to continue the efforts of TAWC. Senator Duncan requested a two page document showing results and future direction of the project.

On February 7th, we were able to assemble a group of researchers and industry leaders to discuss what may have been observed about water management in the drought of 2011. This meeting was held at the USDA Plant Stress Lab in Lubbock. A total of twenty-six people were in attendance representing USDA, Texas Tech University, Texas A&M University, Monsanto, Bayer Crop Science, TAWC, and Wilbur-Ellis Co. Our objective was to develop information for producers for best management practices. This group agreed that this goal was attainable and were willing to meet on a regular basis to reach this goal. TAWC and AgriLife Extension hosted two field days in February. The first was held in Muleshoe on February 14th, and the second field day was held in Levelland on February 24th. We plan to continue cooperating with AgriLife with additional field days outside the current demonstration area in the future.

Presentations this year:

March 4 2011	Texas Tech Forage Class	
March 30, 2011	Wesley Burgett	
April 13, 2011	David Baurer	
May 18 ,2011	Floydada Rotary Club	
August 13, 2011	UCOWR	Boulder, Colorado
September 29, 2011	Texas & Southwestern Cattle Raiser Association	
November 18, 2011	39th Annual Bankers Agricultural Credit Conference	
December 7, 2011	Plainview Lions Club	
January 2, 2012	Pioneer Field Day	Plainview, Texas
January 3, 2012	Pioneer Field Day	Olton, Texas
January 4, 2012	Pioneer Field Day	Farwell, Texas
January 5, 2012	Pioneer Field Day	Hereford, Texas
February 8, 2012	Monsanto Consultants Meeting, Santa Fe New Mexico	
February 14, 2012	TAWC & AgriLife	Muleshoe, Texas
February 24, 2012	TAWC & AgriLife	Levelland, Texas

Tours this year:

March 8, 2011	Jane and David Henry
April 14, 2011	TWDB
May 2, 2011	Dr. Mike Galyean
July 6, 2011	Area Texas AgriLife county agents
September 13, 2011	Bloomberg News

September 27, 2011	Voice of America
September 28, 2011	Dr. Sara Trojan
October 10, 2011	T. J. Martinez, The University of Texas

We have held our monthly management team meeting each month and I have made regular site visits this year.

2.2 Secretary/Bookkeeper: Angela Beikmann. *(three-quarter time position).* Year 7 main objectives for the secretarial and bookkeeping support role for the TAWC project include the following.

Accurate Accounting of All Expenses for the Project. This includes 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 7 of the project.

Administrative Support for Special Events. The 2011 Production Agriculture Planning Workshop was held on Thursday, February 24, 2011 at Muncy, TX. Sponsor donations were received, deposited and used for event expenses such as catering services, facility rental and advertising. Also attended the event to assist project team members as needed.

The TAWC Farmer Field Day was held on Thursday, August 4, 2011 at Muncy, TX. Sponsor donations were received and deposited and were used for field day expenses such as catering services, facility rentals, bus rental and advertising and print services.

Ongoing Administrative Support. The 6th Annual Report was completed and revised as suggested by TWDB. Electronic and printed versions of the annual report were distributed to TAWC producers, team members and participants as requested. TAWC producer binders were assembled for each TAWC producer to categorize their records. These binders greatly assist the research team in acquiring useful data for this annual report and other communications.

Professional Service Agreements and subcontract for the Implementation Phase of the TAWC demonstration project were extended and amended as appropriate for the 2011 growing year.

The 4th TAWC budget amendment and project extension request were submitted to TWDB; both were approved. The budget amendment allowed for re-categorization of funds and did not increase the awarded amount. The request for a no-cost extension of the TAWC project resulted in a new study completion date of April 30, 2014 and a final report deadline of August 31, 2014.

Assistance was given to the newly hired Communications Director, Samantha Borgstedt, as requested, including travel and purchase order support.

Quarterly reports have been assembled and forwarded to TWDB. These quarterly reports, dated May 31, 2011, August 31, 2011, November 30, 2011 and February 29, 2012, coincide with quarterly reimbursement requests submitted by TTU. Management Team meeting minutes have been recorded and transcribed for each meeting. These meetings were held on March 10, April 14, May 12, June 9, July21, August 11, September 8, October 13, November 10, December 8, 2011, and January 12 and February 16, 2012. Daily administrative tasks include many clerical procedures and documents pertaining to a business/education setting.

TASK 3: FARM ASSISTANCE PROGRAM

Dr. Steven Klose
Jeff Pate
Jay Yates

Year 7 project progress regarding task 3 in the overall project scope of work 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 most of the 2011 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, and continue 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 2010 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 2010 data. This analysis can be used by each producer to establish some economic goals for the future. 2011 analysis will be completed this summer, as yield data has only recently been finalized for the 2011 crop.

Economic Study Paper. Farm Assistance members completed a study paper utilizing the economic data on all sites within the TAWC project. The paper examined the profitability of irrigated cotton grown during the extreme drought conditions of 2011. The results of this paper were presented at the Beltwide Cotton Conference held in Orlando, Florida this past January. Also, a paper examining the timeliness of sunflower emergence and its effect on profitability was delivered in Boulder, Colorado at the annual UCOWR meeting.

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 T.A.W.C. project.

Field Days. For the first time in the TAWC project, Field Days were held outside of the project area. These Field Days were held in February 2012 in Muleshoe and Levelland. The purpose of these meetings were to allow producers that operate outside of the project area to see what takes place in the project, as well as demonstrate decision-aid tools developed by members of the Management Team. Personnel from AgriLife Extension, AgriLife Research, Farm Assistance, the High Plains Water District, and Texas Tech University were involved in these field days.

TASK 4: ECONOMIC ANALYSIS

Dr. Phillip Johnson
Dr. Eduardo Segarra
Dr. Justin Weinheimer
Cody Zilverberg

Objective

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 2011:

- 2011 represented the seventh year of economic data collection from the project sites. Data for the 2011 production year has been complied and enterprise budgets have been generated.

- The economic decision tool for agricultural producers developed under *"TAWC Solution: Decision Aids for Irrigation, Economics, and Conservation"* was presented at numerous meetings and conferences. The tool is an economic planning aid for irrigated producers that provide field level crop allocation options that maximize net returns per acre under limited irrigation conditions. Variables such as water available for irrigation, production cost, expected commodity prices, and acreage plans are used to provide a unique output that matches available water resources and production capabilities.

- Secured funding through the Natural Resource Conservation Service/USDA for a Conservation Initiative Grant (CIG) which will complement the demonstration sites to include sites in Parmer, Deaf Smith, Crosby and Lubbock Counties. These sites will remain separate from the TAWC project sites but will add to the overall information generated from this effort.

Journal Articles related to the TAWC in 2011:

- Zilverberg, C., P. Johnson, J. Weinheimer and V. Allen. 2011. Energy and Carbon Costs of Selected Cow-Calf Systems. *Rangeland Ecology & Management.* 64.6(November 2011):573-584.

- Johnson, J., P. Johnson, B. Guerrero, J. Weinheimer, S. Amosson, L. Almas, B. Golden, and E. Wheeler-Cook. 2011. Groundwater Policy Research: Collaboration with Groundwater Conservation Districts in Texas. *Journal of Agricultural and Applied Economics.* 43.3(August 2011):345-356.

Proceedings related to the TAWC in 2011:

- Weinheimer, J., P. Johnson, J. Pate, and J. Yates. 2011. Economic Considerations for Water Conservation: Texas Alliance for Water Conservation. Presentation at the Universities Council on Water Resources, Boulder, CO. July 2011.

- Guerrero, B., S. Amosson, J. Johnson, and J. Weinheimer: Economic Evaluation of Water Conservation Strategies for North Plains Groundwater Conservation District. Presentation at the Universities Council on Water Resources, Boulder, CO. July 2011.

Presentations related to the TAWC in 2011:

- Weinheimer, J. Presentation of Texas Alliance for Water Conservation, Amarillo Farm and Ranch Show, Amarillo TX, December, 2011

- Weinheimer, J. Presentation of economic research and the TAWC to The AAEC Advisory Council, Lubbock TX, November, 2011

- Weinheimer, J., P. Johnson, J. Johnson, B. Guerrero, and S. Amosson. Presentation of results for the GMA2 analysis to the board of the Permian Basin Water District, Stanton, TX. December, 2011

- Weinheimer, J., P. Johnson, J. Johnson, B. Guerrero, and S. Amosson. Presentation of results for the GMA2 analysis to the board of the Llano Estacado Water District, Seminole, TX. December, 2011

- Weinheimer, J., P. Johnson, J. Johnson, B. Guerrero, and S. Amosson. Presentation of results for the GMA2 analysis to the board of the South Plains Underground Water Conservation District, Brownfield, TX. October, 2011.

- Weinheimer, J., P. Johnson, J. Johnson, B. Guerrero, and S. Amosson. Presentation of results for the GMA2 analysis to the board of the High Plains Underground Water Conservation District No. 1, Lubbock, TX. October, 2011.

- Weinheimer, J., and P. Johnson. TAWC Solutions: Tools for Water Management. Presentation at the 39th Bankers Agricultural Credit Conference, Lubbock, TX. November, 2011.

- Weinheimer, J., P. Johnson, J. Johnson, B. Guerrero, and S. Amosson. Presentation of results for the GMA2 analysis to the board of the Llano Estacado Underground Water Conservation District, Seminole, TX. December, 2011.

- Weinheimer, J., P. Johnson, J. Johnson, B. Guerrero, and S. Amosson. Presentation of results for the GMA2 analysis to the board of the Permian Basin Underground Water Conservation District, Stanton, TX. December, 2011.

Demonstration Project Profitability Evaluation 2005 – 2010

Profitability for each demonstration site was calculated for the years 2005 through 2010 (as noted previously the current years report runs one year behind for each report year due to incomplete data). Efficiency related to the primary resources - land and applied irrigation water – was measured by gross margin per acre of land and gross margin per acre-inch of applied irrigation water. Gross margin (gross revenue less direct costs) was used as the measure of profitability.

Tables 26 and 27 give a summary of irrigation applied, gross margin per acre and per acre-inch of applied irrigation, irrigation technology, and crop or rotation for each site over the period 2005 through 2010. Table 26 ranks the sites by gross margin per acre. The average irrigation applied ranged from 5.55 to 22.59 acre-inches. Ten sites had average gross margins over $300 per acre, with average irrigation ranging from 9.75 to 22.59 acre-inches.

Figure 25 shows the distribution of gross margin per acre to acre-inches of applied irrigation. The area delineated by the rectangle in the upper left corner of the chart represents gross margins greater than $300 per acre and applied irrigation of 15 acre-inches or less. Six sites met these criteria over the 6-year period 2005 – 2010. The sites shown in the oval met the $300 gross margin per acre criteria and averaged less than 18 acre-inches. One site, site 20, met the gross margin per acre criteria with an average applied irrigation of 22.59 acre-inches.

Table 27 ranks the sites by gross margin per acre-inch of applied irrigation. Gross margin per acre-inch ranged from $58.55 to $16.29. Figure 26 shows the distribution of gross margin per acre and gross margin per acre-inch of applied irrigation. The area delineated by the rectangle in the upper right corner of the chart represents gross margin per acre over $300 and gross margin per acre-inch over $27. The criteria for gross margin per acre-inch was based on the top 10 sites relative to gross margin per acre-inch shown in Table 27.

Six sites were in the “top ten” for gross margin per acre and gross margin per acre-inch of irrigation. These included sites 7, 8, 6, 26, 2, and 27, representing, grass seed monoculture, grass seed monoculture, cotton/corn rotation, multi-crop rotation with grazing, cotton/corn/sunflower rotation, and cotton/corn rotation, respectively.

Abbreviations used in the tables: CC – Cow/Calf, CT – Cotton, CR – Corn, CS – Corn Silage, FS – Forage Sorghum, GR – Grass, GS – Grass Seed, ML – Millett Seed, OS – Oat Silage, SC – Stocker Cattle, SF – Sunflowers, TR – Triticale, WH – Wheat, WS – Wheat Silage, LESA – Low Evaluation Spray Application, LEPA – Low Energy Precision Application, MESA Mid Evaluation Spray Application, SDI – Subsurface Drip System. Gross Margin (GM) represents Gross Revenues less Direct Costs

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.

Net Returns – Gross margin less fixed costs.

Table 26. Systems ranked by Gross Margin per Acre, 2005 - 2010.

Site	Irrigation Applied	Gross Margin Per Acre	Gross Margin Per Acre Inch	Irrigation Technology	Crop or Rotation					
	Acre Inches	$/Acre	$/Acre Inch		2005	2006	2007	2008	2009	2010
7	9.83	575.25	58.55	LESA	GS	GS	GS	GS	GS	GS
20	22.59	530.84	23.50	LEPA	WH/FS/CR	CS/FS	TR/FS	WH/SR/FS	CS/CT	CR/TR/CT
8	9.75	505.48	51.84	SDI	GS	GS	GS	GS	GS	GS
27	17.88	493.32	27.59	SDI		CT	CS	CT/CR	CT/CR	CT/CS
22	17.46	468.28	26.82	LEPA	CT/CR	CT/CR	CT	CR	CT	CR
6	12.25	427.54	34.89	LESA	CT	CT	CT	CT/CR	CT/CR	CT/CR
26	13.03	420.00	32.24	LEPA	CT/CR	CT/CR	CR/ML/CC	SR/ML/ CR/CC	CR/SF	WH/CT/ CR/CC
24	17.57	380.18	21.64	LESA	CT/CR	CT/CS	CR	CR	CR/SF	CR
2	12.04	347.56	28.87	SDI	CT	CT	CT	SF	CT	CR
4	11.47	307.97	26.85	LESA	CT/A	CT/A/ WS/FS	CT/WH/ A/CC	A/SR/ WH/CC	WH/SR/ CT/A	A/CT/ WH/FS
21	11.66	293.07	25.15	LEPA	CT	CT/CR/SC	CR/GS	GS/FS	WH/HAY/GS	CT/CR
5	7.02	292.38	41.64	MESA	GR/CC	GR/CC	GR/CC	GR/CC	GR/CC	GR/CC
15	8.90	290.92	32.69	CF/SDI	CT	CT/SR	CT/SR	CT/WH	CT	CT
17	11.02	275.51	25.00	MESA	GR/CR/CT	GR/CC/ CT/CR	GR/CC/CT	GR/CC/GS/ CT/WH	GR/CC/ SF/GS	GR/CR
19	7.30	240.83	33.01	LEPA	CT/ML	CT/ML	CT/ML	CT/ML	CT/WH	CT/WH
3	10.27	224.68	22.33	MESA	CT/SR	CT	WH/SR	CT/SR/WH	CT/SR	CT/SR/WH
14	7.52	213.20	16.29	LEPA	CT	CT	CT	CT	CT/WH	CT/WH
9	5.55	188.10	21.89	MESA	GR/SC/CT	GR/SC/CT	GR/SC/SR	GR/CC/CT	GR/CT	GR/CC/CT
18	6.42	146.92	28.36	LEPA	SR/CT	CT/OS/FS	WH/SR	CT/WS/FS	CT/WH	CT/WH
12	0	58.21	NA	DRY	CT/FS	CT/WH	CT/SR	FS	WH/FS	CT

Table 27. Systems ranked by Gross Margin per Acre-Inch of Applied Irrigation, 2005 - 2010.

