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

14th Annual Comprehensive Report 2005-2018

to the

Texas Water Development Board

TAWC

TEXAS ALLIANCE FOR WATER CONSERVATION

OCTOBER 1, 2019

Texas Alliance for Water Conservation participants:

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

Appreciation is expressed to

Texas Water Development Board

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

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

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Water Conservation Demonstration Producer Board

Glenn Schur, Chair

Boyd Jackson, Co-Chair

Eddie Teeter, Secretary

Keith Phillips

Mark Beedy

Jeff Don Terrell

Jody Foster

Lanney Bennett

Louis (Bubba) Ehrlich

Rick Kellison (ex-officio), Project Director

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

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

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

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

Texas Alliance for Water Conservation 2018 Participants

Texas Tech University
Dr. Chuck West, Project Administrator*
Mr. Rick Kellison, Project Director*
Mr. Philip Brown*
Dr. Phillip Johnson*
Dr. Wenxuan Guo*
Dr. Steve Fraze*
Dr. Rudy Ritz*
Ms. Samantha Borgstedt,
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Texas A&M AgriLife Extension
Dr. Steven Klose
Mr. Jeff Pate*
Dr. Will Keeling*
Dr. Nithya Rajan

High Plains Underground Water
Conservation District No. 1
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Mr. Keith Whitworth*

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

Producer Board Chairman
Mr. Glenn Schur*

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(past and present)
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Morgan Newsom
Jarrott Wilkinson
Rachel Oates
Jennifer Zavaleta
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Victoria Xiong
Lisa Baxter
Krishna Bhandari
Madhav Dhakal
Libby Durst
Cassie Godwin
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Kathryn Radicke

* Indicates Management Team member

Producers of the TAWC Project (past and present)

Ronnie Aston	Jody Foster	Charles Nelson	Dan Smith
Mark Beedy	Scott Horne	Danny Nutt	Eddie Teeter
Lanney Bennett	Boyd Jackson	Keith Phillips	Jeff Don Terrell
Troy Bigham	Jimmy Kemp	Glenn Schur	Aaron Wilson
Bob Meyer	Lloyd Arthur	Blake Davis	Jerry Don Glover
Barry Evans	Randy McGee	R.N. Hopper	Jerry Brightbill
S. Clevenger			

The dedication of all these participants is gratefully acknowledged.

AN INTERATED APPROACH TO WATER CONSERVATION FOR ARICULTURE IN THE TEXAS SOUTHERN HIH PLAINS

Objective

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

Background

The Texas High Plains generates a combined annual economic value of crops and livestock that exceeds $12.0 billion ($2.6 crops; $9.4 livestock; USDA, National Agricultural Statistics Service, 2017). Such productivity is highly dependent on water from the Ogallala Aquifer. Groundwater supplies have been declining significantly in the South Plains region (average water level during 2007-2017 declined 8.84 feet in High Plains Underground Water Conservation District No. 1[1], while costs related to pumping the water (energy, system infrastructure, maintenance) have escalated. Improved irrigation technologies including low energy precision application (LEPA) and subsurface drip irrigation (SDI) have increased irrigation efficiencies to around 95% but have not necessarily led to decreased water use. TAWC provides information on efficient irrigation systems and guidelines for matching water supply to crop needs as a means of reducing the risk of overwatering. There is increasing importance of diversifying the crop choice to include low-water demanding crops, concentrating irrigation rates onto the most profitable crops, and reducing tillage to protect soil quality,

Diversified systems include growing more than one type of crop on a farm at the same time, rotating crops on a field across years, growing minor crops for a niche market, and integrating crops and livestock. Cattle can utilize perennial and annual forages that are not irrigated or receive very low irrigation and can graze crop residue after the grain is harvested. Local supplies of by-products from processing cottonseed, corn, and sorghum for oil and ethanol provide high-protein feed to supplement local forages. Crop-livestock integrated systems reduce soil erosion and inputs of nitrogen fertilizer and pesticides while building soil health and stabilizing income (Allen et al., 2012; Johnson et al., 2013). Research on crop production, soil science, economics, and communication dynamics underpin the demonstration project. Results from the demonstration sites serve to validate the research and inform approaches to transferring technology to users.

No single technology will successfully address water conservation. Rather, the approach must be a combination of techniques, including monitoring crop needs for water and soil moisture status, precise timing and amount of irrigation, improved plant genetics, and practices that reduce water demand and optimize value so that profitability is maintained or improved. Conservation of the Ogallala Aquifer will prolong the regional economic benefits of agriculture. As state and global populations increase with an increasing demand for agricultural products, the future of the Texas High Plains depends on our ability to protect

[1] High Plains Water District 2018 Water Level Report source: http://www.hpwd.org/reports/

and appropriately use our water resources. Nowhere is there greater opportunity to demonstrate the results of successfully meeting these challenges than in the High Plains of west Texas.

A multidisciplinary and multi-university/agency/producer team, coordinated though Texas Tech University, assembled during 2004 to address these issues. In September of 2004 the project *'An Integrated Approach to Water Conservation for Agriculture in the Texas Southern High Plains'* was approved by the Texas Water Development Board and funding was received in February 2005 to begin the demonstration project conducted in Hale and Floyd Counties. A producer Board of Directors was elected to oversee all aspects of this project. The purpose of this project was to understand where and how water conservation could be achieved while maintaining acceptable levels of profitability. Results of this study assist area producers in meeting the challenges of declining water supplies and reduced pumping capacities by demonstrating various production systems and water-saving technologies. The first nine years of the Texas Alliance for Water Conservation (TAWC) project are considered Phase I of our effort to demonstrate and compare irrigation systems and crop types for agronomic and economic water use efficiencies. In Phase I, 26 producer sites were identified to represent 26 different 'points on a curve' that characterize cropping and livestock grazing system monocultures with integrated cropping systems and integrated crop/livestock approaches to agriculture in this region. All data from Phase I are contained in the Appendix section of this report.

In 2013, continuing under the infrastructure of Phase I, a new source of funding via the Texas Water Development Board for TAWC was approved by the Texas Legislature. This allowed TAWC to expand its impact area and establish Phase II during the 2014-2018 cropping seasons. In the first year, Phase II dropped four original sites and added 10 sites in six new counties, namely Bailey, Crosby, Deaf Smith, Lamb, Lubbock, and Parmer. An additional site in Castro county was added in 2015, bringing the total project area to 9 counties. The number of sites and producers varies across years as new sites are added and some of the original sites replaced. This is to facilitate the time and effort toward the new expanded area allowing focus on a larger more diverse group of agricultural producers in Phase II. Many of the additional farms were formerly participants in a Conservation Innovation Grant program funded by the United States Department of Agriculture Natural Resources Conservation Service, aimed at transferring technologies for conserving irrigation.

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

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

It is important to note that these data and their interpretations are based on certain assumptions which are critical to objectively compare information across different sites. We adopted constants for productivity and efficiency calculations, such as pumping depth of wells, in order to make unbiased economic and agronomic comparisons (see p. 30 for detailed assumptions). Therefore, the economic data for an individual site are valid for comparisons of systems but do not represent the actual economic results of that farm. Actual economic returns for each site were calculated and confidentially shared with the individual producer but are not a part of this report. Likewise, the identity of the participating producers is not matched to the demonstration sites.

This is the fifth annual report of Phase II of TAWC and is a compendium of data over the life of the project. Data collection technologies gradually changed over time as better equipment became available and were installed. As each annual report updates 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. This report contains numerous corrections of data from previous years with all previous yearly data contained in the Appendix section of this report.

Overall Summary of Years 2005-2018 ***Chuck West, Philip Brown (TTU)***

Sites 4 and 31 (totaling 232 acres) had no data collected in 2018 and are not included in these summaries; however, both currently remain a part of the project. With 14 years completed of this study, we see substantial annual variations in economic returns and water received from irrigation and precipitation (Figure 1). Each year's results are highly influenced by weather, availability of irrigation water, input costs, actual and anticipated prices for crops and livestock, and previous years' experiences. During the 14 years, annual precipitation ranged from 5.3 inches (2011) to 30.5 inches (2015) (Figure 1), averaging 18.7 inches, which matches the long-term mean for the region. Eight of 14 years exhibited below-average rainfall, with 2011-2013 substantially below average. Precipitation for 2018 averaged 15.6 inches across all sites, with 9.6 inches occurring from planting to approximately harvest (May through September), May rainfall was significantly below normal, with only 1 inch average received across all sites as compared to the Lubbock long-term (1911-2018) average of 2.65 inches. June rainfall was about average at 2.5 inches, with July at about half the long-term average with a normal August and September (Figure 14; Table 2; p. 23-24). Long-term average for Lubbock (1911-2018) for May through September is 12 inches of total precipitation.

Figure 1 shows annual changes in economic returns above all costs and gross margins (red and yellow lines) in relation to precipitation and irrigation (green and blue lines). Gross margin equals total revenue less total variable costs. Returns above all costs equals gross margin less fixed costs and is the same as net returns.

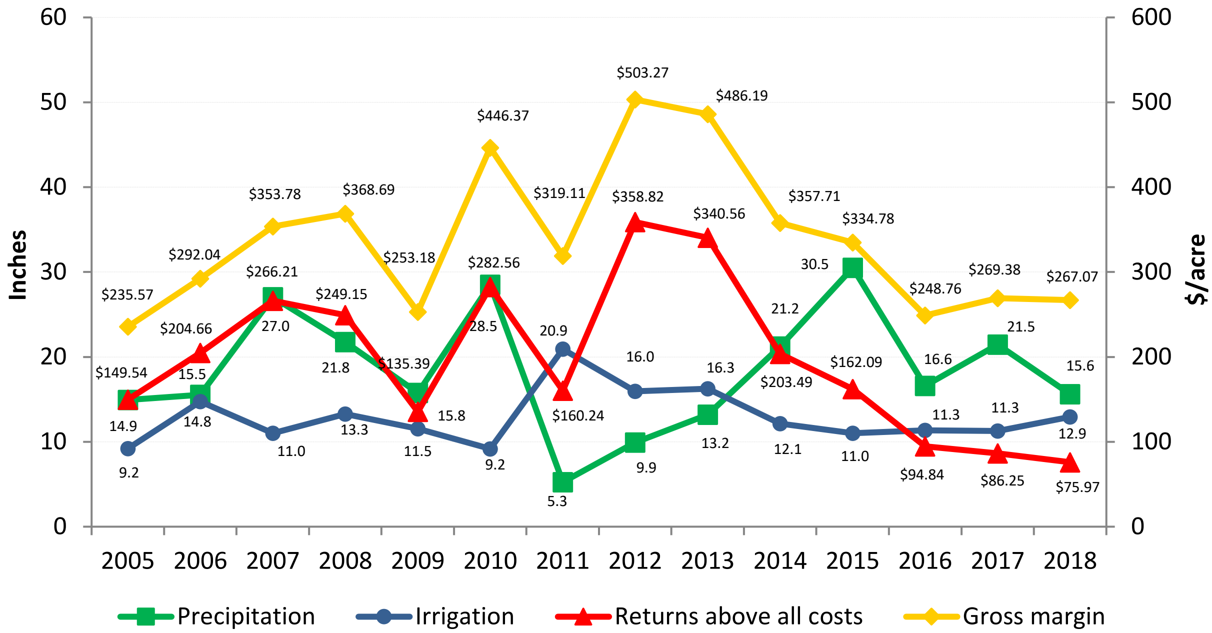

Figure 1. Average precipitation (inches), irrigation applied (inches), returns above all costs ($/acre), and gross margin ($/acre) for irrigated sites only.

Amount of system irrigation averaged over 14 years on the irrigated sites was only 12.9 inches, with a range of 9.2 to 20.9 inches (Figure 1). Irrigation was greatest during the dry years of 2011-2013. Average system irrigation plus average rainfall (18.4 inches) equaled 31.3 inches of water received per year. This suggests that 30-32 inches of total annual water input is a general norm for typical crop production in this region. In-season (May-September) rainfall for the project sites (9.8 inches in 2018) ranged from approximately 1 inch in 2011 to 16.7 inches in 2010, with an average of 12.9 system inches per season during 2005-2018. Timing of this rainfall is critical for producing a viable crop in drier years. In the six "wet" years (annual rainfall exceeding 20 inches), total water received ranged from 33.3 to 41.5 inches. In such years, excessive rains were concentrated in particular weeks or months. This meant that irrigation was still required in the drier months of those years to make up water deficits caused by high evapotranspiration. The extremely dry year of 2011 was a test of how much irrigation could buffer against the low precipitation. Irrigation supplied 20.9 inches for a total water input of 26.2 inches. In 2011, irrigation rates generally were inadequate to meet crop water demand. As well outputs decline over time, the expectation is that even in less severe droughts than that of 2011, irrigation will fall short of meeting crop water demand. When all sites including the non-irrigated fields (Figure 2) are included in the means, average irrigation applied declines from 12.9 to 12.2 inches.

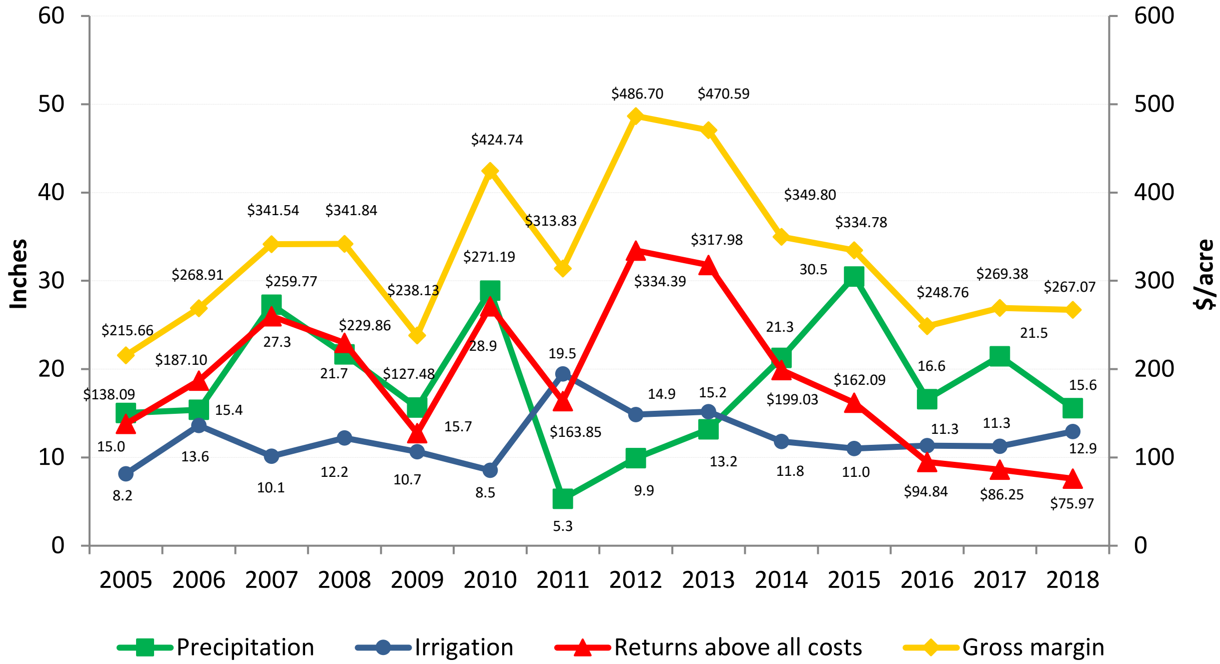

Figure 2. Average precipitation (inches), irrigation applied (inches), returns above all costs ($/acre), and gross margin ($/acre) for all sites, irrigated and dryland (there are no dryland sites after 2014).

Two basic strategies can be used alone or in combination to stretch water supplies as irrigation well outputs decline: a) apply less water per acre to a level that still maintains profitable yields (70-80% of crop ET demand); and b) apply available water to fewer acres. Both approaches have merit depending on the crop species and variety, how water is allocated over the cropland, and the timing of precipitation within a year. Both strategies require careful planning and monitoring of crop water use, skills which are supported by information and web-based decision-aid tools offered by TAWC.

Yearly trends in gross margin and returns above all costs fluctuated tremendously owing to variable commodity prices and crop yields (Figures 1 and 2). The trends were essentially parallel, with the difference between them reflecting fixed costs. Closer inspection reveals that the difference more than doubled over the years from $77/acre in 2005 to $191/acre in 2018. Profitability in 2005 and 2009 was negatively impacted by high production costs in relation to values of crops and livestock. Low profitability during the 2011 drought reflected reduction in livestock numbers and yield losses in crops but was buffered somewhat by insurance payments. Profitability in 2014-2018 showed a continual drop from 2013, which was the one of the highest of all years. The low returns in 2014 and 2015 were attributed largely to low commodity prices, but also to decreased crop yields resulting from heavy spring rains setting back crop planting and early-fall rains hampering harvest. The late start and low fiber quality for cotton depressed prices and limited profitability.

Producers in the TAWC project make their own decisions each season on enterprise selection and production practices. Land use reflects current crop and livestock prices, contracts, expected profitability, water supply, and decisions to terminate leases, sell property, or retire. Therefore, the number of acres and number of sites of the enterprise choices varied over time. Figures 3 and 4 show the acreages and number of sites, respectively, that were devoted to cotton, corn, sorghum, perennial forages, cattle, small grains, and other crops. The total of enterprise acres exceeds total acres in the project in any given year because of double cropping and multi-use for livestock. The main changes in 2018 relative to 2017 were decreases in cotton and corn acreage (Figure 3), and slight upticks in small grains and cattle.

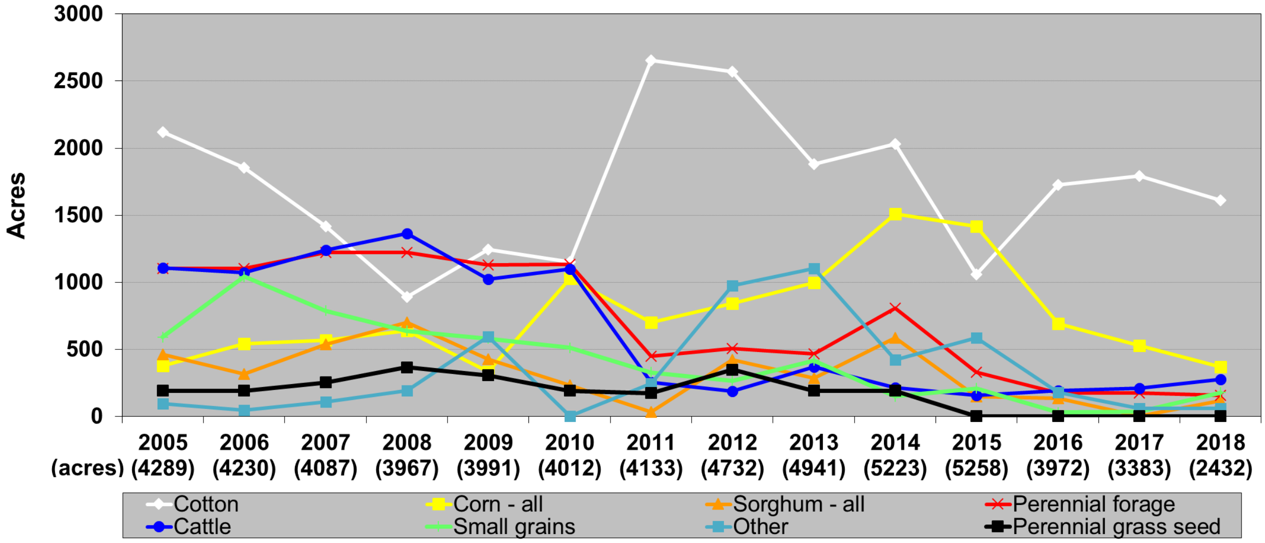

Figure 3. Number of acres of various crops and cattle enterprises. Sites were located in two counties through 2013 (Phase I) and in nine counties for Phase II (2014 and later).

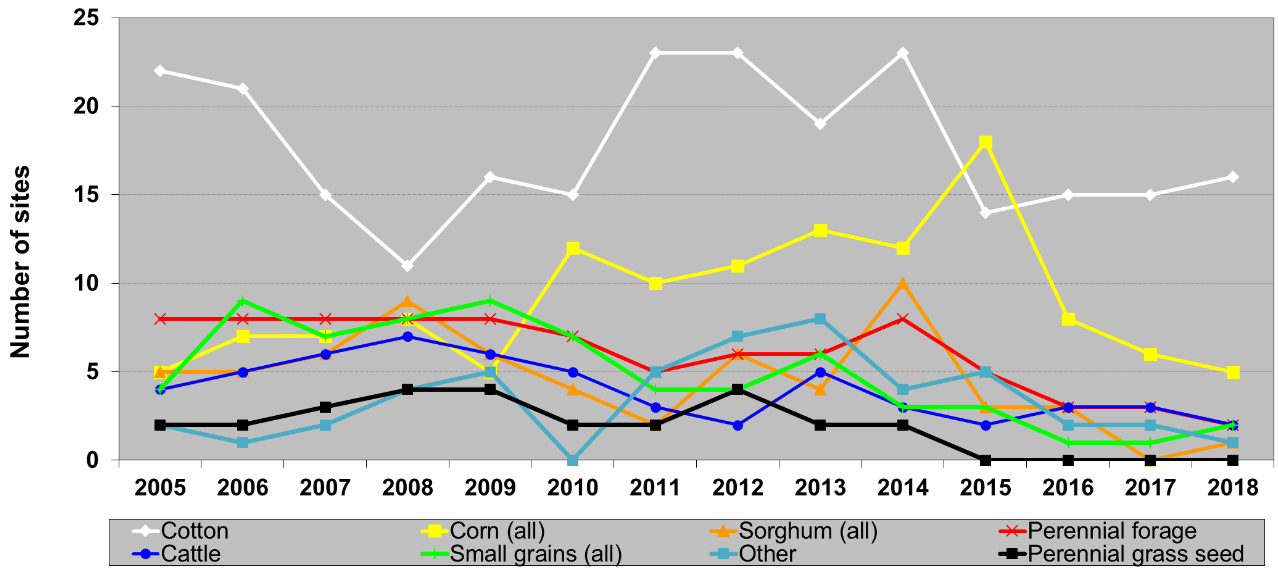

Figure 4. Number of sites of various crops and cattle enterprise. Sites were located, in two counties through 2013 (Phase I) and in nine counties for Phase II (2014 and later).

The trends in number of sites where different commodities were produced (Figure 4) generally followed the trends in acreage distribution (Figure 3). The perennial grass seed production sites were dropped from the project after the 2014 crop year due to producer retirement (Figures 3 and 4).

Water Use and Profitability

Profitability in relation to irrigation applied is important because of the constant need to increase water use efficiency by the crops and prolong the groundwater supply, while maintaining or even increasing profitability of agricultural production in the High Plains. To examine systems for meeting criteria of relatively low water use and high profitability, we arbitrarily selected a maximum of 15 inches of irrigation and a minimum of $300 gross margin per acre as a desired target for performance (Figure 5). Please note that these levels were selected only to identify whether certain sites and cropping systems consistently performed to those criteria and *not* to relate system performance to pumping restrictions nor to state a minimum amount of revenue required for economic viability.

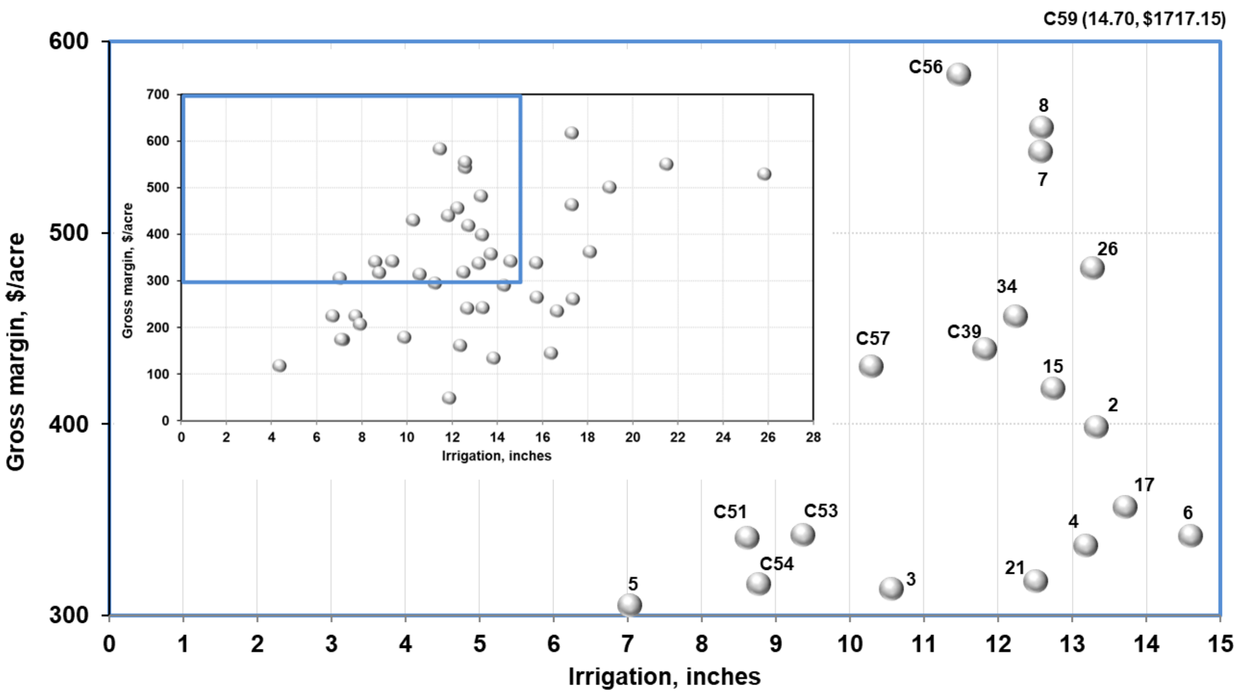

Figure 5. Gross margin per acre in relation to inches of applied irrigation averaged over 2005 to 2018. Each point represents one site, of which all were irrigated, averaged across all years in which they were in the project. See Table 1 for site descriptions. The large graph depicts sites which met the arbitrary criteria of relatively low irrigation and high gross margin. The insert shows all sites, except C59, which was off scale. This site produced alfalfa, provided 14.7 inches of irrigation and grossed $1717, averaged over 2 years for 2014 and 2015 only.

Table 1. Description of cropping system and current irrigation type used for sites plotted in Figure 5 which met criteria of 15 or fewer inches of irrigation and $300 or more gross margin/acre. Descriptions of cropping systems (as categorized across years within which they appear) by site from 2005-2018 are shown. Site numbers with "C" indicate new Phase II sites.

Site	Cropping system	Irrigation type
2	Multi-crop, cotton/corn/sunflower	Subsurface drip
3	Multi-crop, cotton/grain sorghum/wheat	Mid elevation spray application
4	Multi-crop, livestock/cotton/grain sorghum/wheat/alfalfa/millet/haygrazer	Low elevation spray/Low energy precision application
5	Livestock only through 2010; Multi-crop, cotton/wheat/sunflower/millet	Low elevation spray application
6	Multi-crop, livestock, cotton/corn/wheat	Low elevation spray application
7	Continuous sideoats grama grass seed	Low elevation spray application
8	Continuous sideoats grama grass seed	Subsurface drip
15	Multi-crop, cotton/grain sorghum/corn	Subsurface drip
17	Multi-crop, livestock/cotton/corn/sunflower /perennial grass	Mid elevation spray application
21	Multi-crop, livestock, cotton/corn/small grain/forage sorghum/grass seed/hay grazer	Low energy precision application
26	Multi-crop, livestock, cotton/corn/small grains/sunflower/millet	Low elevation spray application
34	Multi-crop, cotton/corn/sunflower (3 year)	Low elevation spray application
C39	Multi-crop, cotton/corn/sorghum (3 year)	Low elevation spray/Low energy precision application
C51	Cotton monoculture (5 year)	Subsurface drip
C53	Cotton monoculture (2 year)	Subsurface drip
C54	Cotton monoculture (2 year)	Subsurface drip
C56	Monoculture, rotation, corn/blackeye pea/corn/blackeye pea/corn (5 year)	Low elevation spray application
C57	Monoculture, corn/corn/sunflower/corn/cotton (5 year)	Low elevation spray application
C59	Alfalfa monoculture (2 year)	Subsurface drip

Nineteen out of 48 total sites since 2005 have met the arbitrary criteria of 15 or fewer inches of irrigation and $300 or more gross margin/acre, when averaged over 2005-2018 inclusive to years these sites were in the project (Figure 5). Seven sites that met the $300 gross margin per acre criterion but with average irrigation over 15 inches (points located to the right of the blue insert box in Figure 5) were mostly multi-crop corn/cotton rotations, with one site being multi-crop cotton/sorghum/small grain/alfalfa and another multi-crop with cotton/grain sorghum and millet. Sites 2, 6, 15, 17, 21, 26, 34 and 39 all included corn in the multi-crop rotations, indicating that inclusion of corn in the cropping system can result in high return at low water use, averaged over years. Corn in sites C56 and C57 were for both grain and silage and represent 4 years of data. Sites C51 (4-year data), C53 and C54 (2-year data) were the only cotton monocultures that met the double criteria. The two sites with grass seed production (7 and 8) were the highest ranked sites during the Phase I years. The alfalfa monoculture in site C59 indicates very high potential for profitability at surprisingly low irrigation, thanks partly to timely rains.

2018 Project Year

Producer sites can be categorized according to type of farming system insofar as a site represents a conceptual farm. The system categories in use in 2018 were corn monoculture (entire site in corn only), cotton monoculture (entire site in cotton only), integrated crop/livestock (site included cattle on pasture plus an annual crop and/or hay), multi-cropping (more than one annual crop species harvested in the reporting year). Systems not occurring in years after 2012 included cow-calf pasture and dryland multi-cropping. A site categorized in one system is re-categorized each year that the crop choice changes. The "Other" category is a catch-all of minor annual crops and fallow whose makeup changes from year to year. There was no grain sorghum acreage in 2018, but there was wheat for grain and millet for hay as part of the multi-cropping system.

In 2018, corn monoculture accounted for 12% of the 17 sites from which yield data were collected, while integrated crop/livestock occupied 12%, cotton monoculture occupied 53%, and multi-cropping occupied 24%. Corn and cotton composed most of the multi-cropping sites with one site having wheat and millet. Various combinations of wheat, forage sorghum for hay, kleingrass/buffalograss, WW-B.Dahl old world bluestem, and cotton constituted the two integrated crop/livestock sites. Site 4 which is normally an integrated crop/livestock had no data reported for 2018.

This section compares the cropping systems for net returns per system acre and per acre-inch of irrigation, and usage of irrigation and nitrogen fertilizer for 2018. Cotton commodity prices were based on $0.76/lb and the cotton monoculture system showed a mean net return of $51.31/system acre (Figure 6) with individual systems ranging from net loss of $(542.85) to $462.31 system acre. The fluctuation in net returns is primarily due to extreme weater conditions resulting in both quality and yield reductions for 2018. Of the nine cotton monoculture systems for 2018 four showed a net loss per system acre and five showed a net gain (Table 11, page 35). For the systems that have been monitored over many years, the highest-return system in 2018 was a cotton monoculture at $462.31/system acre, followed by a multi-cropping system at $459.90. Integrated crop/livestock showed a mean net loss of $(29.68)/system acre (Figure 6). Site 10 had the greatest loss with $(120.97)/system acre primarily due to cotton crop failure due to hail out, while site 9 had a net gain of $61.61/system acre (Table 11, page 35). Weather conditions in 2018 with a dry spring and wet fall were a major influence on yields resulting in a wide range of net returns for all systems in the project with the greatest impact on cotton systems.

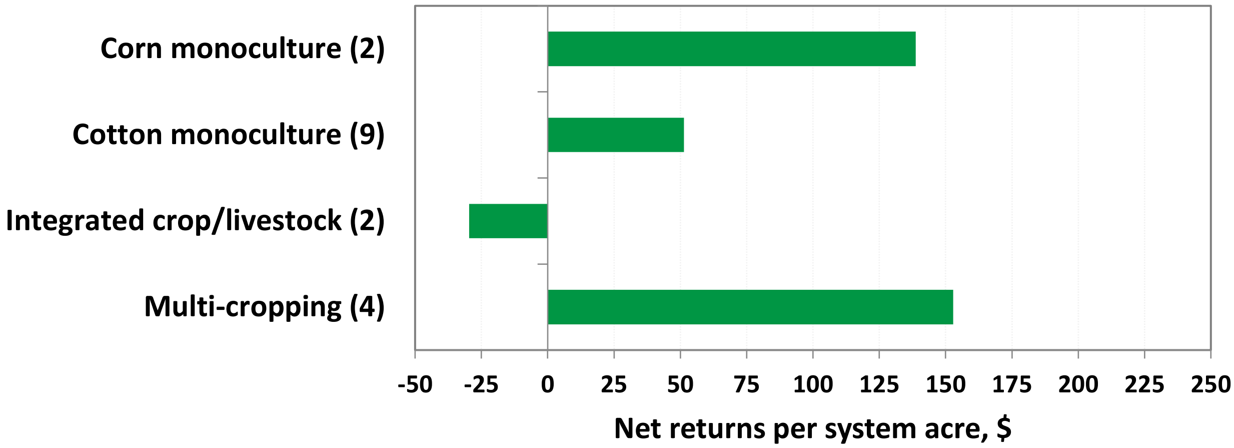

Figure 6. Net returns per system acre for four cropping systems in 2018 with number of sites in parentheses.

These systems were also examined in terms of net returns per acre-inch of irrigation applied (Figure 7, green bars). Integrated crop/livestock had a net loss, while corn monoculture had the greatest return, followed by multi-cropping and cotton monoculture systems. The blue bars in Figure 7 indicate average inches of irrigation applied per system. Integrated crop/livestock had the lowest application (10.6 inches) and multi-cropping had the highest (15.7 inches).

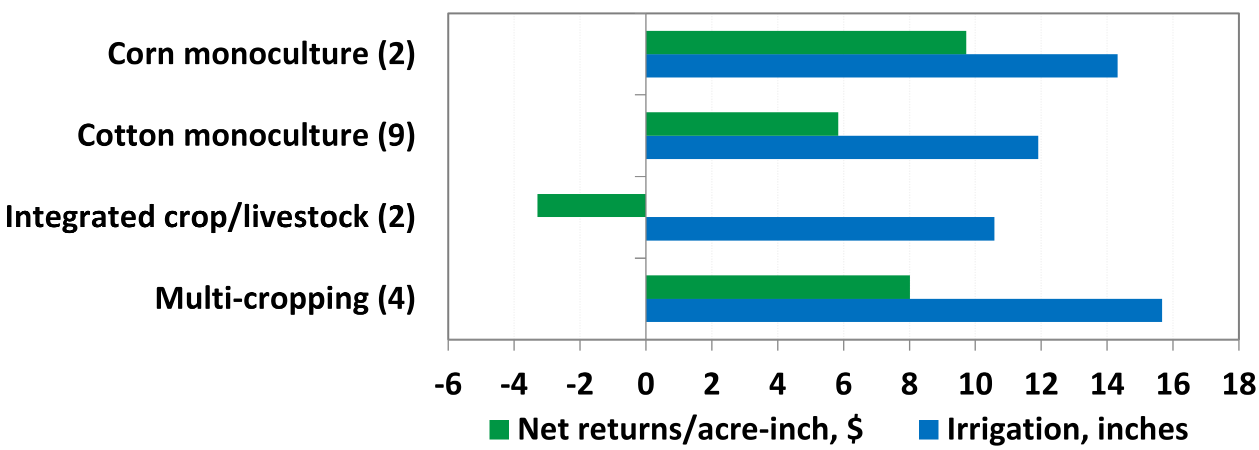

Figure 7. Net returns per acre-inch irrigation water (green bars), and inches of irrigation applied (blue bars), 2018 with number of sites in parentheses.

The amount of nitrogen applied in fertilizer varied across cropping system (Figure 8). Multi-cropping was greatest at 143 lbs/acre, followed by corn monoculture, integrated crop/livestock, and cotton monoculture, at 114, 77 and 68 lbs/system acre, respectively (Figure 8). Three of the four multi-crop systems contained corn, which pushed nitrogen input levels higher. Commercial N fertilizer application is a major input cost and therefore greatly influences the calculation of net return.

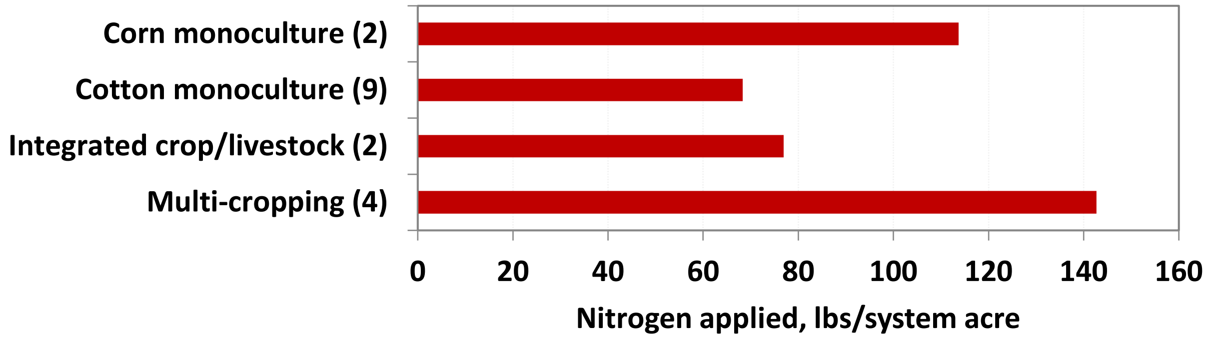

Figure 8. Pounds per system acre of nitrogen applied in fertilizer by cropping system, 2018 with number of sites in parentheses.

Project years 1 through 14 (2005-2018)

Figure 9 summarizes net returns per acre by system over the life of the project so far. Not all systems were grown in all years. For example, alfalfa and blackeye pea were grown in only two years. Grass seed monoculture was the most profitable system in the long term at $376/acre (2005-2014). While irrigated multi-cropping and cotton monoculture yielded similar average net returns per system acre ($212 and $179/acre, respectively), integrated crop/livestock was at $144 and corn monoculture was $145/system acre. Grain sorghum monoculture (one year only) showed the most negative net returns among all systems.

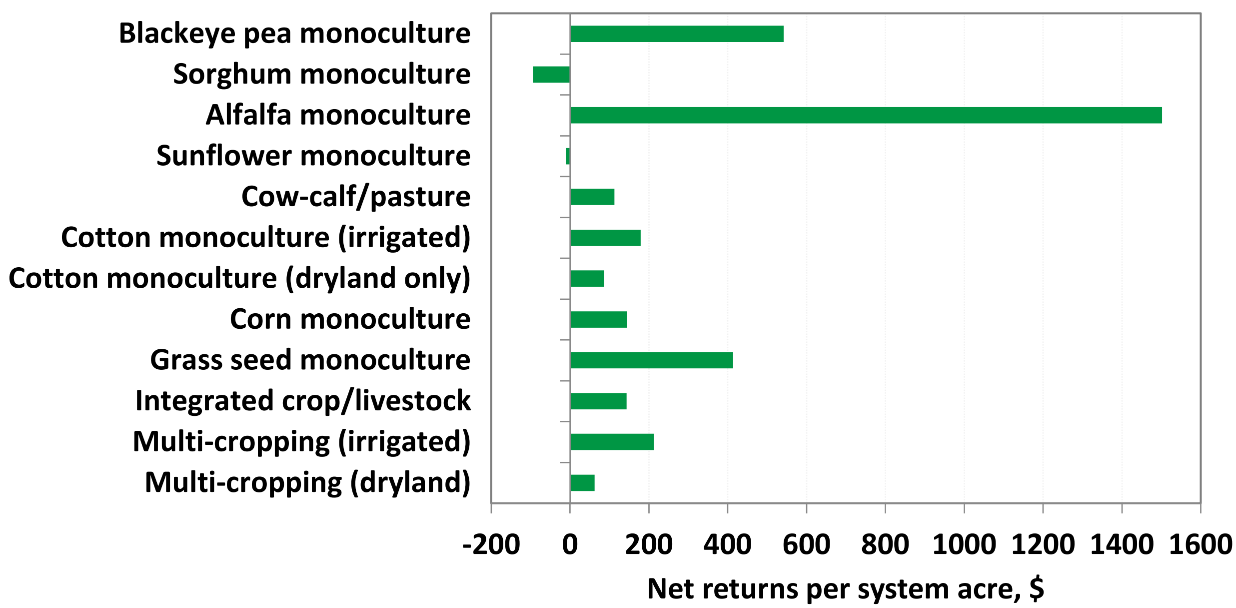

Figure 9. Net returns per system acre, average of 2005-2018, or for those years which those systems occurred. Data for cow-calf includes 2005-2010 data only, for alfalfa monoculture 2014-2015 only, for blackeye pea 2015 and 2017 only, sorghum monoculture in 2014 only, sunflower monoculture in 2008, 2009 and 2016 only.

Net returns per acre-inch of irrigation applied over the project life (Figure 10, green bars) were greatest for the two years of blackeye pea and the two years of alfalfa, and least for sorghum monoculture, for which the number of years of data is very limited. Net returns for irrigated cotton monoculture averaged $19.67/acre-inch, about twice as great as the net return for corn monoculture $10.23 (Figure 10). Corn monocultures were not present in some of the earlier years of this project and thus their means reflect fewer years. The droughts of 2011 and 2012 hit corn yields particularly hard, therefore with fewer years in the mean, the effects of drought have a proportionally greater effect on this crop's performance. Dryland systems have always had the lowest average net returns in this project. Irrigation amount applied annually (Figure 10, blue bars) was greatest for corn monoculture (17.1 inches), followed by alfalfa (14.7 inches). Irrigated cotton monoculture received about the same amount of irrigation (11.1 inches) as grass seed (12.6 inches) and the integrated crop-livestock system (11.6 inches).

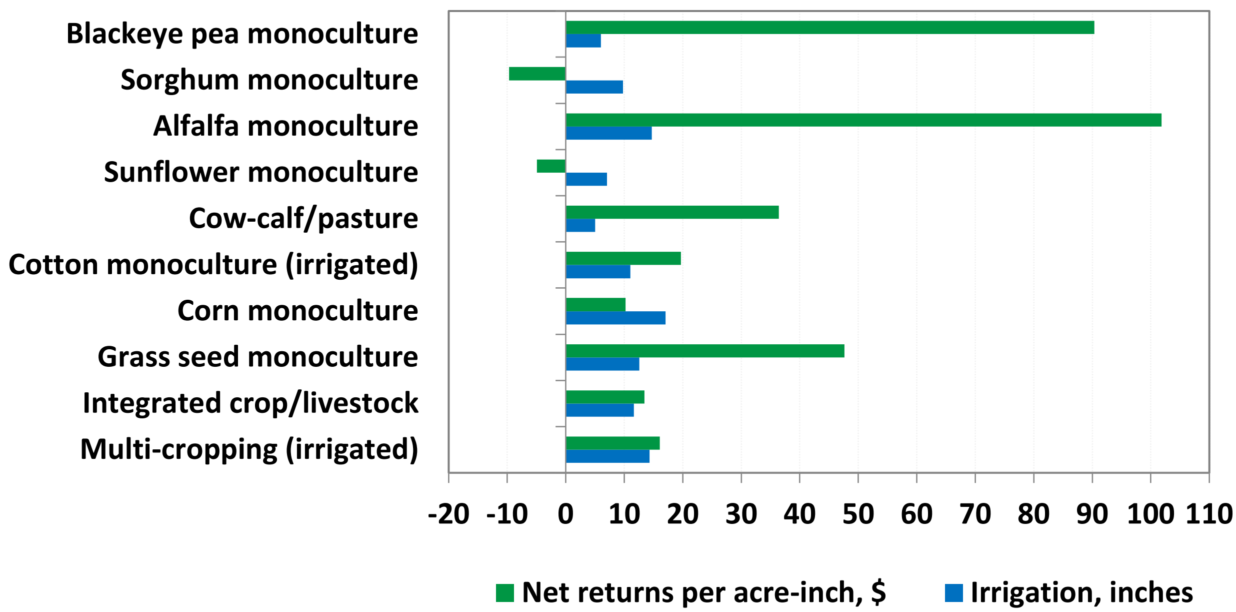

Figure 10. Net returns per acre-inch of irrigation water (green bars), and inches of irrigation applied (blue bars), average of 2005-2018. Data for cow-calf/pasture includes 2005-2010 only, for alfalfa monoculture 2014-2015 only, 2 years for blackeye pea, 2015 and 2017, sorghum in 2014 only, sunflower in 2008, 2009 and 2016 only.

Dryland cotton and dryland multi-cropping received the least nitrogen fertilizer per system acre, followed by sorghum monoculture and cow-calf operations on perennial grass pastures (Figure 11). In contrast, corn monoculture represented the other extreme with 190 lbs N/acre. Multi-cropping systems were second highest, receiving 142 lbs N/acre. Multi-cropping systems frequently have had corn as a component increasing nitrogen input. All other systems received from about 39 to 133 lbs/acre of N.

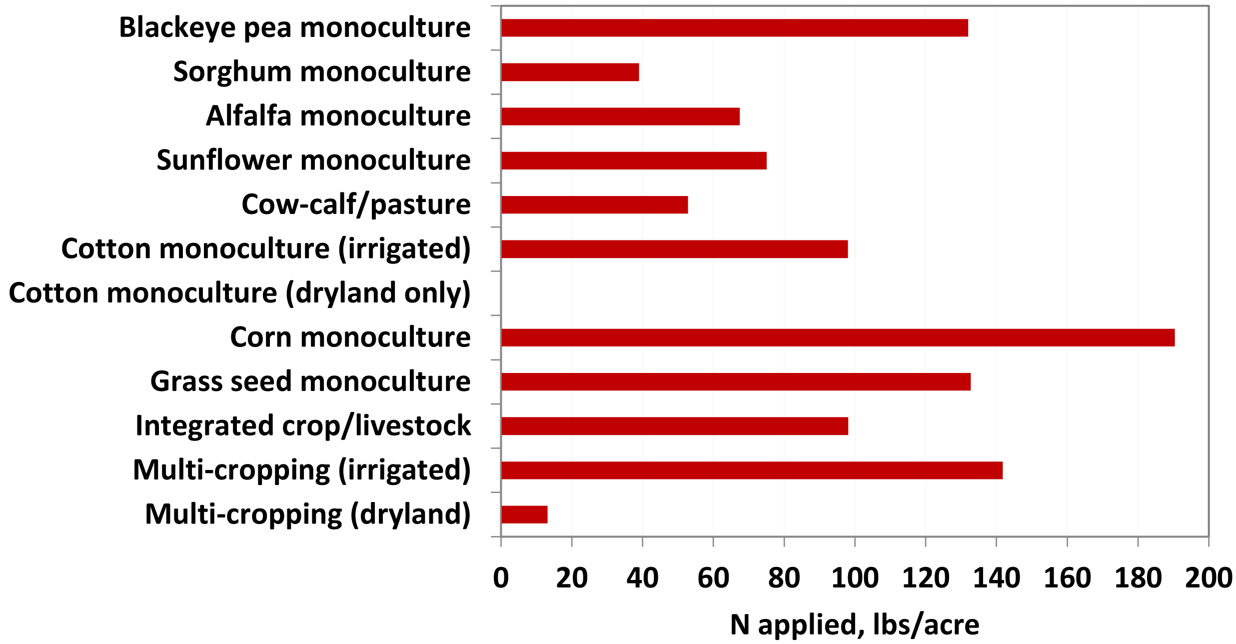

Figure 11. Pounds of nitrogen per system acre applied in commercial fertilizer, average of 2005-2018. Data for cow-calf/pasture includes 2005-2010 only, for alfalfa monoculture 2014-2015 only, for blackeye pea 2015 and 2017, sorghum in 2014 only, sunflower in 2008, 2009 and 2016 only.

Water Use and Efficiency Discussion

Depth to water in the Ogallala Aquifer has been monitored annually by the High Plains Underground Water Conservation District for many years. The District used those measurements and saturated thickness data to calculate the amount of water stored in an area defined by a perimeter around the TAWC producer sites taking part in Phase I in Floyd and Hale Counties (see Figure 12 for map of the perimeter). The graph in Figure 13 tracks the amounts of water storage in that area as a percentage of the 2003 measurement. The measurement time was January; therefore, the values reflect the change that occurred over the previous calendar year. Starting in 2007, water storage declined at a fairly constant rate over 8 years to 73% of the initial amount in 2003. The small decline in 2011 reflected the above-normal rainfall during 2010. Subsequently, the sharp drop at the 2012 reading was a response to the severe drought of 2011, which intensified the demand for irrigation. The high rainfall amount in 2015 reduced the amount of irrigation that year, contributing to no net change in the 2016 reading. The modest decline in the 2017 reading occurred after a year of 16.6 inches of rainfall, which was below the long-term average; however, rain events were well timed so as to relieve some need for irrigation. There was only a 0.2 percentage-point drop in water volume in 2018 despite below average rainfall for the year and for the May-September irrigation season.

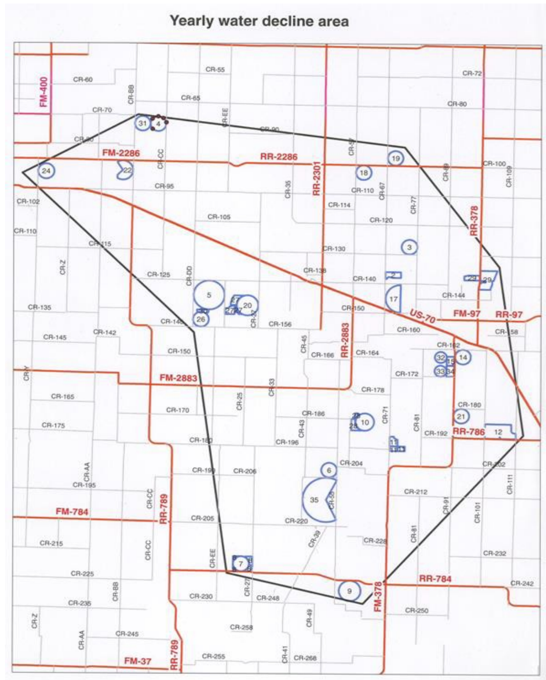

Figure 12. Original TAWC project area for determining water in storage (area encompassed within solid black line; 97,900 total acres) and cooperator demonstration sites (areas in blue symbols).

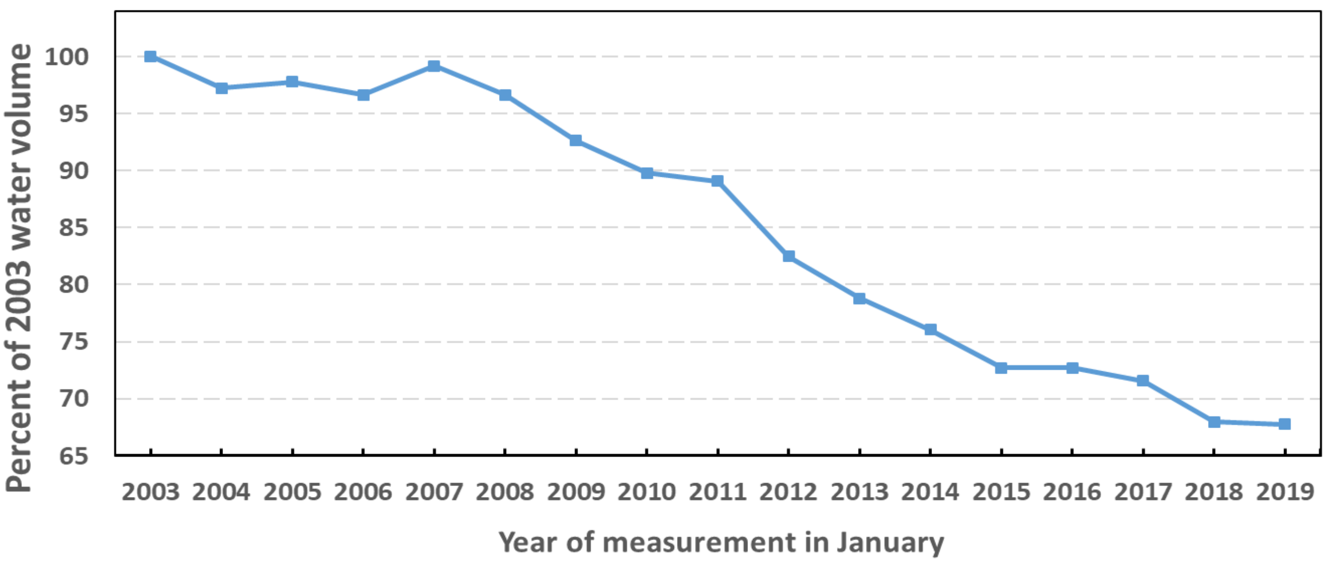

Figure 13. Graph of volume of water change in percent for Hale and Floyd Counties, January 2019. The 2019 value is at 67.7% of what it was in 2003, and only 0.2% points lower than 2018. Volume in 2003 was 1,748,630. Volume in January 2019 is 1,184,999.

Delivering water more precisely to the crop roots by using improved irrigation equipment, and timing that water delivery according to actual crop needs (based on monitoring soil moisture and evapotranspiration) results in conservation of the aquifer. We have calculated the amount of groundwater potentially saved for each year of the TAWC project. It is calculated as the difference between the total amount of water required to replace 100% of crop water demand and the amount which was provided by rainfall (assuming 50% effectiveness), stored soil water from before the growing season, and irrigation, summed over all sites. Details of those calculations are found in Water and Crop Use Efficiency Summaries (p. 25-31) and in Tables 3 to 6. In 2018, the amount of irrigation water potentially conserved was 2,030 acre-feet over 2,434 acres, or 10.6 inches of depth (Table 4). Over the 14 years of the project, the annual depth of water conserved averaged 12.5 inches (Table 4).

Saving water involves reducing unnecessary irrigations and targeting total water received to less than 100% crop water demand. The reason to aim short of 100% is that most crops can achieve near maximum yield when water is provided at 70-80% of crop water demand. In 2018, irrigation provided an average of 53% of crop water demand, while effective rainfall provided an additional 27%, with no soil storage collected, for a total of 80% (Table 3). Total crop water supply ranged from 20% to 178% of crop water demand among the sites that were not hailed out. The occurrence of sites receiving greater than 80% of crop water demand illustrates room for further improvements in conserving water, of which there were 13 out of 21 sites. Greater use of the TAWC online irrigation scheduling tool and equipment demonstrated by this project can help reduce irrigation needs. See Table 6 for means of water use efficiency by crop type.

Overall Discussion

Over 14 years of the project we have observed a number of system configurations under varied environmental conditions, irrigation technologies, and market conditions. Management is the key to how these systems behave under the extreme year to year variations. Producers make strategic and tactical production decisions to maintain economic viability and utilize available resources efficiently. Strategic decisions relate to crop and livestock enterprise selection, whether it is year to year crop selection or longer-term planning. Planting perennial grasses for seed and pasture production, integrating livestock into an operation, and the selection of irrigation technologies are examples of "strategic" *decisions*. "Tactical" *decisions* relate to enterprise management within the growing season, such as variety selection, fertilizer management, irrigation scheduling and harvest timing. There are many irrigation management technologies such as FieldNet®, SmartField™, Crop Metrics™, and AquaSpy®, which aid specifically in the tactical decision process. Over the years of the project we have provided various technologies to producers within the TAWC project. Information received from these technologies in conjunction with measurement of evapotranspiration (ET) on a field by field basis has helped producers gain insight into better irrigation management techniques. Feedback from producers who have used these technologies has helped us formulate tools to address the short-term and long-term irrigation management challenges facing the region. Continual adoption of water-saving technologies and monitoring will contribute to advances in the efficiency of water applied and amounts of water saved.

Various management tools have been developed and made freely available to producers in the region through the TAWC Solutions web site (http://www.tawcsolutions.org). These include an Irrigation Scheduler, Resource Allocation Analyzer, Heat Unit Calculator for corn and cotton, and a general Daily Cotton Water Use Tracker. In 2017, the TAWC Heat Unit Calculator was enhanced by integrating the use of an existing web-based Agro-Climate Monitor from USDA-ARS. The intent was to increase both function and coverage area by adding more weather stations from the Texas Tech, West Texas Mesonet. We continued using the enhanced Tracker in 2018 to increase the climate information available to aid producers in many weather-related crop management decisions. This included tracking precipitation, soil temperatures, cumulative hard freeze hours, growing degree days (heat units), and average first freeze dates.

The dissemination of results and information from the project through various outreach efforts is an important part of the project. The TAWC Annual Winter Field Day from previous years was modified in 2015, and in 2018 we held the fifth Annual TAWC Water College event to promote education in water conservation. See page 19 for the most recent Water College program agenda.

Summer field walks were also continued to demonstrate technologies and how to schedule irrigation in relation to meeting crop needs. See Task 6 beginning on page 48 for more detailed information. These field days and field walks allow attendees to visit project sites and observe the technologies that are currently being demonstrated within the project to better manage and monitor irrigation use and timing. In addition to the field days, the project was represented at several farm shows within the region. This allowed further dissemination of findings and information related to the project concerning demonstrations and producer interaction on the management tools that are being provided on the TAWC Solutions website. Detailed listings of outreach presentations, articles and activities are listed on pages 60-63 and beginning on p. 256 of appendix.

Texas Tech University is part of a consortium of eight universities and USDA research centers located across the Ogallala Aquifer region who received a $10 million grant from the USDA in 2016 to conduct research and extension activities related to conserving irrigation water to prolong the profitability of agriculture (http://ogallalawater.org). TAWC activities are now connected to extension, information exchange, and technology transfer efforts across the region so that producers and water policymakers can access the latest developments in promoting efficient water use. This consortium will extend the visibility and geographic reach of education and technology delivered by TAWC. More details are described in the Task 8 report beginning on page 52.

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

5th Annual Water College

January 17, 2019
Lubbock Memorial Civic Center
Lubbock, TX

__**Morning Sessions:**__

8:30 am	**Registration and exhibits**	
8:50 am	**Welcome & Introductions**	***Dean Bill Brown**, College of Agricultural Sciences and Natural Resources, TTU* ***Cameron Turner**, Manager, Agricultural Water Conservation Program, TWDB*
9:15 am	**Utilizing Cover Crops and Irrigation Technology**	***Kelly Kettner**, Bailey County Producer* ***Jeff Miller**, Forefront Agronomy*
10:15 am	**Utilizing New Online Tools for Producers**	**Shawn Wade**, *Plains Cotton Growers*
10:45 am	**Break with exhibits**	
11:00 am	**Cotton Yield Response to Water and Cropping Alternatives Based on Water Economy**	***Bob Glodt,** AgriSearch Consulting*
11:40 am	**Caught in the Crossfire: The US Sorghum Industry's Battle with the Chinese Ministry of Foreign Commerce.**	**John Duff**, *National Sorghum Producers*
12:10 pm	**Keynote Address**	**Dr. Lawrence Schovanec,** *President of Texas Tech University*

The TAWC project was made possible through a grant from the
Texas Water Development Board

Afternoon Sessions:

12:30 pm **Lunch**

1:15 pm **From Farm to Brands: US Cotton Industry's Approach to Sustainability**

***Jesse Daystar**, Cotton Inc.*

1:45 pm **Texas Water Law and Policy Update**

***Victoria Whitehead**, High Plains Undergound Water District*

2:15 pm **Break with exhibits**

2:40 pm **Update from Texas Water Development Board**

***Kathleen Jackson**, Texas Water Development Board*

3:00 pm **Upcoming Weather Patterns Video**

***Brian Bledsoe**, Chief Meteorologist & Climatologist, Colorado Springs*

3:30 pm **Close**

TAWC

TEXAS ALLIANCE FOR WATER CONSERVATION

The TAWC project was made possible through a grant from the

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High Plains Water District*
Hurst Farm Supply*
Lindsay Sales and Service*
Miller Chemical*
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Ogallala CAP Project*
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***Please see Display Booth in Exhibit Hall.**

2018 Weather data (See Appendix for 2005-2017 data)

The 17 active project sites received below-average rainfall in 2018 with an overall mean of 15.6 inches, using Plainview, TX for the long-term average (Figure 14). Precipitation was below-average from January through August, except for an average June. Temperature was above average for most of growing season from May through August. September and October had above-average rainfall with normal temperatures and July through September had significantly higher rainfall with near normal temperatures. Rainfall by site (Table 2) indicates an average below normal range in precipitation from an average of 10.7 to a single site with 22 inches across all TAWC Sites.

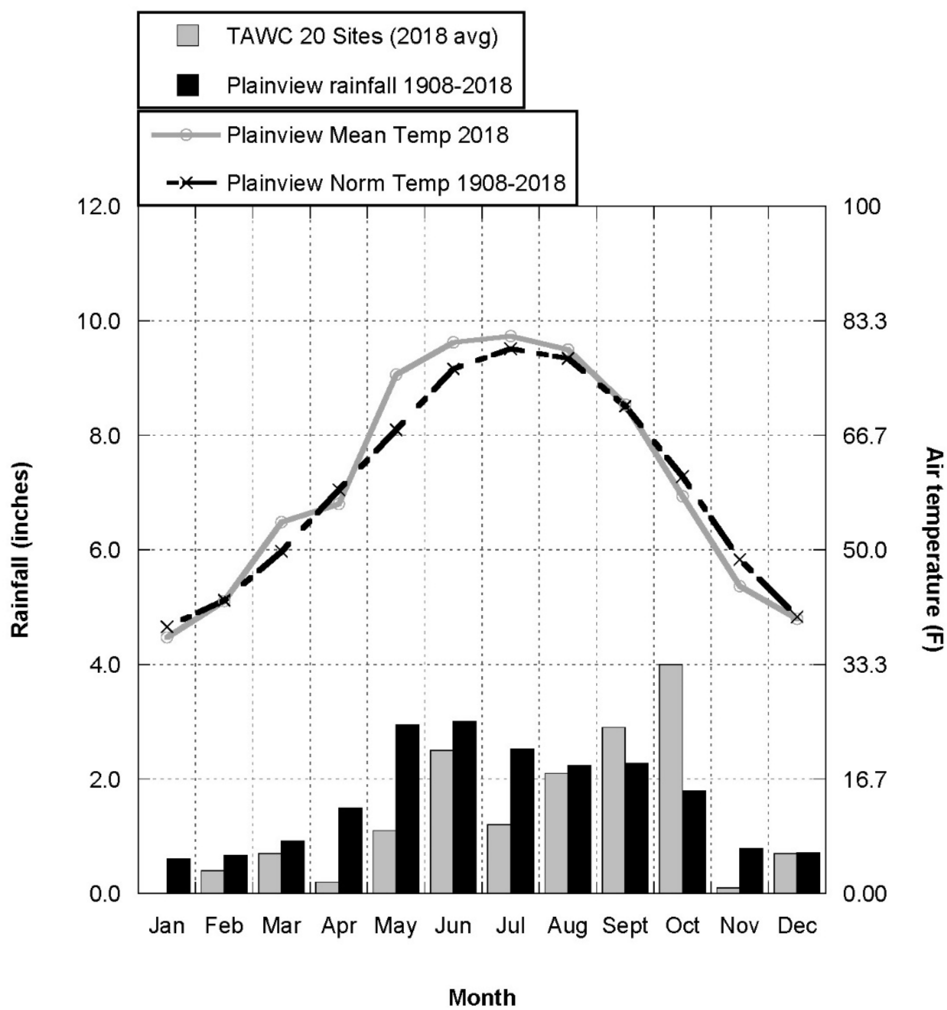


Figure 14. Temperature (lines) and precipitation (bars) by month for 2018 near the demonstration area (Plainview, TX) compared with long term averages.

Table 2. Precipitation (inches) at each site in the demonstration area during 2018.

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
4	0.0	0.7	0.7	0.4	1.5	3.6	1.0	1.5	2.2	4.2	0.1	0.5	**16.5**
9	0.0	0.3	1.0	0.3	0.9	2.3	1.5	2.1	3.1	3.9	0.1	0.9	**16.3**
10	0.0	0.4	0.8	0.2	1.0	3.6	0.8	1.8	3.5	3.5	0.0	0.7	**16.5**
11	0.0	0.4	0.8	0.3	0.6	2.3	0.1	2.5	3.7	3.5	0.1	0.9	**15.1**
14	0.0	0.4	0.7	0.1	0.4	3.4	1.4	1.9	3.2	2.8	0.1	0.7	**15.0**
17	0.0	0.6	1.0	0.2	0.8	7.4	1.3	2.5	2.5	4.8	0.1	0.8	**22.0**
21	0.0	0.4	1.0	0.2	1.5	2.3	1.7	3.4	3.6	3.5	0.1	0.9	**18.5**
22	0.0	0.7	0.1	0.0	0.8	0.4	0.3	1.5	2.2	4.2	0.1	0.4	**10.7**
31	0.0	0.7	0.7	0.4	1.5	3.6	1.0	1.5	2.2	4.2	0.1	0.5	**16.5**
32	0.0	0.4	0.8	0.2	0.7	2.9	1.7	1.6	3.0	2.8	0.0	0.9	**15.0**
35	0.0	0.4	1.0	0.2	1.5	2.3	1.7	3.4	3.6	3.5	0.1	0.9	**18.5**
C37	0.0	0.4	0.9	0.1	0.9	1.6	0.5	2.2	2.6	4.0	0.1	0.7	**13.9**
C38	0.0	0.4	1.0	0.0	0.3	1.4	0.3	1.7	3.4	4.6	0.1	0.8	**13.9**
C39	0.0	0.5	0.0	0.0	2.3	1.1	1.0	0.9	1.4	3.2	0.0	1.0	**11.4**
C50	0.0	0.1	0.9	0.0	1.4	2.6	1.1	1.2	3.7	5.1	0.1	0.9	**17.1**
C51	0.0	0.1	0.9	0.0	1.4	2.6	1.1	1.2	3.7	5.1	0.1	0.9	**17.1**
C56	0.0	0.2	0.3	0.7	0.7	1.0	3.9	2.3	2.8	3.9	0.1	0.1	**15.8**
C57	0.0	0.0	0.1	0.1	0.8	1.2	1.6	2.0	1.6	6.1	0.0	0.3	**13.9**
C60	0.0	0.6	0.2	0.6	1.0	2.0	0.8	2.7	2.6	3.3	0.1	0.5	**14.4**
Avg	**0.0**	**0.4**	**0.7**	**0.2**	**1.1**	**2.5**	**1.2**	**2.1**	**2.9**	**4.0**	**0.1**	**0.7**	**15.6**

*Greyed sites had no field data collected for 2018

Water and Crop Use Efficiency Summaries

Philip Brown and Chuck West

Total Irrigation, Crop Water Use and Water Conserved
Definitions and Methods

Table 3 lists information on 2018 crop water use and irrigation water conserved in the 24 fields that made up the 17 sites for which data are available. Collected data include **site**, **field**, **crop**, special harvest **status**, **irrigation type, acres, rainfall,** and **irrigation** amount for each field. From these inputs, crop water demand and use were calculated to estimate the amount of irrigation water potentially conserved; that is the amount of groundwater pumped which was less than the amount needed to meet 100% of ET replacement (crop water demand).

Seasonal rainfall is based on individual sites and represents an estimated 50% effective rainfall received during the growing season (approximately planting to harvest). This is the amount of rainfall contributing to plant-available water in the soil. In TAWC annual reports covering 2005 to 2013, rainfall was considered to be 70% effective to correct for estimated losses to runoff, evaporation, and deep percolation. The 2014 report revised all water use estimates from 2005-2013 to 50% effective rainfall which has now become the standard. Rain events in the High Plains tend to be high intensity, resulting in ponding and slow infiltration and therefore high evaporation losses. 50% was deemed as a more realistic effective rainfall correction factor based on the typical rain intensity for this area, and the NRCS (retired) representative recommended we adopt the 50% effective rainfall using FAO formulas (http://www.fao.org/docrep/S2022E/s2022e08.htm). **Total irrigation** (inches) is the total amount of irrigation applied to each individual site's crop. **Soil moisture contribution** (inches) refers to the difference between beginning and end-of-season plant-available soil water contents. Gravimetric soil water measurements are made by extracting soil with a hand corer to a maximum depth of 3 feet in 1-foot increments. Inability to punch to a depth resulted in an assumed 0% plant-available soil water content below that depth. Gravimetric soil water content was converted to plant-available water based on the site-specific soil texture, bulk density, wilting point and maximum available water capacity values from NRCS SSURGO from the USDA Natural Resources Conservation Service (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053627). No gravimetric soil water measurements were made for 2018 due to limits in personnel.

Total crop water supplied is the sum of 50% effective rainfall, total irrigation and plant-available soil water contribution. **ET crop water demand** is the average crop water demand (inches) required for an individual crop at 100% potential ET based on crop-specific coefficients and/or a standardized estimated season ET value based on research experience and history with crops lacking these coefficients. Use of an estimated ET value when specific crop coefficients were not available enabled calculation of the ET crop water demand (potential ET) for all sites and crops within the project. Percentages of **crop water demand provided by rainfall (50% effective), irrigation,** and plant-available **soil moisture** (when available) illustrate the breakdown of crop water supplied by each of these sources. **Total**

crop water demand provided by total crop water (%) is the sum of the three sources of water.

Total irrigation potentially conserved in acre-feet is the total amount of irrigation water estimated to have been conserved across all irrigated project acres below the **100% season crop ET water demand**. Acre-feet was converted to inches of depth so that fields, crop types, and years involving different acreages could be compared.

Results and Discussion

Total crop water supplied during the 2018 cropping year provided an average of 80% of the total crop water demand across the TAWC fields and ranged from 3 (hailed out cotton field) to 178 % (Table 3, third column from the right). Irrigation at greater than 100% crop water demand indicates excessive water application with 8 fields among the 24 total fields exceeding 100% (17 sites) in 2018, therefore considered to be over-watered. On average across all sites and irrigation systems, irrigation alone provided 53% of the total crop water demand with 27% provided by effective in-season rainfall. These variables total to the 80% crop water demand being provided by the total crop water supplied excluding soil moisture reserves. Stored plant-available soil moisture was not collected for 2018 due to the difficulty in collection and lack of available personnel. The estimated total irrigation potentially conserved across the TAWC project sites totaled 2,030 acre-feet for the growing season.

Newer irrigation systems, while designed for greater efficiency of water delivery to the crop, sometimes result in excessive water being applied rather than conserving water because of lack of careful monitoring of soil and crop water status. This indicates a need for increased user awareness and education on the operation and management of advanced irrigation systems such as subsurface drip and the potential of newer technologies such as variable rate irrigation. Greater use of the TAWC online irrigation scheduling tool and new technology demonstration within this project will continue to aid in reducing over-irrigation and potentially improve water conservation.

Table 3. Total water use summary by individual fields across the TAWC sites in 2018.

Year	Site	Field	Crop	Status	Irrigation type	Field Acres	50% Effective season rainfall (inches)	Total irrigation (inches)	Soil moisture contribution to WUE (inches)	Total crop water supplied (inches)	ET crop water demand (inches)	Crop water demand provided by rainfall (%)	Crop water demand provided by irrigation (%)	Crop water demand provided by soil moisture (%)	Crop water demand provided by total crop water (%)	Total irrigation potentially conserved (acre-feet)	Indexed depth (inches)
2018	9	1	Grass	Grazed	MESA	100.8	7.0	0.0	na	7.0	9.8	71%	0%	na	71%	81.9	9.8
2018	9	5	Cotton		MESA	135.0	6.9	19.5	na	26.4	20.0	35%	98%	na	132%	5.6	0.5
2018	10	6	Grass	Grazed	LESA	57.7	5.4	12.0	na	17.4	9.8	55%	123%	na	178%	-10.8	-2.3
2018	10	3	Wheat		LESA	116.6	0.6	3.0	na	3.6	18.0	3%	17%	na	20%	145.8	15.0
2018	10	3	Cotton	Hail out	LESA	116.6	0.5	0.0	na	0.5	20.0	3%	0%	na	3%	194.3	20.0
2018	10	3	Forage Sorghum	Hay	LESA	116.6	4.3	6.0	na	10.3	27.0	16%	22%	na	38%	204.1	21.0
2018	11	9	Cotton	Hail out	FUR	15.0	4.8	0.0	na	4.8	20.0	24%	0%	na	24%	25.0	20.0
2018	11	13	Corn	Cotton Hail	SDI	80.0	4.8	15.0	na	19.8	35.0	14%	43%	na	56%	133.3	20.0
2018	14	4	Cotton	2 in – 2 out	MESA	124.1	6.5	15.0	na	21.5	20.0	33%	75%	na	108%	51.7	5.0
2018	17	5	Corn		LEPA	54.5	8.7	23.0	na	31.7	35.0	25%	66%	na	91%	54.5	12.0
2018	17	6	Cotton		LEPA	54.4	9.7	14.0	na	23.7	20.0	48%	70%	na	118%	27.2	6.0
2018	21	1	Wheat	Double crop	LEPA	60.1	2.4	9.0	na	11.4	18.0	13%	50%	na	63%	45.1	9.0
2018	21	1	Millet	Double crop	LEPA	60.1	3.1	2.8	na	5.9	20.0	16%	14%	na	29%	86.4	17.3
2018	21	2	Cotton		LEPA	60.6	7.3	10.3	na	17.5	20.0	36%	51%	na	88%	49.2	9.8
2018	22	1	Cotton		LEPA	145.0	4.8	20.8	na	25.6	20.0	24%	104%	na	128%	-9.1	-0.8
2018	32	1	Cotton		LEPA	70.0	6.4	10.8	na	17.2	20.0	32%	54%	na	86%	53.7	9.2
2018	35	4	Cotton		SDI	115.0	7.8	15.6	na	23.4	20.0	39%	78%	na	117%	42.6	4.5
2018	35	5	Corn	White Food	SDI	115.0	4.6	18.1	na	22.6	35.0	13%	52%	na	65%	162.4	17.0
2018	C37	1	Cotton		VRI	124.0	5.9	19.0	na	24.9	20.0	29%	95%	na	124%	10.3	1.0
2018	C38	2	Cotton		VRI	242.7	6.1	13.0	na	19.1	20.0	31%	65%	na	96%	141.6	7.0
2018	C39	1	Corn		LESA/LEPA	60.0	3.9	16.8	na	20.7	35.0	11%	48%	na	59%	91.3	18.3
2018	C39	2	Cotton		LESA/LEPA	60.0	5.1	16.0	na	21.1	20.0	25%	80%	na	105%	20.0	4.0
2018	C50	1	Cotton		LESA/VRI	120.6	6.9	10.6	na	17.5	20.0	35%	53%	na	87%	94.7	9.4

Table 3. Continued

Year	Site	Field	Crop	Status	Irrigation type	Field Acres	50% Effective Season rainfall (inches)	Total irrigation (inches)	Soil moisture contribution to WUE (inches)	Total crop water supplied (inches)	ET crop water demand (inches)	Crop water demand provided by rainfall (%)	Crop water demand provided by irrigation (%)	Crop water demand provided by soil moisture (%)	Crop water demand provided by total crop water (%)	Total irrigation potentially conserved (acre-feet)	Indexed depth (inches)
2018	C51	1	Cotton		SDI	45.7	7.3	9.8	na	17.0	20.0	36%	49%	na	85%	39.0	10.3
2018	C56	1	Corn		LESA	60.0	3.9	16.0	na	19.9	35.0	11%	46%	na	57%	95.0	19.0
2018	C57	1	Cotton		LESA	124.0	6.7	6.0	na	12.7	20.0	33%	30%	na	63%	144.7	14.0
2018	C60	1	Cotton		LESA	59.5	6.2	9.8	na	16.0	20.0	31%	49%	na	80%	50.6	10.2
Average							**5.4**	**11.5**			**22.1**	**27**	**53**	**na**	**80**		
Total						**2200**										**2030**	

MESA-Mid elevation spray application, LESA- Low elevation spray application, LEPA-Low energy spray application, VRI-Variable rate irrigation, SDI- Subsurface drip irrigation

Table 4 is a summary across all 14 years of the project for the sources of plant-available water. The data are based on 50% effective season rainfall, plant-available soil moisture (average, if available), and total irrigation applied. The average total crop water demand supplied by rainfall ranged from 6.8% in 2011 receiving 5.3 inches, which was the most severe drought year in the history of the area, to 51.2% in 2010 with 28.9 inches of annual rainfall, which was the second wettest year for the project. The differences in rainfall were balanced by differences in irrigation.

Table 4. Amounts and percentage make-up of the sources of water contributing to total crop water use averaged across fields and calculation of amount and depth of irrigation potentially conserved for TAWC sites in 2005-2018.

Year	Field acres	Annual rainfall (inches)	Average season rainfall (50% effective-inches)	Average total irrigation (inches)	Average ET crop water demand (inches)	Average crop water demand provided by rainfall (%)	Crop water demand provided by soil moisture (%)	Average crop water demand provided by irrigation (%)	Average crop water demand provided by total crop water (%)	Total irrigation potentially conserved all sites (acre-feet)	Indexed depth (inches)
2005	3939	14.9	5.4	8.2	22.5	25.4	na	35.9	61.3	5,134	15.6
2006	4132	15.5	4.2	13.2	25.2	18.0	1.9	52.1	72.1	4,526	13.1
2007	4058	27.0	8.6	8.9	18.9	50.4	na	46.7	97.1	4,130	12.2
2008	3996	21.8	9.1	11.3	22.1	44.7	-6.9	49.0	87.9	4,139	12.4
2009	3861	15.1	5.4	10.5	23.6	27.0	14.7	44.8	82.2	4,365	13.6
2010	3934	28.5	9.6	7.9	21.7	51.2	-14.3	34.7	78.5	4,841	14.8
2011	4033	5.3	1.5	19.0	26.7	6.8	17.6	76.6	89.2	3,475	10.3
2012	3962	9.9	3.6	13.8	26.1	15.9	8.4	58.7	79.6	5,131	15.5
2013	4552	13.2	5.2	14.6	23.5	24.7	8.7	63.8	92.6	4,099	10.8
2014	5114	21.2	8.6	11.5	23.2	41.1	4.1	50.0	95.4	5,454	12.8
2015	3740	30.5	7.3	11.1	25.3	32.5	17.2	42.7	92.5	4,429	14.2
2016	2826	16.6	6.3	11.6	23.2	30.2	2.6	49.5	81.4	2,629	11.2
2017	2656	21.5	8.0	10.9	20.5	43	na	51.8	94.8	1882	8.5
2018	2434	15.6	5.4	11.5	22.1	27	na	53	80	2030	10.6
Average		**18.5**	**6.3**	**11.7**	**23.2**	**31.3**	**5.4**	**50.7**	**84.6**	**4,019**	**12.5**

Crop Water Use Efficiency - 2018

Table 5 lists information related to 2018 crop water use efficiency. Data include **site**, **field**, **crop**, special harvest **status**, **irrigation type**, **acres, harvest yield** (lbs/acre), **in-season irrigation** (inches) and **in-season total crop water supplied** (inches), which includes in-season irrigation, plant-available soil water, and 50% in-season effective rainfall (planting to harvest) for each site, field, and crop. Crop water use efficiency is presented as **pounds of harvest product** (lint, in the case of cotton) **per acre-inch of irrigation** water applied and the **pounds per acre-inch of total water** input.

Table 5. Crop water use efficiency summary by fields across the TAWC sites in 2018.

Year	Site	Field	Crop	Status	Irrigation type	Field Acres	Harvest yield (lbs/acre)	In-season irrigation (inches)	In-season total crop water supplied (inches)	WUE of irrigation (lbs/acre-inch)	WUE of total water (lbs/acre-inch)
2018	9	1	Grass	Grazed	MESA	100.8		0.0	7.0	na	na
2018	9	5	Cotton		MESA	135.0	1,666	19.5	26.4	85.4	63.0
2018	10	6	Grass	Grazed	LESA	57.7		12.0	17.4	na	na
2018	10	3	Wheat		LESA	116.6		3.0	3.6	na	na
2018	10	3	Cotton	Hail out	LESA	116.6	Ins.	0.0	0.5	na	na
2018	10	3	Forage Sorghum	Hay	LESA	116.6	2,800	6.0	10.3	466.7	273.2
2018	11	9	Cotton	Hail out	FUR	15.0	0	0.0	4.8	0	0
2018	11	13	Corn	Cotton Hail	SDI	80.0	8,170	15.0	19.8	544.7	413.7
2018	14	4	Cotton	2 in – 2 out	MESA	124.1	1,150	15.0	21.5	76.7	53.5
2018	17	5	Corn		LEPA	54.5	13,216	23.0	31.7	574.6	416.9
2018	17	6	Cotton		LEPA	54.4	1,850	14.0	23.7	132.1	78.2
2018	21	1	Wheat	Double crop	LEPA	60.1	2,760	9.0	11.4	306.7	241.7
2018	21	1	Millet	Double crop	LEPA	60.1	4,560	2.8	5.9	1,658.2	779.5
2018	21	2	Cotton		LEPA	60.6	1,210	10.3	17.5	118.0	69.1
2018	22	1	Cotton		LEPA	145.0	1,558	20.8	25.6	75.1	60.9
2018	32	1	Cotton		LEPA	70.0	1,850	10.8	17.2	171.3	107.9
2018	35	4	Cotton		SDI	115.0	1,995	15.6	23.4	128.3	85.4
2018	35	5	Corn	White Food	SDI	115.0	9,856	18.1	22.6	546.0	436.1
2018	C37	1	Cotton		VRI	124.0	1,724	19.0	24.9	90.7	69.4
2018	C38	2	Cotton		VRI	242.7	358	13.0	19.1	27.5	18.7
2018	C39	1	Corn		LESA/ LEPA	60.0	12,824	16.8	20.7	765.6	619.7
2018	C39	2	Cotton		LESA/ LEPA	60.0	2,328	16.0	21.1	145.5	110.5
2018	C50	1	Cotton		LESA/ VRI	120.6	807	10.6	17.5	76.3	46.2
2018	C51	1	Cotton		SDI	45.7	964	9.8	17.0	98.9	56.7
2018	C56	1	Corn		LESA	60.0	45,880	16.0	19.9	2,867.5	2,300.3
2018	C57	1	Cotton		LESA	124.0	1,321	6.0	12.7	220.2	104.3
2018	C60	1	Cotton		LESA	59.5	1,062	9.8	16.0	108.4	66.4

Water use efficiency comparisons among crops are difficult to compare because the nature of the harvested material is different; for example, pounds of lint, grain, or forage. In Table 6 we show the average yields, irrigation supplied, total water supplied, and calculated WUE by crop type calculated on irrigation basis and total water supplied basis.

Table 6. Water use efficiency (WUE) based on irrigation supplied and total water supplied averaged by harvested crop type across fields in 2018.

Crop	Number of fields	Total field acres	Average Harvest yield (lbs/acre)	Average In-season irrigation (inches)	Average In-season total crop water supplied (inches)	Average WUE of irrigation (lbs/acre-inch)	Average WUE of total water (lbs/acre-inch)
Corn grain	4	309.5	11,017	18.2	23.7	607.7	471.6
Corn silage	1	60.0	45,800	16.0	19.9	2,867.5	2,300.3
Cotton lint	14	1,612.2	1,417	11.9	20.2	111.0	61.9
Wheat grain	1	60.1	2,760	7.0	11.4	306.7	241.7
Forage sorghum hay	1	116.6	2,800	6.0	10.3	466.7	273.2
Millet hay	1	60.1	4,560	2.75	5.9	1,658.2	779.5

Systems Management for Water Savings - 2018

It should be noted that water savings can also be achieved through management of the cropping system and tillage types being implemented. There are many benefits to minimum/no-till management practices, which can conserve water and/or improve infiltration and rainfall capture as well as other agronomic benefits to the overall system and soil health.

Crop selection and planting management can also have an impact on water use. For example, Site 14 is a pivot field with approximately 120 acres. This site implemented a 2 in, 2 out planting scheme every year since 2014 (2 planted rows alternating with 2 fallow rows). Water is applied only over the planted rows. This results in only half of the field area being planted and irrigated. Therefore, on a land-area basis, when 8 inches of irrigation is applied to the crop rows, only 4 inches of irrigation has been applied across the system acres. This constitutes a 50% water savings to the overall cropping system. Other systems can include individual fields that have been fallowed or the integration of low water use crops such as specialty crops and perennial grasses that use less water, combined with higher water-use crops allowing a producer to concentrate more water onto a smaller high-value cropping area, but achieve water savings on the whole land area. Education/outreach components focusing on such management practices are continually being improved through the TAWC efforts.

Table 7. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 17 of 19 producer sites in the project during 2018. (See Appendix for 2005-2017)

Site	Irrigation type	System acres	Cotton	Corn grain	Corn silage	Fallow	Grain sorghum	Seed sorghum	Forage sorghum	Alfalfa	Grass seed	Hay	Perennial forage	Cattle grazed	Wheat for grain	Wheat silage	Grazed wheat	Sunflower	Blackeye pea	Millet hay
4	LESA/LEPA	110.0																		
9	MESA	235.8	135										100.8	100.8						
10	LESA	174.3	116.6						116.6			116.6	57.7	174.3			116.6			
11	FUR/SDI	95.0	95	80		**15**														
14	MESA	124.1	124.1																	
17	MESA	108.9	54.4	54.5																
21	LEPA	120.7	60.6									60.1			60.1					60.1
22	LEPA	145.0	145.0																	
31	LEPA/LESA/ LDN/PMDI	121.9																		
32	LEPA	70.0	70.0																	
35	SDI	230.0	115.0	115.0																
C37	VR-LESA	124.0	124.0																	
C38	VR-LESA	242.7	242.7																	
C39	LESA/LEPA	120.0	60	60																
C50	LESA	120.6	120.6																	
C51	SDI	45.7	45.7																	
C56	LESA	60.0			60															
C57	LESA	124.0	124.0																	
C60	LESA	59.5	59.5																	
Total acres 2018		2432 (2200 active)	1612.2	309.5	60	15			116.6			176.7	158.5	275.1	60.1		116.6			60.1
Total # of Sites		19 (17 active)	16	4	1	1	0	0	1	0	0	2	2	2	1	0	1	0	0	1

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

Red denotes field crop failure/Insurance claim, **Yellow denotes original purpose altered, **Brown** denotes fallowed, Grey denotes no producer field data for this year.

Phase II Economic Summaries of Results from Monitoring Producer Sites in 2014-2018.

Phase II - Economic assumptions of data collection and interpretation

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

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

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

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

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

Economic Term Definitions

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

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

Gross Margin – Total revenue less total variable costs

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

Net Returns – Gross margin less fixed costs.

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

Phase II - Assumptions of energy costs, prices, fixed and variable costs (Tables 8-10)

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

Table 8. Electricity irrigation cost parameters for Phase II 2014-2018.

Item	2014	2015	2016	2017	2018
Gallons per minute (gpm)	450	250	250	250	250
Pumping lift (feet)	303	310	313	320	325
Discharge pressure (psi)	15	15	15	18	18
Pump efficiency (%)	60	60	60	50	50
Motor efficiency (%)	88	88	80	80	80
Electricity cost per kWh	$ 0.14	$ 0.10	$ 0.10	$ 0.11	$ 0.11
Cost of electricity per acre-inch	$ 8.26	$ 5.93	$ 6.14	$ 8.66	$ 9.12
Cost of maint. & repairs per acre-in.	$ 3.87	$ 3.15	$ 3.53	$ 3.16	$ 3.03
Cost of labor per acre-inch	$ 1.10	$ 1.10	$ 1.10	$ 1.10	$ 1.12
Total cost per acre-inch	$13.23	$10.18	$10.77	$12.92	$13.27

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

Table 9. Commodity prices for Phase II 2014-2018.

Commodity	2014	2015	2016	2017	2018
Cotton lint ($/lb)	$0.65	$0.63	$0.68	$0.68	$0.76
Cotton seed ($/ton)	$175	$190	$180	$150	$155
Grain sorghum-grain ($/cwt)	$7.10	$3.45	$3.45	$3.45	$3.45
Grain sorghum-seed ($/lb)	-	-	-	-	-
Corn-grain ($/bu)	$5.00	$4.76	$4.71	$4.71	$4.60
Corn-food ($/bu)	$5.99	$5.10	$5.10	$4.95	$5.10
Barley ($/cwt)	-	-	-	-	-
Wheat-grain ($/bu)	$6.85	$4.25	$4.25	$5.25	$4.25
Sorghum silage ($/ton)	$24.00	$24.00	$24.00	$24.00	$24.00
Corn silage ($/ton)	$30.60	$30.60	$30.60	$30.60	$37.75
Wheat silage ($/ton)	$26.59	$26.59	$26.59	$26.59	$26.59
Oat silage ($/ton) -	$14.58	$14.58	$14.58	$14.58	$14.58
Millet seed ($/lb)	$0.38	$0.50	$0.50	$0.32	$0.50
Sunflower ($/lb)	$0.38	$0.25	$0.25	$0.25	$0.25
Alfalfa ($/ton)	$264	$205	$140	$130	$140
Hay ($/ton)	$60	$60	$60	$60	$60
WW-BDahl hay ($/ton)	$40	$40	$40	$40	$40
Haygrazer ($/ton)	$80	$80	$80	$80	$80
Sideoats seed ($/lb)	$8.12	$8.12	$8.12	$8.12	$8.12
Sideoats hay ($/ton)	$35	$35	$35	$35	$35
Triticale silage ($/ton)	$45	$45	$45	$45	$45
Triticale forage ($/ton)	$140	$140	$140	$140	$140
Blackeye pea ($/cwt)	-	$40.00	$40.00	$40.00	$40.00

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

4. Other variable and fixed costs are given for Phase II 2014-2018 in Table 10.

Table 10. Other variable and fixed costs for Phase II 2014-2018.

VARIABLE COSTS	**2014**	**2015**	**2016**	**2017**	**2018**
Boll weevil assessment: ($/ac)					
Irrigated cotton	$1.00	$1.00	$1.00	$1.00	$1.00
Dryland cotton	$1.00	$1.00	$1.00	$1.00	$1.00
Crop insurance: ($/ac)					
Irrigated cotton	$40.00	$40.00	$40.00	$40.00	$40.00
Dryland cotton	$32.00	$32.00	$32.00	$32.00	$32.00
Irrigated corn	$15.50	$15.50	$15.50	$15.50	$15.50
Irrigated corn silage	$15.50	$15.50	$15.50	$15.50	$15.50
Irrigated wheat	$19.50	$19.50	$19.50	$19.50	$19.50
Irrigated sorghum grain	$29.00	$29.00	$29.00	$29.00	$29.00
Dryland sorghum grain	$16.50	$16.50	$16.50	$16.50	$16.50
Irrigated sorghum silage	$29.00	$29.00	$29.00	$29.00	$29.00
Irrigated sunflowers	$17.00	$17.00	$17.00	$17.00	$17.00
Cotton harvest – strip and module ($/lint lb)	$0.08	$0.08	$0.09	$0.09	$0.09
Cotton ginning ($/cwt)	$2.20	$2.20	$2.50	$2.50	$2.50
Bags, ties, & classing ($/bale)	$14.63	$14.63	$15.40	$15.40	$15.40

FIXED COSTS	**2014**	**2015**	**2016**	**2017**	**2018**
Irrigation system:					
Center pivot system	$40.00	$40.00	$40.00	$60.00	$40.00
Drip system	$75.00	$75.00	$75.00	$100.00	$75.00
Flood system	$25.00	$25.00	$25.00	$40.00	$25.00
Cash rent:					
Irrigated cotton, grain sorghum, sun-flower, grass, pearl millet, and sorghum silage.	$100.00	$100.00	$100.00	$130.00	$100.00
Irrigated corn silage, corn grain, and alfalfa.	$140.00	$140.00	$140.00	$130.00	$140.00
Dryland cropland	$30.00	$30.00	$30.00	$30.00	$30.00

5. The custom tillage and harvest rates used for 2018 were based on rates reported in Texas A&M AgriLife Extension, 2017 Texas Agricultural Custom Rates, May 2017.

Table 11. Summary of results from monitoring 19 producer sites during 2018 (Year 14).

System	Site No.	System Acres	Irrigation Type[1]	System inches	Net Return/ System acre	Net Return/ inch water	Gross margin per inch irrigation
Monoculture systems							
Corn	11	95	Fur/SDI	12.6	126.82	10.04	27.00
Cotton (2 in 2 out)	14	124.1	MESA	7.5	-7.92	-1.06	11.62
Cotton	22	145.0	LEPA	20.8	119.23	5.75	14.90
Cotton	32	70.0	LEPA	10.8	462.31	42.81	60.40
Cotton	C37	124.0	VRI	19.0	355.31	18.70	30.81
Cotton	C38	242.7	VRI	13.0	-542.85	-41.76	-27.14
Cotton	C50	120.6	LESA/VRI	10.6	-156.78	-14.82	3.14
Cotton	C51	45.7	SDI	9.8	-108.22	-11.10	12.49
Corn	C56	60.0	LESA	16.0	150.65	9.42	21.92
Cotton	C57	124.0	LESA	6.0	298.31	49.72	81.39
Cotton	C60	59.5	LESA	9.8	42.37	4.32	23.71
Multi-crop systems							
Corn/Cotton	17	108.9	MESA	18.5	254.68	13.76	22.68
Wheat/Millet/Cotton	21	120.7	LEPA	11.0	-116.60	-10.60	6.67
Corn/Cotton	35	230.0	SDI	16.8	13.65	0.81	14.80
Corn/Cotton	C39	120.0	LESA/LEPA	16.4	459.90	28.08	39.98
Crop-Livestock systems							
Perennial grass: contract grazing/Cotton	9	235.8	MESA	11.2	61.61	5.52	20.24
Perennial grass: contract grazing, /Corn/Cotton	10	174.3	LESA	10.0	-120.97	-12.11	6.91

[1]SDI – Subsurface drip irrigation; MESA – Mid elevation spray application; LESA – Low elevation spray application; LEPA – Low energy precision application; LDN – Low drift nozzle; VRI – Variable rate irrigation; FUR – furrow irrigation; DL – dryland

Table 12. Summary of crop production, irrigation and economic returns within all production sites for Phase I (See Appendix for detailed list by year) and Phase II 2014-18.

Item			Average Phase I 2005-2013	Phase II 2014	Phase II 2015	Phase II 2016	Phase II 2017	Phase II 2018	2005-2018 Crop Year Average
Crop			(yrs)	(fields)	(fields)	(fields)	(fields)		
	Cotton								
		Lint, lbs	1,300 (9yr)	1,138 (20)	1,258 (16)	1,360 (18)	1,294 (18)	1,417 (14)	1,298
		Seed, tons	0.9	0.8 (20)	0.9 (16)	1.0 (18)	0.9 (18)	1.0 (14)	0.9
	Corn								
		Grain, lbs	10,680 (9yr)	11,538 (8)	10,452 (19)	9,996 (9)	11,830 (6)	11,017 (4)	10,783
		Silage, tons	26.8 (8yr)	16.4 (4)	-	22 (1)	-	22.9 (1)	25.1
	Sorghum								
		Grain, lbs	5,231 (9yr)	6,675 (7)	3,944 (3)	6,748 (1)	-	-	5,371
		Silage, tons	18.5 (5yr)	-	-	-	-	-	18.5
		Seed, lbs	3,507 (1yr)	-	-	-	-	-	3,507
	Wheat								
		Grain, lbs	2,458 (8yr)	1,333 (1)	3,652 (3)	-	2,400 (1)	2,760	2,484
		Silage, tons	8.6 (4yr)	-	-	-	-	-	8.6
		Hay, tons	1.5 (2yr)	-	-	-	-	-	1.5
	Oat								
		Silage, tons	8.7 (2yr)	-	-	-	-	-	8.7
		Hay, tons	1.8 (1yr)	-	-	-	-	-	1.8
	Barley								
		Grain, lbs	3,133 (1yr)	-	-	-	-	-	3,133
		Hay, tons	5.5 (1yr)	-	-	-	-	-	5.5
	Triticale								
		Hay, tons	3.0 (1yr)	-	-	-	-	-	3.0
		Silage, tons	13.3 (5yr)	-	-	-	-	-	13.3
	Sunflower								
		Seed, lbs	2,182 (4yr)	2,867 (4)	1,790 (3)	1,473 (2)	-	-	2,123
	Millet								
		Seed, lbs	2,840 (7yr)	3,800 (1)	3,350 (2)	-	6,855 (2)	-	3,389
	Blackeye p.								
		Bean. lbs	0	-	2,700 (1)	-	2,200 (1)	-	2,450
Perennial forage									
	WW-BDahl								
		Seed, PLS lbs	58.6 (3yr)	-	-	-	-	-	58.6
		Hay, tons	2.5 (1yr)	-	-	-	-	-	2.5
	Sideoats								
		Seed, PLS lbs	257.2 (9yr)	184 (2)	-	-	-	-	249.9
		Hay, tons	1.7 (9yr)	1.3 (2)	-	-	-	-	1.7
	Other								
		Hay, tons	2.3 (3yr)		-	-	-	3.7 (2)	2.6
	Alfalfa								
		Hay, tons	9.1 (9yr)	8.2 (3)	7.8 (3)	6.5 (1)	7.5 (1)	-	8.6
Annual forage									
	Forage sorg.								
		Hay, tons	3.5 (3yr)	5.5 (1)	-	4.1 (1)	-	1.4 (1)	3.6
		Seed, lbs	3,396 (1yr)	3,742 (1)		3,200 (1)			3,446
Precipitation, inches (including all sites)			16.9	21.3	30.5	16.6	21.5	15.6	18.4
By System			**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**
Total irrigation water (system average)			13.6	12.1(39)	11.0 (31)	11.3 (22)	11.3 (19)	12.9 (17)	12.9
By Crop		**Primary crop**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**
	Cotton	lint	13.6	9.8 (20)	9.3 (16)	10.6 (18)	10.8 (18)	13.6 (14)	12.6
	Corn	grain	19.1	15.2 (8)	16.4 (19)	16.8 (9)	16.4 (6)	18.2 (4)	18.2
	Corn	silage	22.8	13.2 (4)	-	15 (1)	-	16.0 (1)	20.6
	Sorghum	grain	12.0	11.6 (7)	6.2 (3)	8.0 (1)	-	-	11.2

Table 12 continued.

Item			Average Phase I 2005-2013	Phase II 2014	Phase II 2015	Phase II 2016	Phase II 2017	Phase II 2018	2005-2018 Crop year average
By Crop			**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**
	Sorghum	silage	12.6		-	-	-	-	12.6
	Wheat	grain	6.4	10.5 (1)	5.3 (3)	-	7.0 (1)	9.0 (1)	6.9
	Wheat	silage	11.3	-	-	-	-	-	11.3
	Oat	silage	10.0	-	-	-	-	-	10.0
	Oat	hay	4.9	-	-	-	-	-	4.9
	Triticale	silage	10.8	-	-	-	-	-	10.8
	Barley	grain	12.8	-	-	-	-	-	12.8
	Small grain	(grazing)	0.0	16.8 (1)	-	1.2 (1)	-	3.0 (1)	4.0
	Small grain	(grains)	6.4	10.5 (1)	5.3 (3)	-	7.0 (1)	9.0 (1)	6.9
	Small grain	(silage)	10.9	-	-	-	-	-	10.9
	Small grain	(hay)	11.3		-	-	-	-	11.3
	Small grain	(all uses)	7.0	13.7 (2)	5.3 (3)	1.2 (1)	7.0 (1)	-	6.9
	Sunflower	seed	10.4	8.9 (4)	5.3 (3)	8.6 (2)	-	-	9.3
	Millet	seed	13.1	14 (1)	11 (2)	-	8.5 (2)	-	12.6
	Blackeye p.	bean	0	0	6.0 (1)	-	6.0 (1)	-	6.0
Dahl									
	Hay		3.7	-		-	-	-	3.7
	Seed		8.1	-		-	-	-	8.1
	Grazing		7.9	0 (1)	0 (1)	-	0 (1)	-	6.3
Sideoats									
	Seed		11.2	15.8 (2)	-	-	-	-	11.7
Bermuda									
	Grazing		7.4	-	0 (1)	-	0 (1)	-	6.3
Other Perennial/Annuals									
	Hay		9.6	5.0 (1)	-	-	-	-	9.1
	Grazing		5.9	8.0 (3)	0 (1)	9.6 (1)	-	-	5.9
Perennial grasses (grouped)									
	Seed		10.4	15.8 (2)	-	-	-	-	10.9
	Grazing		6.2	2.3 (3)	0 (2)	9.6 (1)	0 (2)	-	5.3
	Hay		1.2	0 (2)	-	-	-	-	1.0
	all uses		6.4	5.5 (5)	0 (2)	9.6 (1)	0 (2)	-	5.6
Alfalfa									
	all uses		23.2	20.1 (3)	15.3 (3)	28 (1)	15.0 (1)	-	22.1
							Income & Expense, $/system acre		
Projected Returns			$895.46	$989.38	$879.95	$884.91	$923.88	$923.88	$913.98
Costs									
	Total variable costs (all sites)		$554.28	$639.58	$545.17	$636.15	$654.50	$714.95	$587.43
	Total fixed costs (all sites)		$115.56	$154.63	$162.24	$153.92	$183.13	$191.10	$135.33
	Total all costs (all sites)		$669.81	$790.35	$707.41	$790.07	$837.63	$906.05	$722.46
Gross margin									
	Per system acre (all sites)		$341.05	$349.80	$334.78	$248.76	$269.38	$267.07	$326.55
	Per acre-inch irrigation water (irrigation only)		$34.07	$29.74	$35.15	$22.39	$28.42	$21.85	$31.73
Net returns over all costs									
	Per system acre (all sites)		$225.52	$199.03	$172.54	$94.84	$86.25	$75.97	$191.52
	Per acre-inch irrigation water (irrigation only)		$21.53	$15.79	$17.74	$7.49	$8.48	$5.73	$17.79
	Per pound of nitrogen (all sites)		$1.86	$3.76	$1.84	$1.99	$0.64	$0.14	$1.82

Reports by Specific Task

TASK 2: ADMINISTRATION AND SUPPORT

Annual Report ending February 28, 2019

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

When it comes to weather in the South Plains of Texas, we sound like a broken record. From one extreme to another. Our region has been extremely dry since October of 2017. Fall wheat grazing was very limited and what fields are being grazed will not last very long. The spring of 2018 looked a lot like the spring of 2011, which is not good for farmers or ranchers. Some fields where cotton has emerged, looked great and then died as the roots grew into dry soil. Most locations that have seen rainfall have also received hail. Some producers with subsurface drip have not been able to establish a stand due to soil surface dryness. Livestock producers are also in serious trouble. Many ranchers have been forced to reduce herd size or liquidate totally. Hay supplies are very limited and quality hay is almost impossible to acquire. After a very dry spring the region progressed into an even drier weather pattern into summer. Rain-fed crops acres are almost nonexistent across all the High Plains region. Many producers are comparing 2018 to the extremely dry conditions we saw in 2011, which was the driest year ever recorded in Texas. In early fall weather conditions changed to extremely wet. The wet conditions has significantly delayed cotton harvest and fall wheat planting. It also reduced quality grades on what appears to be a good irrigated cotton crop. Cotton harvest and ginning finally got into full swing in early December. The majority of cotton was off of the stalk by the end of January, with most ginning completed by late February. As a whole, yields on irrigated acres were good with quality better than we expected.

