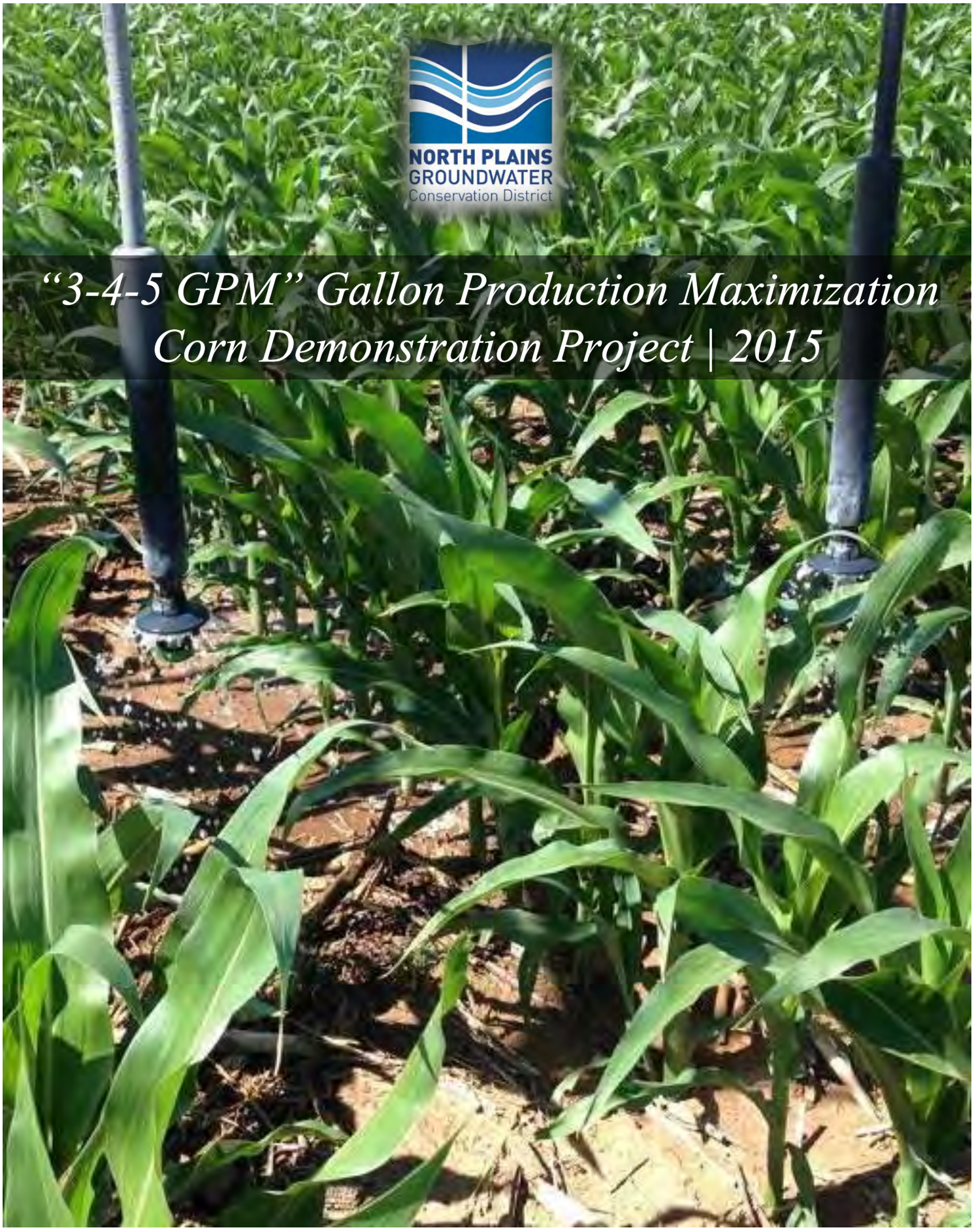
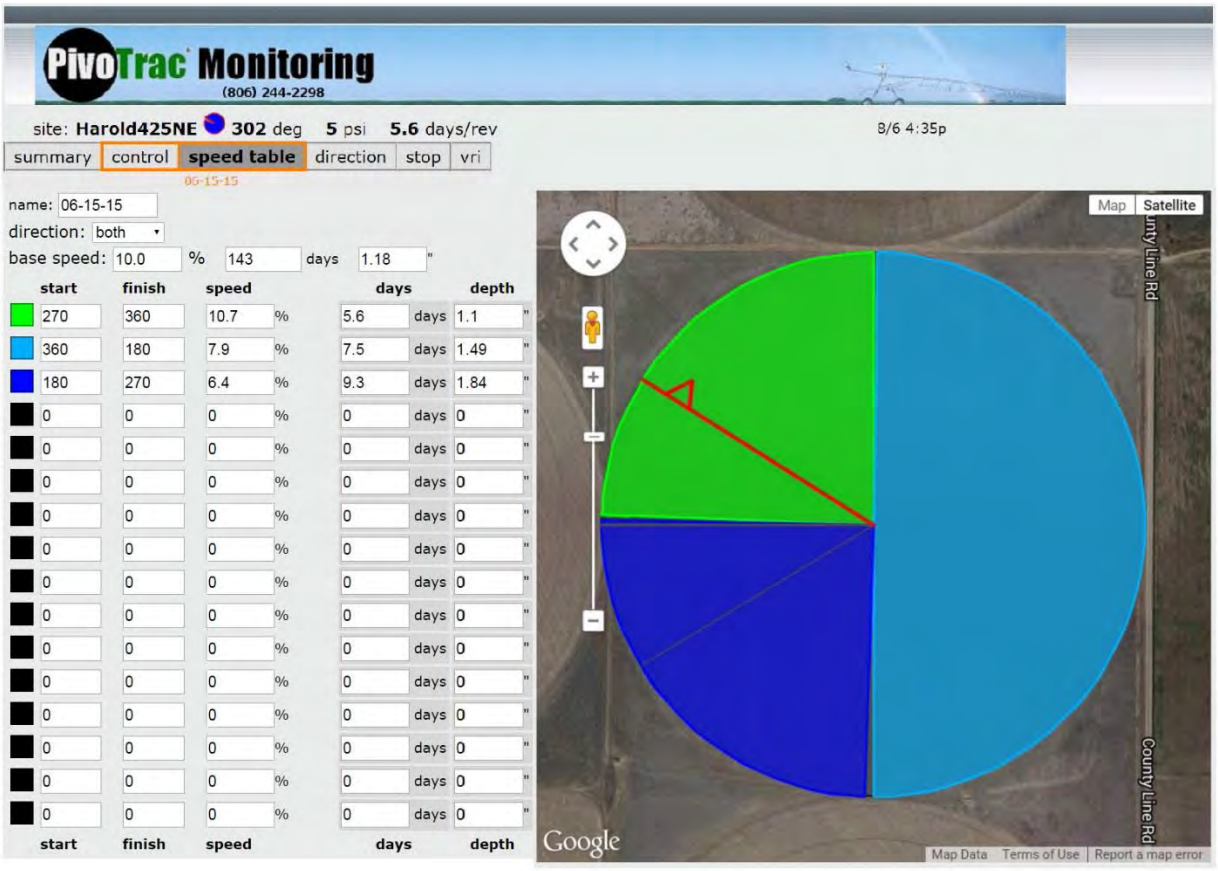


"3-4-5 GPM" Gallon Production Maximization Corn Demonstration Project | 2015



PivoTrac Website shows 3 GPM field in green; 270-360 degrees, 4GPM field in light blue; 0-180 degrees, 5 GPM field in dark blue; 180-270 degrees. Red line in green field shows current position of center pivot at 302 degrees at 4:35 pm August 6 moving clockwise irrigating the 3 GPM field.

Principal Participants:

Harold Grall - Moore County Cooperator (NPGCD Director)

Danny Krienke - Ochiltree County Cooperator (NPGCD Director)

Zac Yoder - Dallam County Cooperator (NPGCD Director)

Dennis Buss, JBS Hartley Feeders - Hartley County Cooperator

Stan Spain - Moore County Cooperator

Principal Staff:

Leon New - Agricultural Engineer (District Conservationist)

Paul Sigle - Agricultural Engineer (NPGCD)

Curtis Schwertner – Natural Resource Specialist (NPGCD)

Additional funding provided by:

Texas Water Development Board - Agricultural Water Conservation Grant

A special thanks goes out to all those not mentioned above who help to make the "3-4-5 GPM" demonstrations possible.