Site	Irrigation Applied	Gross Margin Per Acre	Gross Margin Per Acre Inch	Irrigation Technology	Crop or Rotation					
	Acre Inches	$/Acre	$/Acre Inch		2005	2006	2007	2008	2009	2010
7	9.83	575.25	58.55	LESA	GS	GS	GS	GS	GS	GS
8	9.75	505.48	51.84	SDI	GS	GS	GS	GS	GS	GS
5	7.02	292.38	41.64	MESA	GR/CC	GR/CC	GR/CC	GR/CC	GR/CC	GR/CC
6	12.25	427.54	34.89	LESA	CT	CT	CT	CT/CR	CT/CR	CT/CR
19	7.30	240.83	33.01	LEPA	CT/ML	CT/ML	CT/ML	CT/ML	CT/WH	CT/WH
15	8.90	290.92	32.69	CF/SDI	CT	CT/SR	CT/SR	CT/WH	CT	CT
26	13.03	420.00	32.24	LEPA	CT/CR	CT/CR	CR/ML/CC	SR/ML/ CR/CC	CR/SF	WH/CT/ CR/CC
2	12.04	347.56	28.87	SDI	CT	CT	CT	SF	CT	CR
18	6.42	146.92	28.36	LEPA	SR/CT	CT/OS/FS	WH/SR	CT/WS/FS	CT/WH	CT/WH
27	17.88	493.32	27.59	SDI		CT	CS	CT/CR	CT/CR	CT/CS
4	11.47	307.97	26.85	LESA	CT/A	CT/A/ WS/FS	CT/WH/ A/CC	A/SR/ WH/CC	WH/SR/ CT/A	A/CT/ WH/FS
22	17.46	468.28	26.82	LEPA	CT/CR	CT/CR	CT	CR	CT	CR
21	11.66	293.07	25.15	LEPA	CT	CT/CR/SC	CR/GS	GS/FS	WH/HAY/GS	CT/CR
17	11.02	275.51	25.00	MESA	GR/CR/CT	GR/CC/ CT/CR	GR/CC/CT	GR/CC/GS/ CT/WH	GR/CC/ SF/GS	GR/CR
20	22.59	530.84	23.50	LEPA	WH/FS/CR	CS/FS	TR/FS	WH/SR/FS	CS/CT	CR/TR/CT
3	10.27	224.68	22.33	MESA	CT/SR	CT	WH/SR	CT/SR/WH	CT/SR	CT/SR/WH
9	5.55	188.10	21.89	MESA	GR/SC/CT	GR/SC/CT	GR/SC/SR	GR/CC/CT	GR/CT	GR/CC/CT
24	17.57	380.18	21.64	LESA	CT/CR	CT/CS	CR	CR	CR/SF	CR
14	7.52	213.20	16.29	LEPA	CT	CT	CT	CT	CT/WH	CT/WH
12	0	58.21	NA	DRY	CT/FS	CT/WH	CT/SR	FS	WH/FS	CT

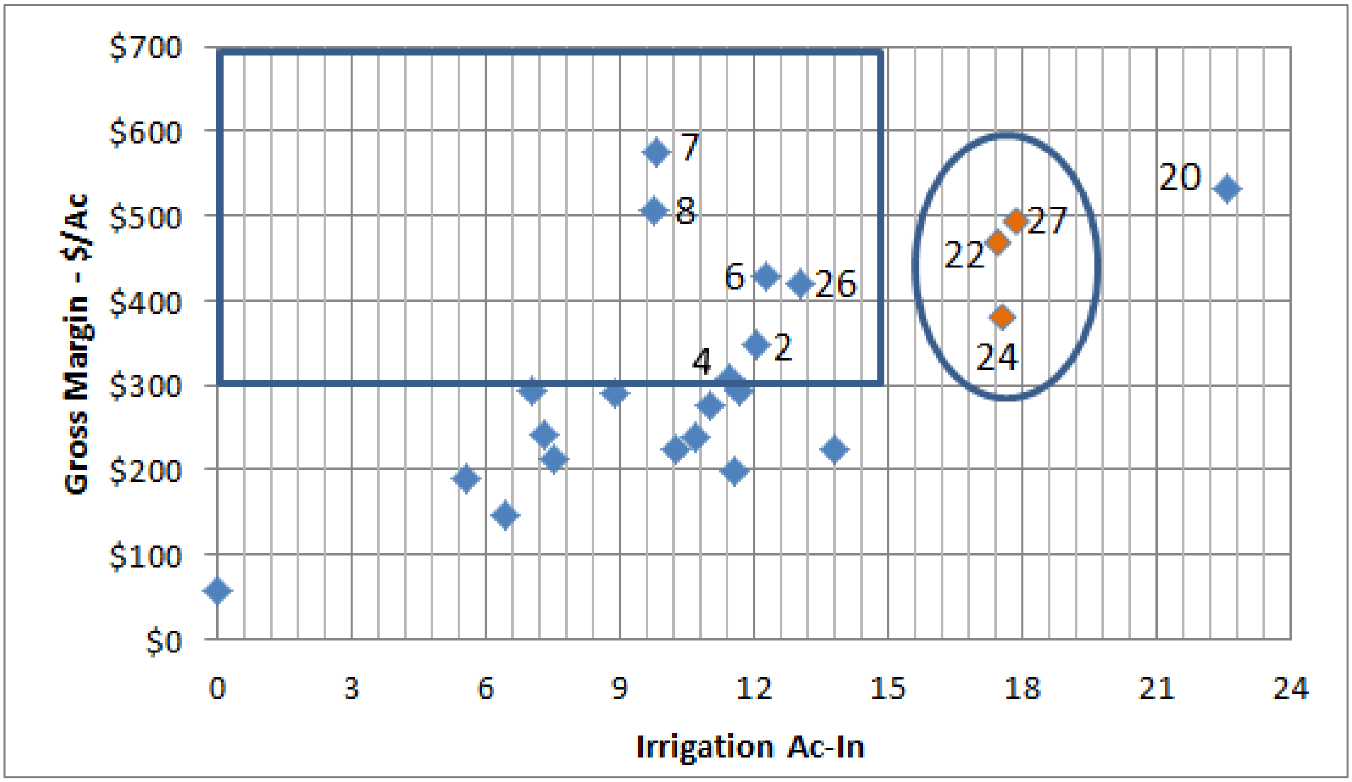


Figure 25. Gross Margin per Acre and Acre-Inches of Applied Irrigation, 2005 - 2010.

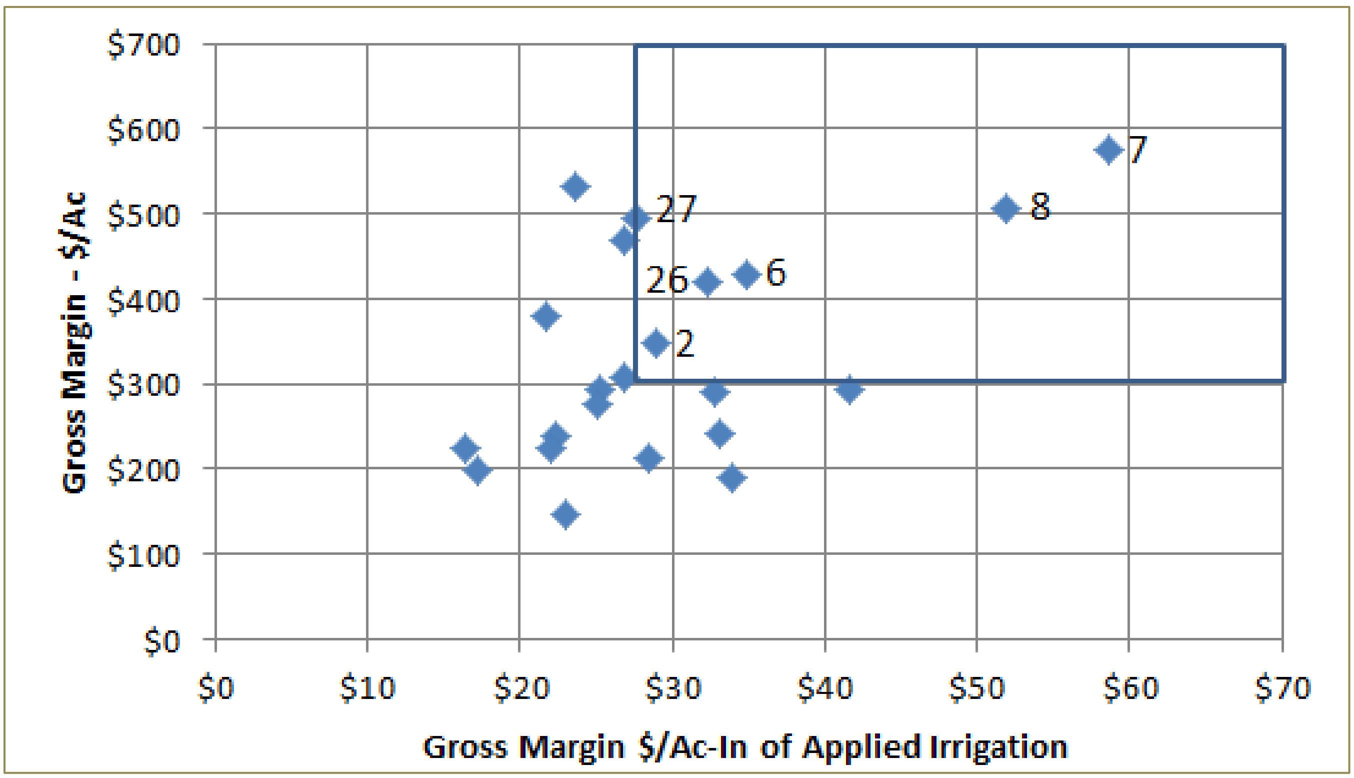


Figure 26. Gross Margin per Acre and Gross Margin per Acre-Inch of Applied Irrigation, 2005 - 2010.

TASK 5: PLANT WATER USE AND WATER USE EFFICIENCY

Dr. Stephan Maas
Dr. Nithya Rajan

Development of the Next Generation TAWC Solutions Irrigation Scheduling Tool (NGIS) was completed in 2011. Implementation of NGIS in the TAWC Solutions website awaits the completion of the development of the web-based version of the tool.

The Next Generation TAWC Solutions Irrigation Scheduling Tool

Standard crop coefficients are designed to estimate crop ET under "standard conditions" which represent "the upper envelope of crop ET where no limitations are placed on crop growth or ET due to water shortage, crop density, or disease, weed, insect, or salinity pressures" (FAO-56, 1998). So, the standard crop coefficient approach can tell you how much water a crop would be using if it were growing under "standard" (non-limited) conditions, but it can't tell you how much water the crop in a particular field is actually using. The objective of the NGIS effort was to develop, test, and implement an irrigation scheduling approach that can estimate the actual water use of individual fields so that irrigation recommendations can be made that are specific to those fields, particularly when the crop is growing under non-standard conditions.

NGIS utilizes the "Spectral Crop Coefficient" Approach in which daily crop water use is estimated from the product of a "spectral crop coefficient" (K_{sp}) that is specific to individual fields and PET calculated for the crop under well-watered, full canopy conditions (PET_{fc}):

$$CWU = K_{sp} * PET_{fc}$$

K_{sp} is numerically equal to the crop GC. Crop GC is a physical quantity that can easily be measured, particularly from medium-resolution satellite remote sensing observations. The ability to estimate crop GC using Landsat imagery is demonstrated in Fig. 27.

Base K_{sp} curves were developed for all major field crops in the TAWC region using 6 years of Landsat-5 and Landsat-7 image acquisitions (see Maas and Rajan, 2011a). K_{sp} is expressed as a function of accumulated growing degree-days rather than days-from-planting to allow the value of K_{sp} to adjust temporally for warmer or cooler growing seasons. Examples of base K_{sp} curves are presented in Fig. 28. The great advantage of the Spectral Crop Coefficient Approach over the standard crop coefficient approach is that the base K_{sp} curves can be adjusted based on within-season GC observations made operationally using satellite imagery. The ability of the Spectral Crop Coefficient Approach to estimate crop water use (CWU) is demonstrated in Fig. 29.

The NGIS tool has the following characteristics:
(1.) Daily CWU is estimated using the Spectral Crop Coefficient Approach.

(2.) Daily soil evaporation is estimated using the 2-phase soil evaporation model of Ritchie (1972. "Model for predicting evaporation from a row crop with incomplete cover," Water Resources Research, Vol. 8, No. 5, p. 1204-1213).
(3.) A daily soil water balance using a 2-layer soil profile is used to track soil moisture.
(4.) The user can specify a target stress level to maintain the crop at during the growing season.
(5.) The tool provides objective irrigation recommendations with 5-day lead time.
(6.) The tool uses within-season updating of K_{sp} using satellite or field observations of crop GC.

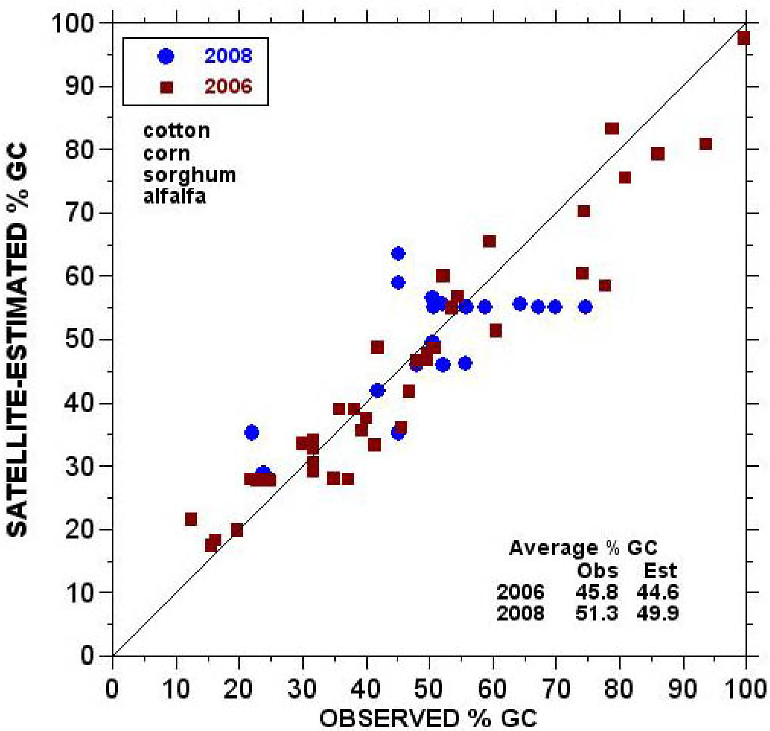


Figure 27. Comparison of crop GC estimated using satellite imagery and measured in the field in 2006 and 2008.

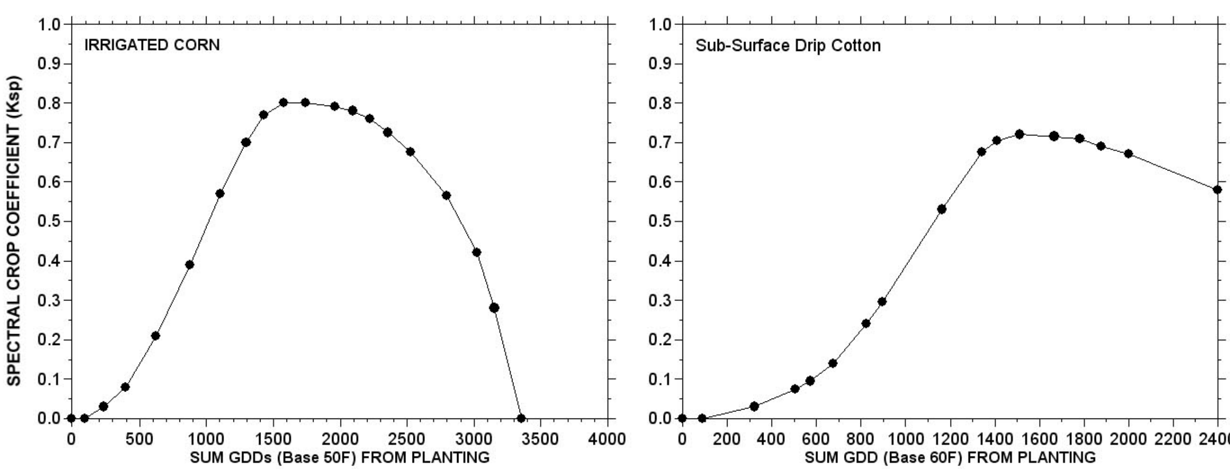


Figure 28. Examples of base K_{sp} curves for two crops.

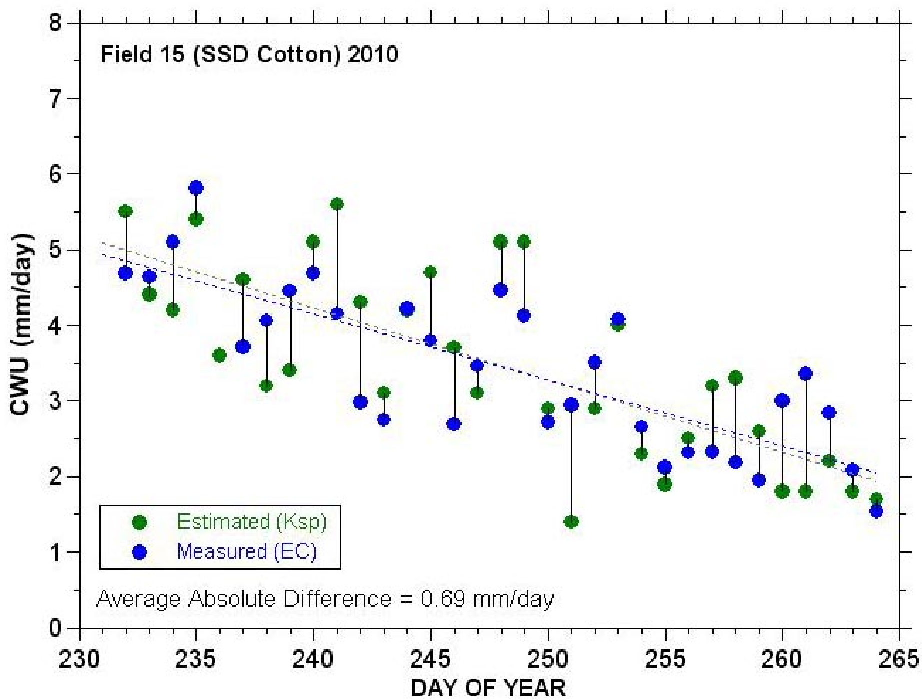
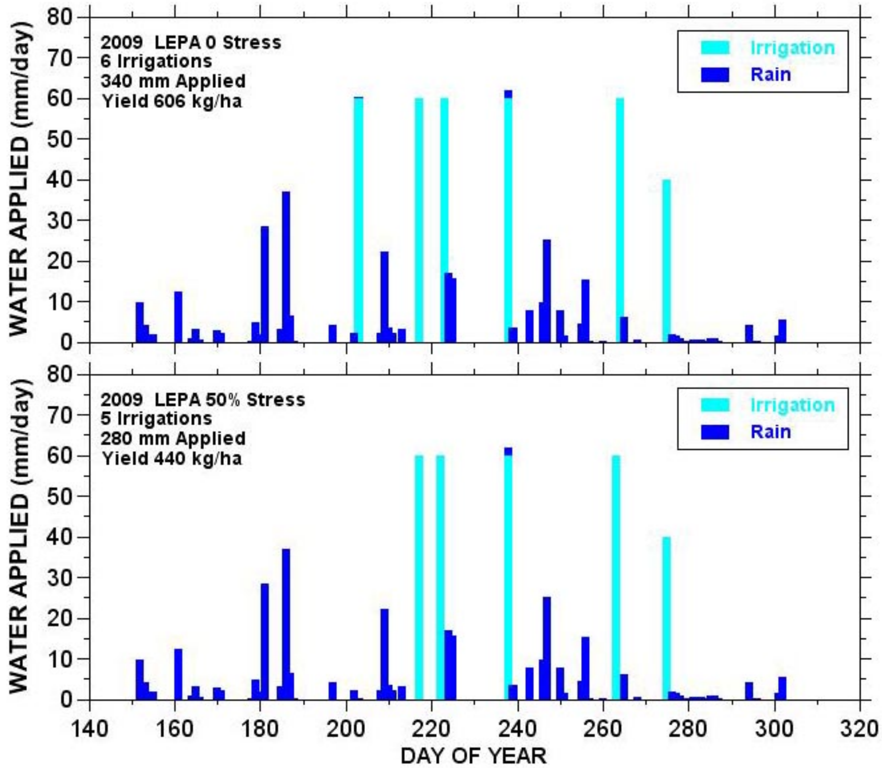


Figure 29. Comparison of daily CWU for TAWC Field 15 estimated using the K_{sp} Approach and measured using eddy covariance (EC).