The 2018 TAWC Water College was held on January 24th at the Lubbock Civic Center with a variety of speakers. Three of the presentations included TAWC producers who explained the water management technologies that they were including in their production strategy. Our luncheon speaker this year was Wymen Minzer, state photographer of Texas. Roian Atwood with Wrangler discussed the Memorandum of Understanding recently signed with TAWC and Texas Tech University.

On April 1st, Dr. Bill Brown from Tennessee became the new Dean of Agriculture at Texas Tech University. The TAWC Management Team made a presentation to Dr. Brown on April 12th, where he indicated he would support our efforts in any way he could.

On June 5th I had the honor to testify to the Texas House Natural Resource Committee in Palo Duro Canyon State Park, Canyon, Texas. Nine of the twelve members were present for this hearing. TAWC received several positive comments about their efforts in helping producers in their water management and conservation efforts.

TAWC in conjunction with Plains Cotton Growers Vice President, Shawn Wade met with the Texas Tech Mesonet representatives to discuss the possibilities of including our heat unit calculator on their nest phone app. The phone app is available for the 2019 growing season.

Laura Lang with IKEA was our guest on September 11th and 12th. While here she had the opportunity to visit with the TAWC management team, Texas Tech officials, and some of the TAWC producers. We are currently working on a proposal for possible funding from IKEA. On September 13th and 14th TAWC and Texas Tech helped host a brand/retailer tour with BCI. There were approximately thirty retail representatives in attendance. BASF also hosted a brand/retailer tour on September 25th thru the 28th. TAWC assisted Jon Mixson with BASF to develop the agenda for this event. The group was taken to the Lloyd Author Farm where they viewed the latest in cotton harvest equipment and heard several presentations on cotton management and conservation technologies being implemented by producers.

I was asked to participate in the Texas Lyceum's Quarterly Meeting, A look at Texas Agriculture, in Lubbock, October 25th thru the 27th. I served on a panel discussing water policy and Texas agriculture with Senator Charles Perry and Billy Howe, government Affairs Director, Texas Farm Bureau.

In early November, I was asked if I would consider being a candidate for the USDA-NRCS position of Chief. After much consideration I agreed. I was able to make it to the final three but didn't get the nod. It did however give me the opportunity to share much information about TAWC and our efforts in aiding producers in their water and soil conservation efforts.

Phil Brown and I had the opportunity to help host a delegation from Nigeria on November 29th and 30th.

The delegation was composed of Ambassador Stuart Symington, American Ambassador to Nigeria, Mr. Andrew Roberts Kwasri, Senior Agricultural Adviser to the President of Nigeria, and Mr. Landon Lewis, Liaison US State Department. The group visited several of the TAWC sites where they were able to visit with producers

We have held twelve management team meetings in 2018 and I have made several site visits.

Presentations in 2018:

12-07-2017	Swisher County Extension Field Day	Tulia, Texas
04-12-2018	Dean Bill Brown	Lubbock, Texas
06-05-2018	Natural Resource Committee	Canyon, Texas
09-14-2018	BCI Tour	Lubbock, Texas
09-26-2018	BASF Tour	Lubbock, Texas
10-26-2018	Texas Lyceum Panel	Lubbock, Texas
11-29-2018	Nigerian Delegation	Lubbock, Texas

2.2: Administrative Coordinator: (TTU)

Year 14 main objectives for the secretarial/administrative and bookkeeping support role for the TAWC Project included the following:

Accurate Accounting of All Expenses for the Project: This included monthly reconciliations of accounts with the TTU accounting system, quarterly reconciliations of subcontractors' invoices, preparation of itemized quarterly reimbursement requests, and preparation of Task and Expense Budgets for Year 14. The budget was balanced for this annual report and is presented in Table 13 on page 64.

Administrative Support for Special Events: Support staff continued to assist the communications director and project director with special events by processing purchase orders, procurement card orders and travel.

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

TASK 3: FARM ASSISTANCE PROGRAM

Annual Report ending February 28, 2019

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

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

Year 14 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 all of the 2018 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 has completed whole farm strategic analysis for several producers in the past, and continues to seek other participants committed to the analysis. Ongoing phone contacts, e-mails, and personal visits with project participants promote this additional service to participants.

Economic Study Papers

Farm Assistance members completed a study poster utilizing the economic data on a site within the TAWC project. The paper examined the "Economics Analysis of Cover Crops on the Southern High Plains" . The results of this paper were presented at the Beltwide Cotton Conference held in New Orleans, Louisiana this past January.

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.

Other Presentations

Farm Assistance members made a presentation to the South Plains Association of Soil and Water Conservation Districts concerning the growth and development of the T.A.W.C. over the past 14 years. A poster presentation was made to the Texas Extension Specialist Association at their annual meeting. A presentation was given to the Matador Institute of Leadership Engagement (MILE) group of Texas Tech University. Also, presentations were made to two local Lions Club groups concerning agricultural water savings methods.

Field Days

A Field Day was held in the T.A.W.C project during the 2018 growing season. The Summer Field Day was held September and hosted about 75 producers and guest. The purpose of the meeting were to allow producers outside of the project to see what takes place within the project, as well as allow producers to hear about the latest research and policy that could have an impact on their operation . Personnel from AgriLife Extension, AgriLife Research, Farm Assistance, members of industry, and Texas Tech University were involved in these field days.

Water College

The Fifth Annual Water College was in held January at the Lubbock Memorial Civic Center with more than 260 attendees. F.A. members were responsible for planning, organizing, and ensuring proper flow of the event. More than 25 members of industry had booths at the event.

Radio Broadcasts

Members of F.A. made more than 12 appearances on various radio stations promoting the T.A.W.C. and its events. Stations included Lubbock, Plainview, Amarillo, and Floydada.

Brands Tour

In August, F.A. members were part of the TAWC team that organized and held a tour for members of the cotton and textile industry from across the nation. The group toured the Cotton Classing Office, Bayer Agricultural Museum, Plains Cotton Cooperative, Idalou Co-op Gin, as well as some local cotton farms and the families producing that cotton. A producer panel was on hand at the Bayer Agricultural Museum to discuss issues facing family farms. The panel was made up mostly of TAWC cooperating producers.

TAWC Booth

F.A. members helped man the TAWC booth, which promotes tools developed by the TAWC team and upcoming TAWC activities, at several events during the year. Those events include the Amarillo Farm and Ranch Show, Texas Cotton Ginners Meeting, High Plains Irrigation Conference, and the Texas No-Till Symposium.

TASK 4: ECONOMIC ANALYSIS

Annual Report ending February 28, 2019

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

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 2018:

- 2018 was the 14th year of economic data collection from the project sites. Data for the 2017 production year were collected and enterprise budgets were generated.

- TAWC cooperated with the National Cotton Council in a project for the Fieldprint Calculator, which is being developed by Field-to-Market – The Keystone Alliance for Sustainable Agriculture. The Fieldprint Calculator estimates the sustainability footprint for crop production. TAWC site information for 2007 through 2017 was entered into the calculator. In August of 2017, TAWC became an affiliate member of Field to Market through Texas Tech University's College of Agricultural Sciences and Natural Resources.

Grant funding received in 2018:

- Application of the Fieldprint Calculator for Cotton Production in the Texas High Plains. Funded by the Cotton Foundation (7/14-8/16, $36,000). PI's – Phillip Johnson and Donna McCallister. The objective of this project is to evaluate cotton production sites in the TAWC project with regard to their sustainability as measured by the Fieldprint Calculator.

- Sustaining Agriculture through Adaptive Management to Preserve the Ogallala Aquifer under a Changing Climate. Funded by USDA AFRI. PI: Chuck West. Collaborator: Donna McCallister. (3/16-2/20, $57,160). The objective of this project is to develop best management practices and technologies, tools, and crop management practices.

- Economic and Policy Implications of Underground Water Use in the Southern Ogallala Region. Co-PI: Donna McCallister. 2017-2019. USDA ARS Ogallala Aquifer Program. Amount: $45,000.

- Evaluation of Soil Conservation Practices and Integrated Advanced Irrigation Technologies on Soil Health and Water Use Efficiency. Co-PI: Donna McCallister. 2017-2019. Texas Corn Producers Board. Amount: $36,324.

- Economic and Policy Implications of Underground Water Use in the Southern Ogallala Region. Co-PI: Donna McCallister. 2016-2018. USDA ARS Ogallala Aquifer Program. Amount: $45,000.

Peer-reviewed Publications during 2018:

1. Lewis, K., J. Burke, W. Keeling, D. McCallister, P. DeLaune, and W. Keeling. 2018. "Soil Benefits and Yield Limitations of Cover Crop Use in Texas High Plains Cotton." *Agronomy Journal*, 110(4):1616-1623.

2. Lange, K., R. Tewari, S. Zivkovic, and D. McCallister. 2018. "Gender Influences in Agricultural Production: The Dynamic Role of the Female Farmer." *CAB Reviews*, 13(25). doi: 10.1079/PAVSNNR201813025.

Extension outreach 2018:

1. Pate, J, D. McCallister, and W. Keeling. 2018. "Economic Advantages of Soil Moisture Probes on the Texas Southern High Plains." Texas A&M AgriLife Extension, Farm Assistance Focus 2018-3.

Professional Presentations during 2018:

1. Baker, C., D. McCallister, P. Johnson, and J. Bordovsky. 2018. "Economic Analysis on the Timing of Cotton Irrigation with Variable Seasonal Irrigation Capacities in the Texas South Plains." Poster Presentation at the 2018 Texas Tech University 10th Annual Undergraduate Research Conference

2. R.B. Williams, E. Segarra, D. Bian, and D. McCallister. 2018. "Impacts of Agricultural Productivity Enhancements and Time Value of Money on Groundwater Extraction." Western Social Science Association, San Antonio, Texas, April 4-7.

3. McCallister, D. and P. Johnson. 2019. "A Fieldprint Calculator Analysis of Resource and Cost Efficiencies in the Southern High Plains." Proceedings of the 2019 Annual Beltwide Cotton Conference, January 10, New Orleans, LA.

4. Pate, J., D. McCallister, and W. Keeling. 2019. "Economic Analysis of Cover Cropps in the Southern High Plains." Proceedings of the 2019 Annual Beltwide Cotton Conference, Poster Presentation, January 9, New Orleans, LA.

5. W. Keeling, D. McCallister, K. Lewis, W. Keeling, P. DeLaune, and J. Burke. 2019. "Economic Comparison of Cover Crop Use in Texas High Plains Cotton." Proceedings of the 2019 Annual Beltwide Cotton Conference, January 10, New Orleans, LA.

Professional Meetings Attended:

- Field to Market summer plenary meeting in Madison, Wisconsin, June 2018
- Field to Market fall plenary meeting in Denver, Colorado, November 2018
- The 46th Annual Banker's Conference was held on Friday, November 16
- USDA Ogallala Water CAP Annual Team Meeting in Santa Fe, NM on Nov 28-30.

Graduate Students:

- Taylor Black. M.S. Student. Department of Agricultural and Applied Economics. Graduated May 2018.
- Rebecca McCullough, Ph.D. Student. Department of Agricultural and Applied Economics. Graduated August 2019.
- Yi Chen, Ph.D. Student. Department of Agricultural and Applied Economics. Expected Graduation Date: 2019.
- Lauren Worley, MS student. Department of Agricultural and Applied Economics. Expected Graduation Date: May 2021.

TASK 5 & 7: PLANT WATER USE AND WATER USE EFFICIENCY

Annual Report ending February 28, 2019

Principal Investigator(s): Drs. Wenxuan Guo and Nithya Rajan (TTU & TAMU)

1). A variable rate irrigation study was conducted in 2017 and 2018. Jasmine Neupane, a graduate student at PSS, successfully defended a thesis on variable rate irrigation study in October 2018. The title was "Cotton yield variability in relation to irrigation rates, soil physical properties and topography." This study was conducted in a 194-ha commercially managed field in Hale County, Texas in 2017. An irrigation treatment with three rates was implemented in a randomized complete block design with two replications throughout the field in two blocks with six 16-row strips. A statistical model was developed to assess cotton lint yield variability as affected by irrigation rates, soil physical properties, and topography. The model showed that the effect of irrigation on cotton lint yield depended on its interaction with soil physical properties and topography. Irrigation rates had no significant effect on cotton lint yield, possibly due to greater than long-term average in-season rainfall for 2017. However, cotton yield response to same irrigation rate varied with different landscape positions and soil physical properties. This response pattern of yield to irrigation rates suggests that applying irrigation based on yield response model can be a basis of VRI. This study provides valuable information for site-specific irrigation to optimize crop production in fields with significant variability in soil physical properties and topography.

2). Another study on the application of unmanned aerial systems (UAS) in irrigation scheduling was conducted in the New Deal research farm in 2018. The objectives of this study were: 1) to develop a UAS remote sensing based irrigation scheduling algorithm for cotton (*Gossypium hirsutum* L.); 2) to evaluate the water use and water use efficiency (WUE) of UAS remote sensing based irrigation scheduling as compared to the Decision Support System for Agrotechnology Transfer (DSSAT) simulations. The algorithm incorporated the FAO-56 ET_0 method and K_c derived from high-resolution UAS images into the computation of crop water requirement. ET_0 was calculated with meteorological data using the FAO-56 method. Ground cover was derived from the UAS images using the maximum likelihood classification. This ground cover was equivalent to the K_c at the corresponding crop growth stage. Daily crop evapotranspiration (ET_c) is then calculated as the product of ET_0 and K_c with adjustment of plant height. The daily water requirement is the difference between ET_c and effective rainfall. Irrigation scheduling was implemented weekly based on the water requirement of the previous seven days. This algorithm was integrated into a Python script for irrigation scheduling. The algorithm was implemented in an experiment with four irrigation treatments in a research field in the SHP in 2018. A master's student worked on this project for his thesis and planned to complete the thesis in 2019.

TASK 6: COMMUNICATIONS AND OUTREACH

Annual Report ending February 28, 2019

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

Awards

TAWC Producer RN Hopper was presented with the Conservation Farmer Award by the Soil and Water Conservation Districts of Area 1.

TAWC Producers Glenn Schur and Eddie Teeter were awarded for Field to Market's Producer of the Year award on June 27-28.

Trade Shows, Meetings and Events Attended

TAWC Water College - Lubbock, Texas - January 2018
High Plains Irrigation Conference – Amarillo Civic Center – February 2018
Texas Soil Symposium - Lubbock, Texas - February 2018
Texas Cotton Ginners' Conference - Lubbock Civic Center - Lubbock, Texas - April 2018
Texas Tech University Earth Day – Texas Tech Campus, Lubbock, TX - April 2018
Texas Wildlife Association's Annual Conference - JW Marriot in San Antonio - July 13-14, 2018
Better Cotton Initiative Meeting - Lubbock, Texas - September 2018
BASF Brands Tour - Lubbock and Ralls, Texas - September 2018
Texas Tech Agricultural and Applied Economics' Bankers' Conference - Texas Tech International Cultural Center -Lubbock, Texas - November 2018
Amarillo Farm and Ranch Show – Amarillo Civic Center – November 2018

TAWC Field Walk, Field Day, and Field Tours

In September TAWC aided in a brands tour with BASF. TAWC management team members, producers and consultants presented at Lloyd Arthur's barn in Ralls, Texas. Several global brands (including Ralph Lauren, Target, Levi's, IKEA, and others) with an interest in sustainability attended the tour and were able to see field sites and ask questions regarding TAWC's efforts. Follow up has been made with several of these brands interested in TAWC helping them achieve their sustainable cotton goals.

TAWC hosted its 13th Annual Field Day at Muncy, TX on September 6. This was attended by approximately 65. Prior to the event 250 save the date cards and fliers were created and distributed at area co-ops, cotton gins and Extension offices. Radio appearances were made to publicize on KKYN and KFLP. The event was broadcasted live on KFLP and excerpts were aired in the month afterwards. Presentations were posted on the TAWC website.

Outreach Materials

Borgstedt worked with the CASNR development office to create a handout describing the TAWC project which can be used for outreach efforts. This general overview of the project is full of pictures, history and information about the project and will be used by both TAWC management team members and the CASNR development office.

USB drives were created with TAWC and TWDB logos and websites on them. These are distributed at our TAWC events.

The Water College website, www.tawcwatercollege.com, was updated with meeting details, agenda, and speaker bios.

2018 Water College

Radio advertisements for Water College began running on KFLP, KKYN, KFLP and Fox Talk 950 on January 14, 2018. A total of 15 live interviews talking about Water College were made by Rudy Ritz, Rick Kellison, Jeff Pate and Samantha Borgstedt across these stations. Borgstedt sent out a press release to newspapers in Lubbock, Lamesa, Plainview, and Hereford. Lubbock television stations were asked to attend Water College. All area county agents were contacted and asked to spread word of the event. Kellison and Pate continued to set out save the date cards and hung fliers at local producer hotspots. Email blasts were made and sent out to the 500+ email contacts and text messages were sent to area producers. The Water College website was updated with speaker bios. All speaker presentations were collected and bonded to be handed out available Water College participants and linked on tawc.us.

Approximately 275 attended Water College. KFLP aired Water College live on its radio station. Fox Talk 950 and the Lubbock Avalanche Journal also covered the event. 26 companies sponsored and had booths at Water College.

Field Talks running on KFLP focused on promoting Water College prior to the event. Excerpts from speakers' presentations from Water College were used for the segments after the event.
Evaluations from Water College were analyzed, and all results were combined into one document to be used for future meeting planning. About 50 evaluations were collected. Borgstedt posted Water College presentations on www.tawcwatercollege.com and www.tawc.us.

Graduate Student Assistants

Sinclaire Dobelbower graduated with her M.S. in Agricultural Communications. Her thesis was titled: Framing the Future of the Ogallala Aquifer: A Comparative Content Analysis of Agricultural and Mainstream Media Publications.

Lauren LaGrande, graduate assistant for TAWC, did feedback research from TAWC Water College evaluations which she turned it into a poster. She presented her poster titled

Recruiting for Water College: Identifying agricultural producers' communication channels and influencers at the Western Region meeting of the American Association for Agricultural Education in Boise, Idaho.

- 114 YouTube videos
- 51 TAWC Field Talk radio segments airing every week on KFLP All Ag All Day
Field Talk reaches around 2000 Class 1 farmers (those that make more than $40,000 per year from agriculture) per airing according to AG Media Research's last survey.
- 12 electronic newsletters using MailChimp
- 721 Facebook followers
- 757 Twitter followers
- 2 Television Appearances
- 31 live Radio Appearances (KFLP, KKYN, KFLP and Fox Talk 950)

2018 Popular Press

Living Life with Less Water: Researchers help farmers conserve water with field days - txH2O Fall 2018 https://twri.tamu.edu/publications/txh2o/2018/fall-2018/living-life-with-less-water/

Mixing it Up - txH20 Fall 2018 - https://twri.tamu.edu/publications/txh2o/2018/fall-2018/mixing-it-up/

Veteran consultant talks irrigation efficiency, concern for struggling farmers - Southwest Farm Press, Sept. 13, 2018 - https://www.farmprogress.com/cotton/veteran-consultant-talks-irrigation-efficiency-concern-struggling-farmers

Texas Tech helps Ag producers have a sustainable operation through an online tool - Fox 34 News, July 18, 2018 - http://www.telemundolubbock.com/story/38678930/texas-tech-helps-ag-producers-have-a-sustainable-operation-through-an-online-tool?removecgbypass&clienttype=smartdevice

South Plains producers facing more difficulties after storms - Lubbock A-J, June 3, 2018 - https://www.lubbockonline.com/news/20180603/south-plains-producers-facing-more-difficulties-after-storms

Dire Drought Dampening Outlooks in Cotton Country - US Farm Report, May 22, 2018 - https://www.agweb.com/article/dire-drought-dampening-outlooks-in-cotton-country

Ogallala Aquifer Summmit: Texas - April 9 - 10, 2018, Garden City, Kansas - http://www.depts.ttu.edu/tawc/reports/OAS_TX2018.pdf

After dry spell, rain brings optimism for area cotton farmers ahead of planting season - Lubbock A-J, March 29, 2018 - https://www.lubbockonline.com/news/20180329/after-dry-spell-rain-brings-optimism-for-area-cotton-farmers-ahead-of-planting-season

VF's Jeanswear Coalition Taking Steps to Reduce Environmental Footprint - Sourcing Journal, February 12, 2018 - https://sourcingjournal.com/topics/sustainability/vf-denim-sustainability-efforts-78544/

Water management technologies for agriculture producers - ABC 7 News Amarillo, January 25, 2018 - https://abc7amarillo.com/news/local/water-management-technologies-for-agriculture-producers

TAWC hosts free Water College for growers, crop consultants Jan. 24 - Southwest Farm Press, January 16, 2018 - https://www.farmprogress.com/water/tawc-hosts-free-water-college-growers-crop-consultants-jan-24

Texas Alliance for Water Conservation 4th Annual Water College set for January 24 - Southwest Farm Press, January 9, 2018 - https://www.farmprogress.com/crops/texas-alliance-water-conservation-water-college-set-jan-24

TASK 7: PRODUCER ASSESSMENT OF OPERATION

Annual Report ending February 28, 2019

Principal Investigator: Dr. Nithya Rajan (TAMU, AgriLife Research)

Task 7 report is combined with Task 5 in this 2018 report because of their combined efforts and due to Task 7 being completed.

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

Annual Report ending February 28, 2019

Principal Investigators: Dr. Chuck West, Mr. Philip Brown, Dr. Darren Henry (TTU)

Several forage and livestock studies were carried out at the Texas Tech New Deal research facility to generate data that were used in publications, outreach presentations, and field tours, all related to testing and demonstrating the role of forages grown for cattle as an alternative economic enterprise to annual cash crops to conserve water from the Ogallala Aquifer.

One trial was the final year of the work by graduate student Madhav Dhakal on improving the quality of dryland pastures (native grasses) by interseeding alfalfa varieties. The objective was to identify planting densities and growth types of alfalfa which, once established, could provide a high-protein, high-digestibility component of native grass pasture without competing too much for soil water. The rationale was that alfalfa could improve yield and quality of perennial pastures under dryland conditions to provide an alternative land use for producers converting to dryland production while trying to minimize profit losses. Averaged across 2016-2018, inclusion of alfalfa into native grass mixture increased total forage yield by 35% over the grass-only control. This means that including alfalfa boosted the efficiency of using rainfall as the source of water for producing forage and producing protein. Low-density alfalfa stands (28-inch row-spacing) provided enough alfalfa in the pasture to greatly improve total forage protein content with very little depletion of soil water, in relation to grass not interseeded with alfalfa. In contrast, the higher-density alfalfa stand (14-inch row-spacing) cause extra depletion of soil water, especially in the 2-3 ft. zone. A low-density planting of alfalfa into native grasses is enough to improve overall forage yield and quality, and therefore increase greater beef production without exacerbating soil water depletion.

Work was finished by graduate student Victoria Xiong on 1) developing use of a simple digital image from a camera to detect the percentage ground cover of the grass, which can then be used to estimate forage yield; and 2) calibrating two computer models (ALMANAC and APSIM) for simulating growth of WW-B.Dahl old world bluestem. The models were successfully calibrated and validated such that forage growth could be tracked at different times during the growing seasons and with differing amounts of water supply. These results can be used in constructing an irrigation scheduling program to decide on irrigation amounts and timing to produce a desired amount of forage for hay production or grazing by cattle.

A new grazing trial was initiated in 2018, part of Kathryn Radicke's graduate research, comparing old world bluestem pastures either with alfalfa and not receiving nitrogen fertilizer vs. bluestem with no alfalfa but receiving 60 lbs./acre of nitrogen each spring. The measurements were on steer liveweight gain, water use efficiency of forage and beef growth, and release of methane by cattle. The average daily gain of cattle on the alfalfa-grass treatment was 2.55 lb, while that of cattle on grass with N fertilizer was 2.33 lb. Data from 2018 are still being analyzed, and the trial is being repeated in 2019. Kathryn also procured a $10,144 grant from USDA-Southern SARE to study effects of cattle trampling on soil bulk density when grazing pearl millet.

Funding was continued from USDA-Southern SARE and USDA-NIFA-AFRI to enhance the efforts of TAWC (see list below). The NIFA-funded project (www.ogallalawater.org) involves eight states and the USDA-ARS in the Great Plains of the U.S. The involvement of TAWC in the NIFA project consists of 1) analyzing data to test the degree to which new irrigation practices can improve crop water use efficiency and maintain profitability, and 2) extending the audience of TAWC field days and water college beyond the South Plains of Texas. The well-documented success of the TAWC program is what brought us in as collaborators with the other institutions.

Chuck West and his graduate students presented a number of talks locally and nationally on strategies of irrigation water conservation being promoted by TAWC, and benefits of diversifying the South Plains cropping systems with high quality forages for beef production as a low-water-input method of sustaining agricultural productivity.

Grants Funded:
USDA-SARE. C. West. Long term agroecosystems research and adoption in the Texas Southern High Plains. $100,000. This is a renewal grant for pasture research at the New Deal Research Field Station.

USDA-NIFA-AFRI. C. West and D. Mitchell McAlister in collaboration with 40 scientists from 8 universities and the USDA-ARS. Sustaining agriculture through adaptive management to preserve the Ogallala Aquifer. $246,636 is the Texas Tech portion of a $2.5 million grant in 2018.

USDA-SARE. C. West and Kathryn Radicke. Effects of cumulative cattle trampling on soil bulk density on an annual forage crop pasture. USDA Southern Regional Sustainable Agriculture Research and Education (SARE). $10,144.

Presentations:
Bernadt, T., D. Brown, D. Dubois, B. Fuchs, W. Hargrove, S. Hermitte, A. Kremen, M. Shafer, C. Steele, R. Steele, C. Turner, and C. West. 2018. Regional drought early warning, impact, and assessment for water and agriculture in the Rio Grande basin, 2016-2017. Annual Meeting American Meteorological Society, Austin, TX.

McCallister, D., A. Cano, C. West, and D. Rudnick. 2018. A meta-analysis on the impact of irrigation technology on cotton yield and WUE. Beltwide Cotton Conference, Cotton Economics and Marketing Conference, San Antonio, TX, 3-5 January.

Chen, Y., D. McCallister, C.P. West, L.L. Baxter, C.P. Brown, and P.E. Green. 2018. Economic evaluation of integrating legume and beef production on low-water-input systems. Southern Section of Am. Soc. Agric. Econ. 2-6 February, Jacksonville, FL.

West, C.P. 2018. Water footprint of stocker beef production. Annual meeting of the American Society of Animal Science. 9-12 July, Vancouver, BC.

Dhakal, M., and C.P. West. 2018. Can interseeded alfalfa deplete water in semiarid grassland? Abstract for International Aridlands Conference, 13-14 August, Lubbock, TX.

Kharel, Geeta, S.K. Deb, and C.P. West. 2018. Evaluation of different models for quantifying water retention and thermal properties of semi-arid pasture soils land. Abstract for International Aridlands Conference, 13-14 August, Lubbock, TX.

Raihan, Abir, W. Guo, S. Deb, Zhe Zhu, J. Neupane, Zhe Lin, Yazhou Sun, and C.P. West. 2018. Application of unmanned aerial systems for estimating soil water content in the Southern High Plains. Abstract for International Aridlands Conference, 13-14 August, Lubbock, TX.

Neupane, Jasmine, W. Guo, F. Zhang, S. Deb, Z. Lin, A. Raihan, Y. Sun, and C.P. West. 2018. Irrigation rates, soil physical properties and topography effects on cotton yield in the Southern High Plains. Abstract for International Aridlands Conference, 13-14 August, Lubbock, TX.

Sun, Yazhou., W. Guo, D.C. Weindorf, F. Sun, S.K. Deb, Z. Lin, J. Neupane, A. Raihan, C.P. West. 2018. Identifying soil properties using proximal sensors in the Southern High Plains. International Aridlands Conference, Aug, 13, 2018, Lubbock, TX.

Otuya, R.K., L.C. Slaughter, C. West, V. Acosta-Martinez, and S.K. Deb. 2018. Effects of compost manure on soil microbial communities and soil health in a semi-arid improved pasture ecosystem. Abstract for International Aridlands Conference, 13-14 August, Lubbock, TX.

West, C.P. 2018. Role of grasslands and cattle in conversion of irrigated cropland to dryland agriculture. Leu Distinguished Lecture Series, Nebraska Center for Grassland Studies. Nov. 12., Lincoln, NE.

<u>Publications</u>

Cano, Amanda, A. Núñez, V. Acosta-Martinez, M. Schipanski, R. Ghimire, C. Rice, and C. West. 2018. Current knowledge and future research directions to link soil health and water conservation in the Ogallala Aquifer region. Geoderma 328:109-118.

Bhandari, Krishna B., C.P. West, and S.D. Longing. 2018. Fly densities on cattle grazing 'WW-B.Dahl' old world bluestem pasture systems. Texas J. Agric. Nat. Res. 31:T1-T5.

Bhandari, K.B., C.P. West, S.D. Longing, C.P. Brown, and P.E. Green. 2018. Comparison of arthropod communities among different forage types on the Texas High Plains using pitfall traps. Crop Forage Turfgrass Management Vol. 4(2):180005.

West, C.P., and L.L. Baxter. 2018. Water footprint of beef production on Texas High Plains pasture. Water International 43:887-891.

Bhandari, K.B., C.P. West, V. Acosta-Martinez, J. Cotton, and A. Cano. 2018. Soil microbial communities, enzyme activities, and total carbon and nitrogen as affected by diverse grasses and grass-alfalfa in pastures. Appl. Soil Ecol. 132:179-186.

Bhandari, K.B., C.P. West, S.D. Longing, C.P. Brown, P.E. Green, and E. Barkowsky. 2018. Pollinator abundances in semi-arid pastures as affected by forage species. Crop Sci. 58:2665-2671.

Bhandari, K.B., C.P. West, and S.D. Longing. 2018. Communities of canopy-dwelling arthropods in response to diverse forages. Agric. Environ. Letters 3(1):180037 (online)

Rudnick, D.R., S. Irmak, C.P. West, I. Kisekka, T.H. Marek, J.P. Schneekloth, D.M. McCallister, V. Sharma, K. Djaman, J. Aguilar, J.L. Chávez, M. Schipanski, D.H. Rogers, and A. Schlegel. 2018. Deficit irrigation management of maize above the High Plains Aquifer: A review. J. Am. Water Res. Asso. 55:38-55.

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

Annual Report ending February 28, 2019

Principal Investigator(s): Jason Coleman and Keith Whitworth (HPWCD #1)

9.1 Equipment Procurement & Installation

- New water level transducers, cables and cell phone telemetry were installed at some sites in November 2018.

9.2 Data Collection and Processing

- Daily rainfall was collected using 23 tipping bucket rain gauges with Hobo data loggers.
- Daily rainfall can be seen on the HPWD.org website for 2017, 2018 and 2019.
- Daily water levels were collected with the use of pressure transducers.
- The 2018 daily water levels were added to the previous year's data, and published on the HPWD website.
- Annual saturated thickness volume was calculated and compared to previous years.
- All equipment was monitored regularly and maintenance preformed if needed.

http://www.tawcsolutions.org

TAWC Solutions: Management tools to aid producers in conserving water

Rick Kellison, Jeff Pate, Philip Brown (TTU, TAMU, TTU)

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 Scheduler** 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.

The **Basic Irrigation Calculator** aids producers in determining the length of time required to apply a specific amount of water by calculating the number of minutes, hours and days required to pump based on the well GPM and the number of acres being applied.

The **Contiguous Acre Calculator** was developed to aid a producer in determining the total allowable amount of irrigation water in inches that could be pumped as established by water policy from the High Plains Underground Water Conservation District.

The **Heat Unit Calculator** was developed to aid a producer in determining the total heat unit accumulation for both corn and cotton. Available sites to select from include: Amarillo, Lamesa, Lubbock, and Plainview. A cumulative heat unit calculator is provided to calculate cumulative heat units for the desired time-period.

In 2017, work was initiated with USDA-ARS to utilize an existing **Agro-Climate Monitor** originally developed by USDA-ARS utilizing data from the Texas Tech West Texas Mesonet. This tool is expected to expand the Heat Unit Calculator adding more weather stations and increasing the climate information and tools available to aid producers in weather-related crop management decisions. This tool includes tracking precipitation, soil temperatures, cumulative hard freeze hours, growing degree days (heat units), and average first freeze dates based on the area selected. This tool will be refined and modified over the next year to enhance use ability and functionality.

The **Cotton Water Use Tracker** is a generalized table provided as an estimate for water use for cotton based on weather data from the Plainview weather station from the West Texas Mesonet and an average planting date. This is not intended to replace the Irrigation Scheduling Tool but is merely intended as a quick reference for daily cotton water use.

As we move forward, we continually seek user input by providing both demonstration of new technologies and the development of new web-based decision-aid tools. These tools and demonstrations deal with our declining water resources by providing alternative management strategies and decision aids with which our producers can make better informed decisions that fit their individual needs.

We would also like to acknowledge our relationship with the Texas Tech West Texas Mesonet and appreciate their invaluable contribution of weather data which enables our ability to provide these tools at no cost to our agricultural producers.

More detail concerning each individual program is provided on our website and in previous annual reports.

2018 Supplementary Grants to Project (See Appendix for 2005-2017 data)

Supplementary grants and grant requests were obtained or attempted through leveraging of the base platform of TAWC and the Texas Coalition for Sustainable Integrated Systems (TeCSIS), and therefore represent added value to the overall TAWC effort.

- USDA-SARE. C. West. Long term agroecosystems research and adoption in the Texas Southern High Plains. $100,000. This is a renewal grant for pasture research at the New Deal Research Field Station.

- USDA-NIFA-AFRI. C. West and D. Mitchell McAlister in collaboration with 40 scientists from 8 universities and the USDA-ARS. Sustaining agriculture through adaptive management to preserve the Ogallala Aquifer. $246,636 is the Texas Tech portion of a $2.5 million grant in 2018.

- USDA-SARE. C. West and Kathryn Radicke. Effects of cumulative cattle trampling on soil bulk density on an annual forage crop pasture. USDA Southern Regional Sustainable Agriculture Research and Education (SARE). $10,144.

- Application of the Fieldprint Calculator for Cotton Production in the Texas High Plains. Funded by the Cotton Foundation (7/14-8/16, $36,000). PI's – Phillip Johnson and Donna McCallister. The objective of this project is to evaluate cotton production sites in the TAWC project with regard to their sustainability as measured by the Fieldprint Calculator.

- Sustaining Agriculture through Adaptive Management to Preserve the Ogallala Aquifer under a Changing Climate. Funded by USDA AFRI. PI: Chuck West. Collaborator: Donna McCallister. (3/16-2/20, $57,160). The objective of this project is to develop best management practices and technologies, tools, and crop management practices.

- Economic and Policy Implications of Underground Water Use in the Southern Ogallala Region. Co-PI: Donna McCallister. 2017-2019. USDA ARS Ogallala Aquifer Program. Amount: $45,000.

- Evaluation of Soil Conservation Practices and Integrated Advanced Irrigation Technologies on Soil Health and Water Use Efficiency. Co-PI: Donna McCallister. 2017-2019. Texas Corn Producers Board. Amount: $36,324.

- Economic and Policy Implications of Underground Water Use in the Southern Ogallala Region. Co-PI: Donna McCallister. 2016-2018. USDA ARS Ogallala Aquifer Program. Amount: $45,000.

2018 DONATIONS TO PROJECT (SEE APPENDIX FOR 2005-2017 DATA)

TAWC Water College, Field Day, Field Walk Sponsors

CASNR Dean's Office	$ 4,000
Cotton Inc.	$ 2,000
Dow/Pioneer	$ 2,000
Diversity D	$ 1,000
Texas Corn Producers	$ 1,000
Forefront Agronomy	$ 500
Hurst Farm Supply	$ 500
Equipment Supply	$ 500
Plains Cotton Growers	$ 500
Lindsay Sales & Service	$ 500
EcoDrip	$ 500
First Bank & Trust	$ 500
WaterMaster	$ 500
Ag Precision Supply	$ 500
Farmers Edge	$ 500
Miller Chemical	$ 500
Water by GMX	$ 500
HPUWD	$ 500
AquaSpy	$ 500
South Plains Valley Irrigation	$ 500
Trellis	$ 500
T-L Irrigation	$ 500
Browning Seed	$ 500
City of Lubbock	$ 500
Nachurs	$ 500
Ogallala CAP Project	$ 500
Capital Farm Credit	$ 200
City Bank	$ 200
TX Grain Sorghum	$ 200
Total	**$21,100**

2018 VISITORS TO THE DEMONSTRATION PROJECT SITES, FIELD WALKS, FIELD DAYS, AND WATER COLLEGE OUTREACH EVENTS (SEE APPENDIX FOR 2005-2017 DATA)

Total Number of Visitors	475+

2018 PRESENTATIONS (SEE APPENDIX FOR 2005-2017 DATA)

Date	Presentation	Spokesperson(s)
12-07-2017	Swisher County Extension Field, Tulia, TX	R. Kellison
04-12-2018	Dean Bill Brown, Lubbock, TX	R. Kellison
06-05-2018	Natural Resource Committee, Canyon, TX	R. Kellison
09-14-2018	BCI Tour, Lubbock, TX	R. Kellison
10-26-2018	BASF Tour, Lubbock, TX	R. Kellison
10-26-2018	Texas Lyceum Panel, Lubbock, TX	R. Kellison
11-29-2018	Nigerian Delegation, Lubbock, TX	R. Kellison, P. Brown

Formal Presentations:

Bernadt, T., D. Brown, D. Dubois, B. Fuchs, W. Hargrove, S. Hermitte, A. Kremen, M. Shafer, C. Steele, R. Steele, C. Turner, and C. West. 2018. Regional drought early warning, impact, and assessment for water and agriculture in the Rio Grande basin, 2016-2017. Annual Meeting American Meteorological Society, Austin, TX.

McCallister, D., A. Cano, C. West, and D. Rudnick. 2018. A meta-analysis on the impact of irrigation technology on cotton yield and WUE. Beltwide Cotton Conference, Cotton Economics and Marketing Conference, San Antonio, TX, 3-5 January.

Chen, Y., D. McCallister, C.P. West, L.L. Baxter, C.P. Brown, and P.E. Green. 2018. Economic evaluation of integrating legume and beef production on low-water-input systems. Southern Section of Am. Soc. Agric. Econ. 2-6 February, Jacksonville, FL.

West, C.P. 2018. Water footprint of stocker beef production. Annual meeting of the American Society of Animal Science. 9-12 July, Vancouver, BC.

Dhakal, M., and C.P. West. 2018. Can interseeded alfalfa deplete water in semiarid grassland? Abstract for International Aridlands Conference, 13-14 August, Lubbock, TX.

Kharel, Geeta, S.K. Deb, and C.P. West. 2018. Evaluation of different models for quantifying water retention and thermal properties of semi-arid pasture soils land. Abstract for International Aridlands Conference, 13-14 August, Lubbock, TX.

Raihan, Abir, W. Guo, S. Deb, Zhe Zhu, J. Neupane, Zhe Lin, Yazhou Sun, and C.P. West. 2018. Application of unmanned aerial systems for estimating soil water content in the Southern High Plains. Abstract for International Aridlands Conference, 13-14 August, Lubbock, TX.

Neupane, Jasmine, W. Guo, F. Zhang, S. Deb, Z. Lin, A. Raihan, Y. Sun, and C.P. West. 2018. Irrigation rates, soil physical properties and topography effects on cotton yield in the Southern High Plains. Abstract for International Aridlands Conference, 13-14 August, Lubbock, TX.

Sun, Yazhou., W. Guo, D.C. Weindorf, F. Sun, S.K. Deb, Z. Lin, J. Neupane, A. Raihan, C.P. West. 2018. Identifying soil properties using proximal sensors in the Southern High Plains. International Aridlands Conference, Aug, 13, 2018, Lubbock, TX.

Otuya, R.K., L.C. Slaughter, C. West, V. Acosta-Martinez, and S.K. Deb. 2018. Effects of compost manure on soil microbial communities and soil health in a semi-arid improved pasture ecosystem. Abstract for International Aridlands Conference, 13-14 August, Lubbock, TX.

West, C.P. 2018. Role of grasslands and cattle in conversion of irrigated cropland to dryland agriculture. Leu Distinguished Lecture Series, Nebraska Center for Grassland Studies. Nov. 12., Lincoln, NE.

Baker, C., **D. McCallister**, P. Johnson, and J. Bordovsky. 2018. "Economic Analysis on the Timing of Cotton Irrigation with Variable Seasonal Irrigation Capacities in the Texas South Plains." Poster Presentation at the 2018 Texas Tech University 10th Annual Undergraduate Research Conference

R.B. Williams, E. Segarra, D. Bian, and **D. McCallister**. 2018. "Impacts of Agricultural Productivity Enhancements and Time Value of Money on Groundwater Extraction." Western Social Science Association, San Antonio, Texas, April 4-7.

McCallister, D. and P. Johnson. 2019. "A Fieldprint Calculator Analysis of Resource and Cost Efficiencies in the Southern High Plains." Proceedings of the 2019 Annual Beltwide Cotton Conference, January 10, New Orleans, LA.

Pate, J., D. McCallister, and W. Keeling. 2019. "Economic Analysis of Cover Cropps in the Southern High Plains." Proceedings of the 2019 Annual Beltwide Cotton Conference, Poster Presentation, January 9, New Orleans, LA.

W. Keeling, D. McCallister, K. Lewis, W. Keeling, P. DeLaune, and J. Burke. 2019. "Economic Comparison of Cover Crop Use in Texas High Plains Cotton." Proceedings of the 2019 Annual Beltwide Cotton Conference, January 10, New Orleans, LA.

2018 Related Non-refereed Publications (See Appendix for 2005-2017 data)

Pate, J, D. McCallister, and W. Keeling. 2018. "Economic Advantages of Soil Moisture Probes on the Texas Southern High Plains." Texas A&M AgriLife Extension, Farm Assistance Focus 2018-3.

2018 Related Refereed Journal Articles (See Appendix for 2005-2017 data)

Cano, Amanda, A. Núñez, V. Acosta-Martinez, M. Schipanski, R. Ghimire, C. Rice, and C. West. 2018. Current knowledge and future research directions to link soil health and water conservation in the Ogallala Aquifer region. Geoderma 328:109-118.

Bhandari, K.B., C.P. West, S.D. Longing, C.P. Brown, and P.E. Green. 2018. Comparison of arthropod communities among different forage types on the Texas High Plains using pitfall traps. Crop Forage Turfgrass Management Vol. 4(2):180005. doi:10.2134/cftm2018.01.0005.

West, C.P., and L.L. Baxter. 2018. Water footprint of beef production on Texas High Plains pasture. Water International 43:887-891. doi:10.1080/02508060.2018.1515574

Bhandari, K.B., C.P. West, V. Acosta-Martinez, J. Cotton, and A. Cano. 2018. Soil microbial communities, enzyme activities, and total carbon and nitrogen as affected by diverse grasses and grass-alfalfa in pastures. Appl. Soil Ecol. 132:179-186. doi:10.1016/j.apsoil.2018.09.002

Rudnick, D.R., S. Irmak, C.P. West, I. Kisekka, T.H. Marek, J.P. Schneekloth, D.M. McCallister, V. Sharma, K. Djaman, J. Aguilar, J.L. Chávez, M. Schipanski, D.H. Rogers, and A. Schlegel. 2018. Deficit irrigation management of maize above the High Plains Aquifer: A review. J. Am. Water Res. Asso. 55:38-55.

Lewis, K., J. Burke, W. Keeling, **D. McCallister**, P. DeLaune, and W. Keeling. 2018. "Soil Benefits and Yield Limitations of Cover Crop Use in Texas High Plains Cotton." *Journal of Agronomy*, 110(4):1616-1623.

Lange, K., R. Tewari, S. Zivkovic, and **D. McCallister**. 2018. "Gender Influences in Agricultural Production: The Dynamic Role of the Female Farmer." *CAB Reviews*, 13(25). doi: 10.1079/PAVSNNR201813025.

2018 Popular Press (See Appendix for 2005-2017 data)

Living Life with Less Water: Researchers help farmers conserve water with field days - txH2O Fall 2018 https://twri.tamu.edu/publications/txh2o/2018/fall-2018/living-life-with-less-water/

Mixing it Up - txH20 Fall 2018 - https://twri.tamu.edu/publications/txh2o/2018/fall-2018/mixing-it-up/

Veteran consultant talks irrigation efficiency, concern for struggling farmers - Southwest Farm Press, Sept. 13, 2018 - https://www.farmprogress.com/cotton/veteran-consultant-talks-irrigation-efficiency-concern-struggling-farmers

Texas Tech helps Ag producers have a sustainable operation through an online tool - Fox 34 News, July 18, 2018 - http://www.telemundolubbock.com/story/38678930/texas-tech-helps-ag-producers-have-a-sustainable-operation-through-an-online-tool?removecgbypass&clienttype=smartdevice

South Plains producers facing more difficulties after storms - Lubbock A-J, June 3, 2018 - https://www.lubbockonline.com/news/20180603/south-plains-producers-facing-more-difficulties-after-storms

Dire Drought Dampening Outlooks in Cotton Country - US Farm Report, May 22, 2018 - https://www.agweb.com/article/dire-drought-dampening-outlooks-in-cotton-country

Ogallala Aquifer Summitt: Texas - April 9 - 10, 2018, Garden City, Kansas - http://www.depts.ttu.edu/tawc/reports/OAS_TX2018.pdf

After dry spell, rain brings optimism for area cotton farmers ahead of planting season - Lubbock A-J, March 29, 2018 - https://www.lubbockonline.com/news/20180329/after-dry-spell-rain-brings-optimism-for-area-cotton-farmers-ahead-of-planting-season

VF's Jeanswear Coalition Taking Steps to Reduce Environmental Footprint - Sourcing Journal, February 12, 2018 - https://sourcingjournal.com/topics/sustainability/vf-denim-sustainability-efforts-78544/

Water management technologies for agriculture producers - ABC 7 News Amarillo, January 25, 2018 - https://abc7amarillo.com/news/local/water-management-technologies-for-agriculture-producers

TAWC hosts free Water College for growers, crop consultants Jan. 24 - Southwest Farm Press, January 16, 2018 - https://www.farmprogress.com/water/tawc-hosts-free-water-college-growers-crop-consultants-jan-24

Texas Alliance for Water Conservation 4th Annual Water College set for January 24 - Southwest Farm Press, January 9, 2018 - **https://www.farmprogress.com/crops/texas-alliance-water-conservation-water-college-set-jan-24**

2018 Theses and Dissertations (See Appendix for 2005-2017 data)

Black, Taylor, 2018. The impacts of water management on cotton production and sustainability in the Texas High Plains. Department of Agricultural and Applied Economics, Texas Tech University. Graduated May, 2018, M.S. student.

Phase II - Budget

Table 13. Task and expense budget for Phase II Year 1-5 of the demonstration project.

TWDB # 1413581688		**Year 1**	**Year 2**		**Year 3**	**Year 4**	**Year 5**	
		(10/17/13 - 02/28/15)	(03/01/15 - 02/29/16)		(03/01/16 - 02/28/17)	(03/01/17 - 02/28/18)	(03/01/18 - 02/28/19)	
Task Budget	**Task Budget***							**Total Expenses**
1								
2	$1,148,395.00	135,179.51	254,325.38		276,943.98	276,429.93	232,507.21	1,175,386.01
3	$571,806.00	19,180.57	79,957.17		102,051.66	65,572.52	45,067.13	311,829.05
4	$469,978.00	39,467.89	47,127.42		38,833.02	55,276.58	75,767.41	256,472.32
5	$360,708.00	110,849.99	82,061.04		9,547.54	62,586.64	35,479.93	300,525.14
6	$582,645.00	50,867.54	110,592.85		86,776.22	96,114.08	118,987.22	463,337.91
7	$27,048.00	3,000.00	6,134.03		18,539.39	0	0	27,673.42
8	$181,110.00	6,671.70	25,277.96		25,184.96	14,373.65	20,493.43	92,001.70
9	$258,310.00	27,058.73	14,607.22		30,578.68	24,027.33	47,124.77	143,396.73
TOTAL	$3,600,000.00	392,275.93	620,083.07		588,455.45	594,380.73	575,427.10	2,770,622.28

		Year 1	**Year 2**		**Year 3**	**Year 4**	**Year 5**	
		(10/17/13 - 02/28/15)	(03/01/15 - 02/29/16)		(03/01/16 - 02/28/17)	(03/01/17 - 02/28/18)	(03/01/18 - 02/28/19)	
Expense Budget	**Total Budget***							**Total Expenses**
Salary and Wages +2%/yr	$1,545,882.00	196,610.27	307,839.14		220,883.72	268,119.75	308,801.08	1,302,253.96
Fringe	$229,910.00	30,751.67	48,664.72		30,891.06	35,696.90	38,113.88	184,118.23
Travel	$106,151.00				20,933.30	21,001.11	21,467.71	63,402.12
Other Operating Expenses (inc. materials & supplies	$130,023.00	16,152.68	24,991.40		18,085.91	27,677.79	9,592.23	96,500.01
Capital Equipment	$76,000.00	14,249.11	16,871.15		0	18,789.30	0	49,909.56
Subcontract Services	$857,164.00	58,070.86	0		199,169.73	104,599.85	104,481.48	466,321.92
Technical/Hardware /Software	$238,033.00	49,239.30	105,048.42		27,634.67	49,389.60	26,410.53	257,722.52
Tuition and Fees	$111,337.00		69,944.98		23,160.74	40,027.24	39,910.35	173,0416.73
Other Expenses (Insurance: auto, medical)	$305,500.00	7,578.05	12,123.75		47,696.32	29,079.19	29,939.42	126,416.73
TOTAL	$3,600,000.00	372,651.94	585,483.56		588,455.45	594,380.73	578,716.68	2,719,688.36

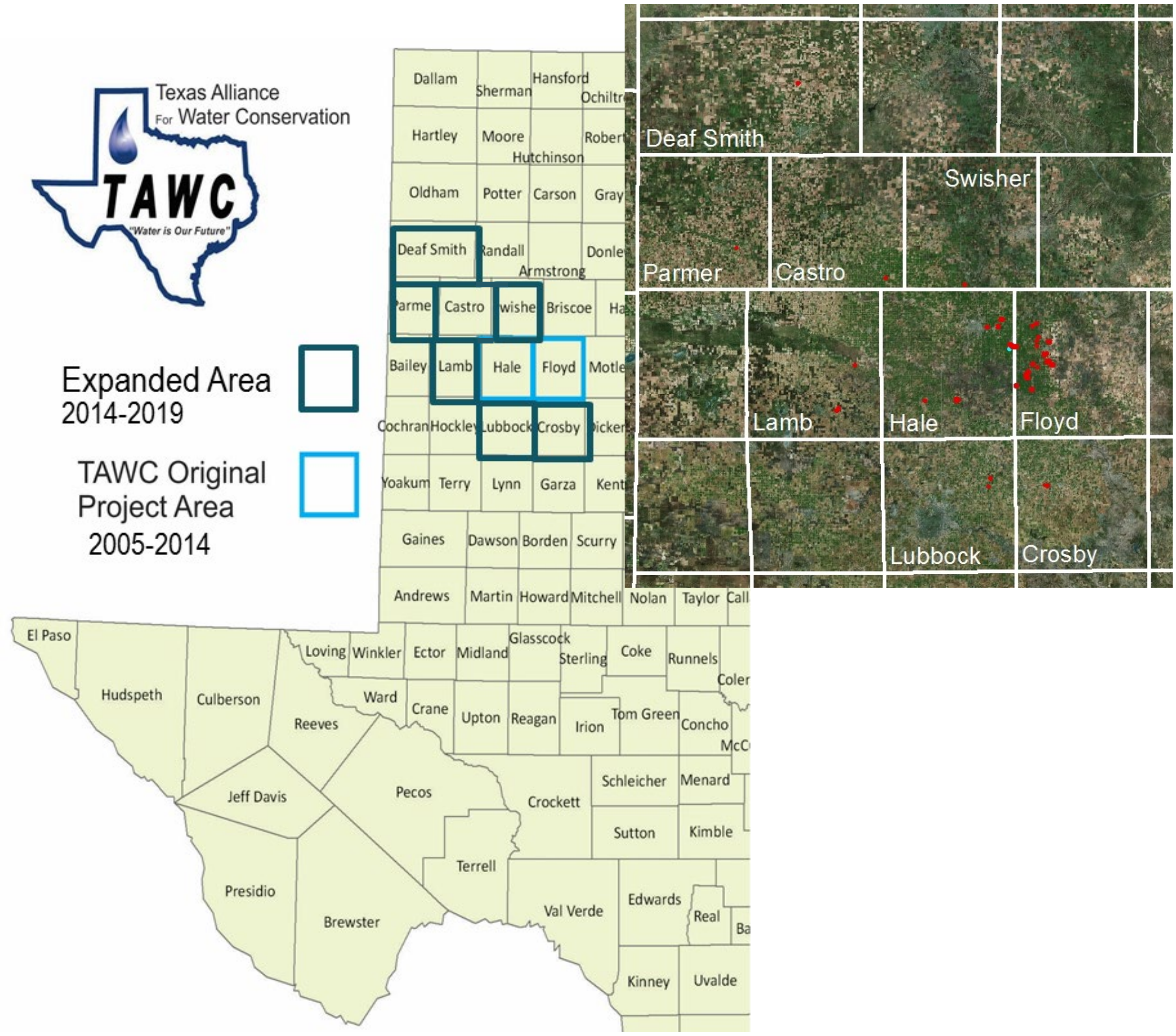


Figure 15. Original project area and new county expansion for Phase II of the demonstration project.

ACTIVE SITE DESCRIPTIONS (SEE APPENDIX FOR 2005-2017 DATA AND TERMINATED SITES)

Phase II Changes and Alterations

Phase II (See Appendix for Phase I Background) was started in 2014 with an additional 5 years of funding by the Texas Water Development Board and expanded the impact area to include a total of 8 counties in the Texas High Plains (Figure 15) with an additional county site location to be added in 2015.

Total number of Phase II acres devoted to each crop and livestock enterprise and management type in 2015 are given in Table 7. Previous year system information for both Phase I and Phase II of this project is provided in the Appendix, Tables A1-A10.

In Phase II year 1 (2014), sites 2, 3, 12 and 18 were dropped from the project, and 10 new sites in six new counties were added (Crosby, Deaf Smith, Lamb, Lubbock, Parmer, Swisher). The 10 new sites are numbered C50-C54 and C56-C60. Total net acres for the project increased from 4,962 in 2013 to 5,223 in 2014 as a result of these changes (Table A10).

In Phase II year 2 (2015), Sites 20, 27 and 29 were dropped and Sites C37, C38 and C39 were added with Site 17 dropping the perennial grass field of 112 acres from the original system acres. This resulted in a net increase in project acres from 5,223 acres in 2014 to 5,258 acres in 2015. While total sites in the project remained the same at 36, data was only collected on 31 producer sites in 2015 and the impact area covered by the project has significantly increased. As Phase II of our project outreach has expanded to include additional counties, some of the original project sites within Hale and Floyd counties are being replaced to facilitate the time and effort toward the new expanded area sites in order to focus on a broader impact area. With the addition of site 39 in Castro county the project area has increased from 2 counties in Phase I to a total of 9 counties in Phase II for 2015.

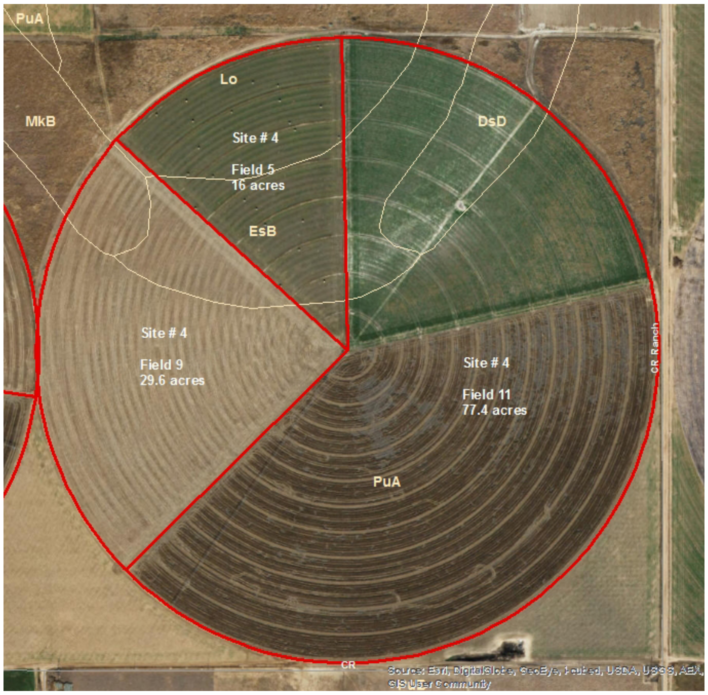
In Phase II year 3 (2016), Sites 5, 7, 8, 15, 19, 26, 30, C52 and C58 were dropped in a continued effort to reduce the number of sites in the project to a more manageable number of sites across a broader area as well as deleting sites in which the participating producer has now retired. No producer records were available for sites 34, C39, C53, C54 and C59 for 2016 though these sites remain a part of the project at the current time. The first year of data was collected for Sites C37 and C38. This resulted in a net decrease in total project acres from 5,258 acres in 2015 to 3,972 acres in 2016 with 27 total sites with producer data collected on 22 of these sites with 2,909 active acres in 2016. The total number of sites will be reduced again in 2017.

In Phase II year 4 (2017), Sites 6, 24, 28, 33, C53 and C54 were dropped in a continued effort to reduce the number of sites in the project to a more manageable number of sites across a broader area as well as deleting sites in which the participating producer has now retired or no longer able to provide field records. No producer records were available for site 34 for 2017 though this site currently remains a part of the project at the current time. This resulted in a net decrease in total project acres from 3,961 acres in 2016 to 3,383 system acres in 2017 with 2,656 active acres. Due to the loss of Sites C53 and C54 we currently no longer have a site in Lamb county reducing the county coverage from 9 to 8 counties with a demonstration site.

In Phase II year 5 (2018), Site 34 was dropped from project due to no records supplied by producer. No producer records were available for site 4 and 31 for 2018 though these sites remain a part of this project. This resulted in a net decrease in total project acres from 3,383 acres in 2017 to 2,432 system acres in 2018 with 2,200 active acres. Due to the loss of Sites C53 and C54 we currently no longer have a site in Lamb county reducing the county coverage from 9 to 8 counties with a demonstration site.

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

SITE 4 – INACTIVE FOR 2018



Description:

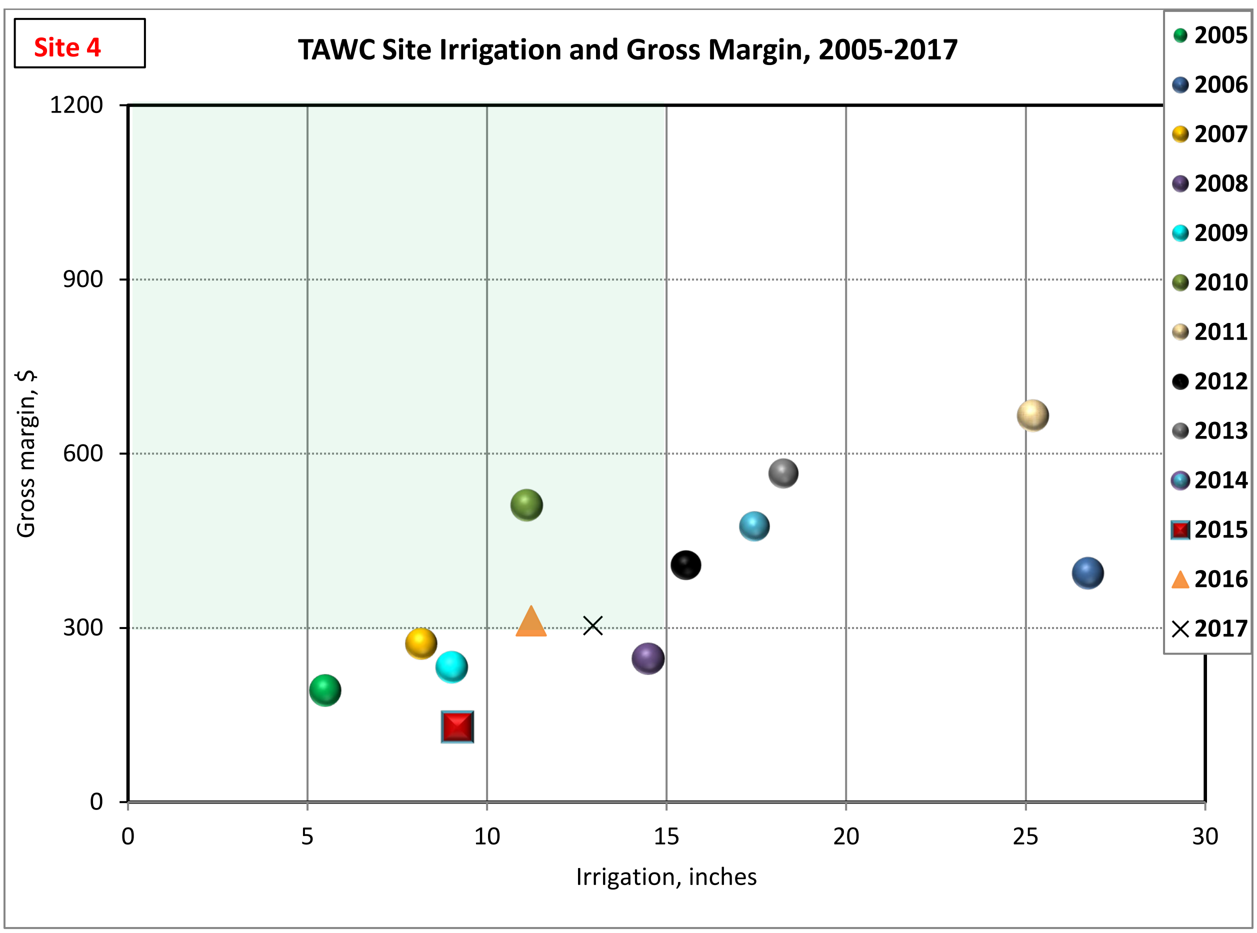
Site acres: 123.0

Soil types:
- PuA-Pullman clay loam, 0 to 1%
- DsD-Drake soils, 3 to 8%
- EsB-Estacado loam, 1 to 3%
- Lo-Lofton clay loam, 0 to 1%

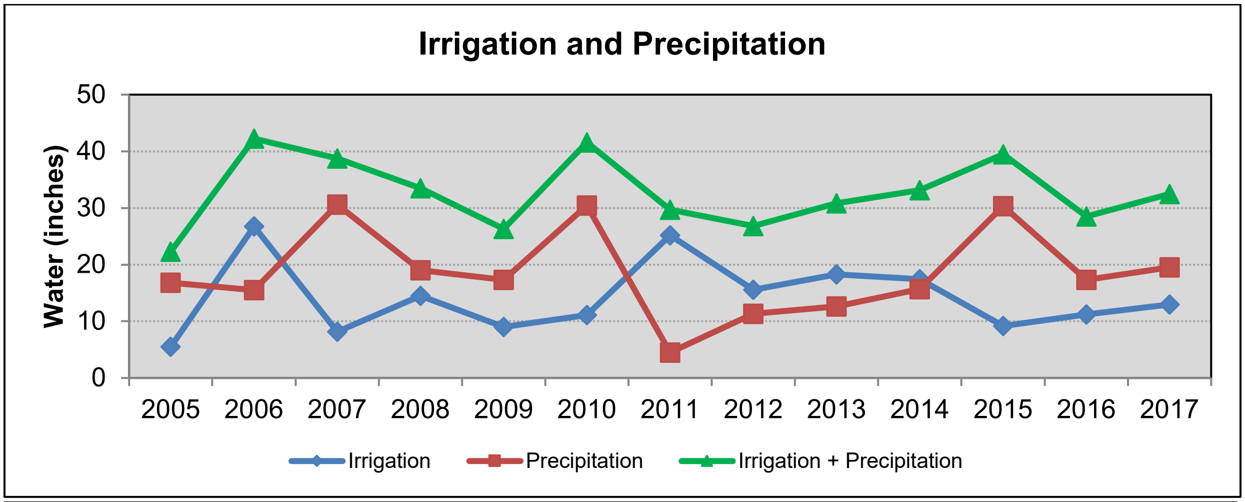
Irrigation:
Center Pivot (LESA) 500 gpm

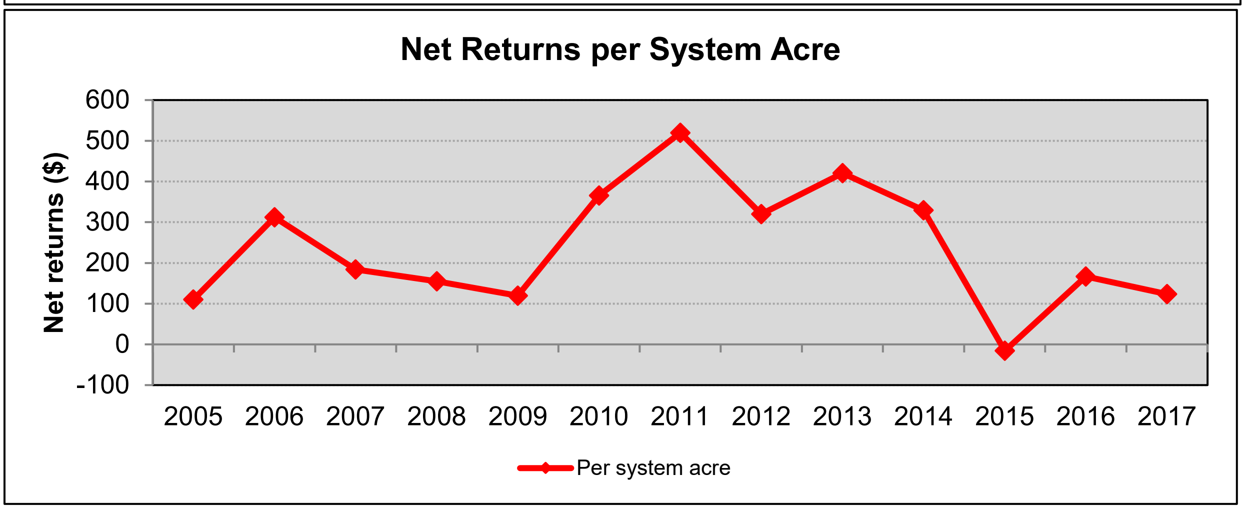
Number of wells: 3

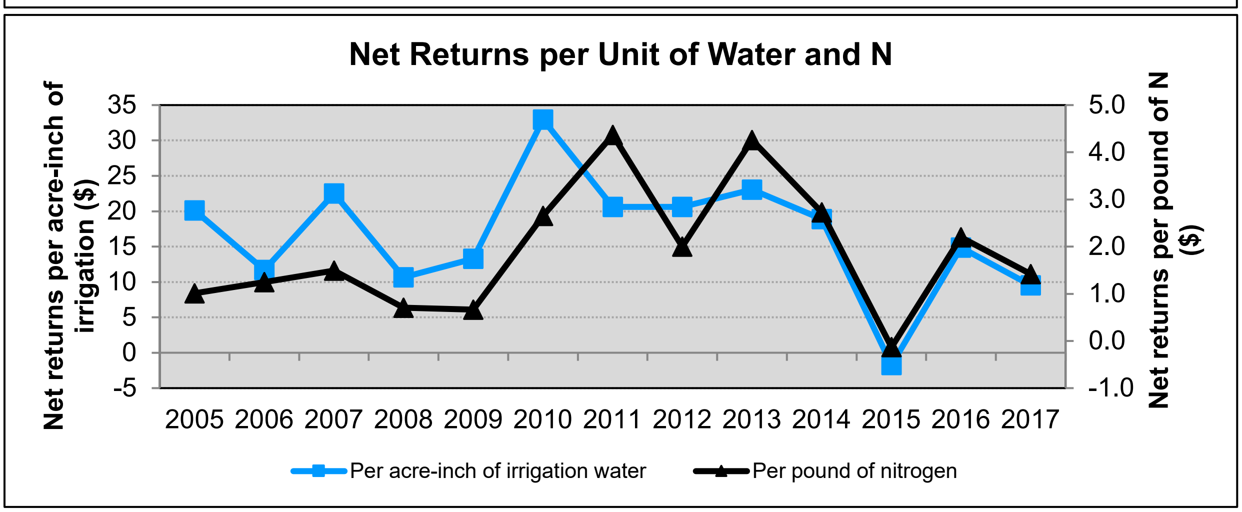
Fuel Source: 1 Natural gas,



Site 4 – Inactive for 2018







Site 4 – Inactive for 2018


May ground prep


Hay production


Cattle grazing

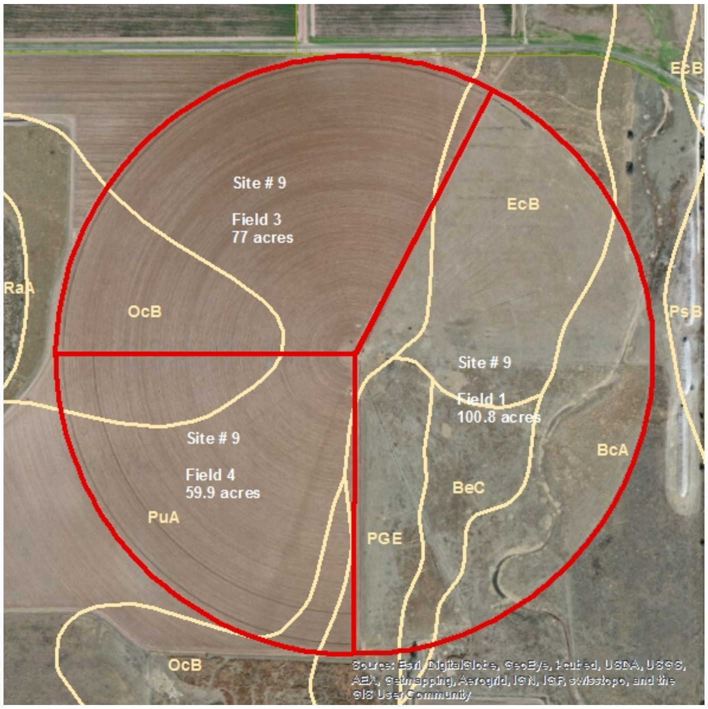

Alfalfa


September Cotton


LEPA Irrigated wheat

Comments: In 2017 this pivot LEPA/LESA integrated crop/livestock irrigated site was planted to wheat, cotton, seed millet, and started a new planting of alfalfa in a different section of the pivot.

SITE 9



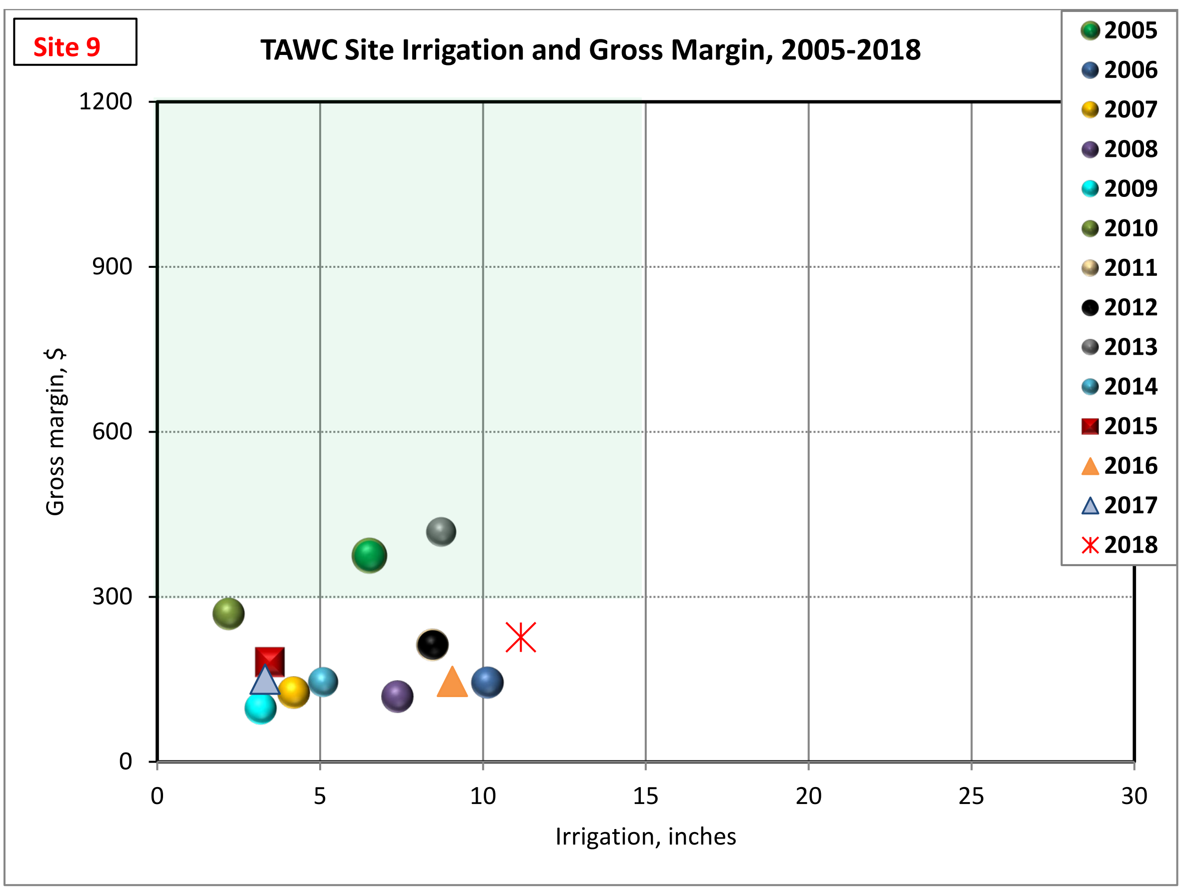
Description:

Site acres:	237.7

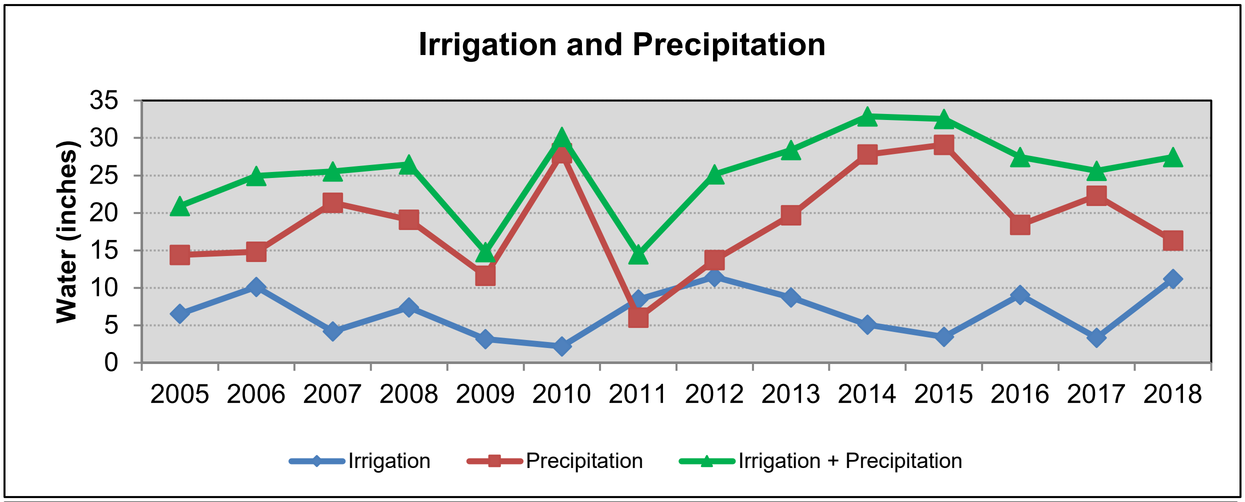
Soil types:
- PuA-Pullman clay loam; 0 to 1%
- OcB-Olton clay loam, 1 to 3%
- EcB-Estacado clay loam; 1 to 3%
- BcA-Bippus clay loam; 0 to 2%
- BeC-Berda loam, 3 to 5%
- PGE-Potter soil, 3 to 20%

Irrigation:

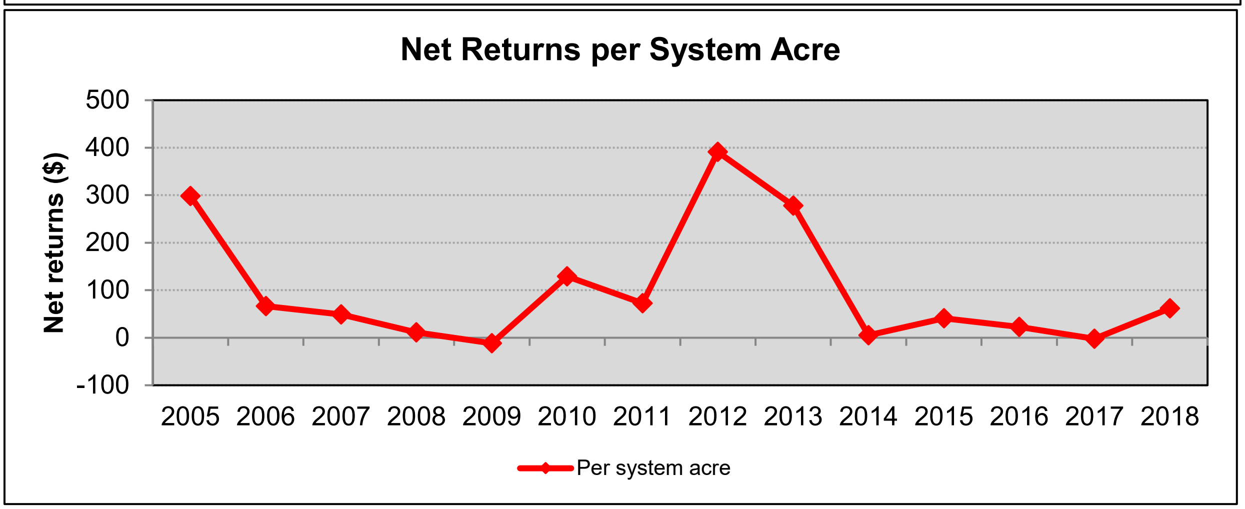
Center Pivot (MESA)	900 gpm
Number of wells:	4
Fuel Source:	2 Natural gas, 2 Diesel



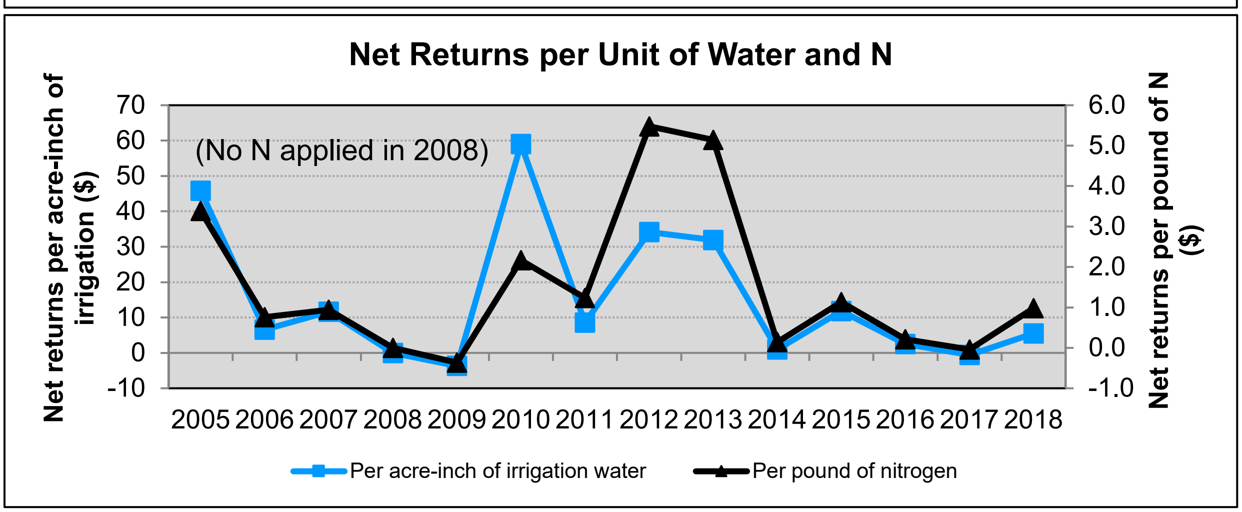
Site 9



Irrigation and Precipitation
Water (inches)
35
30
25
20
15
10
5
0
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Net returns ($)
500
400
300
200
100
0
-100
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Per system acre



Net Returns per Unit of Water and N
Net returns per acre-inch of irrigation ($)
70
60
50
40
30
20
10
0
-10
(No N applied in 2008)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
Net returns per pound of N ($)
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site 9


Perennial grass


September cotton


Cow/calf grazing grass


Perennial grass for grazing


Momma cows


Cotton ready for harvest

Comments: In 2018 this pivot irrigated integrated crop/livestock site was minimum till planted to cotton. The perennial grass mix was grazed by 50 cows with 40 calves born.

SITE 10

Description:

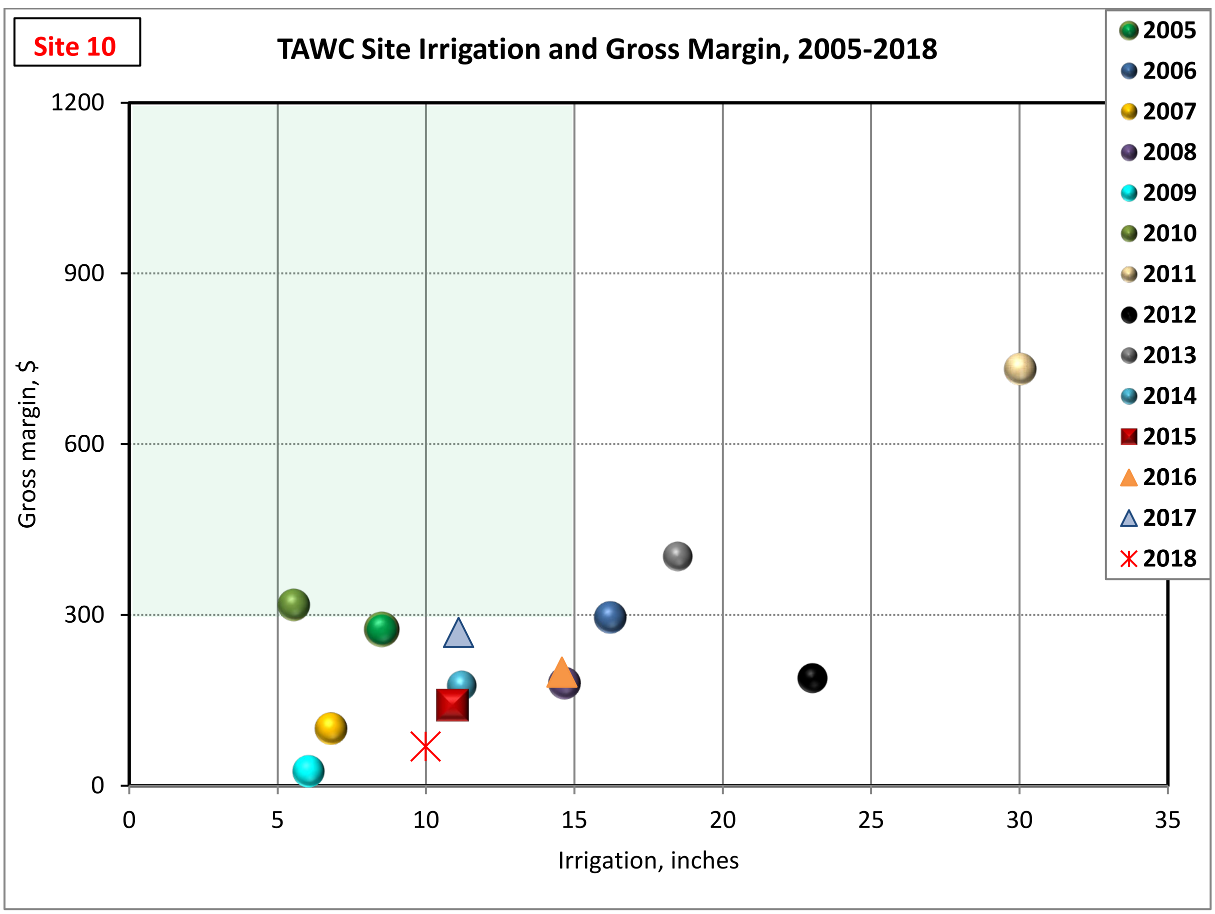
Site acres: 173.6

Soil types:
- PuA-Pullman clay loam; 0 to 1%
- PuB-Pullman clay loam, 1 to 3%
- EcA-Estacado clay loam; 0 to 1%
- LoA-Lofton clay loam; 0 to 1%

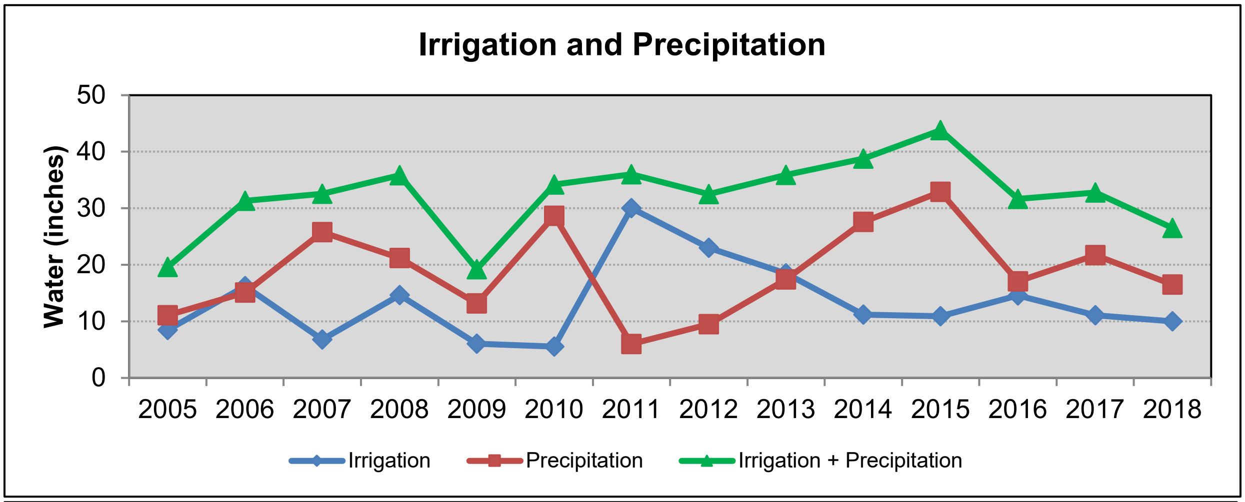
Irrigation:
Center Pivot (LESA) 800 gpm

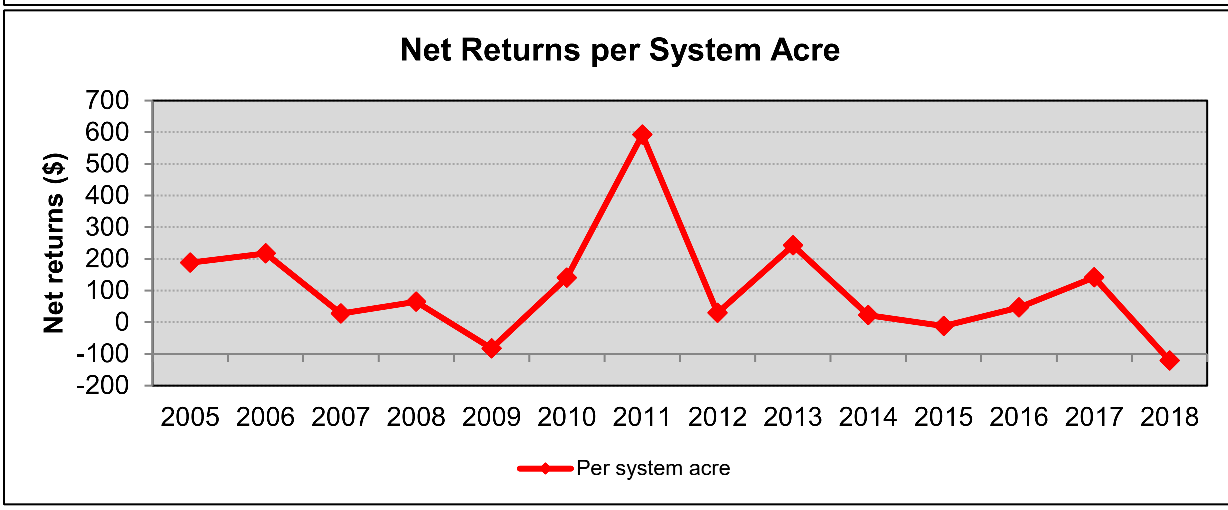
Number of wells: 2

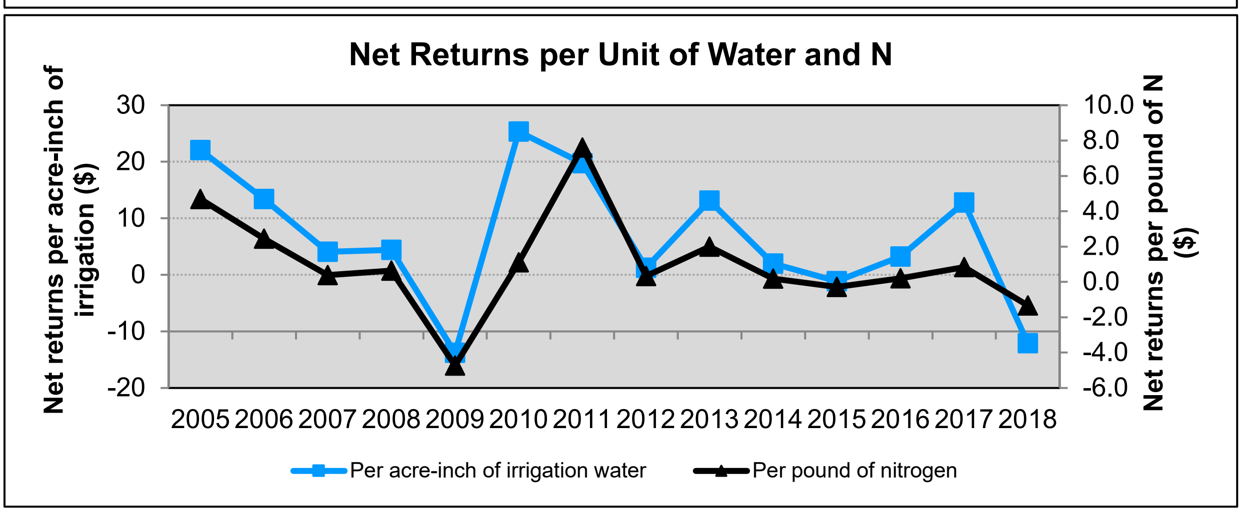
Fuel Source: Electric



Site 10


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
700
600
500
400
300
200
100
0
-100
-200
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Per system acre


Net Returns per Unit of Water and N
Net returns per acre-inch of irrigation ($)
30
20
10
0
-10
-20
Net returns per pound of N ($)
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site 10


Early May


Cow/calf pairs


Cattle grazing mixed grass


Grazing corn residue


November cotton


November cotton bales

Comments: In 2018 this pivot LESA irrigated integrated crop/livestock site was planted to minimum tillage cotton. The cotton was hailed out and replanted to forage sorghum for hay production and continued in perennial grass. The perennial grass was grazed by 34 cattle pairs for 143 days. 3.5 tons of compost was applied.

SITE 11

Description:

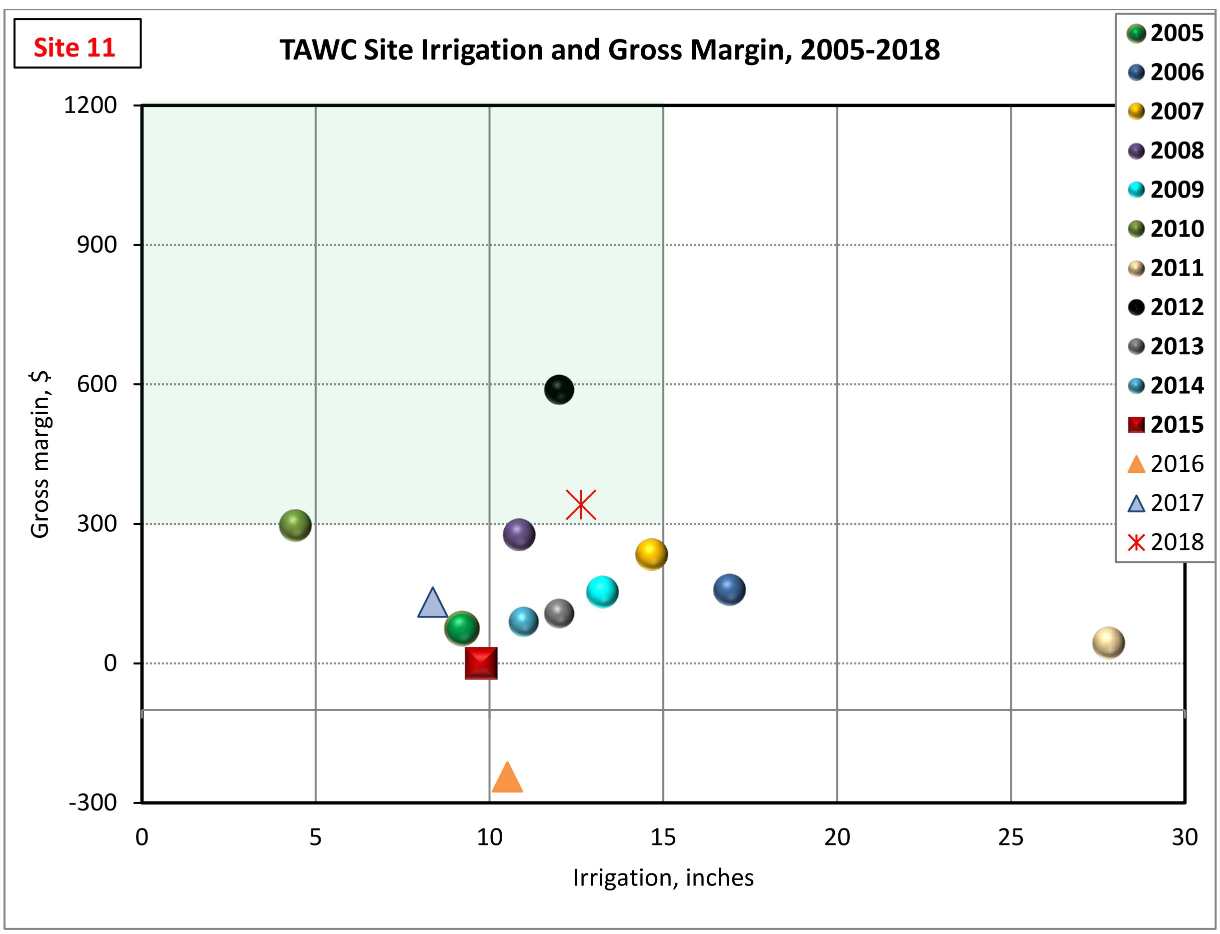
Site acres: 82.6

Soil types:
- PuA-Pullman clay loam; 0 to 1%
- LoA-Lofton clay loam; 0 to 1%
- EcB-Estacado clay loam; 1 to 3%
- OcB-Olton clay loam; 1 to 3%

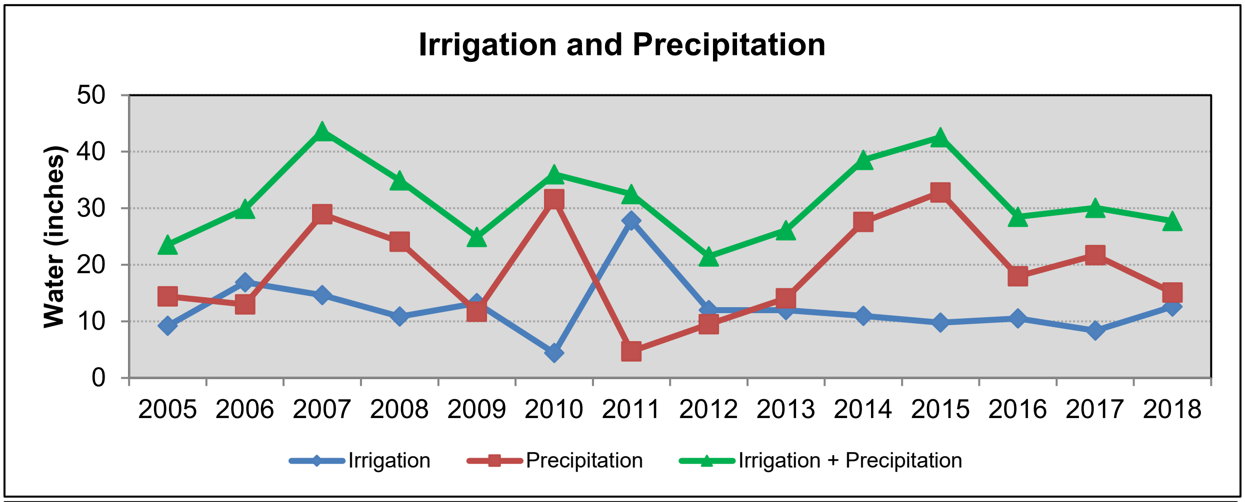
Irrigation:
- Furrow/Drip (FUR/SDI) 490 gpm

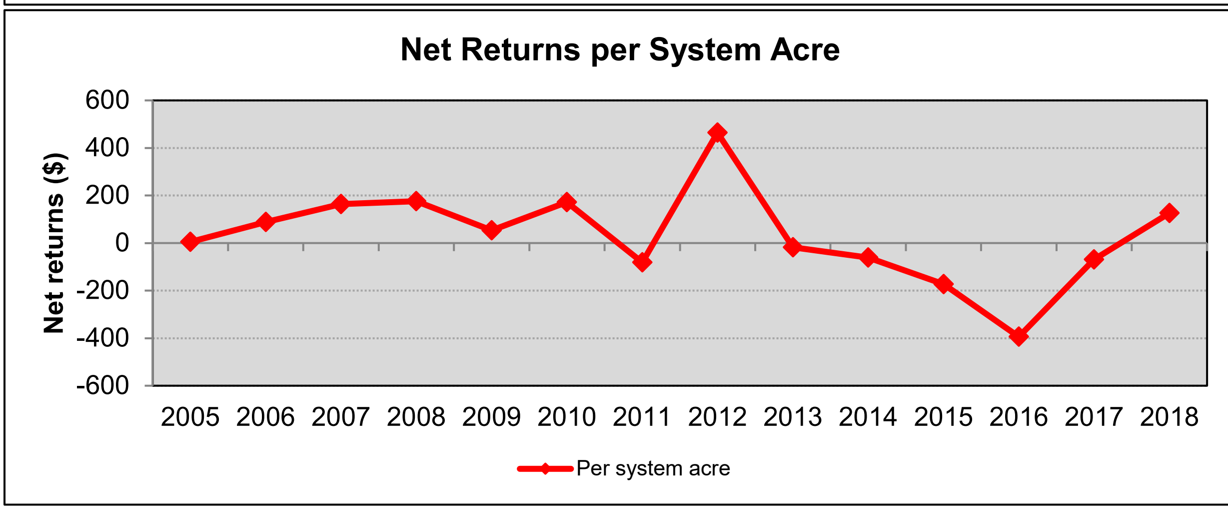
Number of wells: 1

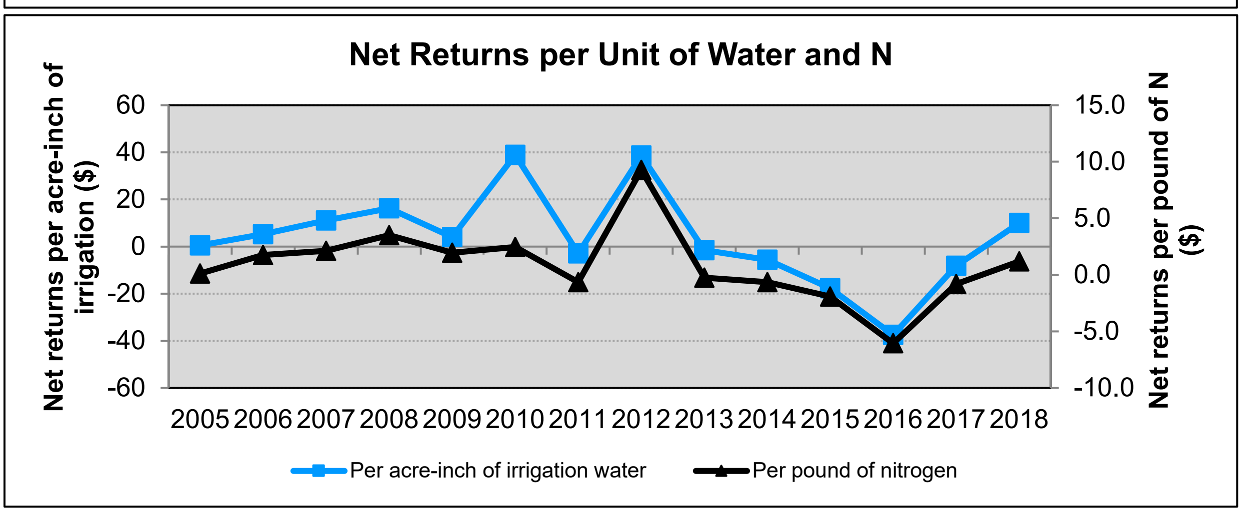
Fuel Source: Electric



Site 11

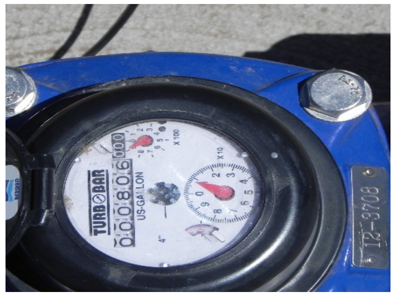

Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
600
400
200
0
-200
-400
-600
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Per system acre


Net Returns per Unit of Water and N
Net returns per acre-inch of irrigation ($)
60
40
20
0
-20
-40
-60
15.0
10.0
5.0
0.0
-5.0
-10.0
Net returns per pound of N ($)
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site 11

May dry conditions



Water meter on system

SDI filtration system

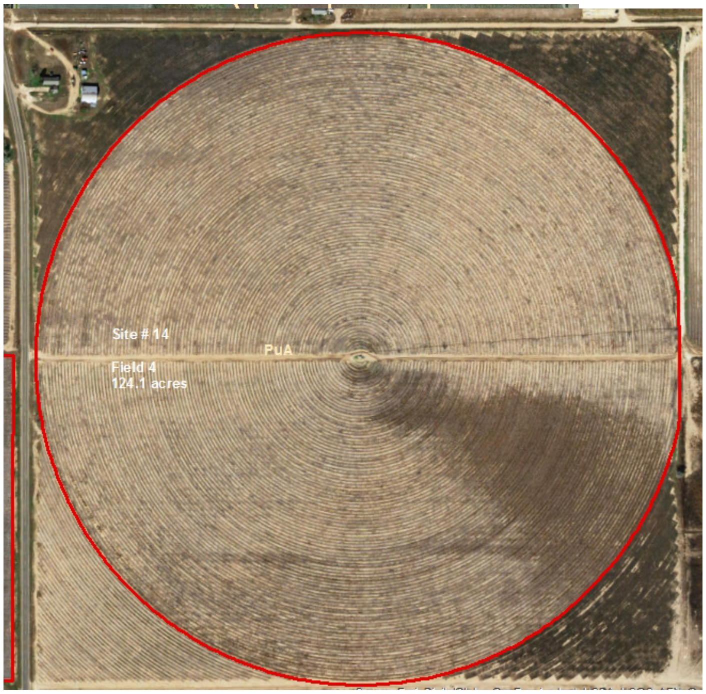
September cotton

September corn

Moisture probe installation

Comments: In 2018 this SDI/FUR irrigated site was planted to cotton. The cotton was planted on 40-inch centers under conventional tillage. The cotton crop was hailed out and field 9 with furrow irrigation was not replanted. Field 13 with SDI was replanted to corn and taken to harvest.