Executive Summary

The "3-4-5 Gallon Production Maximization (GPM)" project is a three year on-farm, field scale project that demonstrates how water conservation technologies and irrigation management practice adjustments can reduce groundwater use and allow agricultural irrigation producers to remain profitable and financially viable with limited and/or diminishing groundwater resources. In 2015, the District planned and initiated the "3-4-5 GPM" field demonstrations based on applying 1.10 inches of irrigation weekly using an irrigation capacity of three gallons per minute (GPM) per acre, 1.49 inches using 4 GPM and 1.85 inches from 5 GPM irrigation capacity. These weekly amounts of irrigation represent one 120 acre center pivot correctly nozzled and pressured to apply 360 gallons per minute (3 GPM), 480 (4 GPM) and 600 gallons (5 GPM) as managed by any grower. Similarly, a 500 acre half mile center pivot nozzled to apply 1500 gallons (3 GPM), 2000 gallons (4 GPM) and 2500 (5GPM). Following results and data from the previous five year "200-12" project, the "3-4-5" project was established to provide information on where to put your groundwater to provide its' most profitable use. Field data collected and tabulated from grower's fields in the "200-12" project show promising optimum corn yields and profitability where center pivot irrigation systems are nozzled for 3.0 & 4.0 gpm per acre. That data show some "200-12" project fields were overwatered managing 4.0 gpm per acre, especially when excessive pre-water was pumped. Likewise, some corn production fields were significantly overwatered, where center pivots were nozzled for 5.0 gpm per acre. Advanced technology and management tools can be conveniently utilized to improve efficiency and increase conservation for both 4.0 and 5.0 gpm per acre corn production.

In **2015**, the "3-4-5 GPM" project's first year, five cooperating growers committed 700 acres to achieve initial field demonstration results. **Harold Grall** dedicated 360 acres in Moore County; **Danny Krienke**, 120 acres in Ochiltree County; **Zac Yoder,** 105 acres in Dallam County; **Dennis Buss,** 60 acres in Hartley County and **Stan Spain,** 55 acres in Moore County. Two of Grall's 120 acre fields demonstrated the use of high efficiency water application center pivot systems. **Appendix A** summarizes the demonstration results that describe water and corn yield for each cooperator growers' field. **Appendix B** shows corn yield per inch of irrigation applied by each cooperating grower and "3-4-5 GPM" field. **Appendix C** describes net return from each inch of irrigation by grower and "3-4-5 GPM" field, **Appendix D** lists net return from each inch of irrigation by grower and "3-4-5 GPM" field, **Appendix E** shows net return from each inch of total water by grower and "3-4-5 GPM" field, **Appendix F** lists net return per inch of total water by grower and "3-4-5 GPM" field, **Appendix G** describes net return per acre by grower and "3-4-5 GPM" field. **Appendix H** summarizes corn hybrids, seeding rates, planting dates and irrigation systems selected by the five cooperators. **Appendix I** describes corn yield vs. net return per acre for all "3-4-5 GPM" fields. **Appendix J** describes yield response to irrigation for all "3-4-5 GPM" fields. Results from the 2015 cooperating producer fields follow.

Stan Spain, in Moore County, produced 12 more bushels per acre in his 4 GPM field than the 3 GPM field. Irrigation was 1.95 inches more. The 5 GPM field produced 33 more bushels per acre than the 3 GPM with 3.85 more inches of irrigation. The 5 GPM yield was 21 more bushels per acre than that from 4 GPM field with 1.90 additional inches of irrigation. Corn production was

23.26 bushels (1302lbs) per inch of irrigation in the 3 GPM field compared to 20.41 bushels (1143lbs) in the 4 GPM and 19.10 bushels (1070lbs) from the 5 GPM field. The 4 GPM field's net gain is $23.04 per acre with 1.95 inches more irrigation used compared to production from the 3 GPM field. The 5 GPM field's net gain compared to the 3 GPM field is $71.38 per acre with 3.85 additional inches of irrigation. Net gain for the 5 GPM field is $48.34 per acre more than the 4 GPM with 1.90 inches more irrigation. Net return from each inch of irrigation is $47.59 for the 3 GPM field compared to $41.64 from the 4 GPM and $39.37 for the 5 GPM field. Net return from each inch of total water is $17.64 for the 3 GPM field, $18.20 for the 4 GPM and $19.78 for the 5 GPM field.

Danny Krienke, in Ochiltree County, produced 6 more bushels per acre in the 4 GPM field than the 3 GPM field and irrigation was 1.88 inches more. The 5 GPM field produced 16 more bushels per acre than the 3 GPM with 3.89 more inches of irrigation. The 5 GPM yield was 10 more bushels per acre than that from the 4 GPM field with 2.01 additional inches of irrigation. Corn production was 23.04 bushels (1290lbs) per inch of irrigation in the 3 GPM field compared to 19.55 bushels (1095lbs) in the 4 GPM and 17.24 bushels (965lbs) from the 5 GPM field. The 4 GPM field's net gain is $3.13 per acre with 1.89 inches more irrigation used compared to production from the 3 GPM field. The 5 GPM field's net gain compared to the 3 GPM field is $16.69 per acre with 3.89 additional inches of irrigation. Net gain for the 5 GPM field compared to the 4 GPM is $13.56 per acre with 2.01 inches more irrigation. Net return from each inch of irrigation is $48.16 for the 3 GPM field compared to $39.99 from the 4 GPM and $34.73 for the 5 GPM field. Net return from each inch of total water is $18.48 for his 3 GPM field, $17.00 for the 4 GPM and $16.88 for the 5 GPM field.

Zac Yoder, in Dallam County, produced 25 more bushels per acre in his 4 GPM field than the 3 GPM and irrigation was 4.11 inches more. The 5 GPM field produced 56 more bushels per acre than the 3 GPM with 8.28 more inches of irrigation. The 5 GPM yield was 31 more bushels per acre than that from 4 GPM field with 4.17 additional inches of irrigation. Corn production was 18.58 bushels (1040lbs) per inch of irrigation in the 3 GPM field compared to 15.66 bushels (877lbs) in the 4 GPM and 14.09 bushels (789lbs) from the 5 GPM field. The 4 GPM field's net gain is $47.65 per acre with 4.11 inches more irrigation used compared to production from the 3 GPM field. The 5 GPM fields' net gain compared to the 3 GPM field is $111.98 per acre with 8.28 additional inches of irrigation. Net gain for the 5 GPM field is $64.33 per acre more than the 4 GPM with 4.17 inches more irrigation. Net return from each inch of irrigation is $37.84 for the 3 GPM field compared to $31.72 from the 4 GPM and $28.60 for the 5 GPM field. Net return from each inch of irrigation, rainfall and net soil water is $18.21 for the 3 GPM field, $18.19 from the 4 GPM and $17.87 for the 5 GPM field.

Harold Grall, in Hartley County, produced 8 more bushels per acre in his 4 GPM field than the 3 GPM field and irrigation was 2.75 inches more. The 5 GPM field produced 11 more bushels per acre than the 3 GPM with 5.36 more inches of irrigation. The 5 GPM yield was 3 more bushels per acre than that from 4 GPM field with 2.61 additional inches of irrigation. Corn production was 15.34 bushels (859lbs) per inch of irrigation in the 3 GPM field compared to 13.35 bushels (747lbs) in the 4 GPM and 11.75 bushels (658lbs) from the 5 GPM field. The 4

GPM field's net gain is $7.68 per acre with 2.75 inches more irrigation used compared to production from the 3 GPM field. The 5 GPM fields' net gain compared to the 3 GPM field is $2.19 per acre with 5.36 additional inches of irrigation. Net gain for the 5 GPM field compared to the 4 GPM is minus $5.49 (lost $5.49) per acre with 2.61 inches more irrigation. Net return from each inch of irrigation is $30.90 for the 3 GPM field compared to $26.41 from the 4 GPM and $22.66 for the 5 GPM field. Net return from each inch of total water is $14.88 for Grall's 3 GPM, $14.83 for the 4 GPM and $13.26 for his 5 GPM field.