Test of the Next Generation TAWC Solutions Irrigation Scheduling Tool

The Next-Generation Irrigation Scheduling Tool was evaluated using virtual "test fields" generated by crop growth simulation models. For a given set of field conditions (planting date, soil type, initial soil moisture, etc.), the Cotton2K model (a plant growth simulation model developed by Dr. Avi Marani that can be used to simulate growth and yield under any environmental conditions) was run with observed daily weather data. At the same time, the NGIS tool was run in parallel. When the tool recommended an irrigation, it was included in the model simulation. Periodically, simulated values of crop GC were used to update the value of K_{sp} in the tool. At the end of the modeled growing season, the impact of using the irrigation tool (in terms of yield, number of irrigations, water applied, etc.) was assessed.

Figure 30 shows the irrigations recommended by NGIS for fully irrigated (no stress) and deficit irrigated (50% stress) cotton during the 2009 growing season. LEPA irrigation was used for both cases. For the fully irrigated field, 6 irrigations totaling 340 mm (13.6 in) were recommended, while 5 irrigations totaling 280 mm (11.2 in) were recommended for the deficit irrigated field. The fully irrigated field yielded 606 kg lint/ha (1.1 bales/ac), while the deficit irrigated field yielded 440 kg lint/ha (0.8 bales/ac). The fully irrigated field required around 1.78 mm of irrigation to produce a kg of lint, while the deficit irrigated field required only 1.57 mm to produce a kg of lint. Figure 31 shows the changes in soil moisture content over the growing season for the two fields. In both cases, NGIS maintained the soil moisture content at or above the specified stress level (solid red line for the fully irrigated field, and dashed line for the deficit irrigated field).



Figue 30. Irrigation recommended by NGIS for fully irrigated (top) and deficit irrigated (bottom) cotton during the 2009 growing season.

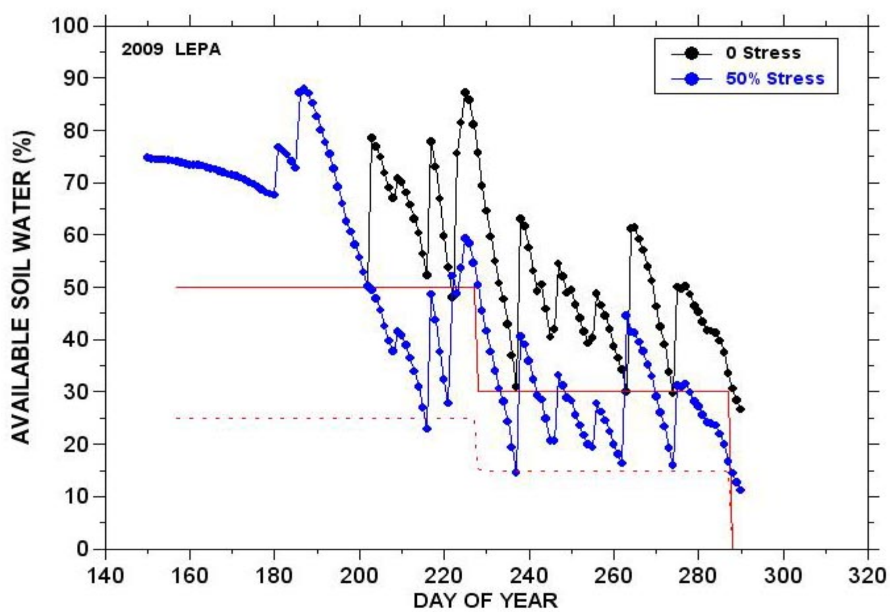


Figure 31. Change in soil moisture for fully irrigated and deficit irrigated cotton in 2009.

Figures 32 and 33 show corresponding results for the 2010 growing season. For the fully irrigated field, 7 irrigations totaling 420 mm (16.8 in) were recommended, while 6 irrigations totaling 360 mm (14.4 in) were recommended for the deficit irrigated field. The fully irrigated field yielded 1678 kg lint/ha (3.0 bales/ac), while the deficit irrigated field yielded 1582 kg lint/ha (2.8 bales/ac). The fully irrigated field required around 4 mm of irrigation to produce a kg of lint, while the deficit irrigated field required 4.39 mm to produce a kg of lint. Differences in other environmental factors (temperature, humidity, and solar radiation) besides water contribute to the differences in water requirements by the cotton crops between the two years.

Testing of the NGIS tool continues. In addition to tests involving the Cotton2K crop model, tests of NGIS involving field plots are scheduled to be conducted in 2012 at the Texas AgriLife Research and Extension Center at Vernon, TX. These field tests will include a comparison of NGIS with the standard crop coefficient approach.

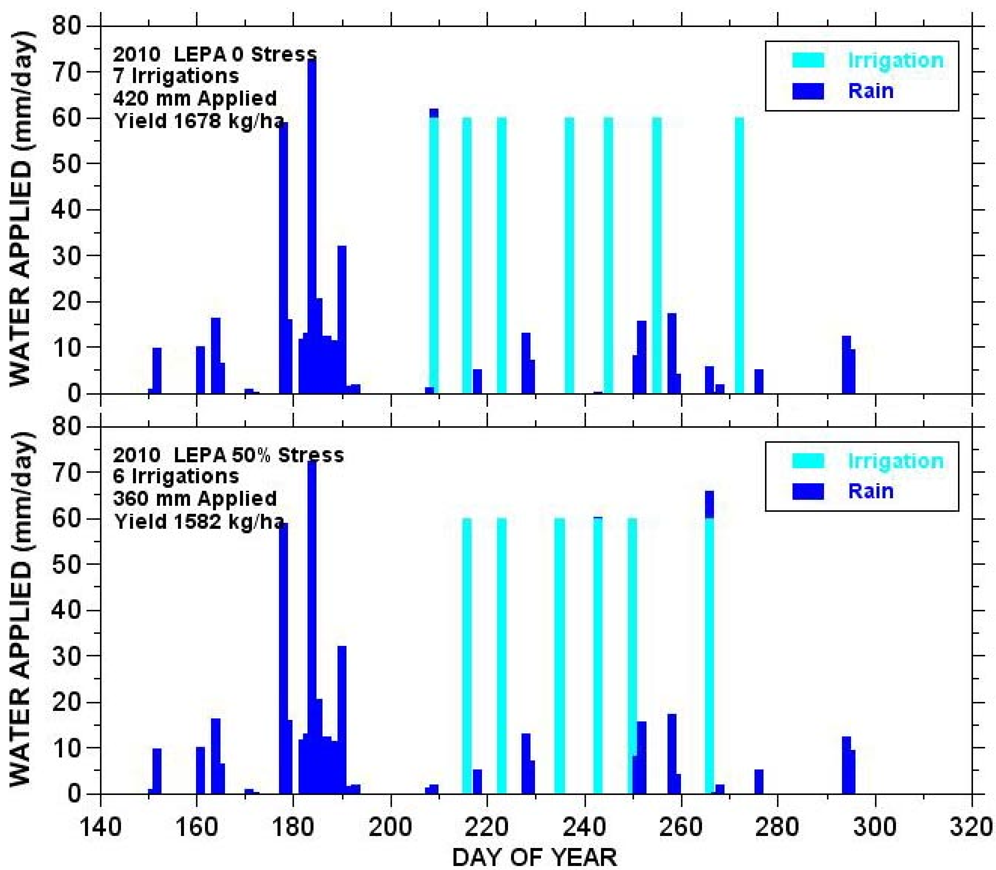


Figure 32. Irrigation recommended by NGIS for fully irrigated (top) and deficit irrigated (bottom) cotton during the 2010 growing season.

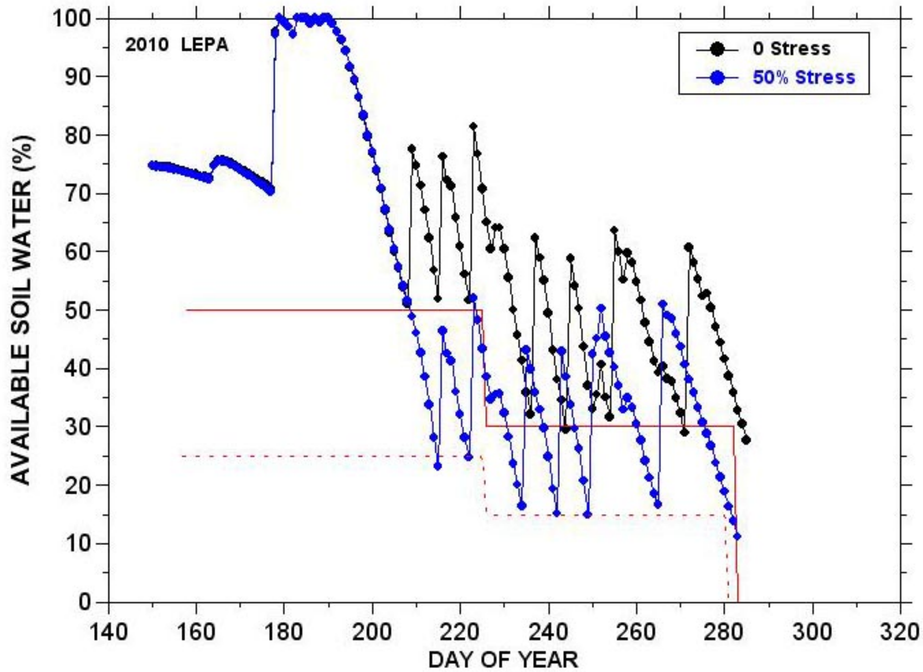


Figure 33. Change in soil moisture for fully irrigated and deficit irrigated cotton in 2009.

PUBLICATIONS AND PRESENTATIONS RELATED TO TAWC

Maas, Stephan, Nithya Rajan and Shyam Nair. 2011. Satellite-based irrigation scheduling. Abstracts, Annual Meetings of the American Society of Agronomy, 16-19 October 2011, San Antonio, TX. (abstract)

Rajan, Nithya, and Stephan Maas. 2011. Comparison of carbon, water and energy fluxes between grassland and agricultural ecosystems. Abstracts, Annual Meetings of the American Society of Agronomy, 16-19 October 2011, San Antonio, TX. (abstract)

Maas, Stephan, and Nithya Rajan. 2011a. Seasonal ground cover for crops in the Texas High Plains. Abstracts, Annual Meetings of the Southern Branch of the American Society of Agronomy, 6-8 February 2011, Corpus Christi, TX. (abstract)

Maas, Stephan, and Nithya Rajan. 2011b. Determining crop water use in the Texas Alliance for Water Conservation Project. Proceedings, 2011 UCOWR/NIWR Annual Conference, 11-14 July 2011, Boulder, CO. (abstract)

Maas, Stephan, and Nithya Rajan. 2011c. Next-generation TAWC Irrigation Scheduling Tool. Texas Alliance for Water Conservation Annual Field Day, 4 August 2011, Muncy, TX.

Task 6: Communications and Outreach

Dr. David Doerfert
Lindsay Graber
Nichole Sullivan
Samantha Borgstedt

During this past year, several activities were designed and implemented towards the goal of expanding the community of practice that is developing around agricultural water conservation. Behind the scenes, steps were taken to increase the awareness and potential influence of the TAWC project beyond the region.

Due to the success of these efforts and the increased need for task-related research, Samantha Yates Borgstedt was added to the staff to assist in the increasing demand for communication/ outreach related tasks so that Dr. David Doerfert could focus his energies on adoption-related research. The TAWC project will paid for 50% of her salary with the remaining portion paid from TTU Dept. of Agricultural and Applied Economics funds. To stay within the budget, TTU's College of Agricultural Sciences and Natural Resources (CASNR) is funding the TAWC graduate assistant positions of Lindsay Graber and Nicole Sullivan for the remainder of their time at TTU. This staffing pattern is on a trial basis and will be re-examined after six months to determine if the needs of all parties are being effectively and efficiently met.

More specific details of these and additional accomplishments are described below under each of the four communication and outreach tasks.

6.1 *Increase awareness, knowledge, and adoption of appropriate technologies among producers and related stakeholder towards the development of a true community of practice with water conservation as the major driving force.*

6.1a — Accomplishments

Farmer Field Day #1 (August 4, 2011)

The majority of time and resources spent this past year were on planning and implementation of the TAWC farmer field days and workshops. For the first time in four years, the locations were expanded beyond the immediate project area. The first event of the year was conducted on Tuesday, August 4, 2011 and centered on sharing with the participants the activities of the second phase of the TAWC project—the Demonstration Phase. Due to the drought, we focused on what results could be experienced by participants in this drought influenced growing season.

Planning activities prior to the event included development of the morning program, coordination of speakers, promotion of the event via various media channels, facilitates and refreshments including a catered lunch, and securing CEUs for participants. As such, the final schedule topics included: (a) managing within a changing water management environment, (b) the latest on water efficient crop varieties, (c) impacts of sprinkler head choice and integrating variable-rate technologies into your management plan, (d) update on water management technology in the TAWC project, and (e) what's next in water management decision tools. Senator Robert Duncan closed the session with a look forward about water use in Texas.

The field day achieved a 31% increase in attendance from the previous field day (Feb. 24, 2011). However, this was a 9% decrease from the previous summer field day (Aug. 3, 2010) when 121 attended the event. A survey was conducted of the participants to determine their satisfaction with the event as gather their thoughts for upcoming events. Based on post-workshop evaluation results submitted by 53 of the participants, attendees were very satisfied with all aspects of the program.

Farmer Field Day #2 & #3 (February 2012)

Two additional TAWC Farmer field days were conducted outside the project area on February 14, 2012, at the Bailey County Electric Co-op in Muleshoe, Texas, and February 24, 2012, at the South Plains College Sundown Room in Levelland, Texas. Planning activities included promotion of the events through radio advertisements, "save the date" cards, mail outs, press releases, email and social media. Additional effort was put forth towards the development of the morning program and coordination of speakers, facilitates and refreshments for the field days which included coffee and donuts, as well as a catered lunch. Nearly 60 farmers and industry professionals attended the two events. The February 24 field day was also broadcast by KFLP All Ag, All Day Radio.

Informational Items Created & Disseminated

With TAWC project in the demonstration phase, work continued on the next phase of the communication strategy that will expand the reach of the project information through new and traditional broadcast technologies. One effort pilot during a 12-month period was the development and airing of eight monthly televised segments related to the project. Under a one-year sub-contract, these segments were filmed by Fox 34 TV and played on their *AgDay Lubbock* television show. Each segments includes multiple interviews. After each segment is completed, the footage is given to the TAWC project for subsequent social media use. This pilot concluded in August 2011 and was not renewed as challenges in scheduling the recording of the segments continue through the duration of the pilot year.

New materials were created for use in the TAWC booth including a "save the date" card for the 2012 field days and a single water drop-shaped card listing the project website, Facebook, YouTube and Twitter account addresses. In addition, two pull-up displays were created for the booth to highlight the two decision-making tools (*a more portable display that can be used without renting booth space*). A beta version of a new web-based water management guide for producers—a collaboration with several of the Texas commodity groups—was created and on display during the farm shows for producer review and feedback. The full rollout of this new web-based tool is expected by July 2012.