SITE 14



Description:

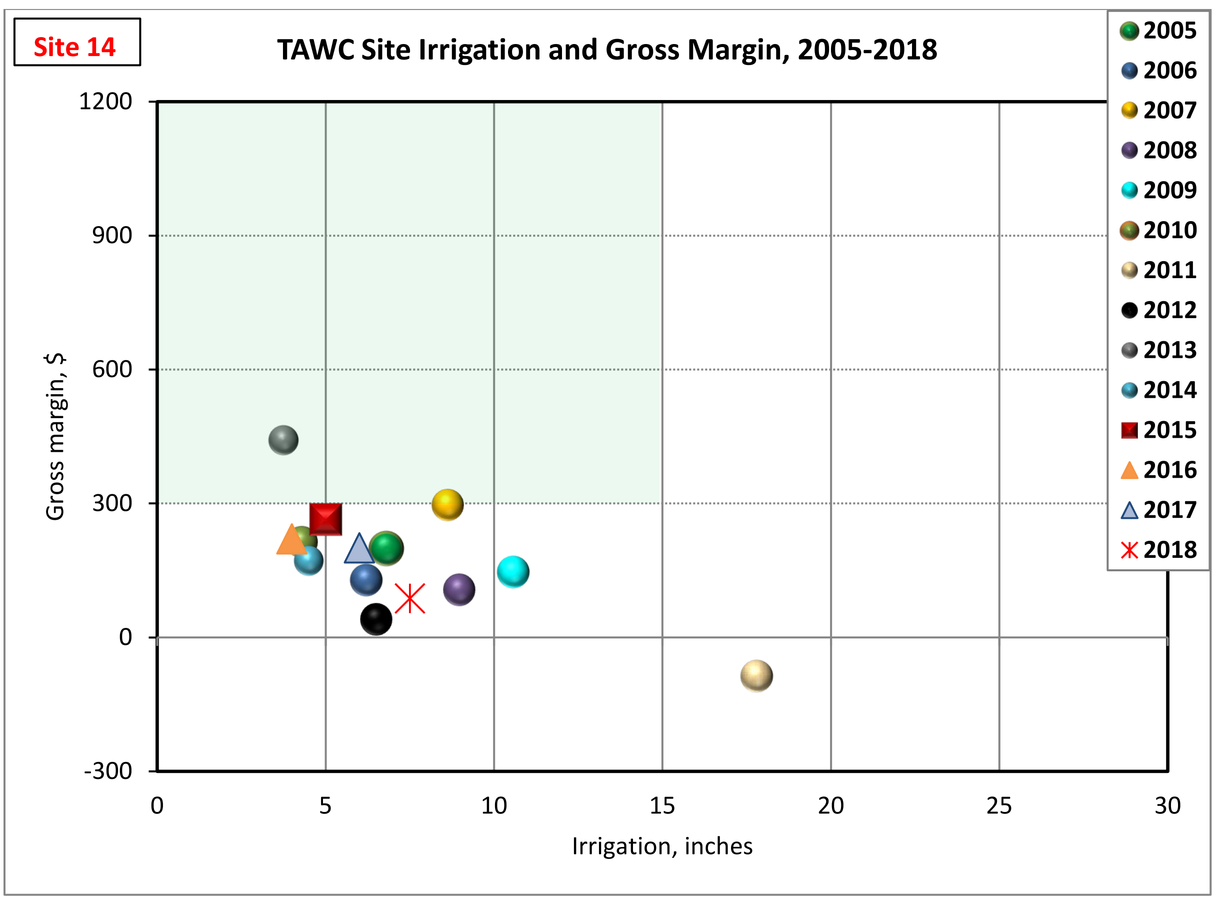
Site acres: 124.1

Soil types:
PuA-Pullman clay loam; 0 to 1%

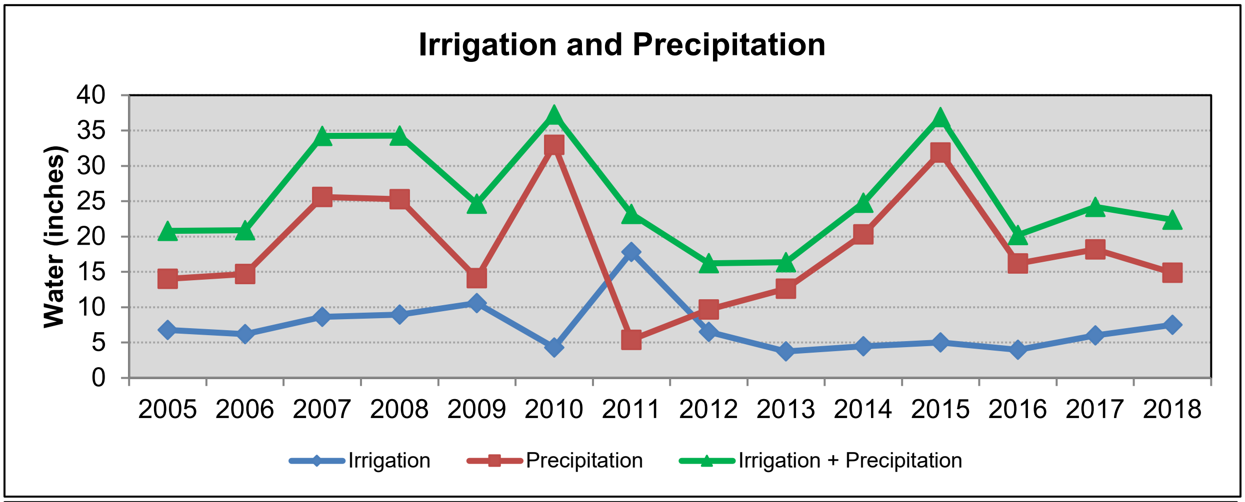
Irrigation:
Center Pivot (LESAA) 300 gpm

Number of wells: 3

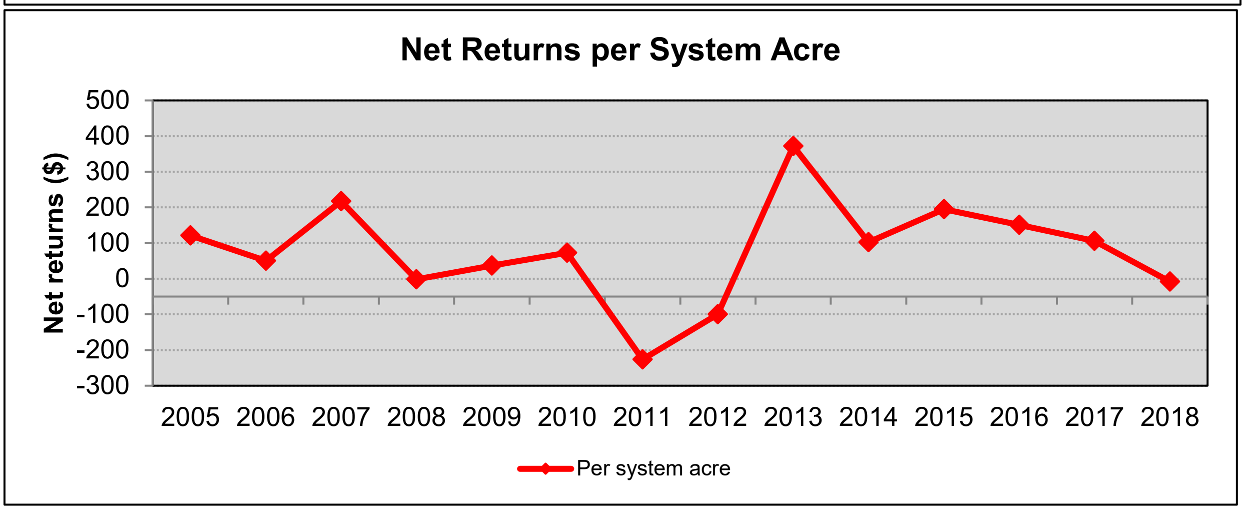
Fuel Source: Electric



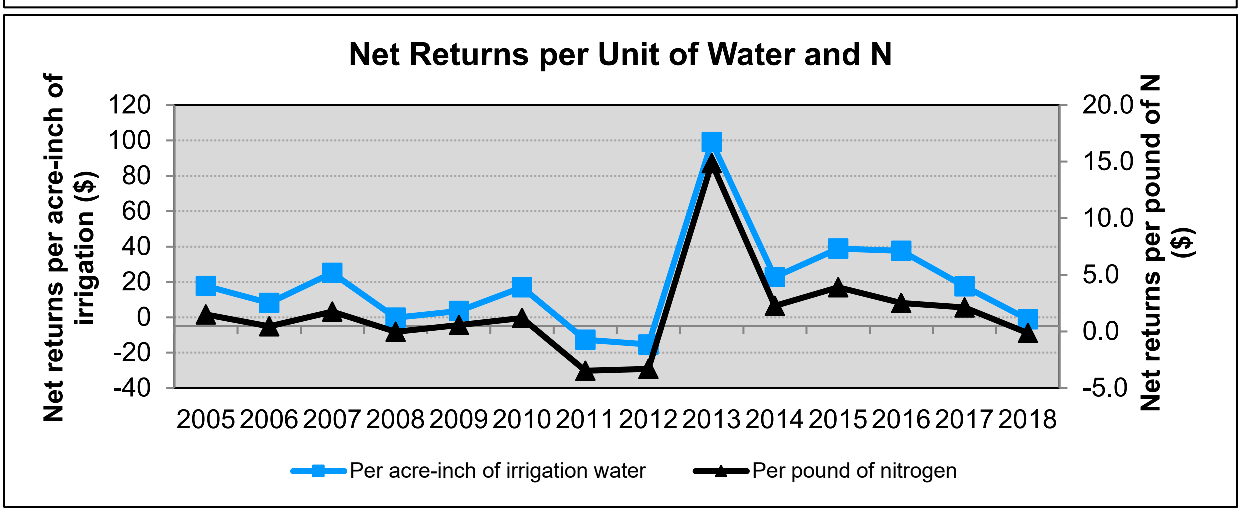
Site 14



Irrigation and Precipitation
Water (inches)
40
35
30
25
20
15
10
5
0
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Net returns ($)
500
400
300
200
100
0
-100
-200
-300
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Per system acre



Net Returns per Unit of Water and N
Net returns per acre-inch of irrigation ($)
120
100
80
60
40
20
0
-20
-40
20.0
15.0
10.0
5.0
0.0
-5.0
Net returns per pound of N ($)
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site 14


Dry conditions March


Early June cotton


Early September cotton


Cotton planted 2 in- 2 out


Cotton ready for harvest


MESA/LEPA irrigation

Comments: In 2018 this pivot MESA/LEPA irrigated site was planted to cotton monoculture in a 2 in 2 out tillage system.

Site 17

Description:

Site acres: 108.9

Soil types:

PuA-Pullman clay loam; 0 to 1%

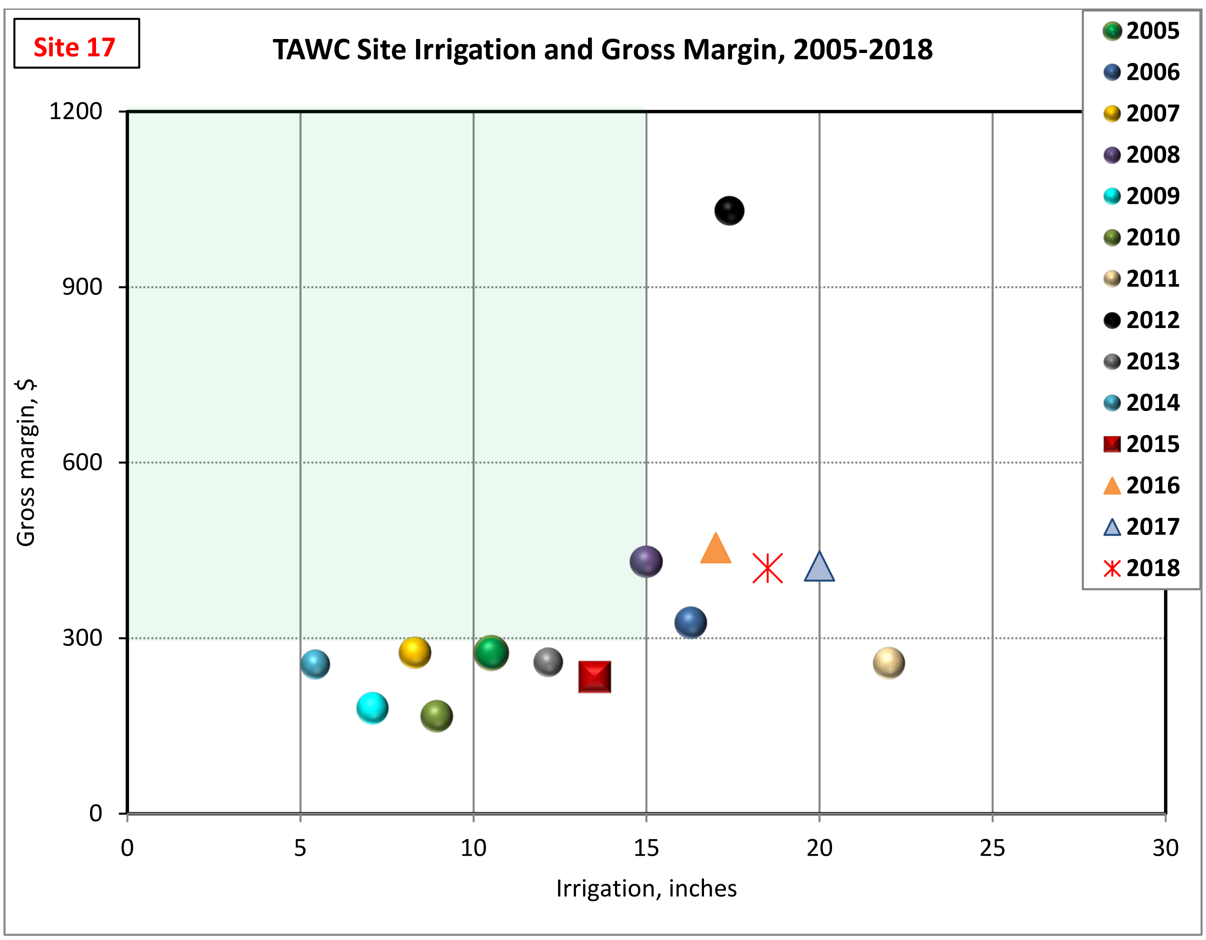
OcB-Olton clay loam; 1 to 3%

Irrigation:

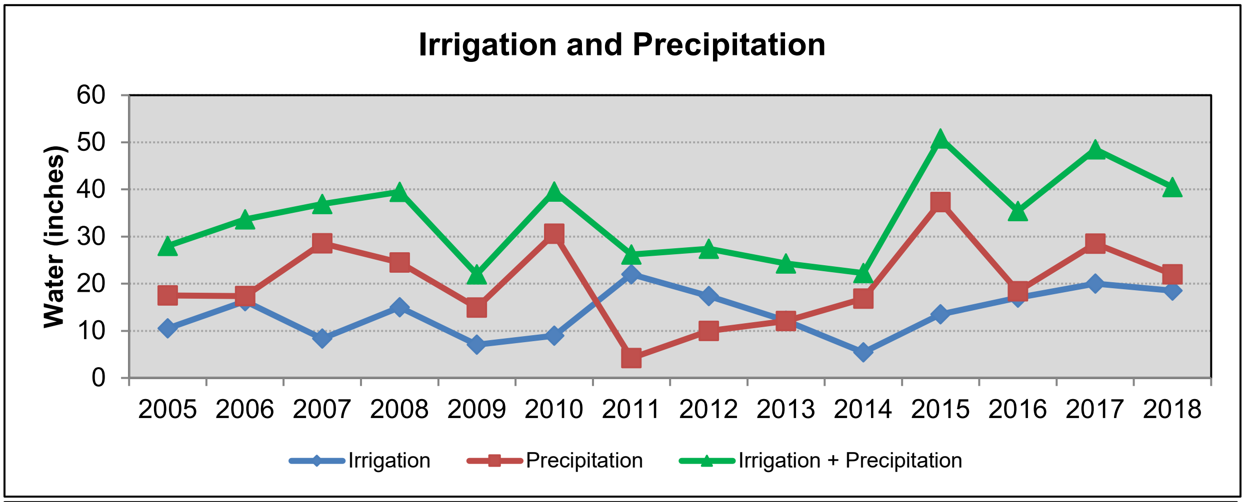
Center Pivot (MESA) 900 gpm

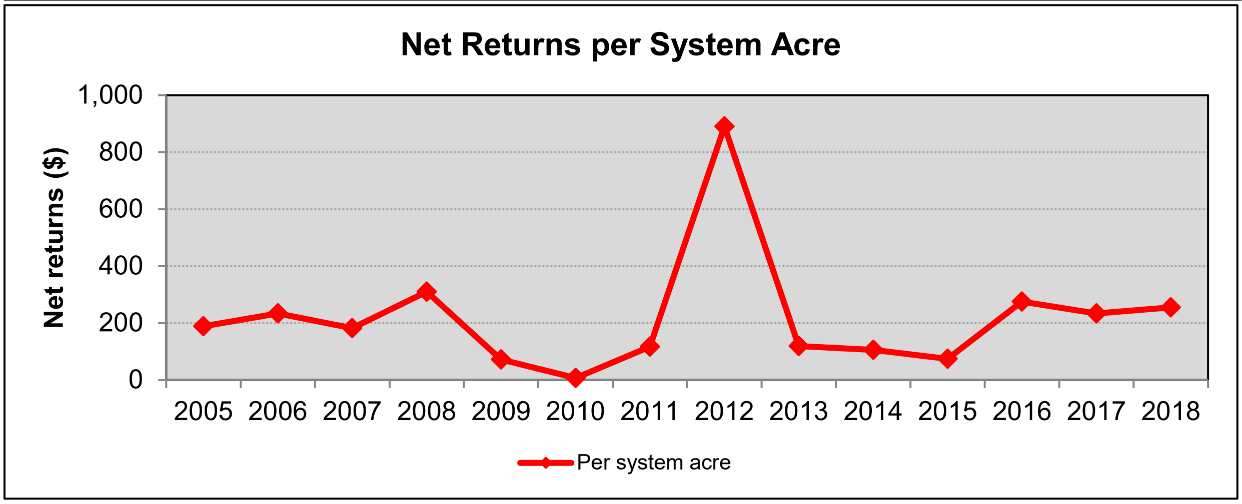
Number of wells: 8

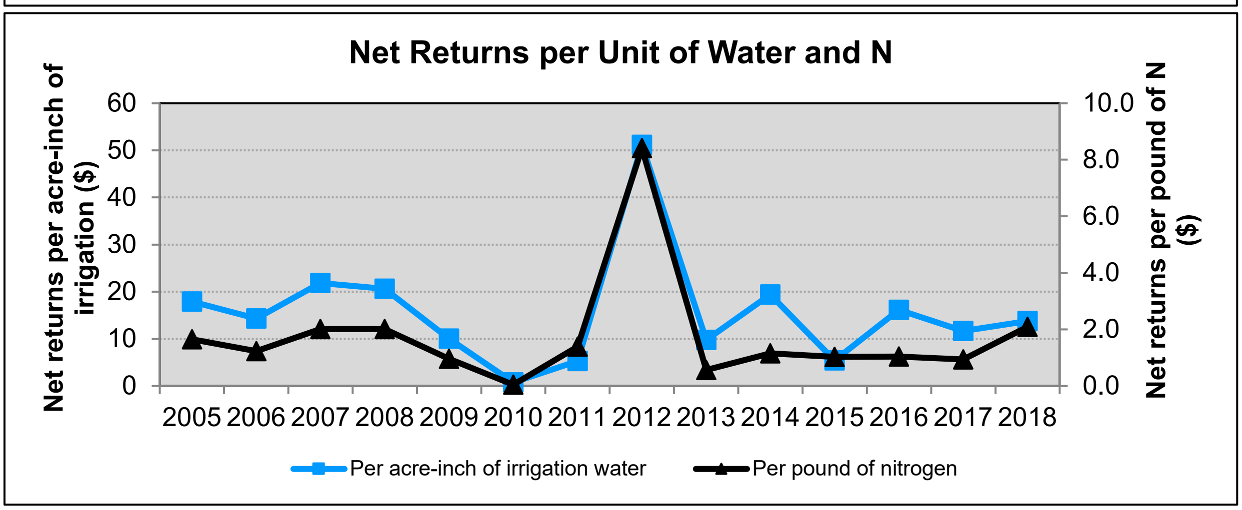
Fuel Source: Electric



Site 17


Irrigation and Precipitation
Water (inches)
60
50
40
30
20
10
0
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
1,000
800
600
400
200
0
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Per system acre


Net Returns per Unit of Water and N
Net returns per acre-inch of irrigation ($)
60
50
40
30
20
10
0
10.0
8.0
6.0
4.0
2.0
0.0
Net returns per pound of N ($)
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site 17


May cotton residue


W.W. B-Dahl fallowed

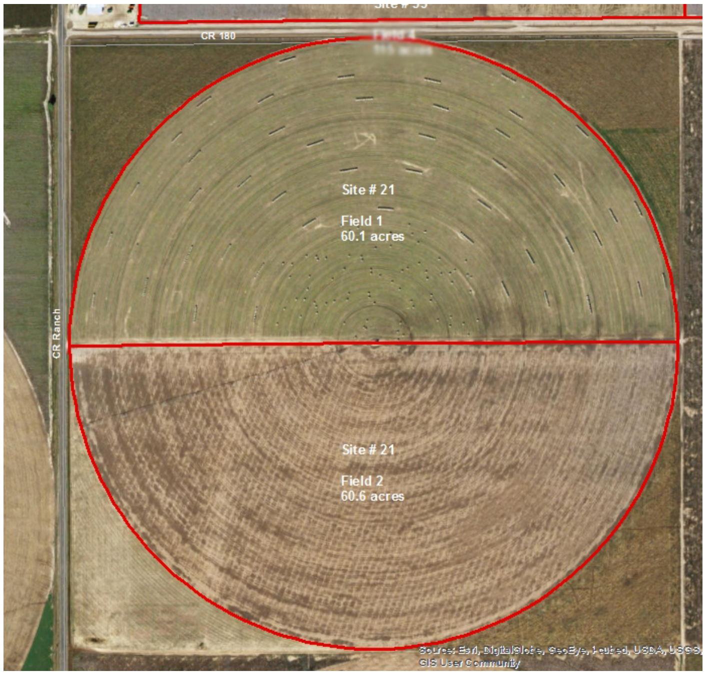

September corn


Perennial grass and corn


Corn ready for harvest

Comments: In 2018 this pivot irrigated site was planted to corn and cotton. The W.W. B-Dahl perennial grass was fallowed.

SITE 21



Description:

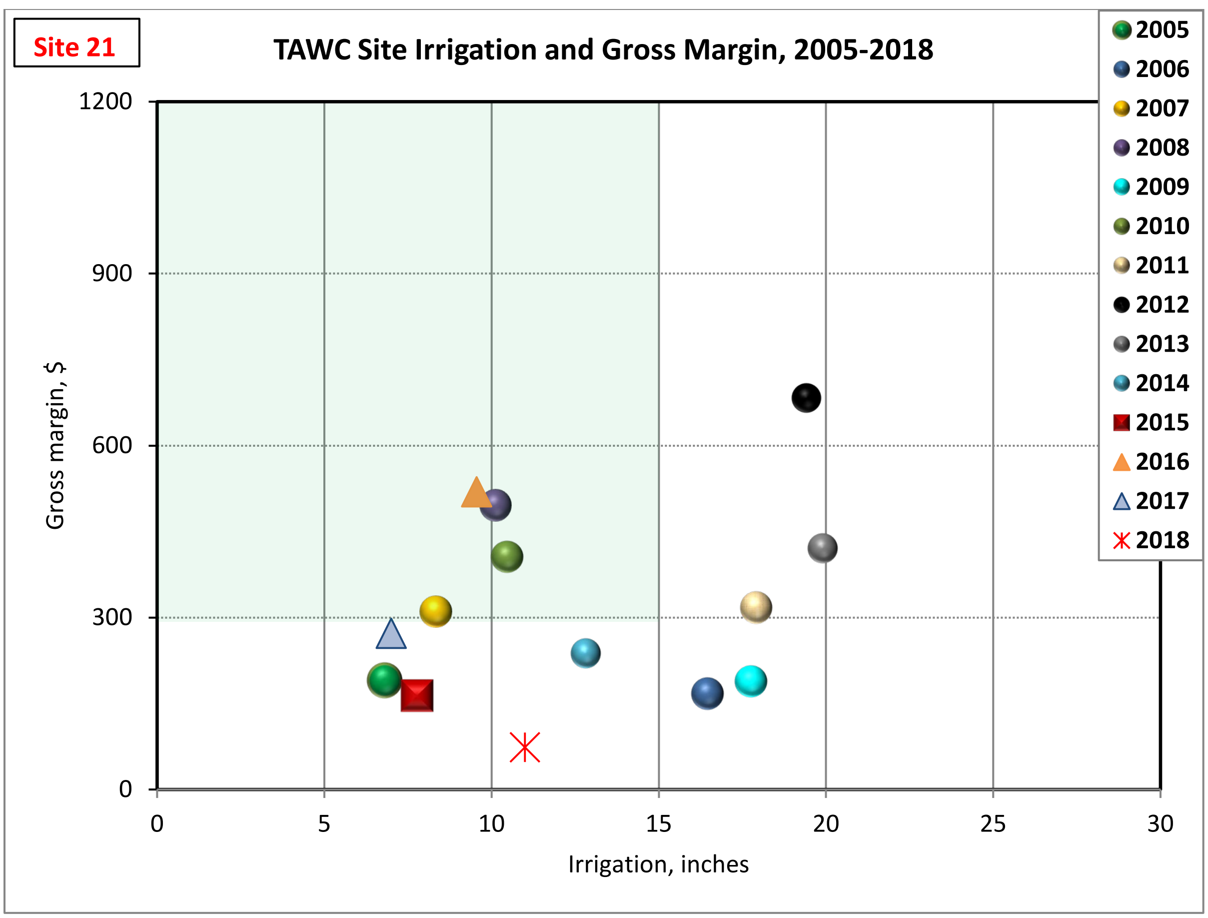
Site acres: 120.7

Soil types:
PuA-Pullman clay loam; 0 to 1%
LoA-Lofton clay loam; 0 to 1%

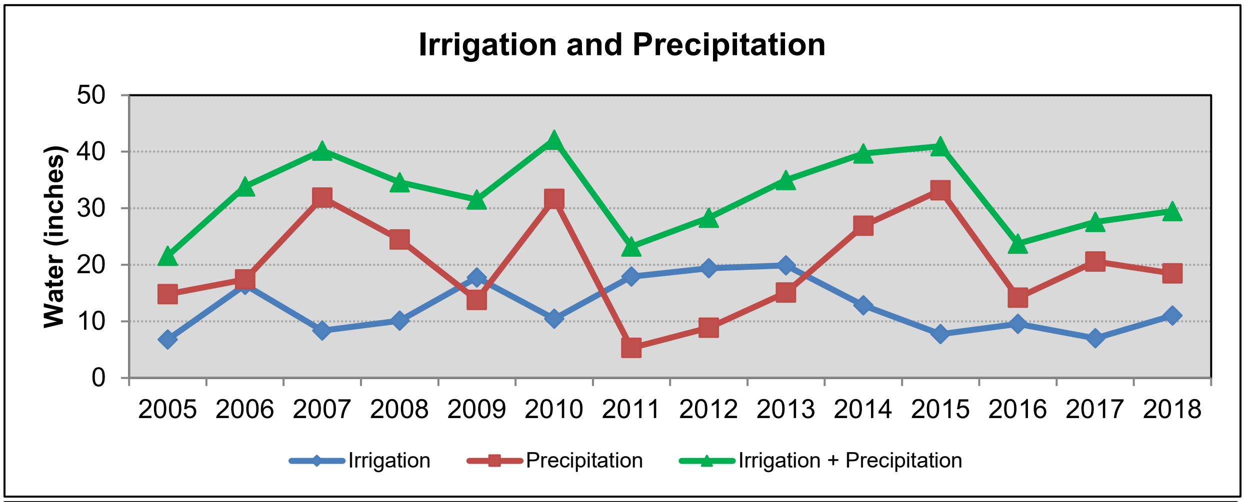
Irrigation:
Center Pivot (LEPA) 500 gpm

Number of wells: 1

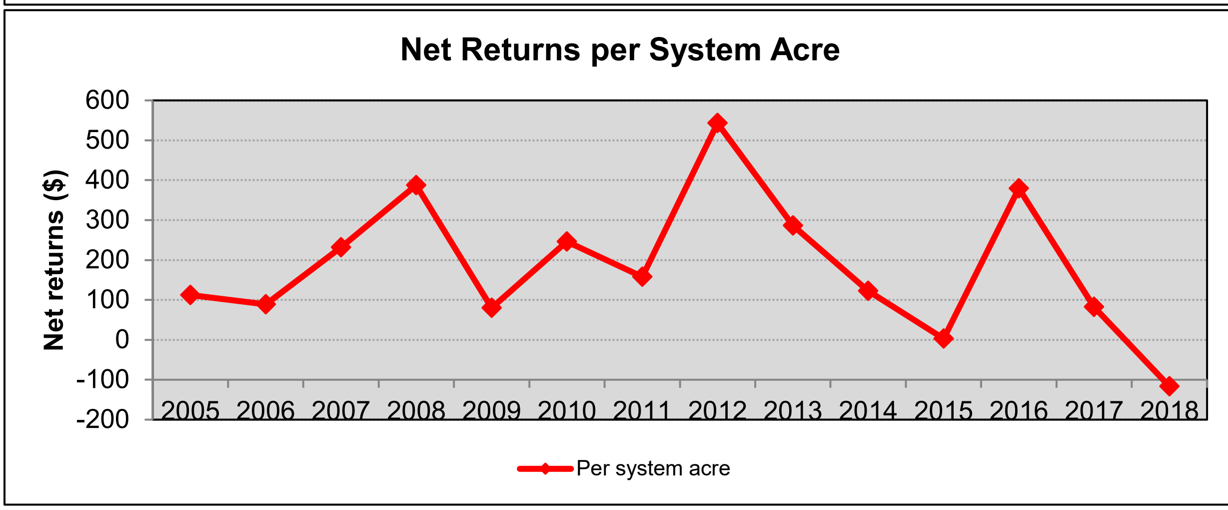
Fuel Source: Electric



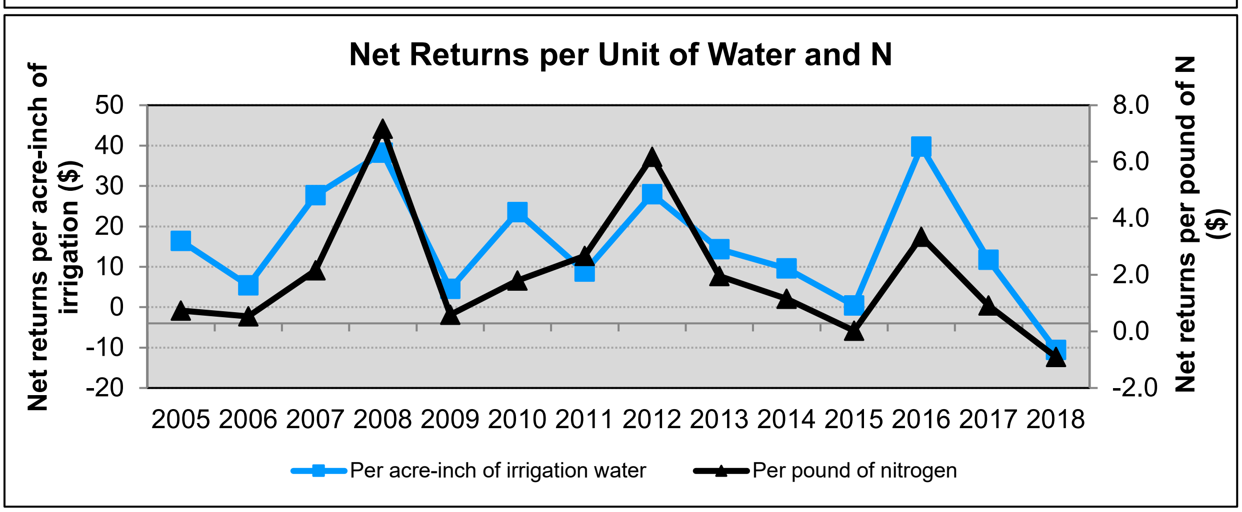
Site 21



Irrigation and Precipitation
Water (inches)
0
10
20
30
40
50
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Net returns ($)
-200
-100
0
100
200
300
400
500
600
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Per system acre



Net Returns per Unit of Water and N
Net returns per acre-inch of irrigation ($)
-20
-10
0
10
20
30
40
50
8.0
6.0
4.0
2.0
0.0
-2.0
Net returns per pound of N ($)
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site 21


May germination application


September irrigation


Cotton harvest equipment


Ready to strip


November cotton


November cotton module

Comments: In 2018 this pivot LEPA irrigated site was planted to wheat and millet as a double crop producing wheat grain and millet hay. Cotton was planted in field 6 on 40-inch vertical tillage rows.

Site 22

Description:

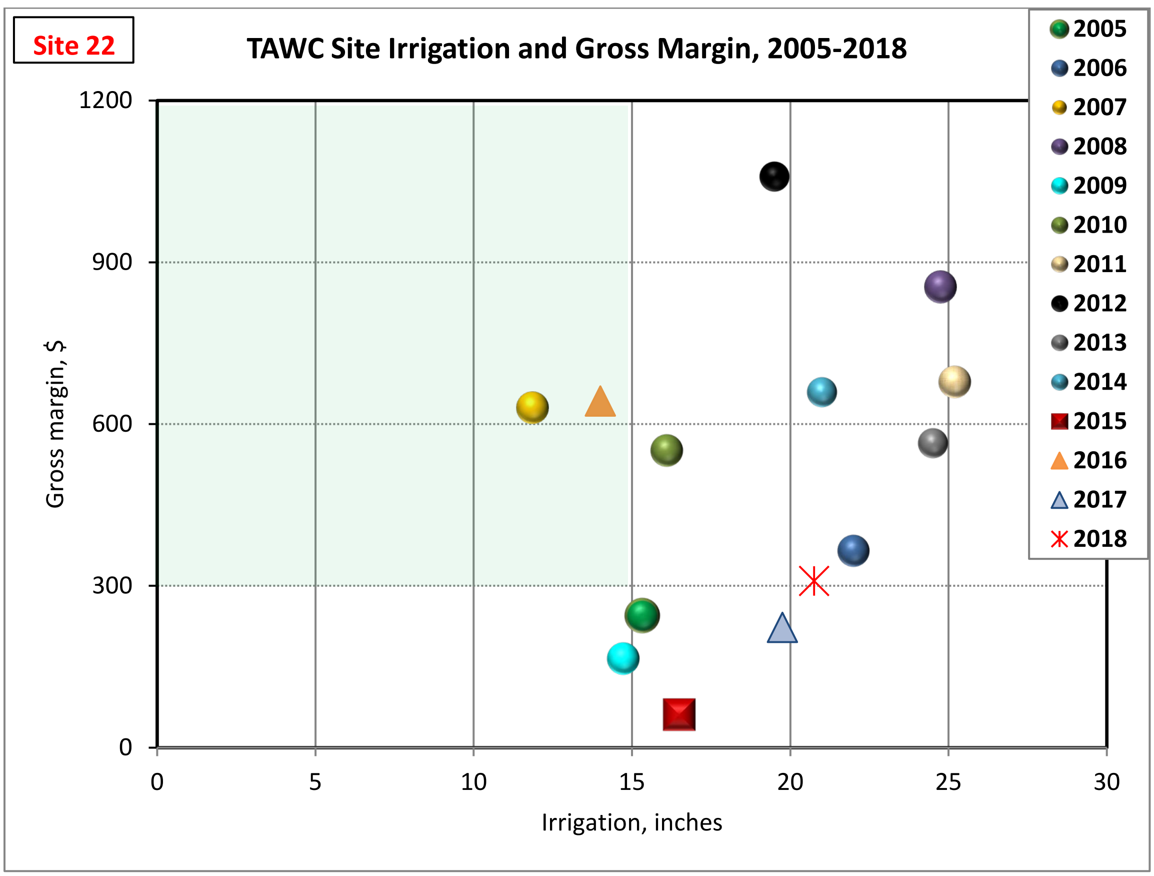
Site acres: 145.0

Soil types:
PuA-Pullman clay loam; 0 to 1%
EsB-Estacado loam; 1 to 3%

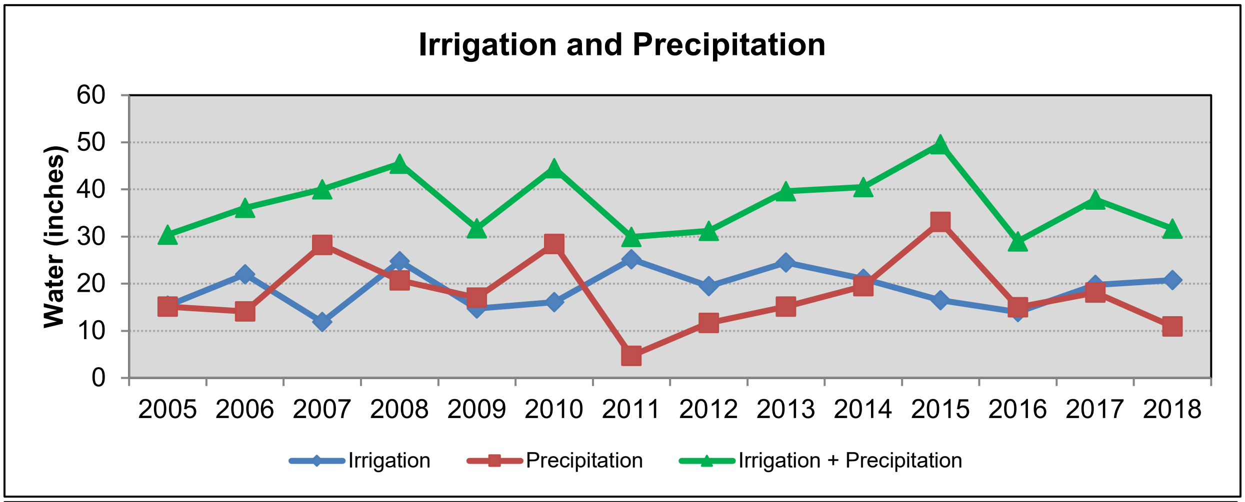
Irrigation:
Center Pivot (LEPA) 800 gpm

Number of wells: 4

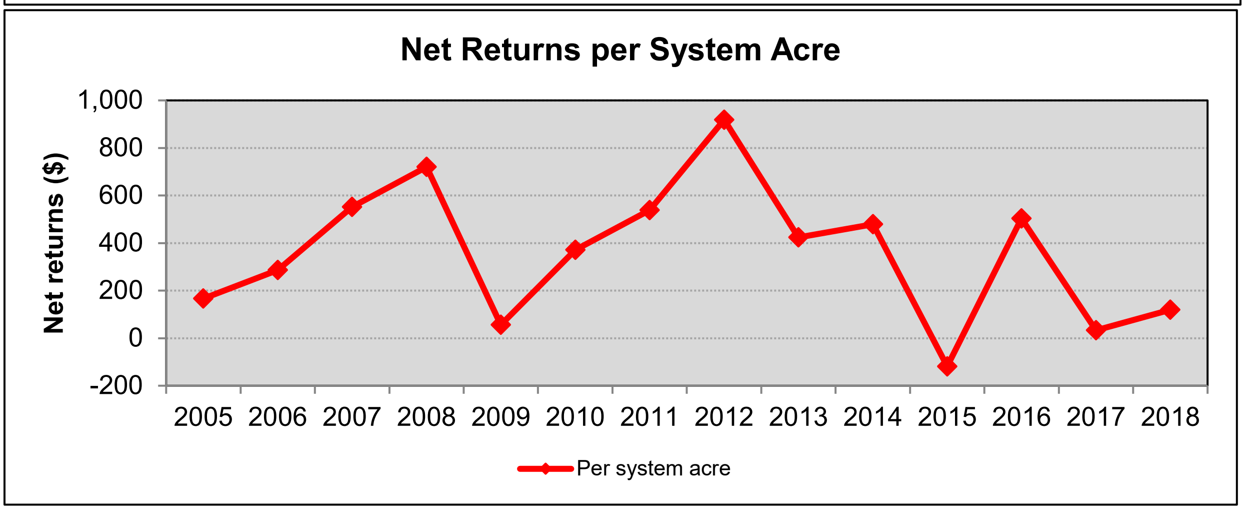
Fuel Source: Electric



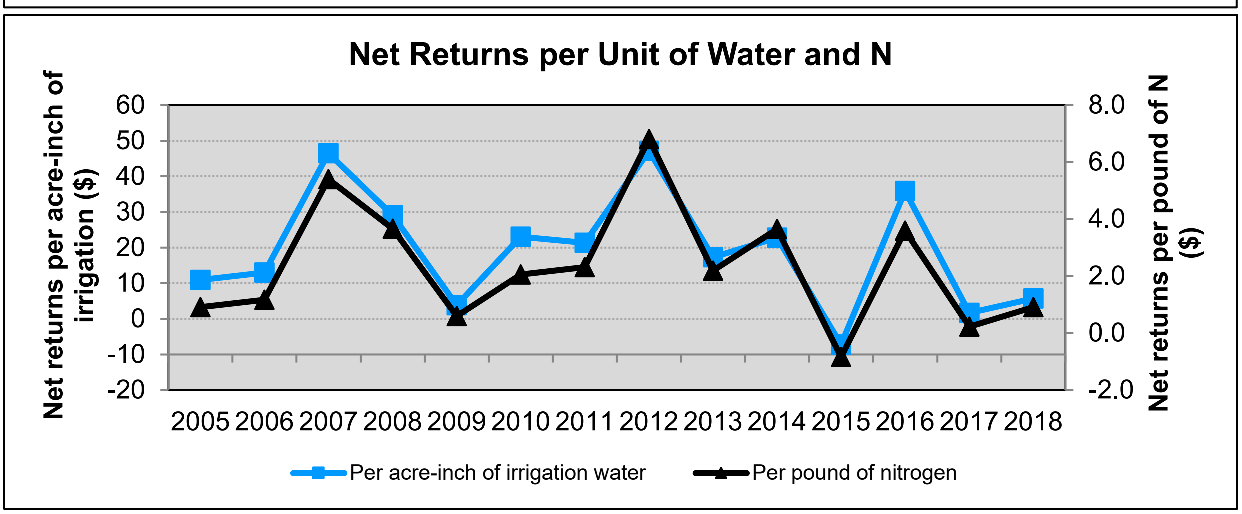
Site 22



Irrigation and Precipitation
Water (inches)
0
10
20
30
40
50
60
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Net returns ($)
-200
0
200
400
600
800
1,000
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Per system acre



Net Returns per Unit of Water and N
Net returns per acre-inch of irrigation ($)
-20
-10
0
10
20
30
40
50
60
Net returns per pound of N ($)
-2.0
0.0
2.0
4.0
6.0
8.0
2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site 22


May


30-inch strip till planting

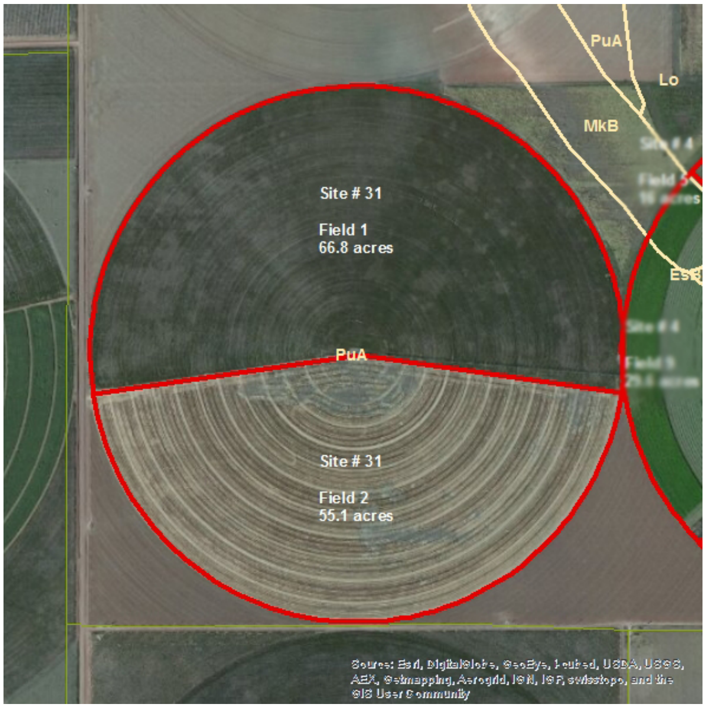

September cotton


Ground preparation


November cotton harvest

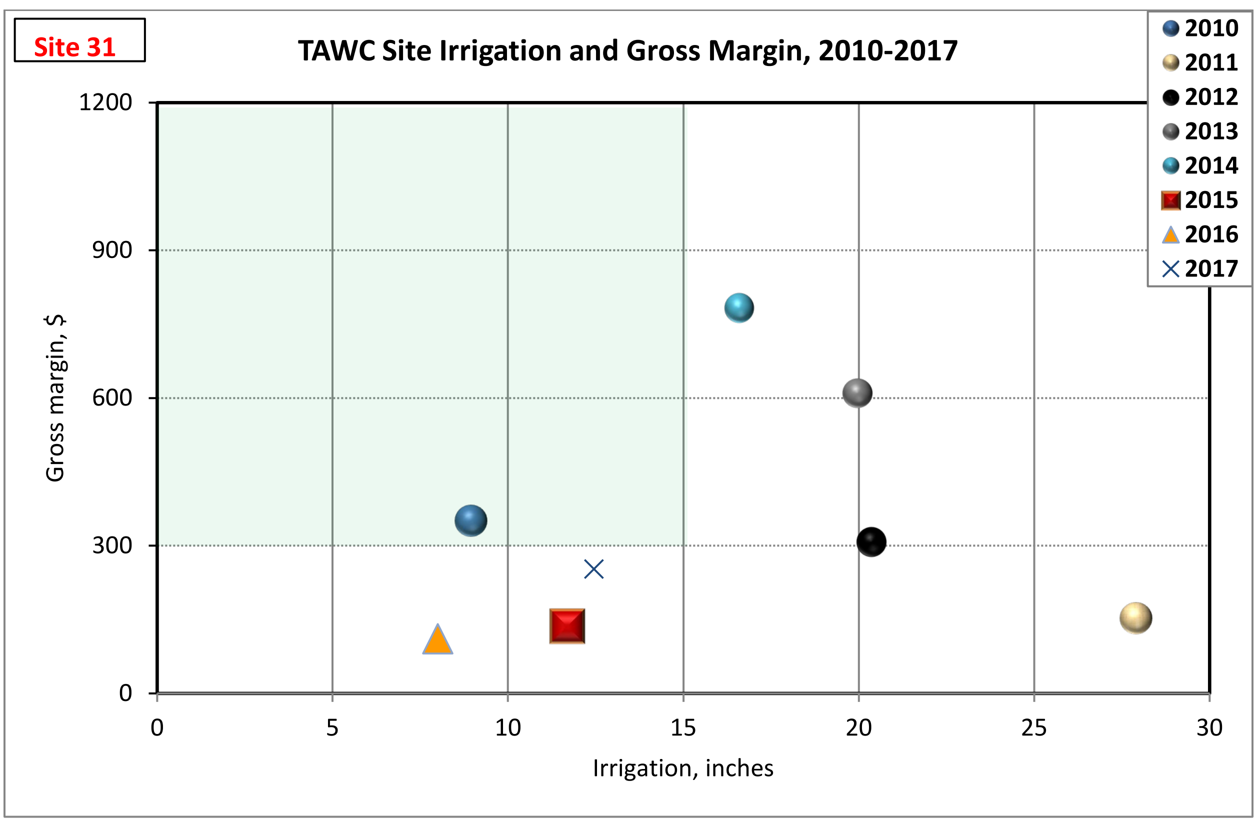
Comments: In 2018 this pivot LEPA irrigated site was planted to cotton. The cotton was planted on 30-inch centers. 2 tons of compost was applied.

SITE 31 – INACTIVE FOR 2018

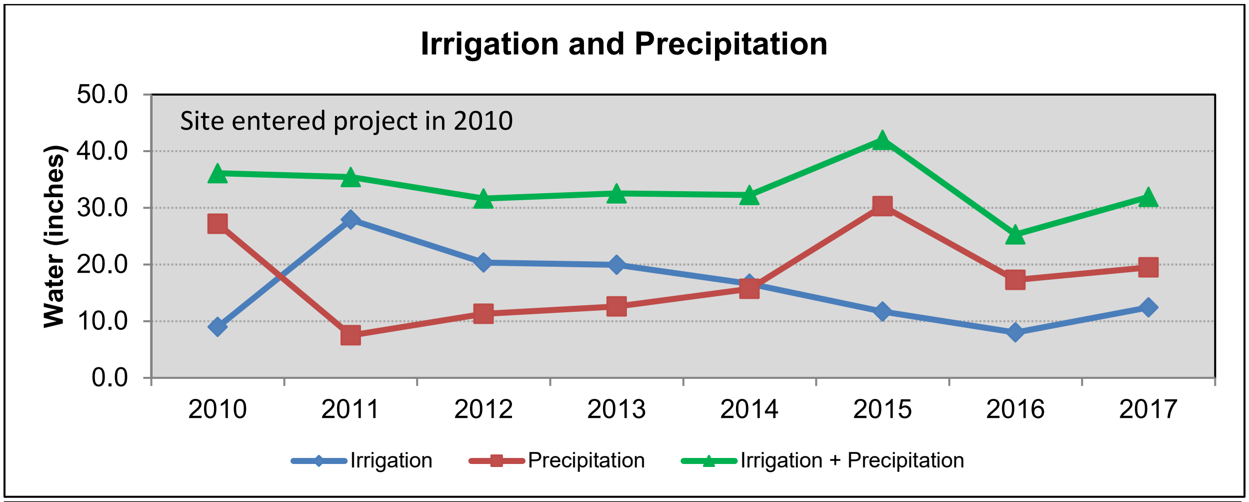


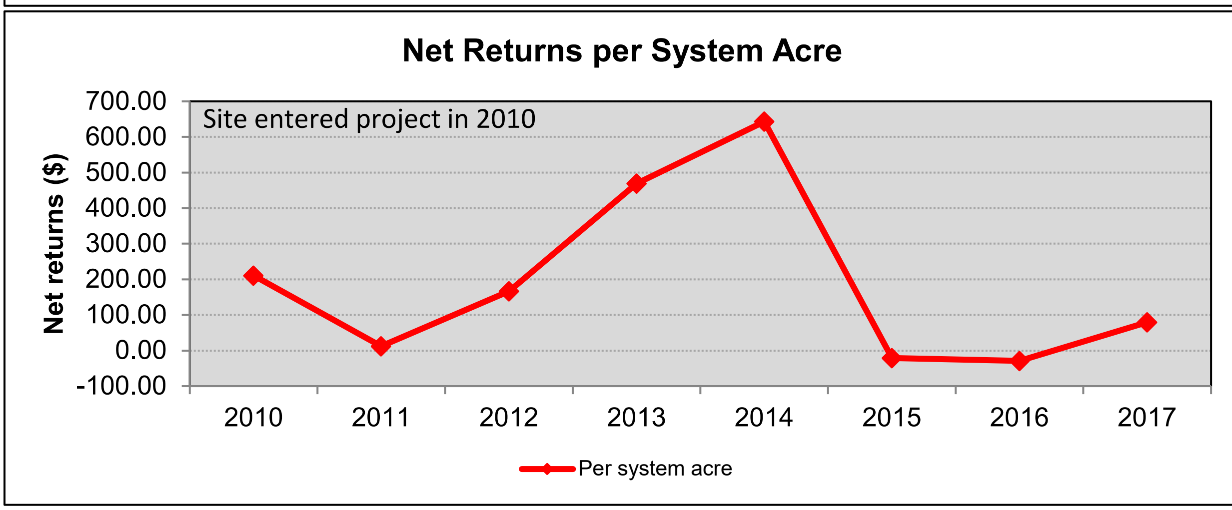
Description:

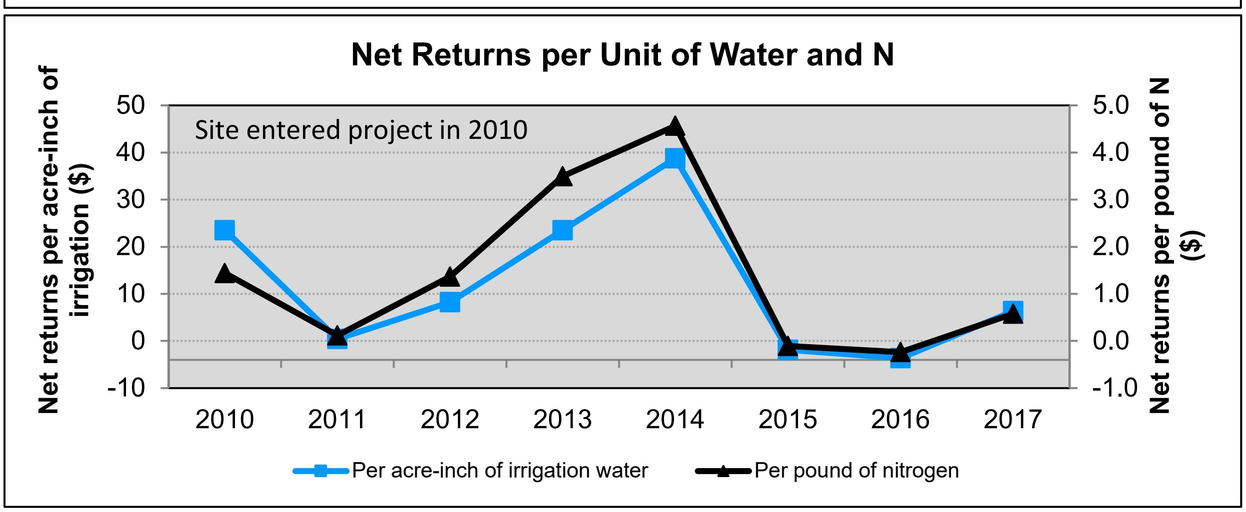
Site acres:	121.9
Soil types:	
PuA-Pullman clay loam, 0 to 1%	
Irrigation:	
Center Pivot (LEPA)	450 gpm
Number of wells:	2
Fuel Source:	1 Natural Gas, 1 Electric



Site 31 – Inactive for 2018







Site 31 – Inactive for 2018


May


PMDI installed on span


LEPA Irrigation head


PMDI drag line


July Grain sorghum


September cotton

Comments: In 2016 this pivot irrigated site was established as an irrigation technology site and fitted with LESA, LEPA 40, LEPA 80, LDN and PMDI technologies for demonstration and comparison. The site was planted to cotton and seed millet in 2017.

SITE 32

Description:

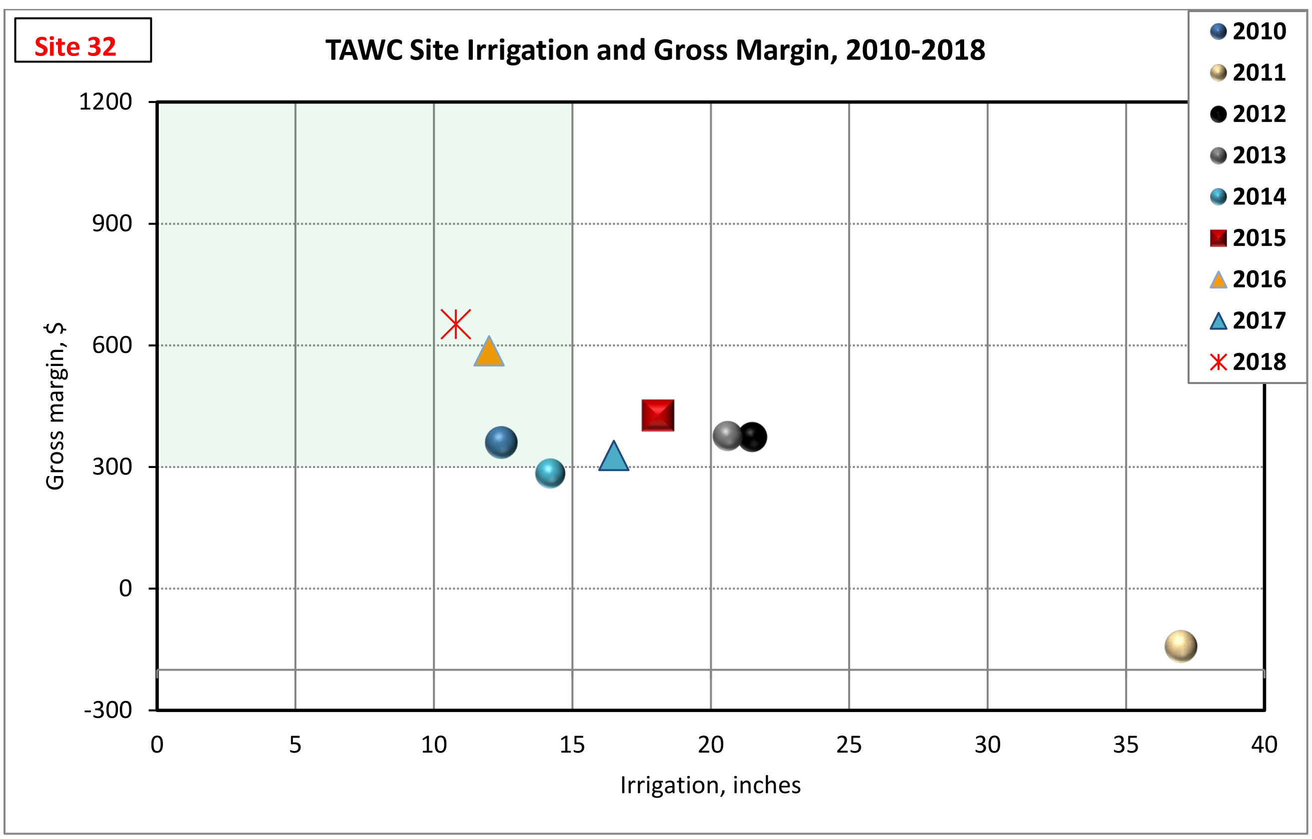
Site acres: 70

Soil types:
PuA-Pullman clay loam, 0 to 1%

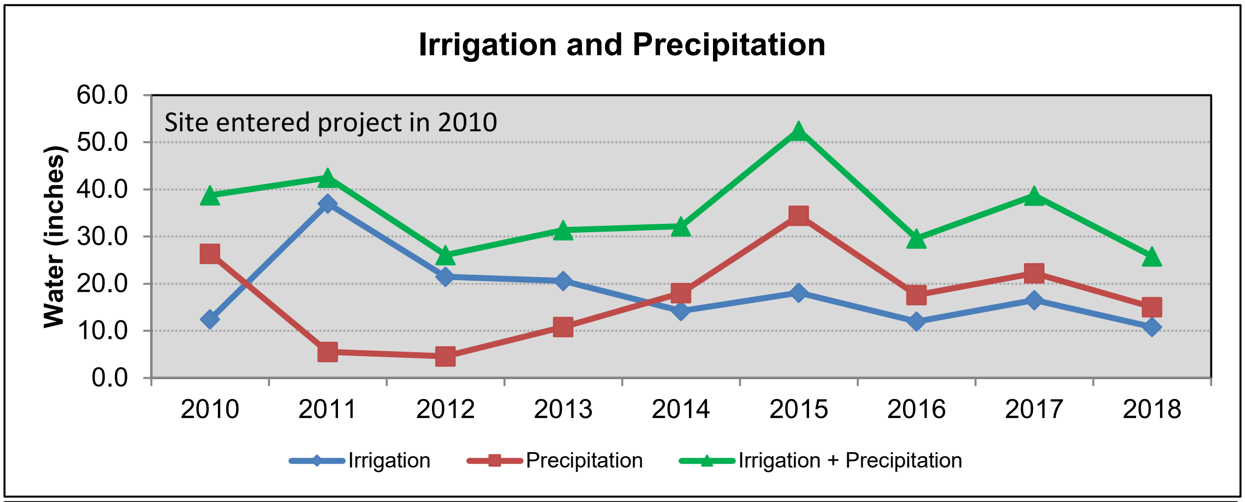
Irrigation:
Center Pivot (LEPA) 350 gpm

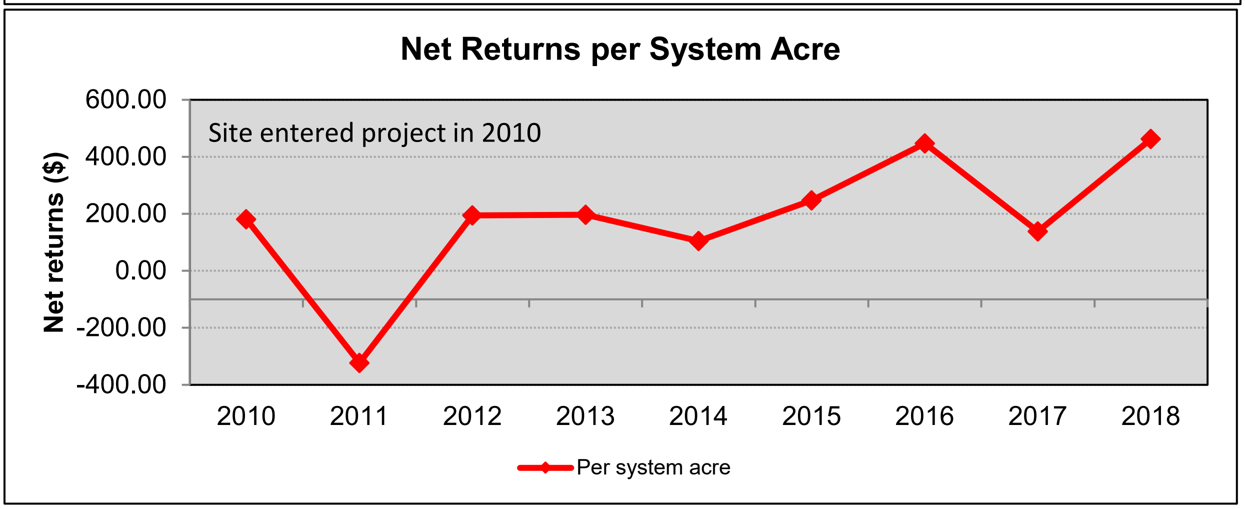
Number of wells: 2

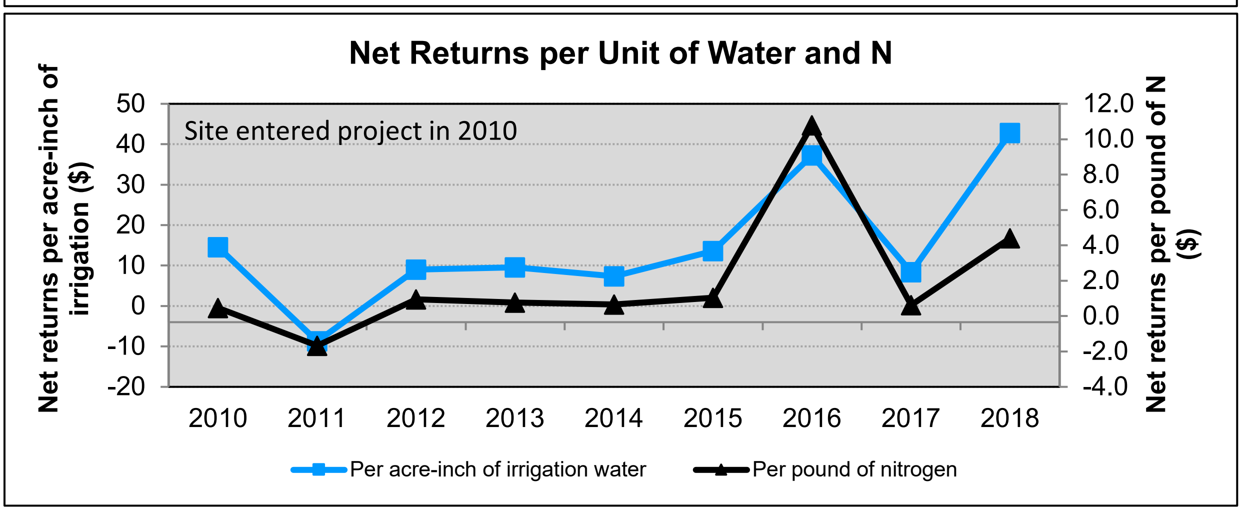
Fuel Source: Electric



Site 32


Irrigation and Precipitation
Site entered project in 2010
Water (inches)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
2010
2011
2012
2013
2014
2015
2016
2017
2018
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Site entered project in 2010
Net returns ($)
600.00
400.00
200.00
0.00
-200.00
-400.00
2010
2011
2012
2013
2014
2015
2016
2017
2018
Per system acre


Net Returns per Unit of Water and N
Site entered project in 2010
Net returns per acre-inch of irrigation ($)
50
40
30
20
10
0
-10
-20
Net returns per pound of N ($)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
2010
2011
2012
2013
2014
2015
2016
2017
2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site 32


March


Corn stubble


August corn

Comments: In 2018 this pivot LEPA irrigated site was vertical till planted to cotton.

SITE 35

Description:

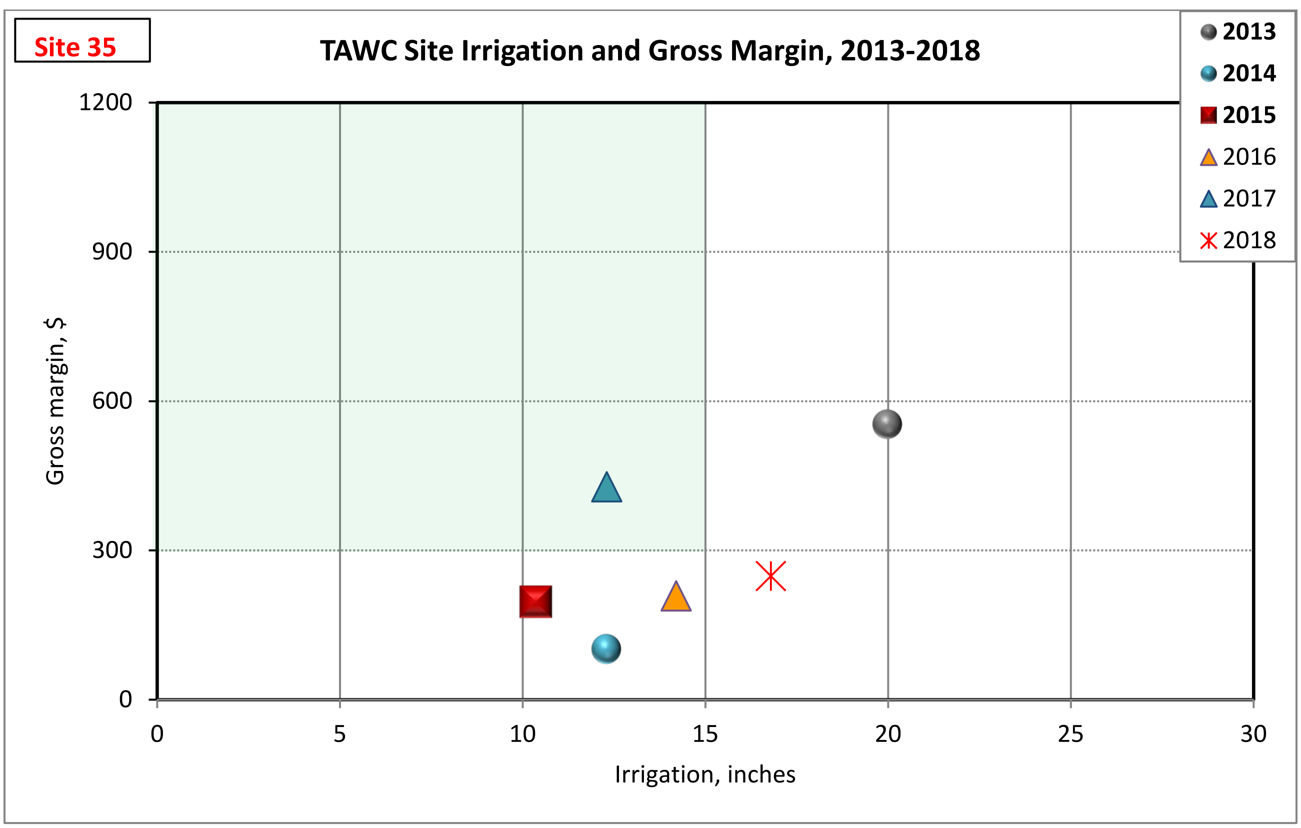
Site acres: 230.0

Soil types:
PuA-Pullman clay loam, 0 to 1%
LoA-Lofton clay loam, 0 to 1%

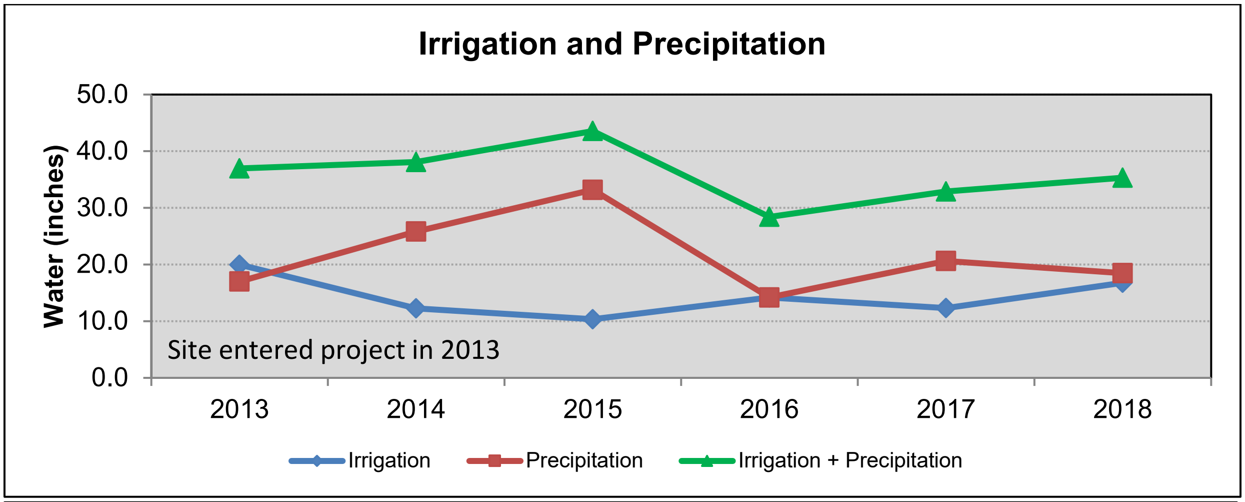
Irrigation:
Sub-Surface Drip (SDI)
650 gpm

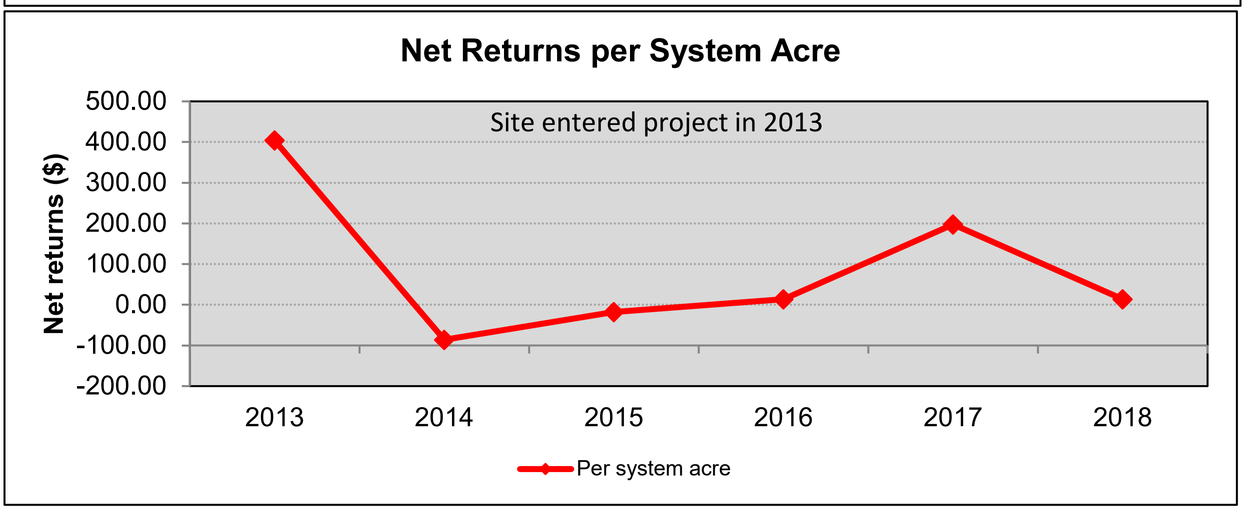
Number of wells: 2

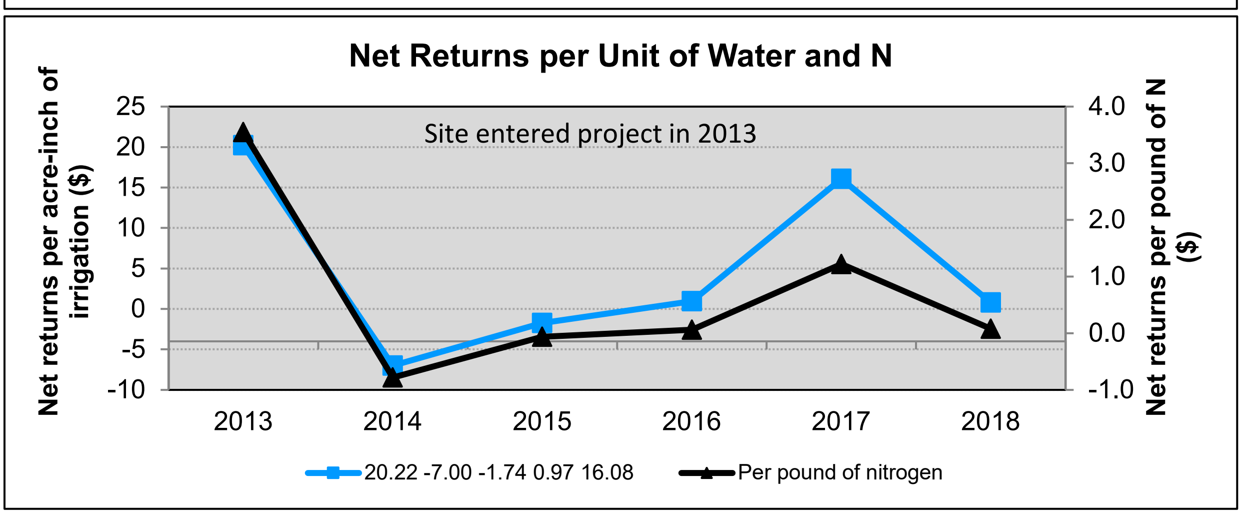
Fuel Source: Electric



Site 35


Irrigation and Precipitation
Water (inches)
50.0
40.0
30.0
20.0
10.0
0.0
Site entered project in 2013
2013
2014
2015
2016
2017
2018
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
500.00
400.00
300.00
200.00
100.00
0.00
-100.00
-200.00
Site entered project in 2013
2013
2014
2015
2016
2017
2018
Per system acre


Net Returns per Unit of Water and N
Net returns per acre-inch of irrigation ($)
Net returns per pound of N ($)
25
20
15
10
5
0
-5
-10
4.0
3.0
2.0
1.0
0.0
-1.0
Site entered project in 2013
2013
2014
2015
2016
2017
2018
20.22 -7.00 -1.74 0.97 16.08
Per pound of nitrogen

Site 35


May


May corn


September cotton


September corn


Corn being harvested


November cotton

Comments: In 2018 this SDI irrigated site was planted to corn and cotton. All crops were planted on 40-inch centers with vertical tillage.

SITE C37

Description:

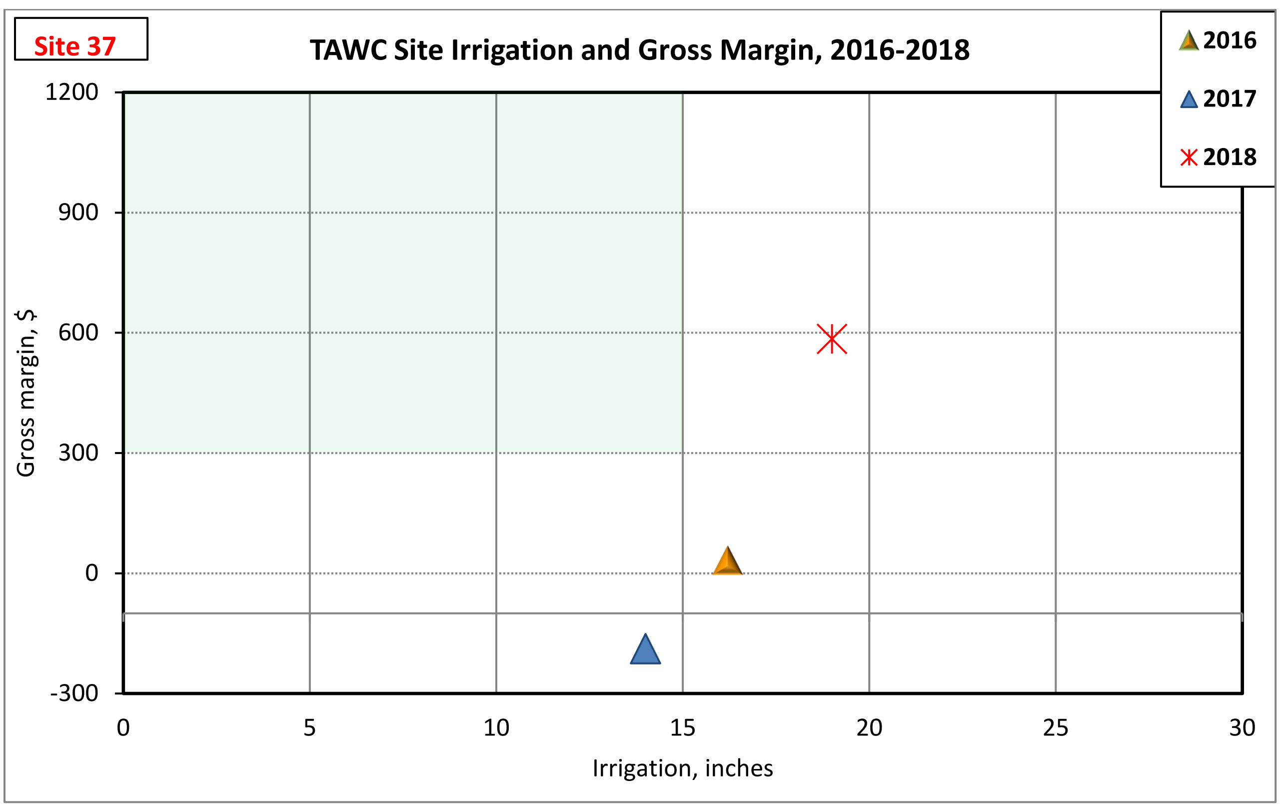
Site acres: 121.1

Soil types:
- PuA-Pullman clay loam, 0 to 1%
- AcB-Acuff loam, 1 to 3%
- EsB-Estacado loam, 1 to 3%
- Mkc-Mansker loam, 3 to 5%
- Ra-Randal clay, 0 to 1%

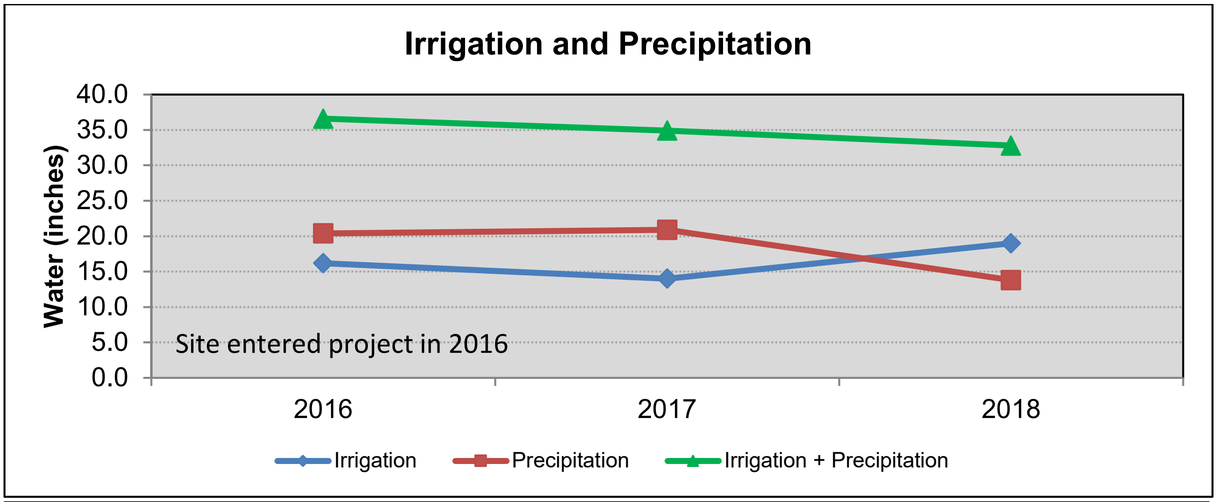
Irrigation:
- Center Pivot (VR) 450 gpm

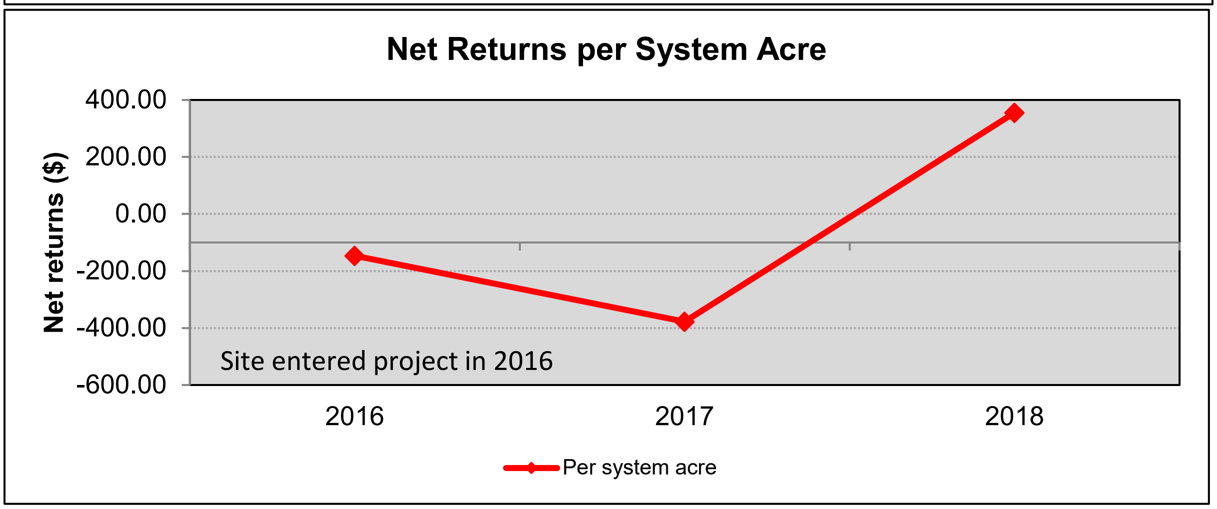
Number of wells: 2

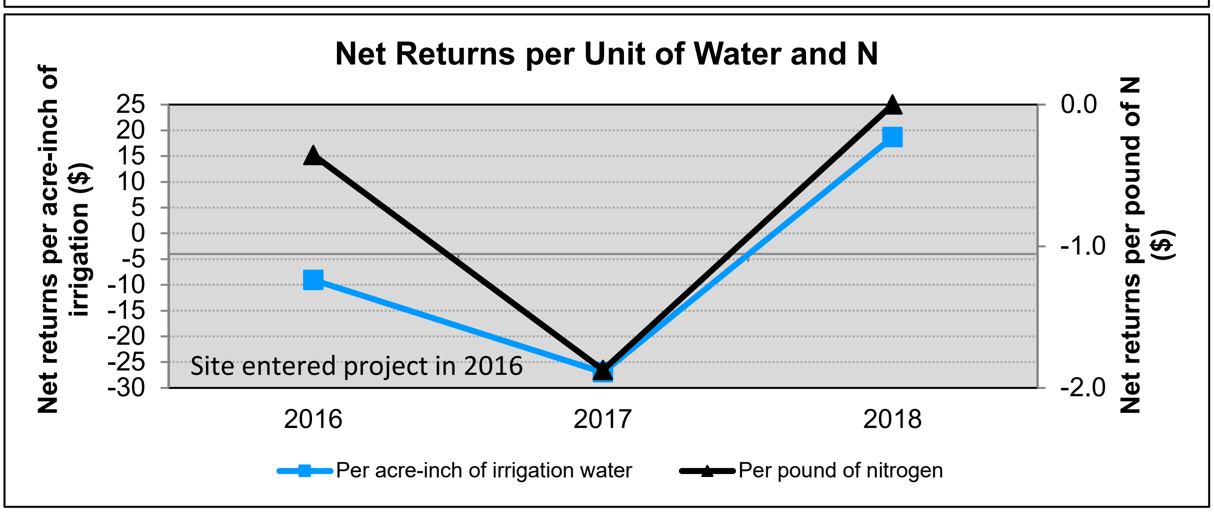
Fuel Source: Electric



Site C37


Irrigation and Precipitation
Water (inches)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Site entered project in 2016
2016
2017
2018
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
400.00
200.00
0.00
-200.00
-400.00
-600.00
Site entered project in 2016
2016
2017
2018
Per system acre


Net Returns per Unit of Water and N
Net returns per acre-inch of irrigation ($)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
Site entered project in 2016
0.0
-1.0
-2.0
Net returns per pound of N ($)
2016
2017
2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site C37


Variable rate valve

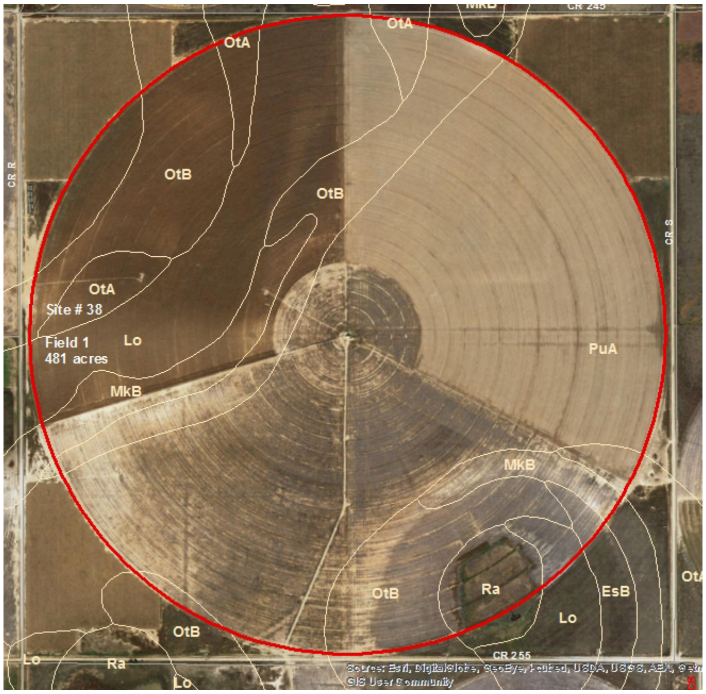

VRI Irrigation System


Cotton


October cotton

Comments: In 2018 this site was planted to cotton on 30-inch centers utilizing a Variable Rate Irrigation (VRI) system.

Site C38



Description:

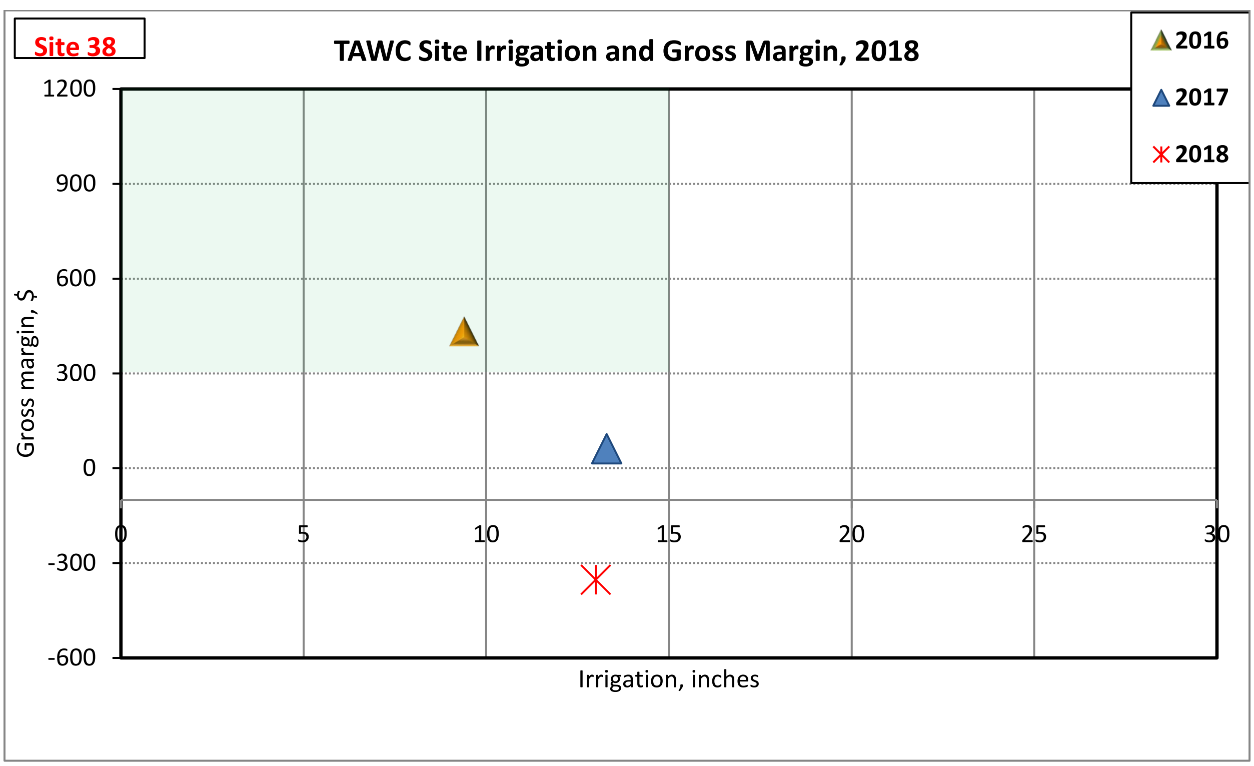
Site acres:	481

Soil types:

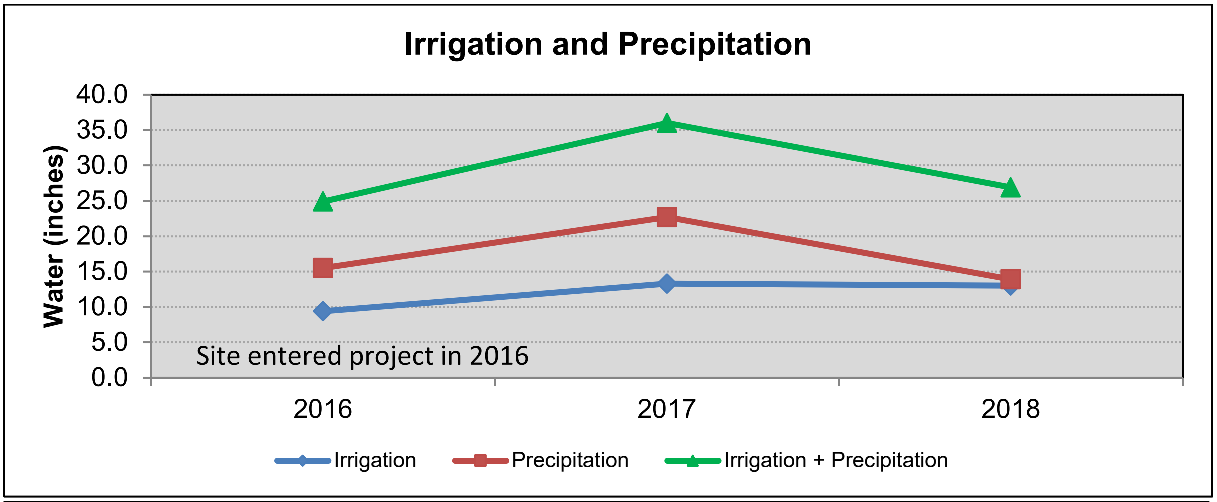
- PuA-Pullman clay loam, 0 to 1%
- Lo-Lofton clay loam, 0 to 1%
- MkB-Mansker loam, 0 to 3%
- OtA-Olton loam, 0 to 1%
- OtB-Olton loam, 1 to 3%
- Ra-Randall clay, 0 to 1%
- EsB-Estacado loam, 1 to 3%

Irrigation:

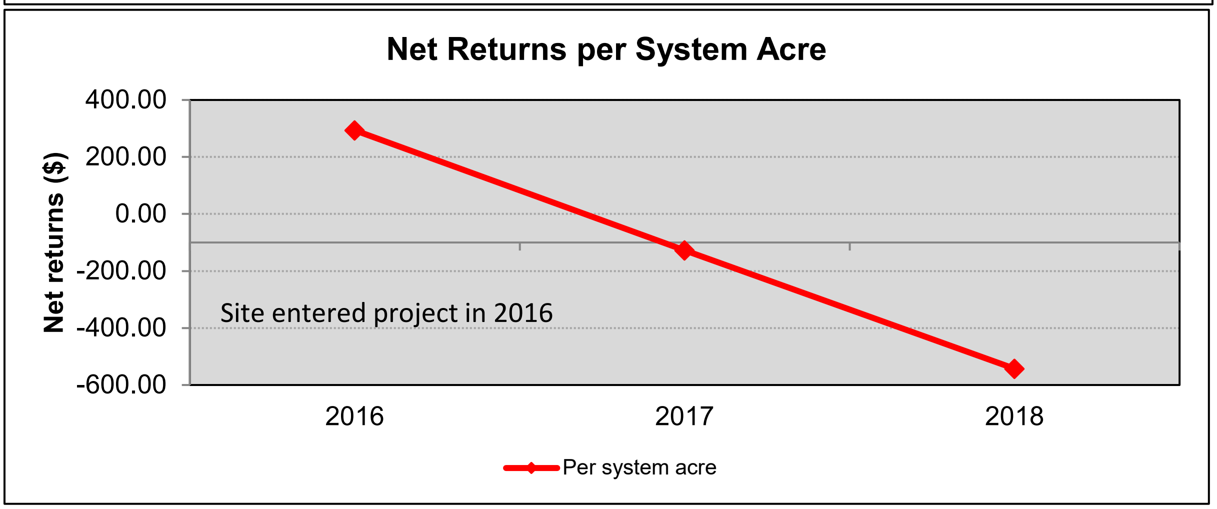
Center Pivot (VR)	750 gpm
Number of wells:	3
Fuel Source:	Electricity



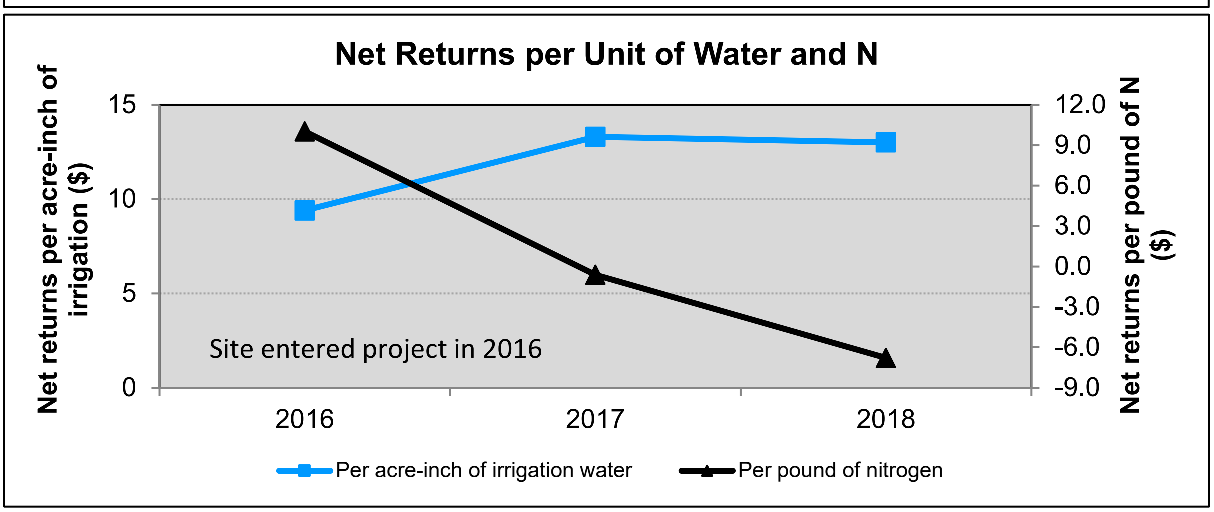
Site C38



Irrigation and Precipitation
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Water (inches)
Site entered project in 2016
2016
2017
2018
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
400.00
200.00
0.00
-200.00
-400.00
-600.00
Net returns ($)
Site entered project in 2016
2016
2017
2018
Per system acre



Net Returns per Unit of Water and N
Net returns per acre-inch of irrigation ($)
15
10
5
0
12.0
9.0
6.0
3.0
0.0
-3.0
-6.0
-9.0
Net returns per pound of N ($)
Site entered project in 2016
2016
2017
2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site C38


Irrigation nozzle

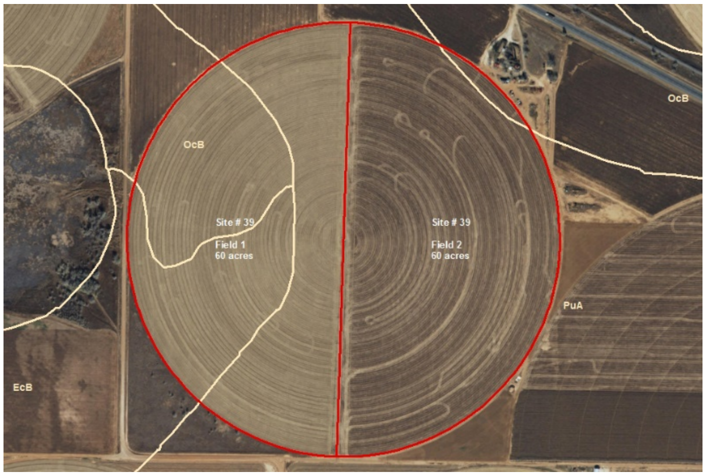

July cotton


July cotton

Comments: In 2018 this site was planted to cotton on 30-inch centers utilizing a Variable Rate Irrigation (VRI) system.