Harold Grall's Irrigation Systems, in Moore County**,** his production was 21.07 bushels (1180lbs) per inch of irrigation in both the LEPA Shroud and T-L Precision Mobile Drip Irrigation fields. Net return from each inch of irrigation is $43.98 for both systems and fields. Net return from each inch of irrigation, rainfall and net soil water that totaled 26.18 inches is $19.45 per inch for the LEPA Shroud and T-L PMDI fields.

Harold Grall's PMDI Drag Line Irrigation Systems, in Moore County, produced 12.61 bushels (706 lbs.) from each inch of irrigation. Net return from each inch of irrigation is $22.66. Net return from each inch of irrigation, rainfall and net soil water that totaled 26.08 inches is $12.40. Corn yield was less than anticipated without a clear reason why. There was sufficient available water throughout the growing season. The yield monitor indicates normal uniform yield within the circle. One speculation is that the 58, 54 and 56 degree overnight temperatures on July 7, 8 and 9 stopped plant growth at the 3 to 4 leaf stage at a previous fast rate. It then required too much time for plants to recover resulting in reduced corn yields.

Introduction

In **2015**, the District planned and initiated a field demonstration project, identified as the "3-4-5 GPM" project, that would use the latest water conservation technologies and practices to grow corn irrigated at three different amounts weekly, as needed. The project is based on applying 1.10 inches of irrigation weekly, using an irrigation capacity of three gallons per minute (GPM) per acre, 1.49 inches using four GPM and 1.85 inches from five GPM. These weekly amounts of irrigation represent one 120 acre center pivot correctly nozzled to apply 360 gallons per minute (3 GPM), 480 (4 GPM) and 600 (5 GPM). And similarly, a 500 acre half mile center pivot nozzled to apply 1500 gallons (3 GPM), 2000 (4 GPM) and 2500 (5 GPM). The "3-4-5 GPM" project is planned for a three year period. Following results and data from the previous five year "200-12" project, the "3-4-5 GPM" project was established to provide information on where to put your groundwater to provide its' most profitable use? Field data collected and tabulated from grower's fields in the "200-12" project show promising optimum corn yields and profitability where center pivot irrigation systems are nozzled for three and four gpm per acre. The data shows some project fields were overwatered managing four gpm per acre, especially when excessive pre-water was pumped. Where center pivots were nozzled for five gpm per acre, some corn production fields were significantly overwatered. Advanced technology can be conveniently utilized to increase water-use efficiency for both four and five gpm per acre corn production. The "200-12" Project was a five year initiative that provides field-scale profitability and feasibility demonstrations of producing 200 bushels of corn utilizing 12 inches of irrigation water combined with seasonal rainfall and available water within the crops root zone. The previous "200-12" project was conducted on 6,247 acres by thirteen cooperating growers in 2010 thru 2014. Corn irrigation averaged 21 inches per acre, while irrigation, rainfall and net soil water averaged 31 inches over the 10 year Agri-Partner field demonstration project conducted by AgriLife Extension from 1998-2007. The Agri-Partner project included 129 field scale corn demonstrations on 18,815 acres with approximately 150 cooperating growers over the ten year period. The District has stepped up to the next level, based on what was learned from the 200-12 and Agri-Partner projects. That is to arrange and demonstrate corn production using center pivot systems to apply managed three, four and five GPM per acre irrigation capacity, or similar, with no or only limited pre-water. The "3-4-5 GPM" project demonstrates how water conservation technologies and irrigation management practices can reduce water use and allow agricultural irrigation producers to remain financially viable with restricted and diminishing groundwater resources. The demonstrations must utilize high-efficiency, center-pivot irrigation systems combined with strip till or no till and crop residue management farming practices. The "3-4-5 GPM" project is designed as a three year initiative that provides field-scale profitability and feasibility demonstrations of variable rate irrigation (VRI) by speed control to apply 1.10 inches (3 GPM), 1.49 (4 GPM) and 1.85 inches (5 GPM) of groundwater weekly as needed for corn production combined with seasonal rainfall and available water within the crops root zone. In **2015**, the "3-4-5 GPM" project's first year, five cooperating growers committed 700 acres to achieve initial field demonstration results. **Harold Grall** dedicated 360 acres in Moore County, **Danny Krienke** used 120 acres in Ochiltree County, **Zac Yoder** 105 acres in Dallam County, **Dennis Buss** 60 acres in Hartley County and **Stan Spain** 55 acres in Moore County. Additional

information compiled in 2015 for the "3-4-5 GPM" and in 2010, 2011, 2012, 2013 and 2014 for the previous "200-12 Project," can be obtained from the website at northplainsgcd.org/education and the District office located at 603 East 1st street, Dumas, Texas (806) 935-6401.

Methods

Each of the five cooperators individually selected sectors of a circle to be irrigated at three, four and five GPM per acre by one center pivot system for the demonstration. Irrigation within the selected sectors was managed to apply 1.10 inches (3 GPM), 1.49 inches (4 GPM) and 1.85 inches (5 GPM) according to NPGCD"s "3-4-5 GPM" project protocols and guidelines. Each cooperator created a variable, center-pivot travel speed prescription to apply the different irrigation amounts weekly. Center pivot travel speed was programed and managed by either PivoTrac™ or Lindsay Mfg. Field Net™ telemetry. Individual irrigation amounts were achieved by slowing travel speed down when the system exited the 3 GPM sector and entered the 4 GPM to apply 1.49 inches of irrigation. Travel speed was reduced again as the system exited the 4 GPM and entered the 5 GPM sector to apply 1.85 inches. When the system exited the 5 GPM sector into the 3 GPM, travel speed was increased to apply 1.10 inches of irrigation. Actual individual center pivot travel speed is dependent on the GPM of the systems nozzle package. The District's project leader received pre-programmed text notification when each center pivot entered and departed individual sectors that were recorded and used to calculate individual three, four and five GPM sector irrigation amounts. Each cooperator individually chose commercially available corn hybrids based on their experience as growers. Seeding and fertilizer rates, as well as pesticide and herbicide applications, were also selected by each cooperator. At each center pivot demonstration site, the District installed water meters to record and verify the amount of irrigation applied on each field, rain gauges to measure rainfall, gypsum block moisture sensors at 1, 2, 3, 4 and 5 foot depths in the crop's root zone to monitor soil water content, and AquaSpy® continuous soil water monitoring probes down to 60 inches. Each irrigation system was equipped with PivoTrac™ or Lindsey Mfg. Field Net™ remote continuous tracking and control to manage and monitor irrigation application. Each cooperator was provided soil and plant leaf sampling for each "3- 4-5 GPM" sector four times during the growing season by Better Harvest, Inc. to monitor and guide fertility levels. During the growing season, District personnel collected water, soil moisture, crop growth and other data and maintained recording equipment weekly in each demonstration field. The District's tabulated demonstration field data is included with each cooperator report that follows. Cooperators and the District's conservationist used the real-time data from AquaSpy®, PivoTrac™ and Lindsey Mfg. Field Net™ websites along with the data collected weekly from each demonstration field to monitor crop and soil moisture conditions, as well as to monitor and manage irrigation frequency and volumes in the sectors. Individual irrigation amounts were calculated using each text message from PivoTrac™ to the District conservationist who recorded when irrigation stopped in one sector and began in the other sector. The time the irrigation system was in the "3 GPM", "4 GPM" and "5 GPM" sectors along with weekly GPM water meter readings, established a method to track irrigation. All demonstrations began at planting and ended at harvest, which each cooperator managed. The District compared harvest and irrigation results from each sector for each grower, and to that of

other cooperators in the project. Yields for each field were adjusted to reflect 15.0% moisture content for corn based on the formula used by the National Corn Growers Association. The District analyzed production gains and losses based on a corn price of $3.97 per bushel and the growers expenses relating to irrigation, seed, fertilizer and harvest costs. For the comparison, a common price for seed, irrigation and harvest costs were as follows: seed, $3.60 per thousand; irrigation, $5.30 per inch applied and harvest, $0.36 per bushel. Fertilizer costs were calculated for each field based on basic nutrients removed to produce the corn yield harvested. Method of calculation and nutrient prices was provided by Better Harvest. The District did not analyze land costs because land costs are highly variable between growers and across the District. Variable rate irrigation (VRI) prescriptions were written using the same information required to prepare a normal center pivot precipitation chart. The following discussion provides detailed growing season data, results and information for each grower's demonstrations measured and recorded in 2015, the first year for the "3-4-5 GPM" project.