Presentations and Project Promotions

Dr. David Doerfert and graduate assistants Lindsay Graber and Nicole Sullivan staffed an information booth at the 2011 Texas Gin Association meeting March 31 – April 2, 2011. Project descriptions and summaries of research were distributed to 3,000 attendees.

Dr. David Doerfert, Samantha Borgstedt and graduate assistants Lindsay Graber and Nichole Sullivan staffed an information booth at the 2011 Amarillo Farm & Ranch Show November 29 - December 1, 2011. Project descriptions and summaries of research were distributed to attendees. Approximately 150 "save the date" card were also distributed for the February 2012 TAWC workshops.

Samantha Borgstedt and graduate assistants Lindsay Graber and Nichole Sullivan staffed an information booth at a Channel Bio Producer Meeting in Amarillo, Texas, on December 13, 2011. Approximately 20 "save the date" cards were distributed for the 2012 field day. Project materials were also shared and attendees were able to view the TAWC online tools and water management guide.

Dr. David Doerfert and Samantha Borgstedt appeared on Fox 950 am radio on Tuesday, January 17th to share latest project activities including information related to the two February field days.

Samantha Borgstedt and Nicole Sullivan staffed an information booth at the 2012 Lubbock Farm & Ranch Show February 7-9, 2012. Project materials were distributed to attendees and the TAWC tools and water management guide were shared. Approximately 30 "save the date" cards were also distributed for the 2012 field day.

6.2 ***Project communication campaign planning, implementation, and related research activities.***

As the communications and outreach activities move from the initial efforts to create awareness of the TAWC project and the launch of a community of practice to activities that will facilitate the adoption of the research results and best practices produced in the previous years, additional communication planning and research activities were conducted to achieve the desired future outcomes. The items that were accomplished are listed below.

6.2a — Accomplishments: Communications Planning.

As described earlier in the *Informational Items Created & Disseminated* section, the communications plan has moved into it next phase. This phase is designed to expand the awareness of the TAWC project and the use of its information and tools beyond the West Texas Region through the use of traditional (TV) and emerging broadcast channels including social media technologies.

Photo documentation of the individual field sites continued with five visits during 2011. These photographs were used in the preparation of a variety of information resources as a visual indicator of the project activities and results. Additional project photos were taken during tours of the project sites and at various related events including the farmer field days.

Finally, a clipping service was continued to help the project monitor the extent and type of print media coverage on the TAWC project. An initial content analysis illustrated that there is very little in the extent of coverage related to water with the majority of the news content focused on urban water use. However, coverage expanded in 2011 to include news related to the potential changes in water policy through local water districts.

6.2b — Accomplishments: Research.

Dr. David Doerfert met with representatives from seven universities in Dallas on November 18-20, 2011 to begin efforts that would secure funding to expand the social science research efforts of the TAWC project. Discussions included adding social science decision-making data sharing to respective projects to add a collaborative element.
Four project-related papers and one research poster were shared at the 47th annual American Water Resources Association (AWRA) conference in Albuquerque, NM November 6-10, 2011 (http://www.awra.org/meetings/ABQ2011/).

- *The Use of Communication Channels Including Social Media Technologies by Agricultural Producers and Stakeholders in the State of Texas* by Lindsay Graber and David Doerfert
- *What We Know About Disseminating Water Management Information to Various Stakeholders* by David Doerfert, Courtney Meyers, Erica Irlbeck, and Cindy Akers
- *The Water Management and Conservation Instructional Needs of Texas Agriculture Science Teachers* by Nichole Sullivan and David Doerfert
- *The Attitudes and Opinions of Agricultural Producers Toward Sustainable Agriculture on the High Plains of Texas* by Courtney Meyers, David Doerfert, Caitlyn Frederick, and Jon Ulmer
- *The Issues That Matter Most to Agricultural Stakeholders: A Framework for Future Research* by Nichole Sullivan, David Doerfert, Courtney Meyers, Erica Irlbeck, and Cindy Akers (research poster presentation)
-

Lindsay Graber successfully completed her thesis titled *Traditional And Social Media Use By Texas Agricultural Producers*. The following is the abstract for her study. The results will be disseminated through research channels and have been shared with three groups. The results will also be used to shape future project communication activities.

> *The increasing pace of advancements in agriculture and communication technology have created a significant need for the industry to continue to effectively communicate agriculture and issues to the public. Social media and networking websites are becoming the most popular forms of inter-personal communication available today. However, little is known of the extent that social media is being used by agriculture stakeholders in the state. The purpose of this study was to understand the current use of traditional and social media by Texas agricultural stakeholders and producers. A random sample was used to survey 3,000 farmers collecting quantitative data related to communication technology use and the extent of trust extended to the sources as they use the various communication technologies to disseminate information. The data analysis process used a set of complementary processes of coding data, categorizing data, and writing informal analytical memos about the data and the resulting categories by each of the researchers. Results of the coding for each stakeholder group were examined into coding families. In this final data analysis step, the researchers examined the results of the stakeholder groups to*

identify similarities and differences between the groups. Results indicated that some agricultural producers and stakeholders in Texas have adopted social media, or are in the process of adopting social media. Producers and stakeholders identified specific communication channels that are predominantly utilized for agricultural news. Reasons for use of social media were identified, while factors of trust in the media were revealed. The results will facilitate the development of communications plans including guidance on the incorporation social media.

Dr. David Doerfert led the TAWC team plus additional researchers in the development of a proposal submitted to the USDA AFRI Food Security initiative for funding consideration on February 15th. The five-year project requested $4,271,502 to develop crop/soil and pasture/beef cattle production models that would enhance farmer decision-making tools. Additional funds were also requested for detailed social science research and enhanced outreach efforts. At the time of this report this proposal request is still pending.

6.3 ***Creation of longitudinal education efforts that include, but are not limited to, Farmer Field Schools and curriculum materials.***

6.3 — Accomplishments.

Building on the thesis research completed by Lindsay Graber, plans are being made to increase the use of social media technologies in promoting the project and water conservation by producers.

6.3.1 ***It is the responsibility of the leader for this activity to submit data and reports as required to provide quarterly and annual reports to the TWDB and to ensure progress of the project.***

6.4 — Accomplishments.

- Timely quarterly reports and project summaries were provided as requested.

TASK 7: INITIAL FARMER/PRODUCER ASSESSMENT OF OPERATIONS

Dr. Calvin Trostle

Support to Producers.

Visited with nine producers during 2011 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 in 2011 centered on small grains for forage and split pivot irrigation scenarios 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 and what to do.

Field Demonstrations.

A) Lockney & Brownfield Range Grass & Irrigation Trials

See report below.

B) Wheat Grain Variety Trial

A variety trial was completed on the R.N. Hopper Farm within the TAWC demonstration area (southwest of Lockney). The trial was heavily affected by drought, and yields were more like typical dryland. This 5/8 mile pivot has been chosen for CIG demonstration work starting in 2012.

Opportunities to Expand TAWC Objectives

Project awareness: Commented on project on five different radio programs, answered producers 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 2 county Extension meetings covering the TAWC demonstration area in 2011. These included the Hale Co. and the Southwest Farm & Ranch Classic in Lubbock in February.

Existing TCE publications and reports were provided in the TAWC target area to at least 11 producers.

Support to Overall Project.

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

Report A
Perennial Grasses for the Texas South Plains: Species Productivity & Irrigation Response (*Supplemental Project not funded through TAWC funding*)

Project conducted at: Eddie Teeter Farm, Lockney, Texas (seeded April 2006)
Mike Timmons Farm, Brownfield, Texas (initial seeding, June 2008; overseeded, May 2009)

Project Overview

Beginning in 2005 the Texas Alliance for Water Conservation (TAWC) participants frequently discussed the slow but steady trend of producers converting cropland back into permanent grassland. Since then, due to expiring Conservation Reserve Program (CRP) contracts, a significant portion of land is being plowed up though in many cases the mix of grass, especially if weeping lovegrass, is the reason for this as these grasses are viewed as not productive in a grazing program or perhaps difficult to manage. Nevertheless, there remains the opportunity for some of this land where row cropping is problematic, that producers and landowners could very well seek to irrigate perennial grasses if that would be a more efficient and profitable use of groundwater resources. The Lockney trial site was initiated in 2006, and a second site was initiated in Terry Co. in 2008 (and overseeded in 2009) as an outreach of the TAWC project into surrounding areas. The Ogallala Aquifer Project (OAP) began partnering with the current project in 2009 to supplement support for the project in fulfilling OAP goals in the region.

As noted in previous reports the primary objective is to determine which perennial grass species and varieties are adapted to the region and productive under conditions ranging from dryland to ~1” irrigation per week (late-April to early October). Two of the four years since this project was initiated have had high rainfall through August hence irrigation levels have been less than expected, and furthermore, we are only able to irrigate when irrigation is occurring on the adjacent pivot, thus sharing water.

Lockney Site (*not included in numbered project sites*)

Record drought in 2011. This was the bottom line for all of the region. Beginning in January when deep soil moisture might be accumulated then through the growing season (end of October) 4.2” of rain was received of which 2.0 was received in October with minimal effect on growth (Table 1). Three supplemental irrigations were applied of 3” and 6” but irrigation was limited due to the limited pumping that occurred on the adjacent center pivot, which must be running in order to irrigate.

Yield data for 2011 is listed in Table 2. There was no harvest on the dryland, and due to minimal growth on the low and moderate irrigation levels, a season ending yield harvest was collected in December.

With limited results for 2011 we still get a window on perennial species performance in severe conditions. Multiyear averages are not updated due to no yield or low yield where irrigated. So what species were "tough" in the 2011? Historically, with irrigation and dryland we have seen since 2007 the old world bluestems and Alamo switchgrass yield at the top, 1.5X and more the yields of the native species of blue grama, sideoats grams, and the native NRCS blend (and Alamo yielding 2X of the natives). In a drought year these native species yielded 1,243 to 1,834 (blue grama) lbs./A whereas the OWB species yielded ,1,049 to 1,350 (Caucasian) lbs./A at the moderate (6") irrigation level. Alamo switchgrass, however, still yielded the highest at 2,263 lbs. of dry forage per acre. Bermudagrass, sprigged or seeded, did not handle the drought as well, and buffalograss, which is perhaps the most drought tolerant of all the grasses yielded low at 494 lbs./A. This one year of drought is not a final view on these species, however, we suggest that the long-term yield potential of the old world bluestems still make these species a better fit for yield over years compared to the native species.

Yields and regrowth ratings of these grasses will be of particular interest, especially in 2012 on the dryland, to evaluate regrowth and recovery.

Table 28. Rainfall and irrigation levels on perennial grass trial, Lockney, TX, 2011.

2011 Lockney Rainfall Month	Monthly Rainfall (inches)	Cumulative 2011 Total (inches)	Irrigation Levels (inches)		
			Level 0	Level 1	Level 2
January	0.1	0.1	D		
February	0.3	0.4	R		
March	0.6	1.0	Y		
April	0.0	1.0	L		
May	0.3	1.3	A		
June	0.0	1.3	N	1.0	2.0
July	0.3	1.6	D	1.0	2.0
August	0.0	1.6	"	1.0	2.0
September	0.6	2.2	"		
October	2.0	4.2	"		
November	0.5	4.7			
December	1.3	6.0			

Table 29. Perennial grass trial yield results for 2011, Lockney, Texas. Exceptional drought curtailed growth (no dryland harvest) and availability of irrigation. Trial established in 2006.

Perennial Grass Species	Variety	Irrigation Level^	Avg. Yield @ Target Irrigation (dry matter, Lbs./A) 12/14/11
Buffalograss	Plains	0	No data
		1	388
		2	494
Sideoats Grama	Haskell	0	No data
		1	805
		2	1,243
Blue Grama	Hatchita	0	No data
		1	1,568
		2	1,834
NRCS Natives Blend	3 Grasses‡	0	No data
		1	1,226
		2	1,623
Switchgrass	Alamo	0	No data
		1	1,200
		2	2,263
Kleingrass	Selection 75	0	No data
		1	985
		2	1,150
Old World Bluestem	Spar	0	No data
		1	573
		2	1,049
Old World Bluestem	WW-B Dahl§	0	No data
		1	760
		2	1,218
Old World Bluestem	Caucasian	0	No data
		1	1,717
		2	1,350
Indiangrass	Cheyenne	0	No data
		1	682
		2	727
Bermudagrass	Ozark sprigged	0	No data
		1	517
		2	723
Bermudagrass	Giant/Common (1:1 ratio,) seeded¶	0	No data
		1	739
		2	1,105
	Trial Averages	**0**	**No Data**
		1	**930**
		2	**1,231**

Table 29. Continued

Rainfall (inches)	4.2
Irrigation, dryland/low/moderate (inches)	0/3.0/6.0
Total Moisture (inches)	4.2/7.2/10.2

P-Value (Variety)	<0.0001
P-Value (Irrigation)	0.0024
P-Value (Variety X Irrigation)	0.0010
Fisher's Least Signif. Diff. (0.05)--Variety¤	464
Fisher's Least Signif. Diff. (0.05)--Irrigation¤	189
Coefficient of Variation, CV (%)	55.3

^Dryland, low, and moderate target irrigation levels.

‡50% Hatchita, 40% Haskell, 10% green sprangletop (NRCS blend for Floyd Co.).

¤Values in the same column that differ by more than PLSD are not statistically/significantly different at 95% confidence level.

Terry Co. Grass Species Test

A TAWC prime area of interest in perennial grasses and the potential to convert irrigated agriculture back to dryland centered on the highly sandy soils of the southwest South Plains. This trial site was initiated on a sandy loam/loamy sand soil near Brownfield in 2008. Weeds remain a limitation at the site. In addition, irrigation is no longer available to the test, so the trial will be converted to dryland, but due to the drought in 2011 there was little to no measureable growth. The site largely remained dormant. The site will continued to be hoed and use spot sprays to check the weeds. Seeded Bermudagrass was to have been added to the site in 2011, but due to the drought this was not completed and will be attempted again in 2012.

Report B

Irrigated Wheat Grain Variety Trial Results, Floyd Co., Texas, 2011 *(not included in numbered project sites)*

Irrigated grain trials for wheat were added in the fall of 2008 in Floyd Co. to represent the eastern South Plains. Duplicate tests occur in Yoakum, Castro, and other counties in the Texas Panhandle. Due to lack of rainfall, this trial's irrigation level places it comparable to dryland yields. The trial received ~6" of irrigation.

The Floyd Co. trial was seeded Oct. 29, then irrigated to a stand on Nov. 3 (initial irrigation for germination Nov. 11) at the R.N Hopper farm at a seeding rate of 1.1 million seeds/acre (on average about 70 lbs./A; this means that pounds per acre varied depending on the seed size). The test was seeded on no-till ground at ½ to 1". The test was harvested July 1, a delay due to needed repairs to the harvest equipment.

Trial results: Trial results statistically noted that there were differences among varieties, however, a measure of variability (coefficient of variation) notes that the results had a relatively high variability among varietal yields (CV, 24.1%; we like to have tests under 15%, and tests are usually discarded if %CV > 20%). The high CV, however, is due in great part because of the range of yields, from 12.9 to 30.5 bu/A.

1) The seven varieties that were currently recommended from Texas AgriLife for irrigated wheat yielded 25.6 bu/A (TAM 111, 112, 304; Hatcher, Endurance, Duster, Bill Brown), compared the rest of the trial averaging 23.7 bu/A. Two additional varieties that yielded well, which I believe will soon be added to the recommended varieties list are TAM 113 (similar to TAM 111 but better disease resistance) and Winterhawk, which has performed well in dryland trials.

2) In spite of drought conditions, test weights were good averaging 59.0 lbs./bu.

3) Texas AgriLife Extension Service agronomy in Lubbock has begun testing of Clearfield herbicide tolerant varieties in the South Plains and southwest Panhandle. Data to this point suggests that Bond CL from Colorado State may have comparable yield to typical varieties in the region.

4) Planting seed quality parameters are measured for the wheat that was drilled in the test, which was drilled for a target seed number of 1.1 million seeds per acre. This trial averaged 75 lbs./A (15,000 seeds/lb.), but the range of seed size was vast, from 11,600 seeds per lb. (large seed, 95 lbs./A) to small seed of 19,600 (small seed, 56 lbs./A). When producers plant by pounds per acre, if small seed has good germination, then seeding rates could be reduced. On the other hand, large seed would necessitate increasing seeding rates.

5) Stand ratings are normally taken ~1 month after drilling to evaluate vigor and stand (this year this observation was not recorded due to late emergence of the wheat). No varieties demonstrated exceptional ground cover.

For further info. on recent Texas High Plains wheat variety trials, consult the multi-year irrigated and dryland summary at http://varietytesting.tamu.edu as well as Extension's list of recommended varieties at http://amarillo.tamu.edu/ (find under 'Agronomy' then 'Wheat') or contact your local county/IPM Extension staff or Calvin Trostle.