Site C39

Description:



Site acres: 120.0

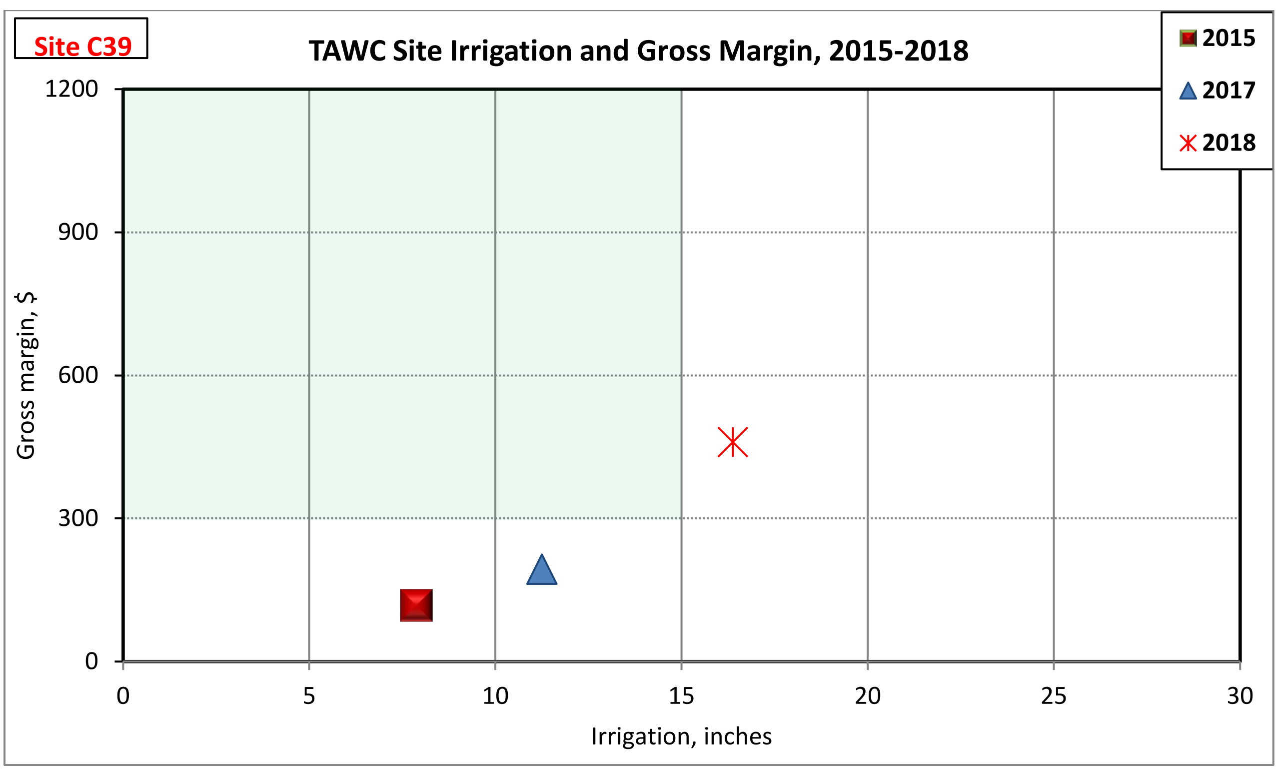
Soil types:
- PuA-Pullman clay loam, 0 to 1%
- OcB-Olton clay loam, 1 to 3%
- EcB-Estacado clay loam, 1 to 3%

Irrigation:
Center Pivot (LESA) 650 gpm

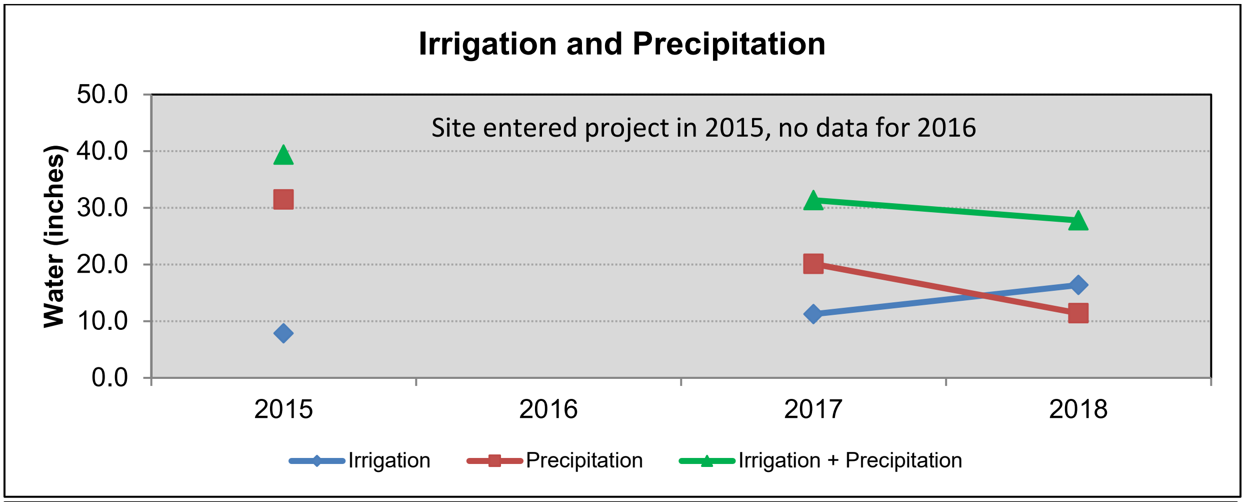
Number of wells: 1

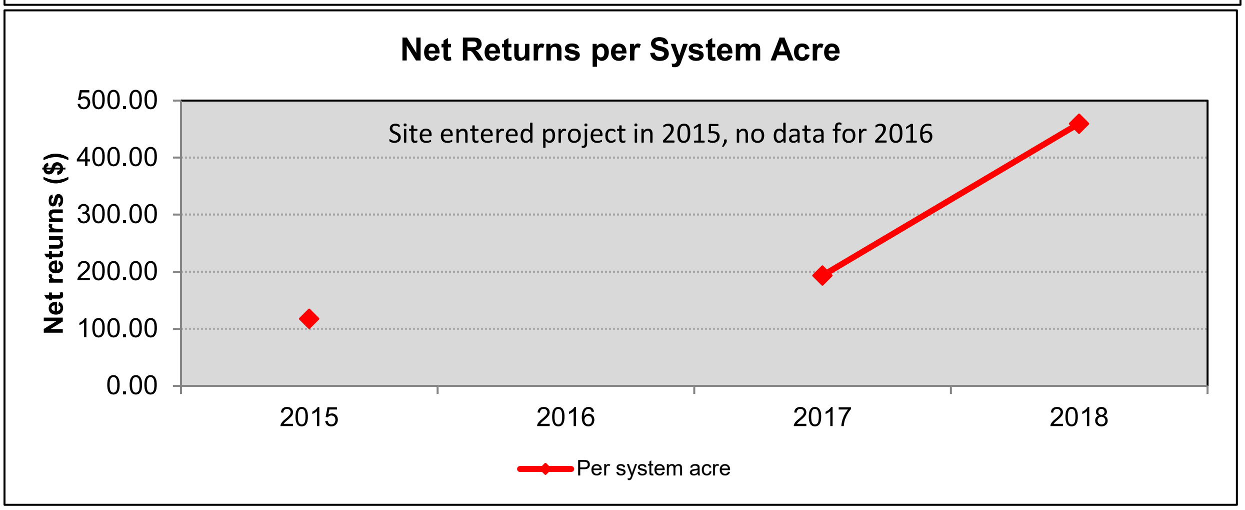
Fuel Source: Electricity

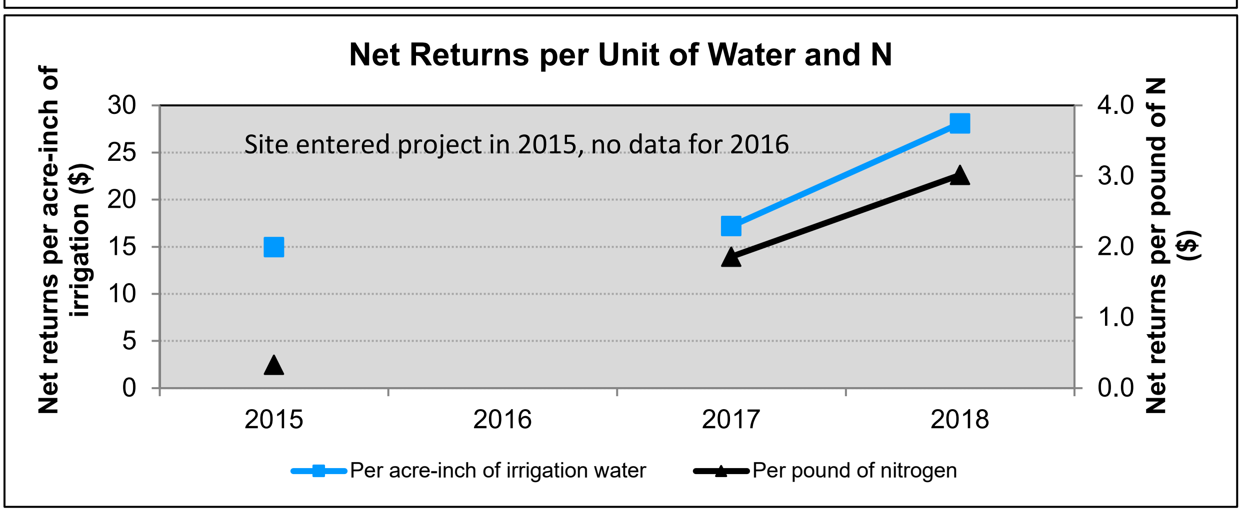
No Site Data for 2016



Site C39 – No Site Data for 2016







Site C39

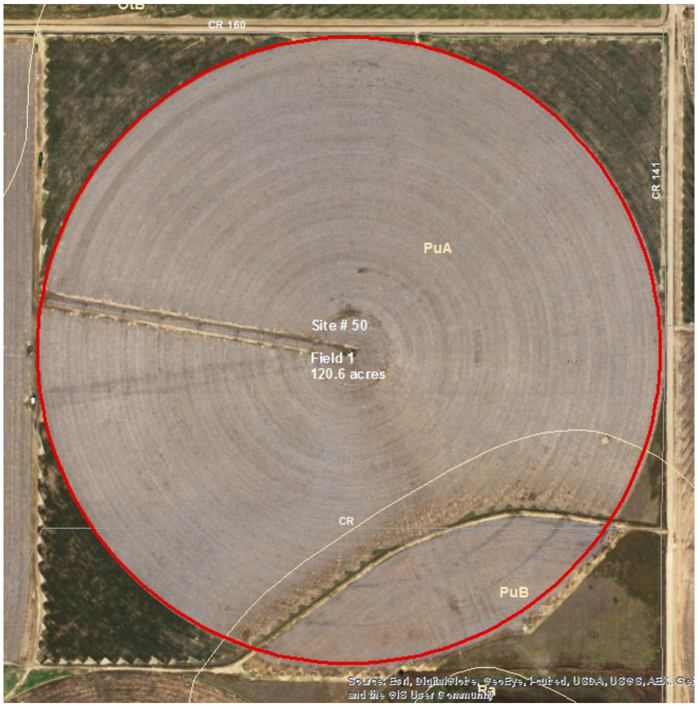
June corn

Fertilize injection

July cotton

Comments: In 2018 this LESA/LEPA site was planted to corn and cotton.

Site C50



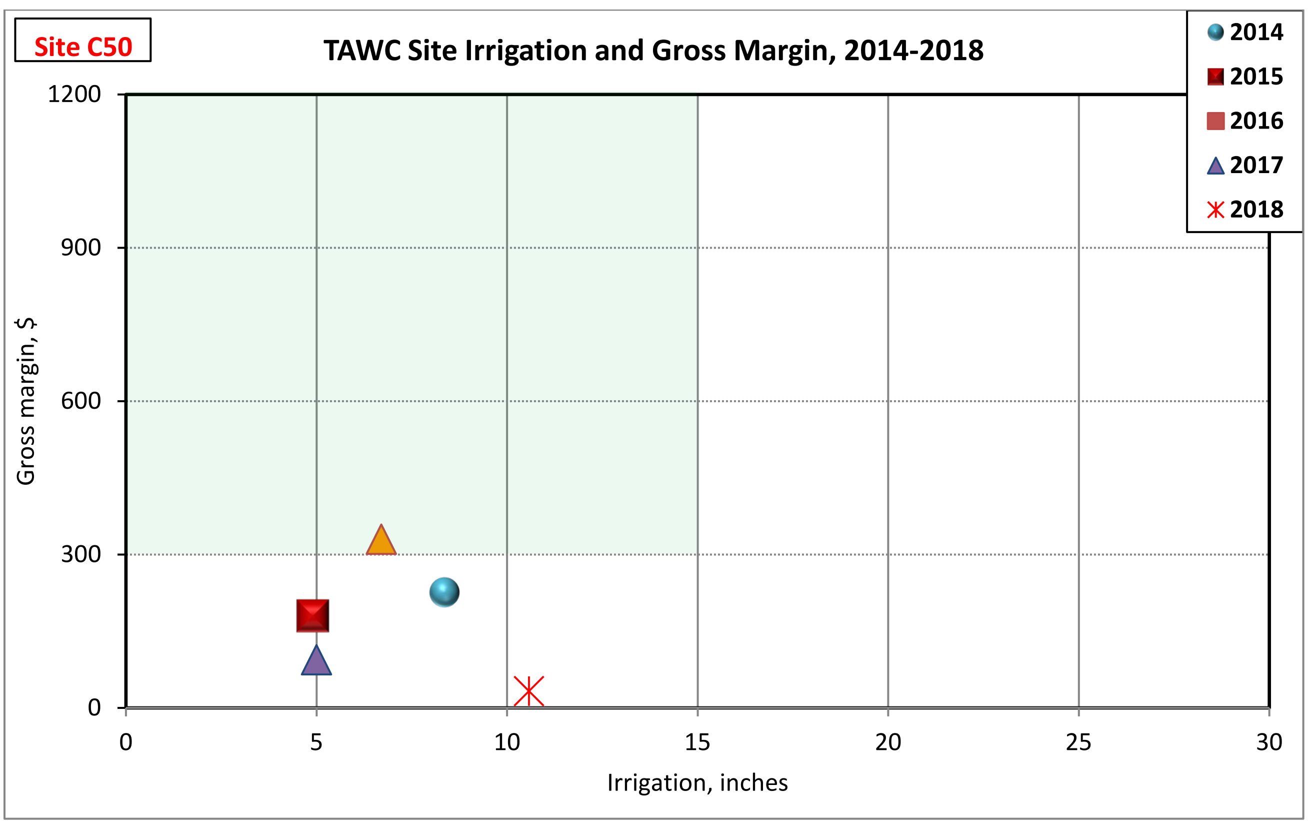
Description:

Site acres:	120.6

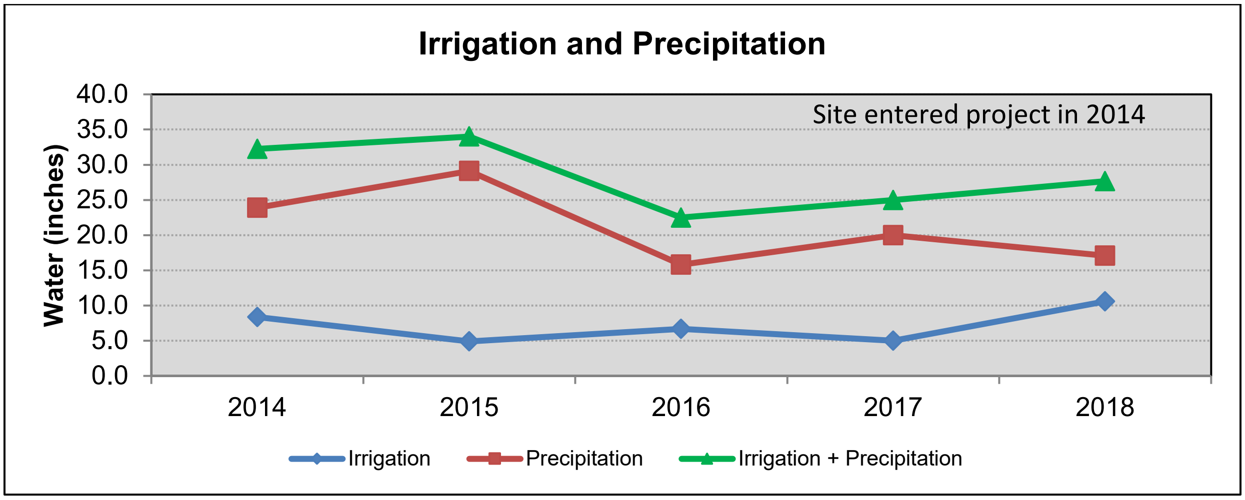
Soil types:
PuA-Pullman clay loam, 0 to 1%
PuB-Pullman clay loam, 1 to 3%

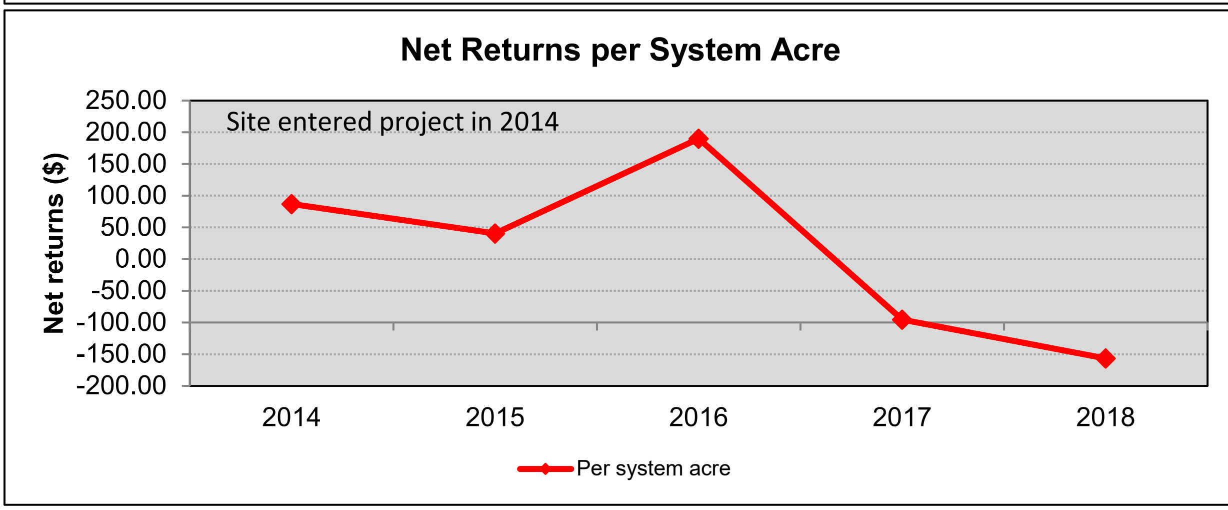
Irrigation:
Low Elevation Spray Application (LESA) 265 gpm

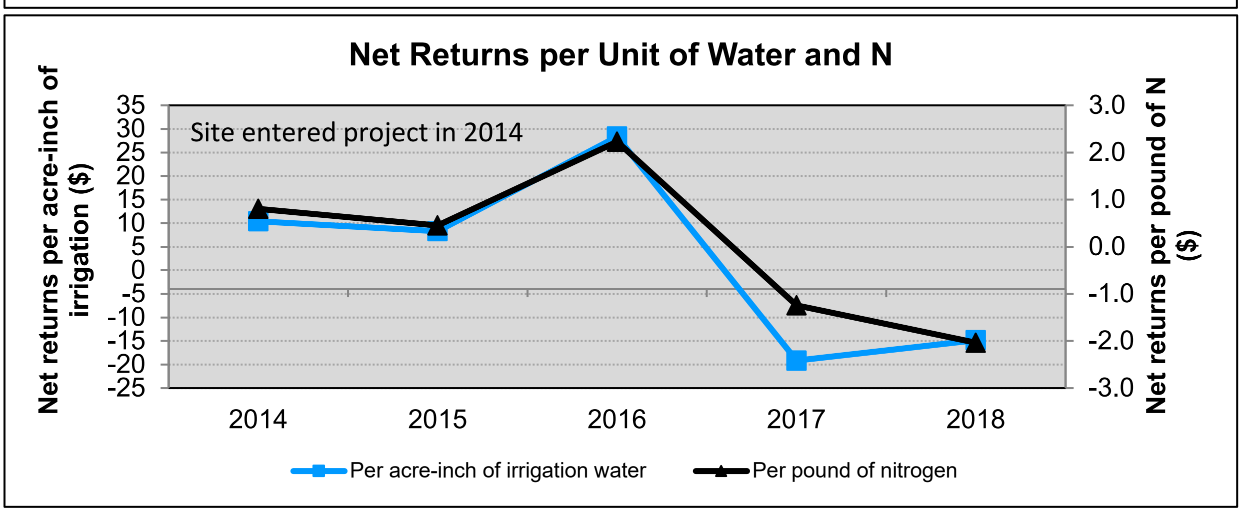
Number of wells:	1
Depth:	300 feet
Fuel Source:	Natural gas



Site C50


Irrigation and Precipitation
Site entered project in 2014
Water (inches)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2014
2015
2016
2017
2018
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Site entered project in 2014
Net returns ($)
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
2014
2015
2016
2017
2018
Per system acre


Net Returns per Unit of Water and N
Site entered project in 2014
Net returns per acre-inch of irrigation ($)
Net returns per pound of N ($)
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
2014
2015
2016
2017
2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site C50

May

August cotton

October cotton

Surface turbine irrigation well

Comments: In 2018 this LESA irrigated site was planted to monoculture cotton but managed as a VRI system through speed adjustment. All crops were planted on 40-inch centers conventional tillage.

SITE C51

Description:

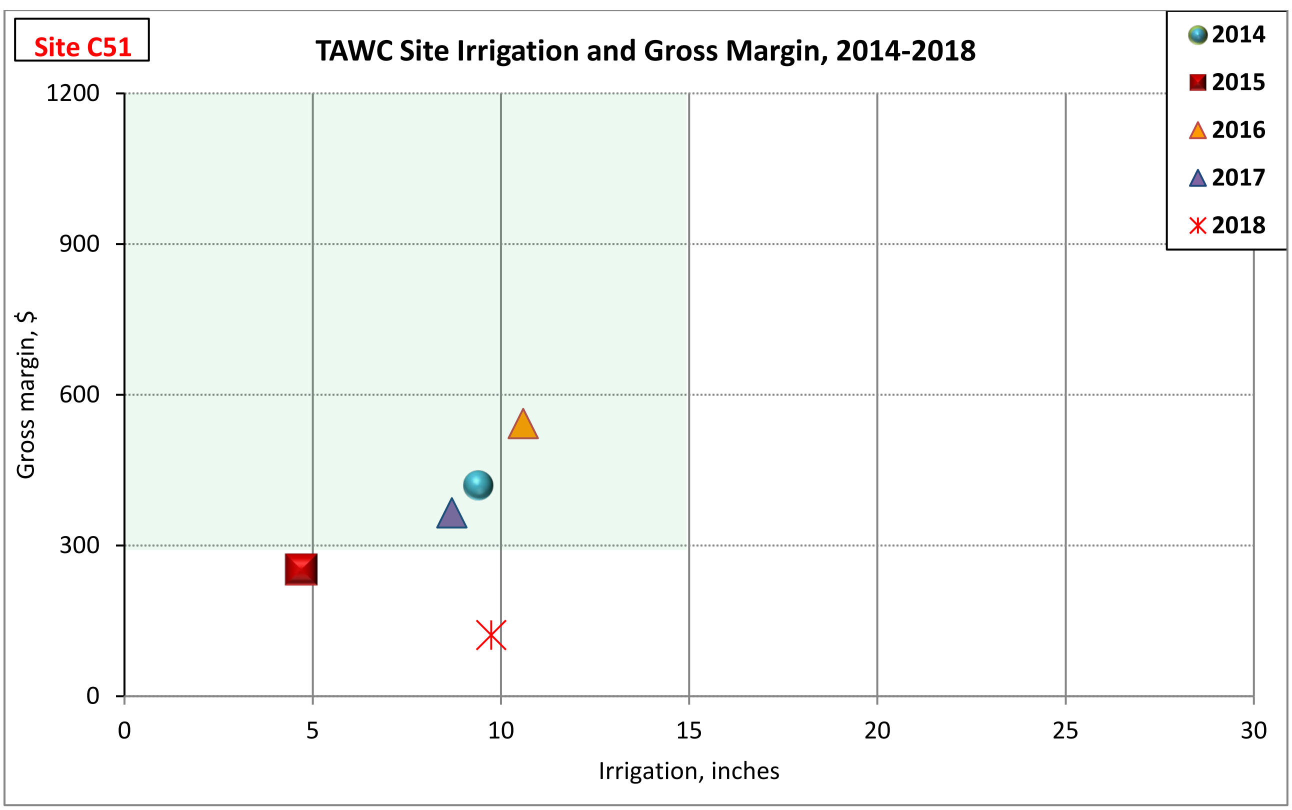
Site acres: 45.7

Soil types:
OtA-Olton loam; 0 to 1%
OtB-Olton loam; 1 to 3%

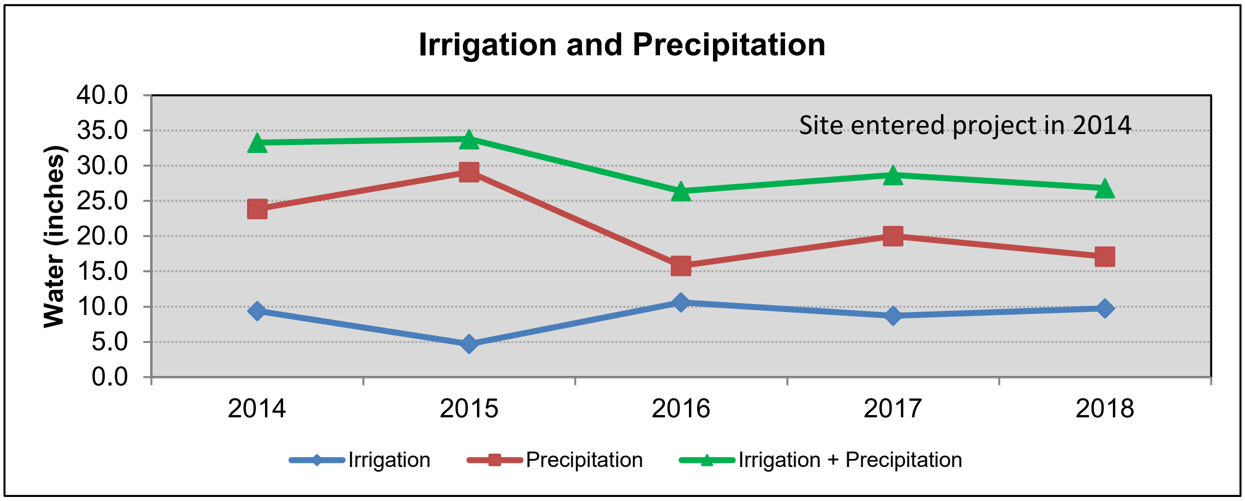
Irrigation:
Sub-surface Drip (SDI) 175 gpm

Number of wells: 1
Depth: 350 feet

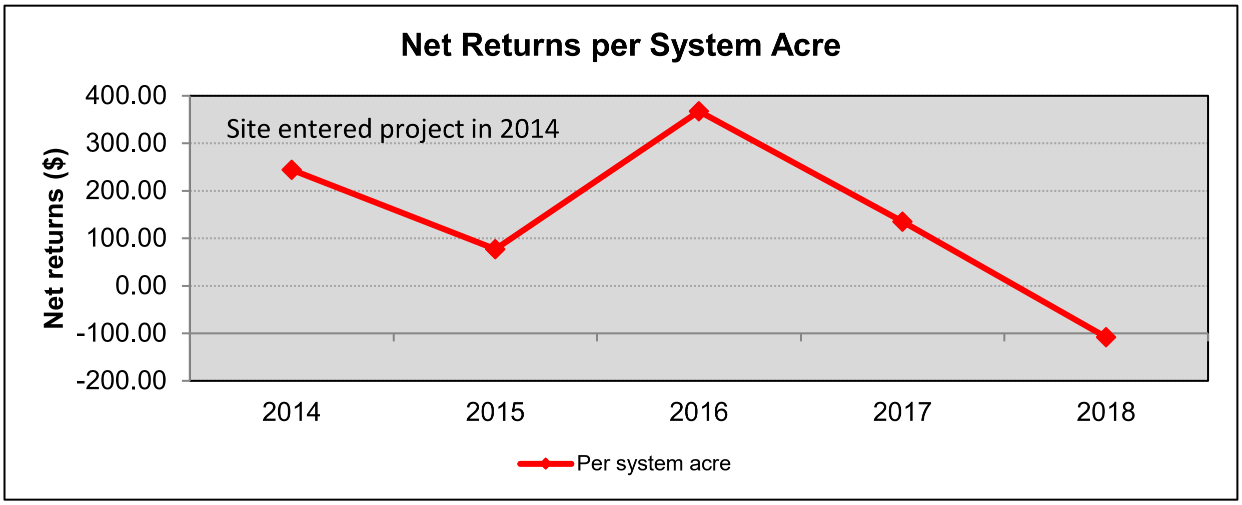
Fuel Source: Natural gas



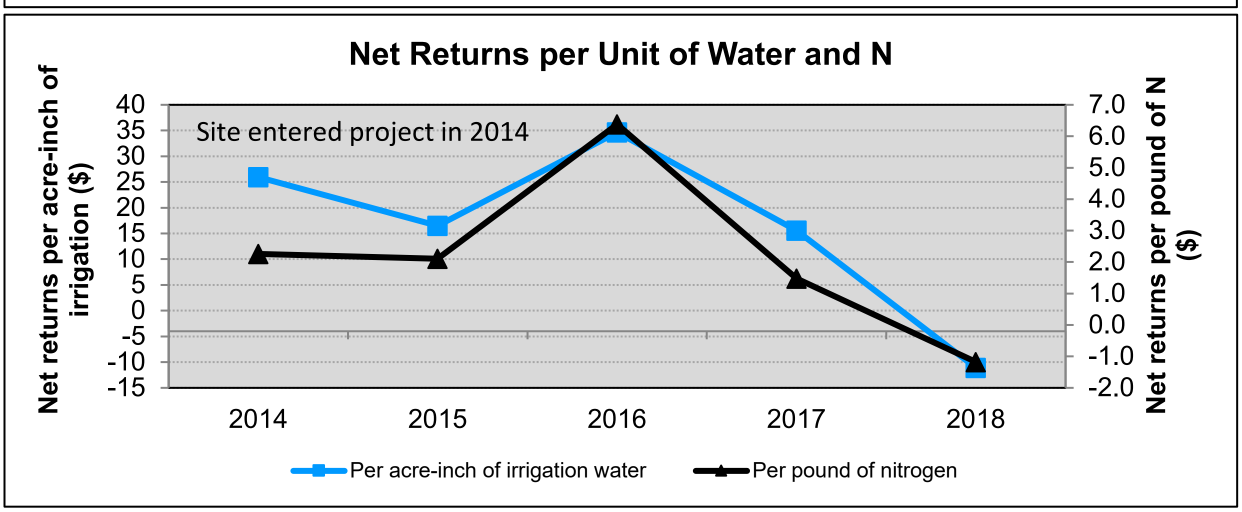
Site C51



Irrigation and Precipitation
Site entered project in 2014
Water (inches)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2014
2015
2016
2017
2018
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Site entered project in 2014
Net returns ($)
400.00
300.00
200.00
100.00
0.00
-100.00
-200.00
2014
2015
2016
2017
2018
Per system acre



Net Returns per Unit of Water and N
Site entered project in 2014
Net returns per acre-inch of irrigation ($)
40
35
30
25
20
15
10
5
0
-5
-10
-15
Net returns per pound of N ($)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
2014
2015
2016
2017
2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site C51


Late May planting


Furrow irrigation to establish


Early August cotton


Checking crop maturity


October cotton

Comments: In 2018 this SDI irrigated site was planted to monoculture cotton. All crops were planted on 40-inch centers. 2 tons of compost was applied to crop.

SITE C56

Description:

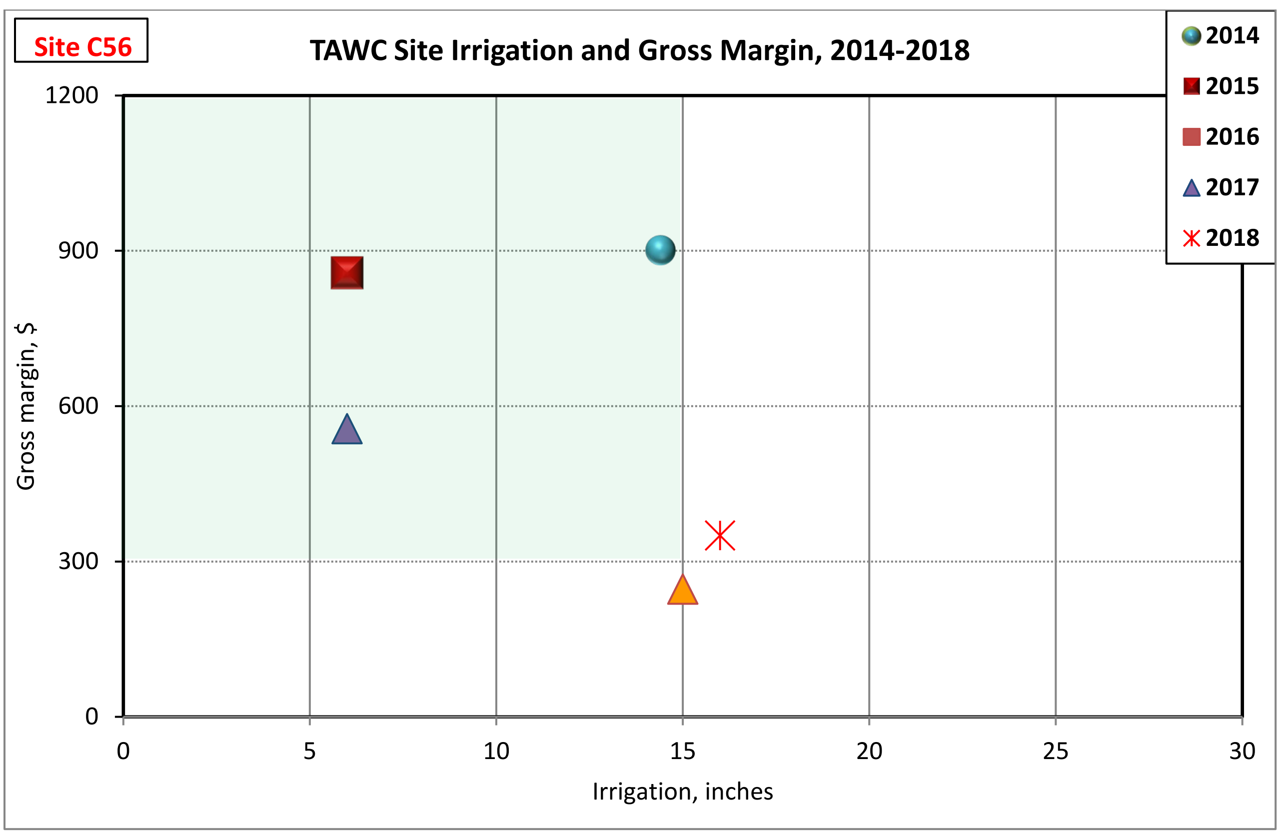
Site acres: 40

Soil types:
- OcA - Olton clay loam, 0 to 1%
- AcA - Acuff loam; 0 to 1%
- AcB - Acuff loam; 1 to 3%
- AfA - Amarillo fine sandy loam, 0 to 1%

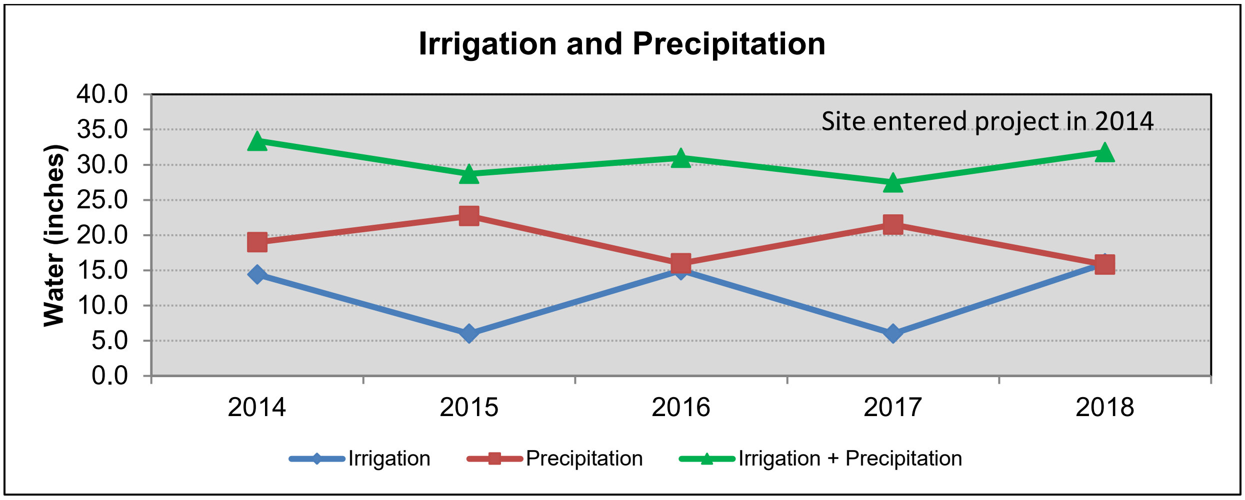
Irrigation:
Low Eleveation Spray Application (LESA) 450 gpm

Number of wells: 3
Depth: 300 feet

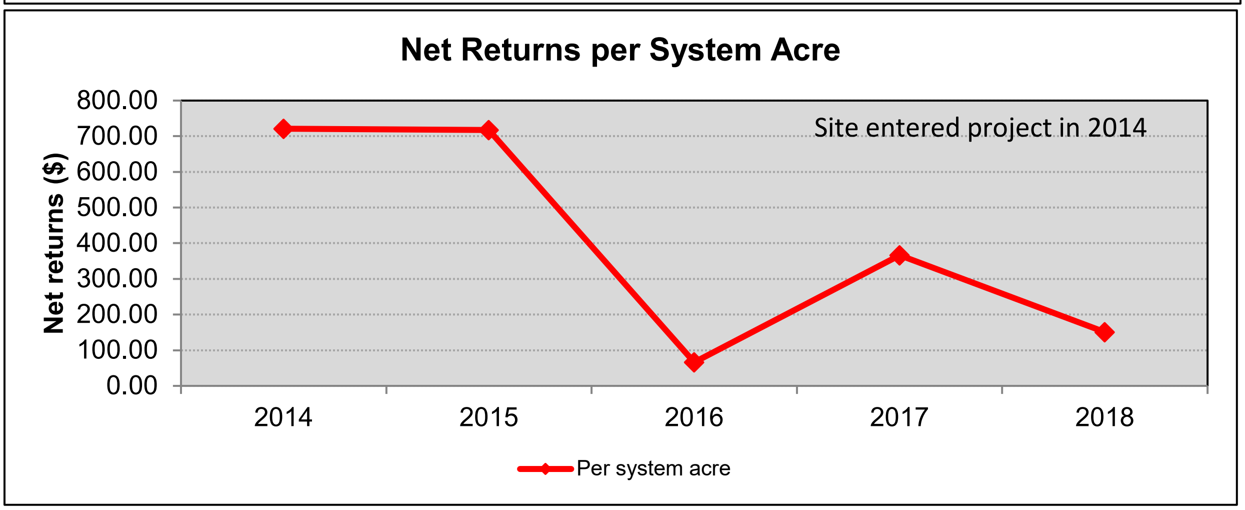
Fuel Source: Electric



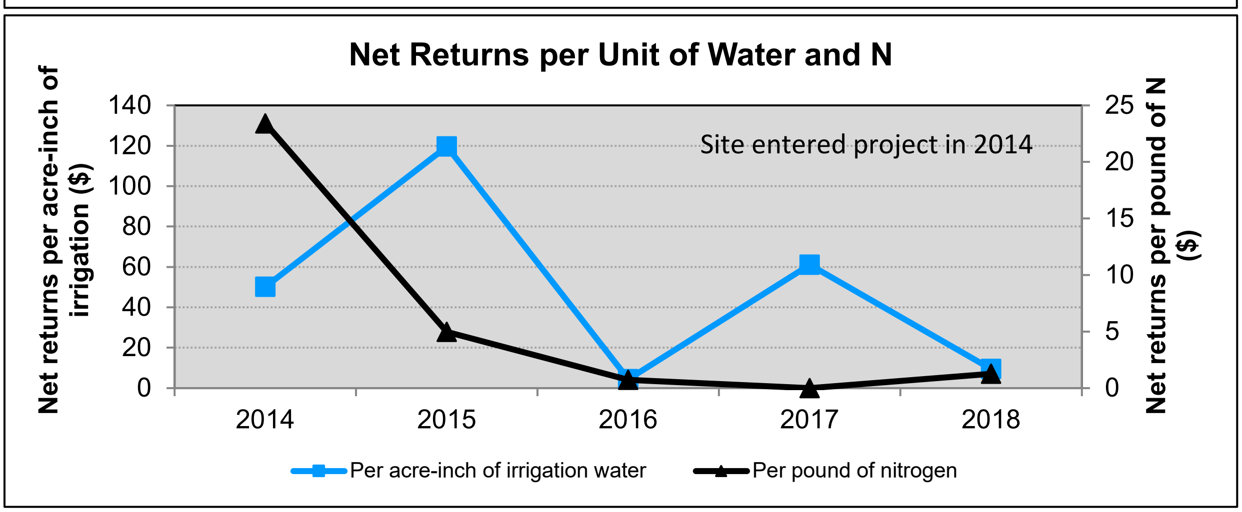
Site C56



Irrigation and Precipitation
Water (inches)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Site entered project in 2014
2014
2015
2016
2017
2018
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Net returns ($)
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Site entered project in 2014
2014
2015
2016
2017
2018
Per system acre



Net Returns per Unit of Water and N
Net returns per acre-inch of irrigation ($)
140
120
100
80
60
40
20
0
Net returns per pound of N ($)
25
20
15
10
5
0
Site entered project in 2014
2014
2015
2016
2017
2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site C56

Early January

Comments: In 2018 this LESA irrigated site was planted to corn to be harvested as silage on 30-inch centers. No commercial fertilizer, but 4 tons of compost was applied to crop.

SITE C57

Description:

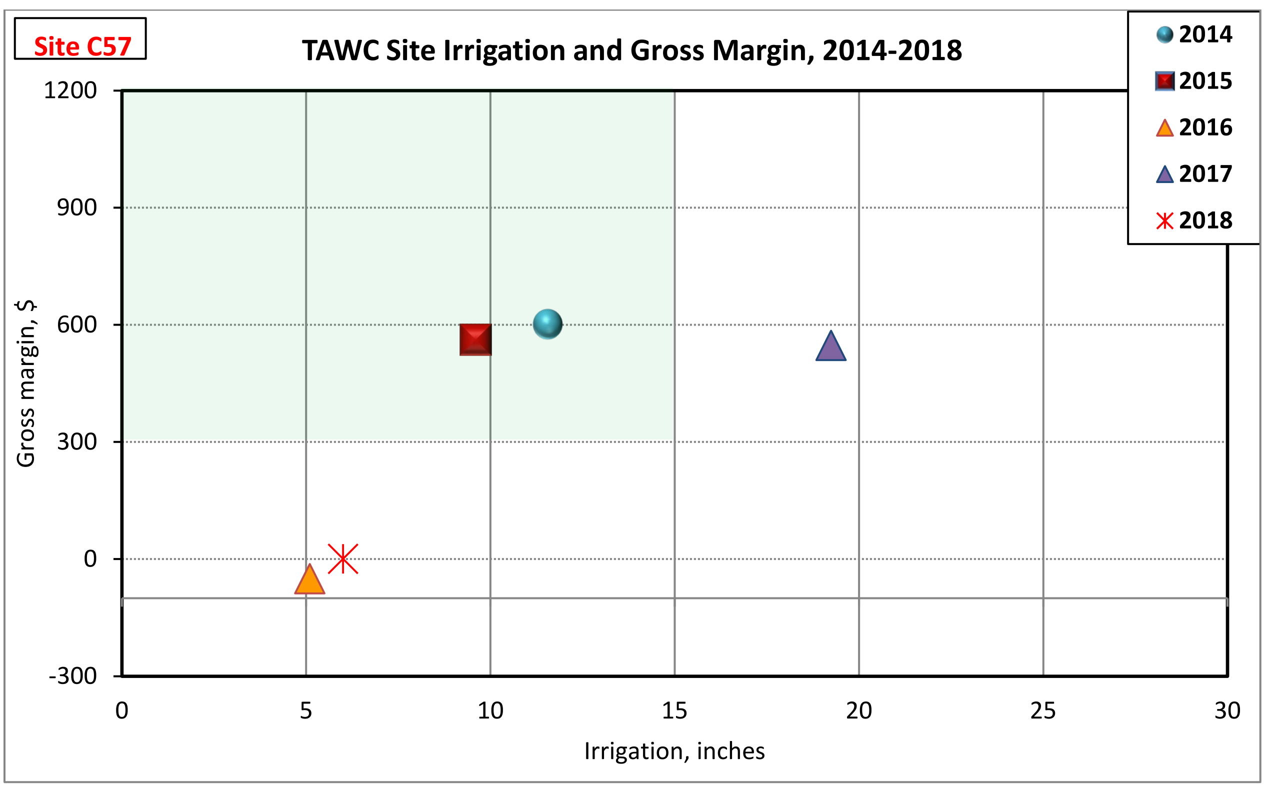
Site acres: 115

Soil types:
- PuA - Pullman clay loam; 0 to 1%
- PcB - Pep clay loam; 1 to 3%

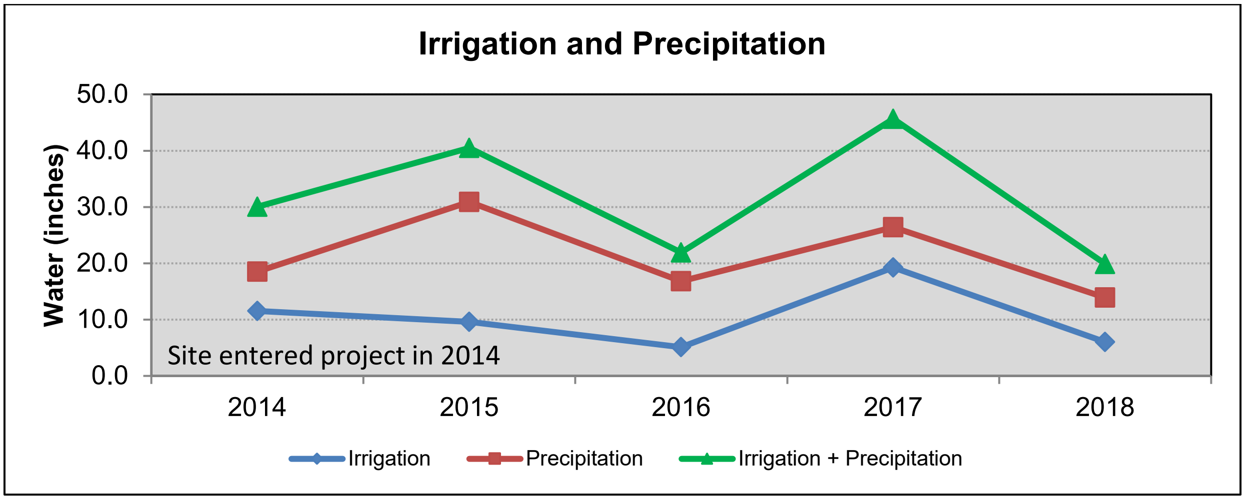
Irrigation:
Low Eleveation Spray Application (LESA) 750 gpm

Number of wells: 4
Depth: 300 feet

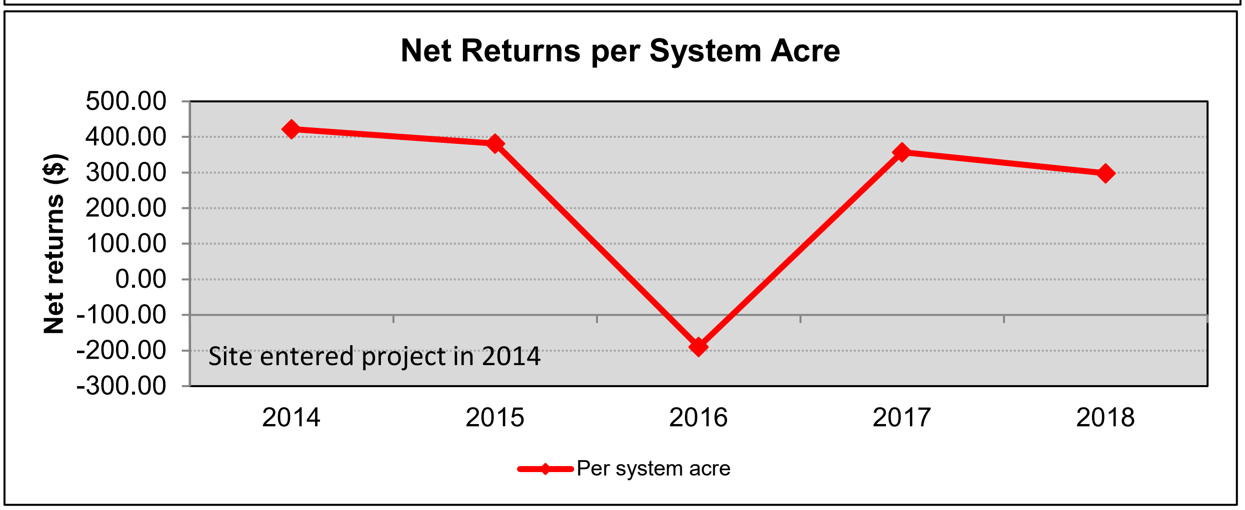
Fuel Source: Electric



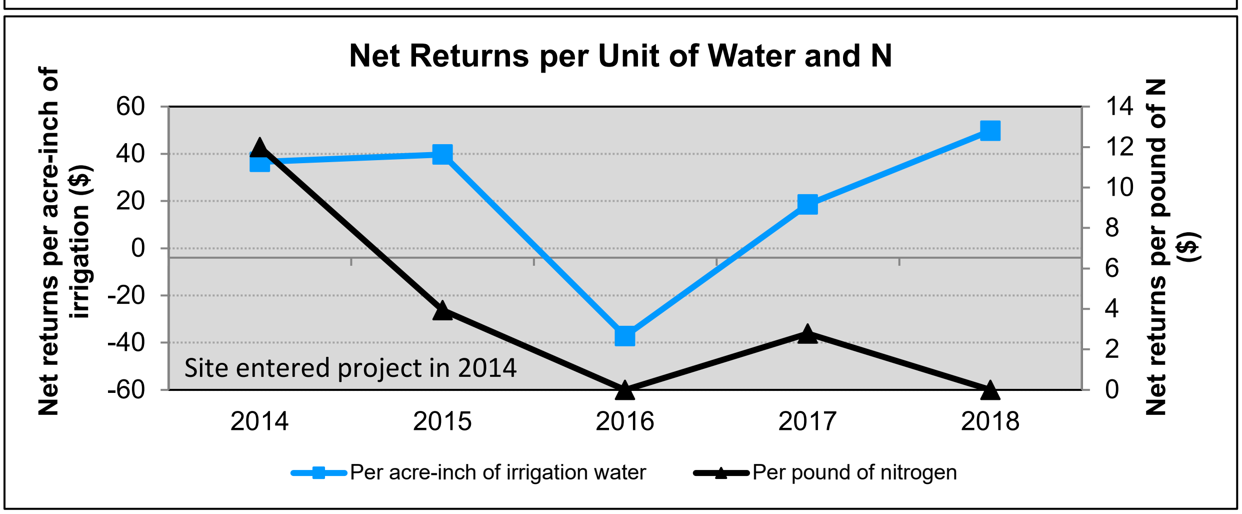
Site C57



Irrigation and Precipitation
Water (inches)
50.0
40.0
30.0
20.0
10.0
0.0
Site entered project in 2014
2014
2015
2016
2017
2018
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Net returns ($)
500.00
400.00
300.00
200.00
100.00
0.00
-100.00
-200.00
-300.00
Site entered project in 2014
2014
2015
2016
2017
2018
Per system acre



Net Returns per Unit of Water and N
Net returns per acre-inch of irrigation ($)
60
40
20
0
-20
-40
-60
Net returns per pound of N ($)
14
12
10
8
6
4
2
0
Site entered project in 2014
2014
2015
2016
2017
2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site C57

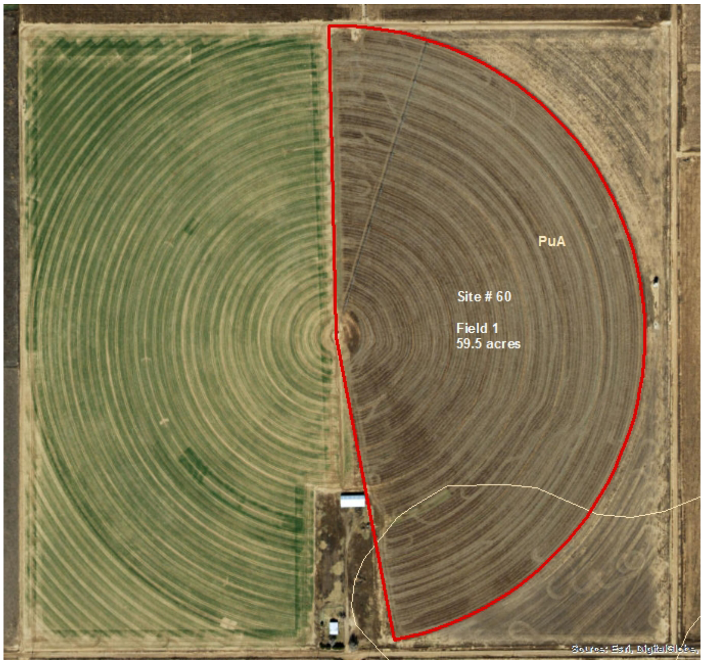

April irrigation


July corn


Residue following harvest

Comments: In 2018 this LESA irrigated site was planted to cotton on 30-inch centers with strip-till tillage management.

Site C60



Description:

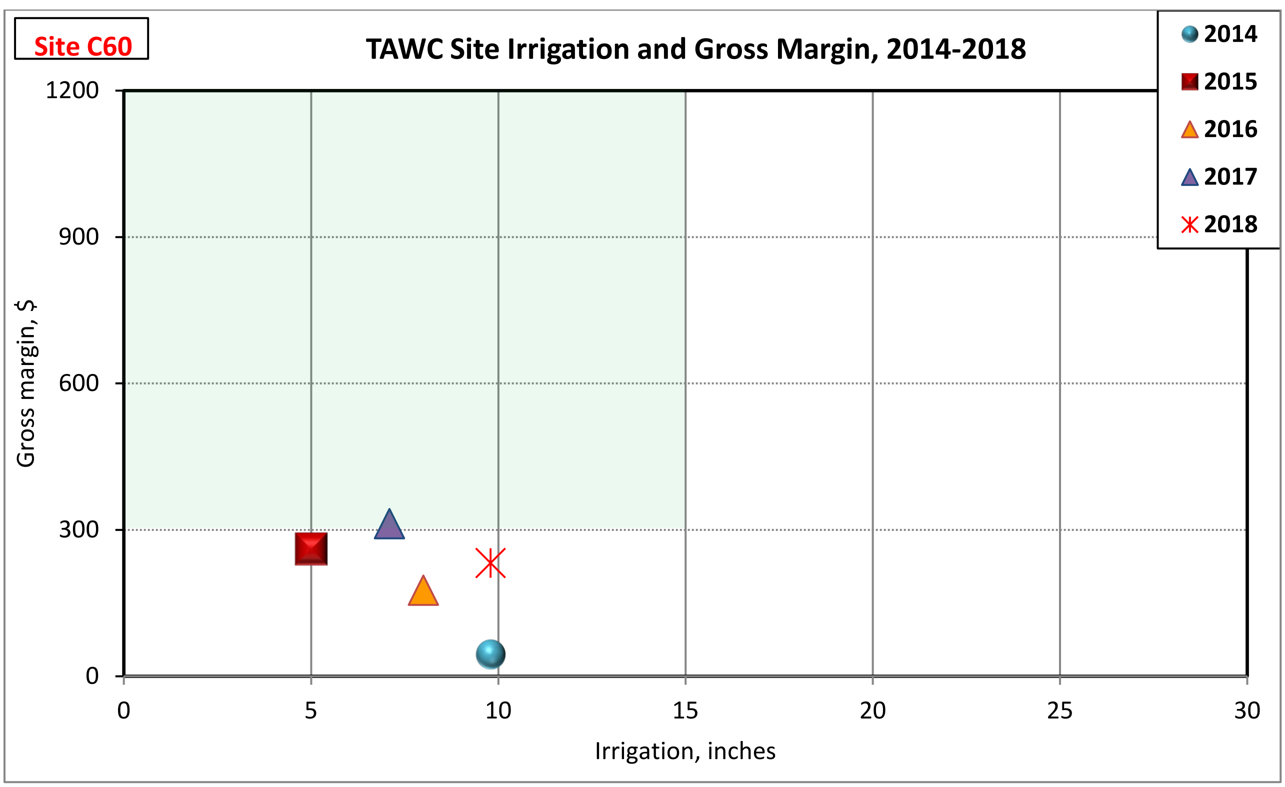
Site acres: 59.5

Soil types:
PuA - Pullman clay loam, 0 to 1%
LoA - Lofton clay loam, 0 to 1%

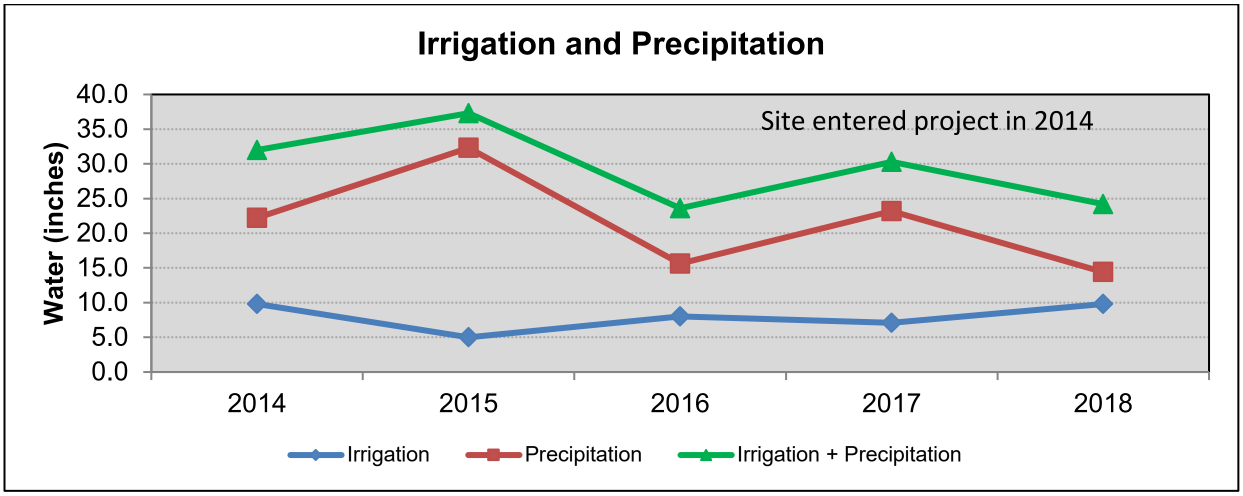
Irrigation:
Low Elevation Spray Application (LESA) 290 gpm

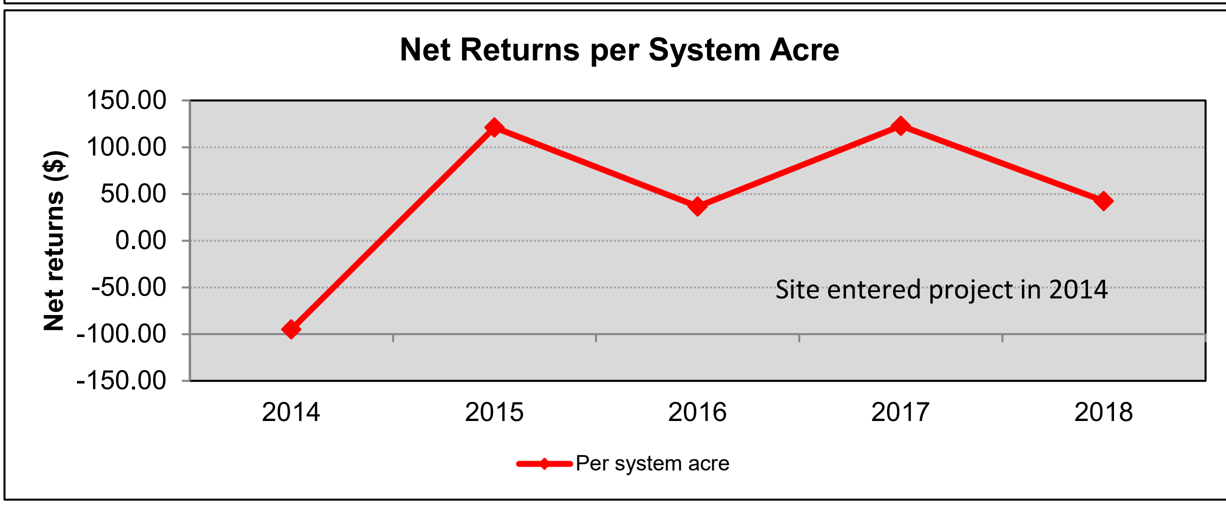
Number of wells: 3
Depth: 280 feet

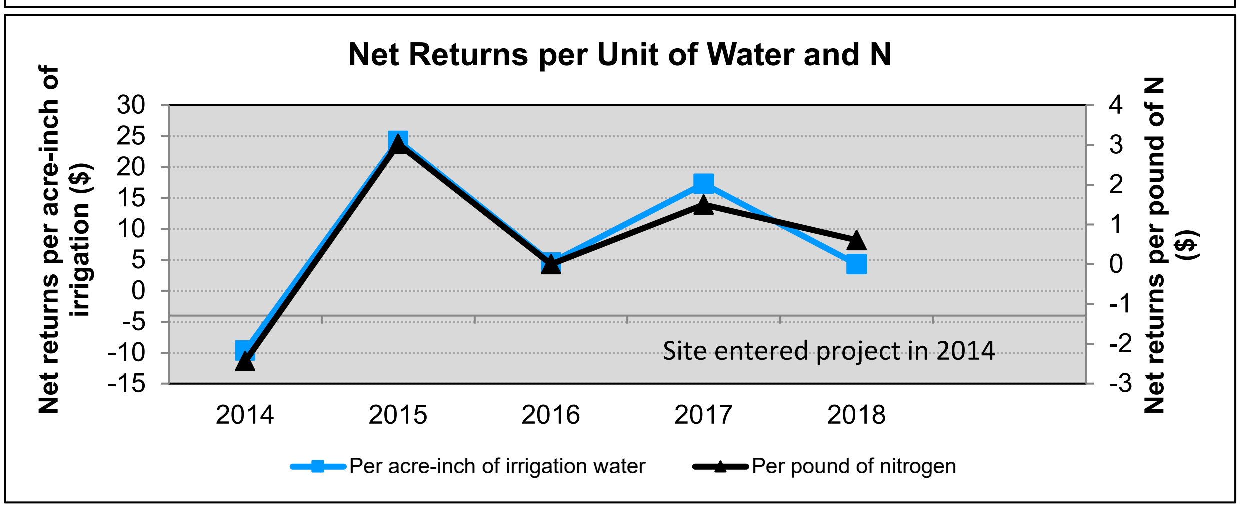
Fuel Source: Electric



Site C60


Irrigation and Precipitation
Site entered project in 2014
Water (inches)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2014
2015
2016
2017
2018
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
Site entered project in 2014
2014
2015
2016
2017
2018
Per system acre


Net Returns per Unit of Water and N
Net returns per acre-inch of irrigation ($)
30
25
20
15
10
5
0
-5
-10
-15
Net returns per pound of N ($)
4
3
2
1
0
-1
-2
-3
Site entered project in 2014
2014
2015
2016
2017
2018
Per acre-inch of irrigation water
Per pound of nitrogen

Site C60


LESA irrigated cotton


July cotton


October

Comments: In 2018 this LESA irrigated site was planted to cotton on 30-inch spacing.

Appendix - Archives

Phase I Changes and Alterations

Phase I of the TAWC program spanned a period (2005-2013) of increasing corn production in response to a growing dairy industry and U.S. policy encouraging renewable biofuels, especially ethanol. This period also encompassed wide swings in annual rainfall (5.3 to 28.5 inches) and commodity prices ($0.54 to $0.90 per lb. of cotton lint and $2.89 to $6.00 per bu. of corn). The decline in aquifer output and intense swings in prices and rainfall have driven producers to seek ways to minimize risk. This project officially began with the announcement of the grant from the Texas Water Development Board in September 2004. It was February 2005, when all contracts and budgets were finalized, and field site selections began. Also by February 2005, the Producer Board was named and functioning, and the Management Team was identified to expedite the decision-making process. The positions of project director and secretary/accountant were filled by June, 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. Soil moisture monitoring points installed, maintained and measured by the High Plains Underground Water Conservation District No. 1 were purposely located close to these sites, and global positioning system (GPS) coordinates were taken for each monitoring point. This was completed during 2005 and was operational for much of the 2005 growing season.

Total number of acres devoted to each crop and livestock enterprise and management type in 2005-2014 are given in Appendix Tables A1-A10. 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 missing information on water use while the original 26 sites were brought on-line. Such information is based on estimates as well as actual measurements during this first year and should be interpreted with caution. The resulting 2005 water use data, however, provided useful information as we began this long-term project. It is important to note that improvements were made in 2006 in calibration of water measurements and other protocols.

In year 2 (2006), site 25 was lost to the project due to a change in land ownership, but was replaced by site 27, thus the project continued to monitor 26 sites. Total acreage in 2006 was 4,230, a decline of about 60 acres. Crop and livestock enterprises on these sites and the acres committed to each use by site are given in Table A2.

In year 3 (2007), all sites present in 2006 remained in the project through 2007. Total acreage was 4,245, a slight increase over year 2 due to expansion of Site 1 (Table A3).

In year 4 (2008), 25 sites comprised 3,967 acres (Table A4). Sites 1, 13, 16, and 25 of the original sites had left the project, and sites 28 and 29 were added.

In year 5 (2009), all sites present in 2008 remained in the project. Site 30 with 21.8 acres was added. Thus, 26 total sites were present in 2009 for a total of 3,991 acres (Table A5).
In year 5 (2009), all sites present in 2008 remained in the project. Site 30 with 21.8 acres was added. Thus, 26 total sites were present in 2009 for a total of 3,991 acres (Table A5).

In year 6 (2010), three new sites were added as part of the implementation phase of the project (Table A6). These sites were designed to limit total irrigation for 2010 to no more than 15 inches. Crops grown included cotton, seed millet, and corn. The purpose of these added sites was to demonstrate successful production systems while restricting the water applied. With the addition of sites 31, 32, and 33, the project now totaled 29 sites and increased the project acreage from 3,991 acres to 4,272 acres, although data from these new sites were treated separately in this year. The new sites also increased the number of producers involved in the project by one.

In year 7 (2011), the previously mentioned implementation sites were incorporated into the whole project and no longer differentiated from other sites in management or data analysis because of changes in water policy. In addition, site 5 was converted from a livestock-only system to an annual cropping system. The site acreage declined from 626.4 to 487.6 by dropping the grassland corners but maintaining the cropping system under the center pivot. Site maps were adjusted for 2012 to reflect this change. Total acres for the project decreased from 4272 acres in 2010 to 4133 acres in 2011 as a result (Table A7).

In year 8 (2012), site 34 was added to the project (Table A8). The new 726.6 acres were partially offset by the exit of site 23 (121.1 acres). The 2012 report includes new satellite imagery of each site, and site information has been updated accordingly. As always, minor corrections to site acreages continued to occur as discrepancies are discovered. Total acres for the project increased from 4133 acres in 2011 to 4732 acres in 2012 as a result of these site changes.

In year 9 (2013), site 35 was added to the project (Table A9). The new 229.2 acres were a drip irrigated site. Total acres for the project increased from 4732 acres in 2012 to 4962 acres in 2013 as a result. Year 9 constituted the last data collection year of Phase I. A final report of Phase I was completed in 2014, and is available at http://www.depts.ttu.edu/tawc/resources.html.

Acres and Crops 2005-2016

Table A 1. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 26 producer sites in Hale and Floyd Counties during 2005.

Site	Irrigation type	Cotton	Corn grain	Corn silage	Sorghum grain	Sorghum forage	Pearl millet	Sunflower	Alfalfa	Grass seed	Perennial pasture	Cattle	Wheat	Rye	Triticale	Oats
1	SDI	62.3														
2	SDI	60.9														
3	PIV	61.8			61.5											
4	PIV	109.8							13.3							
5	PIV/DRY								69.6		551.3	620.9				
6	PIV	122.9										122.9	122.9			
7	PIV									130.0						
8	SDI									61.8						
9	PIV	137.0									95.8	232.8		232.8		
10	PIV	44.5									129.1	129.1				
11	FUR	92.5														
12	DRY	151.2				132.7										
13	DRY	201.5											118.0			
14	PIV	124.2														
15	FUR	95.5														
16	PIV	143.1														
17	PIV	108.9		58.3							53.6					
18	PIV	61.5			60.7											
19	PIV	75.3					45.1									
20	PIV			115.8		117.6							117.6			
21	PIV	122.7														
22	PIV	72.7	76.0													
23	PIV	51.5						48.8								
24	PIV	64.7	65.1													
25	DRY	90.9			87.6											
26	PIV	62.9	62.3													
Total	**2005 acres**	**2118.3**	**203.4**	**174.1**	**209.8**	**250.3**	**45.1**	**48.8**	**82.9**	**191.8**	**829.8**	**1105.7**	**358.5**	**232.8**	**0.0**	**0.0**

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

Table A 2. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 26 producer sites in Hale and Floyd Counties during 2006.

Site	Irrigation type	Cotton	Corn grain	Corn silage	Sorghum grain	Sorghum forage	Pearl millet	Sunflowers	Alfalfa	Grass seed	Perennial pasture	Cattle	Wheat	Rye	Triticale	Oats
1	SDI	135.2														
2	SDI	60.9														
3	PIV	123.3														
4	PIV	44.4				65.4			13.3				65.4			
5	PIV/DRY								69.6		551.3	620.9				
6	PIV	122.9														
7	PIV									130.0						
8	SDI									61.8						
9	PIV	137.0									95.8	95.8		137.0		
10	PIV					44.5					129.1	129.1				44.5
11	FUR	92.5														
12	DRY	132.7											151.2			
13	DRY	118.0											201.5			
14	PIV	124.2														
15	FUR	67.1			28.4											
16	PIV	143.1														
17	PIV	58.3		108.9							53.6	162.5	108.9			
18	PIV	60.7				61.2										61.2
19	PIV	75.1					45.3									
20	PIV			117.6		115.8									115.8	
21	PIV	61.3	61.4									61.3	61.3			
22	PIV	72.7	76													
23	PIV	51.5	48.8													
24	PIV	65.1		64.7												
26	PIV	62.3	62.9													
27	SDI	46.2														
Total	**2006 acres**	1854.5	**249.1**	**291.2**	**28.4**	286.9	45.3	0.0	82.9	191.8	829.8	1069.6	588.3	**137.0**	**115.8**	**105.7**

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

Table A 3. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 26 producer sites in Hale and Floyd Counties during 2007.

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	135.1														
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															
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		105.9													
24	PIV		129.8													
26	PIV		62.3				62.9					62.9				
27	SDI			46.2												
Total	**2007 acres**	**1415.4**	**358.5**	**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 A 4. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 25 producer sites in Hale and Floyd Counties during 2008.

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

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

Table A 5. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 26 producer sites in Hale and Floyd Counties during 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 A 6. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 26 producer sites in Hale and Floyd Counties during 2010.

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

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

Table A 7. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 29 producer sites in Hale and Floyd Counties during 2011.

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

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

Table A 8. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 29 producer sites in Hale and Floyd Counties during 2012.

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

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

Table A 9. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 30 producer sites in Hale and Floyd Counties during 2013.

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

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

Table A 10. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 36 producer sites in the project during year 1 Phase II 2014.

Site	irrigation type	System acres	Cotton	Corn grain	Corn silage	Fallow	Grain sorghum	Seed sorghum	Forage sorghum	Alfalfa	Grass seed	Hay	Perennial forage	Cattle grazed	Wheat for grain	Wheat silage	Grazed wheat	Sunflower	Triticale hay	Seed millet
4	PIV	122.9	29.6				29.6	50.5	26.8	16		16	16	53.6			26.8			
5	PIV	484.1	241.8															119.4		122.9
6	PIV	122.7	62.1	60.6																
7	PIV	130									130.0	130	130							
8	SDI	61.8									61.8	61.8	61.8							
9	PIV	237.7	59.9				77.0						100.8	100.8						
10	PIV	173.6	59.2	59.2									57.7	57.7						
11	FUR	92.3	77.3				15.0													
14	PIV	124.1	124.1																	
15	SDI	101.1	101.1																	
17	PIV	220.7		54.4		111.8							111.8					54.5		
19	PIV	120.3	120.3																	
20	PIV	233.3			233.3															
21	PIV	122.0	60.6						61.4			61.4			61.4					
22	PIV	148.7		148.7																
24	PIV	129.7		64.6														65.1		
26	PIV	125.1		62.9														62.2		
27	SDI	108.4			108.4															
28	SDI	51.4	51.4																	
29	DRY	221.7	221.7																	
30	SDI	21.8	21.8																	
31	PIV	121.9	66.8				66.8													
32	PIV	70	70.0				70.0													
33	PIV	70	70.0																	
34	PIV	726.0	242.0	484.0																
35	PIV	230.2	80.5	75.0			74.7	55.1												
C50	PIV	120.6	120.6																	
C51	SDI	45.7	45.7																	
C52	PIV	135	135																	
C53	SDI	50	50																	
C54	SDI	85	85																	
C56	PIV	45			45															
C57	PIV	115			115															
C58	PIV	120								60									60	
C59	SDI	76								76										
C60	PIV	59.5					59.5													
Total acres 2014		**5223.3**	2196.5	1009.4	501.7	111.8	392.6	105.6	88.2	152	191.8	269.2	478.1	212.1	61.4	0	26.8	301.2	60	122.9
# of Sites		36	23	8	4	1	7	2	2	3	2	4	6	3	1	0	1	4	1	1

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

Table A 11. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 36 producer sites in the project during year 1 Phase II 2015. Sites 6, 7, 34, C37 and C38 had no data collected for 2015.

Site	Irrigation type	System acres	Cotton	Corn grain	Corn silage	Fallow	Grain sorghum	Seed sorghum	Forage sorghum	Alfalfa	Grass seed	Hay	Perennial forage	Cattle grazed	Wheat for grain	Wheat silage	Grazed wheat	Sunflower	Blackeye pea	Seed millet
4	LESA/LEPA	123.0	77.4							16					29.6		29.6			
5	LESA	484.1		122.9											119.4			85.8		156.0
6	LESA	122.7	60.6	62.1																
7	LESA	130.0																		
8	SDI	61.8																		
9	MESA	237.7	136.9										100.8	100.8						
10	LESA	173.6	59.2	59.2									57.7	57.7						
11	FUR/SDI	82.6	10	37.6			35.0													
14	MESA	124.1	62.1			62.0														
15	SDI	101.1	101.1																	
17	MESA	108.9		54.5														54.4		
19	LEPA	120.4	60.2			60.2														
21	LEPA	120.7		60.1											60.6					
22	LEPA	145.0	145.0	145.0																
24	LESA	129.7		65.1														64.6		
26	LESA	125.1		62.9																62.2
28	SDI	51.5		51.5																
30	SDI	21.8		21.8																
31	LEPA/LESA/ LDN/PMDI	121.9		66.8			55.1													
32	LEPA	70.0		70.0																
33	LEPA	70.0		70.0																
34	LESA	726																		
35	SDI	230.0		230.0																
C37	VR-LESA	121.1																		
C38	VR-LESA	481.0																		
C39	LEPA	120.0		60.0			60.0													
C50	LESA	120.6	120.6																	
C51	SDI	45.7	45.7																	
C52	LESA	130	130.0																	
C53	SDI	50	50.0																	
C54	SDI	80	80.0																	
C56	LESA	40																	40.0	
C57	LESA	115		115.0																
C58	LESA	120		60.0						60.0										
C59	SDI	93								93.0										
C60	LESA	59.5	59.5																	
Total acres 2015		**5,258**	1,053.3 (harvested)	1,414.5	0	122.2	150.1	0	0	169.0	0	0	158.5	158.5	209.6	0	29.6	204.8	40.0	218.2
# of Sites		36	14	18	0	2	3	0	0	3	0	0	2	2	3	0	1	3	1	2

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

**Red denotes field crop failure/Insurance claim, Yellow denotes original purpose altered, Brown denotes fallowed, Grey denotes no field data for this year.

Table A 12. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 22 producer sites in the project during year 1 Phase II 2016. Sites 34, C39, C53, C54 and C59 had no data collected for 2016.

Site	Irrigation type	System acres	Cotton	Corn grain	Corn silage	Fallow	Grain sorghum	Seed sorghum	Forage sorghum	Alfalfa	Grass seed	Hay	Perennial forage	Cattle grazed	Wheat for grain	Wheat silage	Grazed wheat	Sunflower	Blackeye pea	Seed millet
4	LESA/LEPA	123.0	26.9					50.5	29.6	16		29.6	16	29.6			29.6			
6	LESA	122.7	62.1	60.6																
9	MESA	236.9	134.0										102.9	102.9						
10	LESA	176.1	59.2	59.2									57.7	57.7						
11	FUR/SDI	93.5	93.5																	
14	MESA	124.1	124.1																	
17	MESA	108.9		108.9																
21	LEPA	121.7	121.7																	
22	LEPA	145.0	145.0																	
24	LESA	129.7		65.1														64.6		
28	SDI	51.5		51.5																
31	LEPA/LESA/ LDN/PMDI	121.9	66.8				55.1													
32	LEPA	70.0	70.0																	
33	LEPA	70.0		70.0																
34	LESA	726																		
35	SDI	230.0	115.0	115.0																
C37	VR-LESA	121.1		121.1																
C38	VR-LESA	481.0	481.0																	
C39	LEPA	120.0																		
C50	LESA	121.0	121.0																	
C51	SDI	46.0	46.0																	
C53	SDI	50																		
C54	SDI	80																		
C56	LESA	35			35.0															
C57	LESA	115																115.0		
C59	SDI	93																		
C60	LESA	59.5	59.5																	
Total acres 2016		3972 (2909 active)	1726.4	651.4	40.0		55.1	50.5	29.6	16	0	29.6	176.6	190.2	0	0	29.6	179.6	0	0
Total # of Sites		27 (22 active)	15	8	1	0	1	1	1	1	0	1	3	3	0	0	1	2	0	0

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

**Red denotes field crop failure/Insurance claim, Yellow denotes original purpose altered, Brown denotes fallowed, Grey denotes no producer field data for this year.

Table A 13. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 20 producer sites in the project during year 2017. Sites 34 had no data collected for 2017.

Site	Irrigation type	System acres	Cotton	Corn grain	Corn silage	Fallow	Grain sorghum	Seed sorghum	Forage sorghum	Alfalfa	Grass seed	Hay	Perennial forage	Cattle grazed	Wheat for grain	Wheat silage	Grazed wheat	Sunflower	Blackeye pea	Seed millet
4	LESA/LEPA	110.0	60.0							15.0		15.0	15.0	51.0	35.0		35.0			35.0
9	MESA	237.7	136.9										100.8	100.8						
10	LESA	176.1	59.2	59.2									57.7	57.7						
11	FUR/SDI	92.6	92.6																	
14	MESA	124.1	124.1																	
17	MESA	108.9		108.9																
21	LEPA	120.7	120.7																	
22	LEPA	145.0	145.0																	
31	LEPA/LESA/ LDN/PMDI	121.9	55.1																	66.8
32	LEPA	70.0		70.0																
34	LESA	726.6																		
35	SDI	230.0	115.0	115.0																
C37	VR-LESA	475.5	475.5																	
C38	VR-LESA	122.9	122.9																	
C39	LESA/LEPA	120.0	60.0	60.0																
C50	LESA	120.6	120.6																	
C51	SDI	45.7	45.7																	
C56	LESA	60.0																	60.0	
C57	LESA	115.0		115.0																
C60	LESA	59.5	59.5																	
Total acres 2017		3382.8 (2656 active)	1792.8	528.1						15.0		15.0	172.3	208.3	35.0		35.0		60.0	101.8
Total # of Sites		20 (19 active)	15	6						1		1	3	3	1		1		1	2

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation
**Red denotes field crop failure/Insurance claim, Yellow denotes original purpose altered, Brown denotes fallowed, Grey denotes no producer field data for this year.

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

Phase I - Economic assumptions of data collection and interpretation

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

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

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

4. Variable cost of irrigation across all systems was based on a center pivot system using electricity as the energy source. Variable costs are nearly constant across irrigation systems, according to Amosson et al. (2011)[3], so this assumption has negligible effect on the analysis. The estimated cost per acre-inch includes the cost of energy, repair and maintenance cost, and labor cost. The primary source of variation in variable cost from year to year is due to changes in the unit cost of energy and repair and maintenance costs.

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

Phase I - Assumptions of energy costs, prices, fixed and variable costs (Tables A10-A13)

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

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

Table A 14. Electricity irrigation cost parameters for 2005 through 2013.

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

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

Table A 15. Commodity prices for 2005 through 2013.

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

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

4. Other variable and fixed costs are given for 2005 through 2013 in Table A12.

Table A 16. Other variable and fixed costs for 2005 through 2013.

VARIABLE COSTS	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Boll weevil assessment: ($/ac)									
Irrigated cotton	$12.00	$12.00	$12.00	$1.50	$1.00	$1.00	$1.00	$1.00	$1.00
Dryland cotton	$6.00	$6.00	$6.00	$1.50	$1.00	$1.00	$1.00	$1.00	$1.00
Crop insurance: ($/ac)									
Irrigated cotton	$17.25	$17.25	$17.25	$20.00	$20.00	$20.00	$30.00	$30.00	$30.00
Dryland cotton	$12.25	$12.25	$12.25	$12.25	$12.25	$12.25	$20.00	$20.00	$20.00
Irrigated corn	$15.00	$15.00	$15.00	$15.00	$15.00	$15.00	$15.00	$15.00	$15.00
Irrigated corn silage	-	-	-	-	-	-	-	$11.00	$11.00
Irrigated Wheat	-	-	-	-	-	-	-	$5.00	$5.00
Irrigated sorghum grain	-	-	-	-	-	-	-	$2.00	$2.00
Dryland sorghum grain	-	-	-	-	-	-	-	$2.00	$2.00
Irrigated sorghum silage	-	-	-	-	-	-	-	$2.00	$2.00
Irrigated sunflower	-	-	-	-	-	-	-	$5.00	$5.00
Cotton harvest – strip and module ($/lint lb)	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08
Cotton ginning ($/cwt)	$1.95	$1.75	$1.75	$1.95	$1.95	$1.95	$1.95	$1.95	$2.10
Bags, ties, & classing ($/bale)	$17.50	$19.30	$17.50	$18.50	$18.50	$18.50	$18.50	$18.50	$18.50
FIXED COSTS	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Irrigation system:									
Center Pivot system	$33.60	$33.60	$33.60	$33.60	$33.60	$40.00	$40.00	$40.00	$40.00
Drip system	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00	$75.00
Flood system	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00
Cash rent:									
Irrigated cotton, grain sorghum, sun-flowers, grass, pearl millet, and sorghum silage.	$45.00	$45.00	$45.00	$75.00	$75.00	$100.00	$100.00	$100.00	$100.00
Irrigated corn silage, corn grain, and alfalfa.	$75.00	$75.00	$75.00	$100.00	$100.00	$140.00	$140.00	$140.00	$140.00
Dryland cropland	$15.00	$15.00	$15.00	$25.00	$25.00	$30.00	$30.00	$30.00	$30.00

5. The custom tillage and harvest rates used for 2005 were based on rates reported in Texas A&M AgriLife Extension, 2013 Texas Agricultural Custom Rates, May 2013.

Table A 17. Summary of results from monitoring 26 producer sites in 2005 (Year 1).

System	Site No.	Acres	Irrigation Type[1]	System Inches	Net Returns/ system Acre	Net Returns/ 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/pearl millet	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/sunflower	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 A 18. Summary of results from monitoring 26 producer sites in 2006 (Year 2).

System	Site No.	Acres	Irrigation type[1]	System inches	Net Returns/ system acre	Net Returns/ 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/pearl millet	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 A 19. Summary of results from monitoring 26 producer sites in 2007 (Year 3).

System	Site No.	Acres	Irrigation Type[1]	System inches	Net Returns/ system acre	Net Returns /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/pearl millet	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/per. 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
Per. 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
Pearl millet: 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 A 20. Summary of results from monitoring 25 producer sites in 2008 (Year 4).

System	Site No.	Acres	Irrigation Type[1]	System inches	Net Returns/ system acre	Net Returns /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/per. 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
Pearl millet: 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 A 21. Summary of results from monitoring 26 producer sites in 2009 (Year 5).

System	Site No.	Acres	Irrigation Type[1]	System inches	Net Returns/ system acre	Net Returns /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/WW-BDahl 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 A 22. Summary of results from monitoring 26 producer sites in 2010 (Year 6).

System	Site No.	Acres	Irrigation Type[1]	System inches	Net Returns/ system acre	Net Returns/ 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/Trititcale 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
Triticale/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 A 23. Summary of results from monitoring 29 producer sites in 2011 (Year 7).

System	Site No.	Acres	Irrigation Type[1]	System inches	Net Returns/ system acre	Net Returns /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 /Haygrazer	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/Triticale 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
Triticale/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 A 24. Summary of results from monitoring 29 producer sites in 2012 (Year 8).

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

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

Table A 25. Summary of results from monitoring 30 producer sites in 2013 (Year 9).

System	Site No.	Acres	Irrigation Type[1]	System inches	Net Returns/ system acre	Net Returns /inch water	Gross margin per inch irrigation
Monoculture systems							
Perennial grass: seed/hay	7	130	CP/LESA	10.3	403.68	39.19	52.78
Perennial grass: seed/hay	8	61.8	SDI	14.1	983.54	69.75	82.17
Cotton	11	92.5	FUR	12.0	-18.10	-1.51	8.91
Cotton – No data	12	283.8	DL	0	0.00	Dryland	Dryland
Cotton (2 in 2 out)	14	124.1	CP/LESA	7.5	371.85	49.58	58.92
Cotton	15	101.1	SDI	17.65	858.11	48.62	58.54
Fallowed	18	122.2	CP/MESA	0	0.00	0.00	0.00
Cotton (2 in 2 out)	19	120.3	CP/LEPA	12.0	199.93	16.66	22.49
Cotton	22	148.7	CP/LEPA	24.5	424.35	17.32	23.03
Cotton	28	51.4	SDI	17.5	163.36	9.33	19.33
Cotton (failed, collected ins.)	29	221.6	DL	0	3.79	Dryland	Dryland
Corn	30	21.8	SDI	13	-30.84	-2.37	14.17
Corn	32	70	CP/LEPA	20.6	196.45	9.54	18.27
Corn	33	70	CP/LEPA	26.8	188.99	7.05	13.77
Multi-crop systems							
Cotton/Corn grain	2	59.9	SDI	21.0	262.95	12.54	21.79
Cotton/Grain sorghum	3	123.3	CP/MEPA	16.2	334.56	20.59	29.21
Wheat/Millet/Cotton/Sunflower	5	484.1	CP/LESA	10.3	454.87	44.37	58.03
Wheat/Cotton	6	122.7	CP/LESA	17.0	149.62	8.78	17.00
Dahl/Corn/Sunflower	17	220.7	CP/MESA	12.2	118.60	9.76	21.27
Trit silage/Corn silage/Cotton	20	233.3	CP/LEPA	27.3	704.25	25.78	31.65
Wheat/Haygrazer/Corn	21	122.6	CP/LEPA	19.9	286.14	14.38	21.16
Corn grain/Sunflower	24	129.7	CP/LESA	17.2	392.45	22.78	32.07
Wheat/Corn	26	125.1	CP/LESA	11.9	157.18	13.20	26.62
Corn silage/Cotton	27	108.4	SDI	36.3	673.31	18.55	23.98
Cotton/Seed millet	31	121.9	CP/LEPA	20.0	469.53	23.52	30.53
Corn/Sunflower	34	726.6	CP/LESA	14.1	445.30	31.58	40.94
Grain sorghum/Corn/Cotton	35	229.3	SDI	20.0	403.82	20.22	27.70
Crop-livestock systems							
Alfalfa/Cotton/Wheat/Seed Sorghum	4	122.9	CP/LEPA	18.3	420.87	23.05	31.01
Perennial grass: contract grazing/cotton	9	237.7	CP/MESA	8.7	277.95	31.89	47.96
Perennial grass: contract grazing/cotton	10	173.6	CP/LESA	18.5	242.86	13.14	21.80

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

Table A 26. Phase II Summary of results from monitoring 36 producer sites during 2014 (Year 1).

System	Site No.	Acres	Irrigation Type[1]	System inches	Net Returns /system acre	Net Returns /inch water	Gross margin per inch irrigation
Monoculture systems							
Perennial grass: seed/hay	7	130	CP/LESA	15.5	-63.58	-4.10	4.93
Perennial grass: seed/hay	8	61.8	SDI	16.0	22.23	1.39	12.33
Cotton (2 in 2 out)	14	124.1	CP/LESA	4.5	102.08	22.68	38.25
Cotton	15	101.1	SDI	15.2	150.58	9.89	21.39
Cotton (2 in 2 out)	19	120.3	CP/LEPA	4.3	43.82	10.31	26.77
Corn silage	20	233.3	CP/LEPA	14.2	-143.00	-10.07	2.61
Corn	22	148.7	CP/LEPA	21.0	478.71	22.80	31.37
Corn silage	27	108.4	SDI	12.7	-162.75	-12.81	4.11
Cotton	28	51.4	SDI	8.0	113.13	14.14	36.02
Cotton	29	221.7	DL	0	43.04	Dryland	Dryland
Cotton	30	21.8	SDI	13	256.73	19.75	33.21
Cotton (failed replanted grain sorghum)	32	70	CP/LEPA	14.2	104.46	7.36	20.03
Cotton	33	70	CP/LEPA	13.9	-18.75	-1.35	11.60
Cotton (1 year)	C50	120.6	CP/LESA	8.4	86.69	10.38	27.15
Cotton (1 year)	C51	45.7	SDI	9.4	244.15	25.97	44.59
Cotton (1 year)	C52	135	CP/LESA	15.5	-176.98	-11.42	-2.39
Cotton (1 year)	C53	50	SDI	8.5	108.94	12.89	33.60
Cotton (1 year)	C54	85	SDI	8.3	74.61	8.99	30.07
Corn silage (1 year)	C56	45	CP/LESA	14.4	721.08	50.08	62.58
Corn silage (1 year)	C57	115	CP/LESA	11.6	422.08	36.54	52.13
Alfalfa (1 year)	C59	76	SDI	15.1	1740.88	115.29	129.53
Grain sorghum (1 year)	C60	59.5	CP/LESA	9.8	-94.87	-9.68	4.61
Multi-crop systems							
Millet/Cotton/Sunflower	5	484.1	CP/LESA	12.5	410.76	32.82	44.01
Corn/Cotton	6	122.7	CP/LESA	13.5	61.24	4.55	16.41
Grain Sorghum/Cotton	11	92.3	FUR/SDI	11.0	-60.97	-5.55	8.16
Perennial grass/Corn/Sunflower	17	220.7	CP/MESA	5.4	105.17	19.38	47.00
Wheat/Haygrazer/Cotton	21	122.0	CP/LEPA	12.8	122.96	9.59	18.55
Corn grain/Sunflower	24	129.7	CP/LESA	12.7	413.56	32.47	45.04
Corn/Sunflower	26	125.1	CP/LESA	11.5	474.52	41.19	55.07
Grain sorghum/Forage Sorghum	31	121.9	CP/LEPA	16.6	643.26	38.78	47.22
Corn/Cotton	34	726.0	CP/LESA	12.6	270.78	21.43	21.50
Grain sorghum/Corn/Cotton	35	230.2	SDI	12.3	-85.97	-7.00	8.31
Triticale/Alfalfa (1 year)	C58	120	CP/LESA	16.7	399.57	24.00	33.61
Crop-Livestock systems							
Alfalfa/Grain Sorg./Wheat/ Haygrazer/Seed sorghum	4	122.9	CP/LEPA	17.4	329.52	18.89	27.21
Perennial grass: Contract grazing/Cotton/Grain Sorghum	9	237.7	CP/MESA	5.1	5.02	0.99	28.47
Perennial grass: Contract grazing/Corn/Cotton	10	173.6	CP/LESA	11.2	22.53	2.01	15.71

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

Table A 27. Phase II Summary of results from monitoring 32 of 36 producer sites during 2015 (Year 2).

System	Site No.	Acres	Irrigation Type[1]	System inches	Net Returns/ system acre	Net Returns/ inch water	Gross margin per inch irrigation
Monoculture systems							
Cotton (2 in 2 out)	14	124.1	MESA	5.0	194.55	38.91	52.92
Cotton	15	101.1	SDI	7.0	65.96	9.42	34.42
Cotton (2 in 2 out)	19	120.4	LEPA	4.0	-13.58	-3.40	14.12
Corn	22	145.0	LEPA	16.5	-118.51	-7.18	3.73
Corn	28	51.5	SDI	17.0	-452.80	-26.64	-13.99
Corn	30	21.8	SDI	18.0	173.18	9.62	21.57
Corn	32	70.0	LEPA	18.1	246.70	13.63	23.57
Corn	33	70.0	LEPA	19.0	185.90	9.78	19.26
Corn	35	230.0	SDI	10.4	-17.99	-1.74	19.03
Cotton	C50	120.6	LESA	4.9	40.57	8.28	36.85
Cotton	C51	45.7	SDI	4.7	77.43	16.47	53.71
Cotton	C52	130.0	LESA	12.2	163.60	13.41	24.89
Cotton	C53	50.0	SDI	10.3	223.99	21.75	38.74
Cotton	C54	80.0	SDI	9.3	207.78	22.41	41.29
Blackeye pea	C56	40.0	LESA	6.0	717.65	119.61	142.94
Corn	C57	115.0	LESA	9.6	381.32	39.72	58.47
Alfalfa	C59	93.0	SDI	14.3	1263.41	88.35	103.39
Cotton	C60	59.5	LESA	5.0	121.17	24.23	52.23
Multi-crop systems							
Alfalfa/Wheat/Cotton	4	123.0	LESA/LEPA	9.2	-15.82	-1.73	14.11
Wheat/Millet/Sunflower/Corn	5	484.1	LESA	10.3	541.62	52.49	66.06
Corn/Cotton	6	122.7	LESA	20.9	29.51	1.42	9.10
Grain Sorghum/Cotton/Corn	11	82.6	FUR/SDI	9.8	-172.78	-17.70	-0.08
Corn/Sunflower	17	108.9	MESA	13.5	73.67	5.45	17.30
Wheat/Corn	21	120.7	LEPA	7.7	3.34	0.43	21.14
Corn grain/Sunflower	24	129.7	LESA	14.0	121.51	8.69	20.15
Corn/Seed Millet	26	125.1	LESA	13.0	690.17	53.02	65.32
Corn/Grain Sorghum	31	121.9	LEPA/LESA/ LDN/PMDI	11.7	-21.51	-1.84	11.68
Grain Sorghum/Corn grain	C39	120.0	LEPA	10.4	-17.99	-1.74	19.03
Corn/Alfalfa	C58	120.0	LESA	18.0	492.12	27.34	37.34
Crop-Livestock systems							
Perennial grass: contract grazing/Cotton	9	237.7	MESA	3.5	40.98	11.86	52.37
Perennial grass: contract grazing, /Corn/Cotton	10	173.6	LESA	10.9	-12.00	-1.10	12.99

[1]SDI – Subsurface drip irrigation; MESA – Mid elevation spray application; LESA – Low elevation spray application; LEPA – Low energy precision application; LDN – Low drift nozzle; FUR – furrow irrigation; DL – dryland

Table A 28. Phase II Summary of results from monitoring 22 of 27 producer sites during 2016 (Year 3).

System	Site No.	Acres	Irrigation Type[1]	System inches	Net Returns/ system acre	Net Returns/ inch water	Gross margin per inch irrigation
Monoculture systems							
Cotton	11	94.1	Fur/SDI	10.5	-394.15	-37.49	-23.21
Cotton (2 in 2 out)	14	124.1	MESA	4.0	150.70	37.68	55.19
Corn	17	108.9	MESA	17.0	274.71	16.16	26.75
Cotton	21	121.7	LEPA	9.6	379.57	39.72	54.38
Cotton	22	145	LEPA	14.0	502.70	35.91	45.91
Corn	28	51.5	SDI	8.0	-552.47	-69.06	-42.18
Cotton	32	70	LEPA	12.0	446.80	37.23	48.90
Corn	33	70	LEPA	20.0	95.74	4.79	13.79
Corn	C37	121.1	VRI	16.2	-147.01	-9.07	2.04
Cotton	C38	481	VRI	9.4	293.47	31.22	46.11
Cotton	C50	121	LESA	6.7	189.96	28.35	49.25
Cotton	C51	46	SDI	10.6	367.43	34.66	51.17
Corn silage	C56	40	LESA	15.0	66.18	4.41	16.41
Sunflower	C57	115	LESA	5.1	-189.61	-37.18	-9.73
Cotton	C60	59.5	LESA	8.0	36.40	4.55	22.05
Multi-crop systems							
Corn/Cotton	6	122.7	LESA	14.2	293.16	20.64	31.89
Corn grain/Sunflower	24	129.7	LESA	12.0	51.41	4.28	17.59
Cotton/Grain Sorghum	31	121.9	LEPA/LESA/ LDN/PMDI	8.0	-29.06	-3.63	13.87
Corn/Cotton	35	230	SDI	14.2	13.79	0.97	14.70
Crop-Livestock systems							
Alfalfa/Forage Sorghum/Wheat grazing/Cotton	4	123	LESA/LEPA	11.2	166.95	14.87	27.80
Perennial grass: contract grazing/Cotton	9	236.5	MESA	9.1	23.06	2.54	16.07
Perennial grass: contract grazing, /Corn/Cotton	10	176.1	LESA	14.6	46.74	3.21	13.73

[1]SDI – Subsurface drip irrigation; MESA – Mid elevation spray application; LESA – Low elevation spray application; LEPA – Low energy precision application; LDN – Low drift nozzle; VRI – Variable rate irrigation; FUR – furrow irrigation; DL – dryland

Table A 29. Phase II Summary of results from monitoring 19 producer sites during 2017 (Year 4).

System	Site No.	System Acres	Irrigation Type[1]	System inches	Net Return/ System acre	Net Return/ inch water	Gross margin per inch irrigation
Monoculture systems							
Cotton	11	92.6	Fur/SDI	8.4	-68.93	-8.24	15.76
Cotton (2 in 2 out)	14	124.1	MESA	12.0	105.53	17.59	33.42
Corn	17	108.9	MESA	20.0	233.44	11.67	21.17
Cotton	21	120.7	LEPA	7.0	82.40	11.77	38.91
Cotton	22	145.0	LEPA	19.8	33.20	1.68	11.30
Corn	32	70.0	LEPA	16.5	138.35	8.38	19.90
Cotton	C37	475.5	VRI	14.0	-377.73	-26.98	-13.41
Cotton	C38	122.9	VRI	13.3	-127.58	-9.59	4.69
Cotton	C50	120.6	LESA/VRI	5.0	-95.75	-19.15	18.85
Cotton	C51	45.7	SDI	8.7	135.24	15.54	41.98
Blackeye pea	C56	60.0	LESA	6.0	366.54	61.09	92.76
Corn	C57	115.0	LESA	19.3	357.58	18.58	28.45
Cotton	C60	59.5	LESA	7.1	122.90	17.31	44.07
Multi-crop systems							
Cotton/Millet	31	121.9	LEPA/LESA/ LDN/PMDI	12.5	79.07	6.35	20.29
Corn/Cotton	35	230.0	SDI	12.3	197.76	16.08	34.78
Corn/Cotton	C39	120.0	LESA/LEPA	11.3	193.45	17.20	34.08
Crop-Livestock systems							
Alfalfa/Millet/Wheat grazing/Cotton	4	111.0	LESA/LEPA	13.0	123.49	9.54	23.47
Perennial grass: contract grazing/Cotton	9	236.5	MESA	3.3	-1.87	-0.56	45.28
Perennial grass: contract grazing, /Corn/Cotton	10	176.1	LESA	11.1	141.71	12.77	24.29

[1]SDI – Subsurface drip irrigation; MESA – Mid elevation spray application; LESA – Low elevation spray application; LEPA – Low energy precision application; LDN – Low drift nozzle; VRI – Variable rate irrigation; FUR – furrow irrigation; DL – dryland

Table A 30. Phase I summary of crop production, irrigation, and economic returns within all production sites during 2005-2013.