Danny Krienke's 2015 Ochiltree County Demonstration

Planting and Crop Information: Danny Krienke strip tilled and planted 120 acres of corn in the south half of the circle of section 47, for his "3-4-5 GPM" demonstration. The 120 acres were equally divided in 40 acres for his 3, 4 and 5 GPM fields. 90 to 150 degrees was his 4 GPM field, 150 to 210 the 3 GPM and 210 to 270 his 5 GPM. Krienke planted each "3-4-5 GPM" field to Pioneer 33B54 hybrid. Seeding rate for the 3 GPM acres was 26,000, 4 GPM 27,000 seeds per acre and 5 GPM 28,000. Center pivot travel speed was by Lindsey Mfg. Field Net™. For management convenience, travel speed was programed to irrigate the 3 GPM field in 18 hours to apply 0.6 inch, 24 hours to apply 0.80 on the 4 GPM field and 30 hours to apply 1.00 inch on the 5 GPM field and stop. When needed, the center pivot ran 33.0 hours each week to apply 1.10 inches on the 3 GPM field, 44.7 hours to apply 1.49 inches on the 4 GPM field and 55.5 hours to apply 1.85 inches on the 5 GPM field. Seasonal water meter readings averaged 575 gpm. Irrigation was with the Senninger LEPA shroud with drops spaced 30 inches apart. Timely rainfall allowed the center pivot to be stopped more than sixty hours during the growing season. Planting and crop information for "Krienke 3 GPM", "Krienke 4 GPM" and "Krienke 5 GPM" are shown in the table 1 below.

Table 1: Planting and Crop Information for Danny Krienke

"3 GPM" Demonstration Site: 150-210 degrees			
Planted:	*May 31*	**Harvested:**	*October 18*
Hybrid:	*Pioneer 33B54*	**Seeding Rate:**	*26,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*40*	**GPM Per Acre:**	*4.79*
Total Water:	*22.96 inches*	**Soil Type:**	*Lazbuddie Clay*
Irrigation:	*8.81inches*	**Insecticide:**	*None*
Herbicide:	*Cinch ATZ, Roundup*	**Fertilizer**:	39-97-0-0
"4 GPM" Demonstration Site: 90-150 degrees			
Planted:	*May 31*	**Harvested:**	*October 18*
Hybrid:	*Pioneer 33B54*	**Seeding Rate:**	*27,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*40*	**GPM Per Acre:**	*4.79*
Total Water:	*25.14 inches*	**Soil Type:**	*Sherm Clay Loam*
Irrigation:	*10.69 inches*	**Insecticide:**	*none*
Herbicide:	*Cinch ATZ, Round Up*	**Fertilizer:**	43-97-0-0
"5 GPM" Demonstration Site: 210-270 degrees			
Planted:	*May 31*	**Harvested:**	*October 18*
Hybrid:	*Pioneer 33B54*	**Seeding Rate:**	*28,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*40*	**GPM Per Acre:**	*4.79*
Total Water:	*26.12 inches*	**Soil Type:**	*Lazbuddie Clay*
Irrigation:	*12.70 inches*	**Insecticide:**	*none*
Herbicide:	*Cinch ATZ, Round Up*	**Fertilizer:**	46-97-0-0

Soil Water Profile and Growing Season Rainfall

"3 GPM" Demonstration Site: Preseason soil water was good at 1, 2, 3, 4 and 5 feet following 13.15 inches of rainfall measured in April and May, prior to planting. Weekly gypsum block readings indicate the crop rooted deep and used 3.38 inches of soil water from 1, 2, 3 and 4 feet in September plus .61 inches of irrigation and .84 inches of rainfall to finish the crop. Only limited soil water was used from 5 feet, likely because sufficient water was available from the upper root zone. Soil moisture sensors show the crop had adequate soil water during the growing season. The soil profile was refilled by more than four inches of rainfall in October, mostly following harvest. The crop was produced in Lazbuddie clay soil that can store approximately 2.0 inches of available water per foot for potential crop use. Timely beneficial rainfall significantly contributed to producing a good corn yield with only 8.81 inches of irrigation. Total rainfall from planting until grain black layer totaled 10.77 inches, and was more normal for this location. Gypsum blocks were installed in early June following planting due to wet soil conditions prior to planting.

"4 GPM" Demonstration Site: Soil water was good at 1, 2, 3, 4 and 5 feet from abundant rainfall during April and May prior to planting. Weekly gypsum block readings show good soil moisture levels were maintained at 1, 2, 3, 4 and 5 feet during the growing season from timely beneficial rainfall and periodic irrigation as needed. The crop used approximately 2.66 inches of soil water mostly from 1, 2 and 3 feet in addition to rainfall and irrigation in August and September. Soil moisture sensors show the crop had sufficient soil water during the growing season. Gypsum block moisture sensors were installed in June following planting. Timely rainfall significantly contributed to producing the 209 bushel per acre corn yield, with only 10.69 inches of irrigation to be applied. Total rainfall from planting thru black layer totaled 11.79 inches. The crop was produced in Sherm silty clay loam soil that holds approximately 2.0 inches available water per foot for potential crop use.

"5 GPM" Demonstration Site: Beginning soil water was good at 1, 2, 3, 4 and 5 feet at planting due to more than 13 inches of rain in April and May. Weekly gypsum block moisture sensors show the crop had sufficient available soil water during the entire growing season. The sensors show that crop roots extracted 2.65 inches of soil water from 1, 2, 3 and 4 feet plus irrigation and rainfall producing the 219 bushel per acre corn yield. Soil water depletion occurred primarily in September finishing the crop. Total rainfall was 10.77 inches. Irrigation totaled 12.70 inches. The crop was produced in Lazbuddie clay soil that holds 2.0 inches of available water per foot for potential crop use.

Table 2: Monthly Rainfall Data for Danny Krienke

	June	July	August	September	Total
"3 GPM"	3.63"	2.58"	3.72"	0.84"	**10.77"**
"4 GPM"	3.63"	3.44"	3.90"	0.82"	**11.79"**
"5 GPM"	3.63"	2.58"	3.72"	0.84"	**10.77"**

Growing Season Water Tracking: The district tracked total water and crop growth throughout the growing season using rain gauges, water meters and both gypsum blocks and

AquaSpy® soil moisture sensors. One set of five gypsum block soil moisture sensors was installed at 1, 2, 3, 4 and 5 feet and an AquaSpy® soil moisture probe was installed down to five feet in the root zone at one location to monitor soil water levels in the "3 GPM" field. Another set of the same type of sensors were installed in both the "4 GPM" and "5 GPM" fields. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in each field. Due to wet soils from abundant April and May rainfall, all Gypsum blocks were installed following planting. Gypsum blocks, water meter, rain gauges and crop growth are read, recorded and utilized weekly by district personnel. Each AquaSpy® probe was installed following crop emergence. A 24/7 AquaSpy® probe website shows soil moisture at four inch increments to 60 inches and monitors plant root growth. The website lists all AquaSpy® soil probes in the "3-4-5 GPM" project and is available to all cooperators and district personnel. Another 24/7 PivoTrac website tracks each center pivot system and monitors and controls irrigation. Each center pivot travel speed prescription written to apply 1.10 inches ("3 GPM"), 1.49 inches ("4 GPM") and 1.85 inches ("5 GPM") is managed from the PivoTrac website. Both the cooperating grower and district "3-4-5 GPM" project leader collectively monitor, control and manage irrigation from the PivoTrac website. Following this paragraph, a series of graphs and tables shows weekly gypsum block readings for the season; growing season water, including rainfall, irrigation, and soil moisture at various growth stages; and the order of irrigation and rainfall events for each "3-4-5 GPM" field. Finally a form describes the protocols for each field. "Total Water," as shown on the graph for growing season water, is the sum of seasonal irrigation, rainfall and net soil water. Graphs and tables for the 3 GPM acres are shown first, followed by the same illustrations for each 4 GPM and 5 GPM.