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

Dr. Vivien Allen
Philip Brown
Song Cui
Cody Zilverberg

Descriptions of sites that include livestock

Of the 29 sites in the demonstration project in 2011, only 3 included livestock. Site 5, that had been an all forage-cow/calf system from the beginning of the project was converted to a cotton/fallow system (Table 24). Sites 9 and 10, integrated crop/livestock systems from the beginning of the project, remained in these systems. Site 17 entered the project in year 3 and has remained as an integrated crop/livestock system. When the project began in 2005, it included 3 integrated crop/livestock systems and the one all forage-cow/calf system. In year 7, this remained constant with the exception of the change in Site 5 from the cow/calf system. Thus, the total number of sites including livestock has remained relatively stable since 2005 (Fig. 12) but with the change in Site 5, the total number of acres devoted to livestock and forages declined in 2011 (Fig. 11). Other individual sites have moved in and out of livestock production during the 7 years of the project. Site 10 have had cow-calf production consistently from the beginning (2005). The drought of 2011 impacted cattle numbers as growth of forages declined and then became dormant. Cattle numbers were reduced and additional supplementation was required for remaining livestock.

In 2001, only site 9 achieved the target of using less than 15 inches total irrigation water. In 2010, Site 9 was within the target of using less than 15 inches of irrigation water while maintaining a minimum of $300 gross margin per system acre and also achieved the target of using less than 10 inches of irrigation water while maintaining at least $200 gross margin per system acre. In the extreme drought year of 2011, Site 9 was the only site in the project that achieved the goal of using less than 10 inches of irrigation water while maintaining a minimum of $200 gross margin per system acre (Fig 17).

All sites with cattle in 2011 included perennial grasses, contract grazing, and cotton production and all three were irrigated by center pivot systems.

Site 9. This system is a two-paddock integrated crop/livestock system that in 2011, included stocker cattle that grazed perennial forages, primarily Kleingrass that also includes buffalograss, blue grama, and some annual forbs. The second field was used for cotton production in 2011 with cotton planted on 40-inch centers. This site had been a no-till system for numerous years until 2011 when it was returned to conventional tillage. Irrigation used on this site has remained at 10 inches or below during the entire life of this project. The drought of 2011 did not increase irrigation above this level. In fact, gross margin in 2011 was the third highest observed during the 7 years of the project.

Site 10. This four-field system originally included 2 fields of WW-B. Dahl old world bluestem, and 1 field bermudagrass for grazing cows and calves. The fourth field was used for cropping. The system provides a small part of the summer grazing required for registered SimmiAngus and ChiAngus cow-calf herds. Different parts of the herd are moved on and off the system as needed, and it generally provides a place for grazing of pairs and calving of older cows. If grazing is not needed, hay is harvested. Although both hay and a seed crop from the old world bluestem have been harvested in previous years, in 2010 neither hay nor grass seed were harvested. Due to the continual movement of cattle on and off the site, livestock income is calculated as contract grazing based on grazing days.

By 2011, both fields of Dahl had been converted to cropping and livestock grazed bermudagrass only. While corn had been the crop planted in 2010, all three fields were planted to cotton in 2011. Irrigation applied to this system was about double that applied in any previous year.

Site 17. This 3-paddock system is a cross-bred cow-calf system and is calculated as contract grazing because of movement on and off the system. Excess forage from WW-B. Dahl on field 1 and 2 is harvested as hay in some years but not in 2010. Fields 1 and 2 provide the majority of the grazing for the cows and calves. These cattle also graze forages off site generally in fall through mid-winter when grazing crop residues. Cattle are supplemented in winter with cotton burrs and hay harvested from the site. The third field (Field 3) in this system was planted to cotton in 2011.

In 2011, all cattle were sold because of the drought. At about 20 inches of irrigation water, this system required more irrigation than in any previous year of the project.

Grants and proposals

A USDA-SARE grant was submitted in 2010 and funded ($300,000 over 3 years) in 2011 to support the long-term, ongoing basic research on integrated crop and livestock systems at the New Deal research site. The intent of the funding agency is to continue this grant beyond 3 years pending availability of funds. This grant contributes directly to the TAWC project through our ability to test hypotheses and answer researchable questions in a replicated research setting. Ongoing research on water use, profitability, and variables potentially contributing to climate change are being tested at both the New Deal research site and within the TAWC project. This provides an unusually robust data set from which to draw conclusions.

The $200,000 USDA-LTAR program for 'Proof of Concept' for research on carbon cycling project was completed and a final report submitted. A copy of this report is attached to the end of this Task Report. Much data for this project was generated within selected TAWC sites and contributes to our understanding of carbon sequestration, microbial relationships to carbon and other greenhouse gas emissions, and effects of different systems on these mechanisms. Several manuscripts are already published or are being written for publication. This research also formed the basis for several graduate students Thesis and Dissertations.

Graduate Student Research in Integrated Crop/Forage/Livestock Systems

Song Cui has completed his PhD research on legumes that have potential for west Texas that would not increase water demands over the associated grasses. He graduated in August, 2011. Results of his research with yellow sweetclover, sainfoin, and alfalfa have now been incorporated into grazing systems research and have potential to reduce nitrogen fertilizer requirements without increasing irrigation demand. The initial paper from this research has been accepted by the Crop Science Society of American for publication in Crop Science. Two other manuscripts are in progress and will be submitted to Crop Science.

Cody Zilverberg's Ph.D. research development of methods to assess the energy inputs into forage/livestock systems. A publication entitled Energy and Carbon Costs of Selected Cow-Calf Systems has been published in the Journal of Rangeland Ecology and Management. Cody will graduate in May, 2012. At least four additional manuscripts are in preparation for publication from his Ph.D. research.

Changes in Personnel:

Dr. Vivien G. Allen retired effective September 1, 2011 but will continue to play an active role in the project post retirement for a short while to provide transition to the next Thornton Distinguished Chair and to complete graduate students, manuscripts, and to assist with ongoing grants. Dr. Charles West, University of Arkansas, has accepted the position of Thornton Distinguished Chair and beginning in late 2012 will provide the leadership to this position. We are fortunate to attract Dr. West to this position.

U.S. Department of Agriculture
Accomplishments Report AD-421
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1. Accession	Agency Identification No.	5. Work Unit/Project No.
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7. Title

The Texas High Plains: a Candidate Site for Long-Term Agroecosystem Research and Education

12. Investigator Name(s) (Last Name and Intitials)

Allen, V. G.; Maas, S. J.; Doerfert, D.; Kellison, R. L.

20. Termination Date 12/14/2011	40. Period Covered (mo/da/year): 12/15/2009 to 12/14/2011

Outputs (Final Report):

Sites were developed, data collected, and results disseminated to achieve project goals to study dynamics of C cycling and C sequestration in water limited environments. Two field research sites, established in Floyd County, TX, collected environmental and geochemical data to compare C sequestration and C and water balance characteristics for two dissimilar cropping systems (continuous cotton and continuous pasture for grazing) selected to represent extremes in C sequestration. Sites were fully instrumented to measure all components of C, water and energy fluxes, and to quantify various components of soil C and spatial variability within fields. Biological measurements,(2 years, quantified vegetation biomass production, dead biomass accumulation on soil surfaces and, in pastures, removal of vegetative biomass by grazing cattle. Aircraft and satellite remote sensing imagery quantified distribution and variability of vegetative ground cover. Data analysis allowed comparisons of potential C sequestration within these systems. Studies at the TTU research farm evaluated cropping systems and land uses for potential to increase soil quality and enhance soil functioning compared to continuous cotton (Ct-Ct), including a mixture of grasses in the Conservation Reserve Program (CRP), a pasture monoculture and a cotton-winter wheat-corn rotation (Ct-W-Cr). Soil microbial communities were evaluated according to microbial biomass C (MBC) and N (MBN), fatty acid methyl ester (FAME) profiling, and molecular cloning techniques. Selected microbial, chemical and biochemical properties were studied (between year 7 and 10) under continuous cotton compared to an integrated cropping-livestock system that included cotton, forage, and Angus-cross-stocker beef steers. Measurements included production of greenhouse gases under the various cropping systems. Preliminary budgets for C and N cycling in three grazed systems ranging from non-irrigated (DRY), minimal (LOW), to moderate irrigation (MED) were examined. Forage (assumed 42% C) consumption by steers was estimated using animal live weights and NRC (1996) equations. Carbon and N retention by steers was estimated based on protein and fat content of gain using live weights and NRC (1996) equations. In the economics component, developed methods sorted operations into coherent subsets that otherwise seem homogeneous. Secondly, since sites that test multi-product systems require inter-annual plans that carry over from year to year, methods to predict single year adverse weather events were adapted to predict incidence of sequential adverse weather events in two or more years. For outreach objectives, a series of four focus groups were held across the Texas High Plains. Participants completed a general questionnaire before each session. The questionnaire included age, production status, area, and water conservation techniques of each participant. Additionally, attendees at the Southwest Council of Agribusiness annual meeting participated in a survey to collect demographic information of gender, age, ethnicity, education level, occupation, and if farming, the size of operation including acreage and number of head.

Outcomes/Impacts

The two years of the project (2010 and 2011) represented extremes in precipitation (mean 48 cm) in this region (2010; 62.2 cm; 2011, the driest year in the past century; 12.6 cm). Grazing removed about 300 g of live biomass m2. Prior to grazing, peak net C exchange (measured using eddy covariance) was around 23 micromoles C m2 per second. Following grazing, about 6 micromoles C m2 per second was measured. During 2010, pasture was a net sink for atmospheric carbon but in 2011, the pasture was a net source for carbon entering the atmosphere. For continuous cotton, peak net C exchange was around 18 micromoles C m2 per second in 2010. Around 970 g m2 of living biomass was produced by cotton by mid-August but little remained following harvest. At the New deal site, soil MBC was higher under alternative systems at depths of 0 to 5 cm (CRP > pasture = Ct-W-Cr > Ct-Ct), 5 to 10 cm (CRP =Ct-W-Cr > pasture > Ct-Ct), and 10 to 20 cm (CRP = pasture = Ct-W-Cr > Ct-Ct). Soil DNA concentration was correlated with key soil quality parameters such as microbial biomass ($r > 0.52$, $P < 0.05$), total C ($r = 0.372$, $P < 0.1$), and total N ($r = 0.449$, $P < 0.05$). Results showed increases in sensitive soil quality parameters under alternative management compared with cotton monoculture. Although pasture had been established for only 3 yr, similar activity levels of beta-glucosaminidase, arylsulfatase, and alkaline phosphatase were found in the CRP land (under a diverse mixture of grasses) and pasture (under a monoculture of Old World bluestem) at the 0- to 20-cm depth. The positive soil microbial responses detected under CRP land, pasture, and a Ct-W-Cr rotation compared with Ct-Ct are suggested to provide early indications of soil quality improvements attributed to reduced tillage, higher residue crops, and elimination of fallow periods for this semiarid region. As management intensity of three forage/livestock systems receiving different levels of irrigation water increased, quantity of C and N consumed and retained by steers also increased. The proportion of consumed C retained and C:N ratio varied as a result of variation in forage quality. Quantity of C and N exported from grazing systems via steers was relatively small compared with that in forage. We improved economic mixture models for better use in applied management for producers and developed a method to estimate incidence of protracted precipitation deficits that local managers and scientists can easily complete with already commonly available MCMC packages. Focus group studies revealed that selected agricultural producers face many complex and intertwined problems - water, legislation, policy, technology, production costs, markets, and outward expansion. Water was by far the most significant concern. Producers are conscious of the depleting water supply, related profitability and issues impacting their ability to succeed but are also concerned with how agriculture is viewed by others. Producers also consider agriculture is a great means of carbon sequestration.

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Participants

Vivien G. Allen, Paul Whitfield Horn Profess and Thornton Distinguished Chair (retired), has served as the project director. Dr. Allen, retired in September, 2011, has had responsibilities in forage management and forage/livestock systems with an emphasis on maximizing use of forages for animal production to enhance sustainability of the forage/livestock system, and integrating grazing animals into sustainable forage/livestock/cropping systems. Stephen Maas, Professor of Agricultural Microclimatology with joint appointment with Texas AgriLife Research, served as the coordinator of the soil, water, and climate aspects of this project. As a member of the faculty in the Department of Plant and Soil Science at Texas Tech, Dr. Maas is responsible for teaching graduate-level courses involving microclimatology, crop modeling, and remote sensing. He also conducts research under a joint appointment with the Texas AgriLife Research and as a visiting scientist at the USDA-ARS Plant Stress Laboratory on the Texas Tech campus at Lubbock, TX, where he specializes in the interactions of crop plants with their environment. David Doerfert, Department of Agricultural Education and Communications, has served as coordinator for the outreach and education component of the grant. Dr. David Doerfert's research includes evaluating alternative water policy and law and their acceptance by Texas; information delivery core and digital skills and mass media resources to support technology transfer; and an integrated approach to water conservation for agriculture in the Texas Southern High Plains. Rick Kellison, Director of the Texas Alliance for Water Conservation, has overall responsibilities for the two-county, 30-site producer demonstration of an array of systems monitored in real-time for water conservation and economic viability. Jennifer Moore-Kucera, Soil and Environmental Microbiology, led the research on soil microbiology and greenhouse gas emissions. Michael Farmer, Department of Agricultural and Applied Economics, led the economic component. Dr. Michael Farmer is an environmental economist working primarily on the issue of water allocation and its consequences on land use.

Target Audiences

The target audience first and foremost is the agricultural industry in west Texas and in similar, water-limited environments where irrigation has been key to production and historic cultivation techniques and practices have led to reduced soil organic matter and the release of carbon to the atmosphere. This group was targeted through the cooperative on-farm research approach where producers are full partners in research and through the focus groups. Additionally, on-farm field days, and dissemination of information though media outlets, industry involvement, and other methods were employed. Secondly, the target audience is the scientific and industry communities to share knowledge and collectively achieve goals for reducing emission of carbon and other greenhouse gasses while improving carbon sequestration in soils leading to improved soil health. Information was disseminated at scientific meetings and publications in major professional journals. A third target audience includes policy makers and government agencies to raise awareness and to provide scientifically based information on opportunities and strategies to achieve national and global objectives for environmental quality. Through the close involvement of policy makers on our advisory board, the involvement of State Agencies, and inclusion of elected officials in field days and in the producer demonstration project per se, we have raised the level of awareness of the information coming from this program. A fourth targeted audience is the public to increase the level of understanding of the role of agriculture in addressing public concerns for climate change and environmental quality. We target this audience through field days, press releases, information provided though radio, television, and local news outlets.

Project Modifications

The 2011 year in the Texas High Plains was the driest year in the past 100 years. Total annual precipitation was only 5.0 in (12.6 cm) and all agricultural systems were severely impacted. In some cases, no crop was planted and in other cases the crop was abandoned before harvest was even attempted. Lack of forages for grazing prevented livestock from even being introduced into research pastures while produces reduced herds or completely liquidated livestock. The effects of the drought changed opportunities for research as anticipated under years of greater precipitation. Drought is a common factor in this environment but the 2011 drought exceeded anything experienced previously in this region. The research was continued through 2011 but the kinds of measurements made and certain opportunities including planned grazing studies to measure carbon cycling in grazed pastures had to be redesigned or deferred. This research will continue as this region is committed to long-term systems studies to continue these types of investigations.

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

Jim Conkwright
Gerald Crenwelge

9.1 *Equipment Procurement & Installation*

- A new brand of flow meter was installed on many sites. The new meters read more dependably when sand and rust are in the irrigation water. They have performed well since installation. They have been calibrated and checked as needed to be sure they are recording the correct flow to the datalogger system.
- Repairs and replacement of datalogger equipment was done as needed.
- Plans are being made to equip one new pivot site into the project, equip an existing site with a separate datalogger, and remove equipment from a site that is being retired from the project.

9.2 *Data Collection and Processing*

- The datalogger information was monitored regularly to indicate malfunctioning equipment
- The datalogger data for 2010 was processed to include in the Annual Report. It included irrigation data, rainfall, and evapo-transpiration data.
- Rainfall data was collected monthly as a backup to the rainfall data collected by the datalogger system.
- Read soil moisture 61 times on sites with a neutron probe to capture a planting and a harvest soil moisture level.

Total Water Efficiency Summary

Table 30 gives the information relating to the irrigation efficiency. The values are based on using 100% of ET and 70% effectiveness for rainfall during the growing season because that is what has been used in the past Annual Reports. Recent discussions talk about using a lower value for ET. The ET Crop Water Demand was calculated using the TAWC's ET calculator tool for the available crops.

This year was an extremely dry year. Several crops were abandoned because of the lack of rainfall. The stress on crops was compounded by the fact that we had more significant days with high winds, high air temperature and very low humidity. Several crops were abandoned because the irrigation was not sufficient to establish a crop or to make a crop once it was established. In some instances, irrigation was applied for insurance purposes only. Therefore, more irrigation was applied than would have been performed by the producer in a more normal rainfall year.

The extreme weather conditions this year make an evaluation of water efficiency difficult. In most cases, the fields that had ample irrigation had to use a large amount of water to insure an adequate crop while those that did not have much irrigation did not use as much water. This difference was not a management difference but a water availability issue that is difficult to translate to an efficiency value.

Table 30. Total water efficiency (WUE) summary by various cropping and livestock systems in Hale and Floyd Counties (2011).