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

Crop		2005	2006	2007	2008	2009	2010	2011	2012	2013	Crop year average
Other											
	Hay, tons	-	-	-	0.11 (1)	4.3 (1)	2.4 (1)	-	-	-	2.3
Alfalfa											
	Hay, tons	8.3 (1)	9.18 (1)	4.90 (1)	12.0 (1)	9.95 (1)	9.0 (1)	10.6 (1)	8.4 (1)	9.5 (1)	9.1
Annual forage											
Forage sorghum											
	Hay, tons	-	-	-	-	-	-	6.8 (1)	1.9 (2)	1.7 (1)	3.5
	Seed, lbs								3,396 (1)		3,396
Precipitation, inches (including all sites)		15.0	15.4	27.3	21.7	15.7	28.9	5.3	10.0	13.2	16.9
By System		**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**
Total irrigation water (system average)		9.2 (26)	14.8 (26)	11.0 (25)	13.3 (23)	11.5 (24)	9.2 (24)	20.9 (27)	16.0 (26)	16.3 (29)	13.6
By Crop	**Irrigation**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**
Cotton	lint	8.7 (19)	14.3 (19)	11.3 (11)	12.2 (10)	11.5 (15)	7.6 (16)	23.2 (19)	14.8 (16)	18.4 (17)	13.6
Corn	grain	17.4 (3)	21.0 (4)	12.7 (4)	22.3 (8)	20.5 (4)	13.0 (10)	21.2 (4)	22.2 (7)	22.0 (9)	19.1
Corn	silage	18.0 (2)	24.0 (3)	14.3 (3)	-	24.3 (1)	15.5 (3)	36.1 (3)	22.4 (4)	27.9 (4)	22.8
Sorghum	grain	5.3 (3)	4.2(1)	6.6 (4)	12.3 (5)	9.4 (3)	6.1 (2)	27.8 (1)	19.7 (2)	16.9 (3)	12.0
Sorghum	silage	15.0 (1)	9.0 (1)	11.6 (1)	11.5 (1)	15.7 (1)	-	-	-	-	12.6
Wheat	grain	-	-	5.3 (3)	7.7 (4)	6.4 (5)	4.8 (3)	7.9 (2)	4.2 (3)	8.2 (5)	6.4
Wheat	silage	7.5 (1)	16.3 (1)	-	5.5 (1)	15.7 (1)	-	-	-	-	11.3
Oat	silage	-	4.3 (1)	-	-	15.7 (1)	-	-	-	-	10.0
Oat	hay	-	4.9 (1)	-	-	-	-	-	-	-	4.9
Triticale	silage	2.5 (1)	10.0 (1)	12.9 (1)	-	-	6.9 (2)	17.8 (2)	19.6 (1)	5.6 (1)	10.8
Barley	grain	-	-	-	12.8 (1)	-	-	-	-	-	12.8
Small grain	(grazing)	0.0 (1)	0.0 (1)	0.0 (1)	-	-	-	-	-	-	0.0
Small grain	(grains)	-	-	5.3 (3)	8.7 (5)	6.4 (5)	3.8 (4)	7.9 (2)	4.2 (3)	8.2 (5)	6.4
Small grain	(silage)	5.0 (1)	10.2 (3)	12.0 (1)	5.5 (1)	15.7 (1)	6.9 (2)	17.8 (2)	19.6 (1)	5.6 (1)	10.9
Small grain	(hay)	-	4.9 (1)	5.0 (1)	-	-	-	24 (1)	-	-	11.3
Small grain	(all uses)	2.5 (2)	5.9 (6)	6.0 (5)	8.2 (6)	8.0 (6)	3.6 (8)	13.9 (4)	7.2 (4)	7.8 (6)	7.0
Sunflower	seed	6.0 (1)	-	-	9.6 (2)	8.9 (4)	-	-	15.1 (1)	12.3 (4)	10.4
Millet	seed	11.5 (1)	10.2 (1)	8.1 (2)	9.6 (2)	-	9.9(1)	14.4 (1)	22.7 (1)	18.3 (3)	13.1
Dahl											
	hay	6.5 (2)	-	0 (1)	4.6 (1)	-	-	-	-	-	3.7
	seed	-	-	6.1 (2)	9.4 (1)	8.5 (1)	-	-	8.2 (1)	-	8.1
	grazing	0 (1)	11.4 (2)	5.5 (2)	-	5.9 (2)	2.8 (2)	8.9 (2)	22.7 (1)	5.6 (2)	7.9
Sideoats											
	seed	10.5 (2)	7.8 (2)	11.9 (2)	8.0 (3)	15.3 (3)	2.8 (2)	13.6 (2)	19.0 (2)	12.2 (2)	11.2
Bermuda											
	grazing	-	-	3.8 (1)	6.2 (1)	5.1 (1)	0 (1)	17.1 (1)	12.0 (1)	-	7.4

Crop		2005	2006	2007	2008	2009	2010	2011	2012	2013	Crop Year Average
By Crop	**Irrigation**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**	**inches applied**
Other Perennials/Annuals											
	hay	-	10.9 (3)	5.0 (1)	6.4 (2)	6.7 (2)	8.5 (1)	21.5 (2)	13.9 (2)	3.6 (1)	9.6
	grazing	1.0 (1)	3.2 (3)	4.4 (4)	7.6 (4)	3.3 (2)	7.6 (5)	16.5 (2)	4.2 (1)	5.7 (2)	5.9
Perennial grasses (grouped)											
	seed	10.5 (2)	7.8 (2)	9.0 (5)	8.6 (4)	13.6 (4)	2.8 (2)	13.6 (2)	15.4 (3)	12.2 (2)	10.4
	grazing	1.0 (3)	8.8 (4)	4.9 (4)	5.2 (3)	4.9 (4)	2.3 (4)	12.4 (3)	13.0 (2)	3.7 (3)	6.2
	hay	8.5 (4)	0 (2)	0 (4)	1.9 (4)	0 (3)	0 (2)	0 (2)	0 (2)	0 (2)	1.2
	all uses	6.7 (6)	6.6 (6)	5.2 (7)	5.2 (7)	6.5 (7)	1.9 (6)	10.0 (5)	10.6 (5)	5.1 (5)	6.4
Alfalfa											
	all uses	10.3 (1)	34.5 (1)	10.6 (1)	15.6 (1)	18.6 (1)	15.6 (1)	44.1 (1)	28.3 (1)	31.6 (1)	23.2
Income and Expense, $/system acre											
Projected returns		$660.53	$773.82	$840.02	$890.37	$745.82	$961.87	$951.66	$1,063.98	$1,171.08	$895.46
Costs											
Total variable costs (all sites)		$444.88	$504.91	$498.48	$548.53	$507.69	$537.14	$658.68	$578.28	$709.95	$554.28
Total fixed costs (all sites)		$77.57	$81.81	$81.77	$111.98	$110.65	$153.55	$149.98	$135.53	$137.19	$115.56
Total all costs (all sites)		$522.45	$586.72	$580.25	$660.51	$618.34	$690.69	$808.67	$713.80	$846.87	$669.81
Gross Margin											
Per system acre (all sites)		$215.66	$268.91	$341.54	$341.84	$238.13	$424.74	$313.83	$469.92	$454.90	$341.05
Per acre-inch irrigation water (irrigated only)		$33.51	$22.53	$34.01	$31.17	$22.95	$71.50	$24.76	$32.72	$33.45	$34.07
Net returns over all costs											
Per system acre (all sites)		$138.09	$187.10	$259.77	$229.86	$127.48	$271.19	$163.85	$334.39	$317.98	$225.52
Per acre-inch of irrigation water (irrigated only)		$21.58	$15.88	$24.99	$20.89	$9.99	$43.71	$10.16	$22.89	$23.70	$21.53
Per pound of nitrogen (all sites)		$1.62	$0.81	$2.34	$1.48	$0.87	$2.40	$1.92	$2.51	$2.78	$1.86

Terminated Site Data (2005-2016)

Site 1 – Terminated after 2007

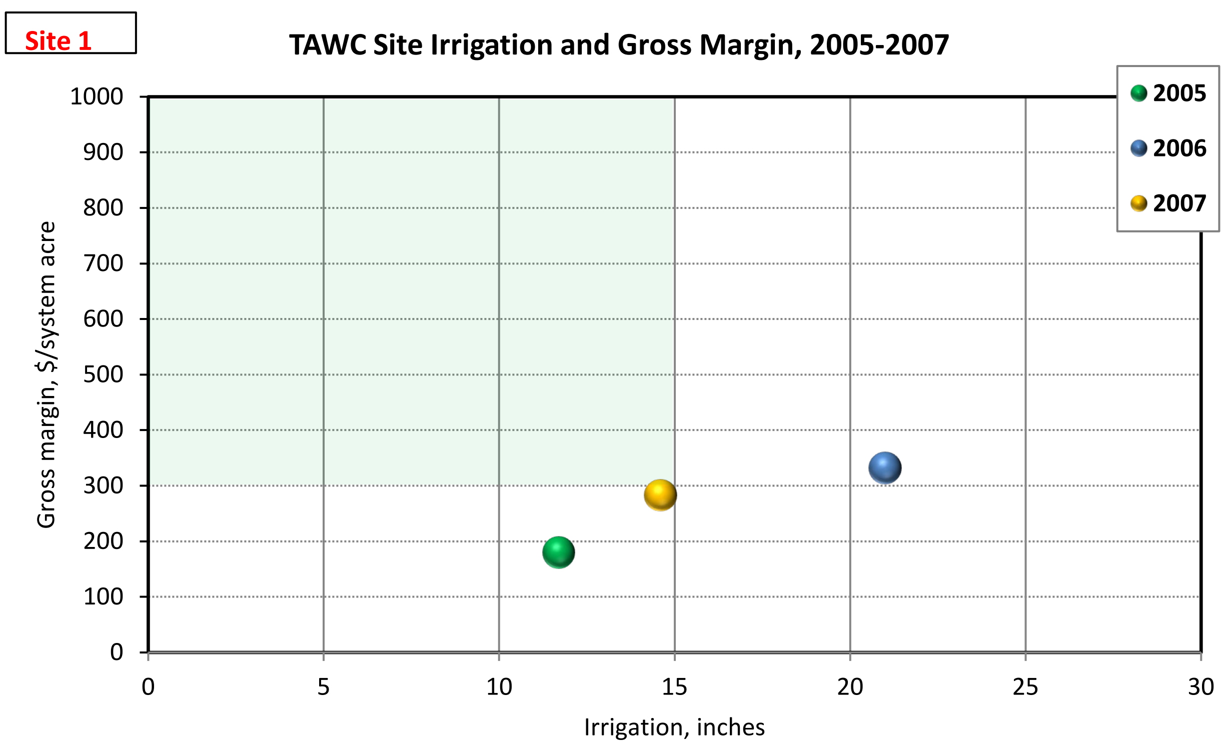
Site acres: 135.2

Soil types:
PuA-Pullman clay loam, 0 to 1%

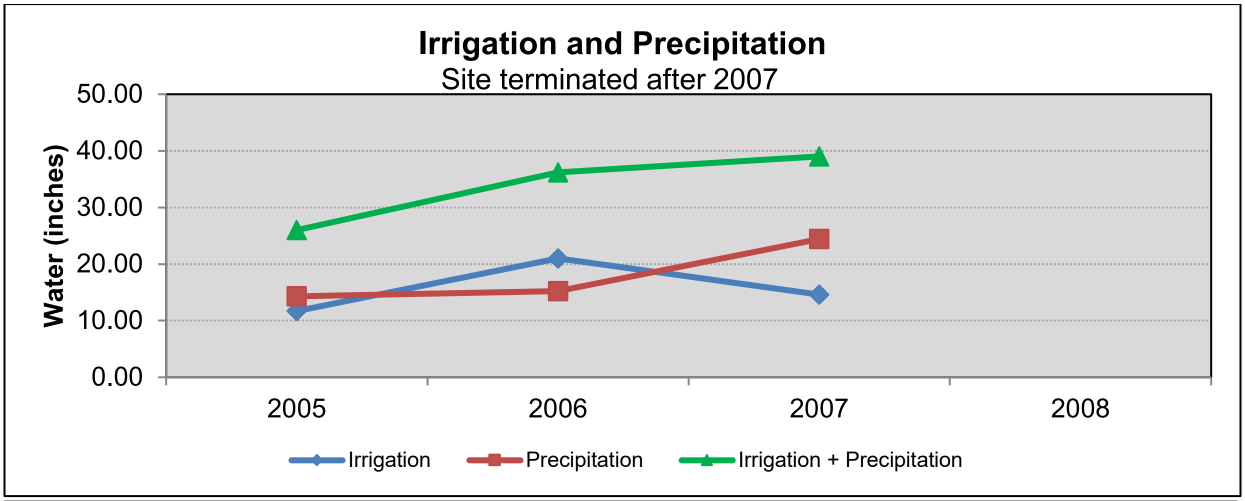
Irrigation:
Sub-Surface Drip (SDI) 850 gpm

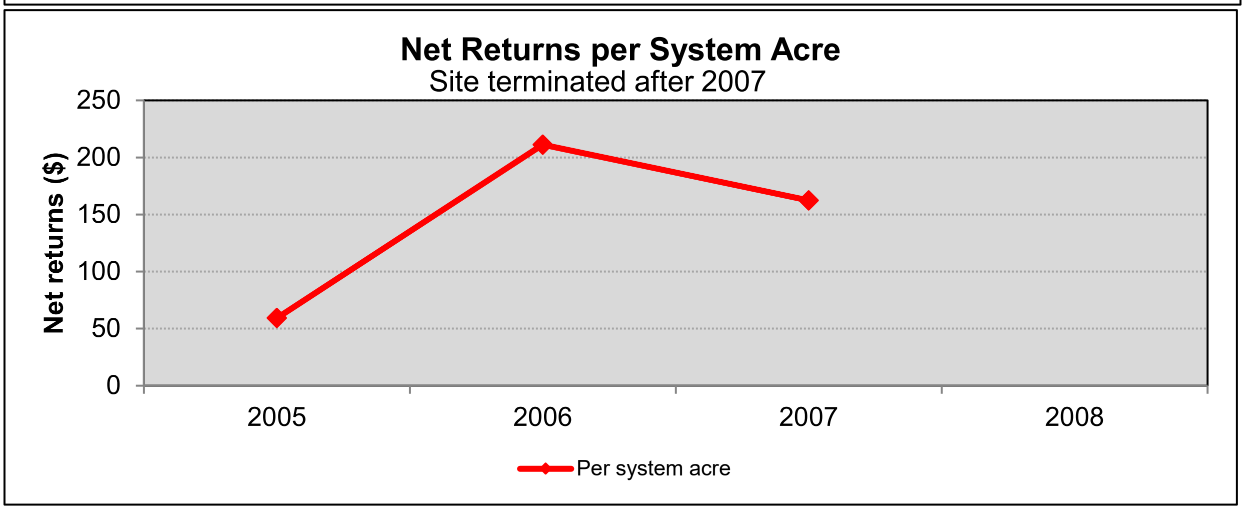
Number of wells: 2

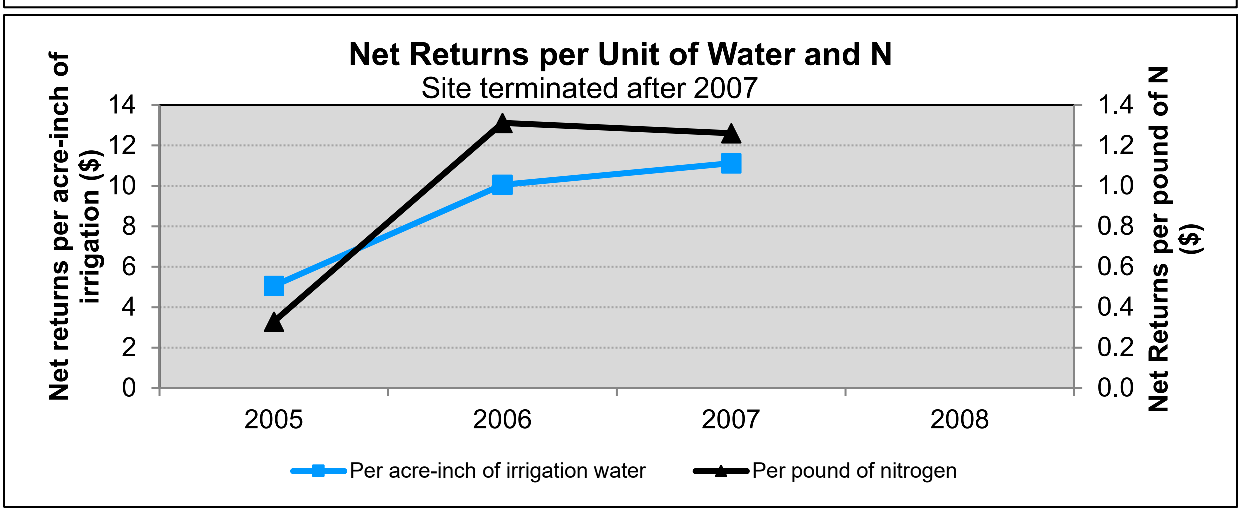
Fuel Source: 1 Natural gas,
1 Electric



Site 1


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


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


Net Returns per Unit of Water and N
Site terminated after 2007
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
2005
2006
2007
2008
Per acre-inch of irrigation water
Per pound of nitrogen

SITE 2 – TERMINATED AFTER 2013

Description:

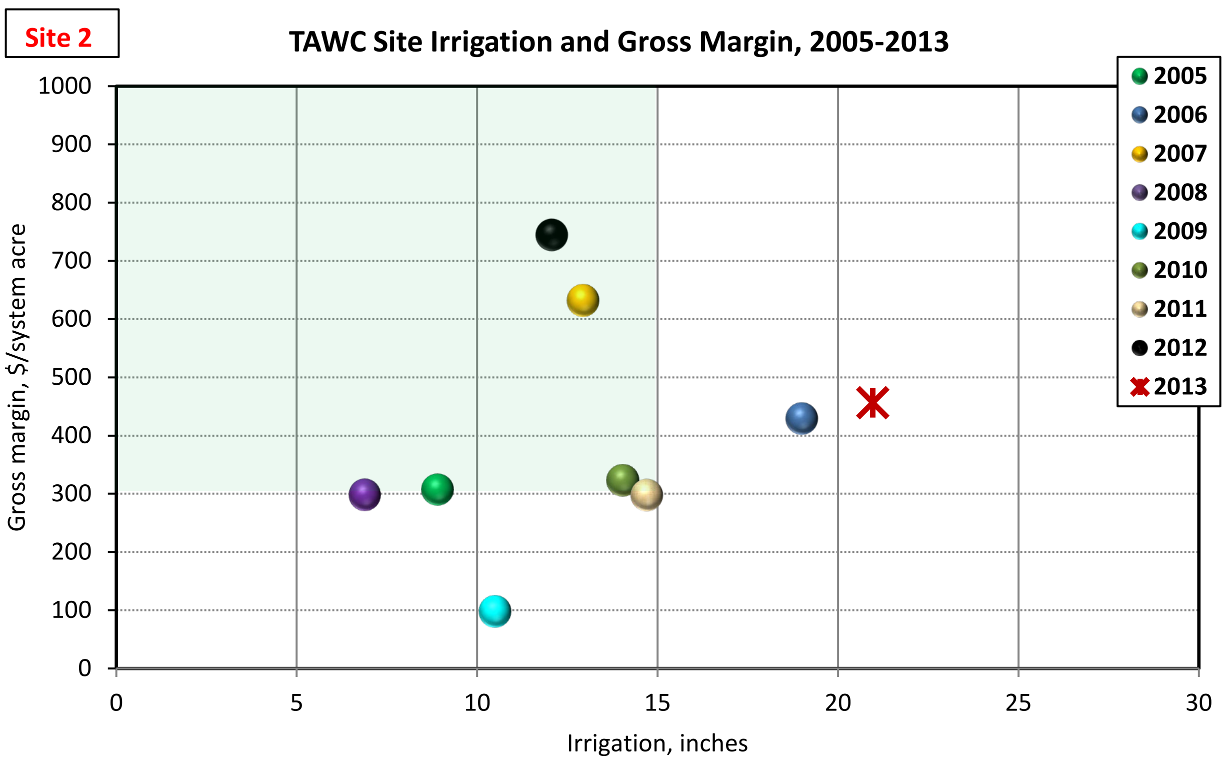
Site acres: 60

Soil types:
PuA-Pullman clay loam, 0 to 1%
OcB-Olton clay loam, 1 to 3%

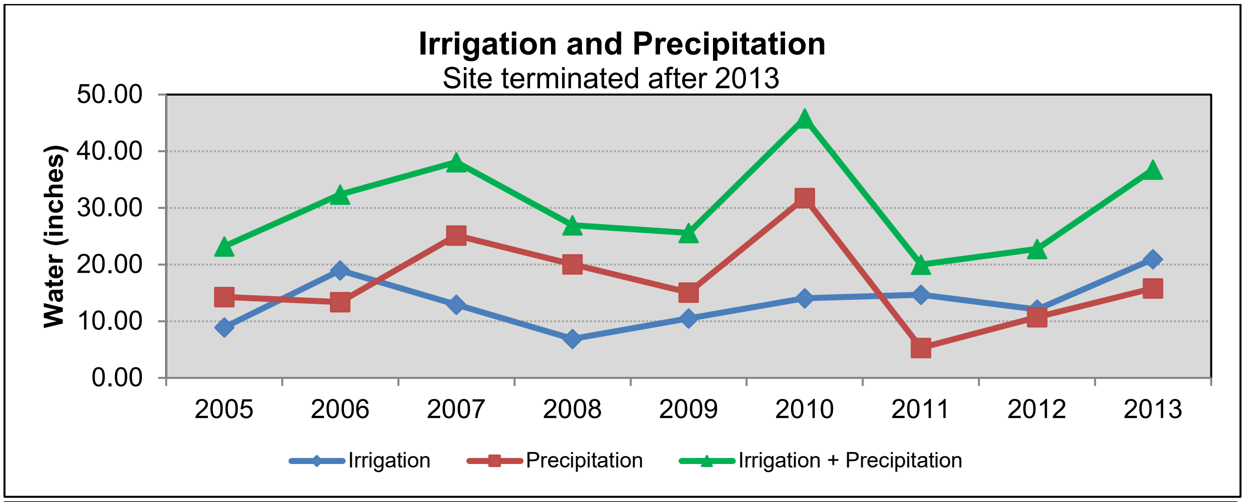
Irrigation:
Sub-Surface Drip (SDI) 3600 gpm

Number of wells: 2

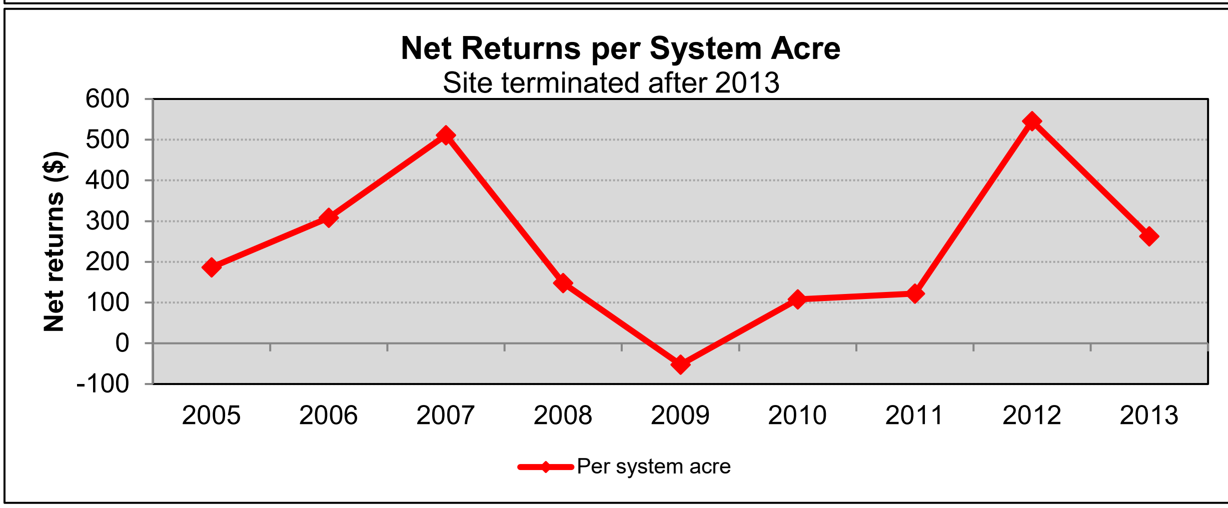
Fuel Source: Electric



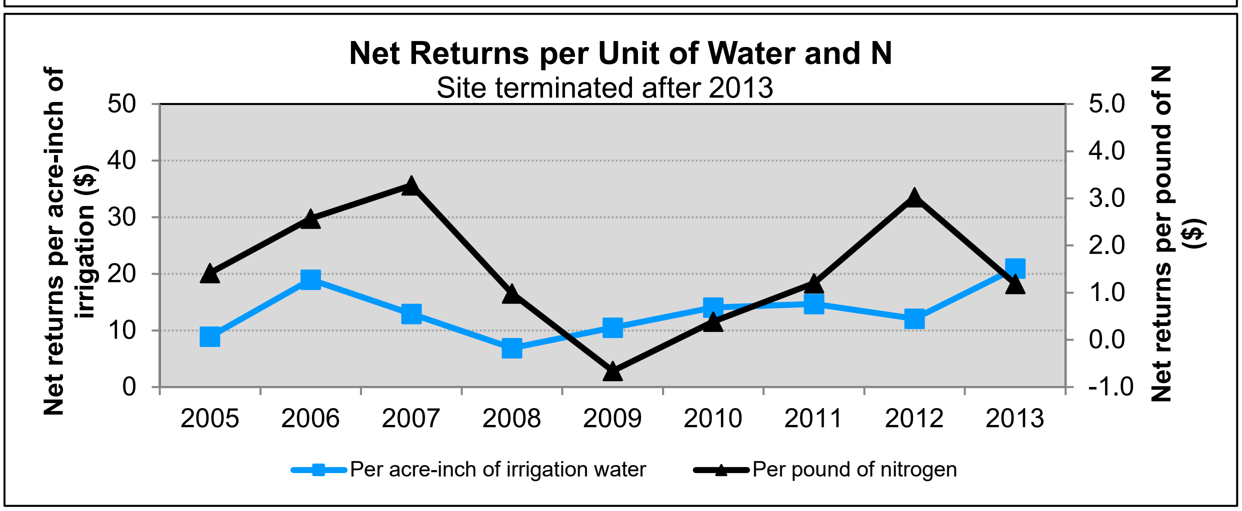
Site 2



Irrigation and Precipitation
Site terminated after 2013
Water (inches)
50.00
40.00
30.00
20.00
10.00
0.00
2005
2006
2007
2008
2009
2010
2011
2012
2013
Irrigation
Precipitation
Irrigation + Precipitation

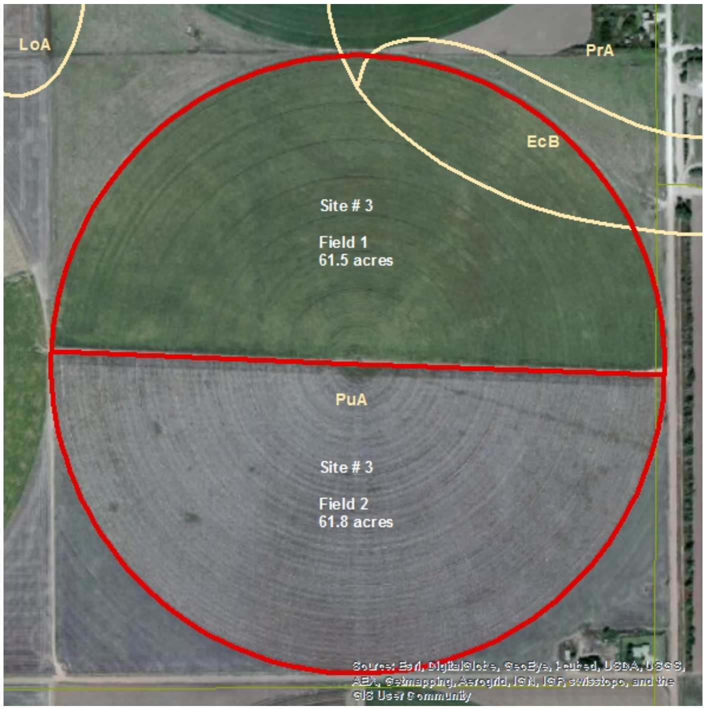


Net Returns per System Acre
Site terminated after 2013
Net returns ($)
600
500
400
300
200
100
0
-100
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per system acre



Net Returns per Unit of Water and N
Site terminated after 2013
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
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen

SITE 3 – TERMINATED AFTER 2013



Description:

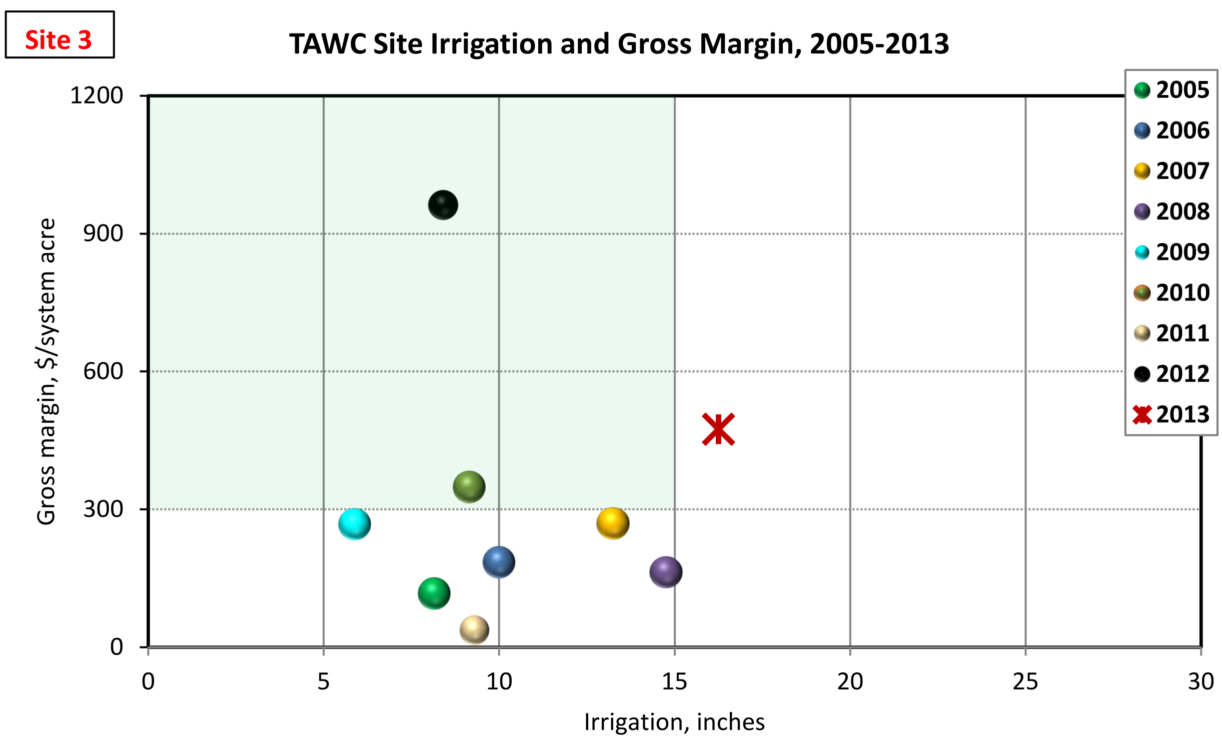
Site acres: 123.3

Soil types:
PuA-Pullman clay loam, 0 to 1%
EcB-Estacado clay loam; 1 to 3%

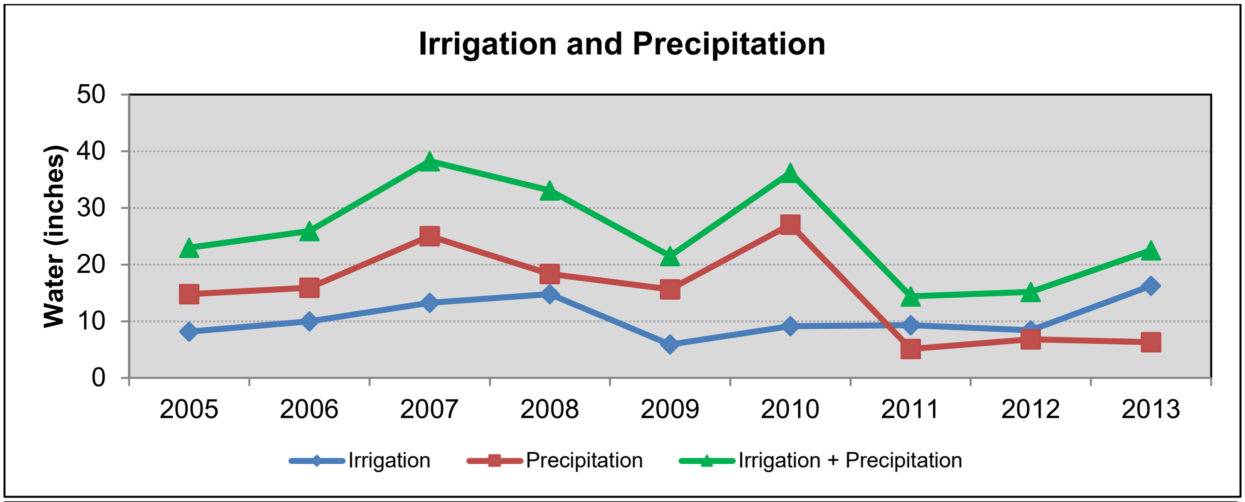
Irrigation:
Center Pivot (MESA) 450 gpm

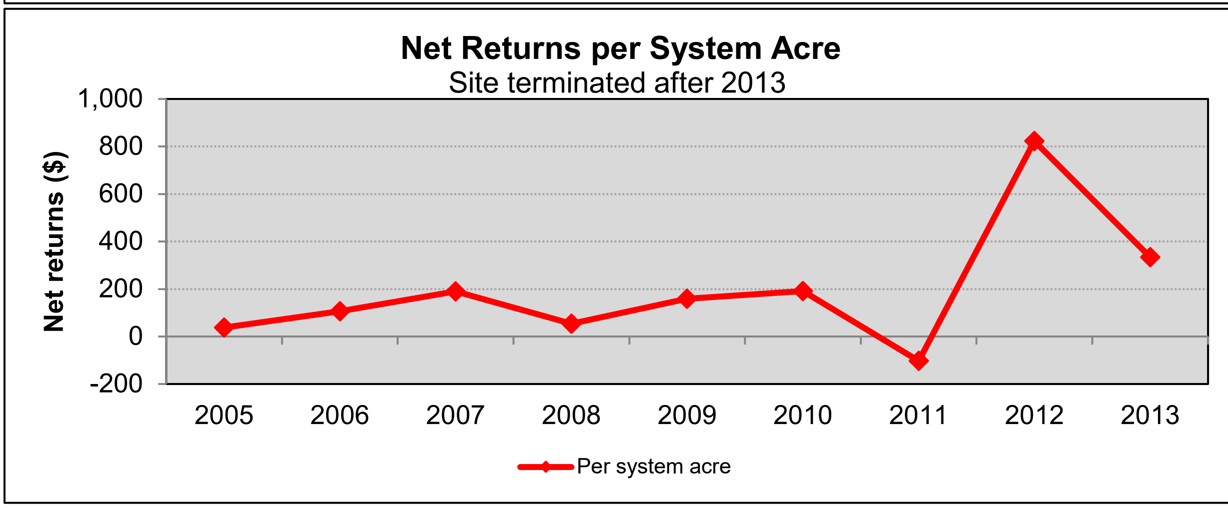
Number of wells: 2

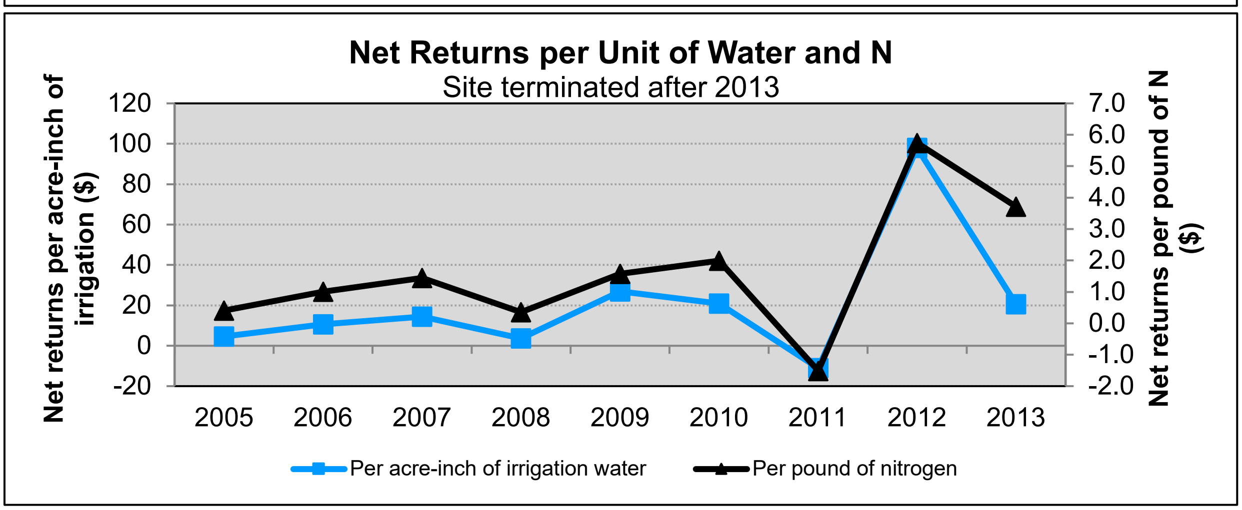
Fuel Source: 1 Natural Gas,
1 Electric



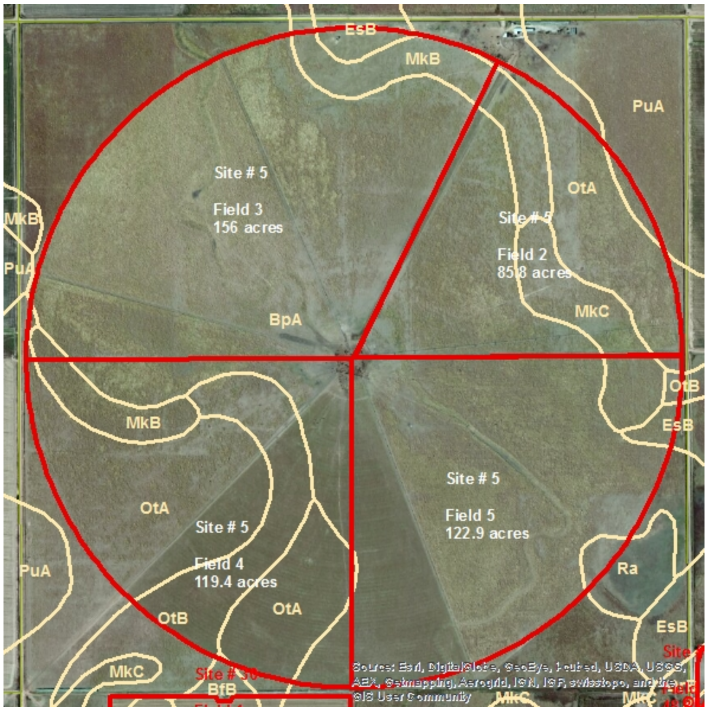
Site 3


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


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


Net Returns per Unit of Water and N
Site terminated after 2013
Net returns per acre-inch of irrigation ($)
120
100
80
60
40
20
0
-20
Net returns per pound of N ($)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
2005
2006
2007
2008
2009
2010
2011
2012
2013
Per acre-inch of irrigation water
Per pound of nitrogen

SITE 5 -TERMINATED AFTER 2015



Description:

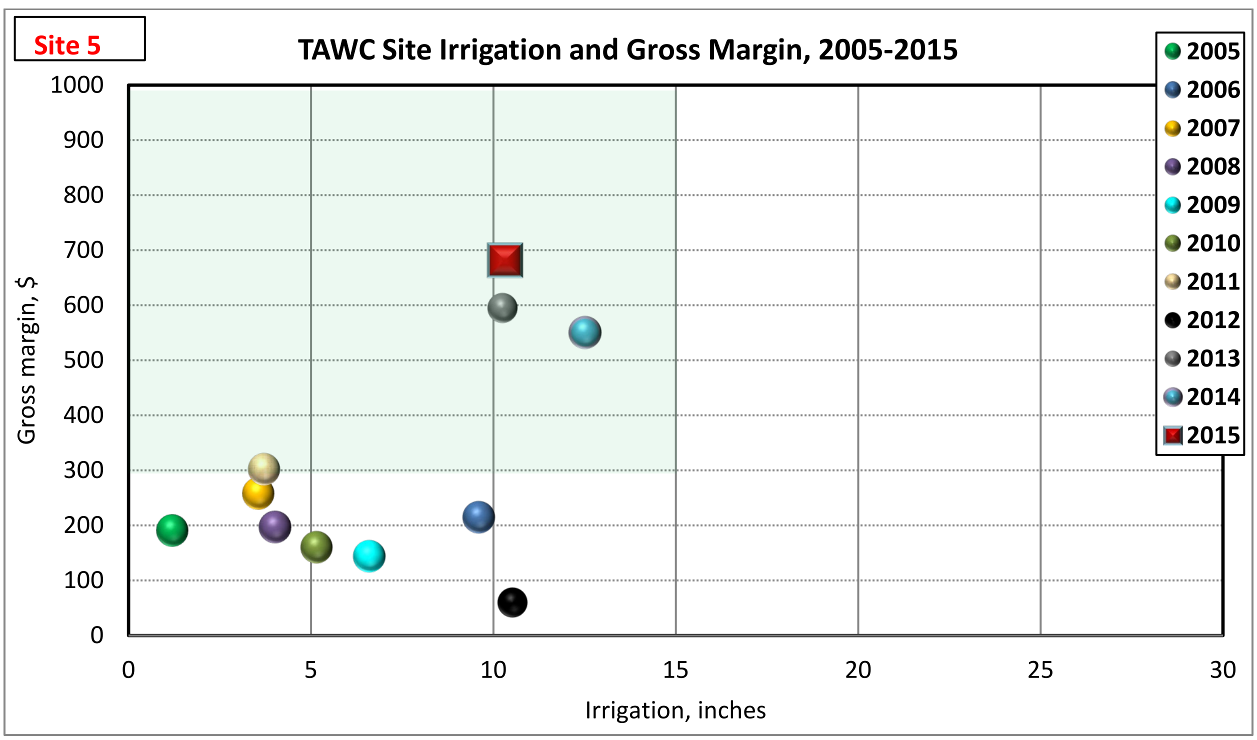
Site acres: 484.1

Soil types:
- BpA-Bippus loam, 0 to 1%
- MkB/MkC-Mansker loam, 0 to 3 and 3 to 5%
- OtA/OtB-Olton loam, 0 to 1% and 1 to 3%

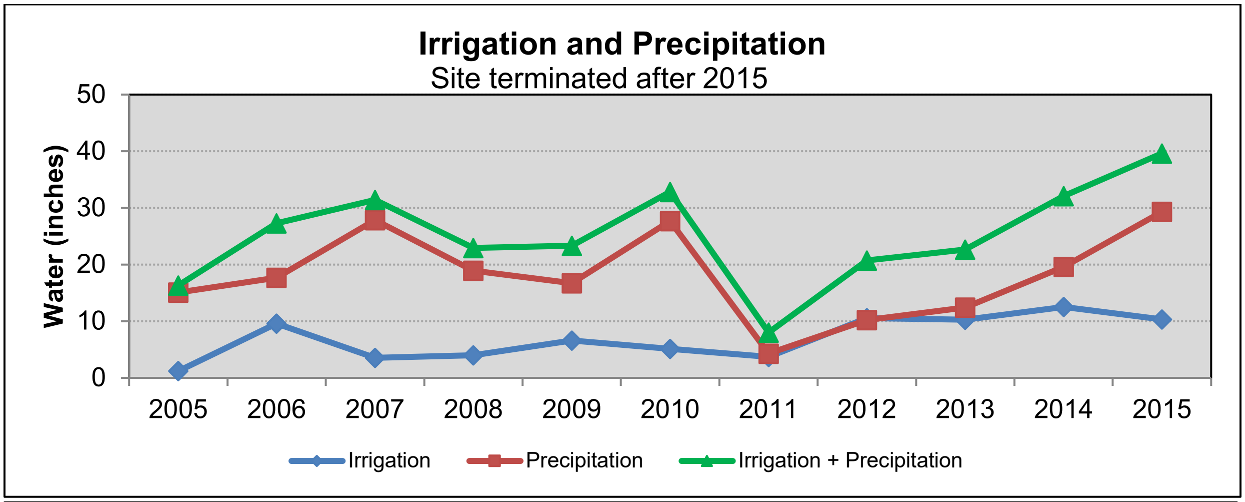
Irrigation:
- Center Pivot (MESA) 1100gpm

Number of wells: 4

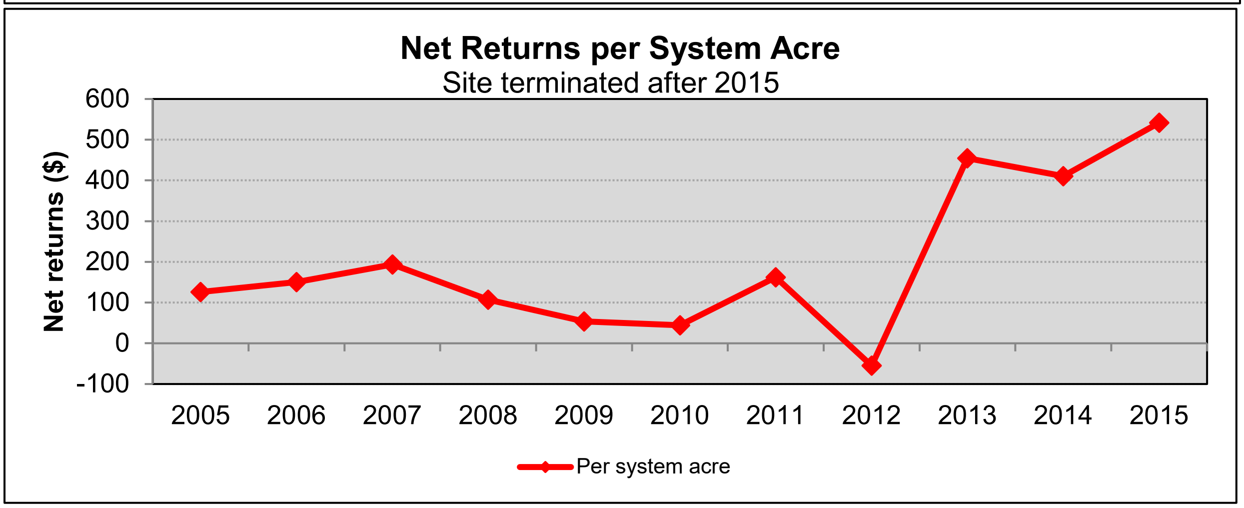
Fuel Source: Electric



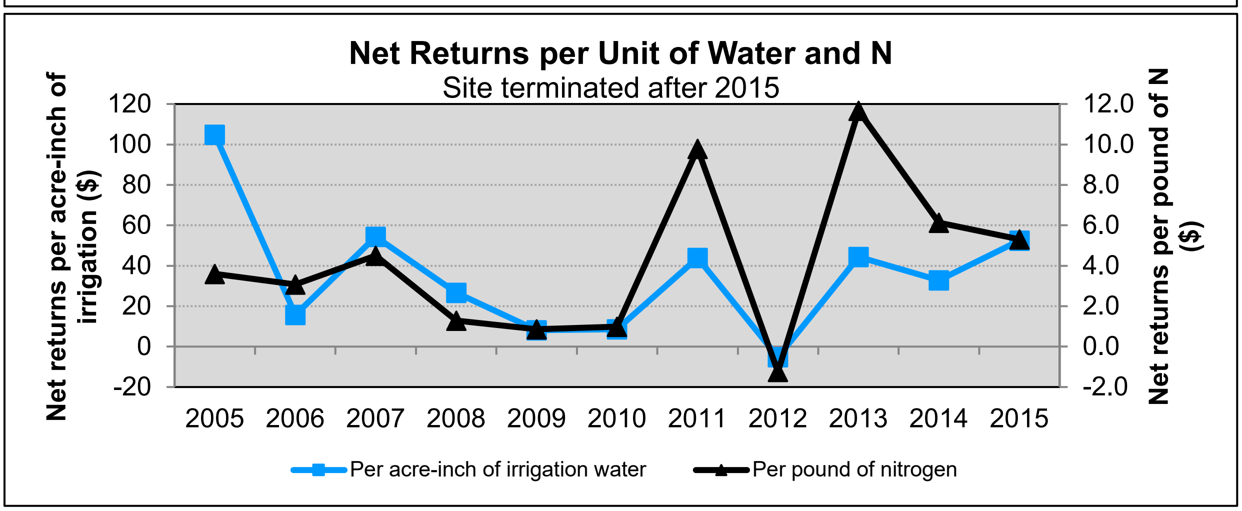
Site 5



Irrigation and Precipitation
Site terminated after 2015
Water (inches)
0
10
20
30
40
50
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Site terminated after 2015
Net returns ($)
-100
0
100
200
300
400
500
600
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Per system acre



Net Returns per Unit of Water and N
Site terminated after 2015
Net returns per acre-inch of irrigation ($)
-20
0
20
40
60
80
100
120
Net returns per pound of N ($)
-2.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Per acre-inch of irrigation water
Per pound of nitrogen

SITE 6 - TERMINATED AFTER 2016

Description:

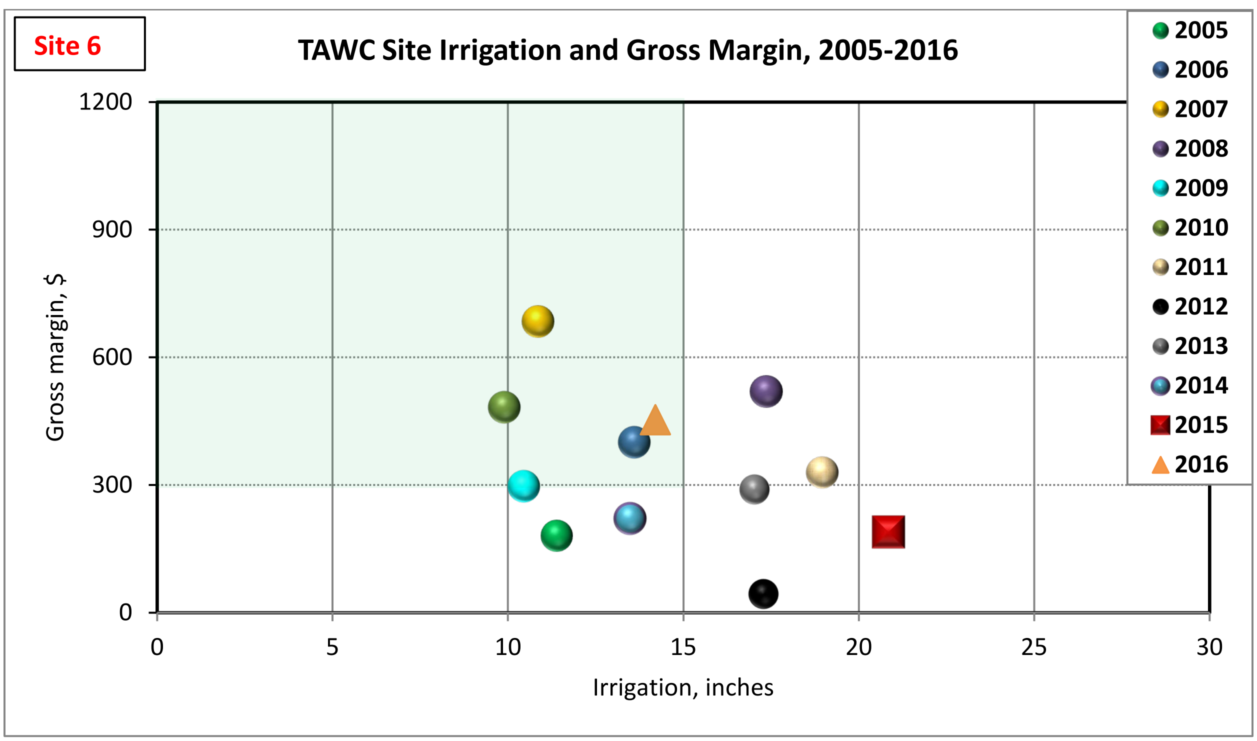
Site acres: 122.7

Soil types:
- PuA-Pullman clay loam, 0 to 1%
- PuB-Pullman clay loam, 1 to 3%
- LoA-Lofton clay loam, 0 to 1%

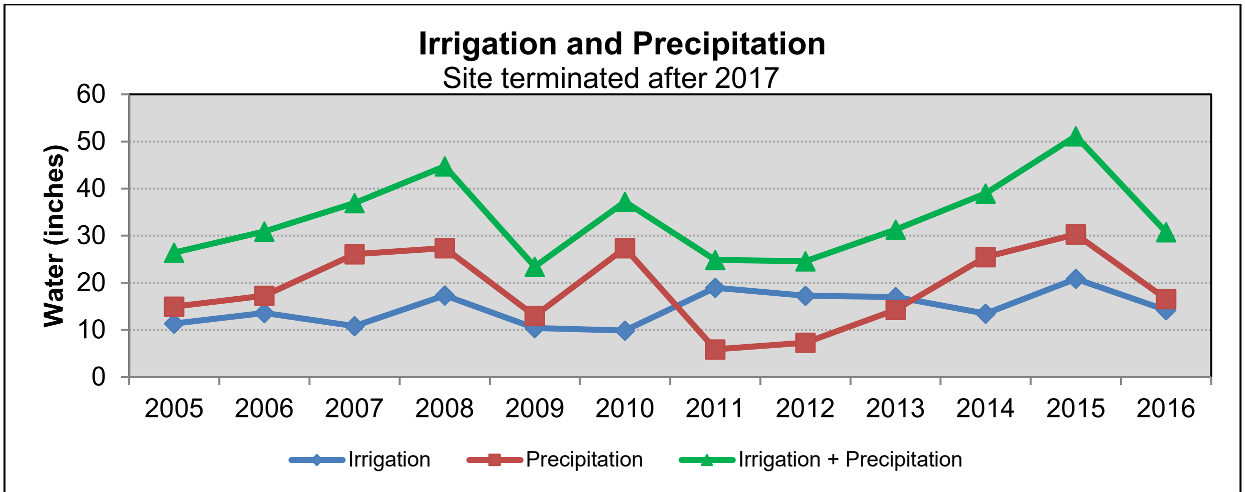
Irrigation:
- Center Pivot (LESA) 500 gpm

Number of wells: 4

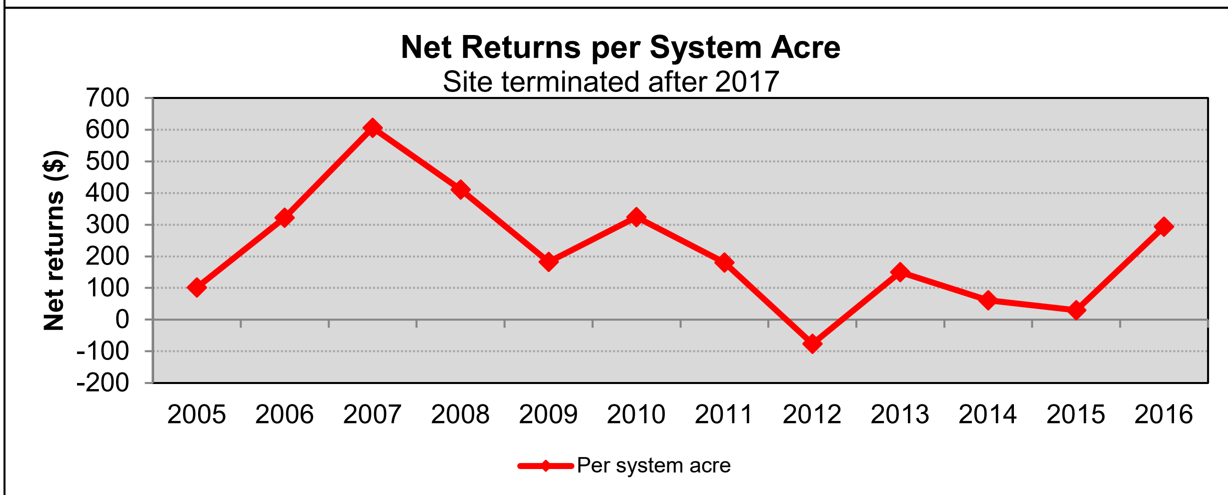
Fuel Source: Natural gas



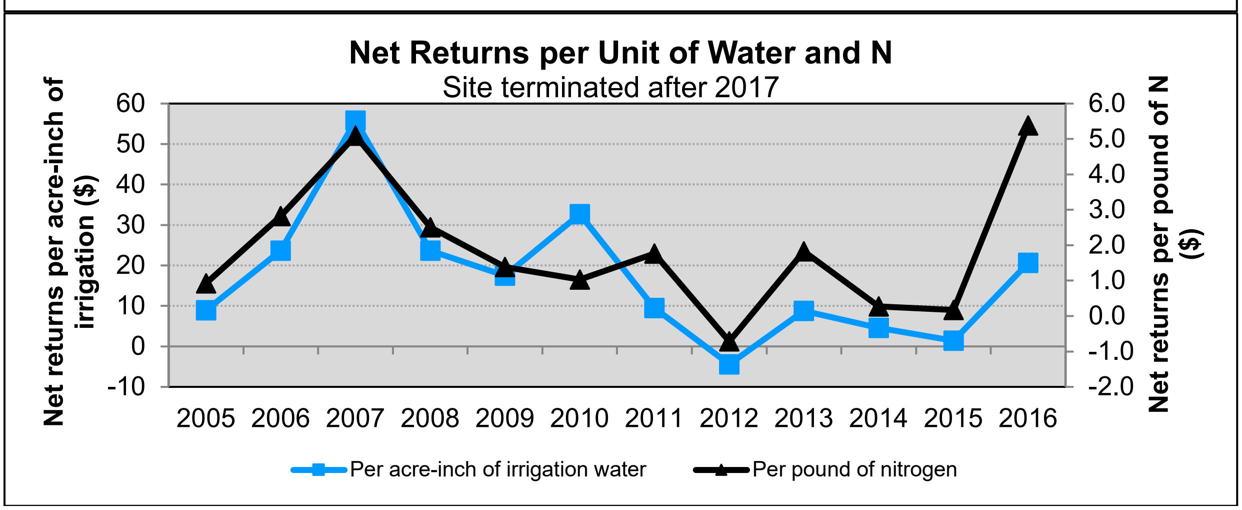
Site 6



Irrigation and Precipitation
Site terminated after 2017
Water (inches)
0
10
20
30
40
50
60
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Irrigation
Precipitation
Irrigation + Precipitation

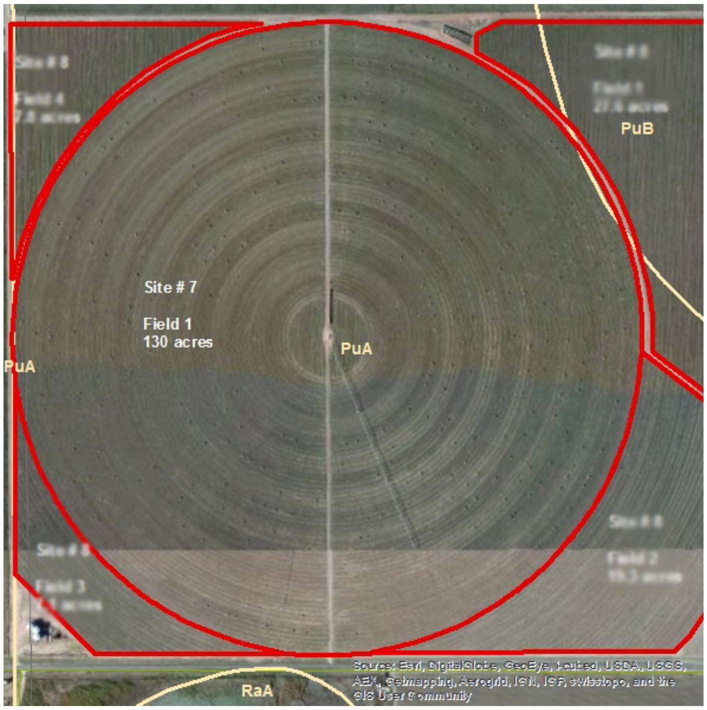


Net Returns per System Acre
Site terminated after 2017
Net returns ($)
-200
-100
0
100
200
300
400
500
600
700
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Per system acre



Net Returns per Unit of Water and N
Site terminated after 2017
Net returns per acre-inch of irrigation ($)
-10
0
10
20
30
40
50
60
Net returns per pound of N ($)
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Per acre-inch of irrigation water
Per pound of nitrogen

SITE 7 – TERMINATED AFTER 2014



Description:

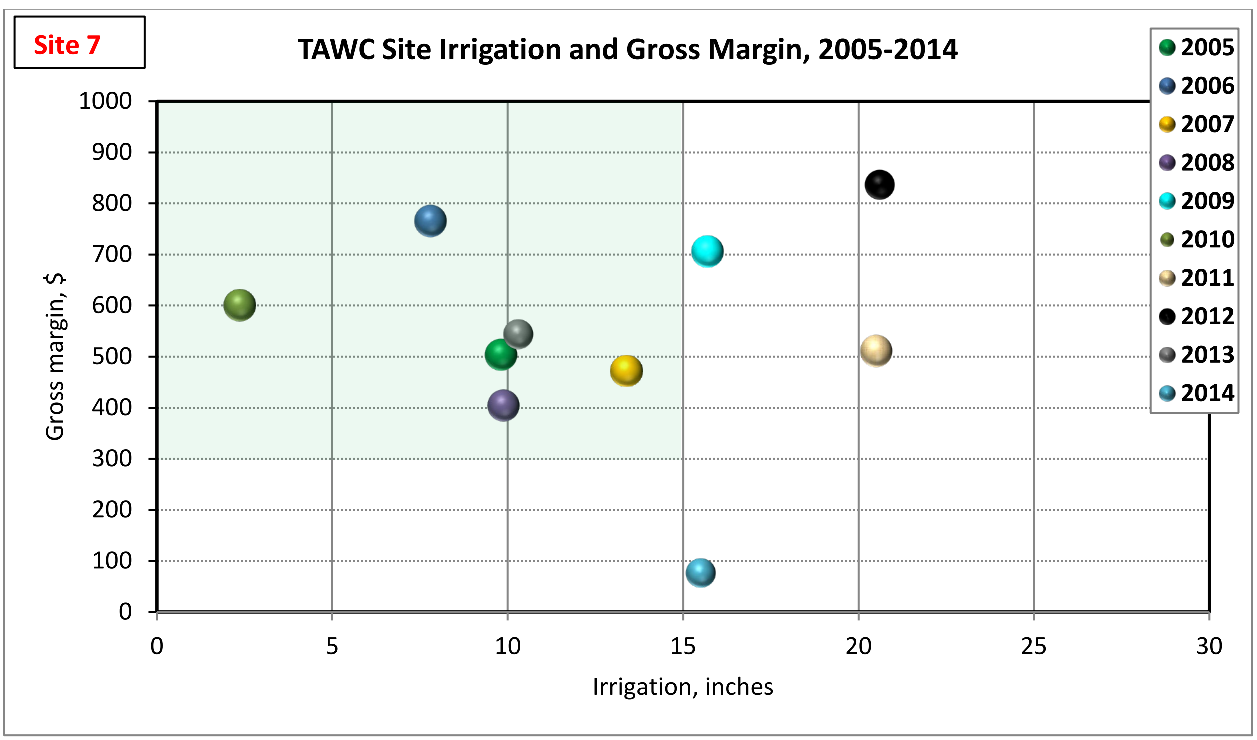
Site acres: 130

Soil types:
PuA-Pullman clay loam, 0 to 1%
PuB-Pullman clay loam, 1 to 3%

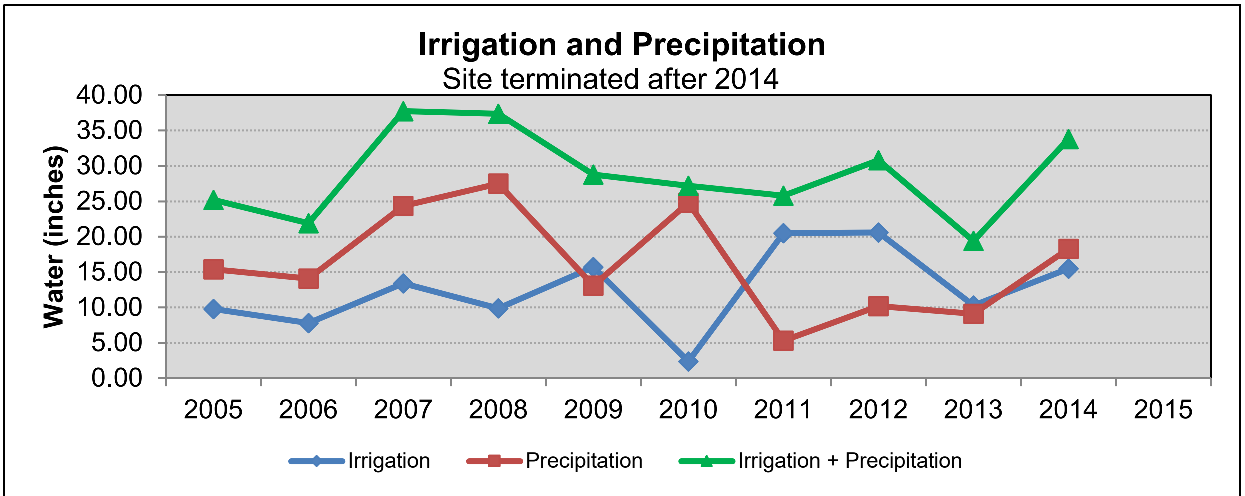
Irrigation:
Center Pivot (LESA) 500 gpm

Number of wells: 4

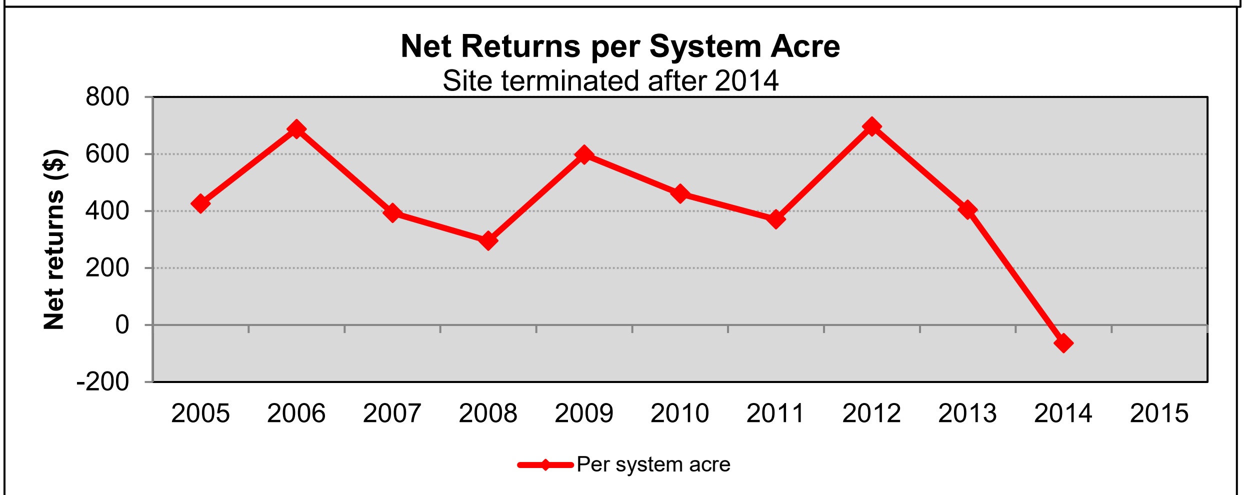
Fuel Source: Electric



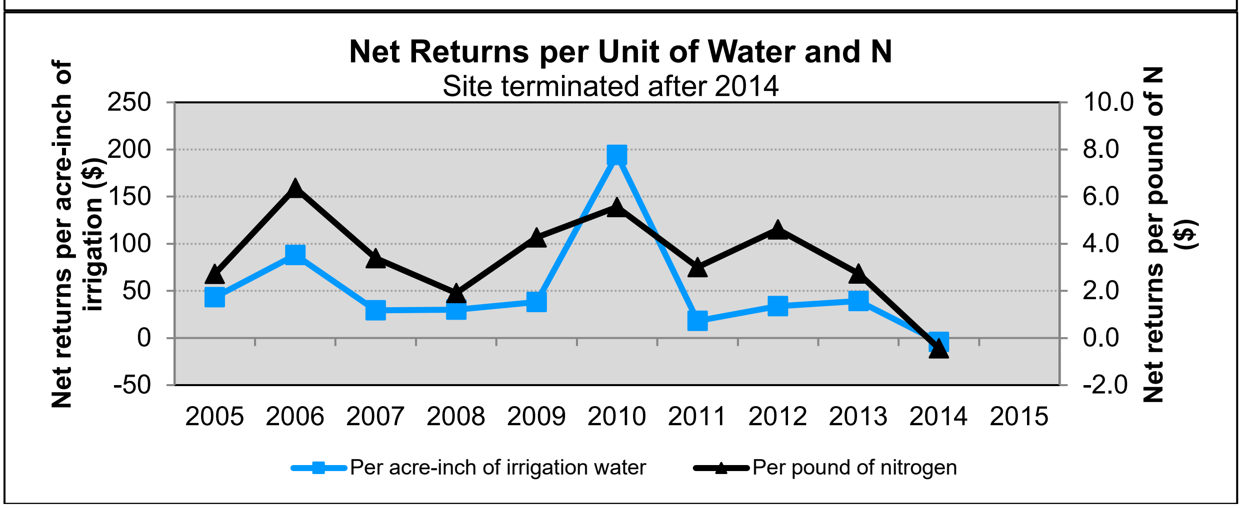
Site 7



Irrigation and Precipitation
Site terminated after 2014
Water (inches)
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Irrigation
Precipitation
Irrigation + Precipitation

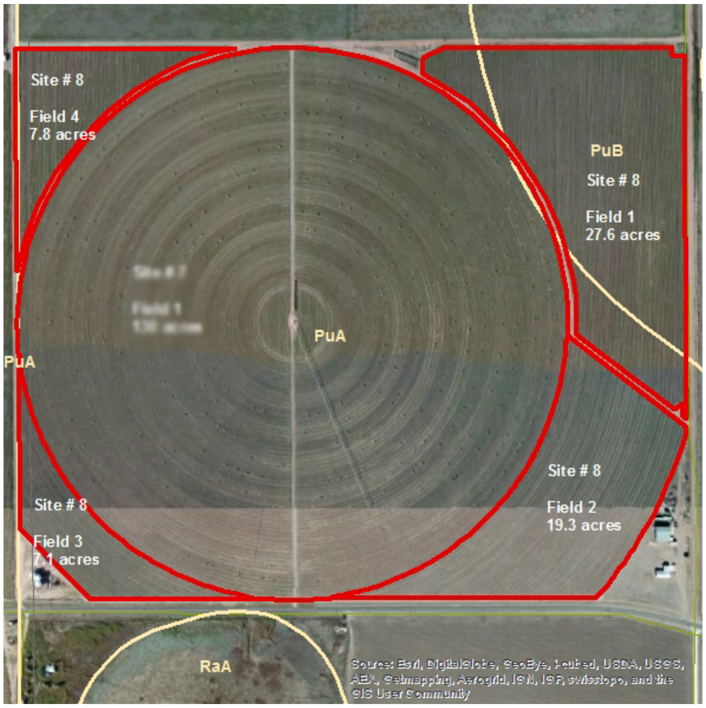


Net Returns per System Acre
Site terminated after 2014
Net returns ($)
800
600
400
200
0
-200
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Per system acre



Net Returns per Unit of Water and N
Site terminated after 2014
Net returns per acre-inch of irrigation ($)
250
200
150
100
50
0
-50
Net returns per pound of N ($)
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Per acre-inch of irrigation water
Per pound of nitrogen

SITE 8 – TERMINATED AFTER 2014



Description:

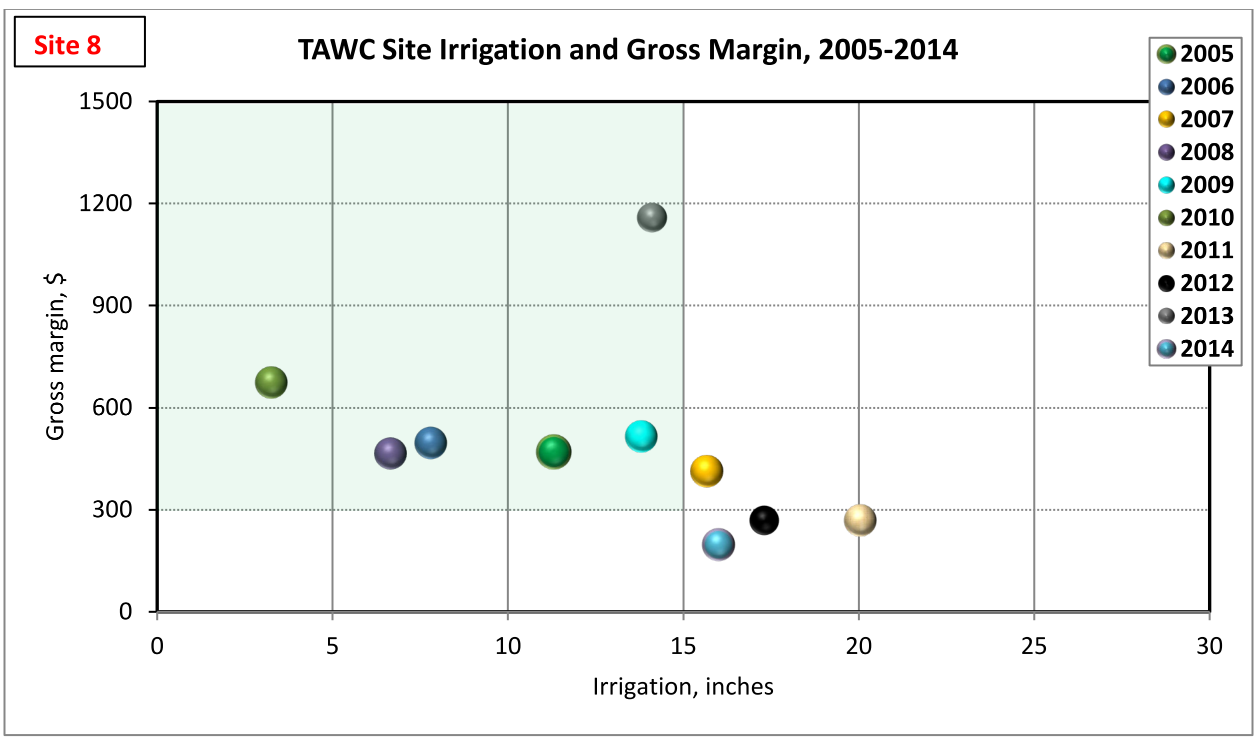
Site acres: 61.8

Soil types:
PuA-Pullman clay loam, 0 to 1%
PuB-Pullman clay loam, 1 to 3%

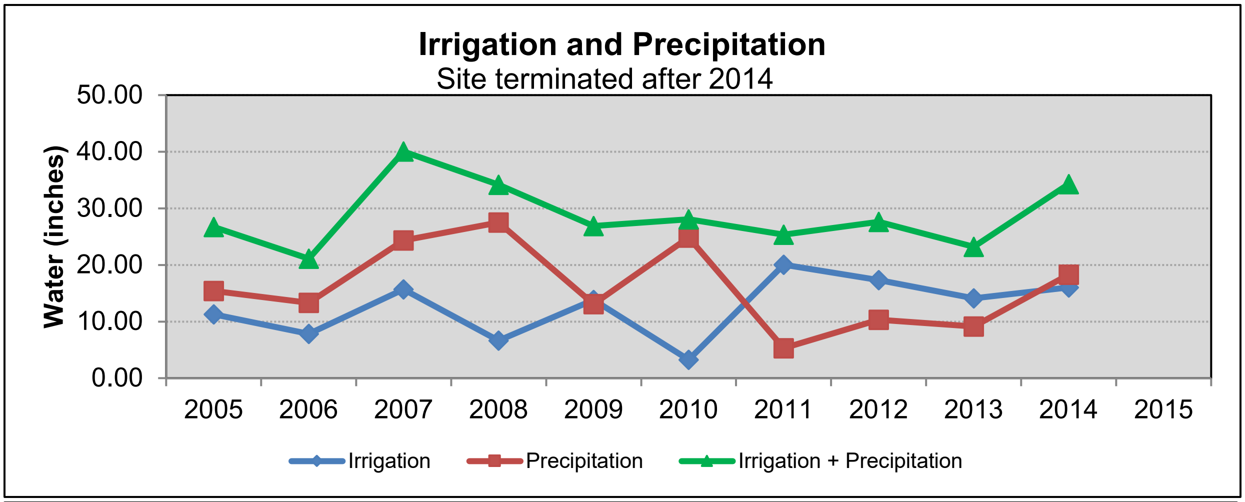
Irrigation:
Sub-surface drip (SDI) 360 gpm

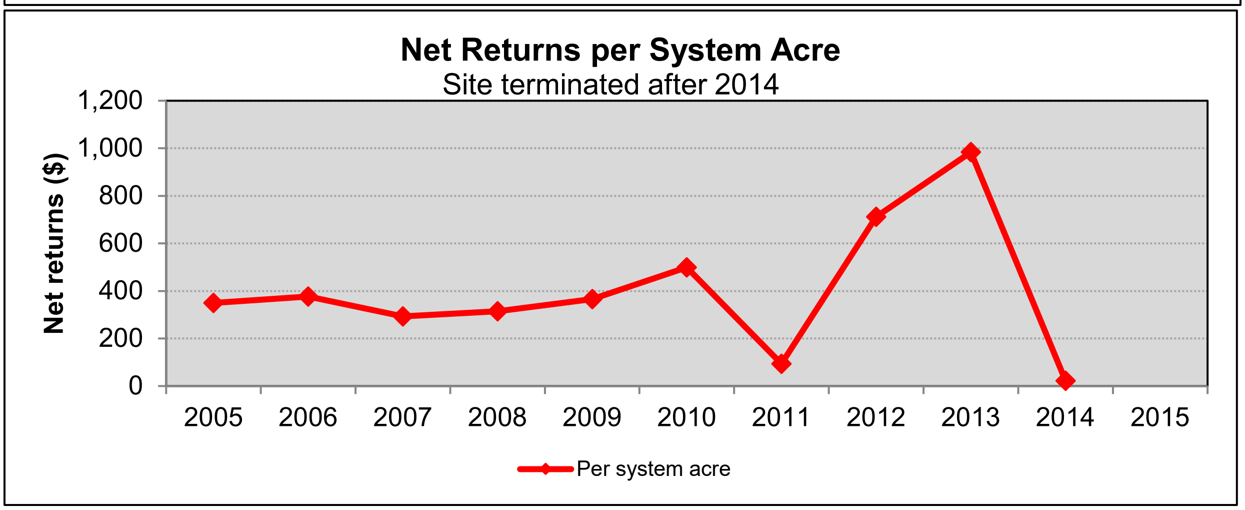
Number of wells: 4

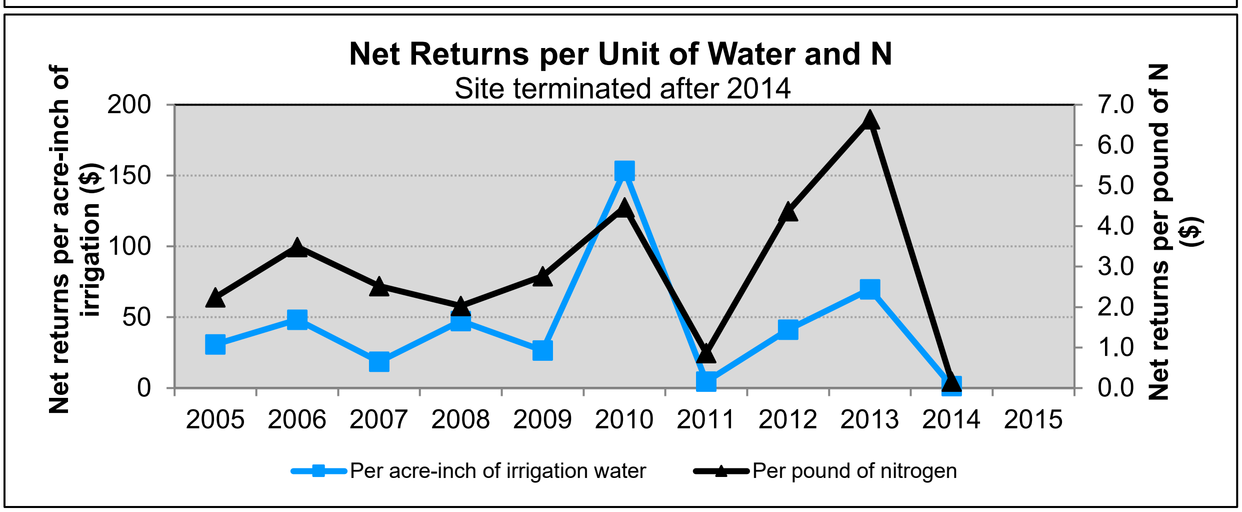
Fuel Source: Electric



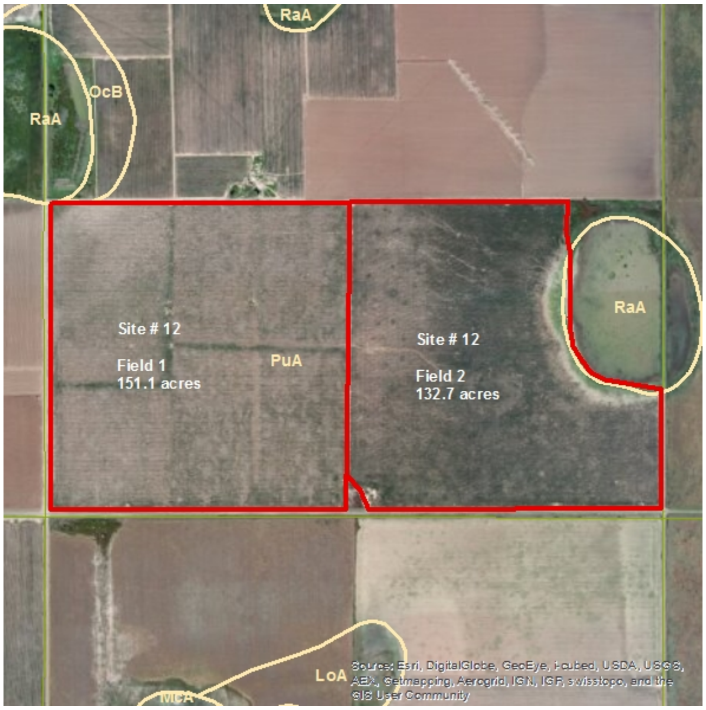
Site 8


Irrigation and Precipitation
Site terminated after 2014
Water (inches)
50.00
40.00
30.00
20.00
10.00
0.00
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Site terminated after 2014
Net returns ($)
1,200
1,000
800
600
400
200
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Per system acre


Net Returns per Unit of Water and N
Site terminated after 2014
Net returns per acre-inch of irrigation ($)
200
150
100
50
0
Net returns per pound of N ($)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Per acre-inch of irrigation water
Per pound of nitrogen

Site 12 – Terminated after 2013



Description:

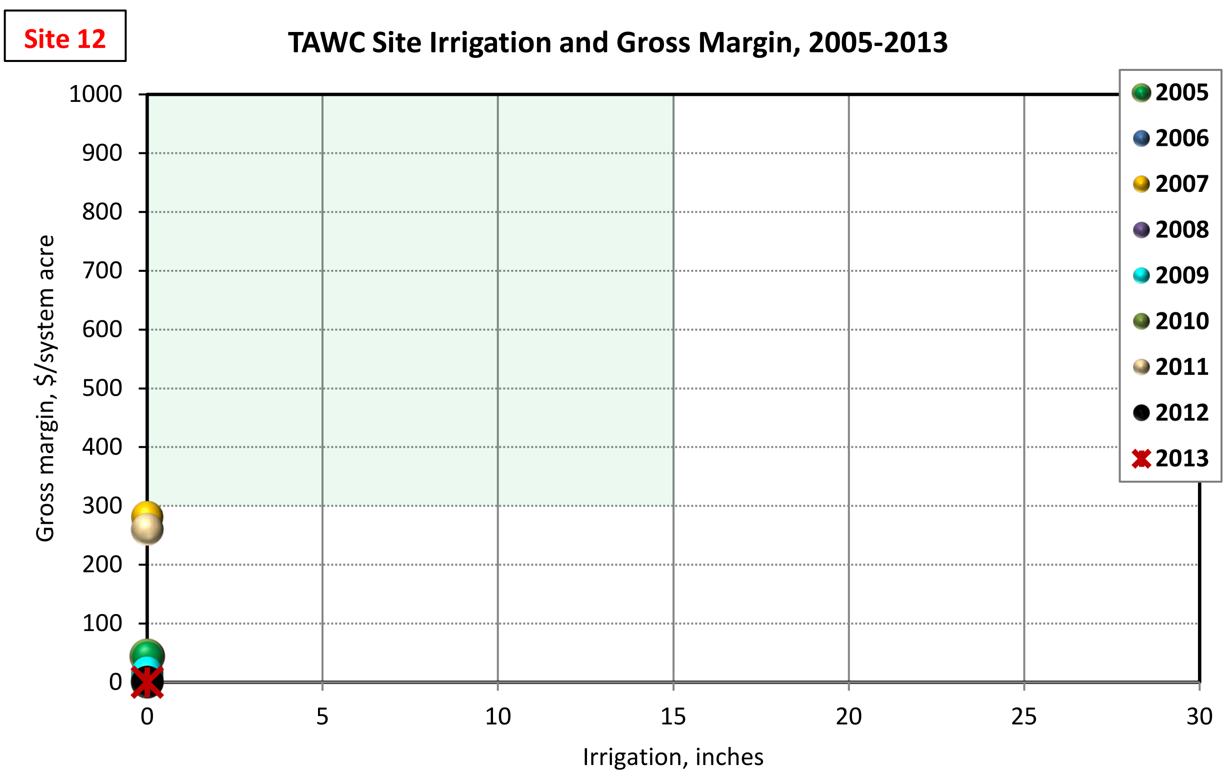
Site acres: 283.8

Soil types:
PuA-Pullman clay loam, 0 to 1%

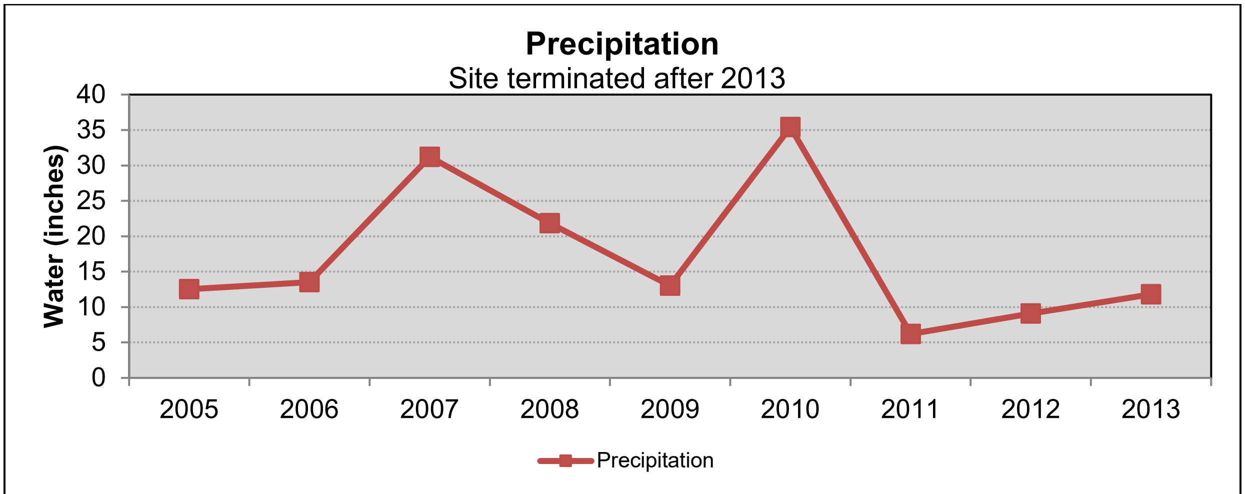
Irrigation:
Dryland (DL) na gpm

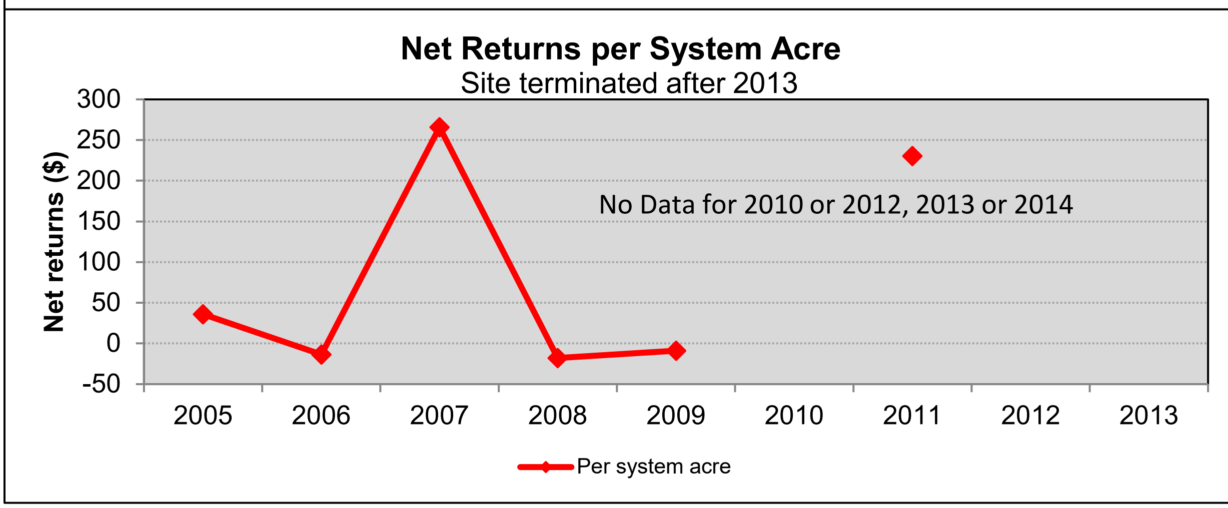
Number of wells: na

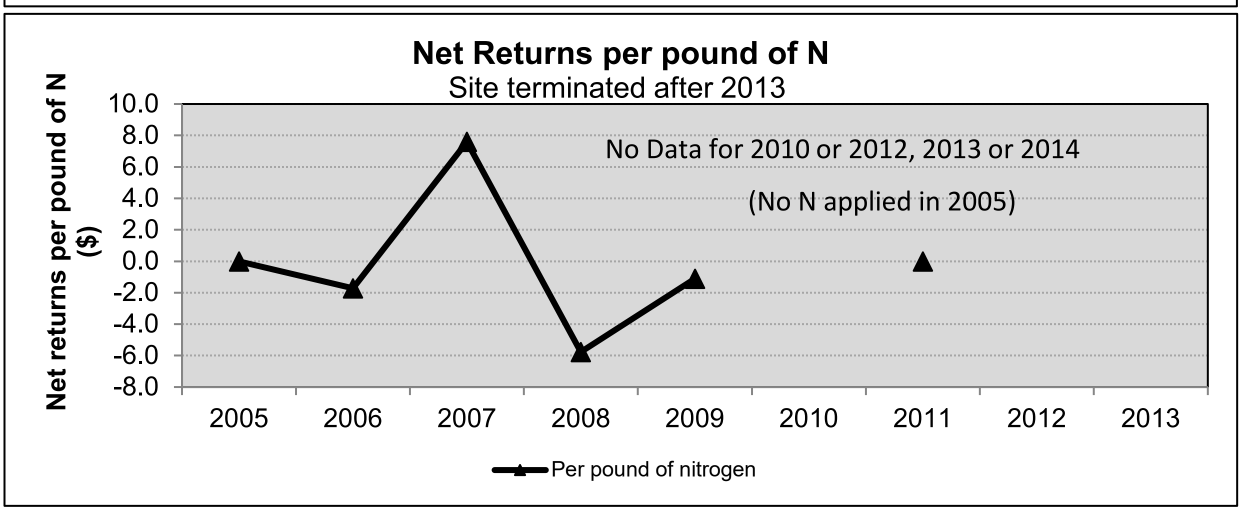
Fuel Source: na



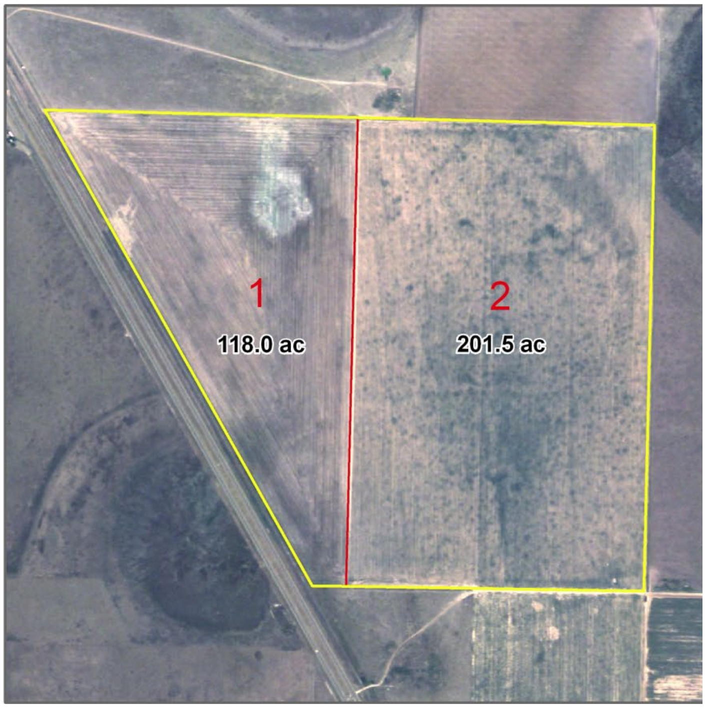
Site 12 – Dryland Site





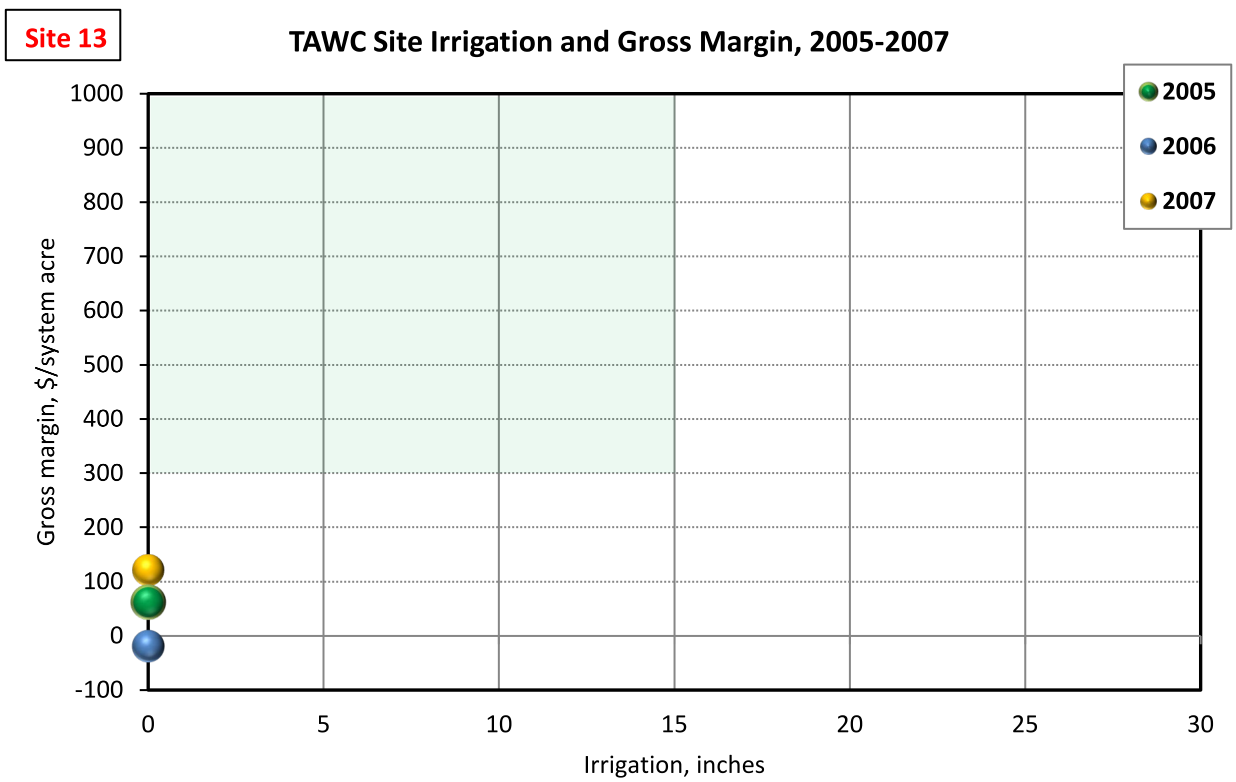


SITE 13 – TERMINATED AFTER 2007

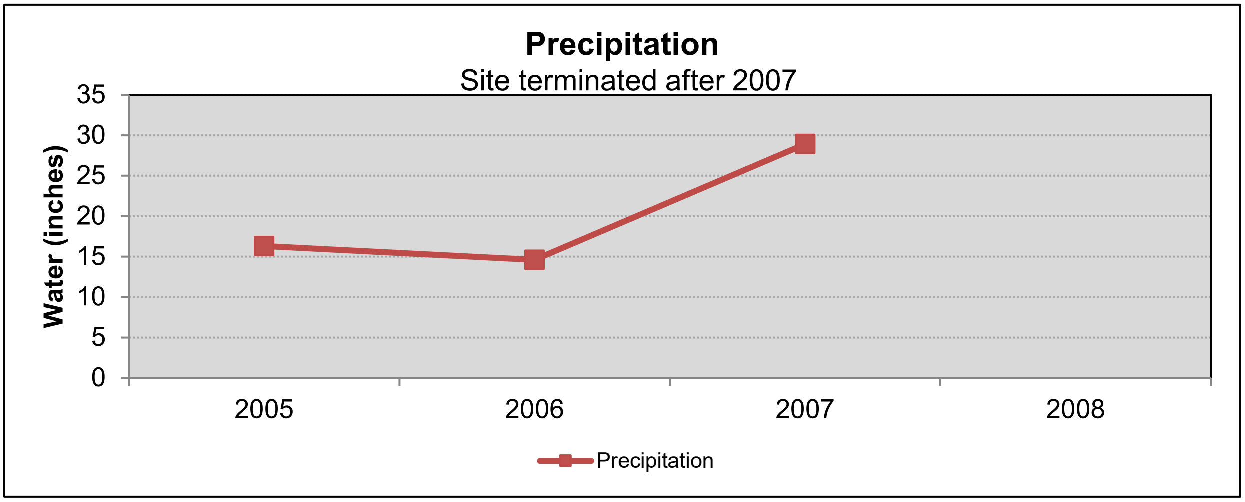


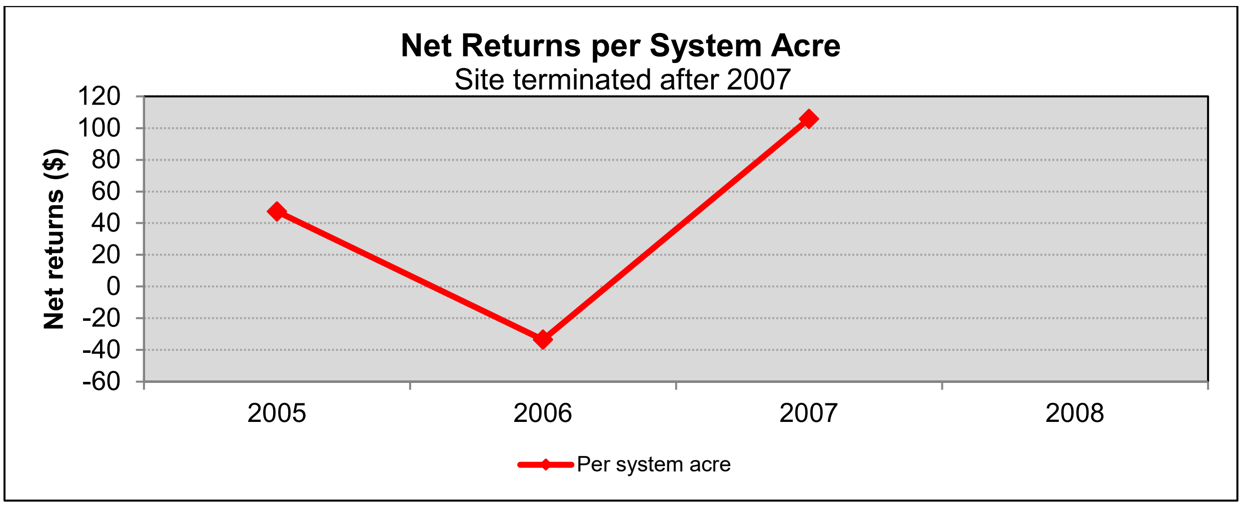
Description:

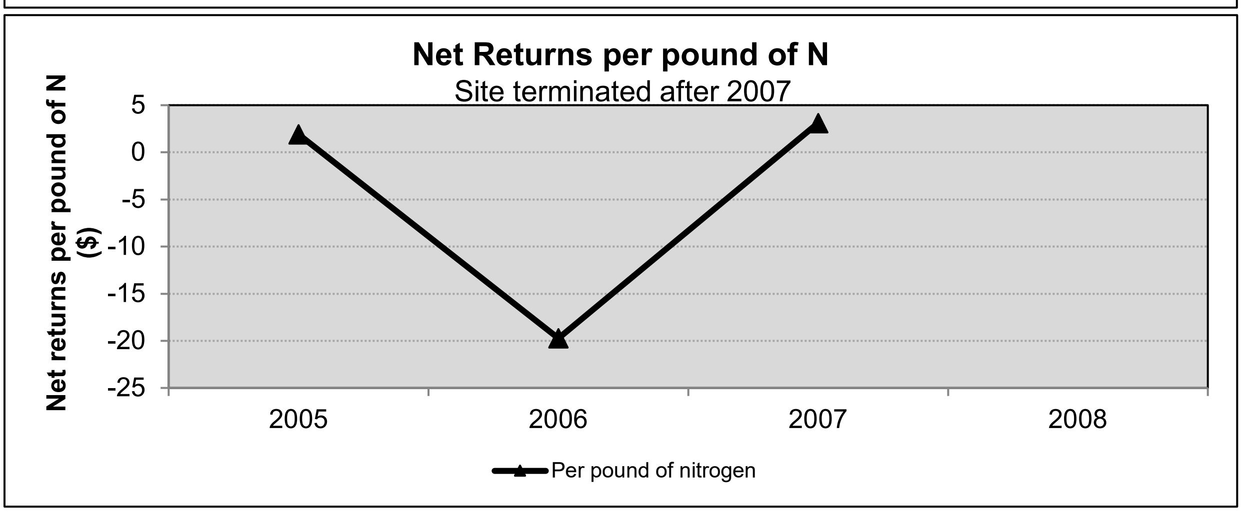
Site acres:	319.5
Soil types:	
PuA-Pullman clay loam, 0 to 1%	
Irrigation:	
Dryland (DL)	na gpm
Number of wells:	na
Fuel Source:	na