Figure 1: Gypsum Block Readings for Danny Krienke's "3 GPM" Demonstration Site (203 bu/ac)

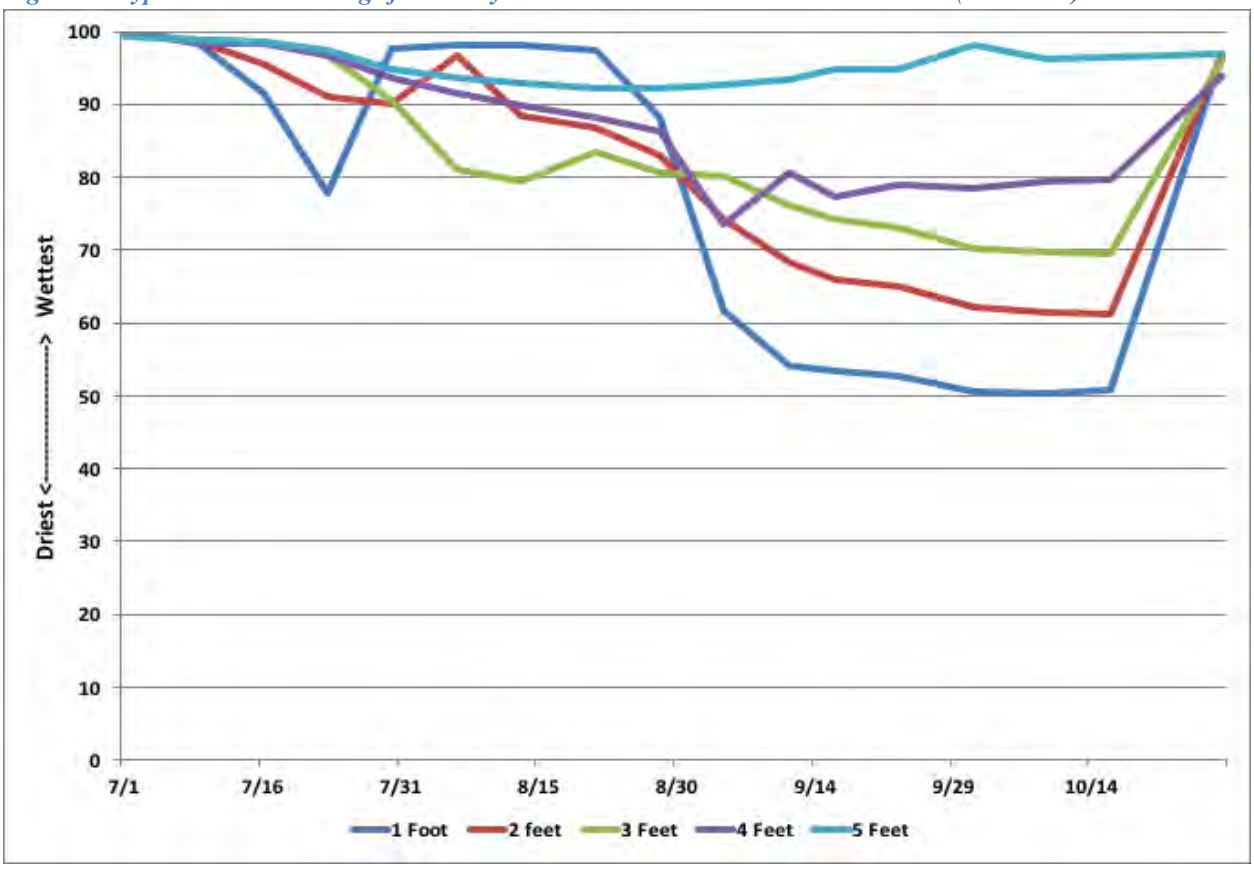


Figure 2: Growing Season Water Tracking for Danny Krienke's "3 GPM" Demonstration Site (203 bu/ac)