Year	System	Field	Crop	Harvest status	Application Method	Acres	Irrigation Applied (Inches per acre)	Total Crop Water (Inches per Acre)	ET Crop Water Demand (Inches per acre)	Total Water Potential Used (%)	Total Water Potential Water Demand Conserved (%)	Total Water Potential Use (inches per acre)	Total Irrigation Potentially Conserved (ac ft)	70% Rain in Growing Season
2011	2	1	cotton		SDI	41.3	24.5	26.9	26.8	100%	-0.37%	-0.1	-0.34	2.4
2011	2	2	fallowed	Fallow		19.6				N/A		N/A	N/A	
2011	3	1	cotton		MESA	61.5	11.1	13.5	25.8	52%	47.67%	12.3	63.04	2.4
2011	3	2	cotton	Abandoned	MESA	61.8	7.5	9.9	25.8	N/A	N/A	N/A	N/A	2.4
2011	4	1	hay		LEPA	13.3	18.9	21.3		N/A	N/A	N/A	N/A	2.4
2011	4	5	alfalfa		LEPA	16	44.1	47.3		N/A	N/A	N/A	N/A	3.2
2011	4	6	cotton		LEPA	79	23.3	25.3	24.2	105%	-4.55%	-1.1	-7.24	2
2011	4	1+7	wheat		LEPA	28	11.3	11.3		N/A	N/A	N/A	N/A	
2011	5	7	grass		Dryland	30	0	2.2		N/A	N/A	N/A	N/A	2.2
2011	5	8	grass		Dryland	32.3	0	0		N/A	N/A	N/A	N/A	
2011	5	9	grass		Dryland	18.8	0	0		N/A	N/A	N/A	N/A	
2011	5	10	grass		Dryland	16.9	0	0		N/A	N/A	N/A	N/A	
2011	5	11	grass		Dryland	35.3	0	0		N/A	N/A	N/A	N/A	
2011	5	12	fallowed		Dryland	139.8	0	0		N/A	N/A	N/A	N/A	
2011	5	13	cotton	Abandoned	LESA	347.8	5.2	5.2	24.4	N/A	N/A	N/A	N/A	
2011	6	5	cotton		LESA	32.3	21.7	23.9	26	92%	8.08%	2.1	5.65	2.2
2011	6	6	cotton		LESA	29.9	20.3	22.5	26	87%	13.46%	3.5	8.72	2.2
2011	6	7	cotton		LESA	30.7	20.7	22.9	26	88%	11.92%	3.1	7.93	2.2
2011	6	8	corn	Abandoned	LESA	29.9	12.8	12.8	41.7	31%	69.30%	28.9	72.01	
2011	7	1	sideoats		LESA	130	20.5	22.3		N/A	N/A	N/A	N/A	1.8
2011	8	1	sideoats		SDI	27.6	24.1	25.9		N/A	N/A	N/A	N/A	1.8
2011	8	2	sideoats	Abandoned	SDI	19.3	11.1	12.9		N/A	N/A	N/A	N/A	1.8
2011	8	3	sideoats		SDI	7.1	24.1	25.9		N/A	N/A	N/A	N/A	1.8
2011	8	4	sideoats		SDI	7.8	24.1	25.9		N/A	N/A	N/A	N/A	1.8
2011	9	1	grass		MESA	100.8	3.5	3.5		N/A	N/A	N/A	N/A	
2011	9	2	cotton		MESA	137	12.1	13.9	24.4	57%	43.03%	10.5	119.88	1.8
2011	10	1	cotton		LESA	44.3	28	30.1	25.1	120%	-19.92%	-5	-18.46	2.1
2011	10	2	cotton		LESA	44.5	36.5	38.6	25.1	154%	-53.78%	-13.5	-50.06	2.1
2011	10	3	cotton		LESA	42.7	38.1	40.2	25.1	160%	-60.16%	-15.1	-53.73	2.1
2011	10	4	grass		LESA	42.1	17.1	17.1		N/A	N/A	N/A	N/A	
2011	11	1	cotton		Furrow	27.2	27.8	29.7	25.8	115%	-15.12%	-3.9	-8.84	1.9
2011	11	2	cotton		Furrow	24.4	27.8	29.7	25.8	115%	-15.12%	-3.9	-7.93	1.9
2011	11	3	cotton		Furrow	22.9	27.8	29.7	25.8	115%	-15.12%	-3.9	-7.44	1.9
2011	11	4	grain sorghum		Furrow	18	27.8	29.7	35.66	83%	16.71%	5.96	8.94	1.9
2011	12	1		Fallow	Dryland	151.2		0		N/A	N/A	N/A	N/A	
2011	12	2		Fallow	Dryland	132.7		0		N/A	N/A	N/A	N/A	
2011	14	2	cotton		MESA	61.8	17.8	20	26.9	74%	25.65%	6.9	35.54	2.2
2011	14	3	cotton		MESA	62.4	17.8	20	26.9	74%	25.65%	6.9	35.88	2.2
2011	15	8	corn		SDI	45.6	18.6	20.8	34.6	60%	39.88%	13.8	52.44	2.2
2011	15	9	cotton		SDI	57.2	20.2	22.2	25.7	86%	13.62%	3.5	16.68	2
2011	17	1	grass		MESA	53.6	11.7	11.7		N/A	N/A	N/A	N/A	

Year	System	Field	Crop	Harvest status	Application Method	Acres	Irrigation Applied (Inches per acre)	Total Crop Water (Inches per Acre)	ET Crop Water Demand (Inches per acre)	Total Water Potential Used (%)	Total Water Potential Water Demand Conserved (%)	Total Water Potential Use (inches per acre)	Total Irrigation Potentially Conserved (ac ft)	70% Rain in Growing Season
2011	17	3	cotton		MESA	108.9	20.7	23.1	26.9	86%	14.13%	3.8	34.49	2.4
2011	18	1			MESA	60.7	0	0		N/A	N/A	N/A		
2011	18	2	wheat	Abandoned	MESA	61.5	1.2	1.2		N/A	N/A	N/A	N/A	
2011	18	1+2	cotton	Abandoned	MESA	100	0.4	0.4	21.4	N/A	N/A	N/A	N/A	
2011	19	9	cotton	Abandoned	LEPA	59.2	13.8	13.8	24.4	N/A	N/A	N/A	N/A	
2011	19	10	cotton		LEPA	61.2	25.8	28	26.8	104%	-4.48%	-1.2	-6.12	2.2
2011	20	1	cotton		LEPA	117.6	38	40.2	24.4	165%	-64.75%	-15.8	-154.84	2.2
2011	20	1	triticale hay		LEPA	117.6	0	0		N/A	N/A	N/A	N/A	
2011	20	1	triticale silage		LEPA	117.6	24	25.2		N/A	N/A	N/A	N/A	1.2
2011	20	2	corn silage		LEPA	115.8	42	42.4	40.3	105%	-5.21%	-2.1	-20.27	0.4
2011	21	1	cotton		LEPA	61.4	21.4	23.2	26	89%	10.77%	2.8	14.33	1.8
2011	21	2	corn	Abandoned	LEPA	61.2	14.4	14.4	43.6	33%	66.97%	29.2	148.92	
2011	22	3	cotton		LEPA	148.7	25.2	27.3	28.6	95%	4.55%	1.3	16.11	2.1
2011	23	6	corn silage		LESA	121.1	22.3	23.6	45.1	52%	47.67%	21.5	216.97	1.3
2011	23	6	triticale silage		LESA	121.1	11.6	11.6		N/A	N/A	N/A	N/A	0
2011	24	1	corn		LESA	64.6	29.2	32	45.7	70%	29.98%	13.7	73.75	2.8
2011	24	2	cotton		LESA	65.1	23.9	26.7	25.4	105%	-5.12%	-1.3	-7.05	2.8
2011	26	1	cotton		LESA	62.9	11.2	13.4	25.8	52%	48.06%	12.4	65.00	2.2
2011	26	2	corn		LESA	62.3	22	22.8	44.6	51%	48.88%	21.8	113.18	0.8
2011	27	1	corn		SDI	46.2	40	40.4	45.5	89%	11.21%	5.1	19.64	0.4
2011	27	3	cotton		SDI	48.8	36	38.2	27	141%	-41.48%	-11.2	-45.55	2.2
2011	27	4	corn		SDI	13.5	40	40.4	45.5	89%	11.21%	5.1	5.74	0.4
2011	28	1	cotton		SDI	51.5	18.8	20.9	26.2	80%	20.23%	5.3	22.75	2.1
2011	29	1	cotton	Abandoned	Dryland	50.8	0	0	23.3	N/A	N/A	N/A	N/A	
2011	29	2	cotton	Abandoned	Dryland	104.3	0	0	23.3	N/A	N/A	N/A	N/A	
2011	29	3	cotton	Abandoned	Dryland	66.6	0	0	23.3	N/A	N/A	N/A	N/A	
2011	30	1	fallowed	Fallow	SDI	21.8	0	0		N/A	N/A	N/A	N/A	
2011	31	1	Pearl millet		LEPA	66.1	29.4	30		N/A	N/A	N/A	N/A	0.6
2011	31	2	cotton		LEPA	55.4	26.1	28.9	23.8	121%	-21.43%	-5.1	-23.55	2.8
2011	32	1	corn		LEPA	70	37	39.2	42.3	93%	7.33%	3.1	18.08	2.2
2011	33	1	corn	Abandoned	LEPA	70	12	12	42.4	28%	71.70%	30.4	177.33	

Water Use Efficiency Summary

Water use efficiency values are shown is the Water Use Efficiency table (Table 31). Data is presented where a neutron probe data was used to determine the beginning and ending of the growing season for the crop that was grown.

The extremely dry year in 2011 influenced the values greatly. In nearly every case, the soil moisture values declined significantly during the crop season, which was expected. In some cases, the significant rainfall that occurred in October occurred just before harvest when the crop could not use it or it occurred after harvest but before a harvest soil moisture values could be taken. If the readings would have been timelier, the difference would have been more drastic. The average soil moisture at planting was 6.3 inches and 2.4 inches at harvest. This demonstrates the limited irrigation available for crop production in 2011. The data also shows several sites that had a significant amount of irrigation applied but the crop was still abandoned before harvest.

In evaluating the results briefly, it is readily apparent that the LEPA and SDI type of irrigation is much more efficient than the other forms of irrigation this year. The values need to be evaluated in a more statistical method at a later time but the results clearly show that the yield per inch of irrigation is much more efficient.

Table 31. Water use efficiency (WUE) by various cropping and livestock systems in Hale and Floyd Counties (2011).

Year	System	Field	Crop	Harvest status	Application Method	Acres	Inches Soil Moisture at Planting (0-5 ft)	Inches Soil Moisture at Harvest (0-5 ft)	Soil Moisture Contribution to WUE	Irrigation Applied (Inches per acre)	Growing Season Rain (in)	Effective Rainfall (70% of Actual Rain)	Total Crop Water (Inches per Acre)	Yield (lbs/ac)	Yield Per Acre Inch Of Irrigation (lbs.)	Yield Per Acre Inch Of Total Water (lbs.)
2011	19	10	cotton		LEPA	61.2	10.8	2.6	8.2	25.8	3.1	2.2	36	954	37	26
2011	11	3	cotton		Furrow	22.9	9.8	3.7	6.1	27.8	2.7	1.9	36	433	16	12
2011	2	1	cotton		SDI	41.3	9.6	2.5	7.1	24.5	3.4	2.4	34	1234	50	36
2011	10	2	cotton		LESA	44.5	9.4	2	7.4	36.5	3.0	2.1	46	1833	50	40
2011	27	1	corn		SDI	46.2	9.3	2.7	6.6	40.0	0.6	0.4	47	44000	1100	936
2011	4	6	cotton		LEPA	79	9.2	4.1	5.1	23.3	2.9	2.0	30	1193	51	39
2011	21	1	cotton		LEPA	61.4	9	2.5	6.5	21.4	2.6	1.8	30	1248	58	42
2011	22	3	cotton		LEPA	148.7	8.7	2	6.7	25.2	3.0	2.1	34	1552	62	46
2011	15	9	cotton		SDI	57.2	8.1	2.9	5.2	20.2	2.9	2.0	27	2356	117	86
2011	24	2	cotton		LESA	65.1	8	2	6	23.9	4.0	2.8	33	1735	73	53
2011	27	3	cotton		SDI	48.8	7.7	1.8	5.9	36.0	3.1	2.2	44	1578	44	36
2011	14	2	cotton		MESA	61.8	7.6	0.8	6.8	17.8	3.1	2.2	27	491	28	18
2011	28	1	cotton		SDI	51.5	7.1	0.5	6.6	18.8	3.0	2.1	28	1017	54	37
2011	10	4	grass		LESA	42.1	6.3	0.7	5.6	17.1	0.0	0.0	23			
2011	20	2	corn silage		LEPA	115.8	6	5.4	0.6	42.0	0.6	0.4	43	44000	1048	1023
2011	20	1	triticale silage		LEPA	117.6	5.9	3.6	2.3	24.0	1.7	1.2	28	6000	250	218
2011	26	1	cotton		LESA	62.9	5.5	0.5	5	11.2	3.1	2.2	18	1372	123	75
2011	18	2	wheat	Abandoned	MESA	61.5	5.5	4.5	1	1.2	0.0	0.0	2	0		
2011	4	5	alfalfa		LEPA	16	5.4	4.3	1.1	44.1	4.6	3.2	48	21200	481	438
2011	15	8	corn		SDI	45.6	5.3	1.6	3.7	18.6	3.1	2.2	25	1597	86	65
2011	3	2	cotton	Abandoned	MESA	61.8	3.9	4.7	-0.8	7.5	3.4	2.4		0		
2011	8	4	sideoats		SDI	7.8	3.1	0.7	2.4	24.1	2.6	1.8	28	245	10	9
2011	12	1		Fallow	Dryland	151.2	2.9	2	0.9					0		
2011	9	2	cotton		MESA	137	2.7	0.9	1.8	12.1	2.6	1.8	16	460	38	29
2011	17	2	grass		MESA	58.3	1.7	1.7	0	17.1	0.0	0.0	17			
2011	5	13	cotton	Abandoned	LESA	347.8	1.7	4	-2.3	5.2	0.0	0.0	3	0		
2011	26	2	corn	0	LESA	62.3	1	0.6	0.4	22.0	1.1	0.8	23	4680	213	202

Irrigation Efficiency Summary

This summary (Table 32) highlights the irrigation efficiency aspects of this study. The "ET Provided to Crop From Irrigation" illustrated the very low percent of ET that irrigation provided this year on many of the crops this year. Again, the values are biased because of the extremely dry conditions this year and the fact that several fields were abandoned at some time during the growing season.

Because several fields were abandoned, this contributed to the savings in water use for the year since water was not used to grow the crop to harvest.

The potential irrigation conserved is represented in the last column.

Table 32. Irrigation Efficiency Summary by various cropping and livestock systems in Hale and Floyd Counties (2011).