Site 13 – Dryland Site



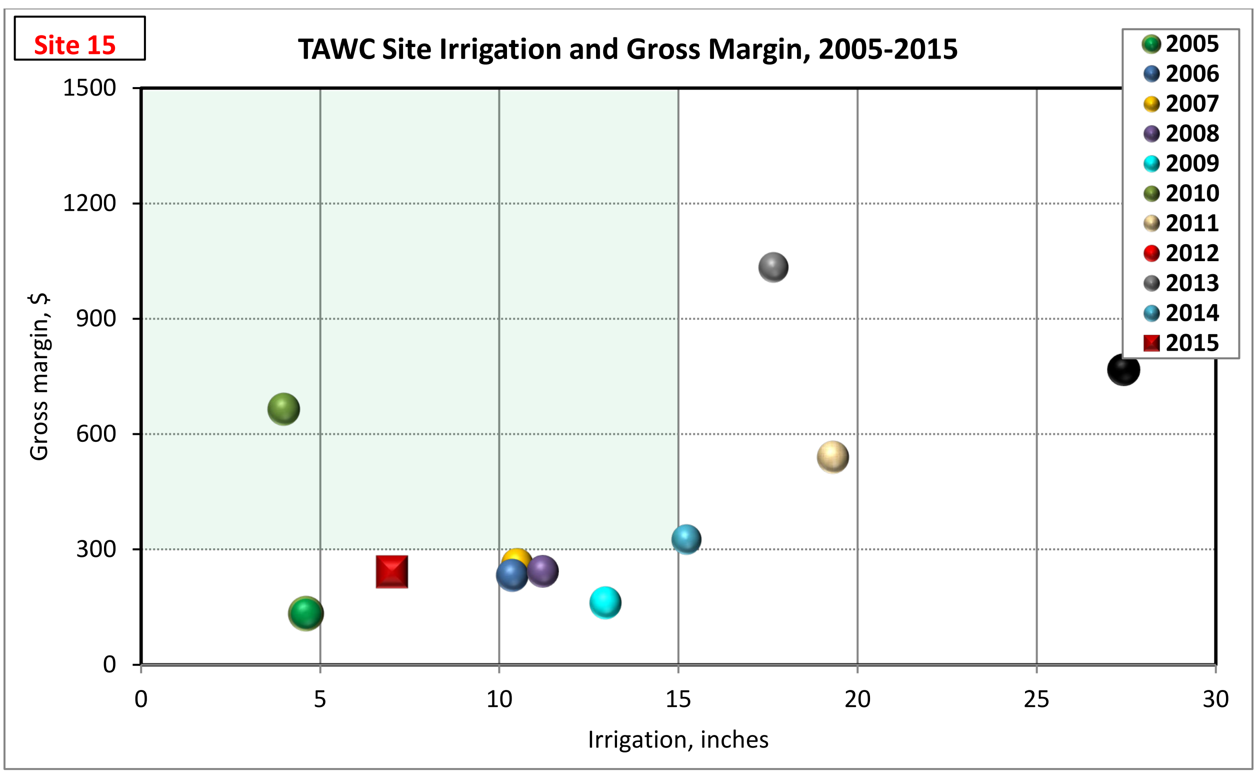




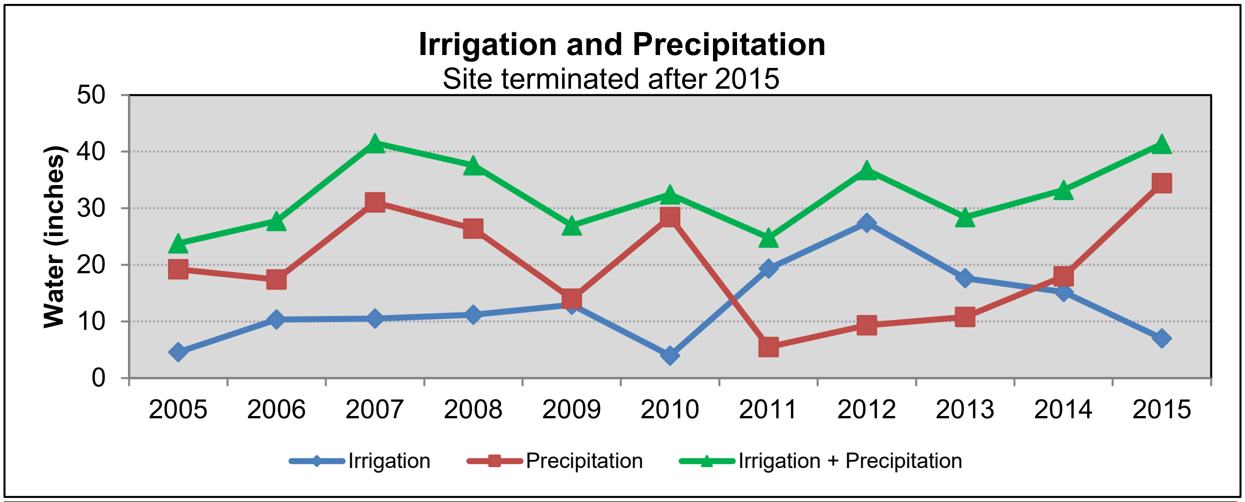
Site 15 – Terminated after 2015

Description:

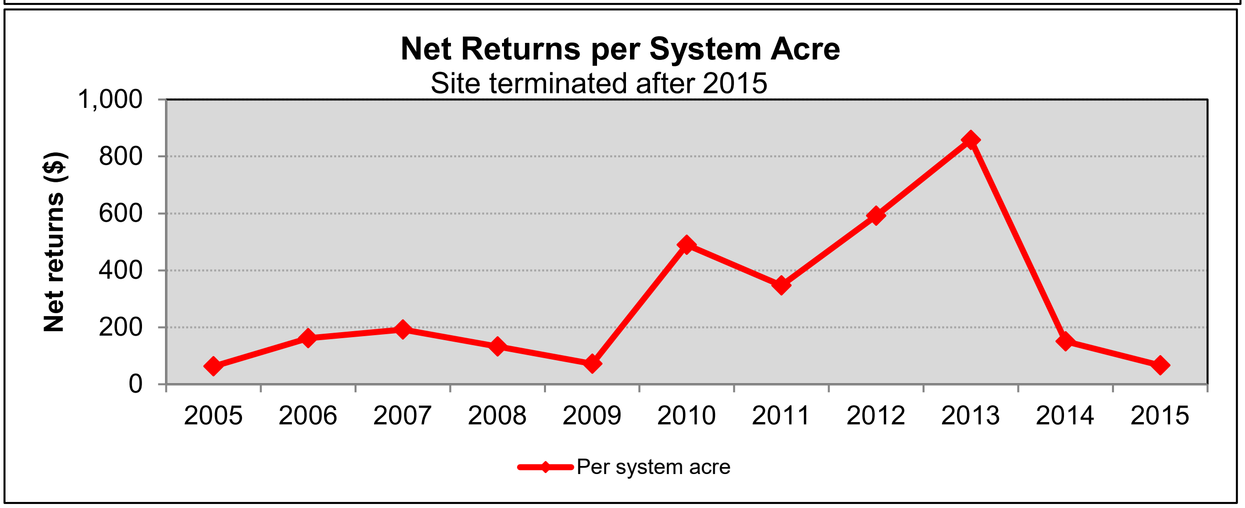
Site acres:	101.1
Soil types:	
	PuA-Pullman clay loam; 0 to 1%
Irrigation:	
Sub-Surface Drip (SDI)	290 gpm
Number of wells:	1
Fuel Source:	Electric



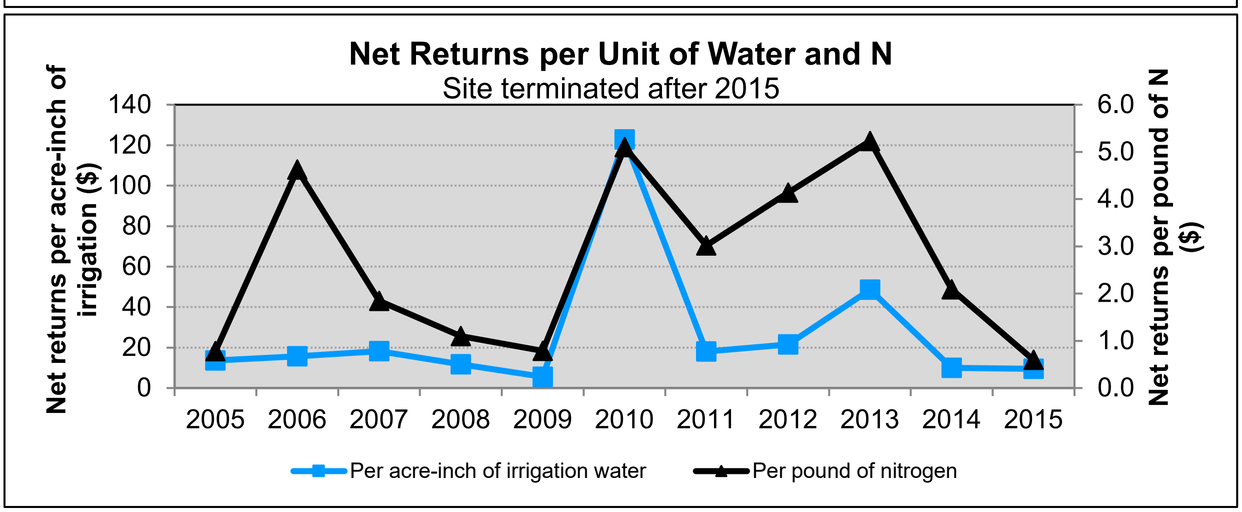
Site 15



Irrigation and Precipitation
Site terminated after 2015
Water (inches)
0
10
20
30
40
50
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Irrigation
Precipitation
Irrigation + Precipitation

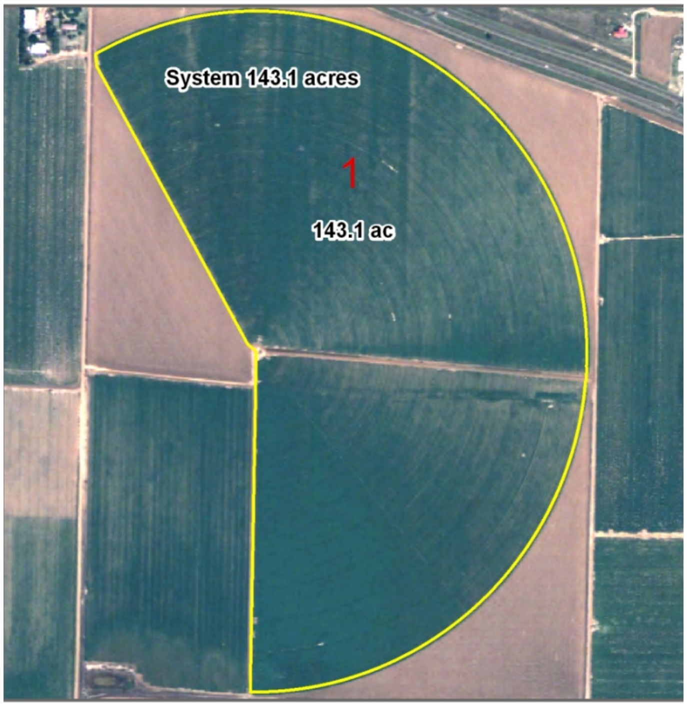


Net Returns per System Acre
Site terminated after 2015
Net returns ($)
0
200
400
600
800
1,000
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Per system acre



Net Returns per Unit of Water and N
Site terminated after 2015
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
2012
2013
2014
2015
Per acre-inch of irrigation water
Per pound of nitrogen

Site 16 – Terminated after 2006



Description:

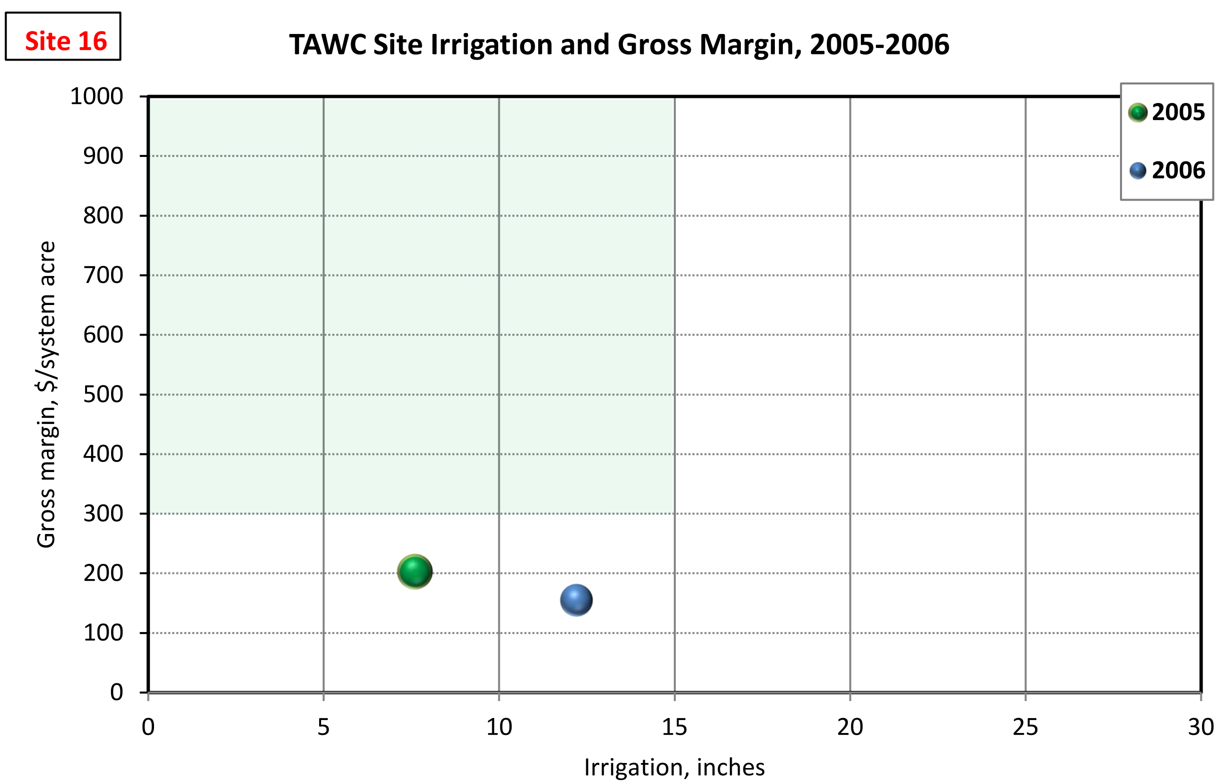
Site acres: 143.1

Soil types:
PuA-Pullman clay loam, 0 to 1%

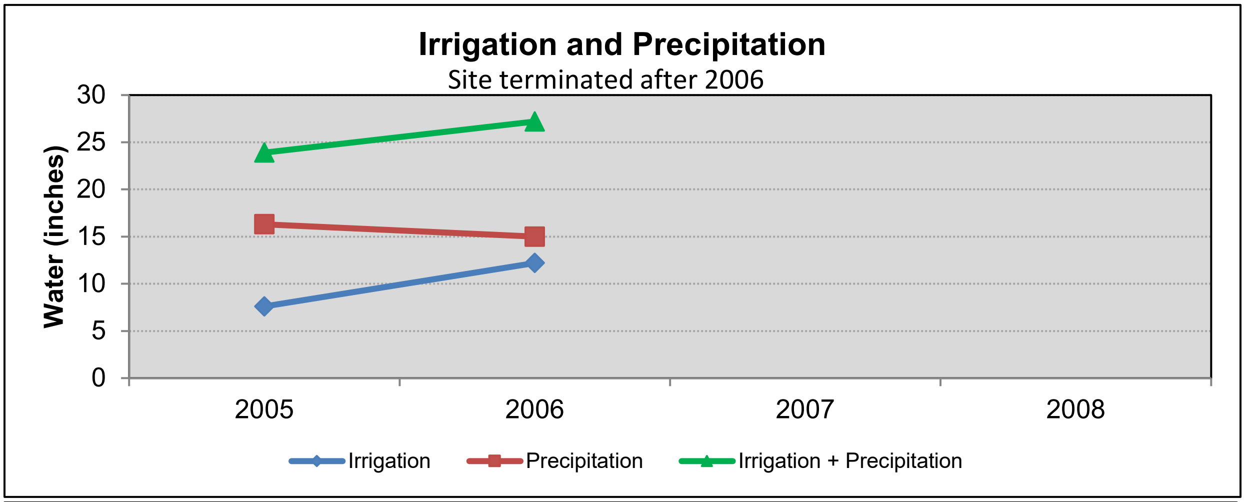
Irrigation:
Center Pivot (LESA) 600 gpm

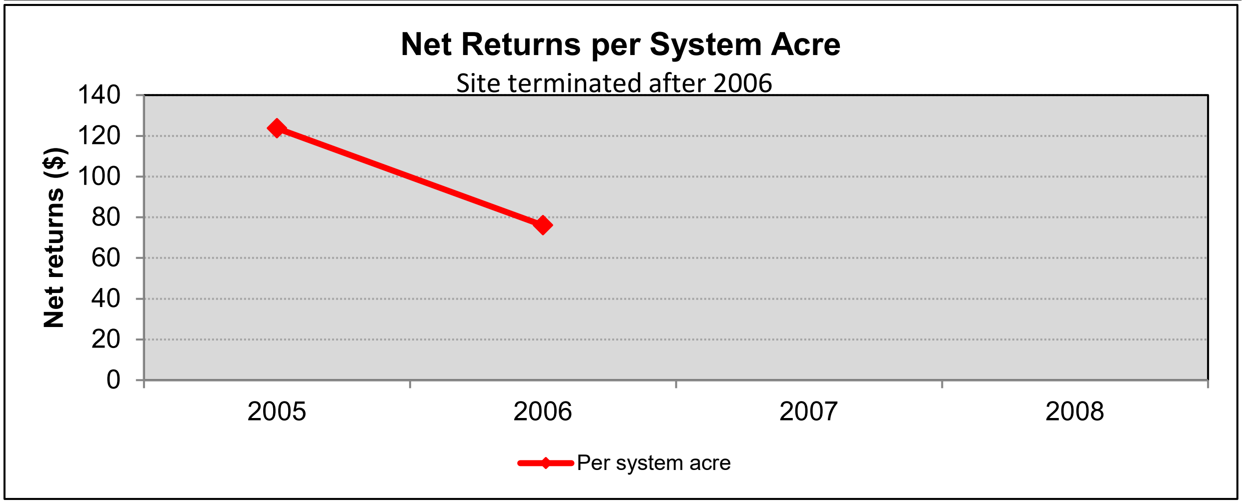
Number of wells: 3

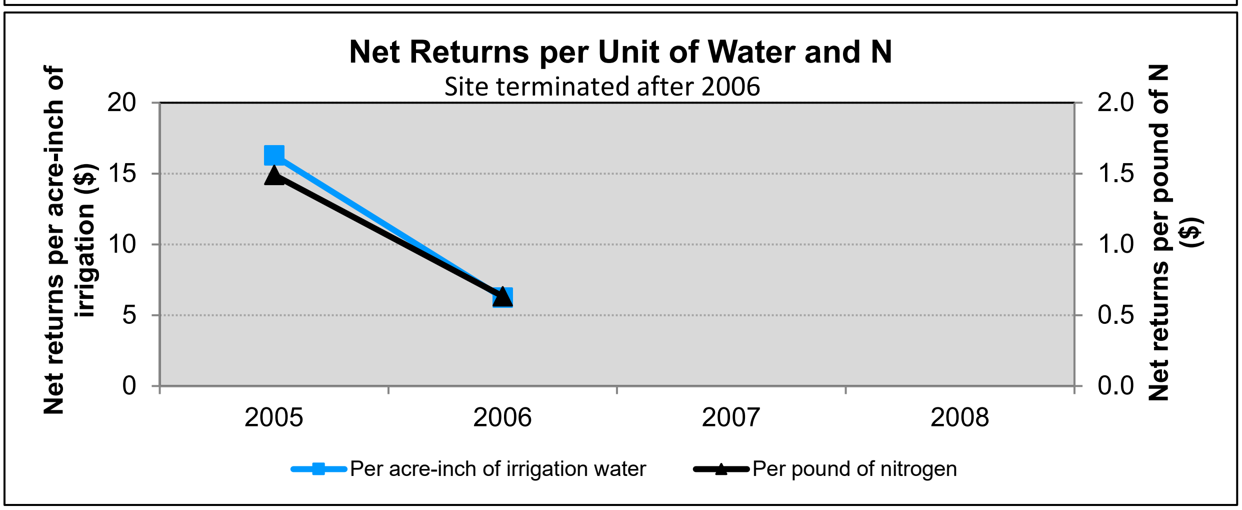
Fuel Source: Electric



Site 16


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


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


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

Site 18 – Terminated after 2013

Description:

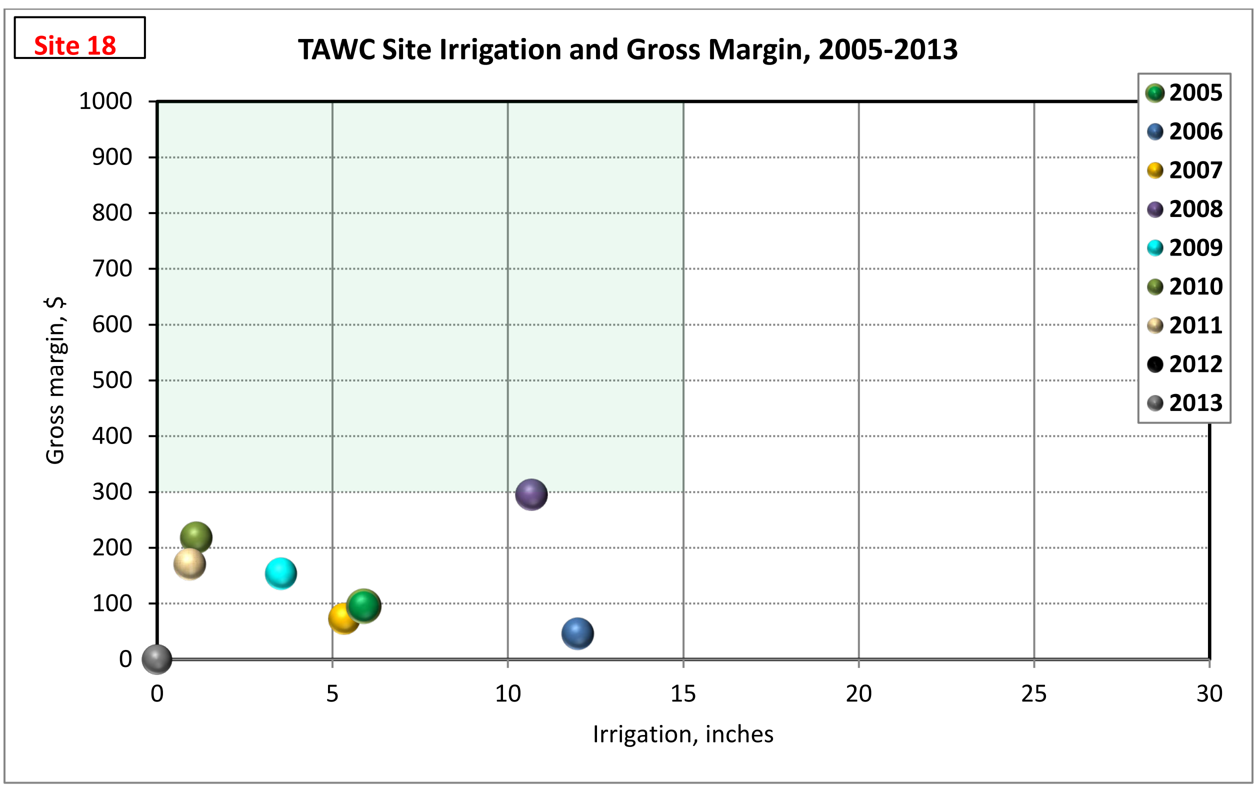
Site acres: 122.2

Soil types:
PuA-Pullman clay loam, 0 to 1%
EcB-Estacado clay loam; 1 to 3%

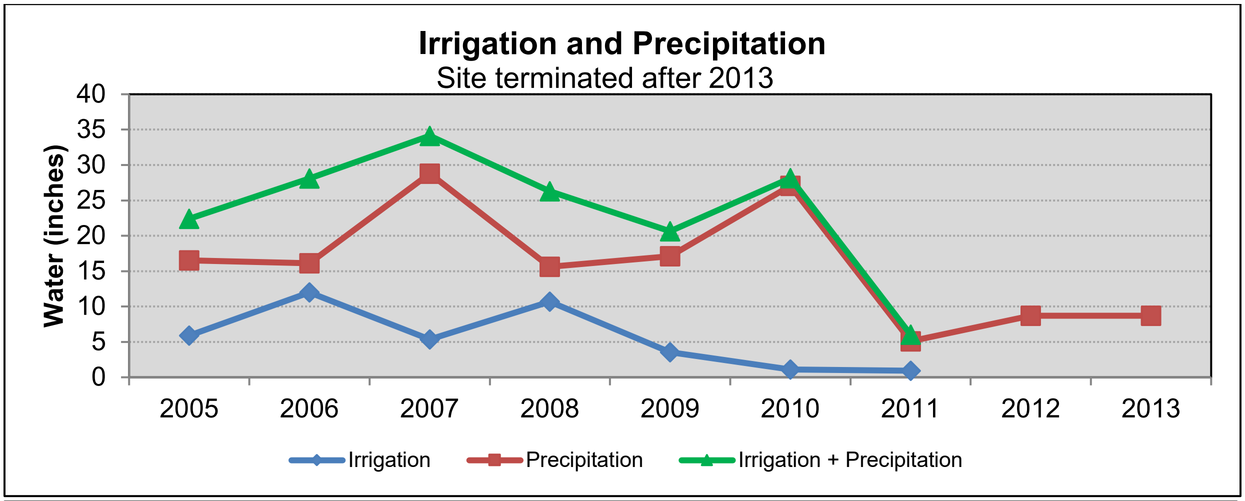
Irrigation:
Center Pivot (LEPA) 250 gpm

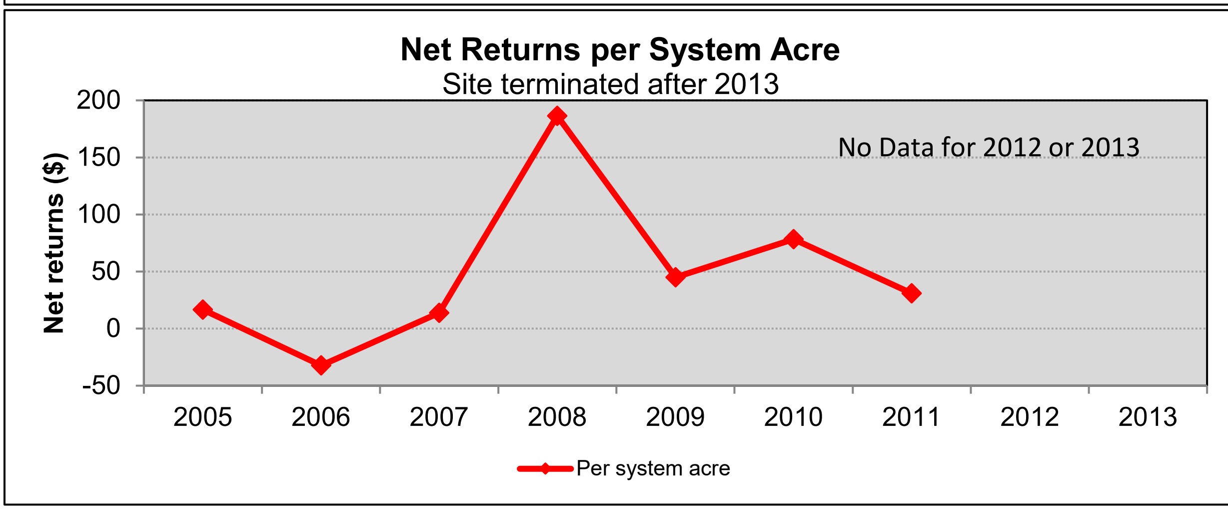
Number of wells: 3

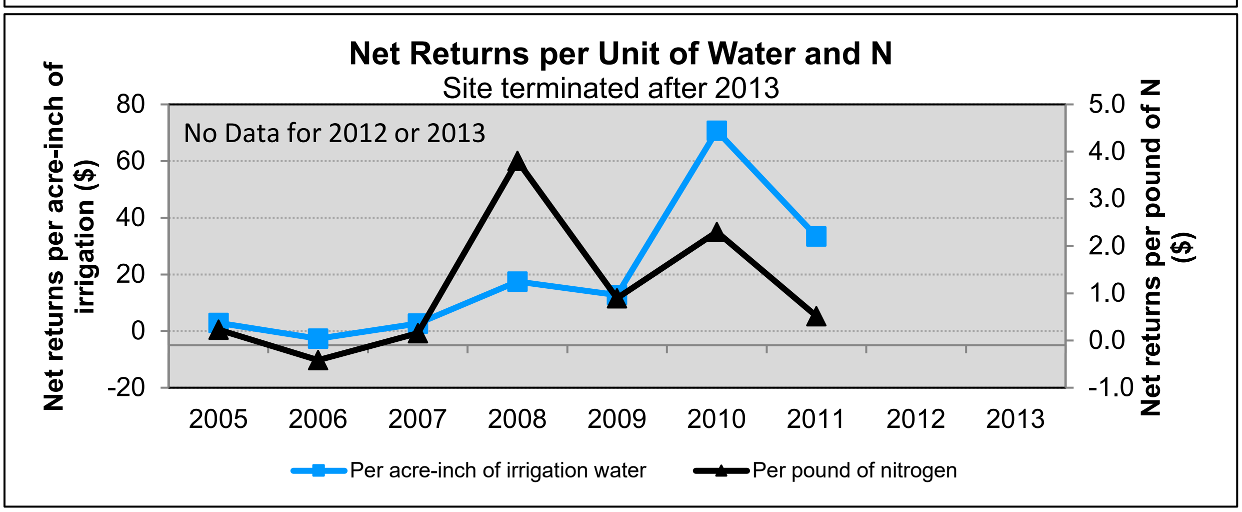
Fuel Source: Electric



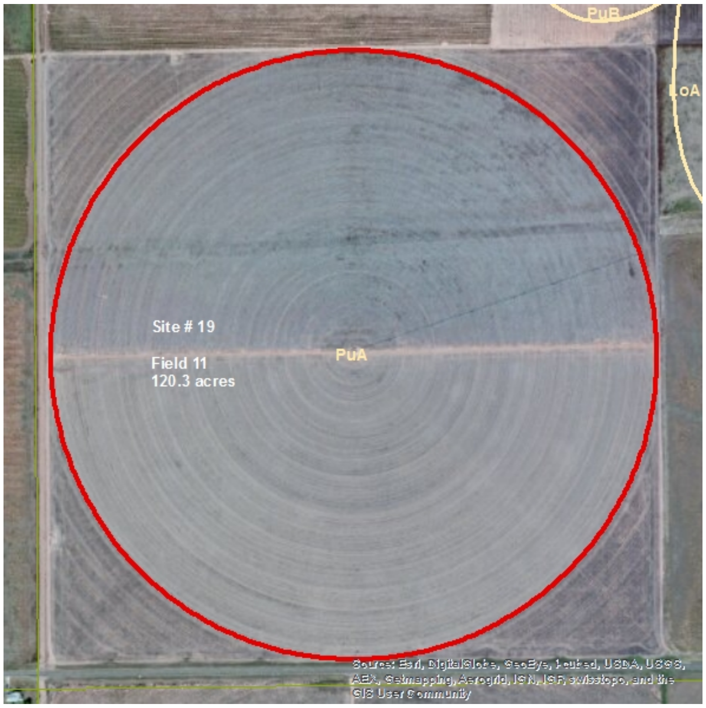
Site 18 – Terminated 2013







Site 19 - Terminated after 2015



Description:

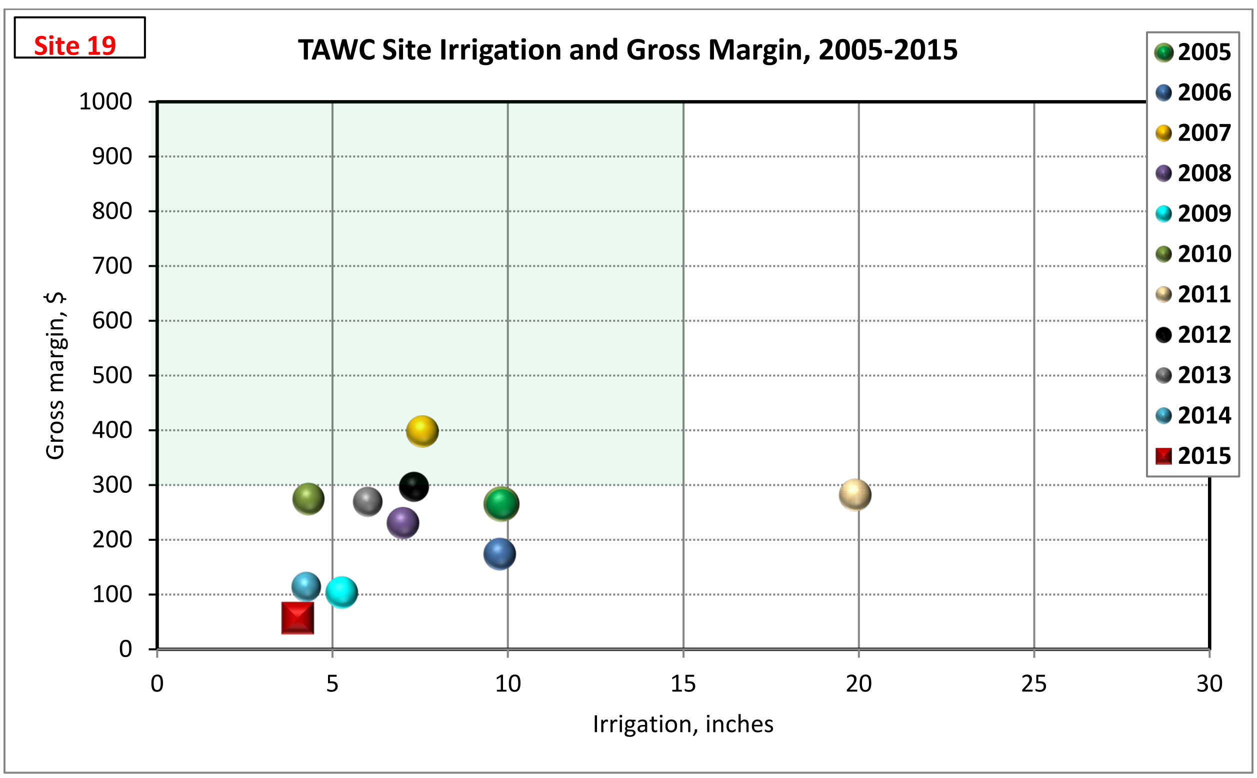
Site acres: 120.4

Soil types:
PuA-Pullman clay loam; 0 to 1%

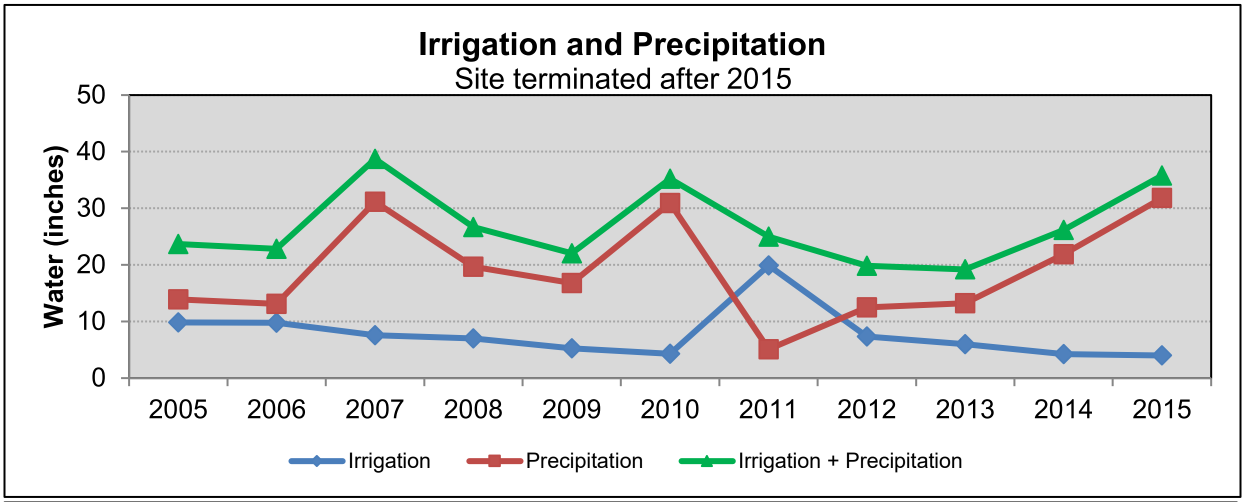
Irrigation:
Center Pivot (LEPA) 400 gpm

Number of wells: 3

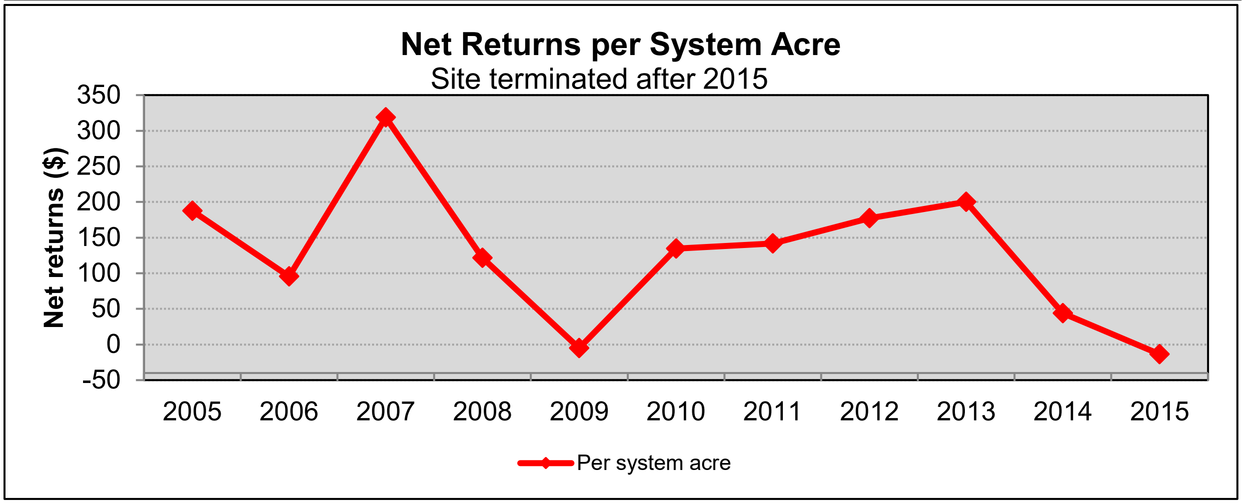
Fuel Source: Electric



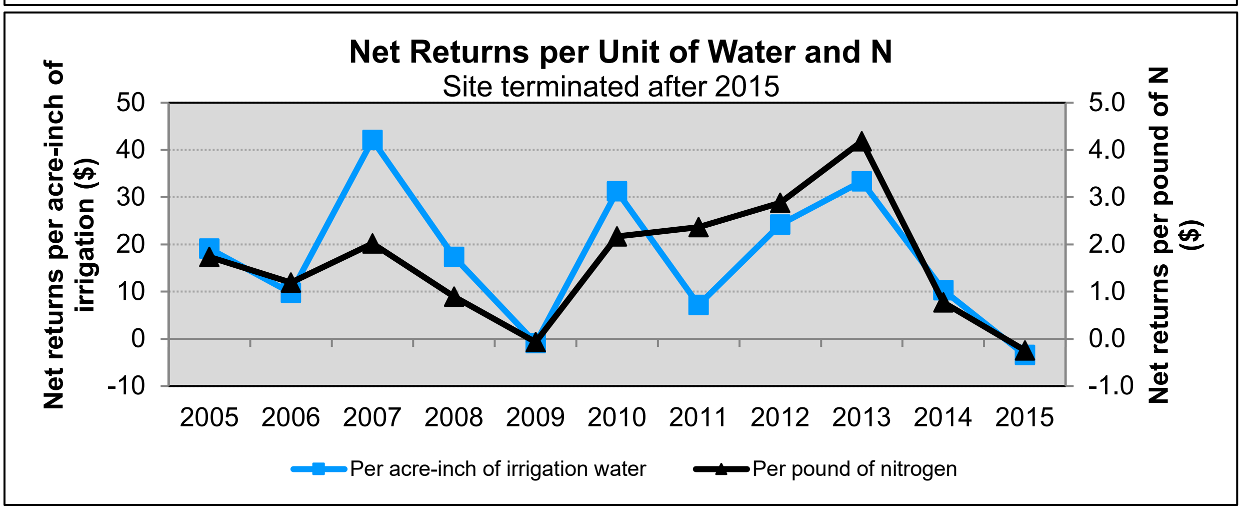
Site 19



Irrigation and Precipitation
Site terminated after 2015
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Irrigation
Precipitation
Irrigation + Precipitation

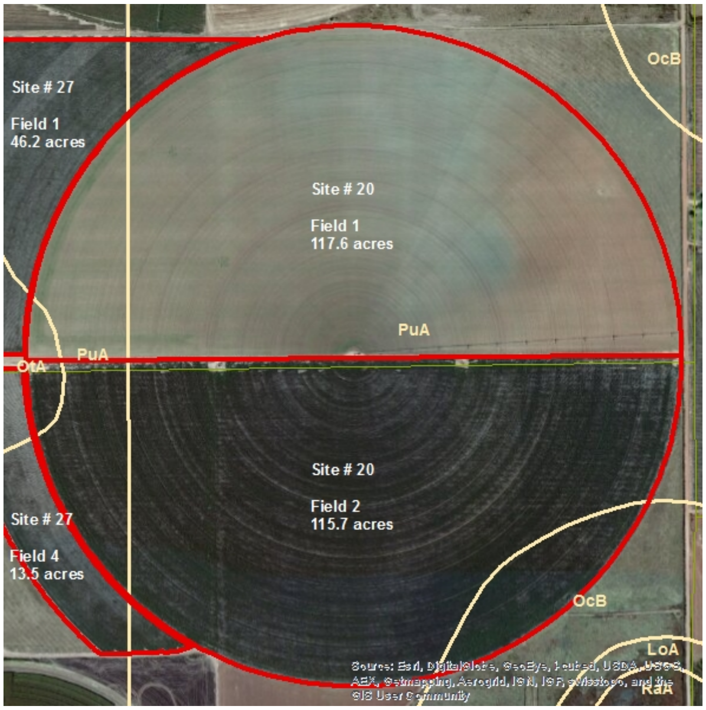


Net Returns per System Acre
Site terminated after 2015
Net returns ($)
350
300
250
200
150
100
50
0
-50
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Per system acre



Net Returns per Unit of Water and N
Site terminated after 2015
Net returns per acre-inch of irrigation ($)
50
40
30
20
10
0
-10
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Per acre-inch of irrigation water
Per pound of nitrogen

Site 20 – Terminated after 2014



Description:

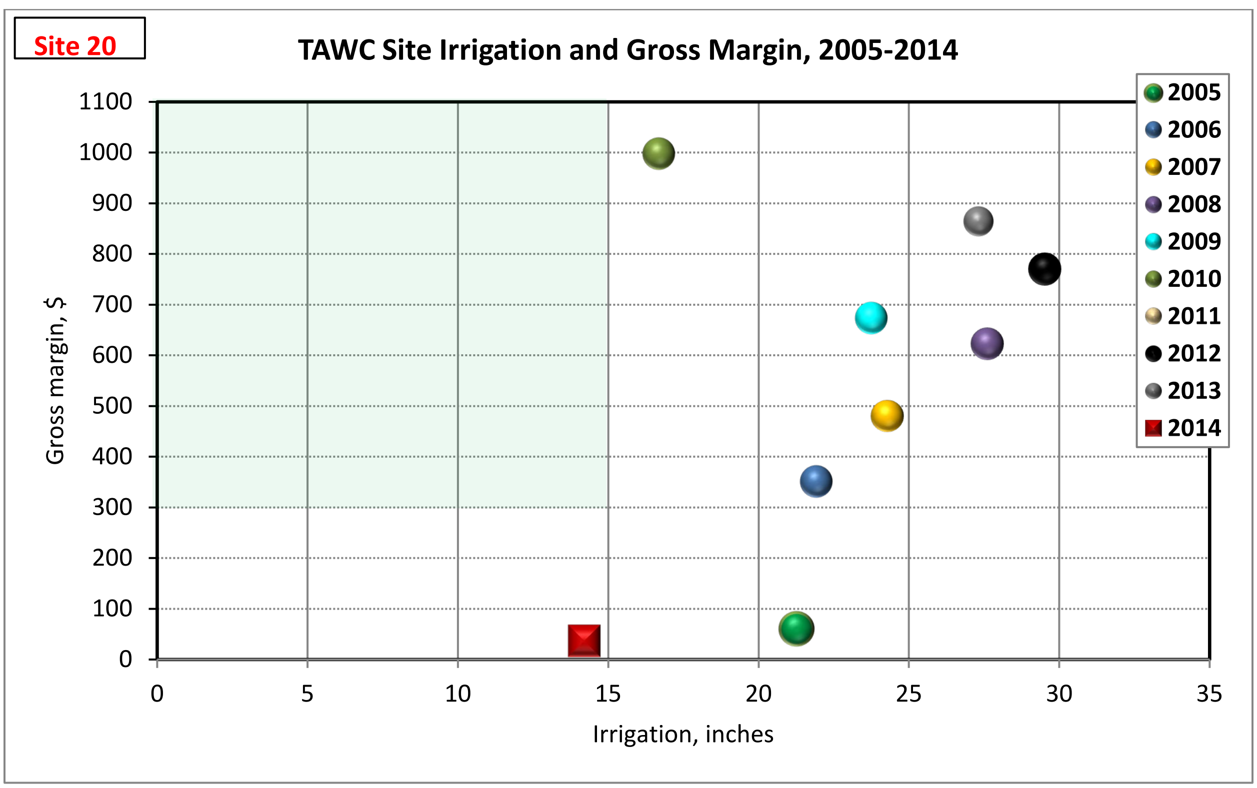
Site acres: 233.3

Soil types:
PuA-Pullman clay loam; 0 to 1%
OcB-Olton clay loam, 1 to 3%

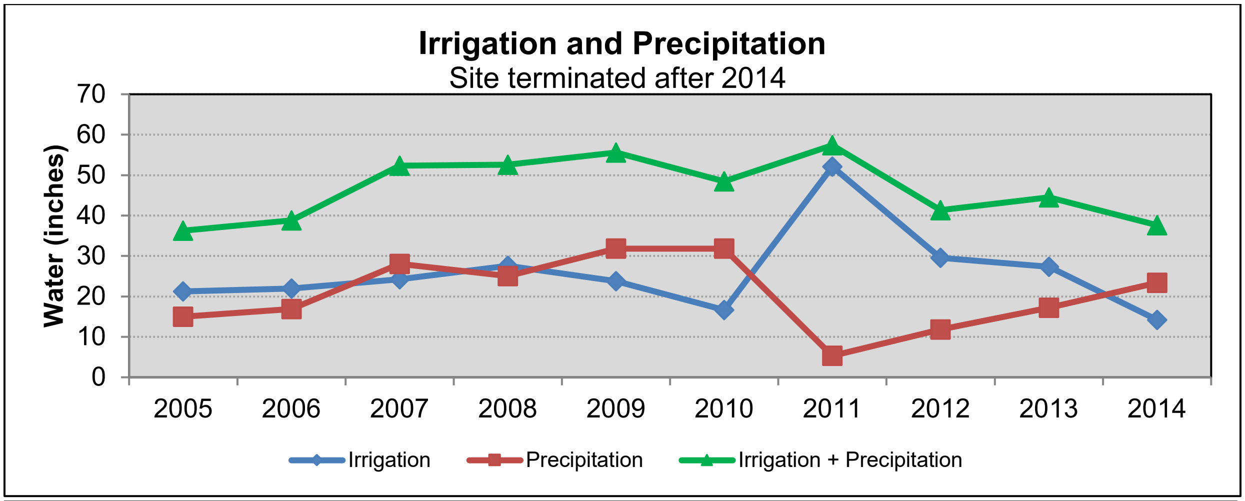
Irrigation:
Center Pivot (LEPA) 1000 gpm

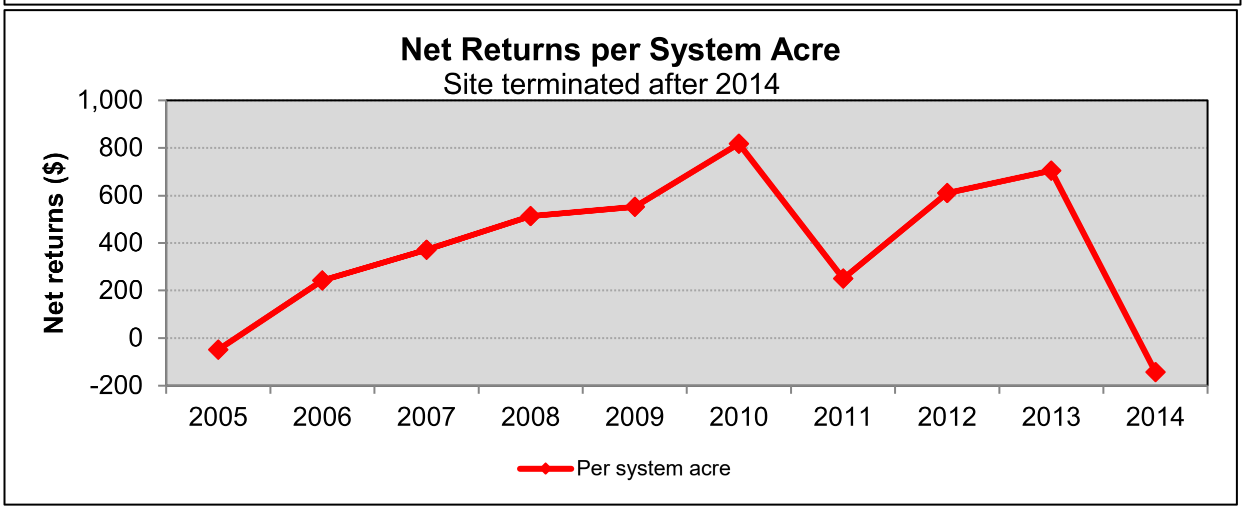
Number of wells: 3

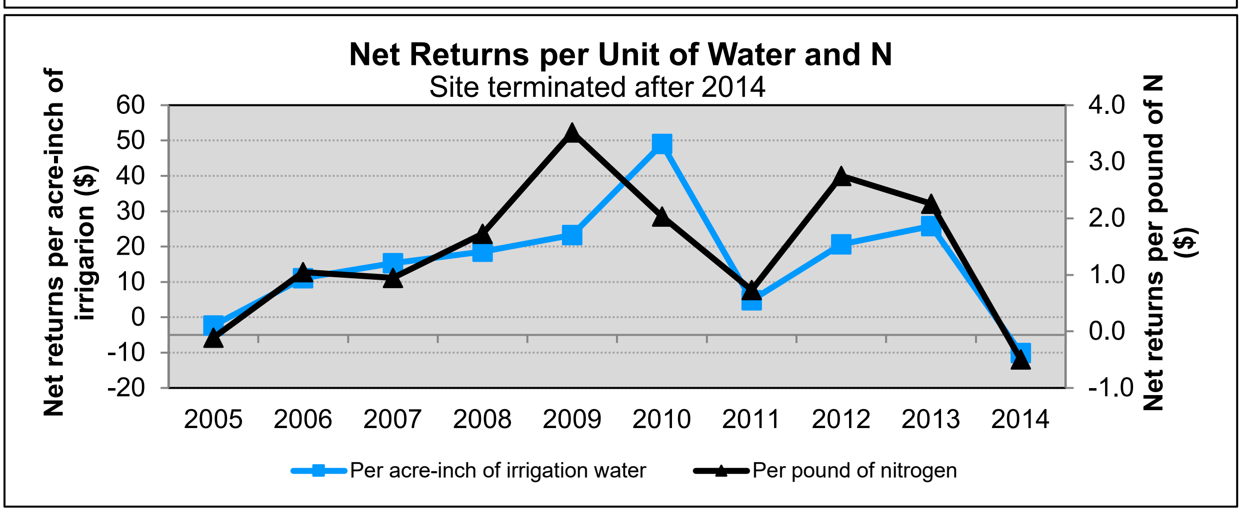
Fuel Source: Electric



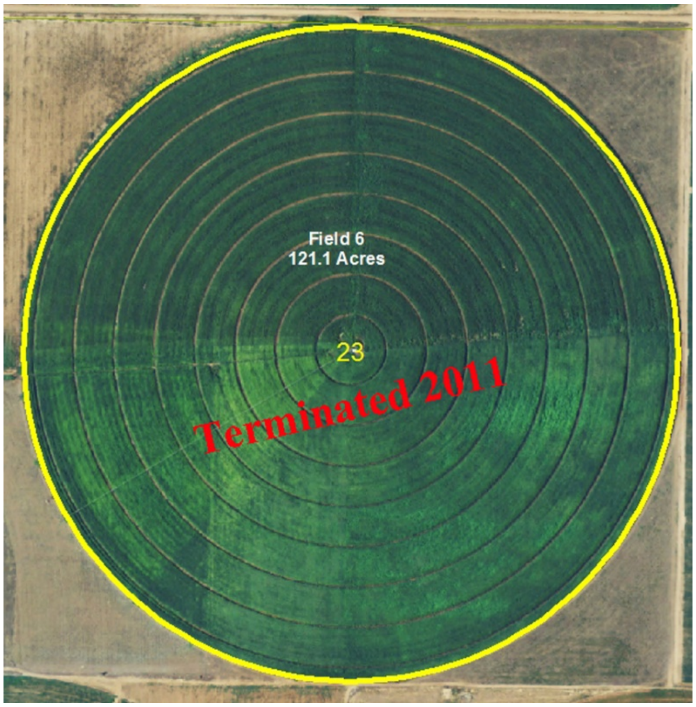
Site 20


Irrigation and Precipitation
Site terminated after 2014
Water (inches)
70
60
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Site terminated after 2014
Net returns ($)
1,000
800
600
400
200
0
-200
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Per system acre


Net Returns per Unit of Water and N
Site terminated after 2014
Net returns per acre-inch of irrigarion ($)
60
50
40
30
20
10
0
-10
-20
Net returns per pound of N ($)
4.0
3.0
2.0
1.0
0.0
-1.0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Per acre-inch of irrigation water
Per pound of nitrogen

SITE 23 – TERMINATED AFTER 2011



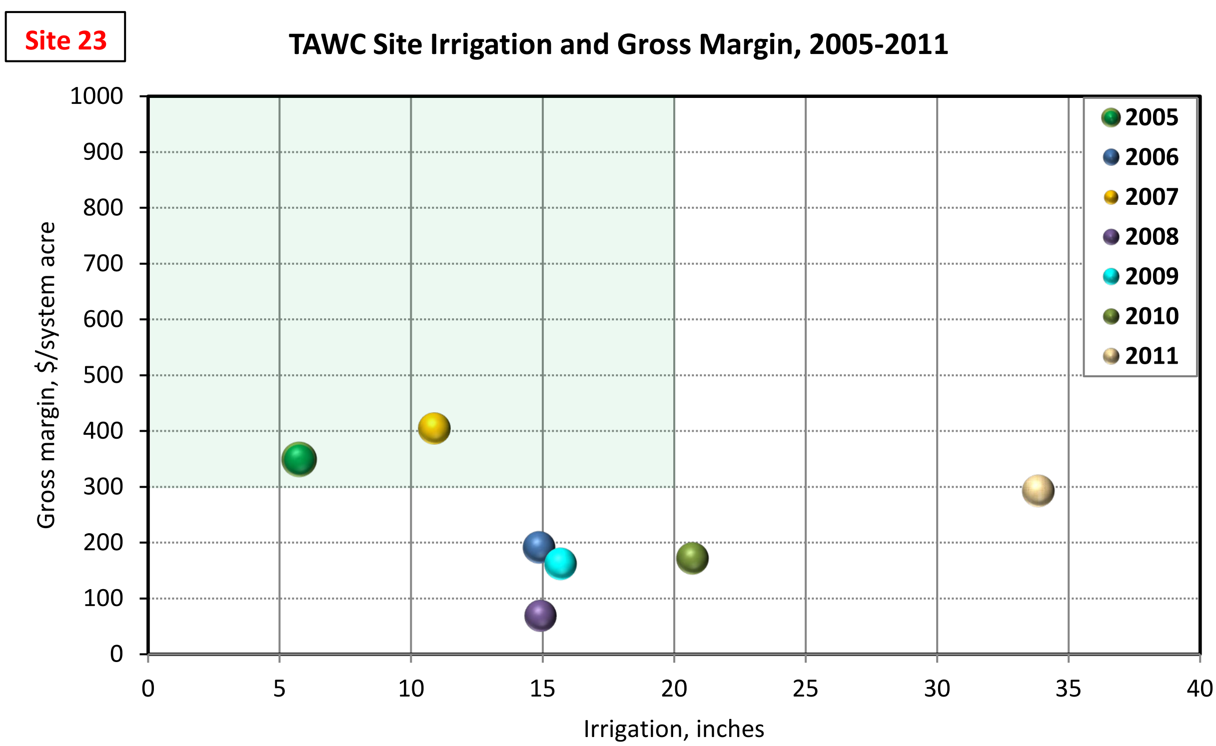
Description:

Site acres: 122.2

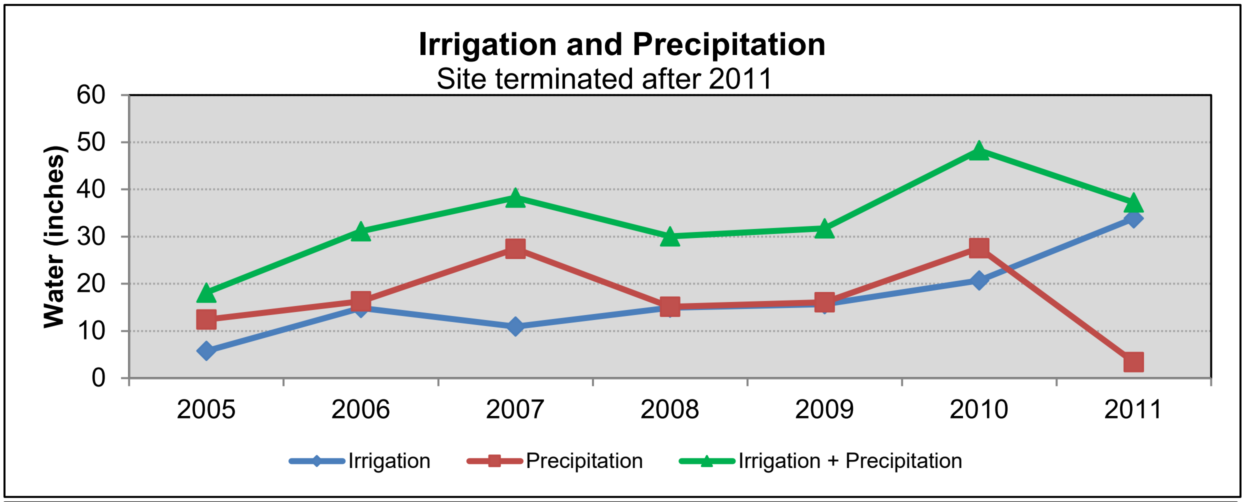
Soil types:
PuA-Pullman clay loam, 0 to 1%
EcB-Estacado clay loam; 1 to 3%

Irrigation:
Center Pivot (LEPA) 250 gpm
Number of wells: 3

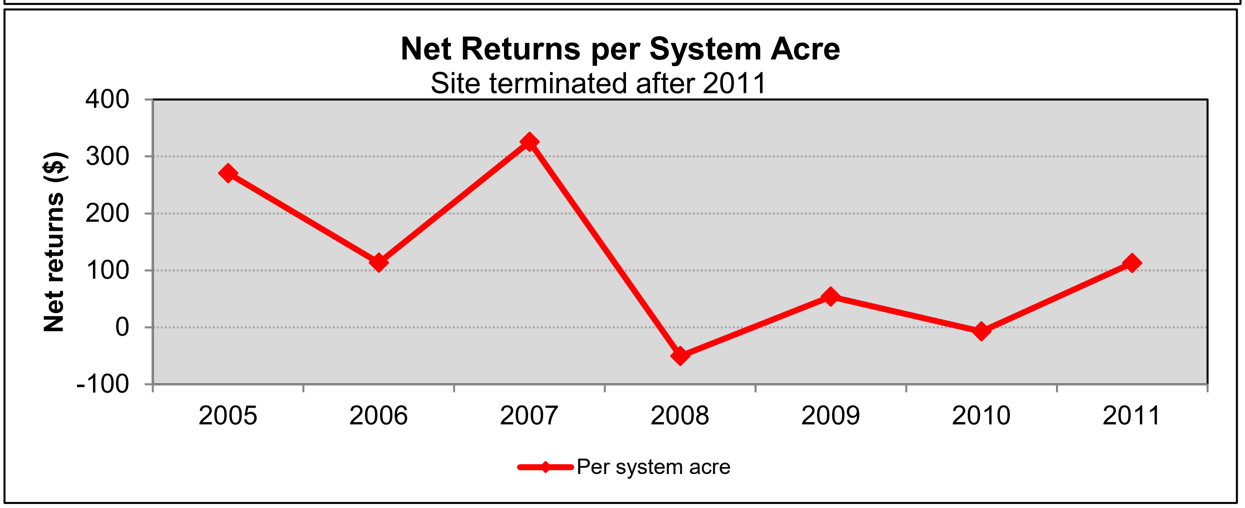
Fuel Source: Electric



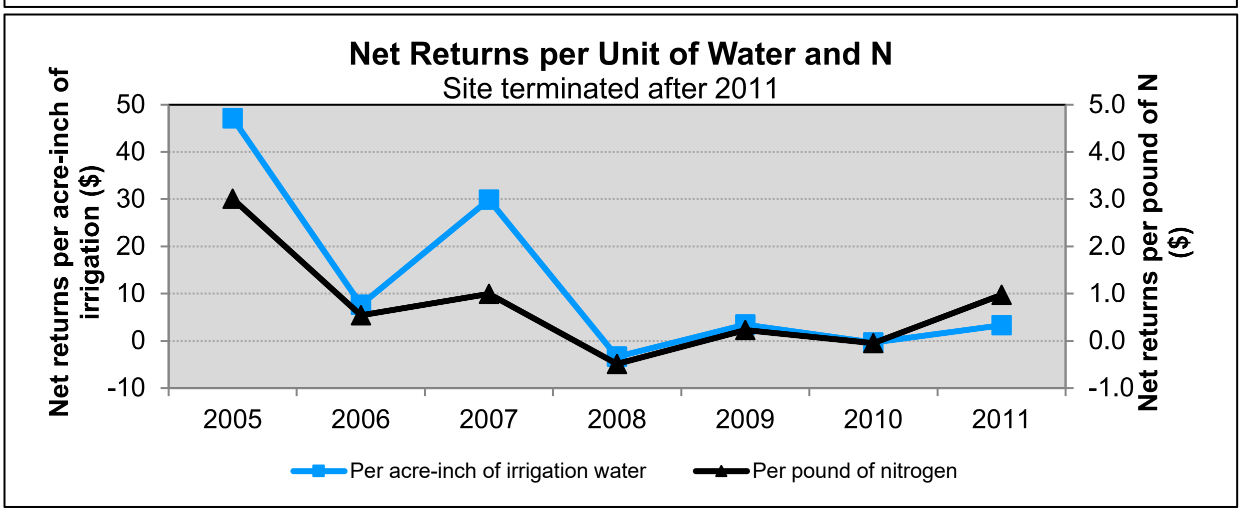
Site 23



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



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



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

SITE 24 – TERMINATED AFTER 2016

Description:

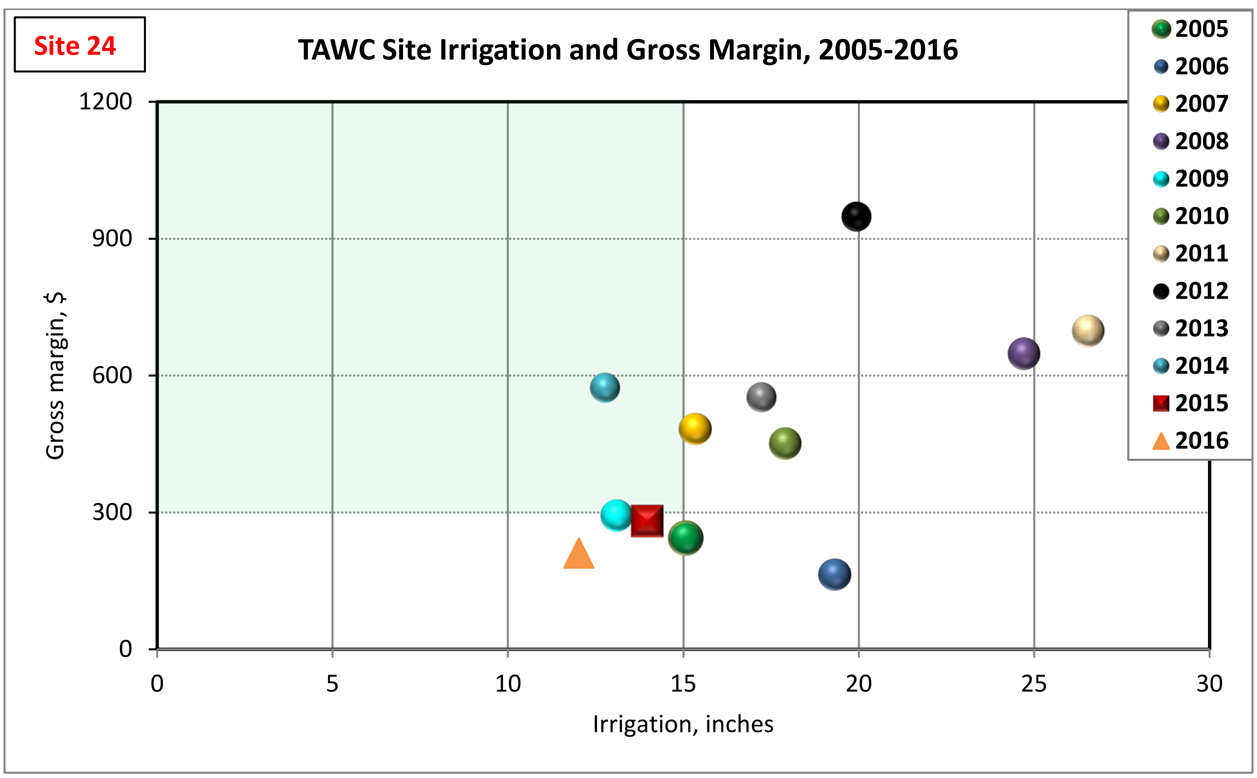
Site acres: 129.7

Soil types:
PuA-Pullman clay loam; 0 to 1%

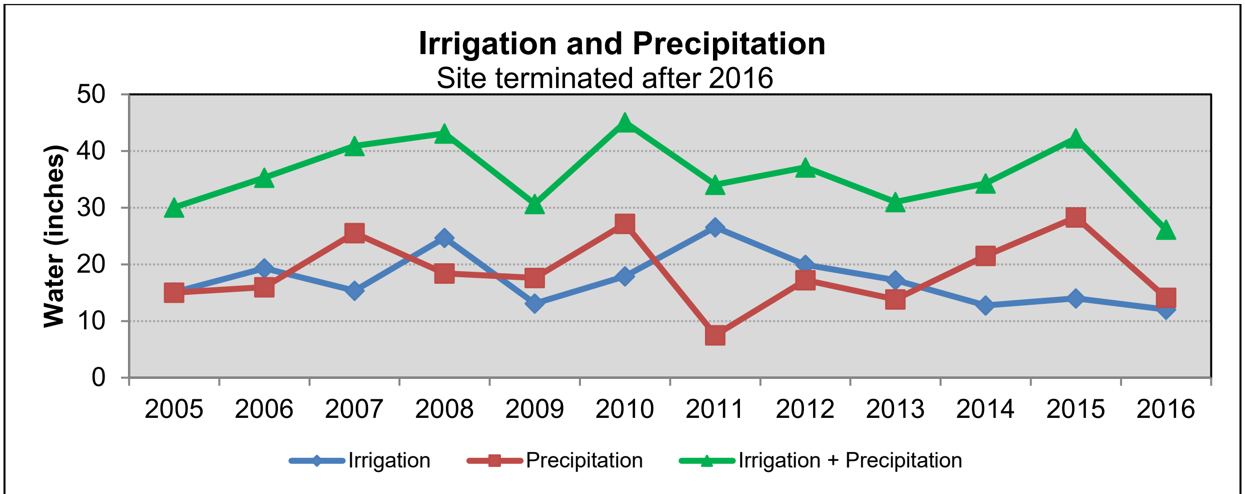
Irrigation:
Center Pivot (LESA) 700 gpm

Number of wells: 1

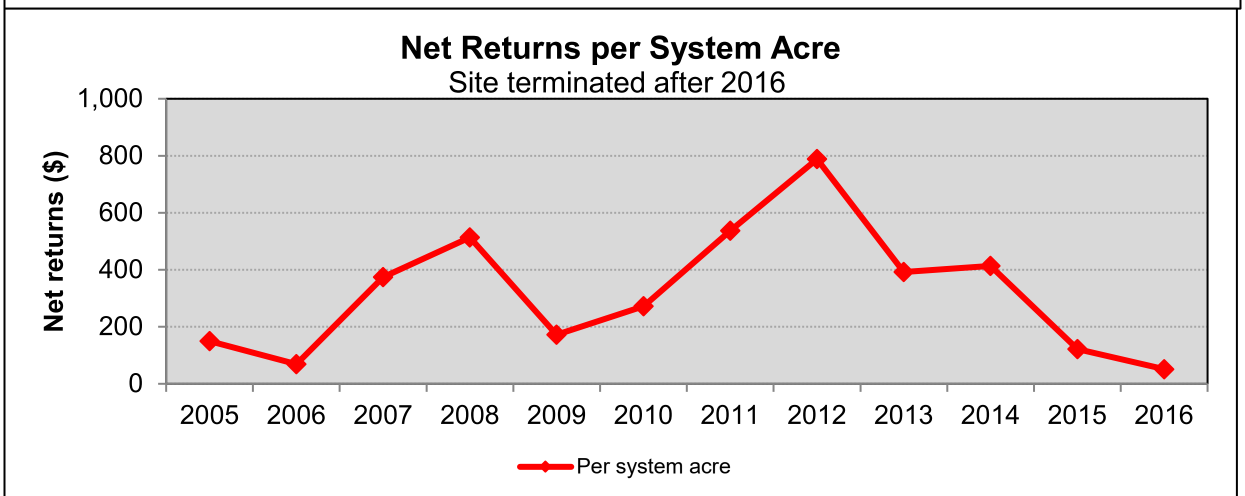
Fuel Source: Diesel



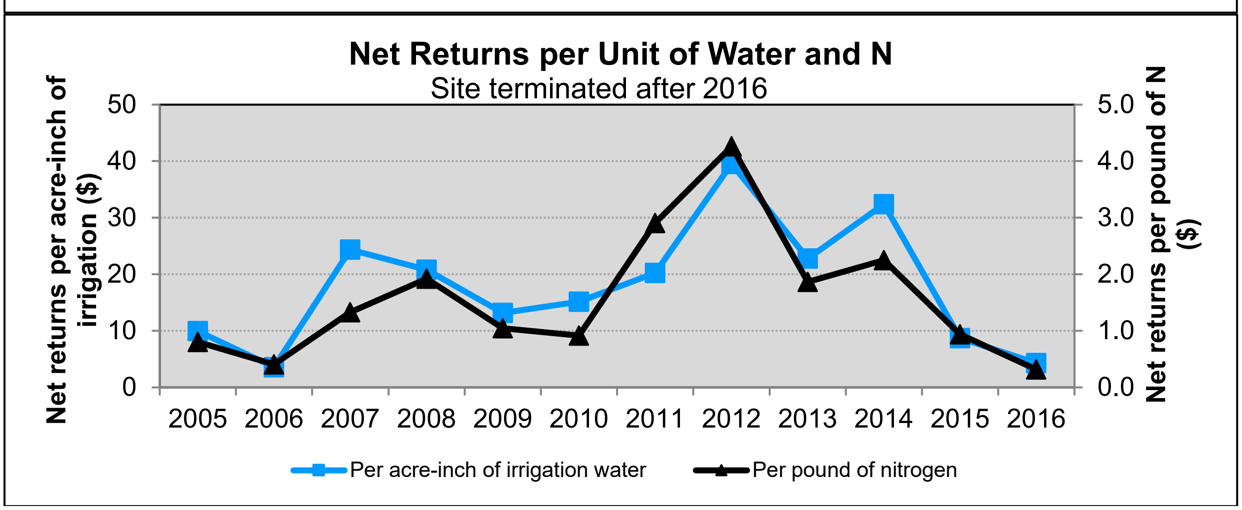
Site 24



Irrigation and Precipitation
Site terminated after 2016
Water (inches)
0
10
20
30
40
50
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Site terminated after 2016
Net returns ($)
0
200
400
600
800
1,000
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Per system acre

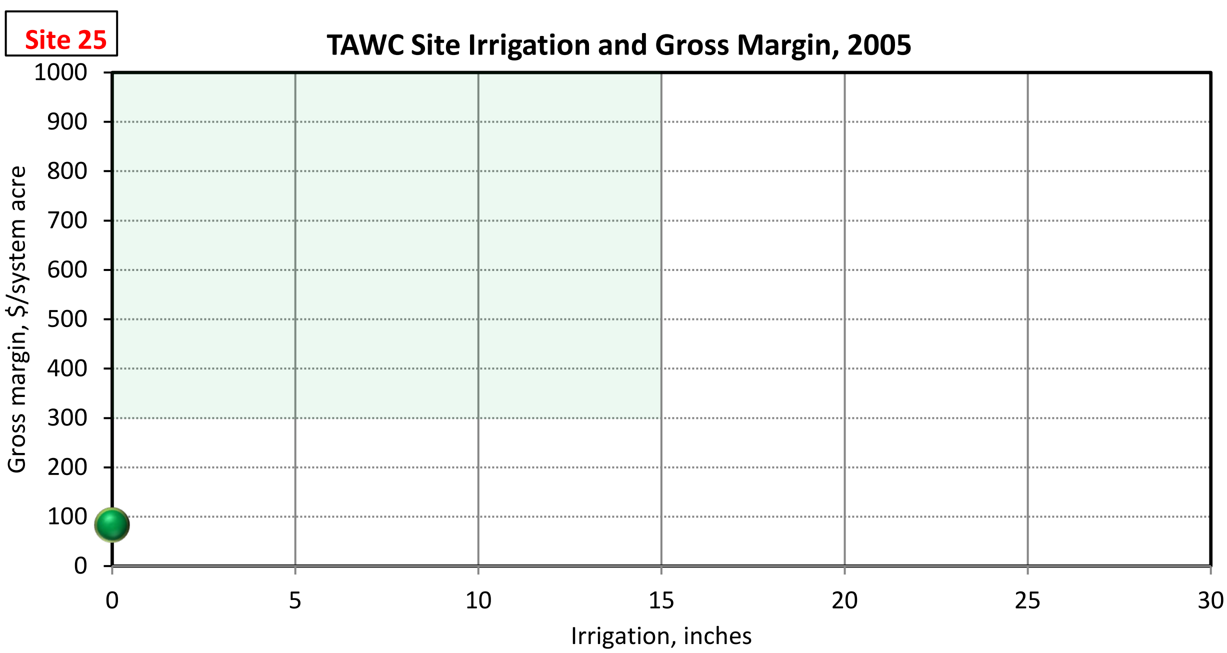


Net Returns per Unit of Water and N
Site terminated after 2016
Net returns per acre-inch of irrigation ($)
0
10
20
30
40
50
Net returns per pound of N ($)
0.0
1.0
2.0
3.0
4.0
5.0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Per acre-inch of irrigation water
Per pound of nitrogen

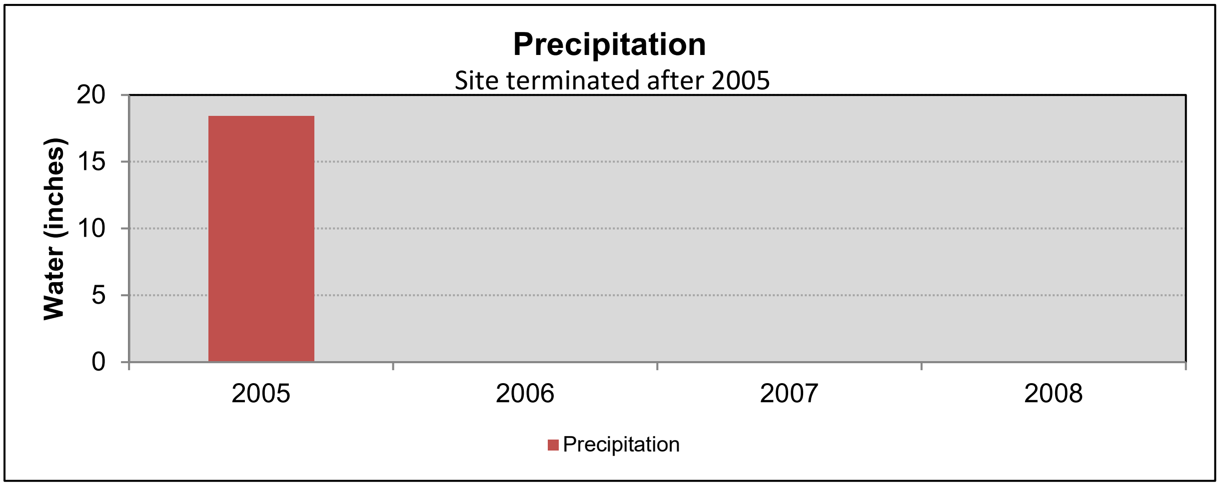
SITE 25 – TERMINATED AFTER 2005

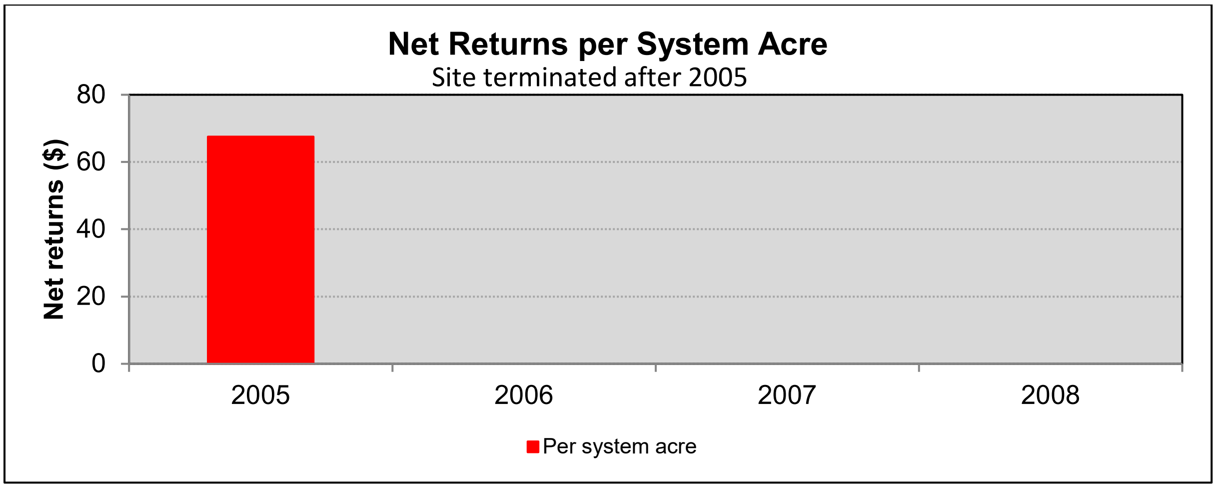
Description:

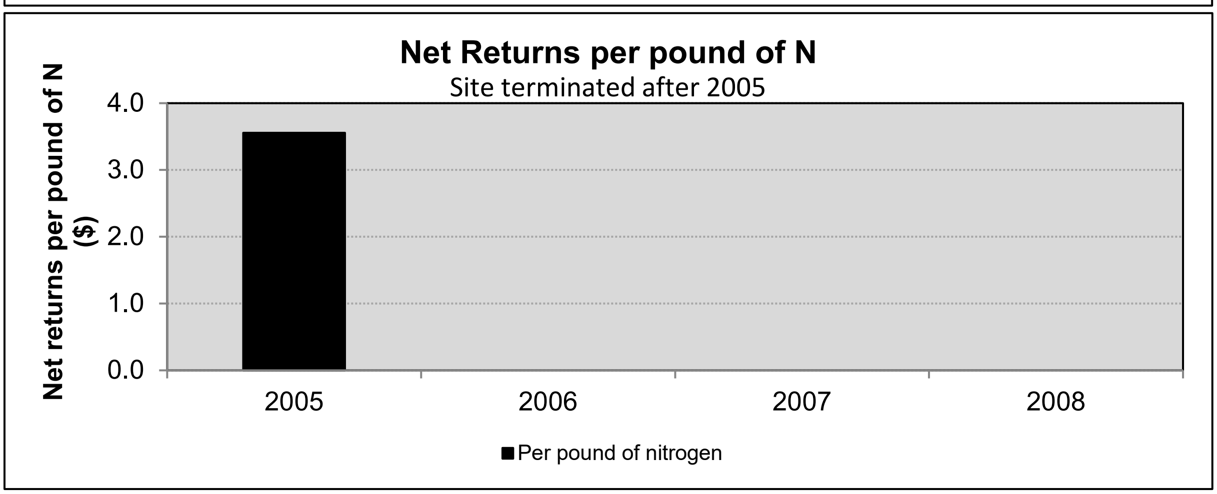
Site acres:	178.5
Soil types:	
PuA-Pullman clay loam, 0 to 1%	
Irrigation:	
Dryland (DL)	na gpm
Number of wells:	na
Fuel Source:	na



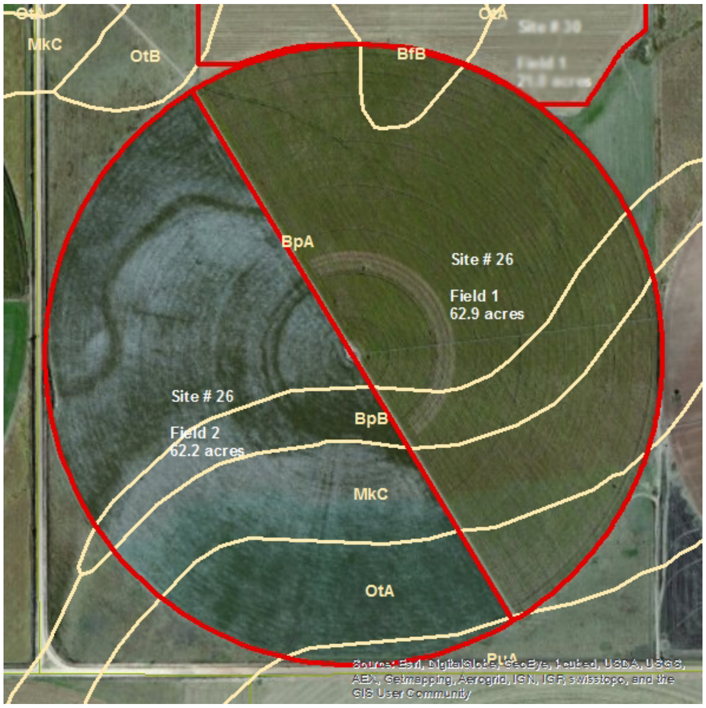
Site 25 - Dryland







Site 26 - Terminated after 2015



Description:

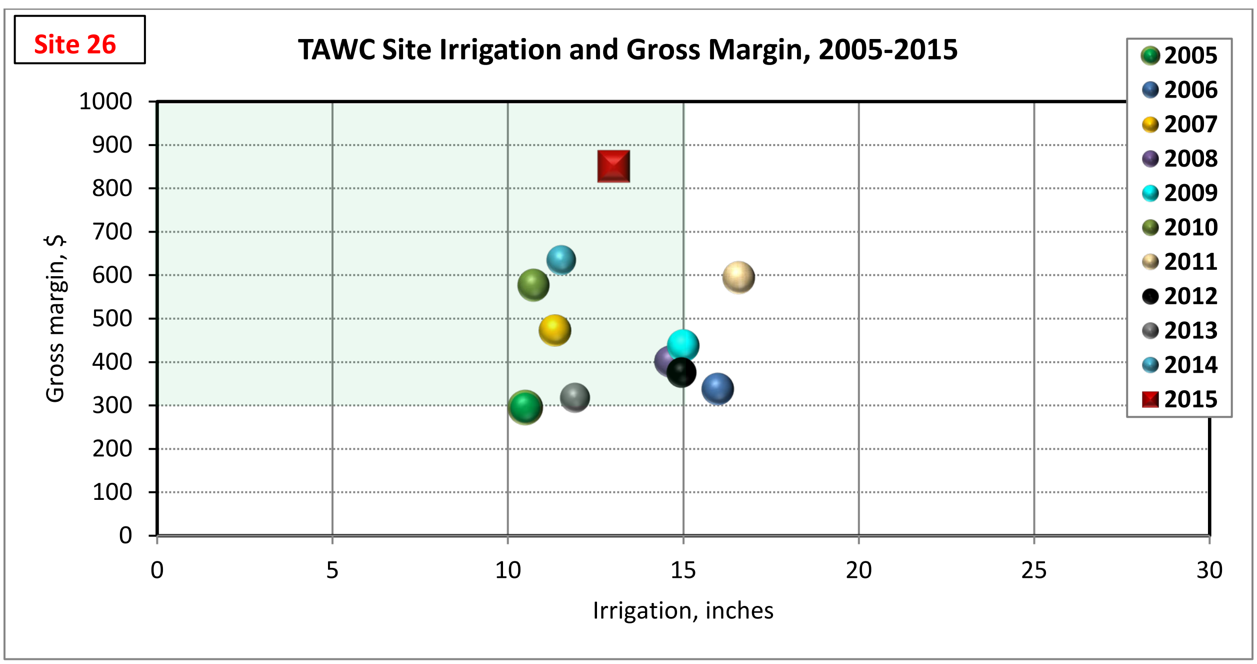
Site acres: 125.1

Soil types:
- BpA-Bippus loam; 0 to 1%
- MkC-Mansker loam; 3 to 5%
- OtA-Olton loam; 0 to 1%

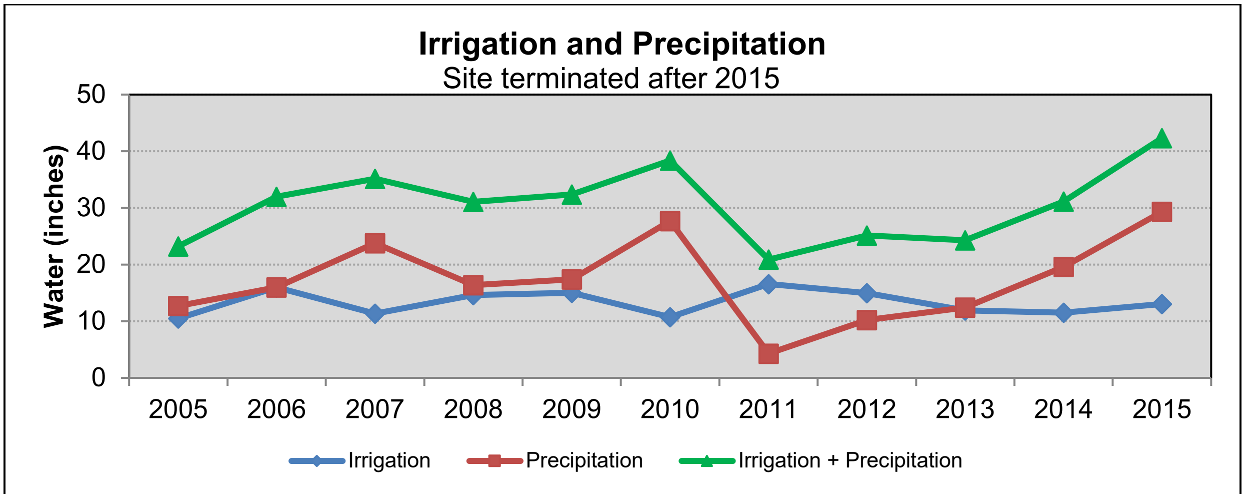
Irrigation:
Center Pivot (LESA) 600 gpm

Number of wells: 2

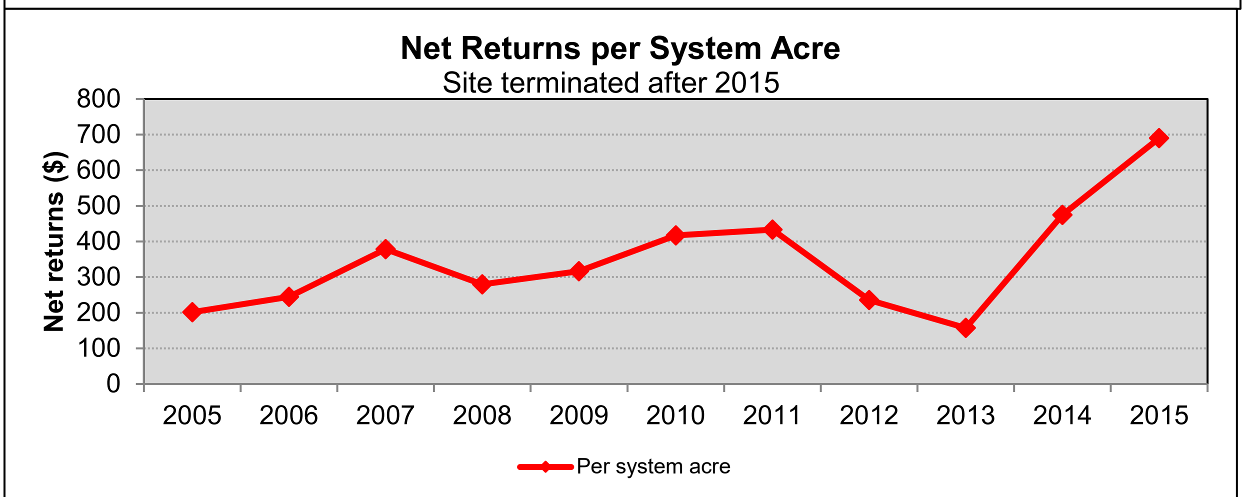
Fuel Source: 1 Electric, 1 Diesel



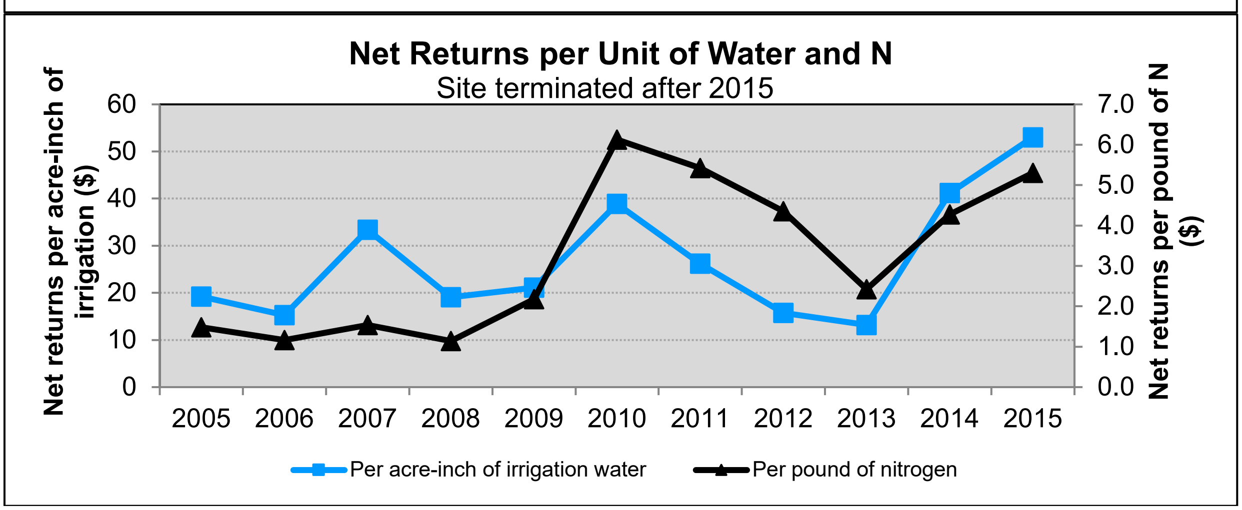
Site 26



Irrigation and Precipitation
Site terminated after 2015
Water (inches)
0
10
20
30
40
50
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Irrigation
Precipitation
Irrigation + Precipitation

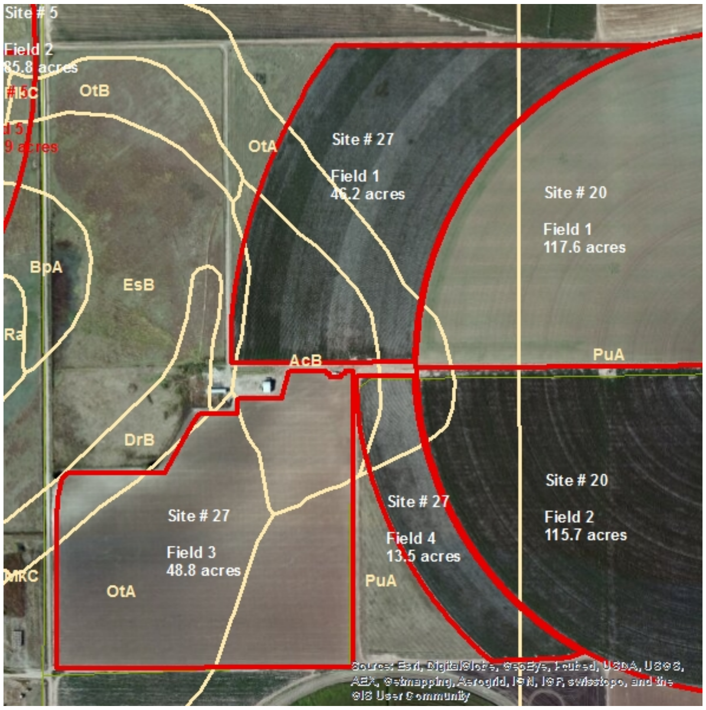


Net Returns per System Acre
Site terminated after 2015
Net returns ($)
0
100
200
300
400
500
600
700
800
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Per system acre



Net Returns per Unit of Water and N
Site terminated after 2015
Net returns per acre-inch of irrigation ($)
0
10
20
30
40
50
60
Net returns per pound of N ($)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Per acre-inch of irrigation water
Per pound of nitrogen

SITE 27 – TERMINATED AFTER 2014



Description:

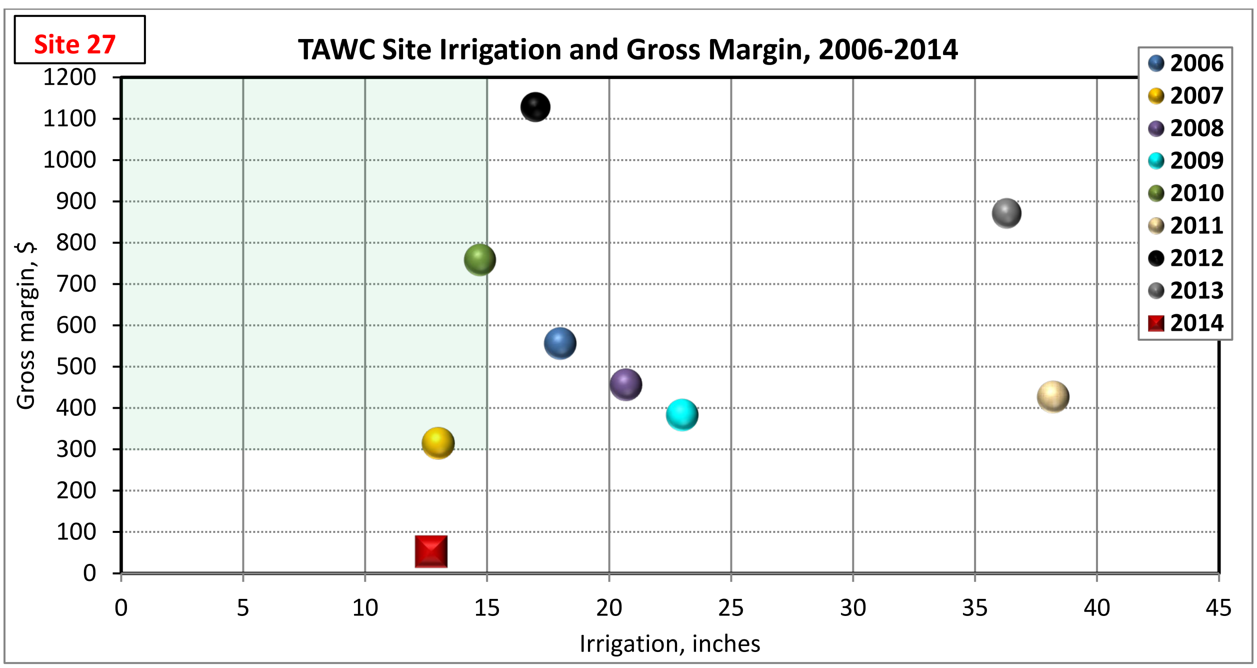
Site acres: 108.4

Soil types:
PuA-Pullman clay loam; 0 to 1%
OtA-Olton loam; 0 to 1%
AcB-Acuff loam; 1 to 3%

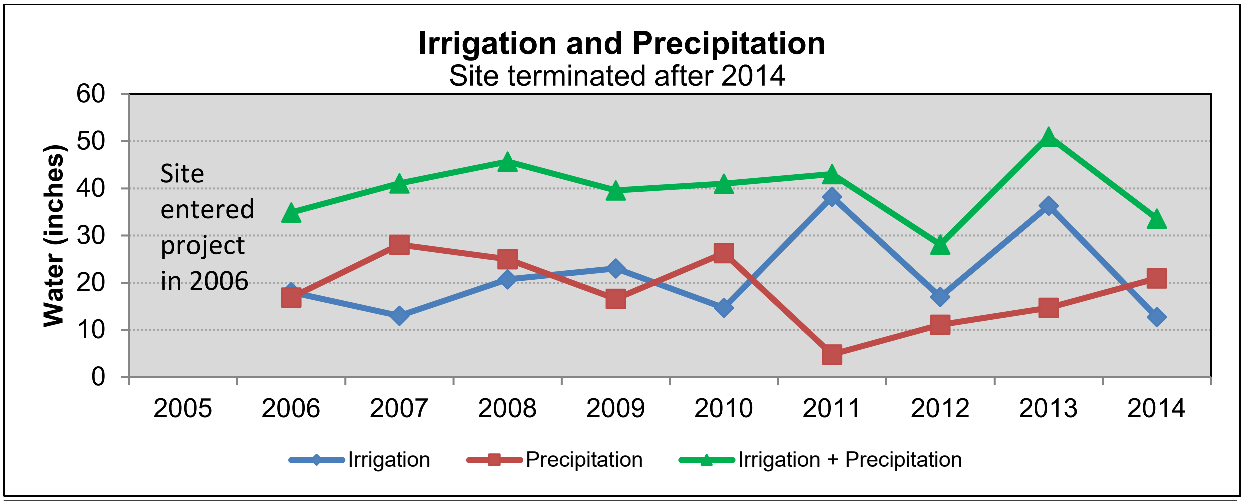
Irrigation:
Sub-Surface Drip (SDI) 400 gpm

Number of wells: 2

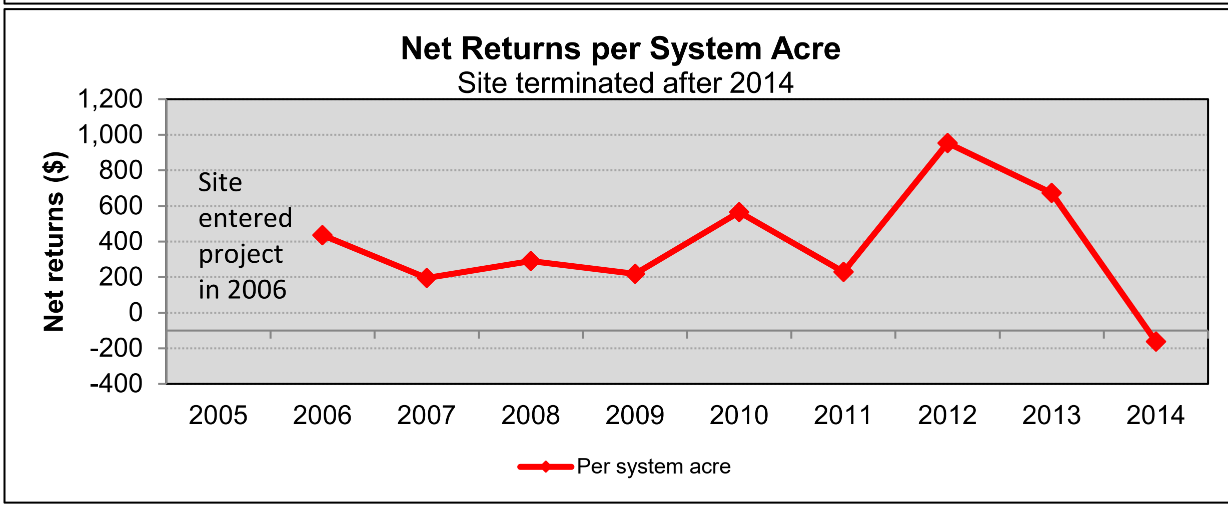
Fuel Source: Electric



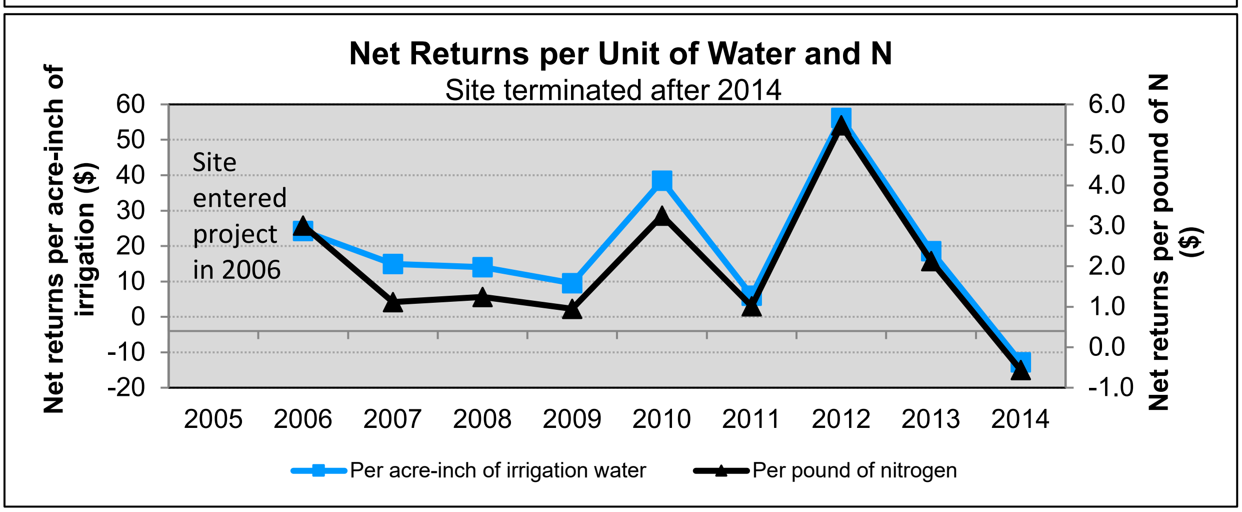
Site 27



Irrigation and Precipitation
Site terminated after 2014
Water (inches)
60
50
40
30
20
10
0
Site entered project in 2006
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Site terminated after 2014
Net returns ($)
1,200
1,000
800
600
400
200
0
-200
-400
Site entered project in 2006
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Per system acre



Net Returns per Unit of Water and N
Site terminated after 2014
Net returns per acre-inch of irrigation ($)
60
50
40
30
20
10
0
-10
-20
Net returns per pound of N ($)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
Site entered project in 2006
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Per acre-inch of irrigation water
Per pound of nitrogen

Site 28 – Terminated after 2016

Description:

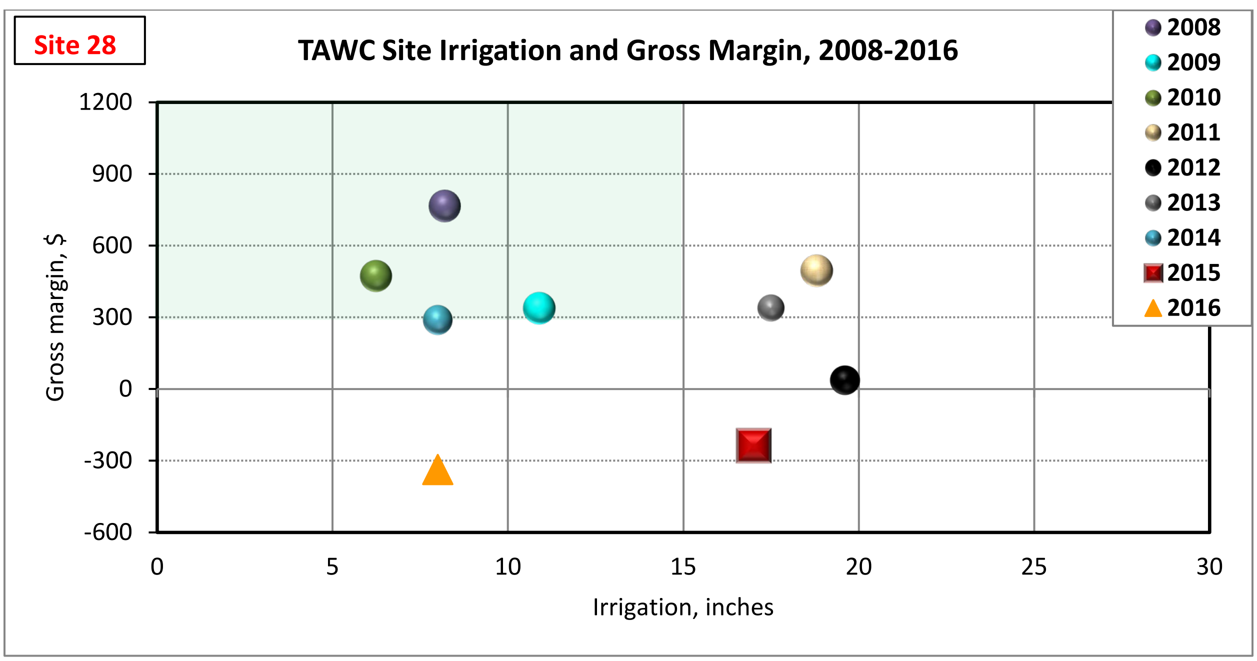
Site acres: 51.5

Soil types:
- PuA-Pullman clay loam; 0 to 1%
- PuB-Pullman clay loam; 1 to 3%
- OtA-Olton loam; 0 to 1%
- McA-McLean clay, 0 to 1%

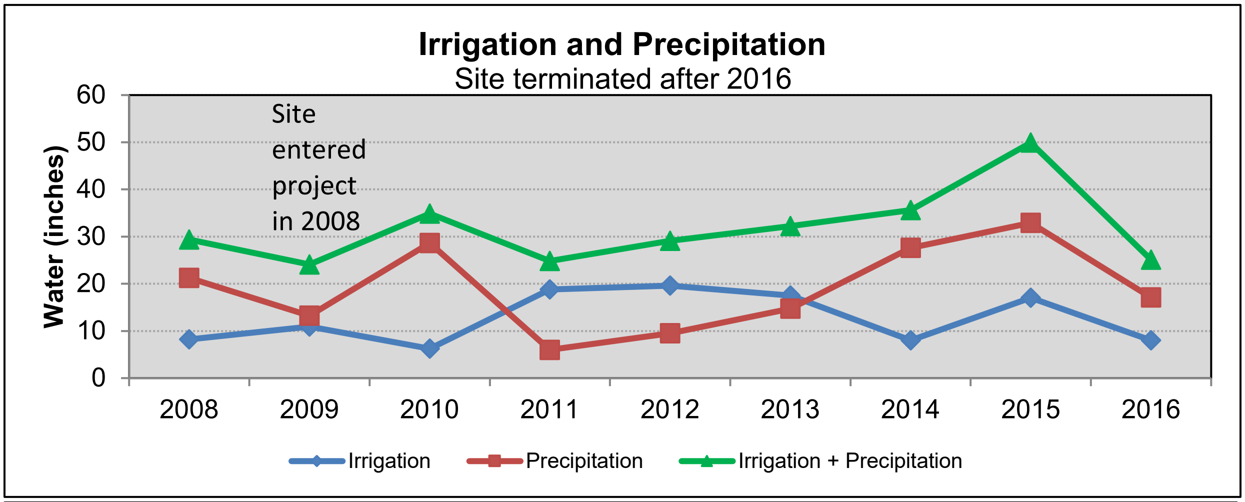
Irrigation:
Sub-Surface Drip (SDI) 300 gpm

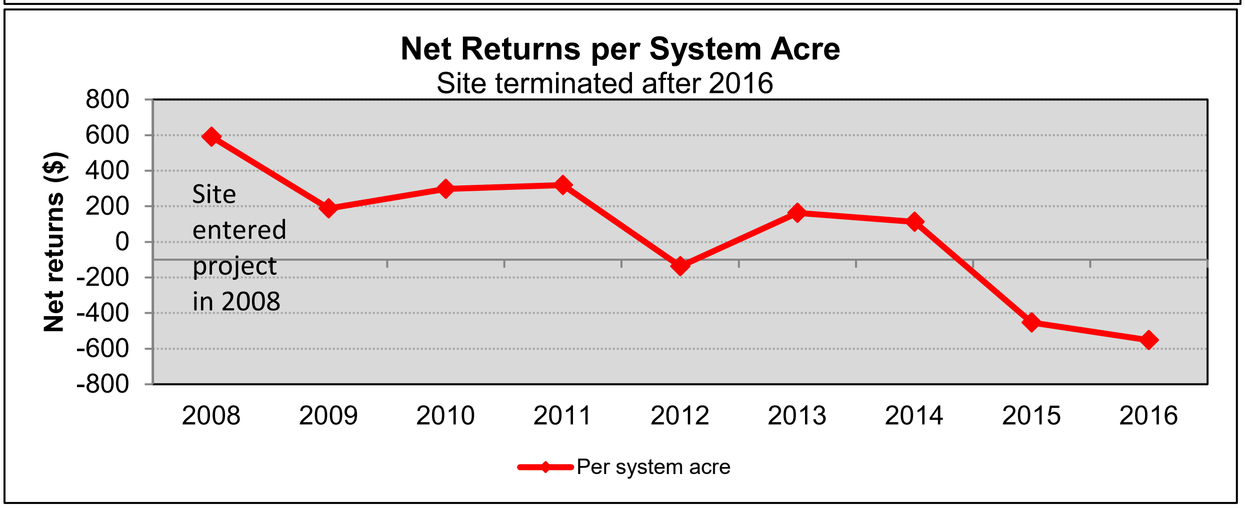
Number of wells: 1

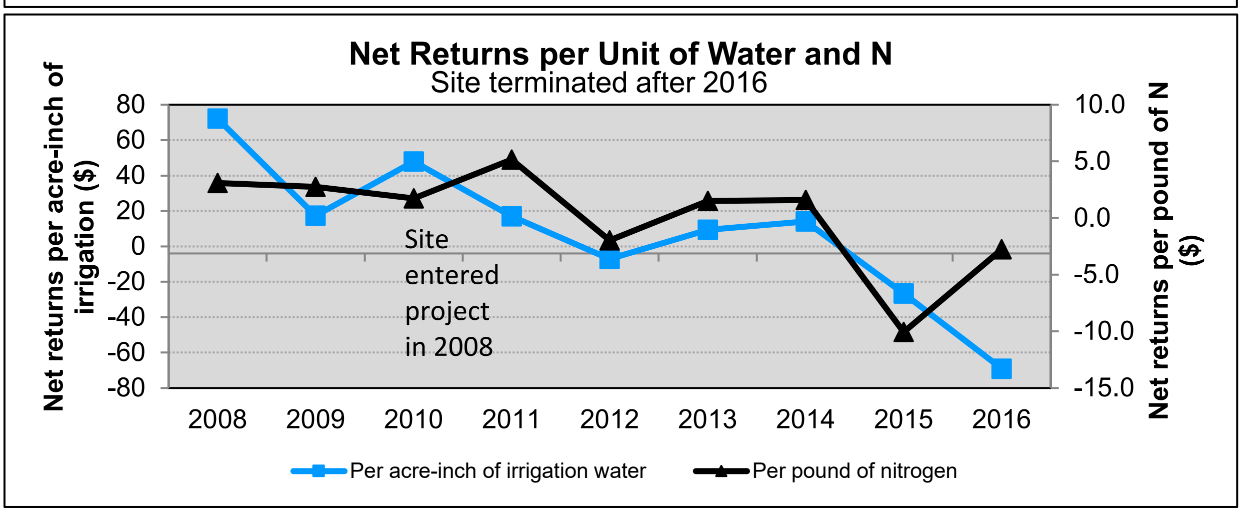
Fuel Source: Electric



Site 28


Irrigation and Precipitation
Site terminated after 2016
Water (inches)
60
50
40
30
20
10
0
Site
entered
project
in 2008
2008
2009
2010
2011
2012
2013
2014
2015
2016
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Site terminated after 2016
Net returns ($)
800
600
400
200
0
-200
-400
-600
-800
Site
entered
project
in 2008
2008
2009
2010
2011
2012
2013
2014
2015
2016
Per system acre


Net Returns per Unit of Water and N
Site terminated after 2016
Net returns per acre-inch of irrigation ($)
80
60
40
20
0
-20
-40
-60
-80
10.0
5.0
0.0
-5.0
-10.0
-15.0
Net returns per pound of N ($)
Site
entered
project
in 2008
2008
2009
2010
2011
2012
2013
2014
2015
2016
Per acre-inch of irrigation water
Per pound of nitrogen

Site 29 – Terminated after 2014

Description:

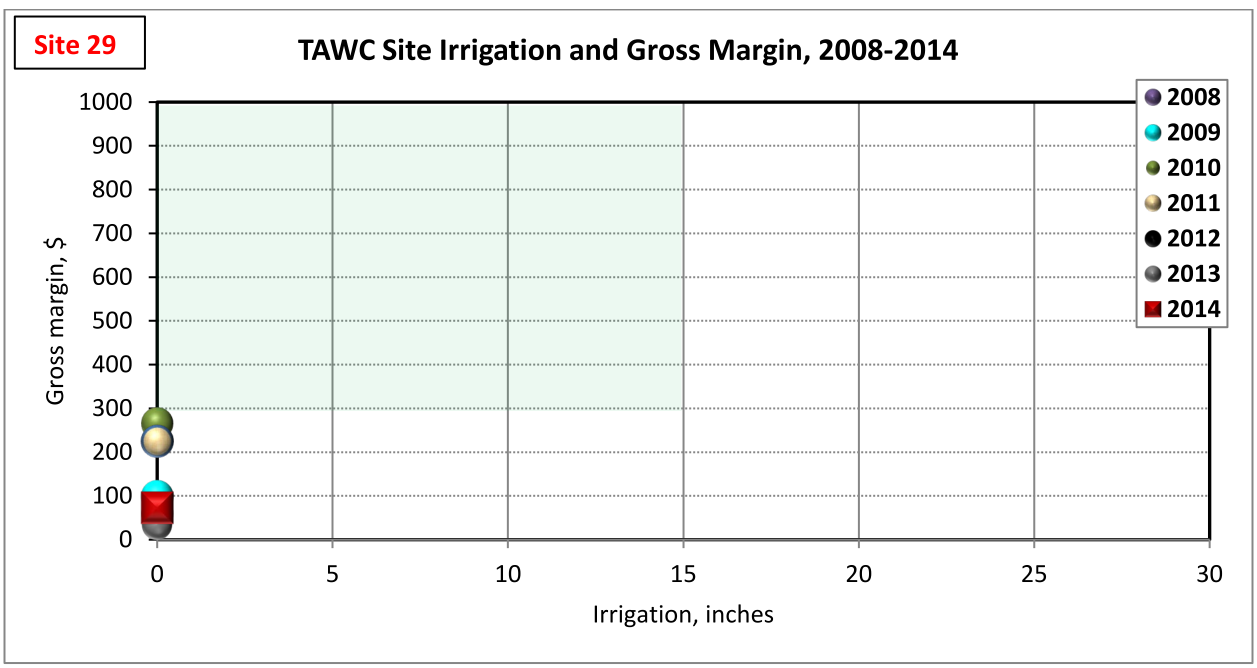
Site acres: 221.7

Soil types:
- PuA-Pullman clay loam; 0 to 1%
- LoA-Lofton clay loam; 0 to 1%
- EcB-Estacado clay loam; 1 to 3%

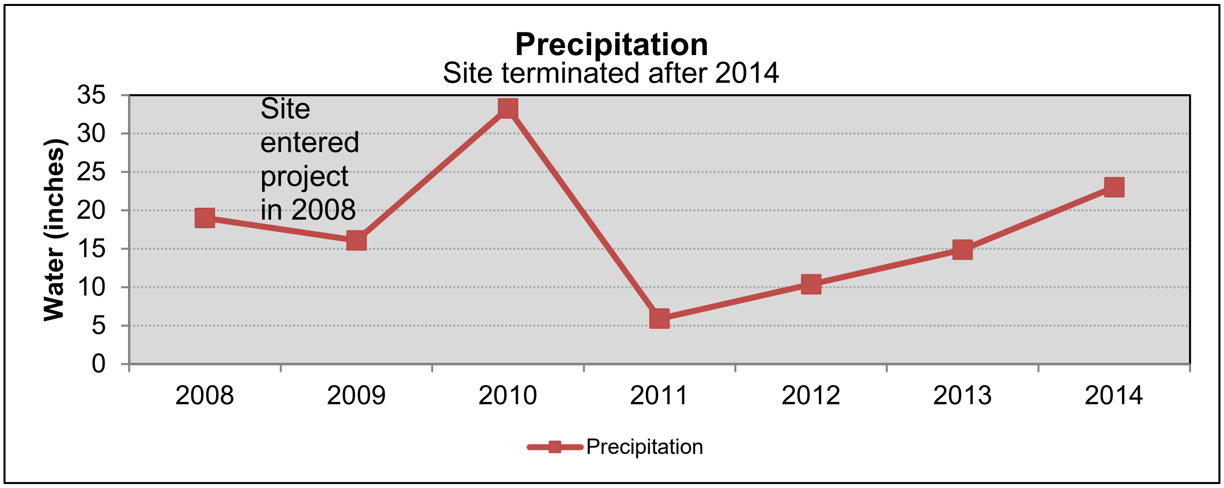
Irrigation:
- Dryland (DL) na gpm

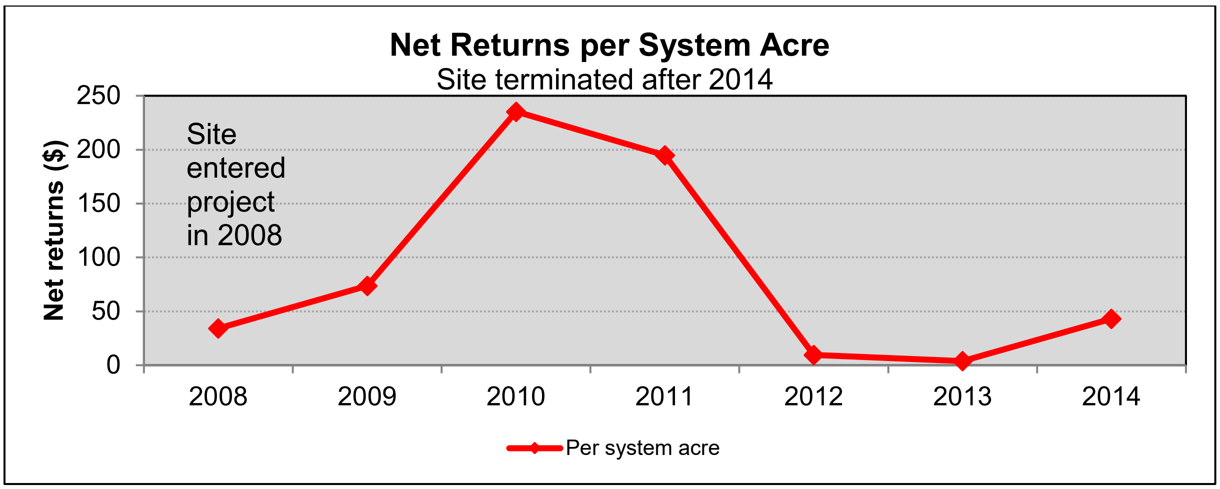
Number of wells: na

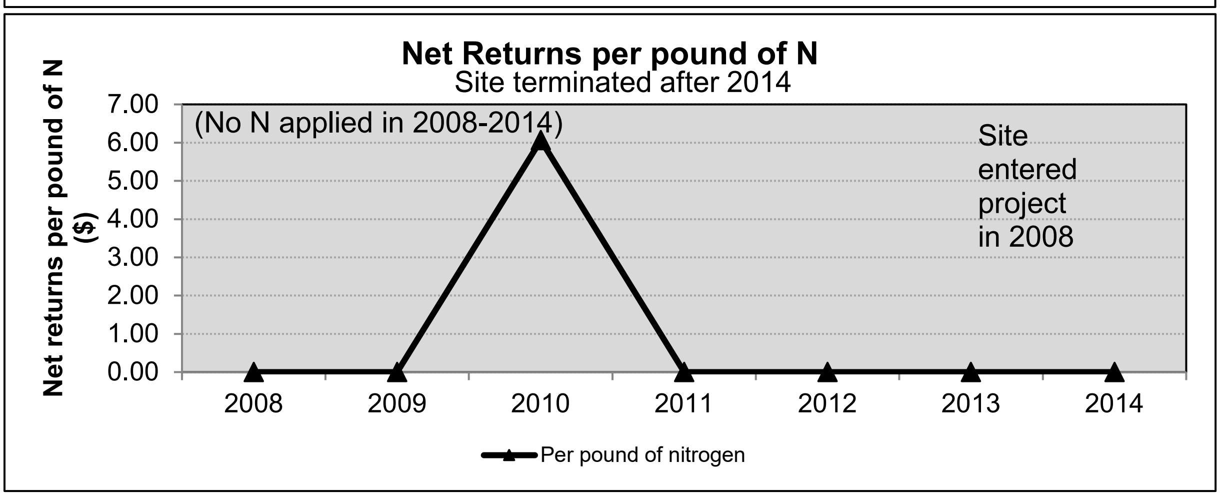
Fuel Source: na



Site 29 – Dryland Site







SITE 30-TERMINATED AFTER 2015

Description:

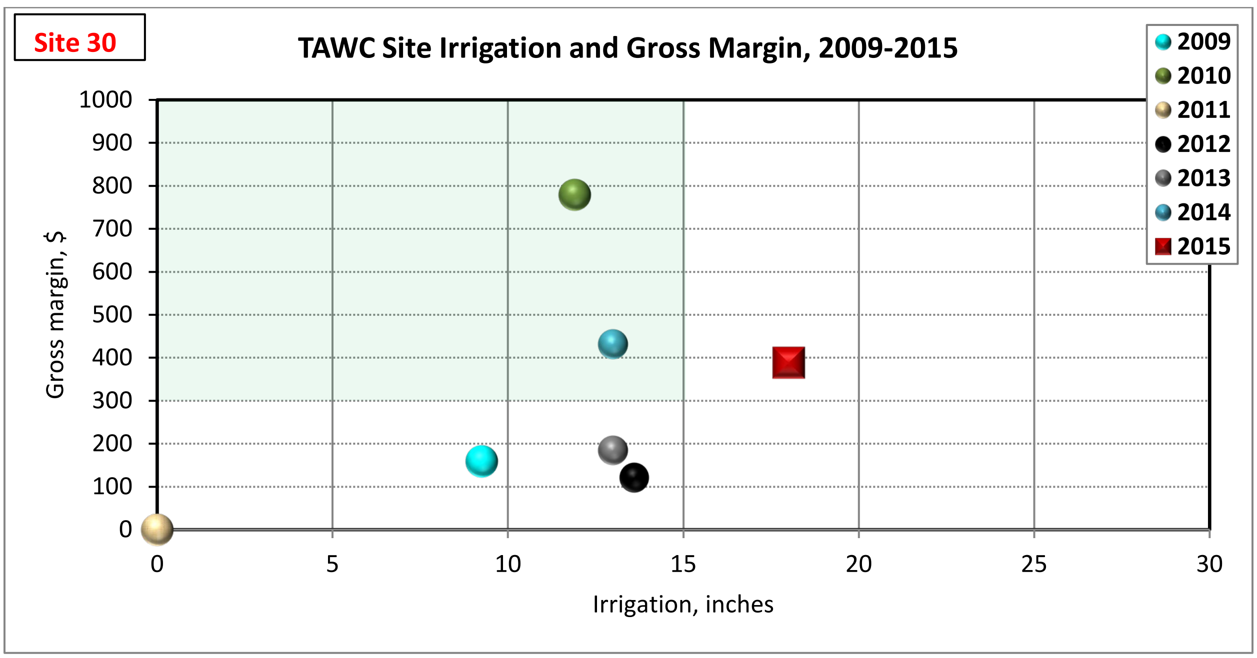
Site acres: 21.8

Soil types:
OtA-Olton loam; 0 to 1%
BpA-Bippus loam; 0 to 1%
BfB-Bippus fine sandy loam; 1 to 3%

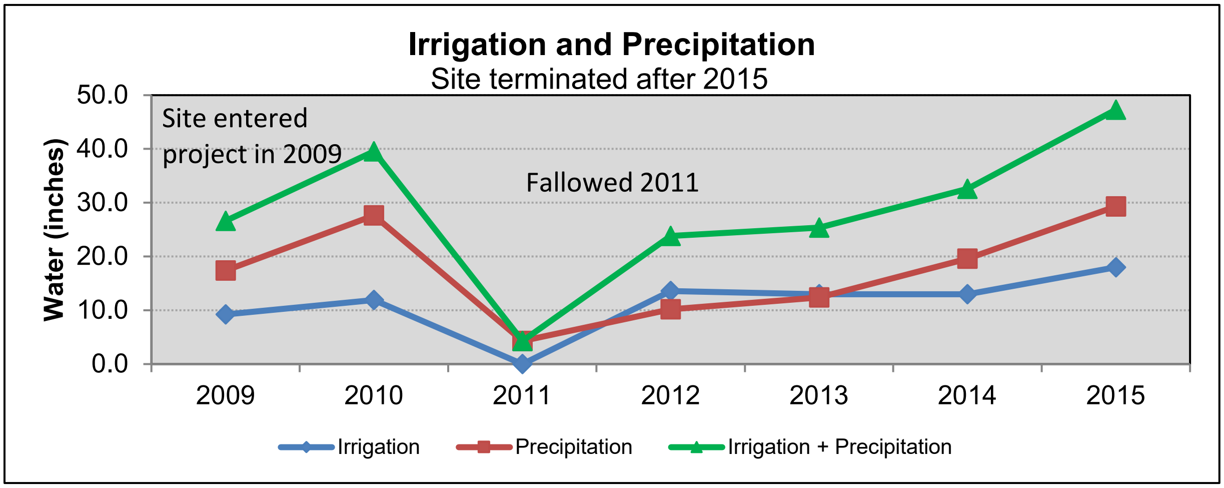
Irrigation:
Sub-Surface Drip (SDI)150 gpm

Number of wells: 1

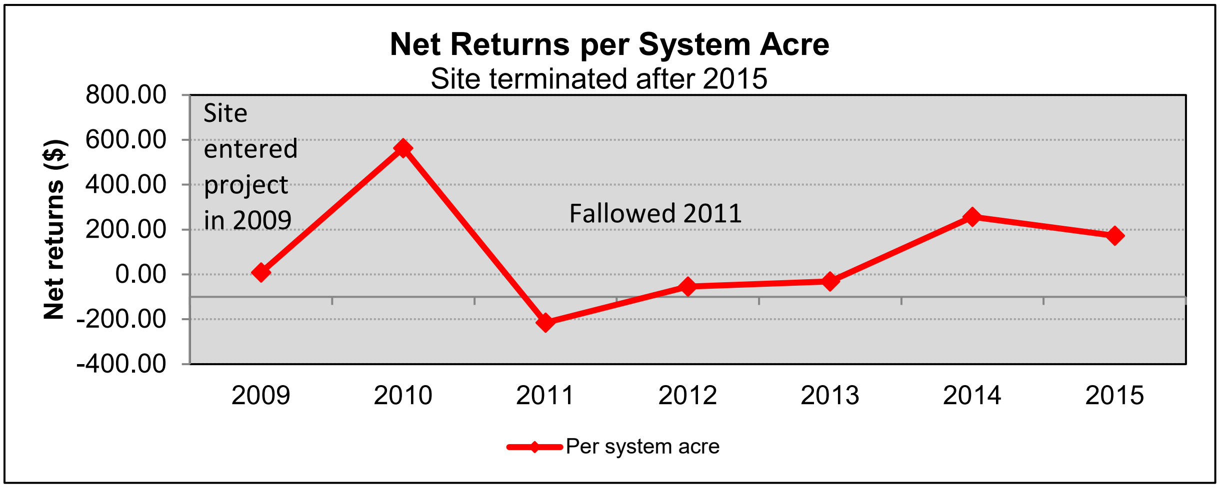
Fuel Source: Electric



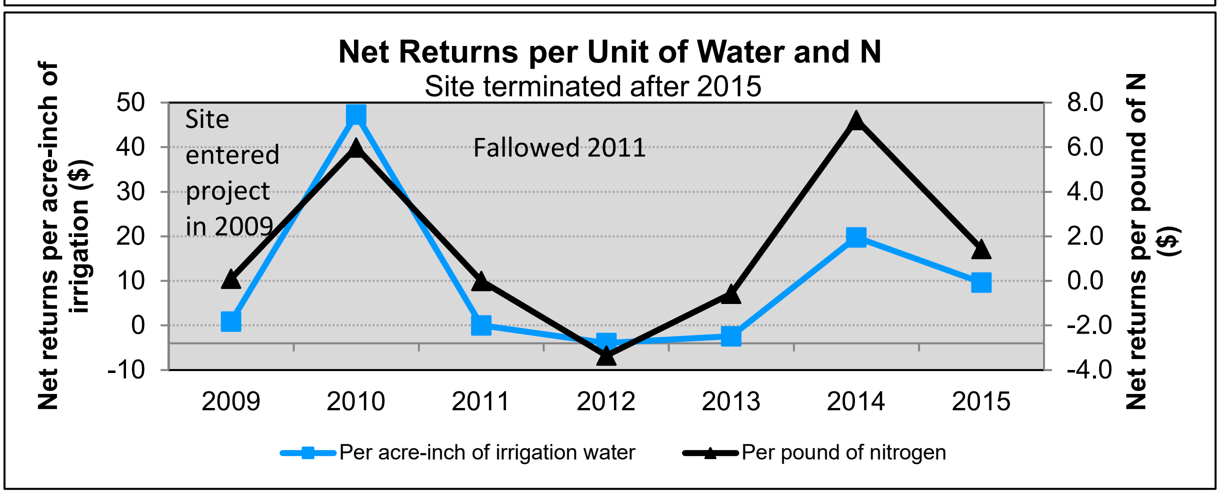
Site 30



Irrigation and Precipitation
Site terminated after 2015
Water (inches)
50.0
40.0
30.0
20.0
10.0
0.0
Site entered project in 2009
Fallowed 2011
2009
2010
2011
2012
2013
2014
2015
Irrigation
Precipitation
Irrigation + Precipitation

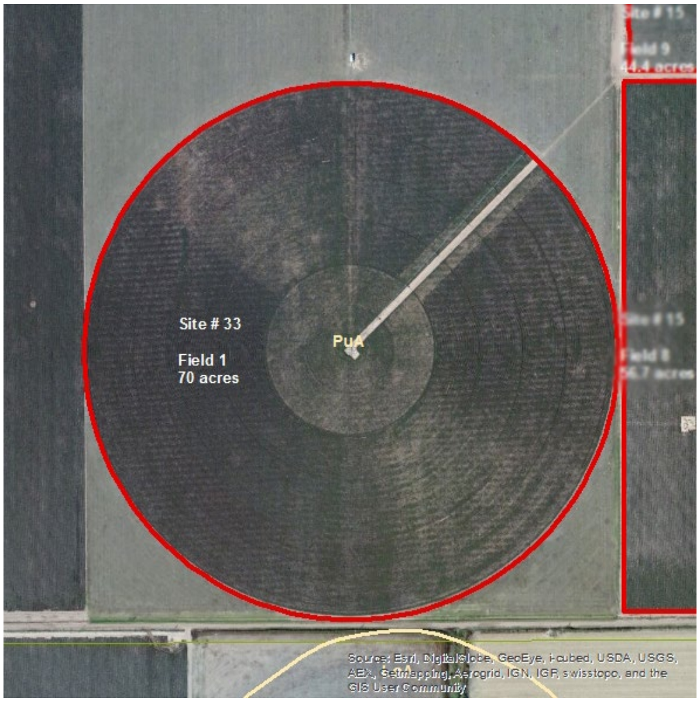


Net Returns per System Acre
Site terminated after 2015
Net returns ($)
800.00
600.00
400.00
200.00
0.00
-200.00
-400.00
Site entered project in 2009
Fallowed 2011
2009
2010
2011
2012
2013
2014
2015
Per system acre



Net Returns per Unit of Water and N
Site terminated after 2015
Net returns per acre-inch of irrigation ($)
50
40
30
20
10
0
-10
Net returns per pound of N ($)
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
Site entered project in 2009
Fallowed 2011
2009
2010
2011
2012
2013
2014
2015
Per acre-inch of irrigation water
Per pound of nitrogen

SITE 33 – TERMINATED AFTER 2016



Description:

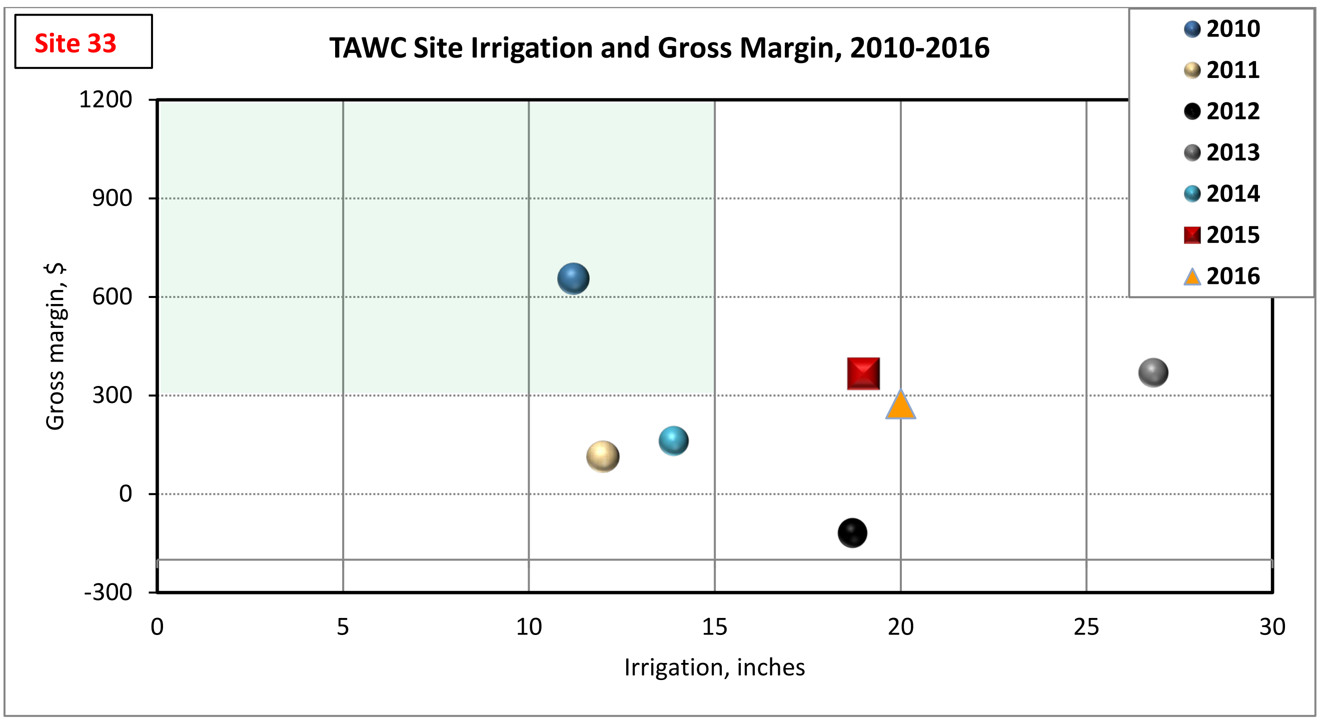
Site acres: 70

Soil types:
PuA-Pullman clay loam, 0 to 1%

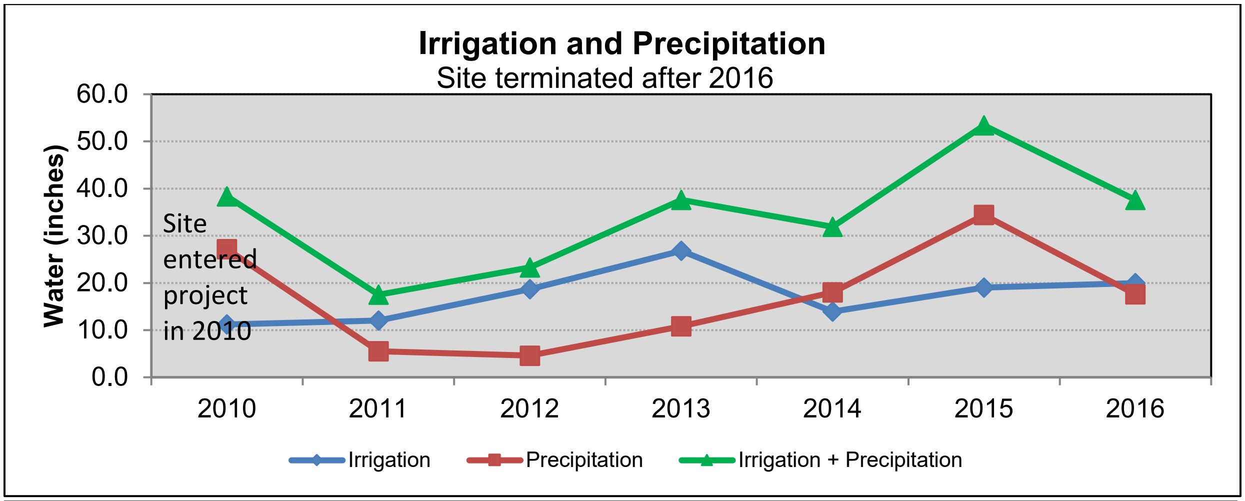
Irrigation:
Center Pivot (LEPA) 350 gpm

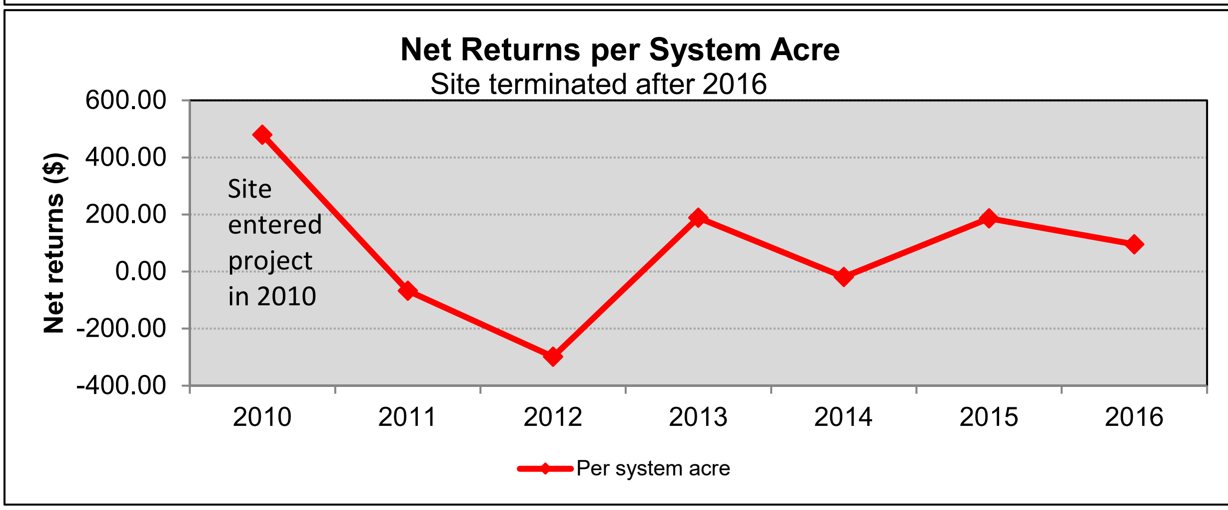
Number of wells: 2

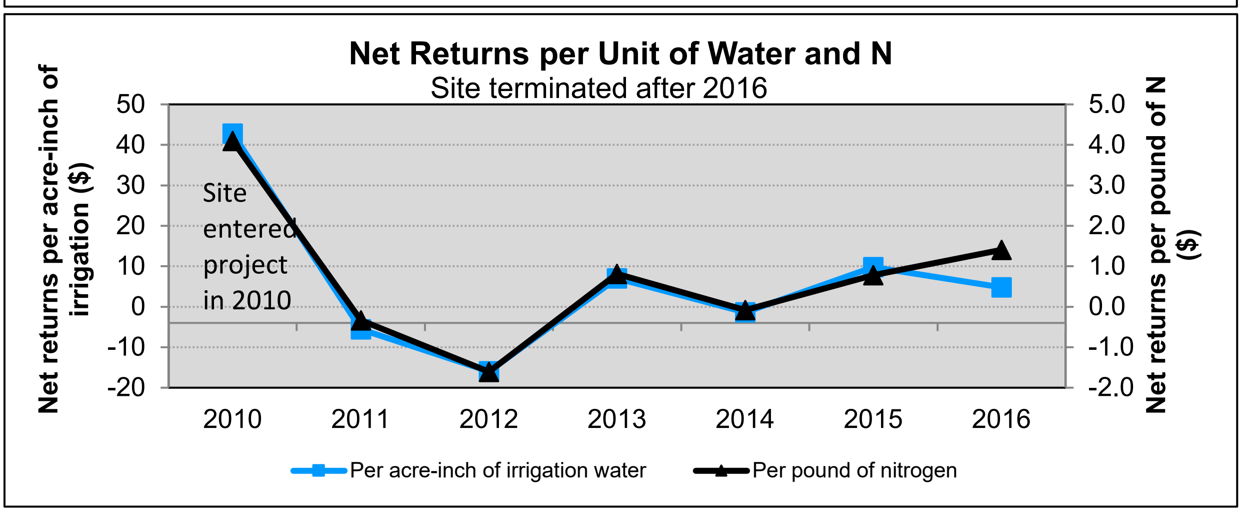
Fuel Source: Electric



Site 33


Irrigation and Precipitation
Site terminated after 2016
Water (inches)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Site entered project in 2010
2010
2011
2012
2013
2014
2015
2016
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Site terminated after 2016
Net returns ($)
600.00
400.00
200.00
0.00
-200.00
-400.00
Site entered project in 2010
2010
2011
2012
2013
2014
2015
2016
Per system acre


Net Returns per Unit of Water and N
Site terminated after 2016
Net returns per acre-inch of irrigation ($)
50
40
30
20
10
0
-10
-20
Net returns per pound of N ($)
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
Site entered project in 2010
2010
2011
2012
2013
2014
2015
2016
Per acre-inch of irrigation water
Per pound of nitrogen

SITE 34 – TERMINATED AFTER 2017

Description:

Site acres: 726

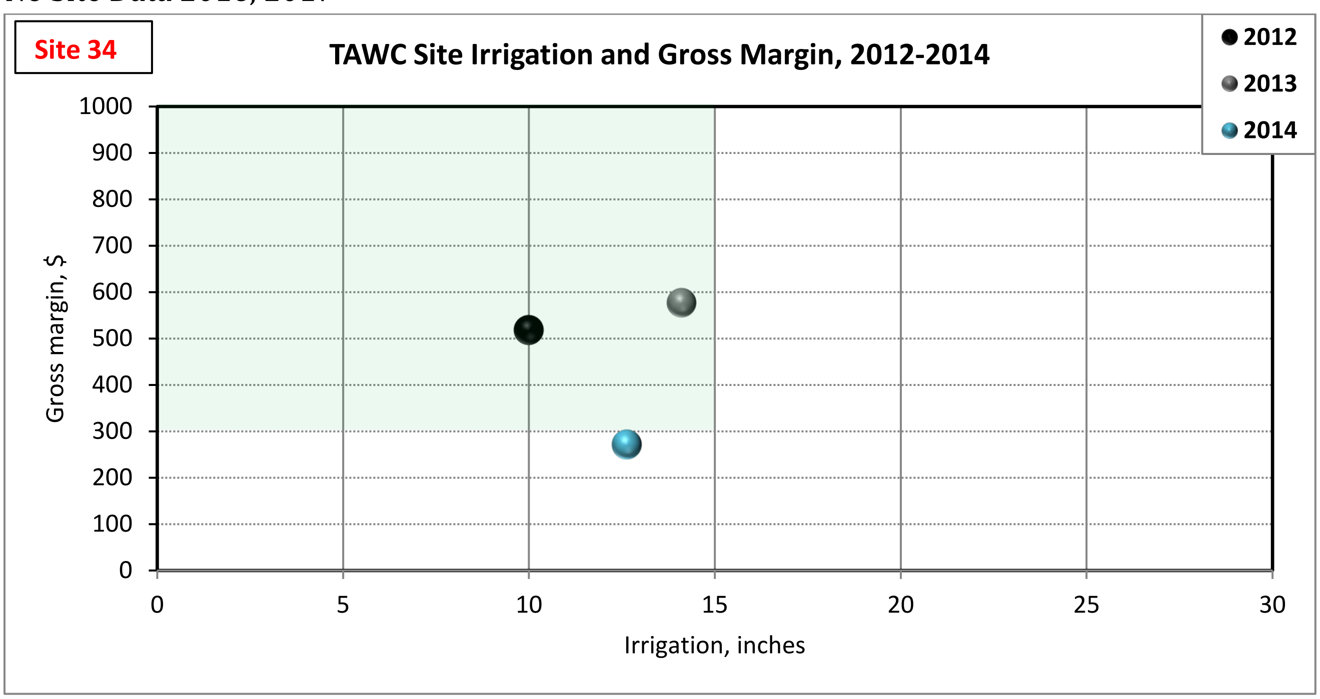
Soil types:
PuA-Pullman clay loam, 0 to 1%
LoA-Lofton clay loam, 0 to 1%
McA-McLean clay, 0 to 1%

Irrigation:
Center Pivot (LESA) 1600 gpm

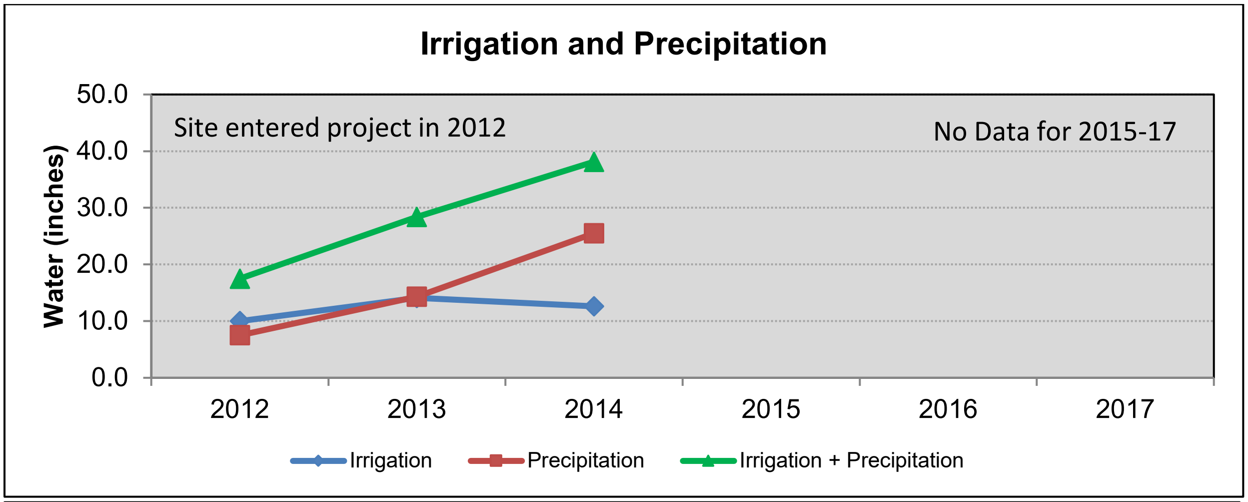
Number of wells: 2

Fuel Source: Electric

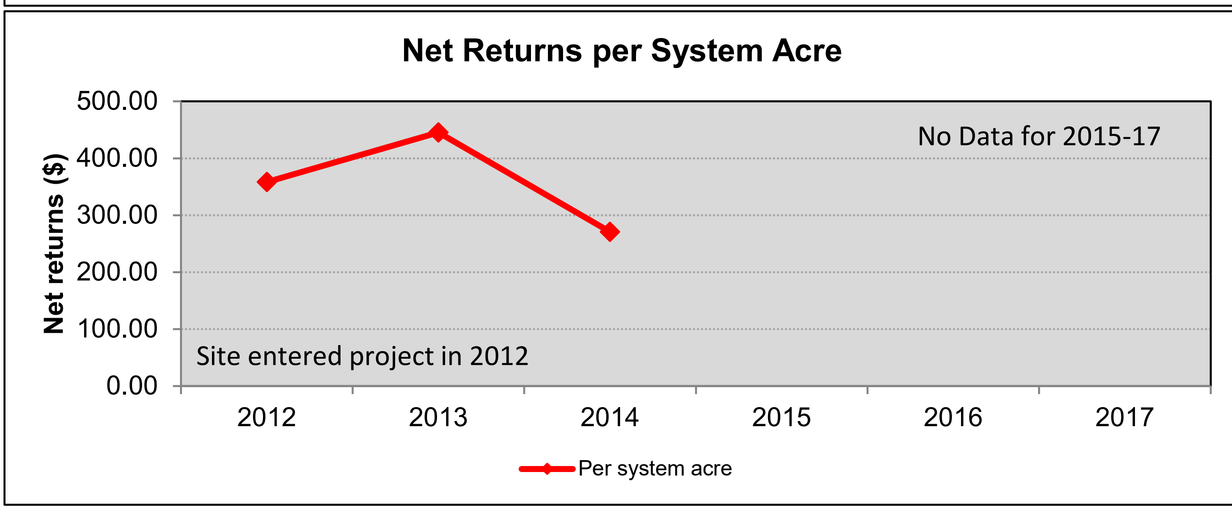
No Site Data 2016, 2017



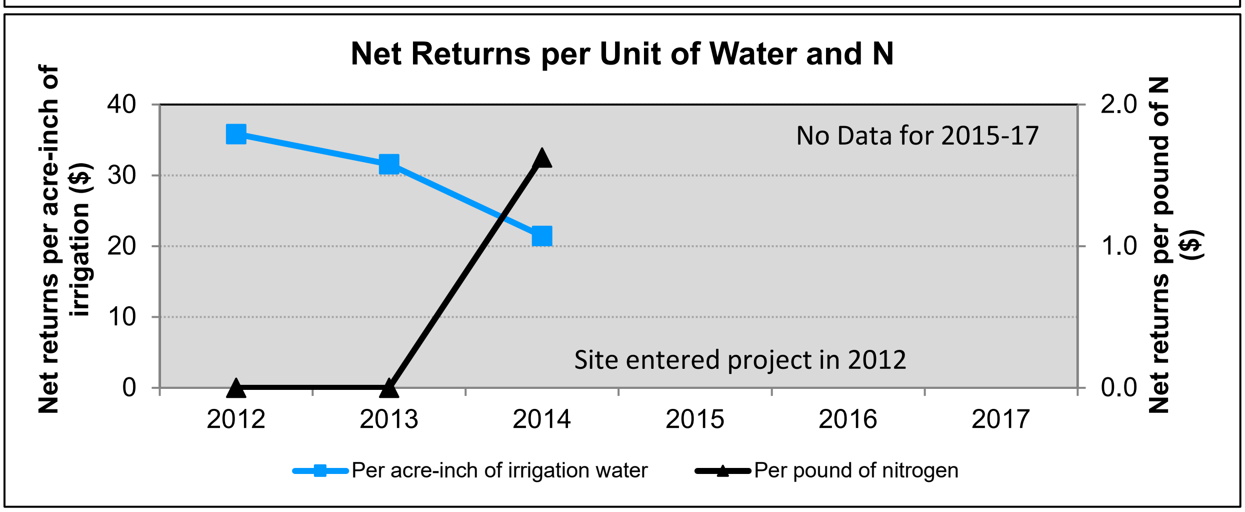
Site 34



Irrigation and Precipitation
Water (inches)
50.0
40.0
30.0
20.0
10.0
0.0
Site entered project in 2012
No Data for 2015-17
2012
2013
2014
2015
2016
2017
Irrigation
Precipitation
Irrigation + Precipitation



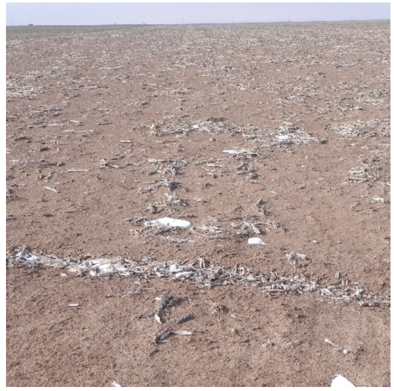
Net Returns per System Acre
Net returns ($)
500.00
400.00
300.00
200.00
100.00
0.00
No Data for 2015-17
Site entered project in 2012
2012
2013
2014
2015
2016
2017
Per system acre



Net Returns per Unit of Water and N
Net returns per acre-inch of irrigation ($)
40
30
20
10
0
Net returns per pound of N ($)
2.0
1.0
0.0
No Data for 2015-17
Site entered project in 2012
2012
2013
2014
2015
2016
2017
Per acre-inch of irrigation water
Per pound of nitrogen

Site 34

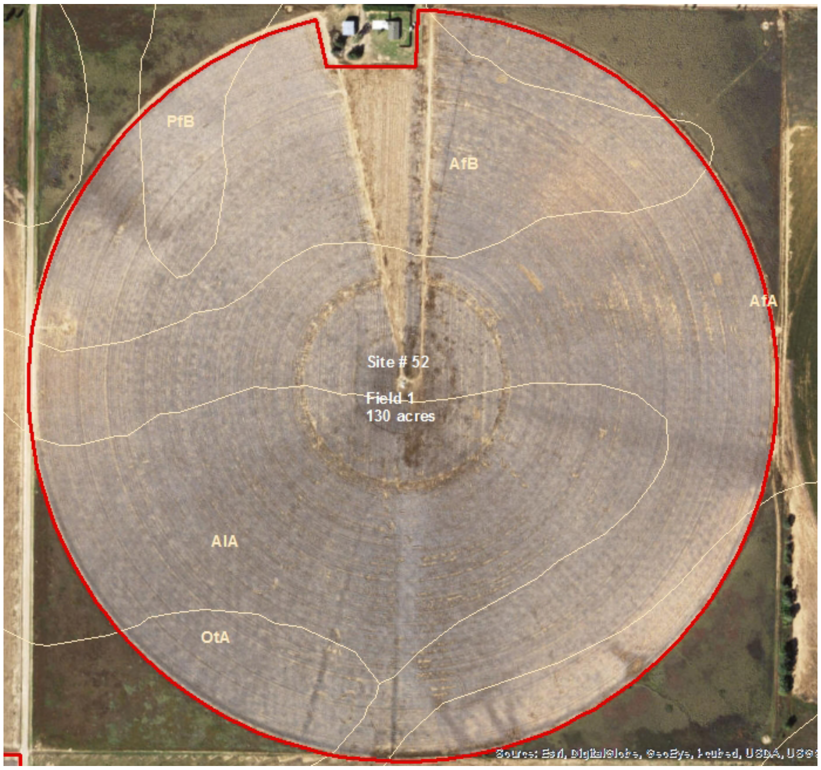
February snow in residue | February snow no residue | Preparing to water



June corn | Fertilize injection | July cotton

Comments: Site dropped after multiple consecutive years of no data collection.

SITE C52 – TERMINATED AFTER 2015



Description:

Site acres: 130

Soil types:

AfA-Amarillo fine sandy loam, 0 to 1%

AfB-Amarillo fine sandy loam; 1 to 3%

AlA- Acuff loam, 0 to 1%

OtA-Olton loam, 0 to 1%

PfB- Portales fine sandy loam, 1 to 3%

Irrigation:

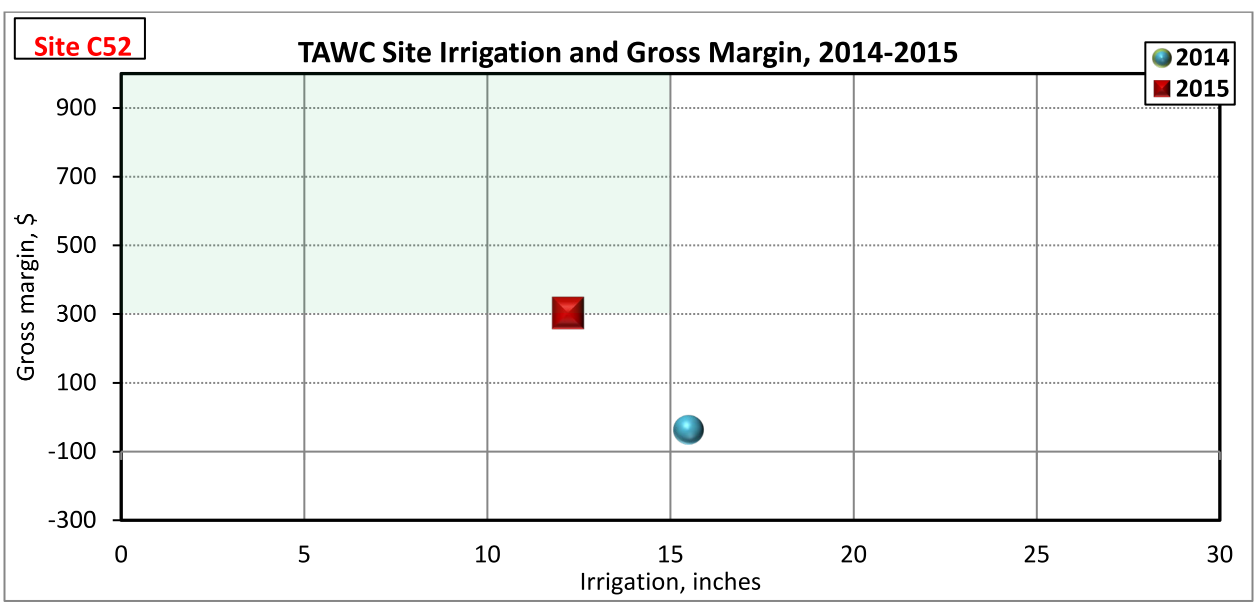
Low Elevation Spray Application

(SDI) 410 gpm

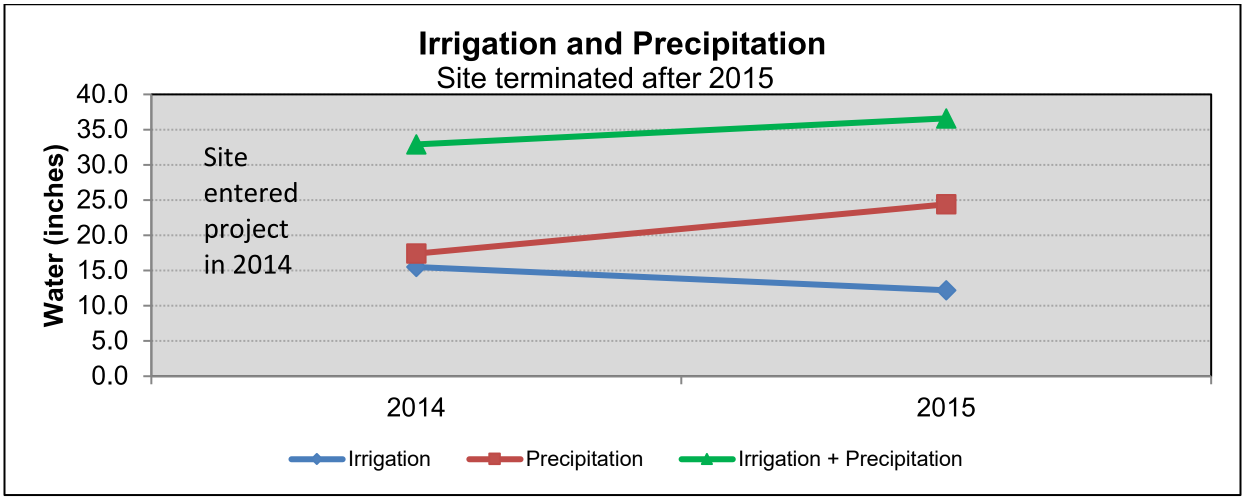
Number of wells: 3

Depth: 300 feet

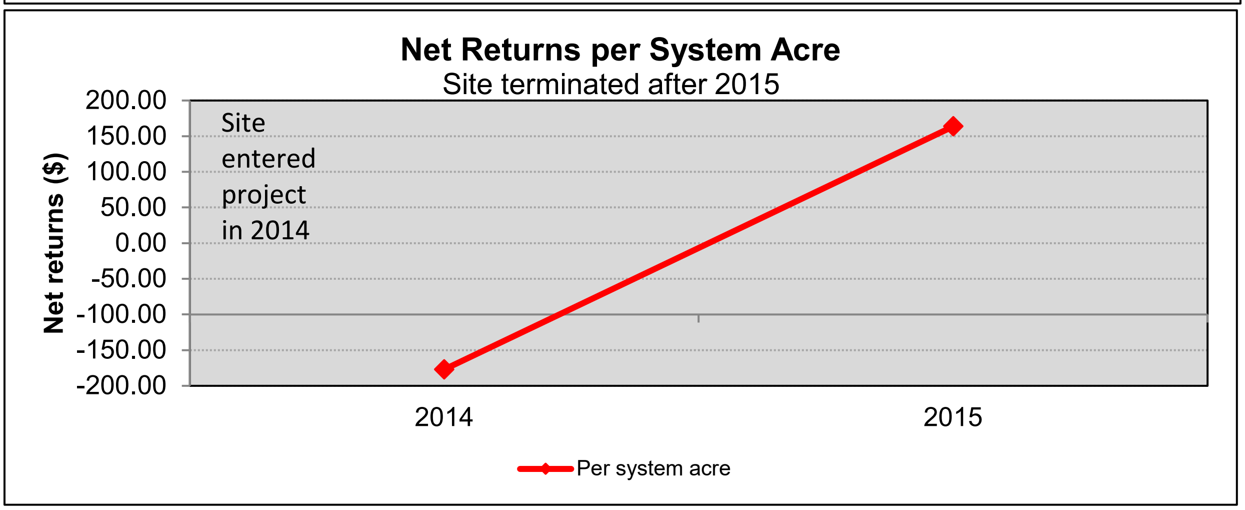
Fuel Source: Electric



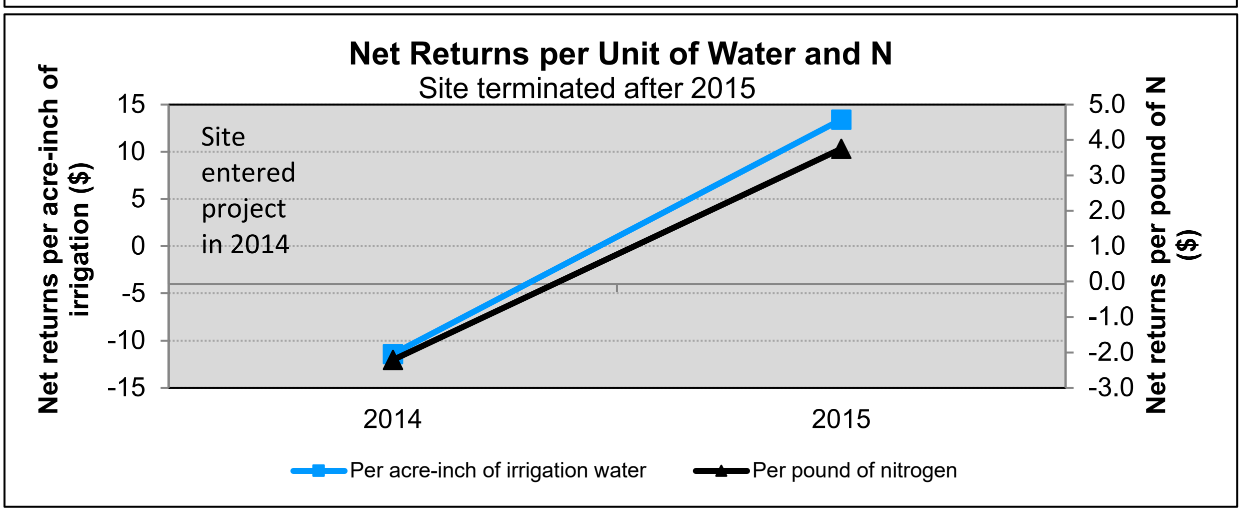
Site C52



Irrigation and Precipitation
Site terminated after 2015
Water (inches)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Site entered project in 2014
2014
2015
Irrigation
Precipitation
Irrigation + Precipitation

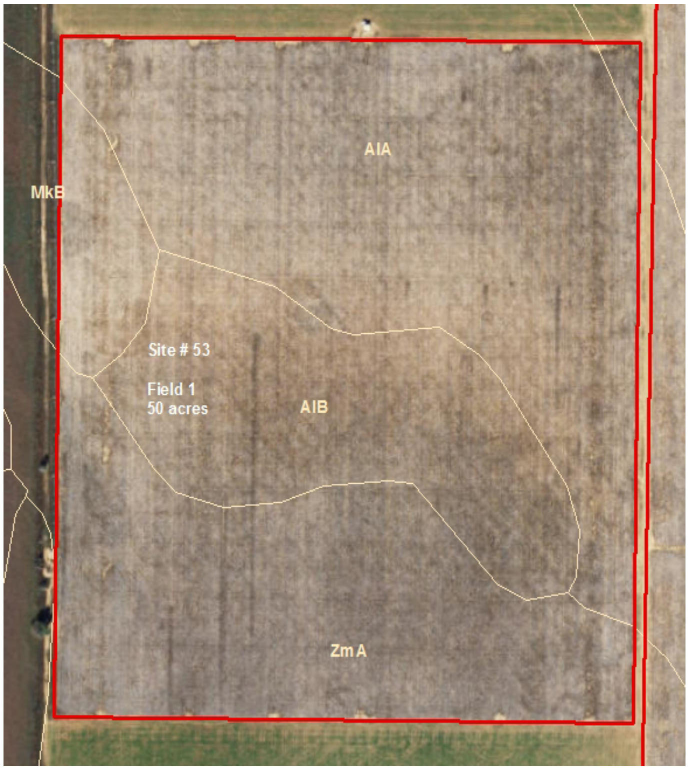


Net Returns per System Acre
Site terminated after 2015
Net returns ($)
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
Site entered project in 2014
2014
2015
Per system acre



Net Returns per Unit of Water and N
Site terminated after 2015
Net returns per acre-inch of irrigation ($)
15
10
5
0
-5
-10
-15
Site entered project in 2014
2014
2015
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
Net returns per pound of N ($)
Per acre-inch of irrigation water
Per pound of nitrogen

Site C53 – Terminated after 2015



Description:

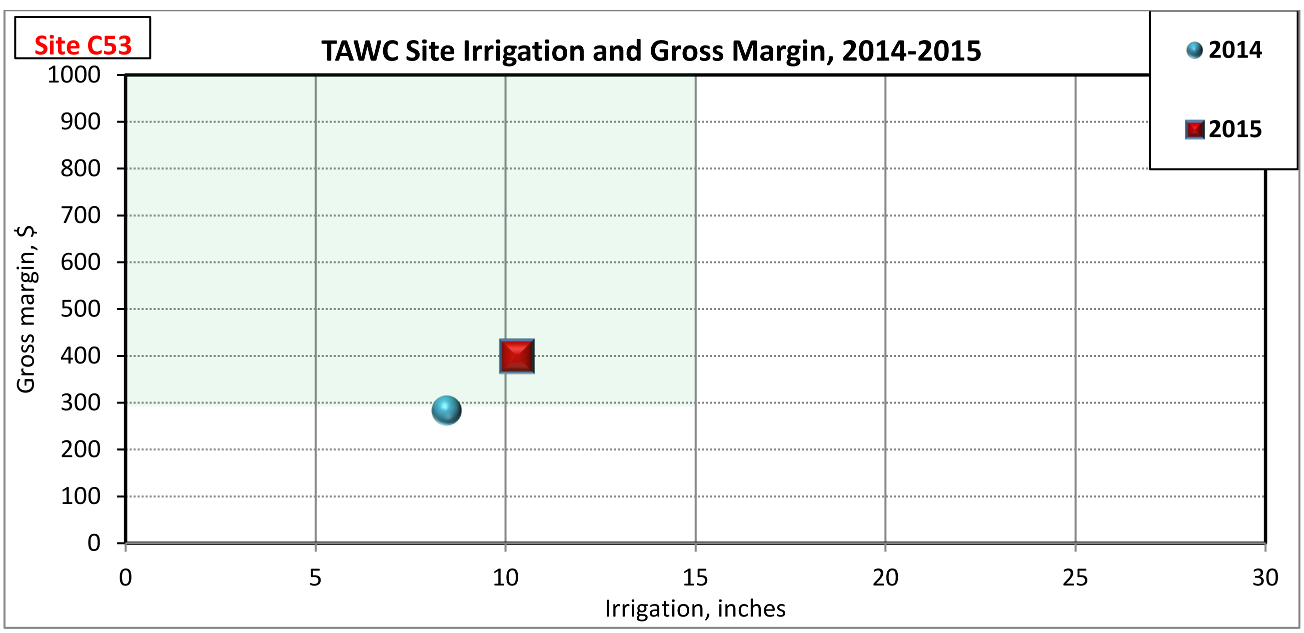
Site acres: 50

Soil types:
- AlA - Acuff loam; 0 to 1%
- AlB - Acuff loam, 1 to 3%
- MkB - Mansker loam 0 to 3%
- ZmA - Zita loam, 0 to 1%

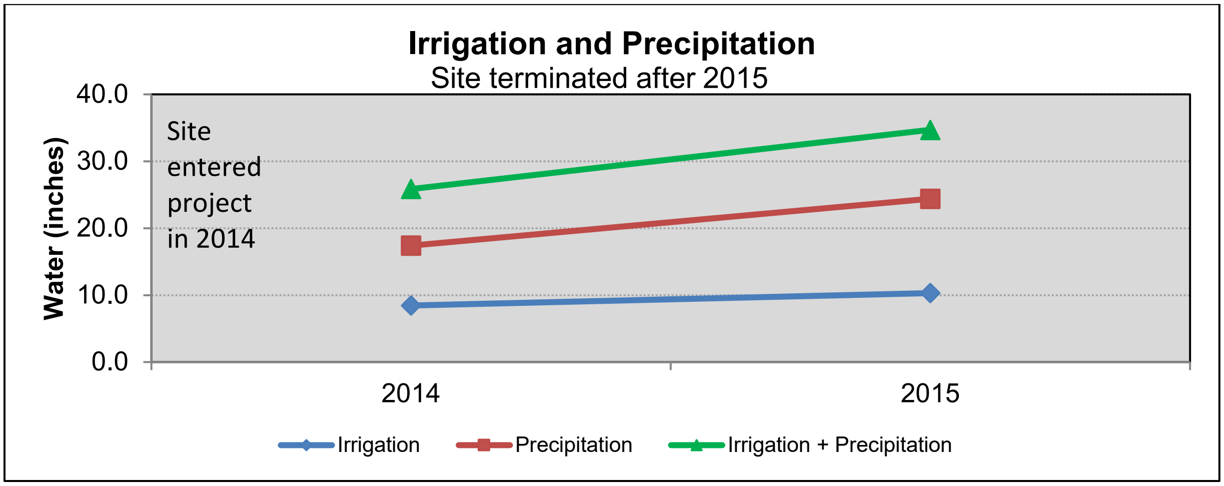
Irrigation:
40" Sub-surface Drip (SDI) 160 gpm

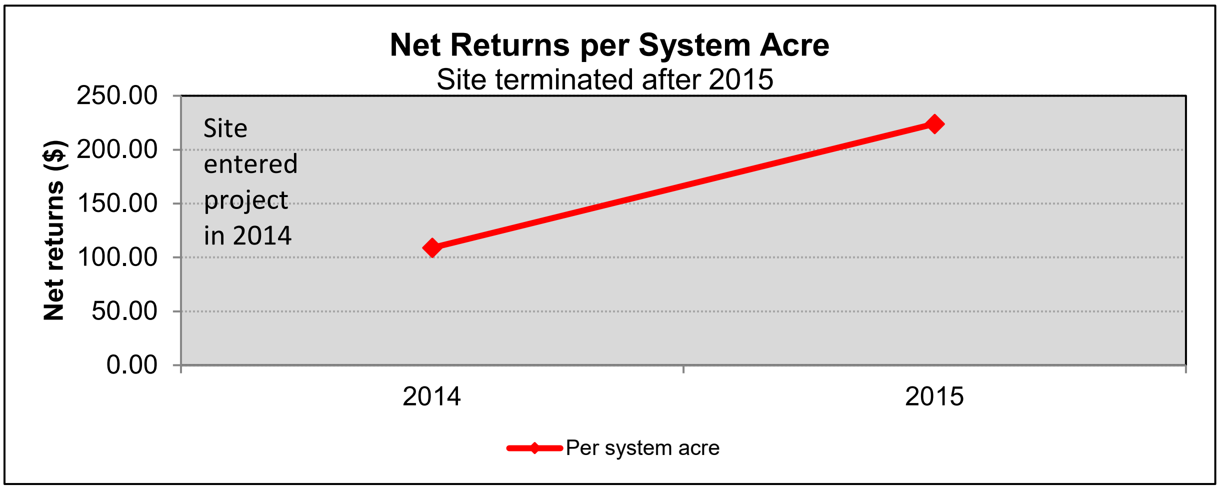
Number of wells: 3
Depth: 300 feet

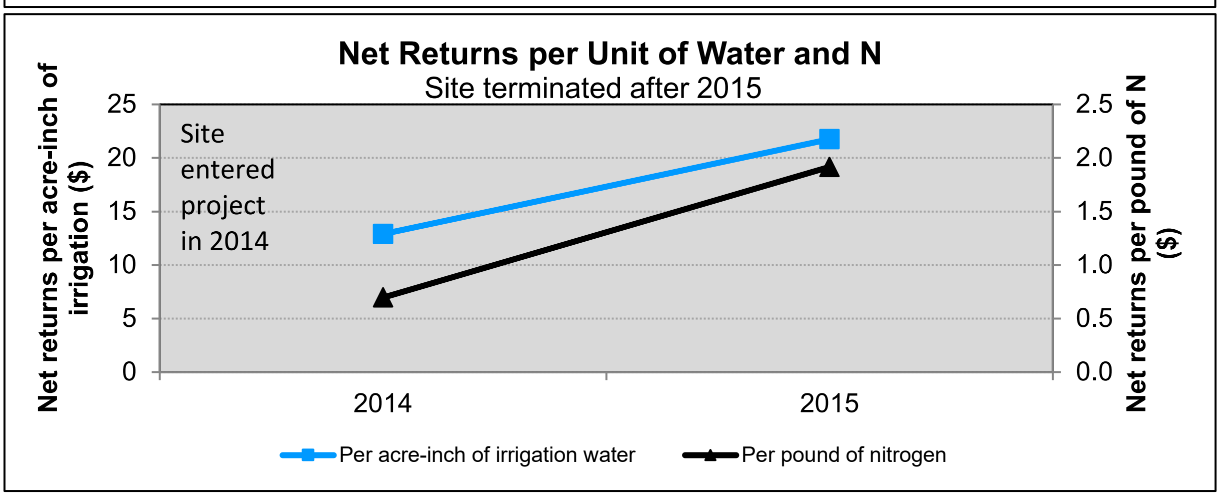
Fuel Source: Electric



Site C53


Irrigation and Precipitation
Site terminated after 2015
Water (inches)
40.0
30.0
20.0
10.0
0.0
Site
entered
project
in 2014
2014
2015
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Site terminated after 2015
Net returns ($)
250.00
200.00
150.00
100.00
50.00
0.00
Site
entered
project
in 2014
2014
2015
Per system acre


Net Returns per Unit of Water and N
Site terminated after 2015
Net returns per acre-inch of irrigation ($)
25
20
15
10
5
0
Site
entered
project
in 2014
2014
2015
2.5
2.0
1.5
1.0
0.5
0.0
Net returns per pound of N ($)
Per acre-inch of irrigation water
Per pound of nitrogen

Site C54 – Terminated after 2016

Description:

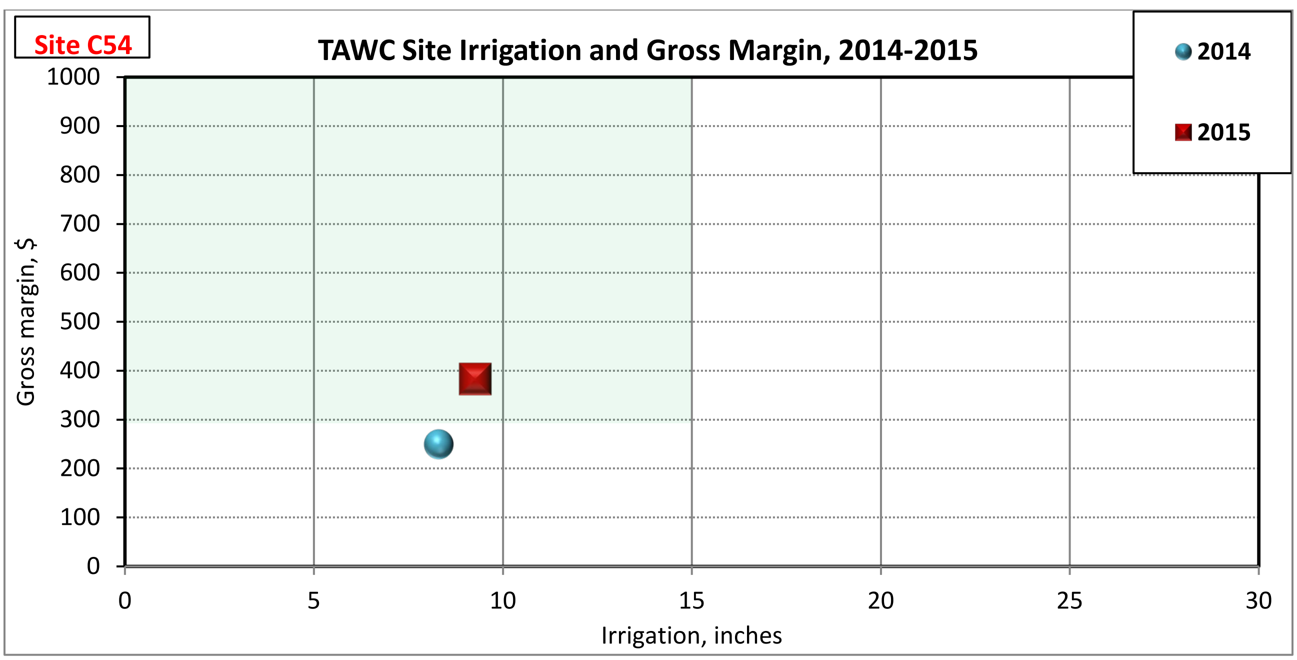
Site acres: 80

Soil types:
- OtA - Olton loam, 0 to 1%
- AlA - Acuff loam, 0 to 1%
- ZmA - Zita loam, 0 to 1%

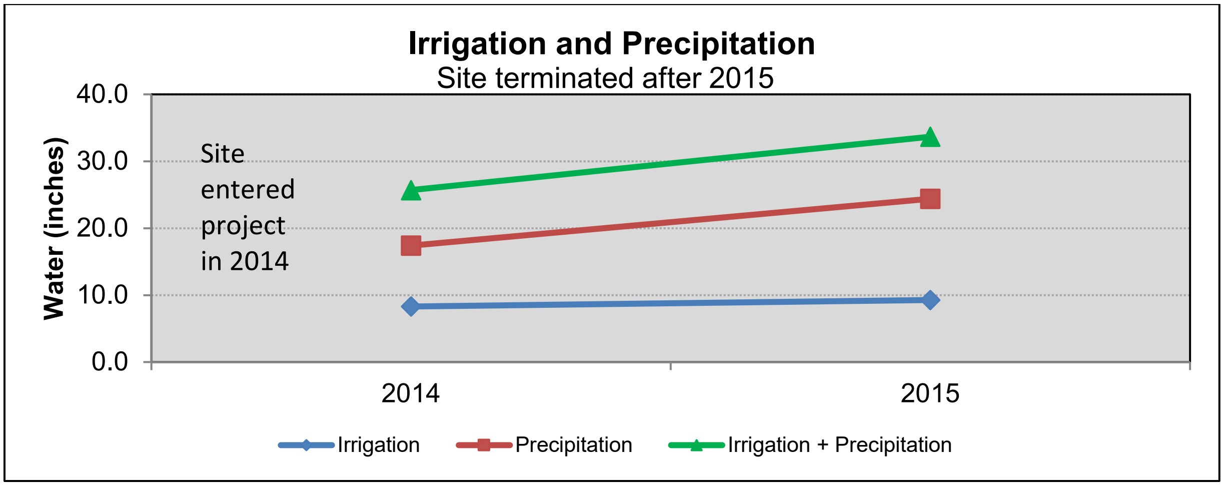
Irrigation:
80" Sub-surface Drip (SDI) 180 gpm

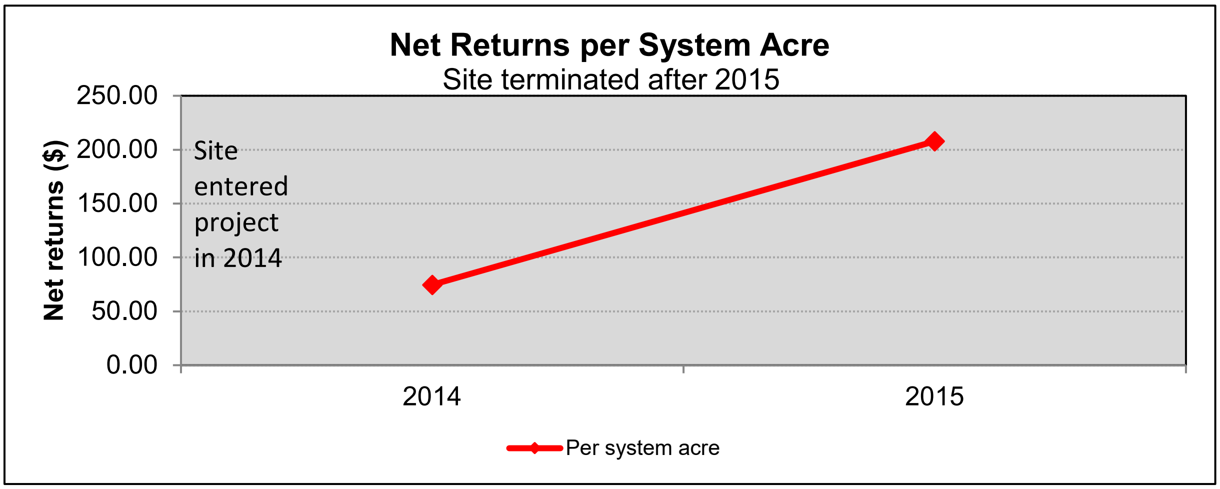
Number of wells: 2
Depth: 300 feet

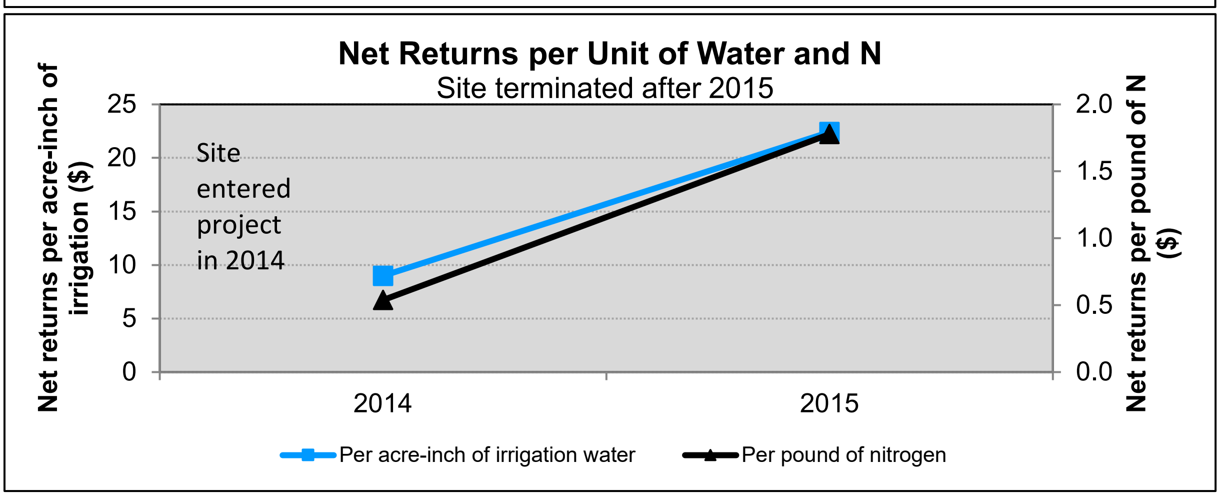
Fuel Source: Electric



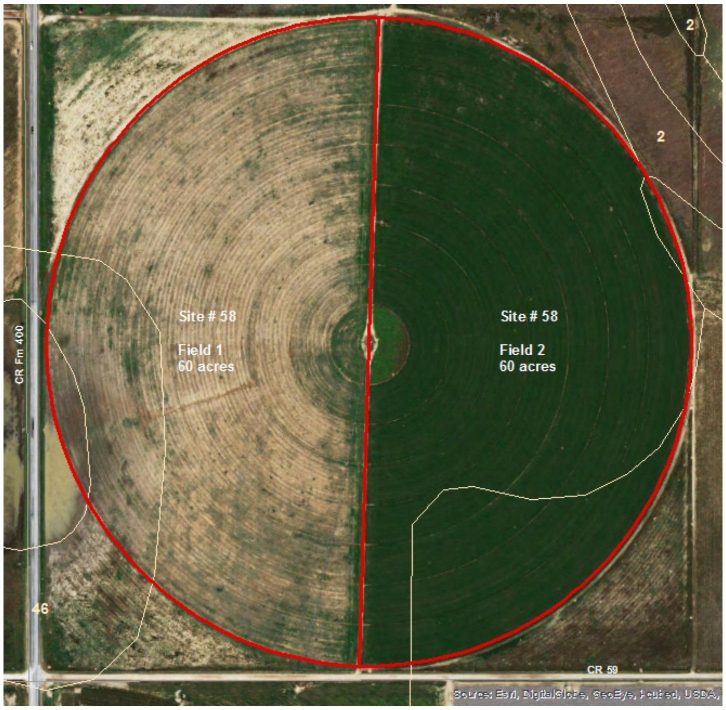
Site C54


Irrigation and Precipitation
Site terminated after 2015
Water (inches)
40.0
30.0
20.0
10.0
0.0
Site entered project in 2014
2014
2015
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Site terminated after 2015
Net returns ($)
250.00
200.00
150.00
100.00
50.00
0.00
Site entered project in 2014
2014
2015
Per system acre


Net Returns per Unit of Water and N
Site terminated after 2015
Net returns per acre-inch of irrigation ($)
25
20
15
10
5
0
Net returns per pound of N ($)
2.0
1.5
1.0
0.5
0.0
Site entered project in 2014
2014
2015
Per acre-inch of irrigation water
Per pound of nitrogen

Site C58 – Terminated after 2015



Description:

Site acres: 120.0

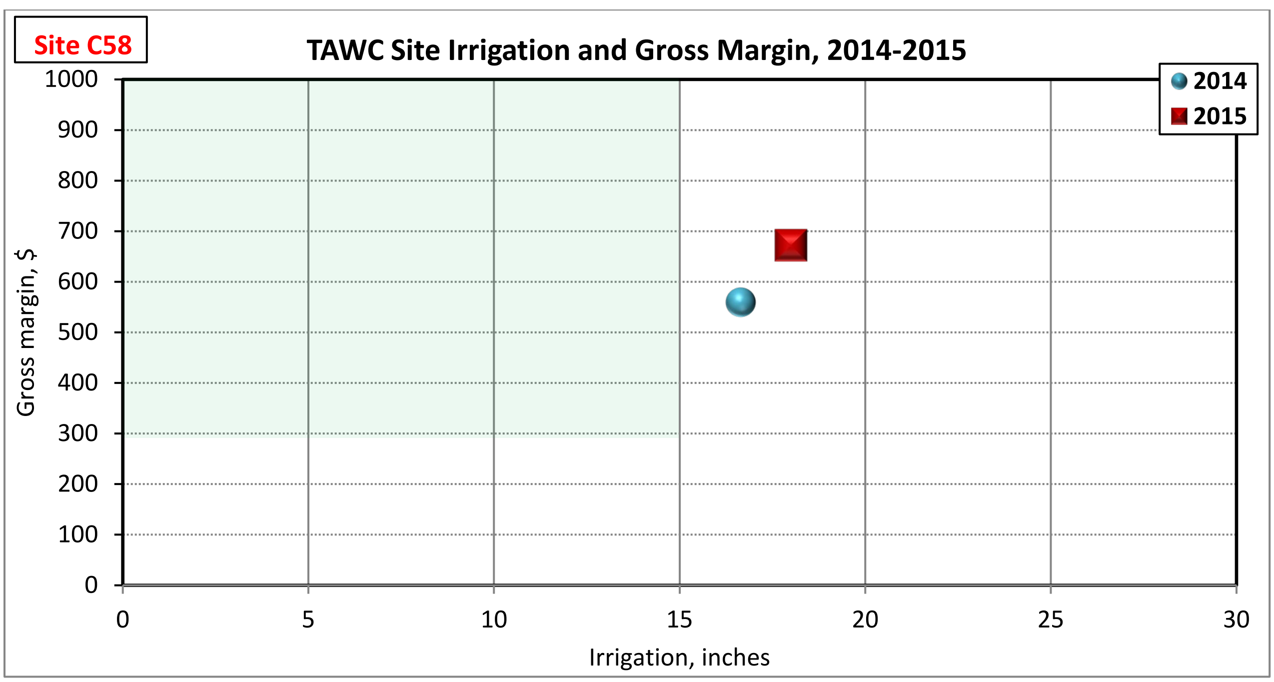
Soil types:
- 30 - Olton clay loam, 0 to 1%
- 41 - Pullman clay loam, 0to 1%
- 46 - Zita loam, 0 to 1%

Irrigation:
Low Elevation Spray Application (LESA) 450 gpm

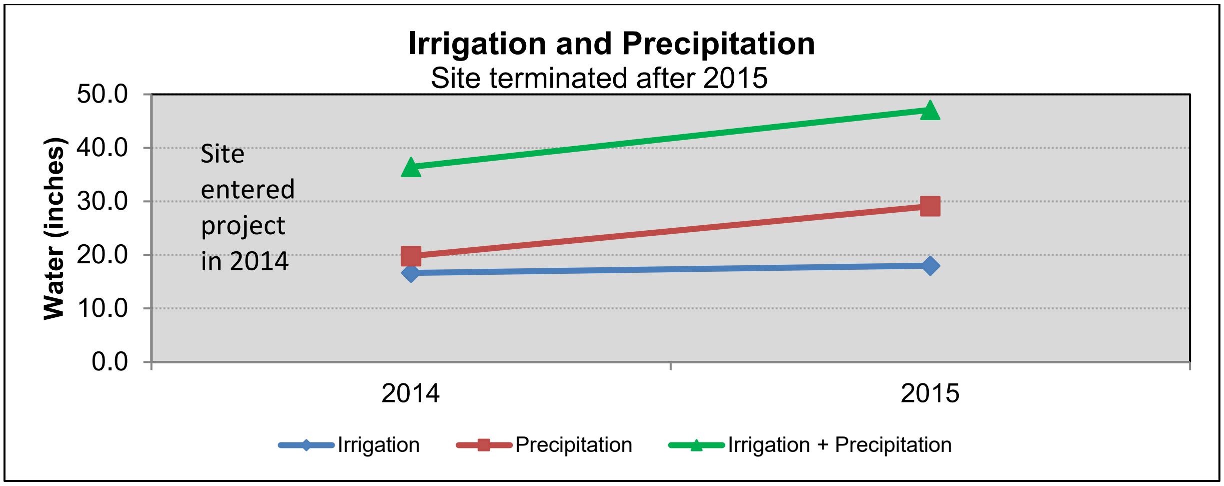
Number of wells: 2
Depth: 300 feet

Fuel Source: Electric

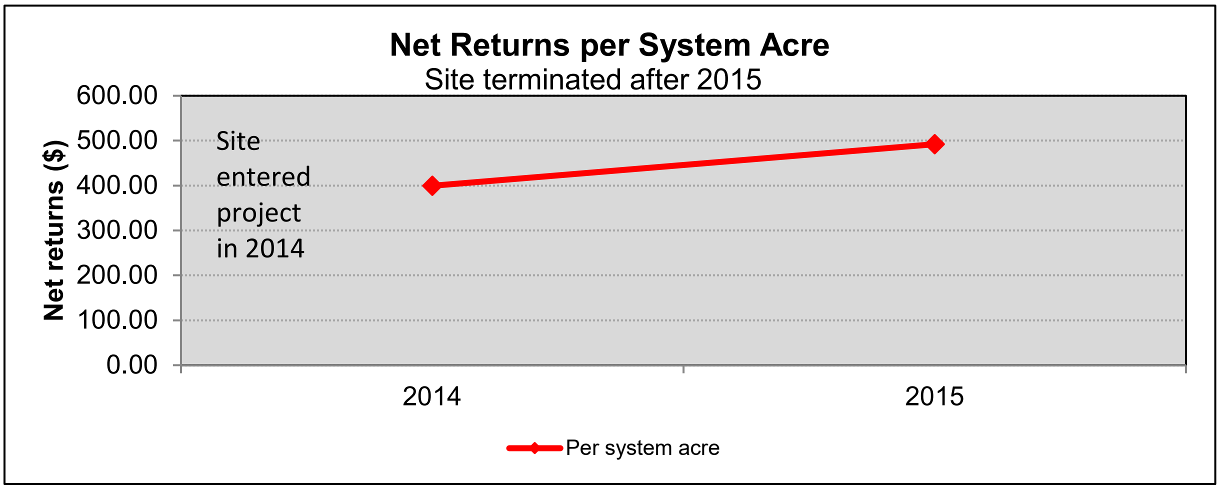
Site C58



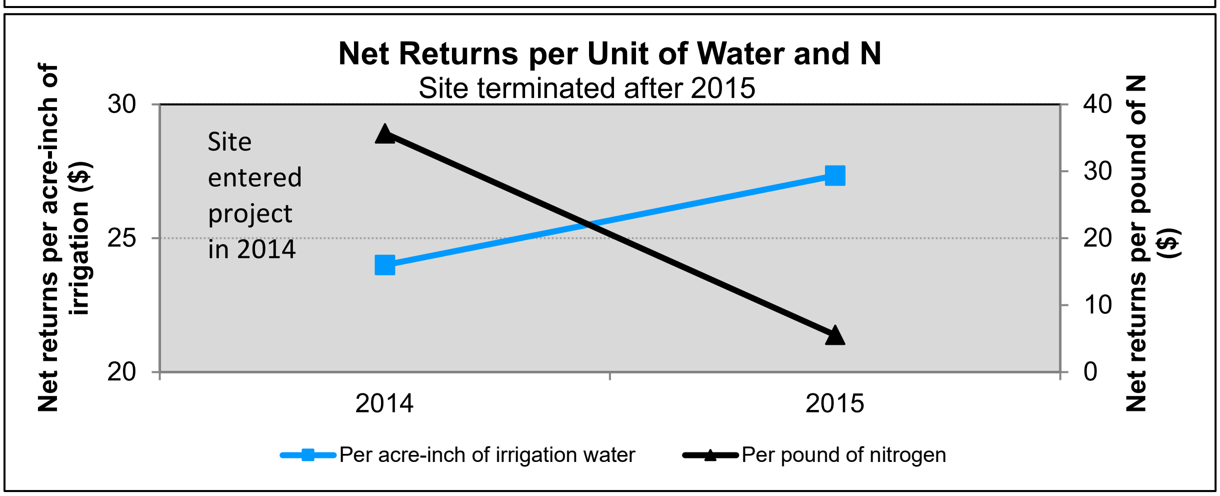
Site C58



Irrigation and Precipitation
Site terminated after 2015
Water (inches)
50.0
40.0
30.0
20.0
10.0
0.0
Site entered project in 2014
2014
2015
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Site terminated after 2015
Net returns ($)
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Site entered project in 2014
2014
2015
Per system acre



Net Returns per Unit of Water and N
Site terminated after 2015
Net returns per acre-inch of irrigation ($)
30
25
20
Net returns per pound of N ($)
40
30
20
10
0
Site entered project in 2014
2014
2015
Per acre-inch of irrigation water
Per pound of nitrogen

Site C59 – Terminated after 2015

Description:

Site acres: 93

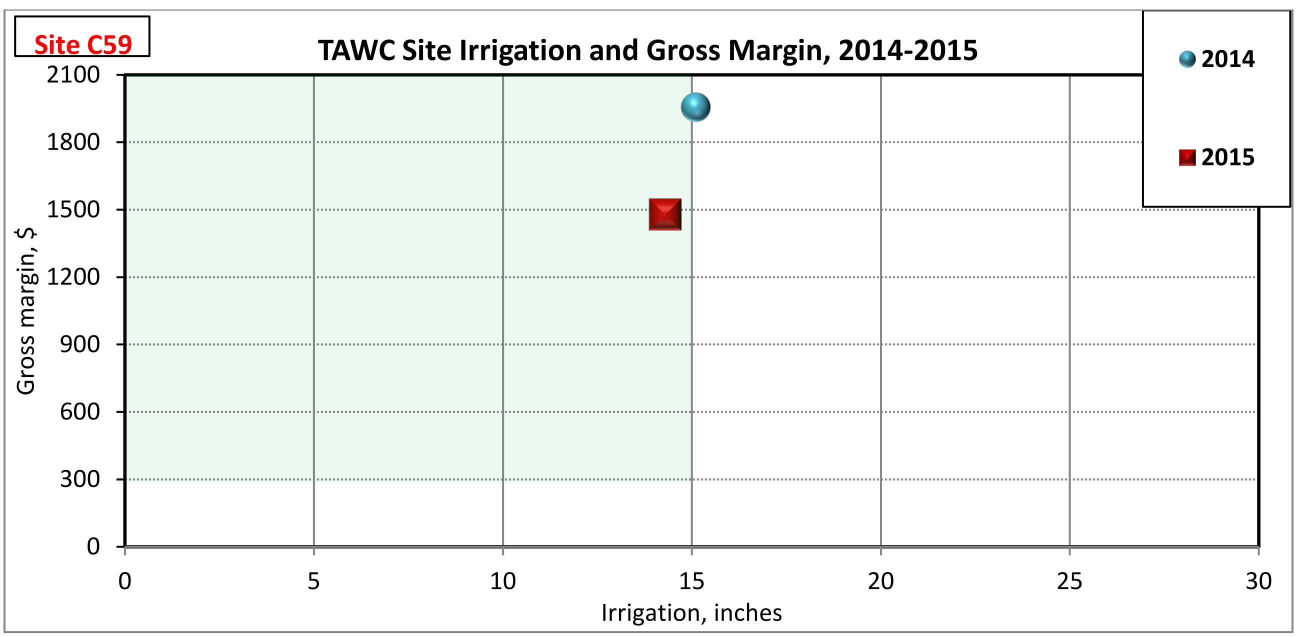
Soil types:
- 30 - Olton clay loam, 0 to 1%
- 31 - Olton clay loam, 1 to 3%
- 41 - Pullman clay loam, 0 to 1%

Irrigation:
Sub-surface Drip (SDI) 350 gpm

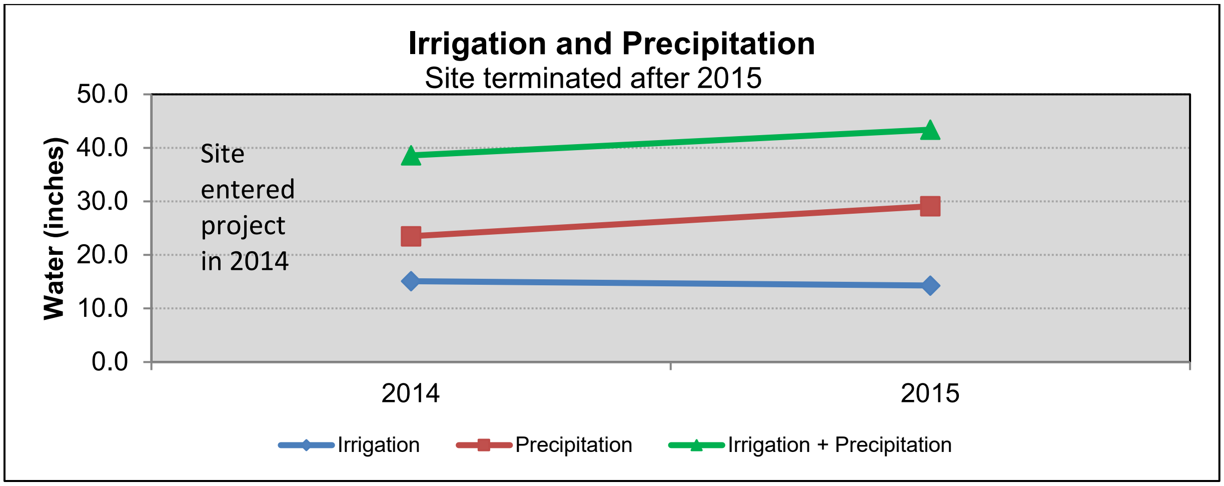
Number of wells: 2

Depth: 300 feet

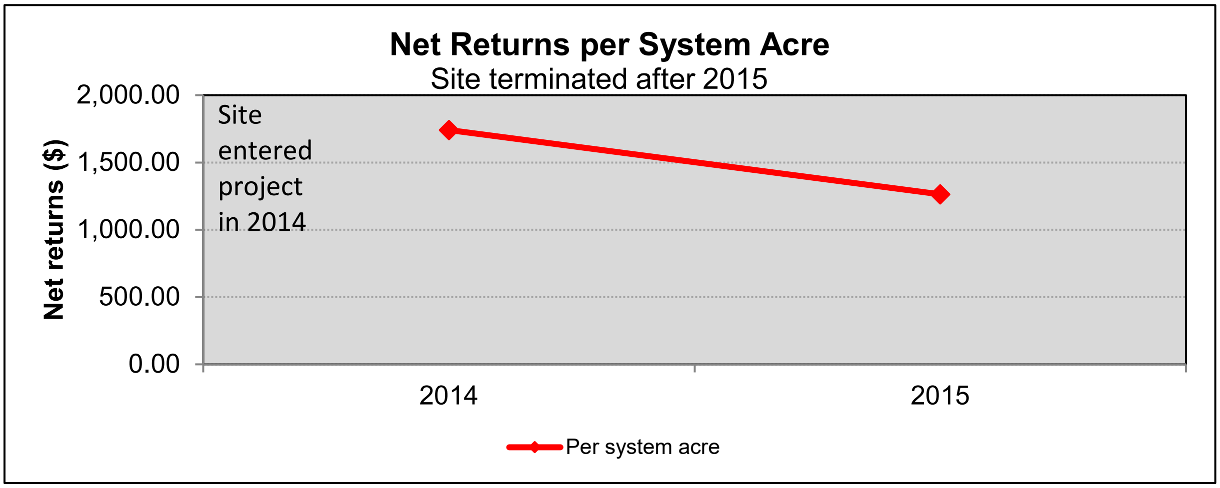
Fuel Source: Electric



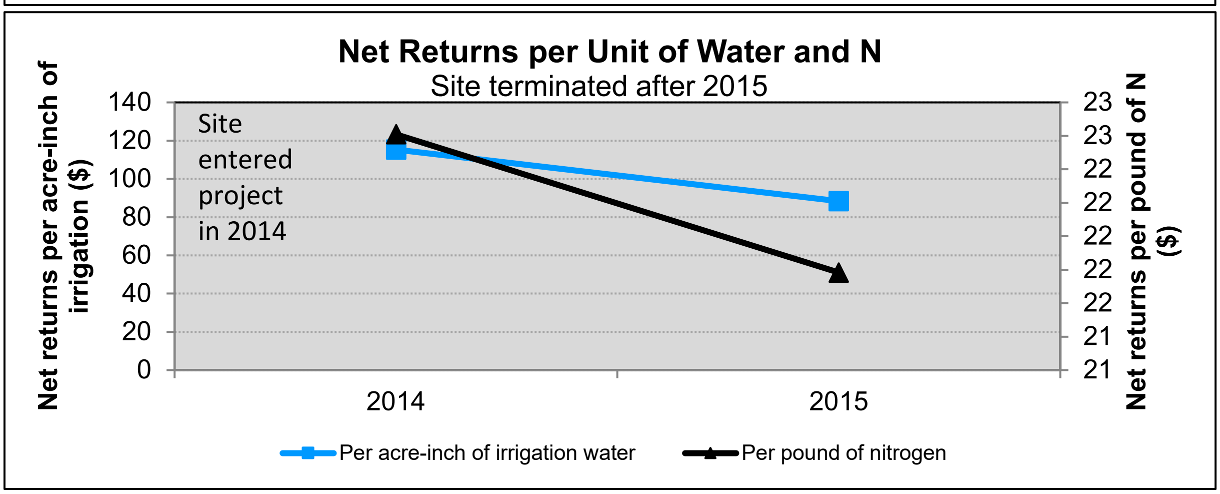
Site C59



Irrigation and Precipitation
Site terminated after 2015
Water (inches)
50.0
40.0
30.0
20.0
10.0
0.0
Site entered project in 2014
2014
2015
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Site terminated after 2015
Net returns ($)
2,000.00
1,500.00
1,000.00
500.00
0.00
Site entered project in 2014
2014
2015
Per system acre



Net Returns per Unit of Water and N
Site terminated after 2015
Net returns per acre-inch of irrigation ($)
140
120
100
80
60
40
20
0
Site entered project in 2014
23
23
22
22
22
22
22
21
21
Net returns per pound of N ($)
2014
2015
Per acre-inch of irrigation water
Per pound of nitrogen

Weather Data (Phase I - 2005-2013/Phase II – 2014-2017)

2005

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

Precipitation for 2005, presented in Table A23, is the mean of precipitation recorded at the 26 sites during 2005, beginning in March when the sites were identified and equipped. Precipitation for January and February are amounts recorded at Halfway, TX; the nearest weather station.