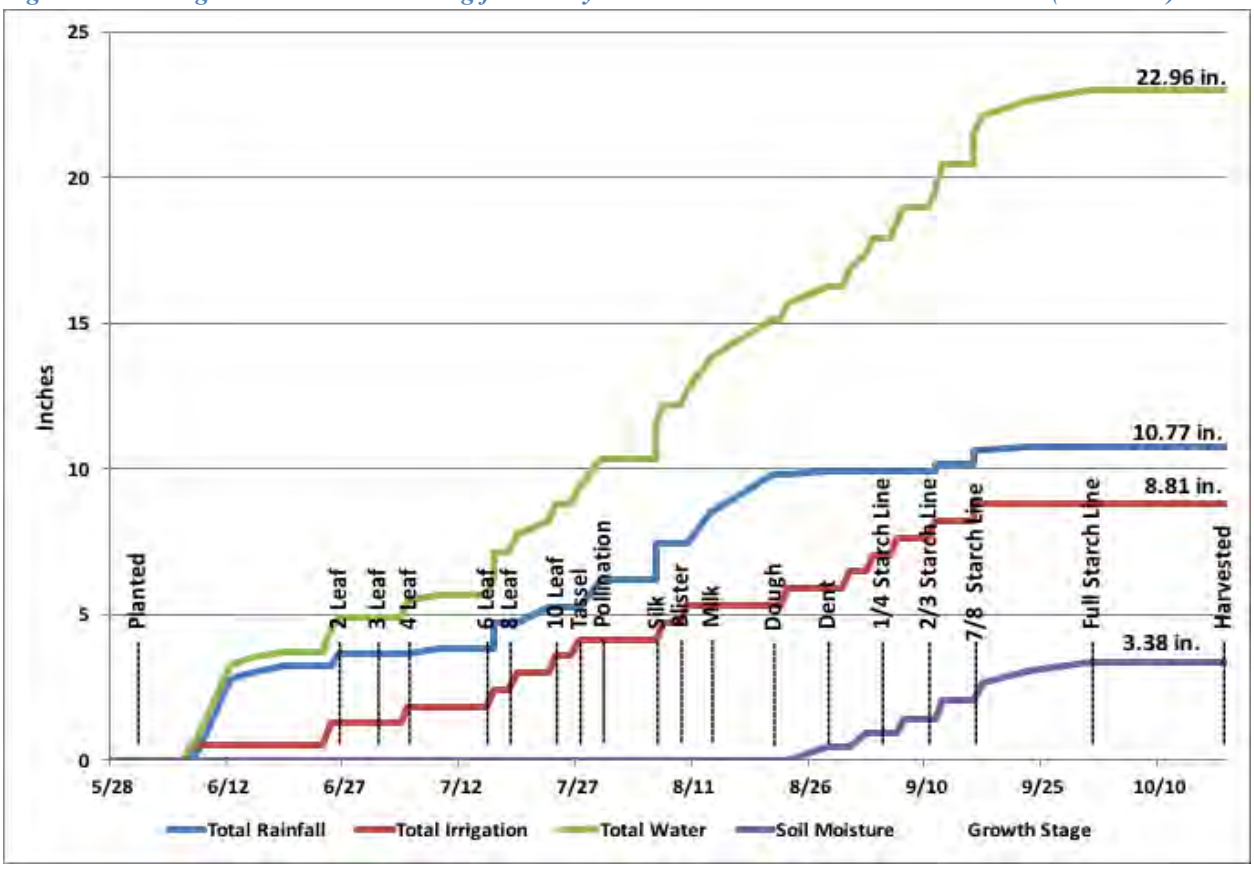


Table 3: Demonstration Field Data for Danny Krienke's "3 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
					1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/20	2.50												Danny
4/27	3.00												Danny
5/5	1.00										312 N		Danny
5/9	0.70										312 N		Danny
5/13	0.50										312 N		Danny
5/16	1.65										312 N		Danny
5/19	1.00										312 N		Danny
5/22	1.80										312 N		Danny
5/31										Planted			Danny
6/1										move dry	270 Y		Pivotrac
6/6			666.21							split	210 Y		Leon
6/7		0.50	667.88							3 gpm	150 Y	575	Leon
6/8	0.32										90 N		Pivotrac
6/12	2.37										90 N		Pivotrac
6/13	0.16										90 N		Pivotrac
6/15	0.17										90 N		Pivotrac
6/19	0.21										90 N		Pivotrac
6/24			672.1							3 gpm	150 Y		Leon
6/25		0.76	674.65							split	210 Y	605	Leon
6/26	0.40		677.2	2 leaf							270 N		C & L
7/1			677.2	3 leaf	100.2	100.0	99.8	100.1	99.3		268 N		C & L
7/4			680.32	3 leaf							210 Y		Field Net
7/5		0.58	682.25	4 leaf						3 gpm	150 Y	575	Leon
7/9	0.21		684.54	5 leaf	98.4	98.5	98.7	98.3	98.7		90 N		C & L
7/15			688.6	6 leaf							150 Y		Field Net
7/16		0.57	690.49	7 leaf						3 gpm	210 Y	575	Leon
7/16	0.90		691.39	7 leaf	91.5	95.6	98.6	98.3	98.6		230 Y	580	C & L
7/18			696.93	8 leaf						3 gpm	210 Y		Leon
7/19		0.57	698.83	9 leaf						3 gpm	150 Y	578	Leon
7/23	0.49		703.35	9 leaf	77.8	91.0	96.6	96.7	97.5	3 gpm	146 Y	565	C & L
7/23			703.82	9 leaf							150 Y		Field Net
7/24		0.58	705.75	10 leaf						3 gpm	210 Y	565	Leon
7/26			711.95	11 leaf						3 gpm	210 Y		Field Net
7/27		0.57	713.85	tassel						3 gpm	150 Y	560	Leon
7/30	0.98		718.64	pollinate	97.6	90.1	90.6	93.5	94.7		151 N		Leon
8/6			718.64	silk						3 gpm	151 Y		Field Net
8/6	1.20		718.79	silk	98.0	96.6	81.1	91.6	93.7	3 gpm	157 Y	577	Curtis
8/7		0.61	720.67	silk						3 gpm	210 Y	560	Leon
8/9			726.83	blister						3 gpm	210 Y		Field Net
8/10		0.57	728.63	blister						3 gpm	150 Y		Leon
8/13	1.10		731.23	milk	98.2	88.4	79.5	89.8	92.9		90 N		Curtis
8/21	1.28		731.31	dough	97.3	86.7	83.4	88.1	92.1	4 gpm	90 Y	645	Curtis
8/22			733.79	dough						3 gpm	150 Y		Field Net
8/23		0.58	735.72	dough						3 gpm	210 Y	575	Leon
8/28	0.14		739.01	dent	88.1	83.0	80.7	86.3	92.3		270 N		Curtis
8/30			742.29	1/8 mat ln						3 gpm	210 Y		Field Net
8/31		0.58	744.24	1/8 mat ln						3 gpm	150 Y	575	Leon
9/2			749.3	1/8 mat ln						3 gpm	150 Y		Field Net

Date	Rain Inches	Irrigation Inches	Water Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
					1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
9/3		0.57	751.1	1/8 mat In						3 gpm	210 Y	575	Leon
9/4			753.58	1/4 mat In	61.7	74.1	80.1	73.4	92.7	5 gpm	263 Y	571	Curtis
9/5			757.49	1/4 mat In						3 gpm	210 Y		Field Net
9/6		0.58	759.41	1/2 mat In						3 gpm	150 Y	575	Leon
9/10			764.53	2/3 mat In						3 gpm	150 Y		Field Net
9/11		0.58	765.46	2/3mat In						3 gpm	210 Y	580	Leon
9/11	0.23		766.94	2/3mat In	54.1	68.4	76.2	80.6	93.4	5 gpm	230 Y	576	Curtis
9/15			768.77	3/4mat In						3 gpm	210 Y		Field Net
9/16	0.49		769.28	3/4mat In	53.5	66.0	74.3	77.2	94.9	3 gpm	207 Y	580	Curtis
9/16		0.61	770.8	7/8mat In						3 gpm	151 Y	580	Leon
9/23	0.12		771.02	7/8mat In	52.6	65.1	73.0	79.0	94.8		150 N		C & L
10/1			771.02	1.0mat In	50.6	62.2	70.3	78.5	98.0		90 N		C & L
10/9	0.72		771.02	1.0mat In	50.4	61.5	69.7	79.3	96.1		90 N		Curtis
10/16			771.02	1.0mat In	50.8	61.2	69.4	79.6	96.4		90 N		Curtis
10/18				harvest				93.8					Danny
10/28	3.45		771.02	harvest	96.6	96.7	96.0	93.8	97.0		90 N		Curtis
Total	**10.77**	**8.81**			**1.0**	**0.9**	**0.8**	**0.7**	**0.0**				**Leon**
Net Soil Moisture is 3.38"													
Irrigation, Rainfall Plus Net Soil Moisture is 22.96"													

* Numbers in red are not counted in the total

NORTH PLAINS GROUNDWATER Conservation District

2015-Corn Demonstration
Irrigated Medium Season Corn

3 GPM

Year:	2015	**County:**	Ochiltree	**Grower:**	Danny Krienke
No. Acres:	40	**Variety/Hyb:**	P33B54	**Soil Type:**	Lazbuddie Clay
Meter Type:	Seametrics				
Meter Mult:	Acre Feet x 1	**Tillage:**	Strip Till		
Fertilizer:	39-97-0-0	**Seeding:**	26,000		
Planted:	May 31, 2015	**Harvest:**	October 18, 2015		
Herbicide:	Cinch, Roundup	**Insecticide:**	None		
Yield:	203 bu/acre @ 15.0% moist.	**Prev. crop:**	Wheat	**Row width:**	30 inches
Irrigation method:	Center Pivot	**Prewater:**	0	**Well GPM:**	575
Distance between drops:	30 inches	**Distance from nozzle to ground:**	18 inches		
Application pattern:	LEPA Shroud	**Crop row direction :**	Planted in circle		

GPS Location of Pivot Pad		**GPS Location of Gypsum Blocks**	
Latitude:	36.402727	Latitude:	36.9806
Longitude:	-100.859866	Longitude:	-100.86137

Danny Krienke's "3 GPM" Site AquaSpy® Probe Summary

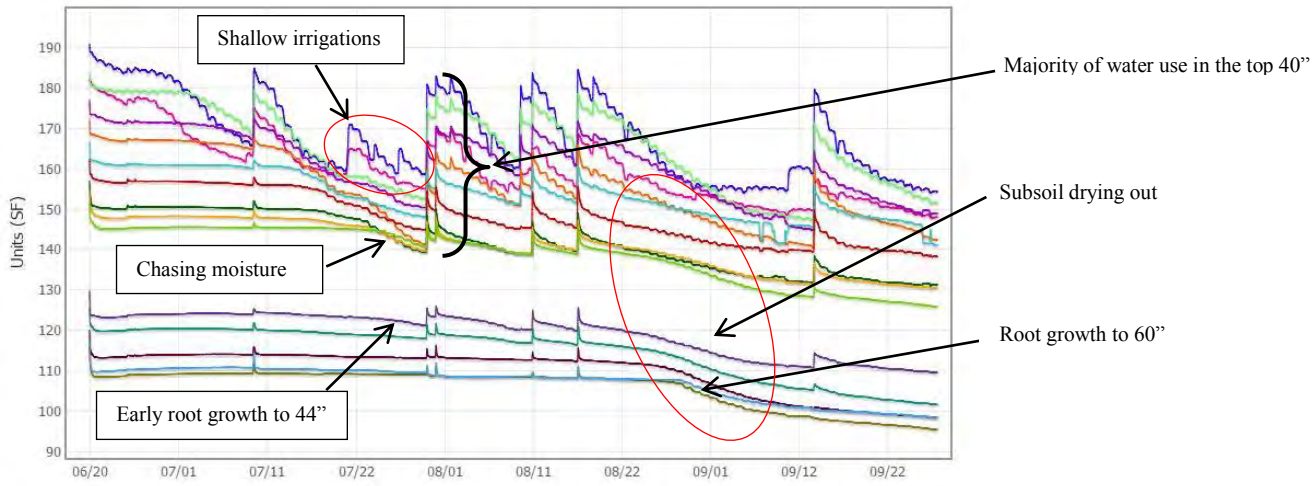


Figure 3. Krienke moisture graph (3 gpm)

This site had a very deep root system, getting to 36" in mid-June and getting to 60" by late August. Indeed this crop drew heavily on sub-soil moisture during grain filling which helped it achieve such a high level of water-use efficiency. Since it also had the highest return per inch of water pumped, fewer inputs may have been used, which might partially explain the relatively low yield. It may have benefitted from some deeper irrigation during mid-late July, where 3 successive events were only able to wet the top 8". While there were several irrigations that reached 60", there was little evidence of measurable drainage.