Crop	Harvest status	Application Method	Acres	Irrigation Applied (Inches per acre)	Total Crop Water (Inches per Acre)	ET Crop Water Demand (Inches per acre)	ET Provided to Crop From Irrigation (%)	Potential Irrigation Conserved (%)	Potential Irrigation Conserved (Inches per acre)	Total Irrigation Potentially Conserved (ac ft)
cotton	0	SDI	41.3	24.5	26.9	26.8	0.9	0.1	2.3	7.9
fallowed	Fallow	0	19.6	0	0					
cotton	0	MESA	61.5	11.1	13.5	25.8	0.4	0.6	14.7	75.3
cotton	Abandoned	MESA	61.8	7.5	9.9	25.8	0.3	0.7	18.3	94.2
hay	0	LEPA	13.3	18.9	21.3					
alfalfa	0	LEPA	16	44.1	47.3					
cotton	0	LEPA	79	23.3	25.3	24.2	1.0	0.0	0.9	5.9
wheat	0	LEPA	28	11.3	11.3					
grass	0	Dryland	30	0	2.2					
grass	0	Dryland	32.3	0	0					
grass	0	Dryland	18.8	0	0					
grass	0	Dryland	16.9	0	0					
grass	0	Dryland	35.3	0	0					
fallowed	0	Dryland	139.8	0	0					
cotton	Abandoned	LESA	347.8	5.2	5.2	24.4	0.2	0.8	19.2	556.5
cotton	0	LESA	32.3	21.7	23.9	26.0	0.8	0.2	4.3	11.6
cotton	0	LESA	29.9	20.3	22.5	26.0	0.8	0.2	5.7	14.2
cotton	0	LESA	30.7	20.7	22.9	26.0	0.8	0.2	5.3	13.6
corn	Abandoned	LESA	29.9	12.8	12.8	41.7	0.3	0.7	28.9	72.0
sideoats	0	LESA	130	20.5	22.3					
sideoats	0	SDI	27.6	24.1	25.9					

Crop	Harvest status	Application Method	Acres	Irrigation Applied (Inches per acre)	Total Crop Water (Inches per Acre)	ET Crop Water Demand (Inches per acre)	ET Provided to Crop From Irrigation (%)	Potential Irrigation Conserved (%)	Potential Irrigation Conserved (Inches per acre)	Total Irrigation Potentially Conserved (ac ft)
sideoats	Abandoned	SDI	19.3	11.1	12.9					
sideoats	0	SDI	7.1	24.1	25.9					
sideoats	0	SDI	7.8	24.1	25.9					
grass	0	MESA	100.8	3.5	3.5					
cotton	0	MESA	137	12.1	13.9	24.4	0.5	0.5	12.3	140.4
cotton	0	LESA	44.3	28	30.1	25.1	1.1	-0.1	-2.9	-10.7
cotton	0	LESA	44.5	36.5	38.6	25.1	1.5	-0.5	-11.4	-42.3
cotton	0	LESA	42.7	38.1	40.2	25.1	1.5	-0.5	-13.0	-46.3
grass	0	LESA	42.1	17.1	17.1					
cotton	0	Furrow	27.2	27.8	29.7	25.8	1.1	-0.1	-2.0	-4.5
cotton	0	Furrow	24.4	27.8	29.7	25.8	1.1	-0.1	-2.0	-4.1
cotton	0	Furrow	22.9	27.8	29.7	25.8	1.1	-0.1	-2.0	-3.8
grain sorghum	0	Furrow	18	27.8	29.7	35.7	0.8	0.2	7.9	11.8
	Fallow	Dryland	151.2	0	0					
	Fallow	Dryland	132.7	0	0					
cotton	0	MESA	61.8	17.8	20	26.9	0.7	0.3	9.1	46.9
cotton	0	MESA	62.4	17.8	20	26.9	0.7	0.3	9.1	47.3
corn	0	SDI	45.6	18.6	20.8	34.6	0.5	0.5	16.0	60.8
cotton	0	SDI	57.2	20.2	22.2	25.7	0.8	0.2	5.5	26.2
grass	0	MESA	53.6	11.7	11.7					
grass	0	MESA	58.3	17.1	17.1					
cotton	0	MESA	108.9	20.7	23.1	26.9	0.8	0.2	6.2	56.3
	0	MESA	60.7	0	0					
wheat	Abandoned	MESA	61.5	1.2	1.2					
cotton	Abandoned	MESA	100	0.4	0.4	21.4	0.0	1.0	21.0	175.0
cotton	Abandoned	LEPA	59.2	13.8	13.8	24.4	0.6	0.4	10.6	52.3
cotton	0	LEPA	61.2	25.8	28	26.8	1.0	0.0	1.0	5.1
triticale hay	0	LEPA	117.6	0	0					
triticale silage	0	LEPA	117.6	24	25.2					
cotton	0	LEPA	117.6	38	40.2	24.4	1.6	-0.6	-13.6	-133.3
corn silage	0	LEPA	115.8	42	42.4	40.3	1.0	0.0	-1.7	-16.4
cotton	0	LEPA	61.4	21.4	23.2	26.0	0.8	0.2	4.6	23.5
corn	Abandoned	LEPA	61.2	14.4	14.4	43.6	0.3	0.7	29.2	148.9
cotton	0	LEPA	148.7	25.2	27.3	28.6	0.9	0.1	3.4	42.1
triticale silage	0	LESA	121.1	11.6	11.6					
corn silage	0	LESA	121.1	22.3	23.6	45.1	0.5	0.5	22.8	230.1

Crop	Harvest status	Application Method	Acres	Irrigation Applied (Inches per acre)	Total Crop Water (Inches per Acre)	ET Crop Water Demand (Inches per acre)	ET Provided to Crop From Irrigation (%)	Potential Irrigation Conserved (%)	Potential Irrigation Conserved (Inches per acre)	Total Irrigation Potentially Conserved (ac ft)
corn	0	LESA	64.6	29.2	32	45.7	0.6	0.4	16.5	88.8
cotton	0	LESA	65.1	23.9	26.7	25.4	0.9	0.1	1.5	8.1
cotton	0	LESA	62.9	11.2	13.4	25.8	0.4	0.6	14.6	76.5
corn	0	LESA	62.3	22	22.8	44.6	0.5	0.5	22.6	117.3
corn	0	SDI	46.2	40	40.4	45.5	0.9	0.1	5.5	21.2
cotton	0	SDI	48.8	36	38.2	27.0	1.3	-0.3	-9.0	-36.6
corn	0	SDI	13.5	40	40.4	45.5	0.9	0.1	5.5	6.2
cotton	0	SDI	51.5	18.8	20.9	26.2	0.7	0.3	7.4	31.8
cotton	Abandoned	Dryland	50.8	0	0	23.3	0.0	1.0	23.3	98.6
cotton	Abandoned	Dryland	104.3	0	0	23.3	0.0	1.0	23.3	202.5
cotton	Abandoned	Dryland	66.6	0	0	23.3	0.0	1.0	23.3	129.3
fallowed	Fallow	SDI	21.8	0	0					
Pearl millet	0	LEPA	66.1	29.4	30					
cotton	0	LEPA	55.4	26.1	28.9	23.8	1.1	-0.1	-2.3	-10.6
corn	0	LEPA	70	37	39.2	42.3	0.9	0.1	5.3	30.9
corn	Abandoned	LEPA	70	12	12	42.4	0.3	0.7	30.4	177.3

<u>Total irrigation potentially conserved totals 2,598 acre ft.**</u>**

http://www.tawcsolutions.org

TAWC SOLUTIONS:
MANAGEMENT TOOLS TO AID PRODUCERS IN CONSERVING WATER

Rick Kellison
Justin Weinheimer
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.

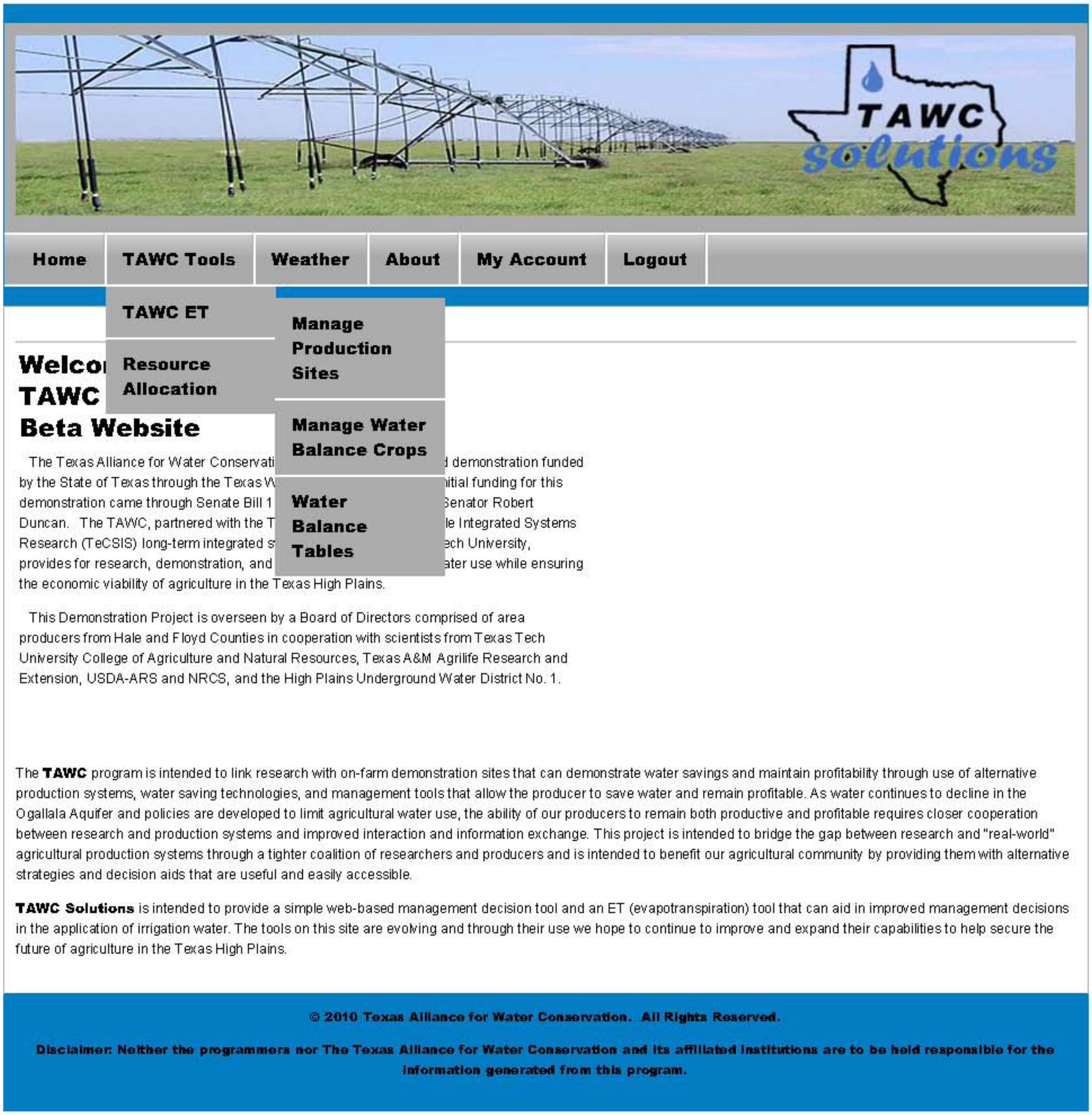
To utilize the **TAWC Solutions ET program** you must first create a User ID and Password by selecting **Request User ID/New Password** from the top of the TAWC Solutions homepage banner next to the logon prompts. Once this is completed, log into the site and place your mouse cursor over **TAWC Tools** 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…).

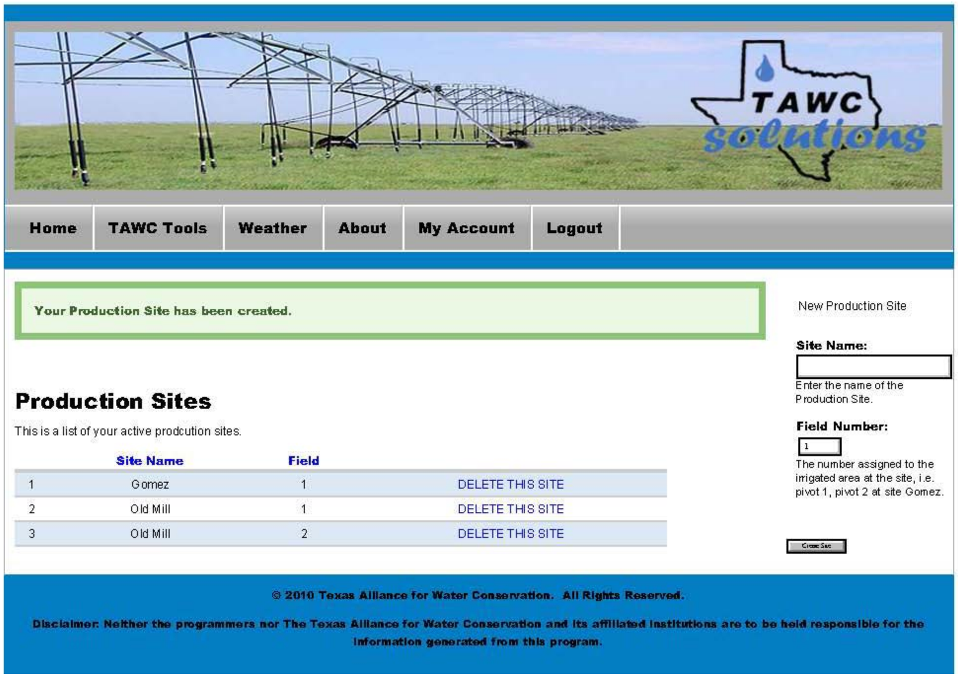
Illustrations and instructions for use of the program are presented on the following pages.

Screen 1



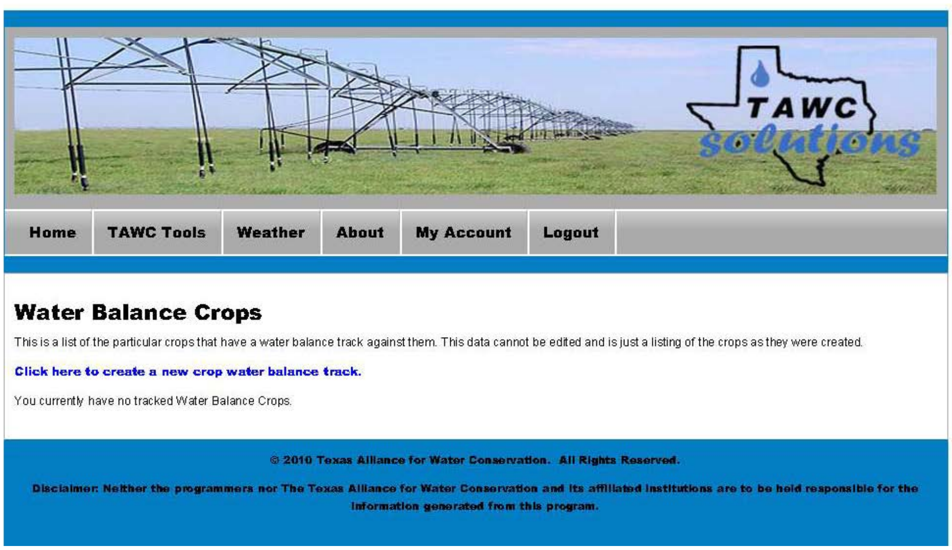
You will see a screen that states "There are no rows in this table." In the right column you have the option of entering a new site location name (ie. Gomez) in the box. Enter the desired name and irrigated field number (ie. pivot 1) and click "**Create Site".** You will then see a green confirmation 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



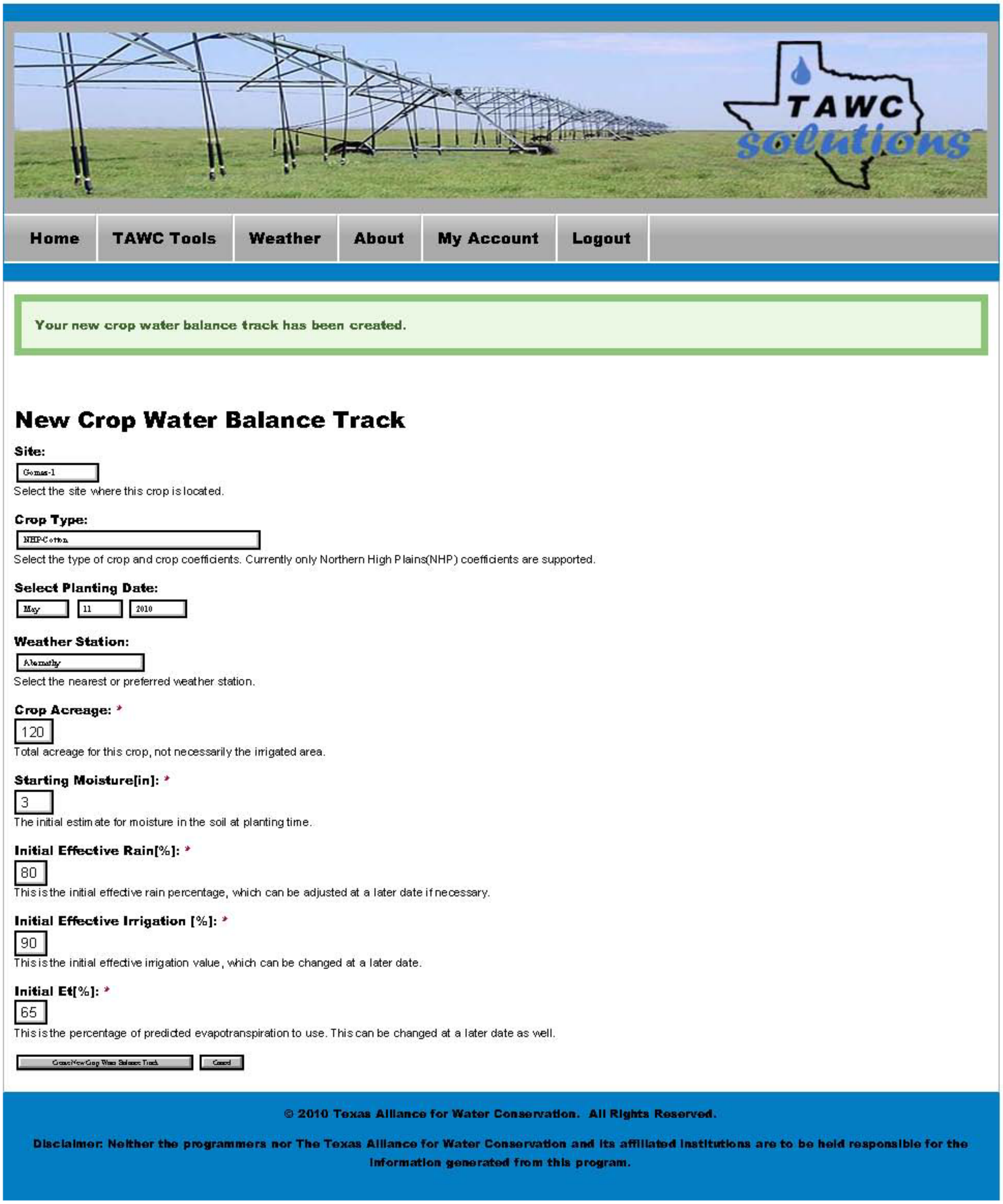
Return to **TAWC ET** on the navigation menu and select the next option "**Manage Water Balance Crops**", a new screen will appear with an option "Click here to create a new crop water balance track".