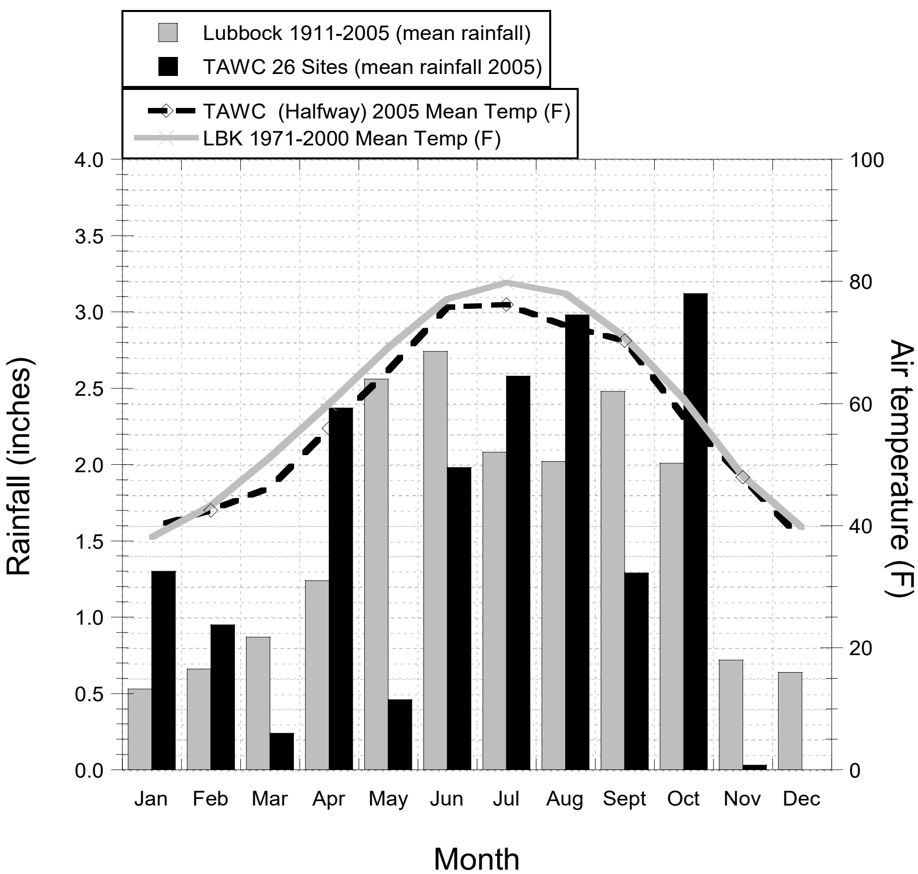


Figure A 1. Temperature and precipitation for 2005 in the demonstration area compared with long term averages.

Table A 31. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2005.

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

2006

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

Precipitation for 2006, presented in Figure A2 and Table A24, is the actual mean of precipitation recorded at the 26 sites during 2006 from January to December. The drought and high temperatures experienced during the 2006 growing season did influence system behavior and results. This emphasizes why it is crucial to continue this type of real-world demonstration and data collection over a number of years and sets of conditions.

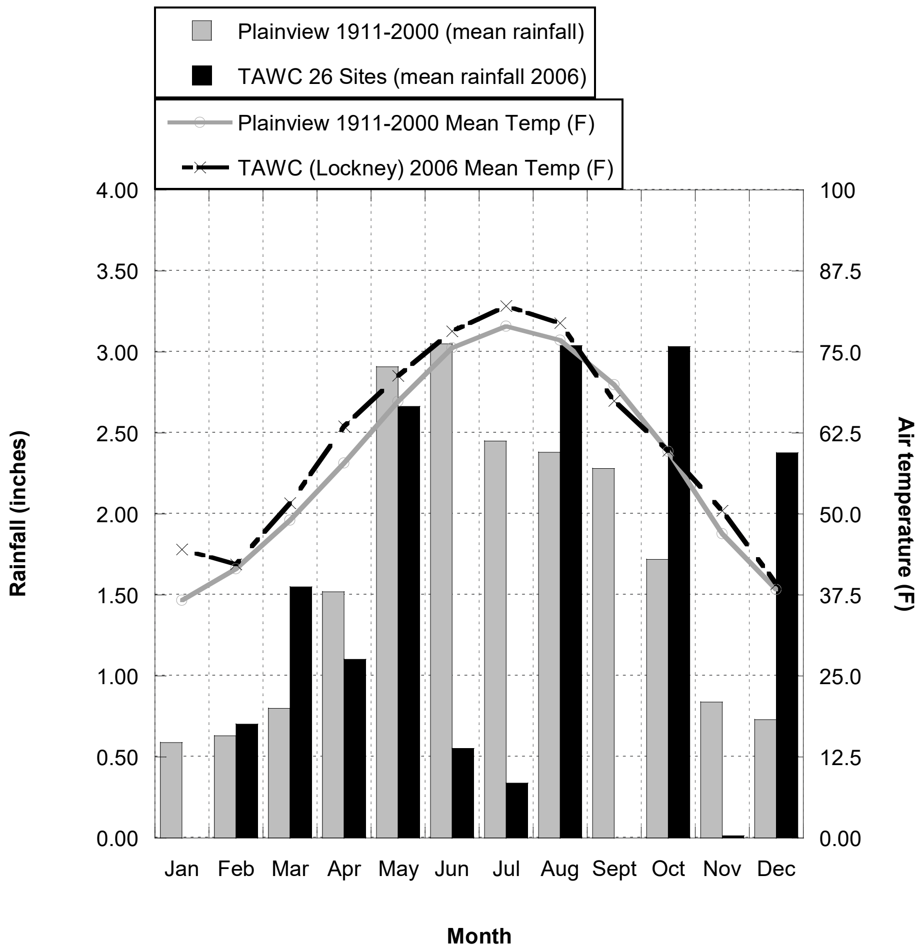


Figure A 2. Temperature and precipitation for 2006 in the demonstration area compared with long term averages.

Table A 32. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2006.

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

2007

Precipitation during 2007 totaled 27.2 inches (Table A25) and was well above the long-term mean (18.5 inches) for annual precipitation for this region. Furthermore, precipitation was generally well distributed over the growing season with early season rains providing needed moisture for crop establishment and early growth (Figure A3). Many producers took advantage of these rains and reduced irrigation until mid-season when rainfall declined. Growing conditions were excellent and there was little effect of damaging winds or hail at any of the sites. Temperatures were generally cooler than normal during the first half of the growing season but returned to normal levels by August. The lack of precipitation during October and November aided producers in harvesting crops.

Precipitation for 2007, presented in Figure A3 and Table A25, is the actual mean of precipitation recorded at the 26 sites during 2007 from January to December. Growing conditions during 2007 differed greatly from the hot dry weather encountered in 2006.

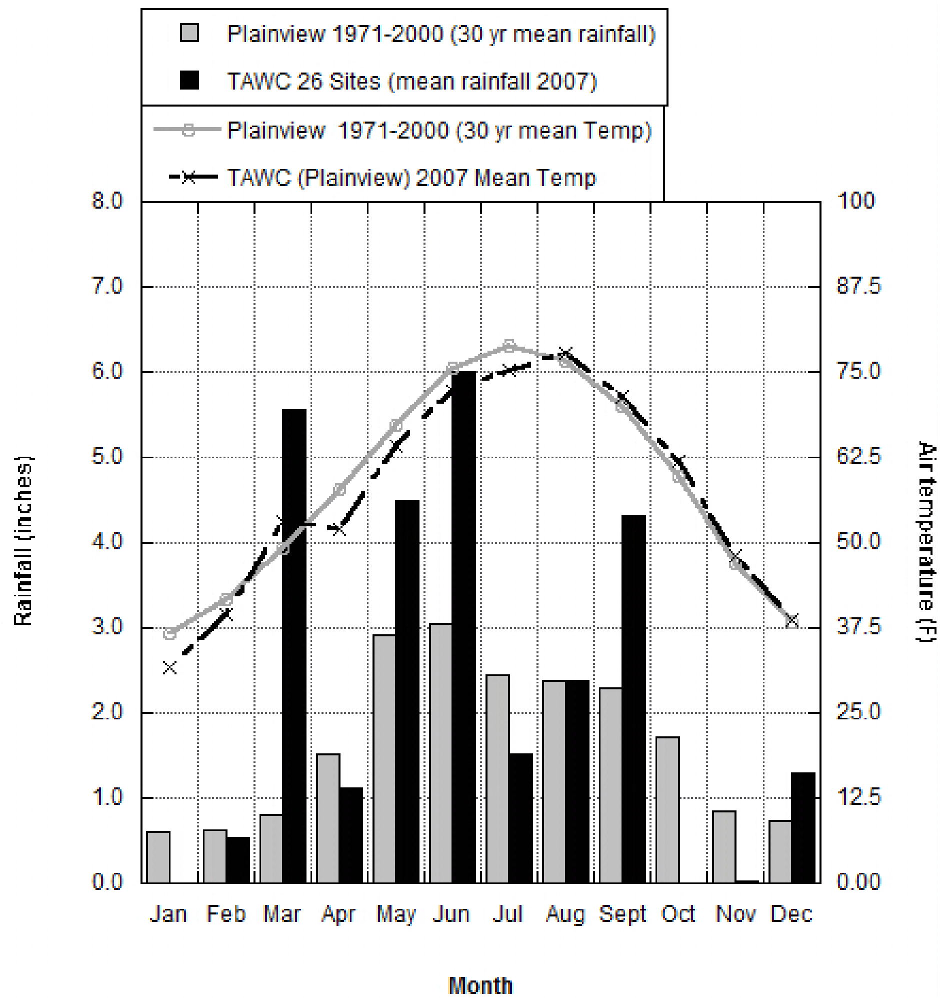


Figure A 3. Temperature and precipitation for 2007 in the demonstration area compared with long term averages.

Table A 33. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2007.

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

2008

Precipitation during 2008, at 21.6 inches, was above average for the year (Table A26). However, the distribution of precipitation was unfavorable for most crops (Figure A4). Beginning the previous autumn, little rain fell until December and then less than an inch of precipitation was received before May of 2008. Four inches was received in May, well above the average for that month. This was followed by below average rain during most of the growing season for crops. In September and October, too late for some crops and interfering with harvest for others, rain was more than twice the normal amounts for this region. Following the October precipitation, no more rain came during the remainder of the year. This drying period helped with harvest of some crops but the region entered the winter with below normal moisture.

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

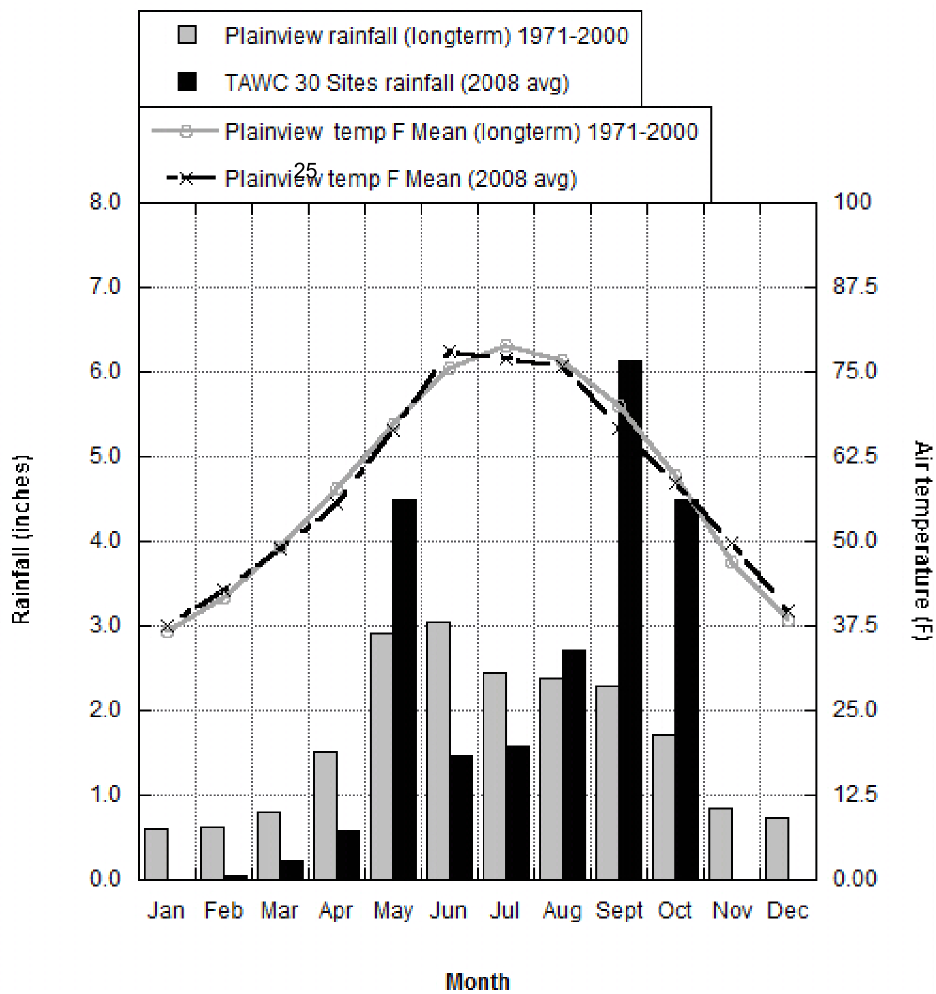


Figure A 4. Temperature and precipitation for 2008 in the demonstration area compared with long term averages.

Table A 34. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2008.

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

2009

Precipitation during 2009 totaled 15.2 inches averaged across all sites (Table A27). This was similar to precipitation in 2005 (Table A23). However, in 2005 above-average winter moisture was received followed by precipitation in April that was nearly twice the long-term mean. July, August, and October precipitation were also higher than normal in that year (Figure A5). In 2009, January began with very little precipitation that followed two months of no precipitation in the previous year (Figure A4). Thus, the growing season began with limited soil moisture. March and May saw less than half of normal precipitation. While June and July were near of slightly above normal, August, September, October and November were all below normal. December precipitation was above normal and began a period of higher than normal moisture entering 2010.

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

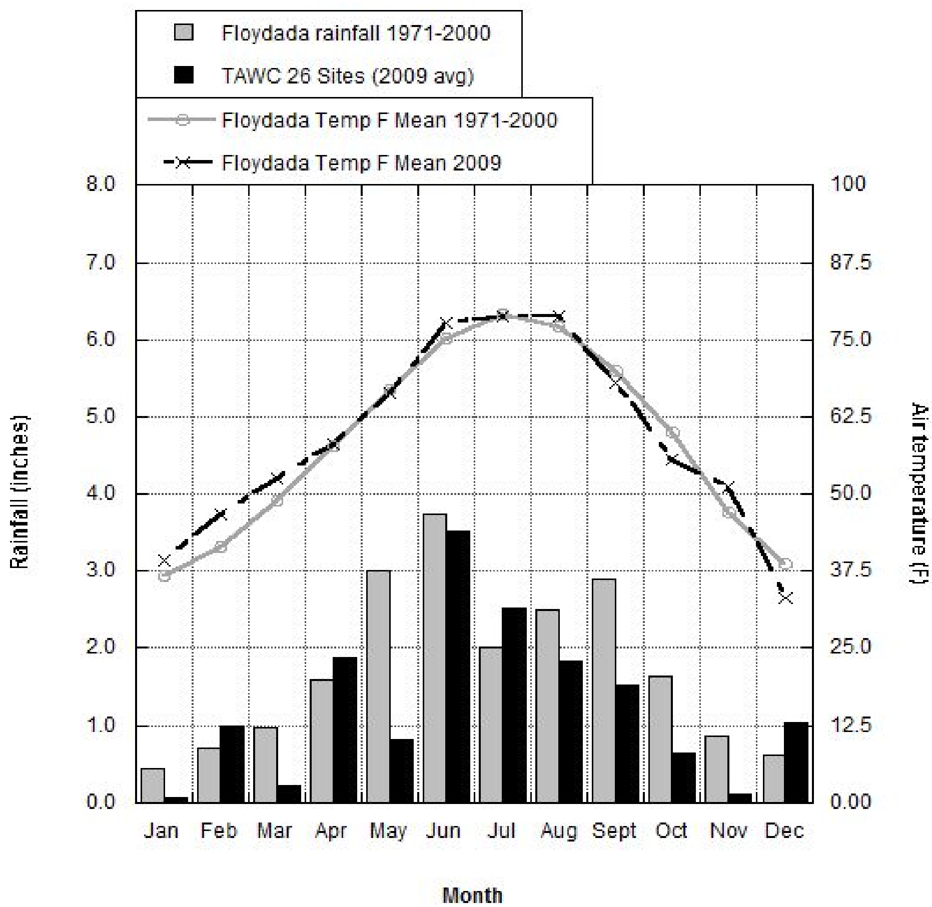


Figure A 5. Temperature and precipitation for 2009 in the demonstration area compared with long term averages.

Table A 35. 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 A28 and illustrated in Figure A6. Much of this rainfall came in the late winter and early spring/summer months, with above average rainfall from January through July, and significant rainfall amounts in the months of April and July. Temperatures for the year were slightly above average during the late fall and early spring months across the TAWC sites, allowing for increased soil temperatures at planting, further stabilizing the germination and early growth stages of the upcoming crops. An average of 6.0 inches fell on the project sites in April and 6.5 inches in July which when combined with the favorable conditions of the previous three months, provided ideal conditions for the 2010 summer growing season. The abnormally high rainfall continued in July and October allowing for summer crops to receive needed moisture during the final stages of production. This record high rainfall allowed some producers to achieve record yields, specifically on cotton and corn, while maintaining or decreasing their irrigation use from previous years of the project.

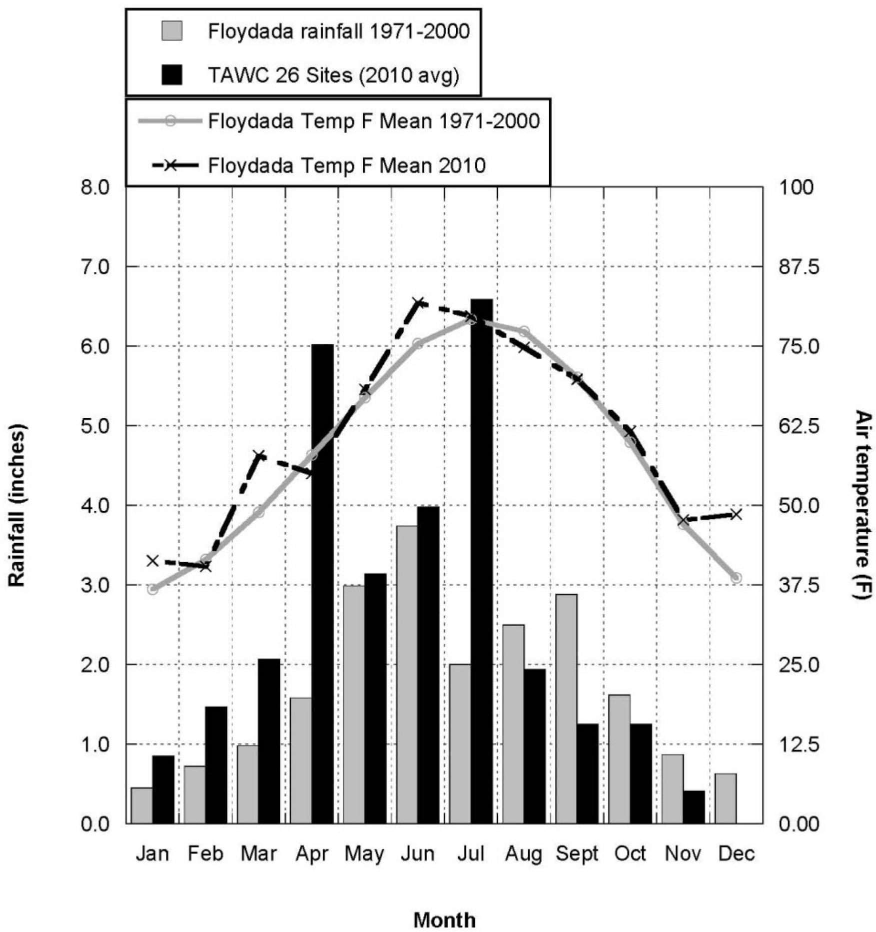


Figure A 6. Temperature and precipitation for 2010 in the demonstration area compared with long term averages.

Table A 36. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2010.

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

2011

The project sites and the region received below average rainfall for the 2011 calendar year with an average of 5.3 inches (Figure A7 and Table A29), compared with a long term average of 18.5 inches. This was the worst drought the Texas High Plains had seen since the 1930's in that virtually no rainfall was received during the normal growing season. Several fields within sites recorded zero crop yields in 2011 because irrigation was insufficient to produce yields high enough to merit the harvest costs.

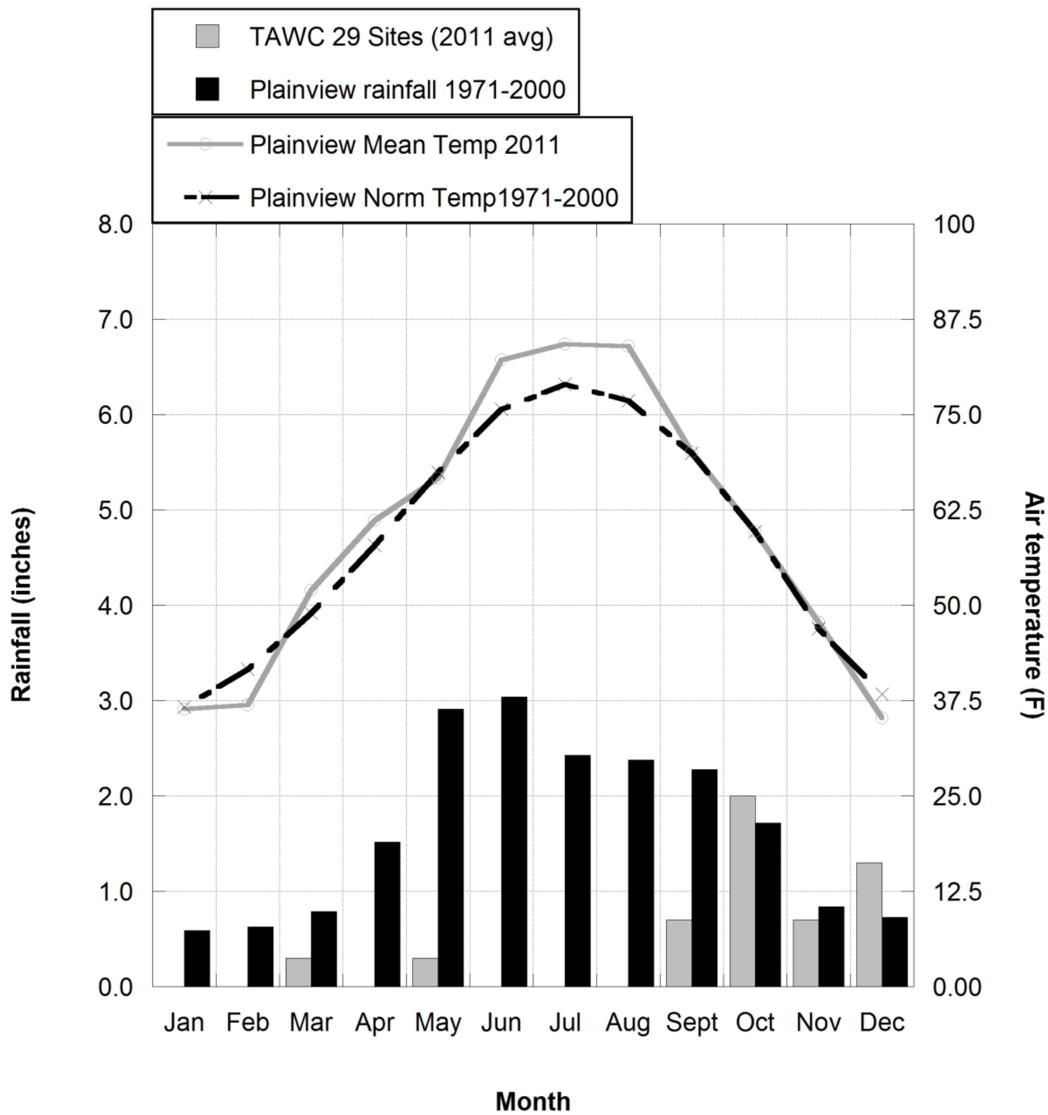


Figure A 7. Temperature and precipitation for 2011 in the demonstration area compared with long term averages.

Table A 37. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2011.

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

2012

The project sites and the region again received below average rainfall for the 2012 calendar year, with an average of 10.0 inches measured across the project (Figure A8 and Table A30). Slightly above average rainfall was received in the months of March, June and September. Mean temperatures ran slightly above normal early in the season, but were close to normal during the growing season.

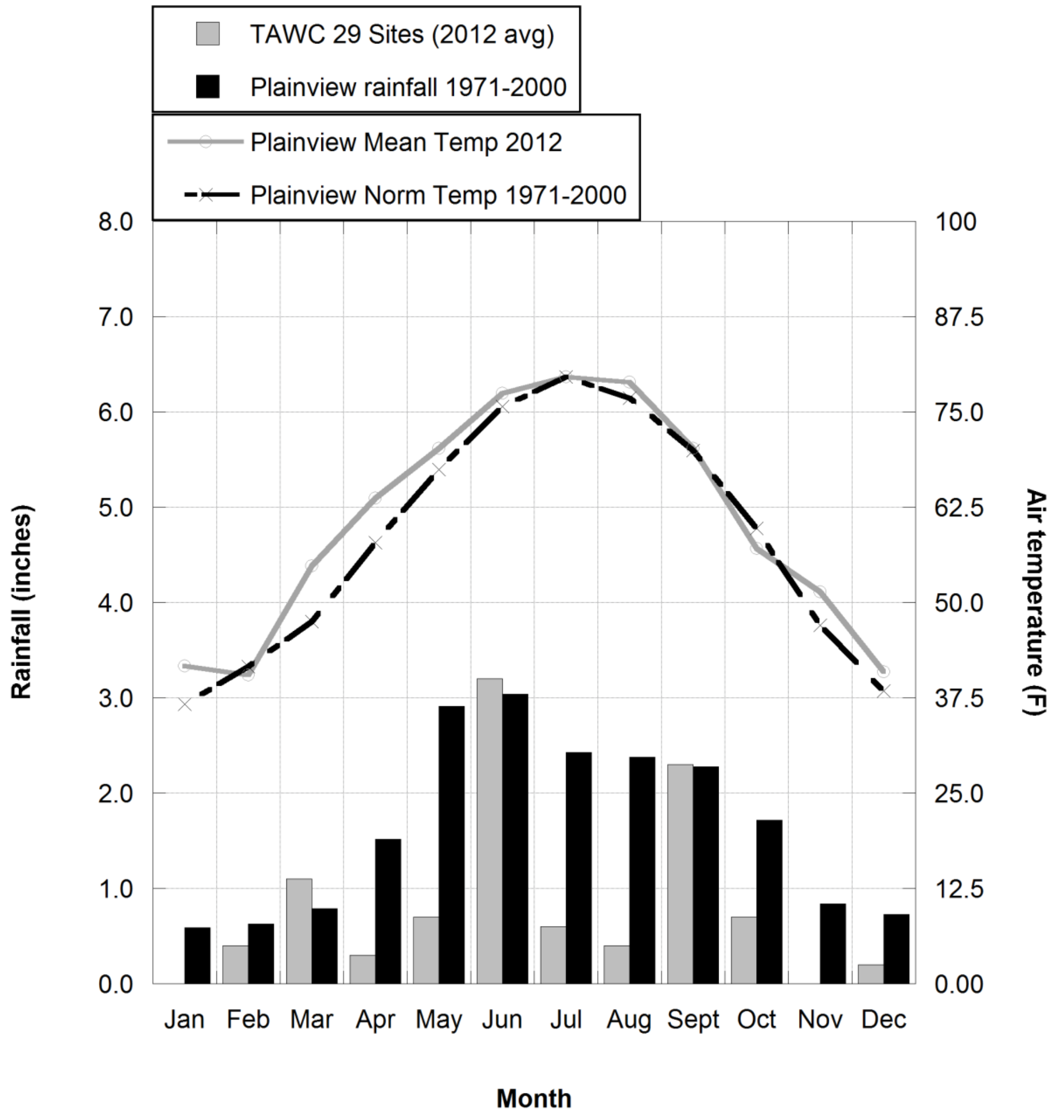


Figure A 8. Temperature and precipitation for 2012 in the demonstration area compared with long term averages.

Table A 38. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2012.

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

2013

The project sites and the region again received below average rainfall for the 2013 calendar year with an average of 13.3 inches measured across the project, as indicated in Figure A9 and illustrated in Table A31. Below average rainfall was received in March through June, but nearly double average rainfall was received in July with about normal rain in August and September. Mean temperatures ran slightly above normal through the growing season with the exception of July which was about average for the long term means. As a result of the above average rainfall in July and warmer than normal temperatures, 2013 was a very good cropping year on average for the TAWC sites in the area.

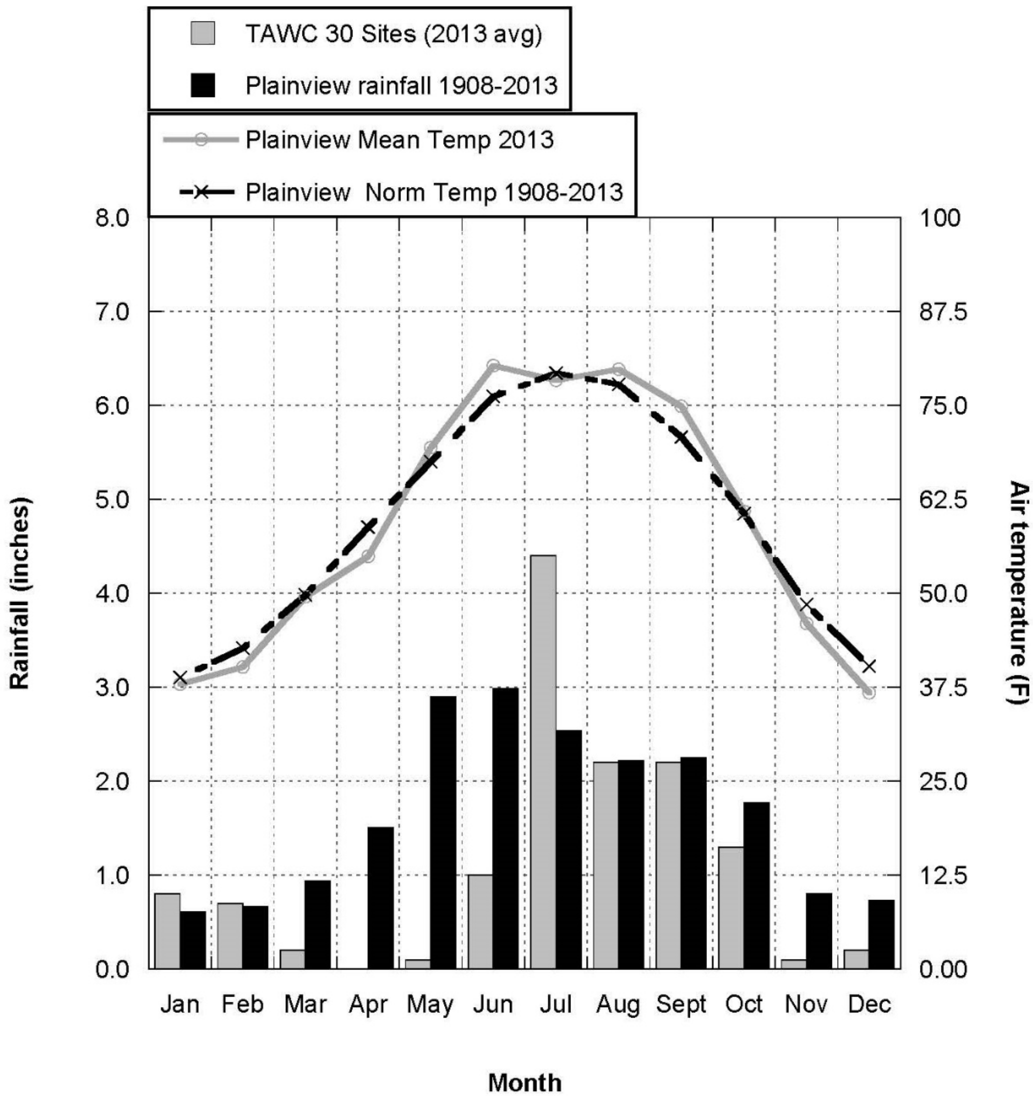


Figure A 9. Temperature and precipitation for 2013 in the demonstration area compared with long term averages.

Table A 39. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2013.

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

2014

The 36 project sites received above-average rainfall in 2014 with an overall mean of 21.7 inches, using Plainview, TX for the long-term average (Figure 12). Below-average rainfall was received in January through April. Precipitation in May, June and September was substantially above average, and occurred in relatively few heavy rain events. Such events typically lead to low efficiency of water use for crop production owing to runoff, soil-surface evaporation, and drainage below the root zone. Furthermore, the heavy May and June rains delayed planting of some crops, and crop water use for transpiration was low because crop canopies were underdeveloped. The heavy rains did help refill soil profiles that were quite depleted after the dry winter and early spring, which saved on irrigation needs during June. The September rain came while crop water needs were declining with crop maturity, so that rain had limited benefit for crop yields. Mean temperatures ran about normal through the growing season with the exception of August, which was hotter than normal. Rainfall by site (Table 2) indicated wide variation, such that some sites did not benefit from above-average precipitation.

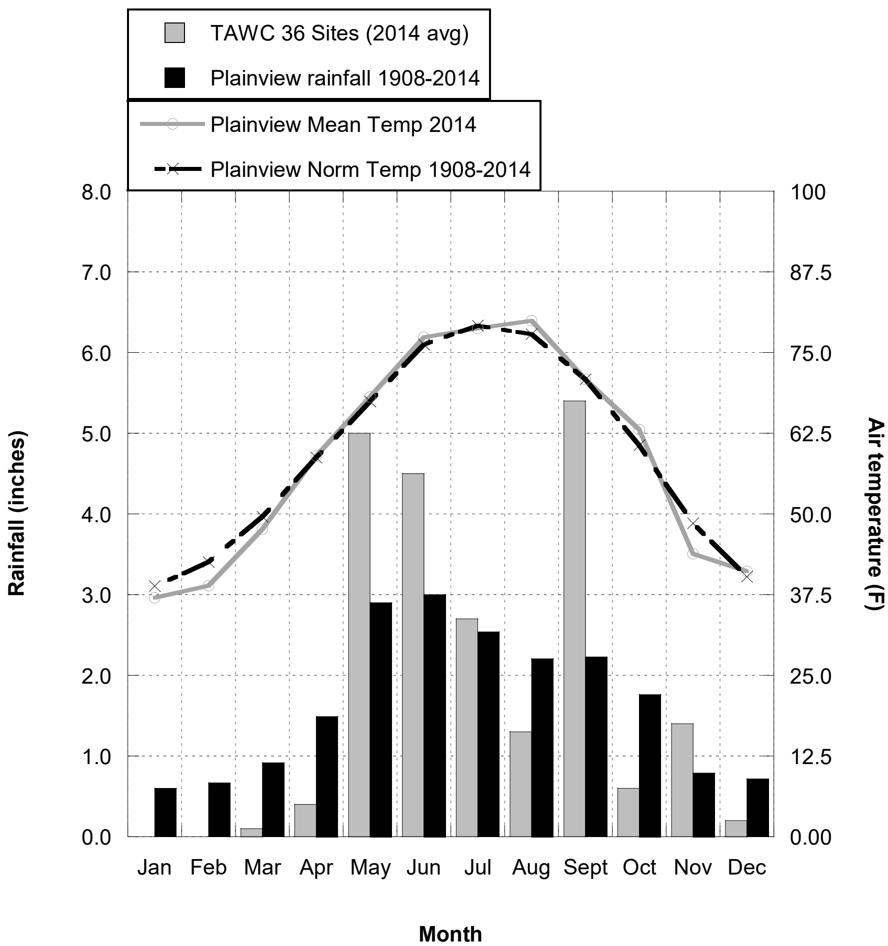


Figure A 10. Temperature and precipitation for 2014 (Phase II Year 1) in the demonstration area compared with long term averages.

Table A 40. Precipitation by each site in the Demonstration Project during 2014 (Phase II Year 1).

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
4	0.0	0.0	0.2	0.8	3.0	4.1	1.8	0.1	3.9	0.6	1.0	0.2	15.7
5	0.0	0.0	0.1	0.0	6.3	4.8	2.7	0.2	3.5	0.6	1.3	0.1	19.6
6	0.0	0.0	0.1	0.3	5.4	6.7	2.8	2.2	5.3	0.6	2.0	0.1	25.5
7	0.0	0.0	0.1	0.4	4.5	3.5	2.6	1.2	3.2	0.7	1.6	0.5	18.3
8	0.0	0.0	0.1	0.4	4.5	3.5	2.6	1.2	3.2	0.7	1.6	0.5	18.3
9	0.0	0.0	0.1	0.5	8.2	4.5	3.1	1.0	6.8	0.8	2.2	0.5	27.7
10	0.0	0.0	0.2	0.5	5.3	5.5	3.0	2.5	7.6	0.7	2.2	0.1	27.6
11	0.0	0.0	0.1	0.6	5.7	5.2	3.6	2.5	7.0	0.6	2.2	0.3	27.8
14	0.0	0.0	0.2	0.6	5.1	2.4	3.0	0.6	6.4	0.7	1.2	0.1	20.3
15	0.0	0.0	0.1	0.4	5.1	4.2	3.0	0.8	3.4	0.3	0.6	0.1	18.0
17	0.0	0.0	0.2	0.5	3.7	2.6	2.2	0.8	4.8	0.4	1.4	0.2	16.8
19	0.0	0.0	0.1	0.2	6.3	5.4	3.5	0.2	4.2	0.7	1.3	0.0	21.9
20	0.0	0.0	0.1	0.5	7.9	4.7	2.4	0.5	4.9	0.5	1.7	0.2	23.4
21	0.0	0.0	0.1	0.4	5.9	3.8	3.7	3.1	6.4	0.7	2.5	0.3	26.9
22	0.0	0.0	0.2	0.5	5.3	4.8	2.2	0.2	3.8	0.8	1.5	0.2	19.5
24	0.0	0.0	0.2	0.7	5.3	5.3	2.2	0.4	4.5	0.7	2.0	0.2	21.5
26	0.0	0.0	0.1	0.0	6.3	4.8	2.7	0.2	3.5	0.6	1.3	0.1	19.6
27	0.0	0.0	0.5	0.3	7.2	4.7	2.4	0.1	4.0	0.5	1.5	0.1	21.3
28	0.0	0.0	0.2	0.5	5.3	5.5	3.0	2.5	7.6	0.7	2.2	0.1	27.6
29	0.0	0.0	0.2	0.4	6.0	4.2	2.8	1.1	5.4	0.8	2.0	0.1	23.0
30	0.0	0.0	0.1	0.0	6.3	4.8	2.7	0.2	3.5	0.6	1.3	0.1	19.6
31	0.0	0.0	0.2	0.8	3.0	4.1	1.8	0.1	3.9	0.6	1.0	0.2	15.7
32	0.0	0.0	0.1	0.4	5.1	4.2	3.0	0.8	3.4	0.3	0.6	0.1	18.0
33	0.0	0.0	0.1	0.4	5.1	4.2	3.0	0.8	3.4	0.3	0.6	0.1	18.0
34	0.0	0.0	0.1	0.3	5.4	6.7	2.8	2.2	5.3	0.6	2.0	0.1	25.5
35	0.0	0.0	0.1	0.5	5.3	6.2	3.5	1.7	5.1	0.8	2.4	0.2	25.8
C50	0.0	0.0	0.01	0.4	4.4	3.0	>	7.6	6.1	0.6	1.3	0.5	23.9
C51	0.0	0.0	0.1	0.4	4.4	3.0	>	7.6	6.1	0.6	1.3	0.5	24.0
C52	0.0	0.0	0.0	0.1	2.5	3.6	>	1.2	8.7	0.4	0.8	0.1	17.4
C53	0.0	0.0	0.0	0.1	2.5	3.6	>	1.2	8.7	0.4	0.8	0.1	17.4
C54	0.0	0.0	0.0	0.1	2.5	3.6	>	1.2	8.7	0.4	0.8	0.1	17.4
C56	0.0	0.0	0.1	0.1	3.5	5.1	>	1.8	8.4	0.0	0.0	0.0	19.0
C57	0.0	0.0	0.1	0.0	2.7	4.7	>	5.8	4.5	0.5	0.0	0.2	18.5
C58	0.0	0.0	0.02	0.2	6.2	5.0	>	1.3	5.2	0.0	1.6	0.3	19.8
C59	0.0	0.0	0.01	na	5.2	5.0	>	1.3	9.7	0.4	1.5	0.4	23.5
C60	0.0	0.0	0.2	0.8	3.5	5.0	>	5.6	4.5	0.7	1.6	0.2	22.1
Avg	0.0	0.0	0.1	0.4	5.0	4.5	2.8	1.0	5.4	0.6	1.4	0.2	21.3

> totaled with August

2015

The 36 project sites received above-average rainfall in 2015 with an overall mean of 30.1 inches, using Plainview, TX for the long-term average (Figure 12). This year also showed a change of +0.37-foot (4.44 inches) water level of the Ogallala as measured and reported by the High Plains Underground Water Conservation District No. 1 (published in the 2016 Water Level Report (http://www.hpwd.org/reports/). This increase was an unusual occurrence given the steady decline in the aquifer observed over previous years. Precipitation in May, July, and October was substantially above average with the May rainfall being 4 times normal, resulting in flooding and difficulty in planting on time. The May and July rainfall events resulted in water saved on irrigation needs throughout the growing season. August and September were substantially below normal rainfall and required supplemental irrigation. Mean temperatures ran about normal through June but were above normal the remainder of the growing season. Rainfall by site (Table 2) indicates relative uniformity in rainfall events, though with a larger project area more variation is to be expected.

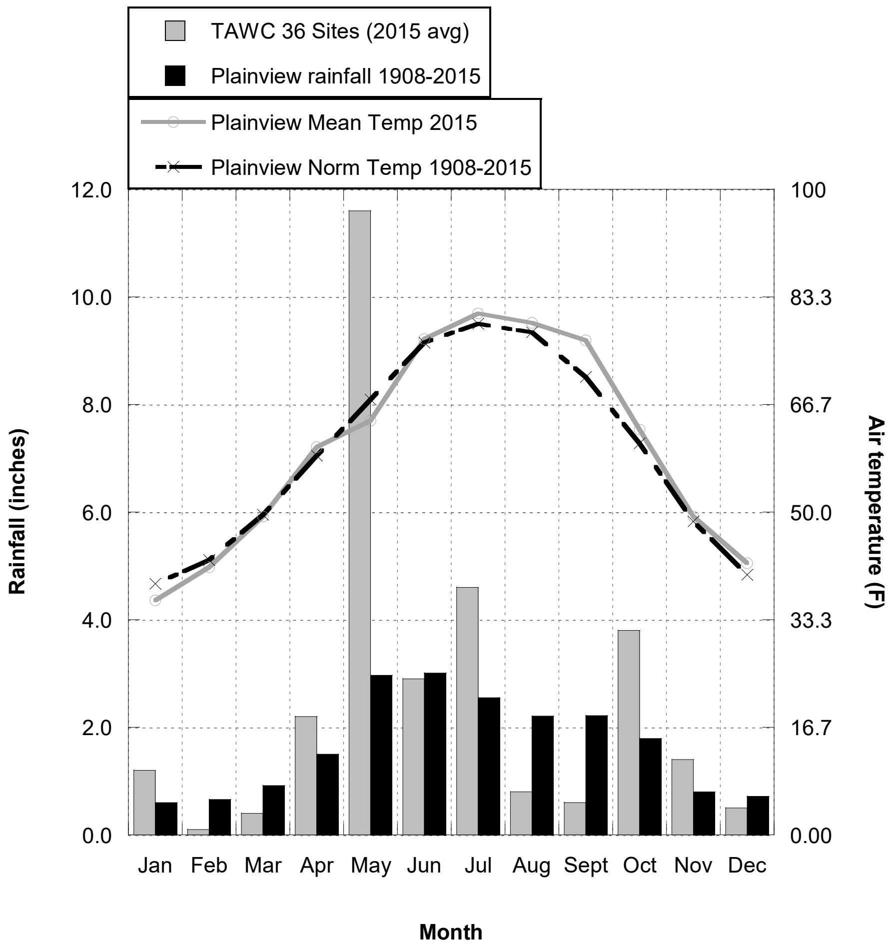


Figure A 11. Temperature and precipitation for 2015 (Phase II Year 2) in the demonstration area compared with long term averages.

Table A 41. Precipitation by each site in the Demonstration Project during 2015 (Phase II Year 2).

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
4	1.0	0.1	0.3	1.8	12.1	2.8	4.9	1.1	0.2	4.4	1.1	0.4	**30.2**
5	1.2	0.1	0.3	2.1	13.6	1.8	3.7	0.7	0.4	3.7	1.2	0.6	**29.4**
6	1.0	0.1	0.2	2.2	12.4	3.0	5.0	0.3	0.4	3.6	1.6	0.5	**30.3**
7	1.2	0.1	0.3	2.6	10.1	2.2	3.7	0.5	0.0	0.5	1.8	0.3	**23.3**
8	1.2	0.1	0.3	2.6	10.1	2.2	3.7	0.5	0.0	0.5	1.8	0.3	**23.3**
9	1.1	0.0	0.2	1.9	10.9	3.1	5.7	0.4	0.5	3.5	1.5	0.3	**29.1**
10	1.1	0.1	0.2	2.7	12.8	4.1	5.5	0.5	0.5	3.4	1.8	0.3	**33.0**
11	1.2	0.1	0.2	2.6	12.3	3.2	5.5	0.5	0.5	3.9	2.0	0.8	**32.8**
14	1.1	0.1	0.4	2.8	13.0	2.7	5.1	0.9	0.7	3.7	1.3	0.4	**32.2**
15	1.4	0.1	0.4	3.3	14.1	3.3	5.6	0.7	0.6	3.4	1.0	0.7	**34.6**
17	1.4	0.1	0.3	3.9	15.5	3.5	5.5	0.9	1.0	3.9	1.0	0.5	**37.5**
19	1.3	0.1	0.3	2.3	14.0	0.0	5.7	1.2	0.6	4.9	0.8	0.6	**31.8**
21	1.2	0.2	0.2	2.3	13.1	2.8	4.7	0.9	0.8	4.7	1.8	0.5	**33.2**
22	1.1	0.1	0.3	2.9	13.4	3.8	4.5	1.0	0.2	4.4	1.0	0.5	**33.2**
24	1.0	0.1	0.3	2.7	11.8	3.2	3.6	0.9	0.2	3.7	0.9	0.0	**28.4**
26	1.2	0.1	0.3	2.1	13.6	1.8	3.7	0.7	0.4	3.7	1.2	0.6	**29.4**
28	1.1	0.1	0.2	2.7	12.8	4.1	5.5	0.5	0.5	3.4	1.8	0.3	**33.0**
30	1.2	0.1	0.3	2.1	13.6	1.8	3.7	0.7	0.4	3.7	1.2	0.6	**29.4**
31	1.0	0.1	0.3	1.8	12.1	2.8	4.9	1.1	0.2	4.4	1.1	0.4	**30.2**
32	1.4	0.1	0.4	3.3	14.1	3.3	5.6	0.7	0.6	3.4	1.0	0.7	**34.6**
33	1.4	0.1	0.4	3.3	14.1	3.3	5.6	0.7	0.6	3.4	1.0	0.7	**34.6**
34	1.3	0.2	0.0	2.2	12.4	3.0	5.0	0.4	0.4	3.6	1.5	0.4	**30.4**
35	1.2	0.2	0.2	2.3	13.1	2.8	4.7	0.9	0.8	4.7	1.8	0.5	**33.2**
C37	1.8	0.1	0.2	1.7	12.3	3.4	2.0	1.1	0.7	4.8	1.5	0.2	**29.8**
C38	1.8	0.1	0.2	1.7	12.3	3.4	2.0	1.1	0.7	4.8	1.5	0.2	**29.8**
C39	1.1	0.2	0.3	1.6	7.9	1.6	8.0	2.0	0.6	5.3	2.4	0.4	**31.4**
C50	1.3	0.0	0.5	1.7	11.6	2.8	3.9	0.0	0.8	3.0	2.1	1.3	**29.0**
C51	1.3	0.0	0.5	1.7	11.6	2.8	3.9	0.0	0.8	3.0	2.1	1.3	**29.0**
C52	0.9	0.2	0.7	1.1	5.8	3.3	2.9	1.4	1.4	5.2	1.1	0.5	**24.5**
C53	0.9	0.2	0.7	1.1	5.8	3.3	2.9	1.4	1.4	5.2	1.1	0.5	**24.5**
C54	0.9	0.2	0.7	1.1	5.8	3.3	2.9	1.4	1.4	5.2	1.1	0.5	**24.5**
C56	1.6	0.3	0.8	1.1	6.8	3.4	4.6	1.8	0.5	1.4	0.3	0.2	**22.8**
C57	1.3	0.4	0.7	1.7	8.1	2.2	7.6	1.0	1.8	4.9	0.9	0.5	**31.1**
C58	1.3	0.0	0.5	1.7	11.6	2.8	3.9	0.0	0.8	3.0	2.1	1.3	**29.0**
C59	1.3	0.0	0.5	1.7	11.6	2.8	3.9	0.0	0.8	3.0	2.1	1.3	**29.0**
C60	1.4	0.1	0.7	2.2	11.6	4.2	5.2	1.3	0.3	4.1	1.1	0.0	**32.2**
Avg	**1.2**	**0.1**	**0.4**	**2.2**	**11.6**	**2.9**	**4.6**	**0.8**	**0.6**	**3.8**	**1.4**	**0.5**	**30.1**

2016

The 22 active project sites received below-average rainfall in 2016 with an overall mean of 16.6 inches, using Plainview, TX for the long-term average (Figure 14). Precipitation in January through July was below normal. With above average August and September rainfall and the warmer than average fall temperatures, heat units resulted in continued crop production and effectively saved the 2016 cotton crop. Rainfall by site (Table 2) indicates a wide range in precipitation amounts but as project area has increased more variation is to be expected.

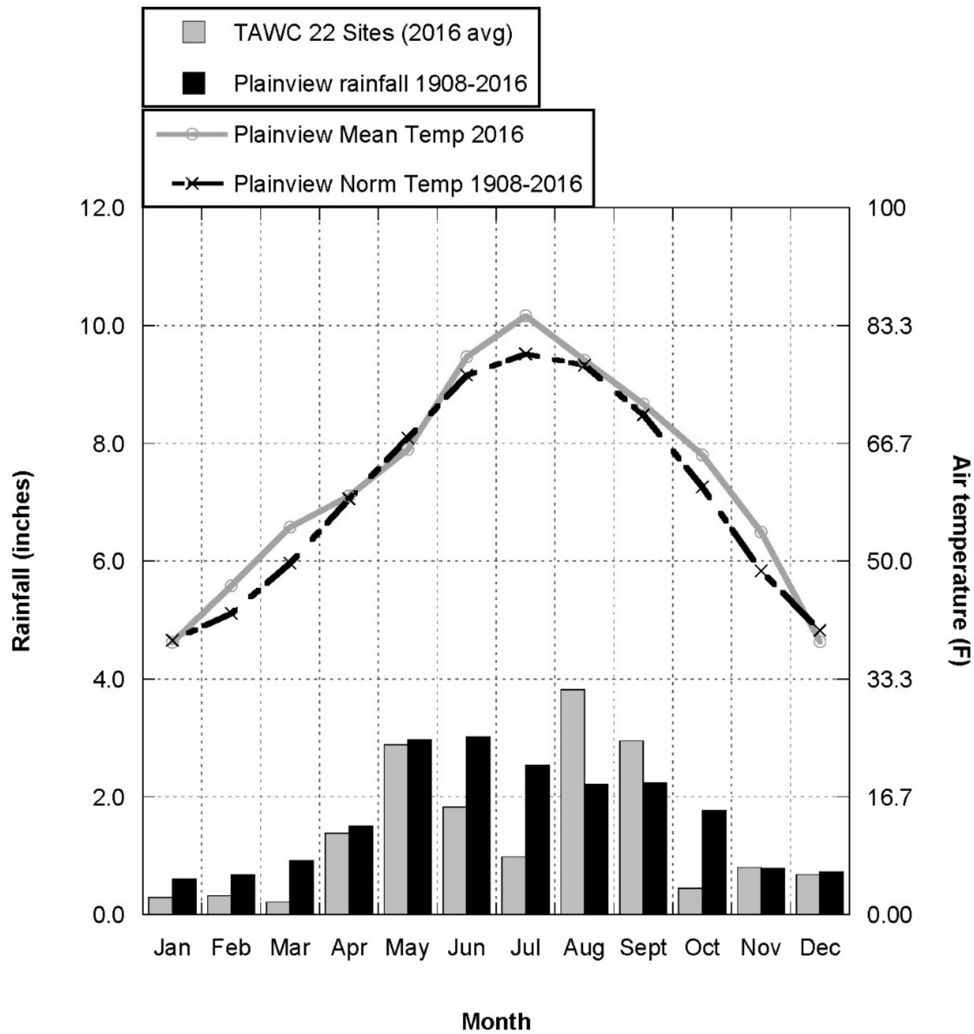


Figure A 12. Temperature (lines) and precipitation (bars) by month for 2016 near the demonstration area (Plainview, TX) compared with long term averages.

Table A 42. Precipitation (inches) by each site in the Demonstration Project during 2016 (Phase II Year 3).

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
4	0.1	0.4	0.2	1.5	2.1	2.4	0.2	6.1	2.4	0.6	0.7	0.6	**17.3**
6	0.3	0.4	0.2	1.5	2.7	1.1	1.7	2.8	4.4	0.4	0.3	0.7	**16.6**
9	0.4	0.3	0.4	1.6	3.1	1.7	2.0	4.0	3.2	0.5	0.5	0.8	**18.4**
10	0.3	0.3	0.2	1.5	3.7	1.7	1.5	2.8	3.5	0.6	0.4	0.7	**17.1**
11	0.4	0.5	0.3	1.1	2.9	1.9	1.8	3.1	4.5	0.4	0.3	0.8	**18.0**
14	0.2	0.4	0.1	1.9	3.7	2.5	0.6	2.9	2.6	0.3	0.3	0.8	**16.2**
17	0.2	0.4	0.5	2.7	3.4	1.6	1.0	3.8	3.0	0.4	0.5	1.0	**18.4**
21	0.4	0.5	0.4	1.0	3.2	1.0	0.5	2.0	3.9	0.3	0.3	0.9	**14.2**
22	0.1	0.4	0.2	1.5	2.0	2.1	0.3	4.2	2.5	0.5	0.7	0.5	**15.0**
24	0.1	0.1	0.1	1.4	1.7	2.1	0.3	4.5	2.2	0.3	0.8	0.5	**14.1**
28	0.3	0.3	0.2	1.5	3.7	1.7	1.5	2.8	3.5	0.6	0.4	0.7	**17.1**
31	0.1	0.4	0.2	1.5	2.1	2.4	0.2	6.1	2.4	0.6	0.7	0.6	**17.3**
32	0.3	0.5	0.2	1.5	3.6	2.4	0.9	3.3	3.5	0.4	0.3	0.9	**17.6**
33	0.3	0.5	0.2	1.5	3.6	2.4	0.9	3.3	3.5	0.4	0.3	0.9	**17.6**
35	0.4	0.5	0.4	1.0	3.2	1.0	0.5	2.0	3.9	0.3	0.3	0.9	**14.2**
C37	0.3	0.2	0.4	1.2	4.7	2.7	0.6	4.7	3.5	0.6	1.0	0.4	**20.4**
C38	0.3	0.2	0.4	1.1	3.5	0.7	0.3	4.8	1.3	0.5	1.8	0.5	**15.5**
C50	0.8	0.3	0.0	0.8	3.3	2.1	1.8	1.6	1.7	0.8	1.5	1.0	**15.8**
C51	0.8	0.3	0.0	0.8	3.3	2.1	1.8	1.6	1.7	0.8	1.5	1.0	**15.8**
C56	0.1	0.2	0.0	0.5	1.3	1.9	1.8	5.2	3.3	0.1	1.5	0.1	**16.0**
C57	0.0	0.0	0.0	1.0	1.2	1.1	0.7	8.5	1.8	0.0	2.4	0.1	**16.8**
C60	0.0	0.1	0.2	2.5	1.6	1.5	0.9	3.8	2.8	0.5	1.4	0.4	**15.6**
Avg	**0.3**	**0.3**	**0.2**	**1.4**	**2.9**	**1.8**	**1.0**	**3.8**	**3.0**	**0.5**	**0.8**	**0.7**	**16.6**

2017

The 19 active project sites received above-average rainfall in 2017 with an overall mean of 21.7 inches, using Plainview, TX for the long-term average (Figure 14). Precipitation and temperature from January through April were above average. May and June had below average rainfall with normal temperatures and July through September had significantly higher rainfall with near normal temperatures. Rainfall by site (Table 2) indicates a normal range in precipitation.

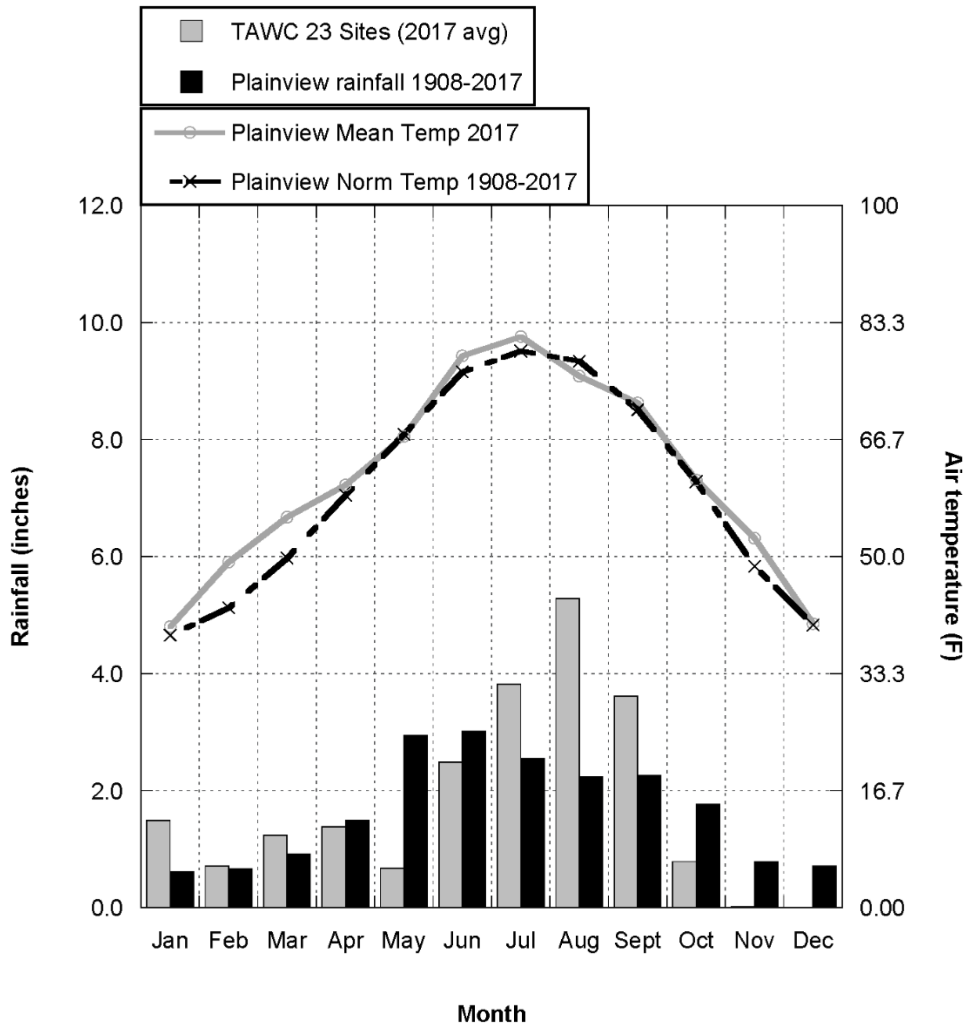


Figure A 13. Temperature (lines) and precipitation (bars) by month for 2017 near the demonstration area (Plainview, TX) compared with long term averages.

Table A 43. Precipitation (inches) by each site in the Demonstration Project during 2017 (Phase II Year 4).

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
4	1.5	0.6	0.7	1.4	0.4	2.9	3.7	3.7	4.2	0.7	0.0	0.0	**19.8**
9	1.4	0.7	1.2	1.5	0.8	2.9	3.7	6.2	3.4	0.5	0.0	0.0	**22.3**
10	1.3	0.6	1.4	1.4	0.6	2.6	3.0	6.0	3.8	1.1	0.0	0.0	**21.8**
11	0.8	0.7	0.9	1.1	0.6	2.3	1.3	5.9	4.0	0.6	0.0	0.0	**18.2**
14	0.7	0.6	1.1	1.0	0.5	1.9	2.9	5.2	3.5	0.8	0.0	0.0	**18.2**
17	1.2	0.7	1.7	1.6	1.0	3.1	5.0	8.4	4.5	1.3	0.0	0.0	**28.5**
21	1.7	0.8	1.1	1.4	0.7	2.0	3.8	4.4	4.1	0.6	0.0	0.0	**20.6**
22	1.4	0.5	0.7	1.2	0.2	1.9	3.3	3.6	4.8	0.5	0.0	0.0	**18.1**
31	1.5	0.6	0.7	1.4	0.4	2.9	3.7	3.7	4.2	0.7	0.0	0.0	**19.8**
32	1.2	0.7	1.3	1.4	0.5	2.4	4.0	6.3	3.5	0.9	0.0	0.0	**22.2**
34	1.1	0.9	1.9	1.7	1.0	3.6	4.4	7.8	4.8	0.8	0.0	0.0	**28.0**
35	1.7	0.8	1.1	1.4	0.7	2.0	3.8	4.4	4.1	0.6	0.0	0.0	**20.6**
C37	1.7	0.5	0.8	1.2	0.1	2.1	4.2	6.0	3.8	0.6	0.0	0.0	**21.0**
C38	2.1	0.5	1.5	1.2	0.3	2.3	4.4	6.6	3.5	0.5	0.0	0.0	**22.9**
C39	1.4	0.6	1.7	2.3	0.4	2.5	2.3	4.8	3.3	0.8	0.0	0.0	**20.1**
C50	2.0	1.4	1.1	1.2	0.9	2.3	3.6	3.6	3.3	0.5	0.1	0.0	**20.0**
C51	2.0	1.4	1.1	1.2	0.9	2.3	3.6	3.6	3.3	0.5	0.1	0.0	**20.0**
C56	1.3	0.5	1.2	0.9	1.7	2.3	4.0	7.2	1.1	1.3	0.0	0.0	**21.5**
C57	2.1	0.5	2.8	1.0	1.3	3.0	3.6	8.1	1.8	2.3	0.0	0.0	**26.5**
C60	1.4	0.6	0.9	3.1	0.6	2.1	3.8	6.3	2.6	1.7	0.0	0.0	**23.1**
Avg	**1.5**	**0.7**	**1.2**	**1.4**	**0.7**	**2.5**	**3.6**	**5.6**	**3.6**	**0.9**	**0.0**	**0.0**	**21.7**

*Greyed sites had no field data collected for 2017

Supplementary rants To Project
(Phase I - 2005-2013/Phase II – 2014-2016)

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

2006

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

2007

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

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

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

2008

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

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

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

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

2009

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

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

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

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

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

2010

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

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

2011

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

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

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

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

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

2012

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

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

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

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

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

2013

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

2014

Supplementary grants and grant requests were obtained or attempted through leveraging of the base platform of TAWC and the Texas Coalition for Sustainable Integrated Systems (TeCSIS), and therefore represent added value to the overall TAWC effort.

West, C.P. 2014. Long-term agroecosystems research and adoption in the Texas Southern High Plains. Southern SARE grant. $100,000. (Funded)

West, C.P. 2014. Improving water productivity and new water management strategies to sustain rural economies. Ogallala Aquifer Program (USDA-ARS). $20,000. (Funded)

2015

Supplementary grants and grant requests were obtained or attempted through leveraging of the base platform of TAWC and the Texas Coalition for Sustainable Integrated Systems (TeCSIS), and therefore represent added value to the overall TAWC effort.

USDA-SARE. C. West. Long term agroecosystems research and adoption in the Texas Southern High Plains. $100,000. This is a renewal grant for pasture research at the New Deal Research Field Station.

USDA-NIFA-AFRI. C. West in collaboration with 40 scientists from 8 universities and the USDA-ARS. Sustaining Agriculture through Adaptive Management to Preserve the Ogallala Aquifer under a Changing Climate. $218,000 is the Texas Tech portion of a $2.5 million grant, to be renewed at that level for an additional 3 years.

USDA Southern SARE Graduate Student Grant Program. L. Baxter (West advisee), and C.P. West. Evaluation of winter annual cover crops under multiple residue managements: Impacts on land management, soil water depletion, and cash crop productivity. $9,511.

2016

USDA-SARE. C. West. Long term agroecosystems research and adoption in the Texas Southern High Plains. $100,000. This is a renewal grant for pasture research at the New Deal Research Field Station.

USDA-NIFA-AFRI. C. West and D. Mitchell McAlister in collaboration with 40 scientists from 8 universities and the USDA-ARS. Sustaining agriculture through adaptive management to preserve the Ogallala Aquifer. $218,000 is the Texas Tech portion of a $2.5 million grant.

CH Foundation. C. West and C. Villalobos Improving grassland quality with drought-tolerant alfalfa. $71,018 2016-2018.

USDA-SARE. C. West and L. Baxter. Evaluation of winter annual cover crops under multiple residue managements: Impacts on land management, soil water depletion, and cash crop productivity.

Application of the Fieldprint Calculator for Cotton Production in the Texas High Plains. Funded by the Cotton Foundation (7/14-8/16, $36,000). PI – Phillip Johnson. The objective of this project is to evaluate cotton production sites in the TAWC project with regard to their sustainability as measured by the Fieldprint Calculator.

An Economic Analysis to Determine the Feasibility of Groundwater Supplementation from the Dockum Aquifer. Funded by the High Plains Underground Water District. Co-PIs – Donna Mitchell and Phillip Johnson. (7/15- 6/16, $10,000). The objective of this project is to evaluate the economic feasibility of using water from the Dockum aquifer for crop production in the Texas High Plains.

Sustaining Agriculture through Adaptive Management to Preserve the Ogallala Aquifer under a Changing Climate. Funded by USDA AFRI. PI: Chuck West. Collaborator: Donna Mitchell. (3/16-2/20, $57,160). The objective of this project is to develop best management practices and technologies, tools, and crop management practices across all states that access the Ogallala aquifer.

2017

- USDA-SARE. C. West. Long term agroecosystems research and adoption in the Texas Southern High Plains. $100,000. This is a renewal grant for pasture research at the New Deal Research Field Station.

- USDA-NIFA-AFRI. C. West and D. Mitchell McAlister in collaboration with 40 scientists from 8 universities and the USDA-ARS. Sustaining agriculture through adaptive management to preserve the Ogallala Aquifer. $218,000 is the Texas Tech portion of a $2.5 million grant.

- CH Foundation. C. West and C. Villalobos Improving grassland quality with drought-tolerant alfalfa. $71,018 2016-2018.

- USDA-SARE. C. West and L. Baxter. Evaluation of winter annual cover crops under multiple residue managements: Impacts on land management, soil water depletion, and cash crop productivity. $9, 511.

- Application of the Fieldprint Calculator for Cotton Production in the Texas High Plains. Funded by the Cotton Foundation (7/14-8/16, $64,000). PI's – Phillip Johnson and Donna McCallister. The objective of this project is to evaluate cotton production sites in the TAWC project with regard to their sustainability as measured by the Fieldprint Calculator.

- Sustaining Agriculture through Adaptive Management to Preserve the Ogallala Aquifer under a Changing Climate. Funded by USDA AFRI. PI: Chuck West. Collaborator: Donna Mitchell. (3/16-2/20, $57,160). The objective of this project is to develop best management practices and technologies, tools, and crop management practices.

- Economic and Policy Implications of Underground Water Use in the Southern Ogallala Region. Co-PI: Donna McCallister. 2017-2019. USDA ARS Ogallala Aquifer Program. Amount: $180,000.

- Evaluation of Soil Conservation Practices and Integrated Advanced Irrigation Technologies on Soil Health and Water Use Efficiency. Co-PI: Donna McCallister. 2017-2019. Texas Corn Producers Board. Amount: $36,324.

- Economic and Policy Implications of Underground Water Use in the Southern Ogallala Region. Co-PI: Donna McCallister. 2016-2018. USDA ARS Ogallala Aquifer Program. Amount: $180,000.

Donations to Project
(Phase I - 2005-2013/Phase II – 2014-2016)

2005

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

2008

July 31, 2008 Field Day sponsors:

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

2010

February 3, 2010 Field Day sponsors:

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

August 10, 2010 Field Day sponsors:

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

2011

February 24, 2011 Field Day sponsors:

Texas Corn Producers Board	$500.00
West Texas Guar, Inc.	$500.00

Texas Grain Sorghum Producers	$500.00
Happy State Bank	$500.00

August 4, 2011 Field Day sponsors:

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

2012

August 4, 2012 Field Day sponsors:

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

January 17, 2013 Field Day sponsors:

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

2013

August 15, 2013 Field Day sponsors:

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

2014

AquaSpy	$ 250.00
Bayer CropScience	$ 800.00
Bamert Seed	$ 250.00
Texas Corn Producers	$ 500.00

DSI Drip Irrigation	$ 500.00
Helena Chemical	$ 500.00
Hurst Farm Supply	$ 500.00
Plains Cotton Growers	$ 250.00
National Sorghum Check-Off Program	$ 250.00
Texas Grain Sorghum Producers	$ 250.00
Total	**$4,050.00**

2015

TAWC Water College Sponsors

Bayer	$ 2,000.00
Cotton Inc.	$ 2,000.00
Sorghum Checkoff	$ 2,000.00
Eco-Drip	$ 2,000.00
DuPont Pioneer	$ 2,000.00
Texas Corn Producers	$ 1,000.00
Texas Sorghum Producers	$ 1,000.00
AgTexas	$ 1,000.00
AAEC	$ 500.00
Hurst Farm Supply	$ 500.00
Lubbock Electric	$ 250.00
Plains Cotton Growers	$ 500.00
Diversity D	$ 250.00
Zimmatic	$ 250.00
Watermaster Irrigation	$ 250.00
Capital Farm Credit	$ 250.00
Total	**$15,750.00**

TAWC Field Day Sponsors

Plains Land Bank	$ 250.00
Sorghum Checkoff	$ 250.00
Eco-Drip	$ 250.00
Texas Corn Producers	$ 250.00
Texas Sorghum Producers	$ 250.00
Hurst Farm Supply	$ 250.00
Plains Cotton Growers	$ 250.00
Netafim	$ 250.00
AquaSpy	$ 250.00
Total	**$ 2,250.00**

2016

TAWC Water College, Field Day, Field Walk Sponsors

Bayer	$2,000
Cotton Inc.	$2,000
Pioneer	$2,000
Texas Corn Producers	$1,000
Diversity D	$1,000
Americot	$ 500
Capital Farm Credit	$ 500
Hurst Farm Supply	$ 500
Dow	$ 500
Equipment Supply	$ 500
TX Grain Sorghum	$ 500
Plains Cotton Growers	$ 500
Zimmatic	$ 500
Texas Department of Agriculture	No Charge
EcoDrip	$ 500
First Bank & Trust	$ 500
City Bank Texas	$ 500
Prosperity Bank	$ 500
Ag Workers	$ 500
Toro	$ 500
HPUWD	$ 500
Sorghum Checkoff	$ 500
AquaSpy	$ 500
Valley Irrigation	$ 500
TX Panhandle Organics	$ 500
AgTexas	$ 250
Total	**$17,750.00**

2017

TAWC Water College, Field Day, Field Walk Sponsors

Cotton Inc.	$ 2,000
Bayer	$ 2,000
Pioneer	$ 2,000
Diversity D	$ 1,000
Texas Corn Producers	$ 1,000
Capital Farm Credit	$ 500
Hurst Farm Supply	$ 500
Dow	$ 500
Equipment Supply	$ 500
TX Grain Sorghum	$ 500
Plains Cotton Growers	$ 500
Zimmatic	$ 500
EcoDrip	$ 500
First Bank & Trust	$ 500
City Bank Texas	$ 500
Prosperity Bank	$ 500
Ag Workers	$ 500

Toro	$ 500
HPUWD	$ 500
Sorghum Checkoff	$ 500
AquaSpy	$ 500
Valley Irrigation	$ 500
TX Panhandle Organics	$ 500
AgTexas	$ 250
Total	**$17,250**

Visitors to the Demonstration Project Sites, Field Walks, Field Days, and Water College Outreach Events
(Phase I - 2005-2013/Phase II – 2014-2016)

2005

Total Number of Visitors 190

2006

Total Number of Visitors 282

2007

Total Number of Visitors 176+

2008

Total Number of Visitors 153+

2009

Total Number of Visitors 126+

2010

Total Number of Visitors 120+

2011

Total Number of Visitors 175+ +

2012

Total Number of Visitors 200 +

2013

Total Number of Visitors 230+

2014

Total Number of Visitors	270+

2015

Total Number of Visitors	350+

2016

Total Number of Visitors	400+

2017

Total Number of Visitors	475+

Presentations
(Phase I - 2005-2013/Phase II – 2014-2017)

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(s)**
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

2011

Date	**Presentation**	**Spokesperson(s)**
13-Jan	High Plains Irrigation Conference	Kellison
13-Jan	TAWC Management Team meeting	
18-Jan	Fox Talk 950 AM radio interview	Doerfert/Graber/Sullivan
24-Jan	Wilbur-Ellis Company	Kellison
25-Jan	Caprock Crop Conference	Kellison
4-Feb	KJTV-Fox 34 Ag Day news program: *TAWC rep discusses optimal irrigation, Field Day preview*, Lubbock, TX	Glodt
6-8-Feb	American Society of Agronomy Southern Regional Meeting: *Seasonal Ground Cover for Crops in The Texas High Plains*, Corpus Christi, TX	Maas/Rajan
7-Feb	KJTV-Fox 34 Ag Day news program: *Risk management specialist gives best marketing options for your crop*, Lubbock, TX	Yates
8-Feb	KJTV-Fox 34 Ag Day news program: *Producer Glenn Schur shares his water conservation tips*, Lubbock, TX	Schur
8-10-Feb	Southwest Farm & Ranch Classic (TAWC booth), Lubbock, TX	Doerfert/Graber/Sullivan
9-Feb	Southwest Farm & Ranch Classic: *Managing Warm Season Annual Forages on the South Plains*, Lubbock, TX	Trostle
9-Feb	KJTV-Fox 34 Ag Day news program: *Rep of the HPWD discusses possible water restrictions*, Lubbock, TX	Carmon McCain
10-Feb	Hale County Crops meeting, Plainview, TX	Trostle
17-Feb	TAWC Management Team meeting	
23-Feb	Pioneer Hybrids	Kellison
24-Feb	2011 Production Agriculture Planning Workshop, Muncy, TX	TAWC participants
25-Feb	KJTV-Fox 34 Ag Day news program: *Producers gain knowledge about water conservation at TAWC Field Day*, Lubbock, TX	Doerfert
4-Mar	Texas Tech Forage class	Kellison
10-Mar	TAWC Management Team meeting (Maas presentation)	

30-Mar	West Texas Mesonet (Wes Burgett), TTU Reese Center, Lubbock, TX	Kellison/Brown/Maas/Rajan /Weinheimer
31-Mar—1-Apr	Texas Cotton Ginners Show (TAWC booth), Lubbock, TX	Doerfert/Graber/Sullivan
13-Apr	USDA-ARS/Ogallala Aquifer project (David Brauer), Lubbock, TX	Kellison/TAWC participants
13-Apr	KJTV-Fox 34 Ag Day news program: *TAWC introduces solution tools for producers*, Lubbock, TX	Weinheimer
14-Apr	TAWC Management Team meeting	
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

2012

Date	**Presentation**	**Spokesperson(s)**
6-Mar	Lubbock Kiwanis Club	Kellison
7-Mar	Monthly Management Team Meeting	Kellison
23-Mar	New Mexico Ag Bankers Conference	Kellison, Klose
3-Apr	AgriLife Extension Meeting	Kellison
12-Apr	Monthly Management Team Meeting	Kellison
10-May	Monthly Management Team Meeting	Kellison
10-May	Carilllon Center	Kellison
11-May	Tours-Comer Tuck with the Texas Water Development Board	Kellison
14-May	Tours-Farm Journal Media	Kellison
17-May	Tours-Secretary of State Group	Kellison
14-June	Monthly Management Team Meeting	Kellison
19-June	Lloyd Author Farm	Kellison
20-June	Blake Davis Farm	Kellison
21-June	Glenn Schur Farm	Kellison
10-July	Tours-Justin Weinheimer	Kellison
12-July	Texas Agricultural Coop Council	Kellison
12-July	Texas Independent Ginners Conference	Kellison
18-July	Monthly Management Team Meeting	Kellison
16-Aug	Monthly Management Team Meeting	Kellison
5-Sep	Leadership Sorghum Class 1	Kellison
20-Sep	Monthly Management Team Meeting	Kellison
18-Oct	Monthly Management Team Meeting	Kellison
24-Oct	Texas Agriculture Lifetime Leadership	Kellison

30-Oct	Special Management Team Meeting	Kellison
8-Nov	Monthly Management Team Meeting	Kellison
27-28-Nov	Amarillo Farm & Ranch Show	Borgstedt/Doerfert/Kellison
13-Dec	Monthly Management Team Meeting	Kellison
16-18-Nov	48th Annual American Water Resources Association conference	Doerfert/Kellison/P. Johnson/Maas
20-Nov	Special Management Team Meeting	Kellison
3-Jan	KFLP Radio	Kellison
7-9-Jan	Beltwide Cotton Conference	Doerfert
15-Jan	Fox 950 AM	Doerfert
4-Feb	Texas Seed Trade Association	Kellison
14-Feb	Monthly Management Team meeting	Kellison
21-Mar	Monthly Management Team meeting	Kellison
29-30-Mar	Texas Gin Association Convention	Borgstedt/Doerfert
11-Apr	Monthly Management Team meeting	Kellison

2013

Date	Presentation	Spokesperson(s)
7-10-Jan. 2013	Field evaluation of a remote sensing based irrigation scheduling tool Beltwide Cotton Conference San Antonio, TX	Rajan, Maas
13-Mar.	John Deere Crop Sense capacitance probe use by TAWC – Lubbock, TX	Pate
2 Apr.	Southern Pasture Forage Crop Improvement Conference, Overton, TX	West, Brown
26-Apr.	Data plans for the initiative for strategic and innovative irrigation management and conservation. presented at the Water Management and Conservation: Database Workshop – Lubbock, TX	Kellison, Johnson
8-May	TAWC Update and Highlights – For D-2 County Agents – Lubbock, TX	Pate
5-Jun.	Radio Interview – Field Walk Update – KFLP	Pate
3-Jul.	Radio Interview – Field Walk Update – KFLP	Pate
19-Jul.	Texas Southwestern Cattle Raisers Association, Lubbock, TX	Kellison
22-Jul.	TAWC and Its Purpose – 4-H Ag. Ambassadors – Lubbock, TX	Pate

9-Aug.	Radio Interview – Field Walk Update – KFLP	Pate
13-Aug.	High Plains Water District board of directors – Lubbock, TX	Kellison
19-Sept.	International Grasslands Conference – Sydney, Australia	Kellison, Brown
25-Sept.	TAWC update and highlights – Monsanto headquarters – St. Louis, Mo.	Pate
26- Sept.	Wayland Baptist University class – Lockney, TX	Kellison
2-Oct.	Congressman Frank Lucas – Lubbock, TX	West, Kellison
7-Oct.	TAIA Annual Meeting	Kellison
9-Oct.	Congressman Mike Conway	West, Kellison
10-Oct.	TAWC Field Walk – Lockney, TX	Kellison
2 Nov.	Am. Soc. Agronomy, Tampa, FL. Modeling Old World bluestem grass	West, Xiong
14-15-Dec.	Remote sensing based water management from the watershed to the field level. CIMMYT and the Gates Foundation- Mexico City	Maas, Rajan
14-15-Dec.	Remote sensing based soil moisture detection. Abstracts, Workshop "Beyond Diagnostics: Insights and Recommendations from Remote Sensing." CIMMYT and the Gates Foundation- Mexico City	Shafian, Maas
7-Jan. 2014	Sorghum U – Levelland, TX	Kellison
7 Jan. 2014	Fieldprint Calculator: A measurement of agricultural sustainability in the Texas High Plains Beltwide Cotton Conference, New Orleans	Stokes, Johnson, Robertson, Underwood
7-Jan. 2014	Poster- LEPA vs. LESA Irrigation – Beltwide Cotton Conference – New Orleans, La.	Pate, Yates
16-Jan. 2014	TWDB Director Bech Bruun & staff – Lubbock, TX	Kellison
28-Jan. 2014	Randall County Producers	Kellison
12-Feb. 2014	Texas Panhandle-High Plains Water Symposium	Kellison
13 Feb. 2014	Nebraska Independent Crop Consultants Assoc. annual meeting. Talk on TAWC	West
24-Feb. 2014	TWDB Directors-Lubbock, TX	Kellison

2014

Date	**Presentation**	**Spokesperson(s)**
1/6/2014	Beltwide Cotton conference, New Orleans, LA	A. Attia/N. Rajan

1/7/2014	Sorghum U, Levelland, TX	Rick Kellison
1/16/2014	TWDB Director Bech Bruun and staff, Lubbock, TX	Rick Kellison
1/28/2014	Texas Panhandle-High Plains Water Symposium, Amarillo, TX	Rick Kellison
2/2-4/2014	Annual Meeting Southern Branch American Society of Agronomy Dallas, TX	S. Sharma/ N. Rajan/S. Maas
2/2-4/2014	Annual Meeting Southern Branch American Society of Agronomy, Dallas, TX	S. Sharma/ N. Rajan/S. Maas
2/13/2014	Nebraska Independent Crop Consultants Assoc., Nebraska City, NE	Chuck West
2/25/2014	Texas Water Development Board, Lubbock, TX	Rick Kellison
3/11/2014	Plainview Producer Meeting, Plainview, TX	Rick Kellison
4/1/2014	Cotton Irrigation Meeting, Plainview, TX	Jeff Pate
4/2/2014	Doug Shaw, TWDB, Lubbock, TX	Rick Kellison
4/23/2014	Region O Water Planning Committee, Lubbock, TX	R. Kellison/C. West
5/6/2014	Lions Club Meeting, Idalou, TX	Jeff Pate
5.6.2014	Texas Tech Climate Science Center Seminar series, Lubbock, TX	Chuck West
5/15/2014	TAWC Field Walk, Lockney, TX	Rick Kellison
5/19/2014	Texas Water Summit, TAMEST, Austin, TX	Chuck West
6/17/2014	North Central Coordinating Committee-31, Grand Rapids, MI	Chuck West
6/24/2014	Brownfield Chamber of Commerce, Brownfield, TX	Rick Kellison
8/5/2014	Stronger Economies Together, Littlefield, TX	Jeff Pate
8/12/2014	Radio Interview 950 AM, Lubbock, TX	Rick Kellison
9/29/2014	Texas Speaker of the House Joe Straus & Texas Rep. John Frullo, Lubbock, TX	Rick Kellison
11/2-5/2014	ASA-CSSA-SSSA Annual Meeting, Long Beach, CA	S. Sharma/ N. Rajan/S. Maas
11/2-5/2014	ASA-CSSA-SSSA Annual Meeting, Long Beach, CA	S. Sharma/ N. Rajan/S. Maas
12/11/2014	Olton Co-op grain Winter Meeting, Olton, TX	Jeff Pate
12/15-19/2014	AGU Fall Meeting, San Francisco, CA	S. Shafian, S. Maas
12/16/2014	Swisher County Producer Meeting, Tulia, TX	Rick Kellison
12/23/2014	Texas Representative Dustin Burrows, Lubbock, TX	Rick Kellison

2015

Date	Presentation	Spokesperson(s)
2/15/2015	Agriculture and Climate Change. Amsterdam, Netherlands	S. Angadi, C. West
3/3/2015	HPACC, Lubbock, TX	R. Kellison
3/11/2015	Marketing 101, Muncy, TX	J. Pate
3/12/2015	Ogallala Aquifer Program, Manhattan, KS	Y. Xiong, C. West
3/18/2015	Farm Budgeting, Lubbock, TX	J. Pate
3/19/2015	Nebraska Water Symposium, Lincoln, Nebraska	R. Kellison, G. Schur
4/8/2015	Briscoe County Ag Days, Silverton, TX	R. Kellison
4/17/2015	Kingpins 2029, Amsterdam	R. Kellison
5/2015	National AAAE Research Conference, San Antonio, TX	L. Durst, C. Myers
5/18/2015	World Environ. Water Resources Conference, Austin, TX	C. West, R. Kellison
7/9/2015	Texas Tech TeCSIS Field Day, New Deal, TX	C. West, P. Brown, R. Kellison, V. Allen
8/3/2015	Nebraska Water Balance Field Day, Sutherland, Nebraska	R. Kellison
8/17/2015	Texas Soil and Water, Lubbock, TX	R. Kellison
8/19/2015	Floydada Rotary Club, Floydada, TX	R. Kellison
11/15-18/2015	ASA-CSSA-SSSA Annual Meeting, Minneapolis, MN	C. West, P. Brown
11/15-18/2015	ASA-CSSA-SSSA Annual Meeting, Minneapolis, MN	S. Sharma, S. Maas
11/15-18/2015	ASA-CSSA-SSSA Annual Meeting, Minneapolis, MN	S. Sharma, N. Rajan, S. Maas
11/15-18/2015	ASA-CSSA-SSSA Annual Meeting, Minneapolis, MN	N. Rajan, S. Sharma, K.D. Casey, S. Maas
11/15-18/2015	ASA-CSSA-SSSA Annual Meeting, Minneapolis, MN	N. Rajan, S. Sharma, S. Maas
1/12/2016	Crop Profitability, Lubbock, TX	J. Pate
1/19/2016	Crop Profitability, Lubbock, TX	J. Pate
1/22/2016	Crop Profitability, Lubbock, TX	J. Pate
2/17/2016	Regional SCS Group Presentation, PYCO, Lubbock, TX	P. Brown

2016

Date	Presentation	Spokesperson(s)
1/5-6/2016	Beltwide Cotton Conference, New Orleans, Louisiana	D. Mitchell and J. Pate
1/10-13/2016	American and Forage and Grassland Council Annual Conference Baton Rouge, LA (3 presentations)	L. Baxter, C.P. West
2/25/2016	HPPAC Conference, Lubbock, TX	R. Kellison
3/30/2016	USDA CIG Presentation	R. Kellison
7/19-23/2016	American Society of Animal Science Western Section Joint Meeting	J.D. Sugg, et. al.
8/02/2016	H2O for Texas (Senator Charles Perry), Lubbock, TX	R. Kellison
2016	Lamesa Rotary Club, Lamesa, TX	D. Mitchell
2016	Annual Meeting ASA, CSSA and SSSA Madison, WI	Y. Xiong, C.P. West and T. McLendon
2016	Annual Meeting ASA, CSSA and SSSA Madison, WI	K. Bhandari , C.P. West et. al.
2016	Annual Meeting ASA, CSSA and SSSA Madison, WI (2 presentations)	L. Baxter , C.P. West et. al.
11/17/2016	TTU Class Presentation, Lubbock, TX	R. Kellison
1/5-6/2017	Economic Poster, Beltwide Cotton Conference, Dallas	J. Pate, D. Mitchell and W. Keeling
1/5-6/2016	Beltwide Cotton Conference, New Orleans, Louisiana	D. Mitchell and J. Pate
1/5-7/2017	Southern Agricultural Economics Association Annual Meeting, San Antonio, Texas	D. Mitchell, R.B. Williams and P. Johnson
1/5-7/2017	Southern Agricultural Economics Association Annual Meeting, San Antonio, Texas	D. Mitchell and John Robinson
1/5-7/2017	Southern Agricultural Economics Association Annual Meeting, San Antonio, Texas	Y. Gao, R.B. Williams and D. Mitchell

Formal Presentations:

Baxter, L.L., C.P. West. 2016. Comparison of productivity, efficiency, and profitability of grass-only and grass-legume beef stocker grazing systems in the Southern High Plains. American and Forage and Grassland Council Annual Conference, 10-13 January, Baton Rouge.

Baxter, L.L., and C.P. West. 2016. Comparison of traditional and novel non-destructive techniques for assessment of botanical composition in grass-legume pastures. American and Forage and Grassland Council Annual Conference, 10-13 January, Baton Rouge.

Baxter, L.L., and C.P. West. 2016. Comparison of productivity and efficiency of grass-only and grass-legume beef stocker grazing systems in the Southern High Plains. In Annual meetings abstracts [CD-ROM]. ASA, CSSA, and SSSA, Madison, WI.

Baxter, L.L., and C.P. West. 2016. Developing novel non-destructive sampling techniques for assessing botanical composition in grass-legume pastures. In Annual meetings abstracts [CD-ROM]. ASA, CSSA, and SSSA, Madison, WI.

Sugg, J.D., P.R. Campanili, C.P. West, L.L. Baxter, J.O. Sarturi, and S.J. Trojan. 2016. Evaluation of *Eragrostis tef* (Zucc.) as a forage option for grazing beef cattle in the Southern High Plains. Proc. Am. Soc. Anim. Sci. Western Section, Am. Dairy Sci. Assoc., and Canadian Soc. Anim. Sci. Joint Annual Meeting, 19-23 July, Salt Lake City, UT.

Xiong, Y., C.P. West, and T. McLendon. 2016. Fractionating rainfall into vegetative interception and soil infiltration in perennial grassland. In Annual meetings abstracts [CD-ROM]. ASA, CSSA, and SSSA, Madison, WI.

Bhandari, K., C.P. West, S.D. Longing, D.M. Klein and V. Acosta-Martinez. 2016. Arthropod community composition of 'WW-B.Dahl' Old World bluestem pasture systems. In Annual meetings abstracts [CD-ROM]. ASA, CSSA, and SSSA, Madison, WI.

Mitchell, D. and J. Pate. 2016. "Profitability of 2 and 2 Production Systems." Poster Presentation at the *2016 Beltwide Cotton Conference, New Orleans, Louisiana.*

Mitchell, D. R.B. Williams, and P. Johnson. 2016. "An Economic Analysis to Determine the Feasibility of Groundwater Supplementation from the Dockum Aquifer." Selected Presentation at the *2016 Southern Agricultural Economics Association Annual Meeting, San Antonio, Texas.*

Mitchell, D. and John Robinson. 2016. "Structural Changes in U.S. Cotton Supply." Selected Presentation at the *2016 Beltwide Cotton Conference, New Orleans, Louisiana.*

Mitchell, D. and John Robinson. 2016. "Structural Changes in U.S. Cotton Supply." Selected Presentation at the *2016 Southern Agricultural Economics Association Annual Meeting, San Antonio, Texas.*

Gao, Y, R.B. Williams, and D. Mitchell. 2016. "Cap and Trade Markets for Groundwater: Efficiency and Distributional Effects of the Permit Allocation Mechanism." Selected Presentation at the *2016 Southern Agricultural Economics Association Annual Meeting, San Antonio, Texas.*

2017

Date	Presentation	Spokesperson(s)
3/01/2017	Oklahoma Irrigation Conference, Altus, OK	R. Kellison
4/03/2017	Texas Tech University (Ag. Communications), Lubbock, TX	R. Kellison
8/01/2017	U.S. House Ag Committee, San Angelo, TX	R. Kellison
8/22/2017	Commissioner Sid Miller, Lubbock, TX	R. Kellison
8/23/2017	Bayer Brands Tour, Lubbock, TX	R. Kellison
12/07/207	Swisher County Extension Ag Tour, Tulia, TX	R. Kellison

Formal Presentations:

West, C.P. 2017. Linking climate to groundwater conservation. Climate Outlook Forum: Managing Risk and Thinking Ahead. 26 April, Clovis, NM. USDA-ARS Southwest Climate Hub, Las Cruces, NM.

West, C.P. 2017. Water footprints in High Plains agriculture. Texas Tech Climate Science Center, Science by the Glass, May 9. https://www.youtube.com/watch?v=cxIW1J2h2q4

West, C., D. Malinowski, and T. McLendon. 2017. Responses of grassland communities to climate changes in Texas and Oklahoma. Proceedings of 71st Southern Pasture and Forage Crop Improvement Conference, p. 9-20. June 5-7, Knoxville, TN. http://agrilifecdn.tamu.edu/spfcic/files/2013/02/Proceedings-71st-SPFCIC.pdf

West, C.P. 2017. Strategies for economical conservation of irrigation in the Great Plains. New Mexico State University Research Center Agricultural Field Day, Clovis, NM. Aug. 9. Clovis, NM.

West, C.P., R. Kellison, C.P. Brown, J. Pate, and D. McCallister. 2017. Stretching the supply of groundwater and making it pay in the Texas South Plains. West Central Research and Extension Center Field Day, Aug. 24. North Platte, NE.

Baxter, L.L., and C.P. West. 2017. Comparison of productivity and efficiency of grass-only and grass-legume beef stocker grazing systems in the Southern High Plains. Presented at: American Forage and Grassland Conference, Roanoke, VA. 24 Jan.

Baxter, L.L., and C.P. West. 2017. Evaluation of winter annual cover crops under multiple residue managements: Impacts on soil water depletion and cash-crop productivity. Poster presented at: American Forage and Grassland Conference, Roanoke, VA. 24 Jan.

Baxter, L.L., and C.P. West. 2017. Comparison of traditional and novel non-destructive sampling techniques for site-specific assessment of botanical composition in grass-legume pastures. Poster presented at: American Forage and Grassland Conference, Roanoke, VA. 23 Jan.

Bhandari, K., C.P. West, S.D. Longing, and V. Acosta-Martinez. 2017. Arthropod and soil microbial community composition of 'WW-B.Dahl' Old World bluestem pasture systems. Presented at: American Forage and Grassland Council, Roanoke, VA. 23 Jan.

Xiong, Y., C.P. West. 2017. Comparison of ALMANAC and APSIM for simulating Old World bluestem growth. Presented at: American Forage and Grassland Council, Roanoke, VA. 23 Jan.

Baxter, L.L., and C.P. West. 2017. Comparison of productivity and efficiency of grass-only and grass-legume beef stocker grazing systems in the Southern High Plains. Presented at: Southern Branch of the American Society of Agronomy, Mobile, AL. 6 Feb.

West, C.P., L.L. Baxter, C.P. Brown, and P.E. Green. 2017. Water use for beef production on pastures in West Texas. Universities Council on Water Resources, annual meeting, June 12-14. Fort Collins, CO.

Kharel, Geeta, S.K. Deb, and C.P. West. 2017. Evaluation of different models for estimating the hydraulic parameters and thermal conductivity of pasture unsaturated soils. In Annual meetings abstracts [CD-ROM]. ASA, CSSA, and SSSA, Madison, WI.

Bhandari, K., C.P. West, S, Longing, and V. Acosta-Martinez. 2017. Arthropod and soil microbial community size and composition of native and introduced pastures. In Annual meetings abstracts [CD-ROM]. ASA, CSSA, and SSSA, Madison, WI.

Xiong, Y., and C.P. West. 2017. ALMANAC and APSIM models for simulating old world bluestem growth and water use under limited irrigation. In Annual meetings abstracts [CD-ROM]. ASA, CSSA, and SSSA, Madison, WI.

Rocateli, A.C., and C.P. West. 2017. Introducing grazeable summer cover crops to wheat systems in the Southern Great Plains. In Annual meetings abstracts [CD-ROM]. ASA, CSSA, and SSSA, Madison, WI.

Neupane, J., W. Guo, Abir Raihan, Zhe Lin, and C.P. West. 2017. Cotton growth variability in relation to topography and soil physical properties in the High Plains. In Annual meetings abstracts [CD-ROM]. ASA, CSSA, and SSSA, Madison, WI.

Florence, Kason, L. Baxter, L. Slaughter, and C. West. 2017. Managing winter annual cover crops for increased productivity and soil health. Poster for SARE James Harrison Hill, Sr. Young Scholar Enhancement Grant. August meeting of USDA-Southern SARE Administrative Council meeting. http://www.southernsare.org/Grants/Types-of-Grants/James-Harrison-Hill-Sr.-Young-Scholar-Enhancement-Grant-Program/2017-Young-Scholar-Enhancement-Grant-Projects

West, C., J. Aguilar, and D. Rudnick. 2017. Boosting producer learning, exchange and adoption of water use efficient technologies: Strategies from the High Plains/Ogallala region. Climate Learning Network/ANREP Community Science Initiative. Nov. 2, 2017. www.climatewebinars.net/webinars.

Black, T., D. McCallister and P. Johnson. 2018. Fieldprint Calculator: A Measurement of Environmental and Economic Sustainability Performance of Agricultural Systems in the Southern High Plains. Selected Presentation at the 2018 Beltwide Cotton Conference, San Antonio, Texas, January 3-5.

Black, T., P. Johnson and D. McCallister. 2018. An Evaluation of Production, Costs, and Sustainability on Crop Production in the Southern High Plains. Selected Presentation at the 2018 Beltwide Cotton Conference, San Antonio, Texas, January 3-5.

McCallister, D., A. Cantu, C. West, D. Rudnick. 2017. Effects of Irrigation Technology and Management on WUE and Crop Yield: A Meta-Analysis. Presentation at the 2017 Universities Council on Water Resources (UCOWR) Annual Meeting, Ft. Collins, Colorado, June 13-15.

West, C.P., R. Kellison, C.P. Brown, J. Pate, and D. McCallister. 2017. Stretching the supply of groundwater and making it pay in the Texas South Plains. West Central Research and Extension Center Field Day, Aug. 24. North Platte, NE.

McCallister, D.M., R.B. Williams, D. Hudson, and P. Johnson. 2017. Policy Implications for Sustainable Development in Uzbekistan. Presentation at The 2nd International Conference on Natural Resource Management in Public Policy, Oct. 18-20, Wuhan, Hubei Province, China.

Durst, L., Meyers, C., Irlbeck, E., & Ritz, R. (2017, May). *Adoption of water conservation practices in irrigation management: An application of the Theory of Planned Behavior in the Texas High Plains.* Paper presented at the National AAAE Research Conference, San Luis Obispo, CA. *Distinguished Manuscript Award

Dobelbower, S., & Meyers, C. (2017, September). *Back to school: The development of an educational event to encourage adoption of irrigation management practices.* Refereed poster session presented at the Western Region meeting of the American Association of Agricultural Education, Fort Collins, CO.

Godwin, C., Meyers. C., Dobelbower, S., Irlbeck, E., & Ritz, R. (2017, September). *A case study of the Texas Alliance for Water Conservation's communication efforts.* Refereed poster session presented at the Western Region meeting of the American Association of Agricultural Education, Fort Collins, CO.

Dobelbower, S., & Meyers, C. (2017, September). *An evaluation of attendees' satisfaction with topics presented at an educational water conservation event.* Refereed poster session presented at the Western Region meeting of the American Association of Agricultural Education, Fort Collins, CO.

Durst, L., Dobelbower*, S., & Meyers, C. (2017, September). *The relationship between familiarity with the Texas Alliance for Water Conservation and use of water conservation behaviors.* Refereed poster session presented at the Western Region meeting of the American Association of Agricultural Education, Fort Collins, CO.

Related Non-Refereed Publications
(Phase I - 2005-2013/Phase II – 2014-2017)

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.

Allen, V.G., D. Philipp, W. Cradduck, P. Brown, and R. Kellison. 2007. Water dynamics in integrated crop-livestock systems. Proc. Simpósio Internacional em Integraçâo Lavoura-Pecuâria. 13, 14, and 15 August, 2007. Curitiba, Parana, Brazil.

Acosta-Martínez, V., G. Burow, T.M. Zobeck, and V. Allen. 2007. Soil microbial diversity, structure and functioning under alternative systems compared to continuous cotton. Annual meeting of the American Society of Agronomy, New Orleans, LA. Nov. 4-8, 2007.

Deycard, Victoria N., Wayne Hudnall, Vivien G. Allen. 2007. Soil sustainability as measured by carbon sequestration using carbon isotopes from crop-livestock management systems in a semi-arid environment. Annual meeting of the American Society of Agronomy, New Orleans, LA. Nov. 4-8, 2007.

Doerfert, D., V. Allen, W. Cradduck, and R. Kellison. 2007. Forage sorghum production in the Southern Plains Region. Texas Alliance for Water Conservation, Summary of Research. Vol. 1, No. 1. Texas Tech Univ., Lubbock, TX.

Leigh, K., D. Doerfert. 2008. Farm-based water management research shared through a community of practice model. 44th Annual American Water Resources Association (AWRA) Conference, New Orleans, LA.

Rajan, N., and S. J. Maas. 2008. Acclimation of crops to soil water availability. Abstracts, Annual Meetings, Amer. Soc. Agronomy. 5-9 October, Houston, TX. (CD-ROM)

Maas, S. J., and N. Rajan. 2008. Estimating plant transpiration and soil evaporation using remote sensing. Abstracts, Annual Meetings, Amer. Soc. Agronomy. 5-9 October, Houston, TX. (CD-ROM)

Rajan, N., and S. J. Maas. 2008. Comparison of PVI and NDVI for estimating crop ground cover for precision agriculture applications. In Proc., 9th International Conference on Precision agriculture. 20-23 July, Denver, CO. (CD-ROM)

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Phase I - Budget

Table A 44. Final task and expense budget for Phase I Years 1-9 of the demonstration project.

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

Phase I - Cost Sharing

Table A 45. Final cost sharing figures for TTU, Texas A&M AgriLife, and HPUWCD for Phase I Years 1-9 of the demonstration project.

Cost Sharing Balance Summary (estimated)

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

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