Figure 4: Gypsum Block Readings for Danny Krienke's "4 GPM" Demonstration Site (209 bu/ac)

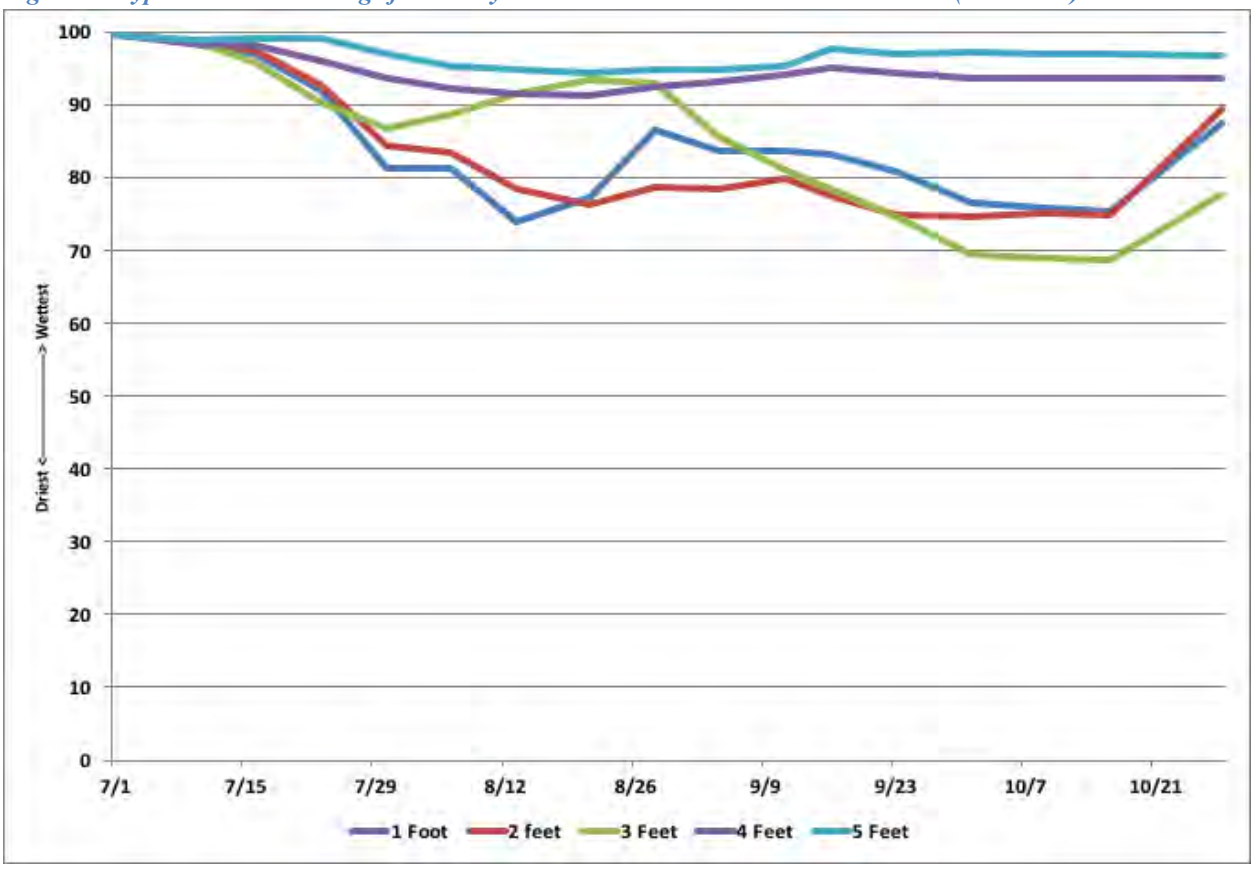


Figure 5: Growing Season Water Tracking for Danny Krienke's "4 GPM" Demonstration Site (209 bu/ac)