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 (ie. 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 (ie. 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 (ie. 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

Home | TAWC Tools | Weather | About | My Account | Logout

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 **1st Square, 1st Bloom, Max Bloom, 1st 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 which maximize per acre profits, whether at field or farm level. Utilizing information such as expected commodity prices, water availability, and enterprise options, irrigated agricultural producers can view cropping options which 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 utilize 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

Home | TAWC Tools | Weather | About | My Account | Logout

TAWC ET

Resource Allocation

Welcome to the TAWC Beta Website

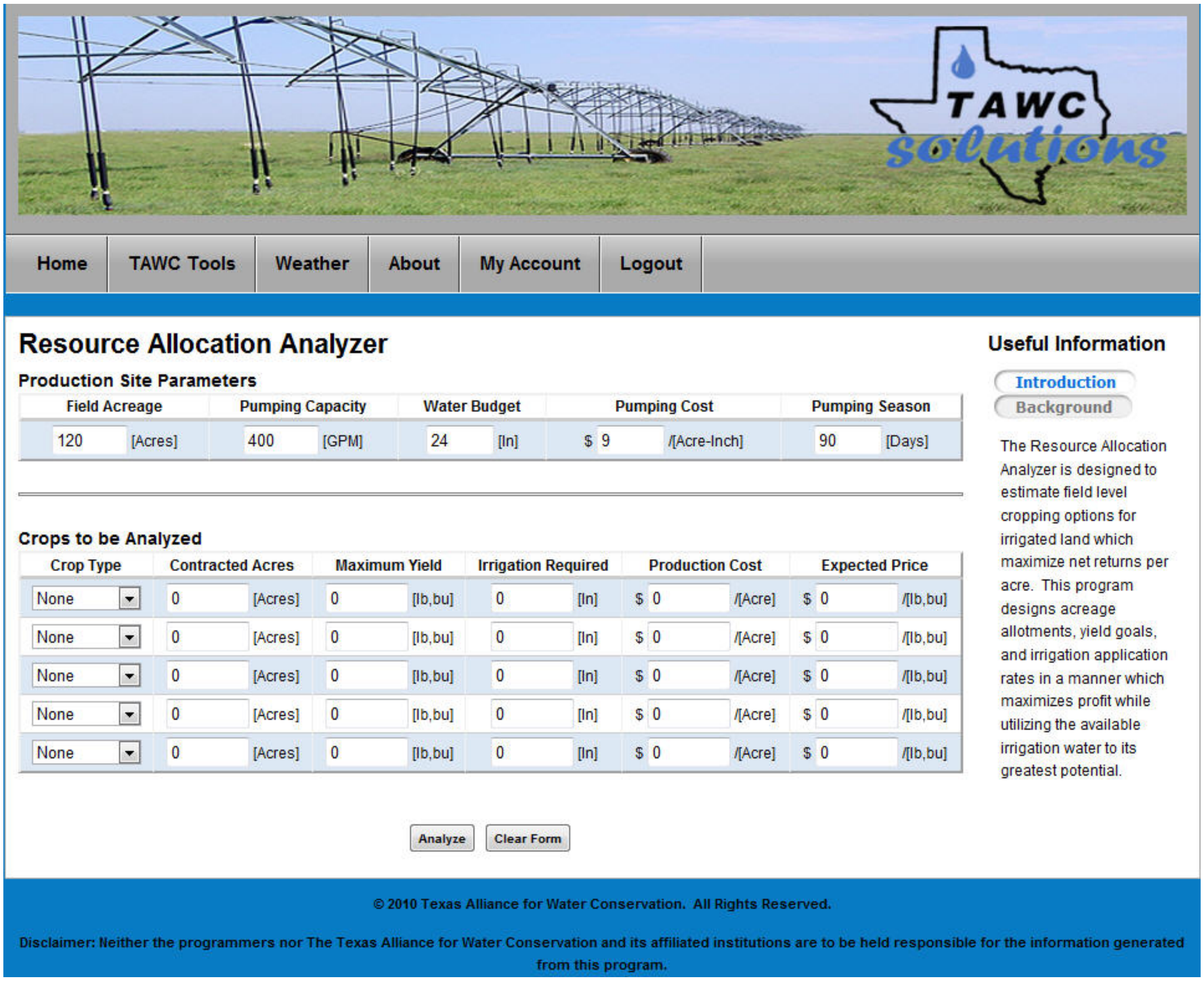
The Texas Alliance for Water Conservation (TAWC) is a producer-led demonstration funded by the State of Texas through the Texas Water Development Board. Initial funding for this demonstration came through Senate Bill 1053 that was sponsored by Senator Robert Duncan. The TAWC, partnered with the Texas 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.

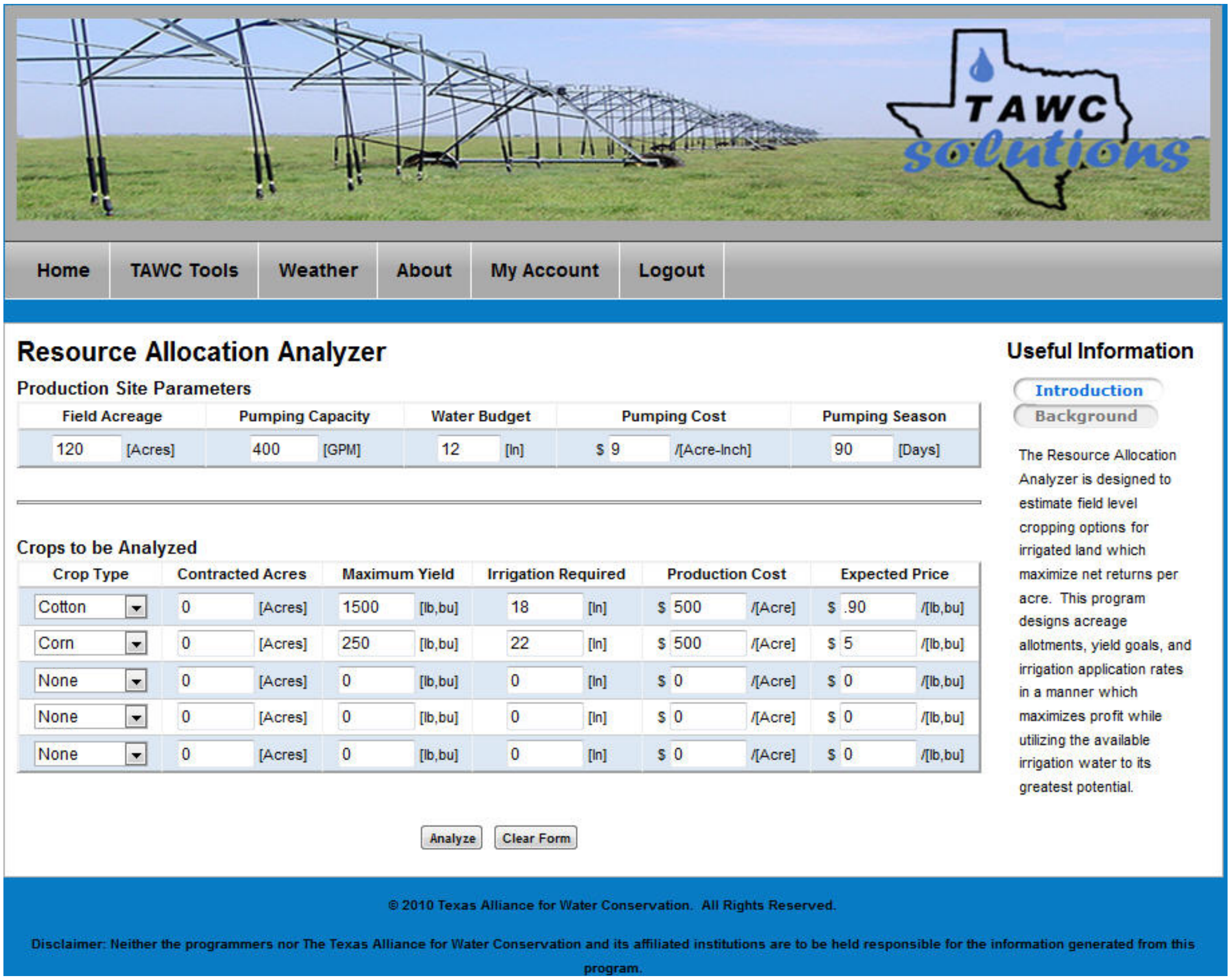
TAWC Solutions is intended to provide a simple web-based management decision tool and an ET (evapotranspiration) tool that can aid in improved management decisions in the application of irrigation water. The tools on this site are evolving and through their use we hope to continue to improve and expand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

Screen 2



Screen 2 represents the platform of which the Resource Allocation Analyzer works from. 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 please refer to the definitions on page 6. With the Production Site Parameters set, choose 1 of 5 crops to analyze. A single crop or up to a maximum of 5 can be chosen for the analysis. An example of selecting corn and cotton is illustrated in **Screen 3**.

Screen 3



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 utilizing 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 7. Utilizing 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				

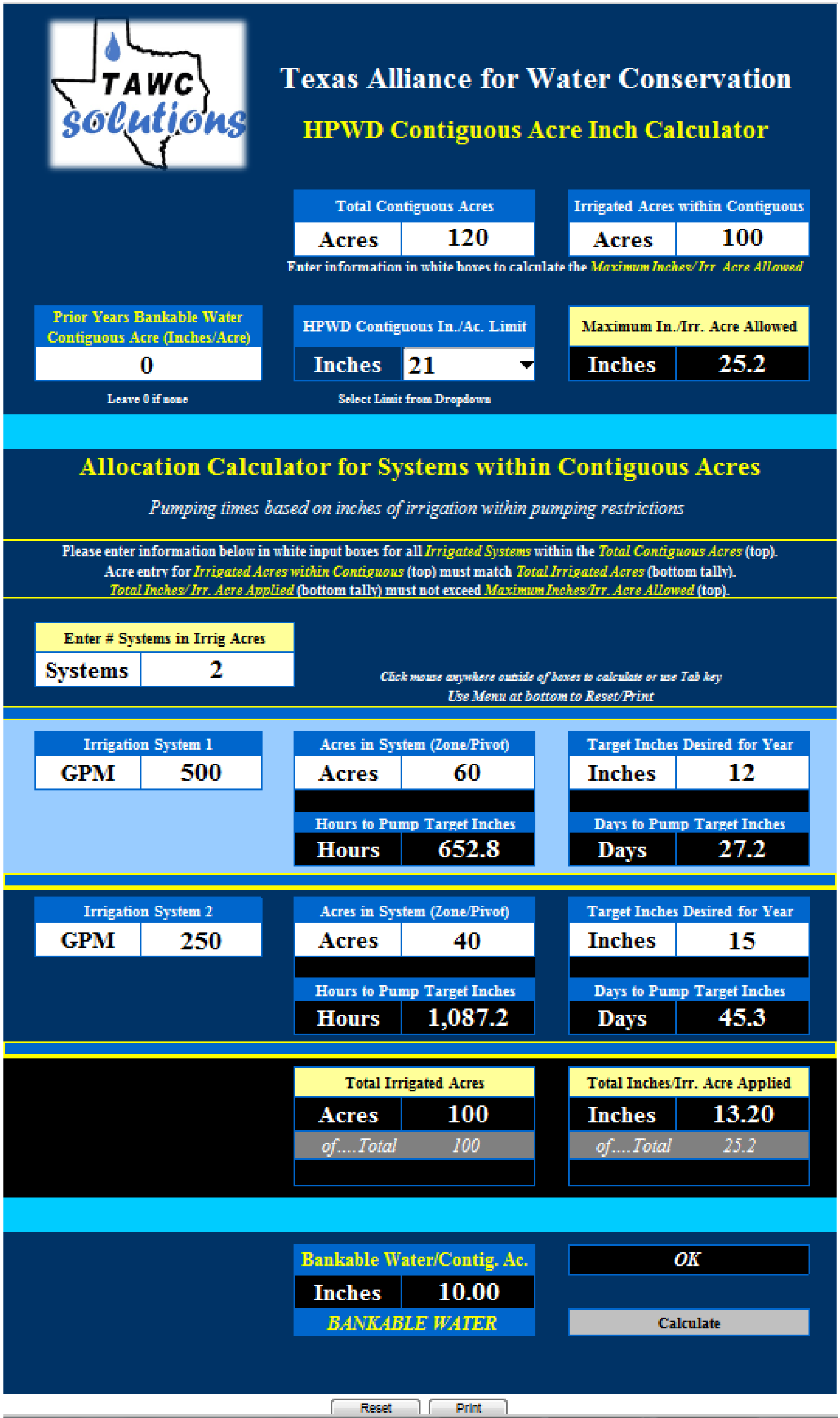
Back

<u>Production Site Parameters and Input Value Descriptions</u>

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, & sunflowers). 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.

<u>Output Definitions and Descriptions</u>

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 chose of crop acreages, irrigation levels, and yield goals which maximize profit 5% below the true maximum.
Alternative Scenario 1 - This scenario presents the optimal chose of crop acreages, irrigation levels, and yield goals which maximize profit 10% below the true maximum.
Crop Acreage – the optimal acres by crop which 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 (HPWD) rules regarding water withdrawal from the Ogallala Aquifer. This tool allows the producer to enter their 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 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 2nd or lower part of the calculator is a water allocation calculator for irrigated systems within the contiguous acres that allow 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 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 include 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 33. Task and expense budget for years 1-7 of the demonstration project.

2005-358-014		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	
		(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	
Task Budget	Task Budget*	*revised*	*revised*						Total Expenses
1	4,537	4,537	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	2,017,013
3	675,402	21,112	33,833	80,984	61,455	56,239	28,122	46,033	344,220
4	610,565	52,409	40,940	46,329	53,602	64,124	43,569	117,206	418,180
5	376,568	42,428	40,534	47,506	38,721	51,158	27,835	29,231	277,413
6	568,773	54,531	75,387	71,106	60,257	39,595	60,473	52,444	413,792
7	306,020	37,014	22,801	30,516	25,841	11,497	14,302	34,398	186,823
8	334,692	44,629	43,089	41,243	43,927	42,084	42,984	37,157	295,112
9	623,288	145,078	39,011	35,656	82,844	52,423	65,785	32,971	453,767
10	162,970	0	0	0	0	0	86,736	55,871	142,607
TOTAL	6,224,775	618,702	630,914	670,657	666,374	566,283	669,355	701,594	4,523,878

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	
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	Total Expenses
Salary and Wages [1]	2,524,172	230,611	304,371	302,411	301,933	259,929	293,198	307,459	1,999,911
Fringe[2] (20% of Salary)	370,655	28,509	34,361	36,263	40,338	37,180	43,410	42,061	262,122
Insurance	186,600	13,634	26,529	25,302	25,942	21,508	23,294	24,918	161,126
Tuition and Fees	199,922	8,127	16,393	21,679	18,502	13,277	9,828	21,803	109,609
Travel	158,482	14,508	25,392	14,650	15,556	16,579	12,329	19,127	118,141
Capital Equipment	154,323	23,080	13,393	448	707	18,668	95,993	(146)	152,141
Expendable Supplies	105,455	14,277	16,100	12,205	18,288	8,614	4,802	8,265	82,551
Subcon	1,758,667	212,718	103,031	161,540	183,125	131,627	115,587	131,779	1,039,407
Technical/Computer	61,364	9,740	3,879	16,225	430	7,990	11,857	10,550	60,671
Communications	270,192	25,339	41,374	35,497	23,062	14,448	18,300	45,344	203,364
Reproduction (see comm)									0
Vehicle Insurance	2,000	0	397	235	187	194	114	130	1,257
Producer Compensation	57,450	0	0	0	0	0	0	39,225	39,225
Overhead	375,493	38,160	45,694	44,202	38,302	36,270	40,644	51,079	294,351
Profit									
TOTAL	6,224,775	618,702	630,914	670,657	666,374	566,283	669,355	701,594	4,523,878

COST SHARING

Table 34. Cost sharing figures for TTU, AgriLife (TAMU), and HPUWCD for years 1-7 of the demonstration project.

Cost Sharing Balance Summary (estimated)

Budget	Total Cost Share Budgeted	*Actual Funds Contributed*	*Balance*
TTU		972,548.12	
TAMU		319,617.00	
HPUWCD		175,052.88	
TOTAL	1,100,000.00	1,467,218.00	(-367,218.00)

Expense Categories	Total Expense Budget	*Actual Funds Contributed*	*Balance*
Salary & Wages		405,243.00	
Fringe		72,943.74	
Overhead		494,361.38	
SubCon - TAMU		319,617.00	
$25,000/yr - HPUWCD		175052.88	
TOTAL	1,100,000.00	1,467,218.00	(-367,218.00)

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Jody Foster
Scott Horne
Boyd Jackson
Jimmy Kemp
Brett Marble
Charles Nelson
Danny Nutt
Keith Phillips
John Paul Schacht
Glenn Schur
Dan Smith
Don Sutterfield
Brian Teeple
Eddie Teeter
Jeff Don Terrell
Aaron Wilson