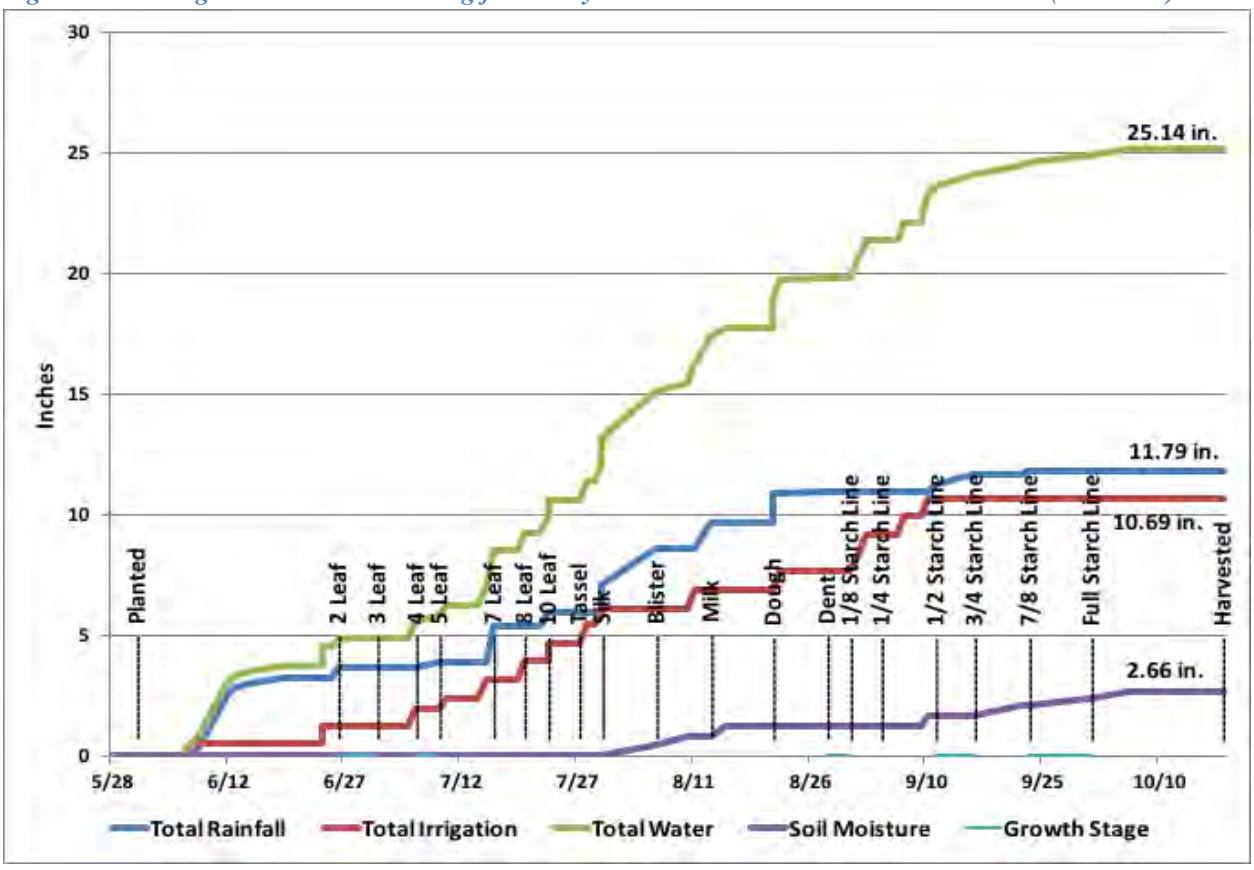


Table 4: Demonstration Field Data for Danny Krienke's "4 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
					1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/20	2.50												Danny
4/27	3.00												Danny
5/5	2.00										312 N		Danny
5/9	0.70										312 N		Danny
5/13	0.50										312 N		Danny
5/16	1.65										312 N		Danny
5/19	1.00										312 N		Danny
5/22	1.80										312 N		Danny
5/31										Planted			Danny
6/1										move dry	270		Pivotrac
6/6			667.88							4 gpm	150 Y		Leon
6/7		0.50	669.55							split	90 Y	575	Leon
6/8	0.32										90 N		Pivotrac
6/12	2.37										90 N		Pivotrac
6/13	0.16										90 N		Pivotrac
6/15	0.17										90 N		Pivotrac
6/19	0.21										90 N		Pivotrac
6/23			669.55							4 gpm	90 Y		Leon
6/24			672.10							4 gpm	150 Y	605	Leon
6/24		0.76	672.10							split	150 Y cw		Leon
6/25			674.65							4 gpm	210 cw	575	Leon
6/26	0.40		677.20	2 leaf							270 N		C & L
7/1			677.20	3 leaf	99.8	99.7	99.5	99.5	99.5		268 N		C & L
7/5			682.25	3 leaf						split	150 Y		Field Net
7/6		0.69	684.54	4 leaf						4 gpm	90 N	525	Leon
7/9	0.21		684.54	5 leaf	98.4	98.5	98.7	98.3	98.7		90 N		C & L
7/9			684.54							start	90 Y		Leon
7/10		0.46	686.07							4 gpm	114 N	575	Pivotrac
7/14			686.07							start	90 Y		Field Net
7/15		0.76	688.60							4 gpm	150 Y	580	Leon
7/16	1.50		691.39	7 leaf	96.9	97.3	95.8	98.1	99.1	5 gpm	230 Y	580	C & L
7/19			698.83							4 gpm	150 Y	578	Leon
7/20		0.75	701.32	8 leaf						4 gpm	90 Y	575	Leon
7/22			701.32							4 gpm	90 Y		Pivotrac
7/23	0.58		703.35	10 leaf	91.9	92.6	90.3	95.9	99.1	4 gpm	146 Y	565	C & L
7/23		0.75	703.82	10 leaf						4 gpm	150 Y	565	Leon
7/27			713.85	tassel						4 gpm	150 Y		Pivotrac
7/28		0.75	716.35	tassel						4 gpm	90 Y	565	Leon
7/29			716.35	tassel						4 gpm	90 Y		Field Net
7/30		0.69	718.64	silk						4 gpm	151 N	520	Leon
7/30	1.15		718.64	silk	81.3	84.3	86.8	93.6	96.8		151 N		Leon
8/6	1.48		718.79	blister	81.3	83.4	88.6	92.1	95.2	3 gpm	157 Y	577	Curtis
8/10			728.83	blister						4 gpm	150 Y		Field Net
8/11		0.75	731.23	blister						4 gpm	90 Y	560	Leon
8/13	1.12		731.23	milk	73.8	78.5	91.5	91.5	94.7		90 N		Curtis
8/21			731.23	dough						4 gpm	90 Y		Field Net
8/21	1.18		731.31	dough	77.3	76.3	93.4	91.3	94.3	4 gpm	90 Y	645	Curtis
8/22		0.77	733.79	dough						4 gpm	150 Y	575	Leon
8/28	0.12		739.01	dent	86.4	78.7	92.8	92.4	94.7		270 N		Curtis

Date	Rain Inches	Irrigation Inches	Water Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
					1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
8/31			744.24	1/8 mat In						4 gpm	150 Y		Field Net
9/1		0.76	746.77	1/8 mat In						reverse	90 Y	575	Leon
9/2		0.76	749.30	1/8 mat In						4 gpm	150 Y	575	Leon
9/4			753.58	1/4mat In	83.5	78.5	85.4	93.2	94.7	5 gpm	263 Y	571	Curtis
9/6			759.41	1/4 mat In						4 gpm	150 Y		Field Net
9/7		0.77	761.97	1/4 mat In						4 gpm	90 Y	575	Leon
9/9			761.97	1/3 mat In						4 gpm	90 Y		Field Net
9/10		0.77	764.53	1/3 mat In						4 gpm	150 Y	580	Leon
9/11	0.24		766.94	1/mat In	83.7	79.7	80.9	94.0	95.3	5 gpm	230 Y	576	Curtis
9/16	0.45		769.28	3/4mat In	83.1	77.5	78.3	95.1	97.6	3 gpm	207 Y	580	Curtis
9/23	0.13		771.02	7/8mat In	80.7	74.8	74.6	94.2	97.0		150 N		C & L
10/1			771.02	1.0mat In	76.6	74.7	69.3	93.7	97.1		90 N		C & L
10/9	0.75		771.02	1.0mat In	75.7	75.1	68.9	93.5	96.9		90 N		Curtis
10/16			771.02	1.0mat In	75.3	74.8	68.7	93.5	96.8		90 N		Curtis
10/1				harvest									Dany
10/28	3.41		771.02	harvest	87.4	89.4	77.6	93.7	96.6		90 N		Curtis
Total	**11.79**	**10.69**			**0.7**	**0.8**	**0.9**	**0.3**	**0.0**				**Leon**
Net Soil Moisture is 2.66"													
Irrigation, Rainfall Plus Net Soil Moisture is 25.14"													

• Numbers in red are not counted in the total

2015-Corn Demonstration
Irrigated Medium Season Corn

NORTH PLAINS GROUNDWATER Conservation District

4 GPM

Year: 2015 **County:** Ochiltree **Grower:** Danny Krienke

No. Acres: 40 **Variety/Hyb:** P33B54 **Soil Type:** Lazbuddie Clay

Meter Type: Seametrics

Meter Mult: Acre Feet x 1 **Tillage:** Strip Till

Fertilizer: 43-97-0-0 **Seeding:** 27,000

Planted: May 31, 2015 **Harvest:** October 18, 2015

Herbicide: Cinch, Roundup **Insecticide:** None

Yield: 209 bu/acre @ 15.0% moist. **Prev. crop:** Wheat **Row width:** 30 inches

Irrigation method: Center Pivot **Prewater:** 0 **Well GPM:** 575

Distance between drops: 30 inches **Distance from nozzle to ground:** 18 inches

Application pattern: LEPA Shroud **Crop row direction :** Planted in circle

GPS Location of Pivot Pad
Latitude: 36.402727
Longitude: -100.859866

GPS Location of Gypsum Blocks
Latitude: 36.40138
Longitude: -100.85409

Danny Krienke's "4 GPM" Site AquaSpy® Probe Summary

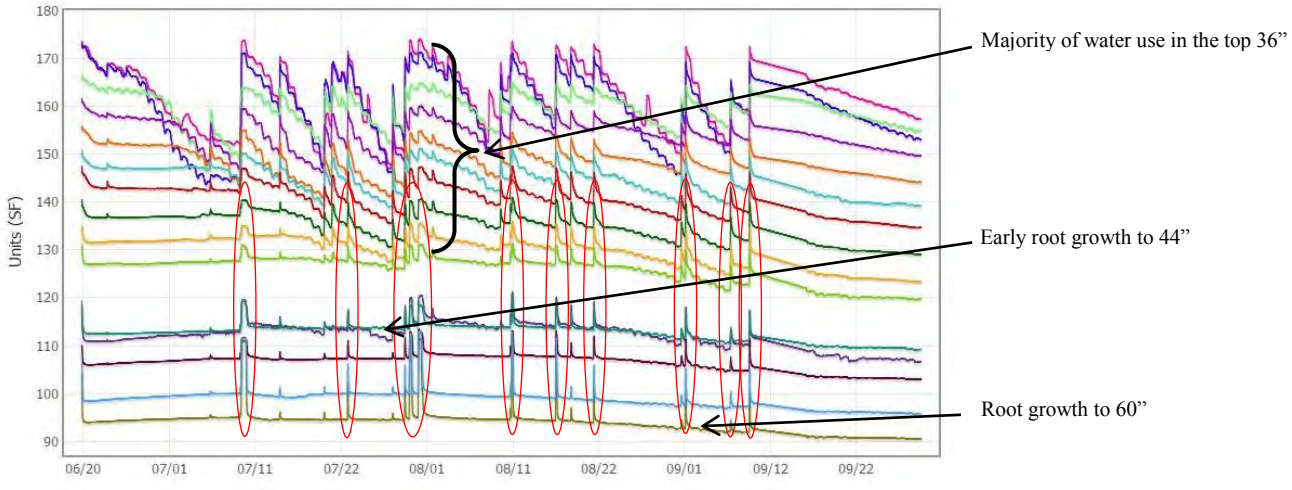


Figure 6. Krienke moisture graph (4 gpm)

This site had a significantly lower economic return per inch of water pumped and it is probably due to the relatively large amounts of drainage early in the season. There were several events in July where the subsoil remained saturated for relatively long periods and this probably caused significant leaching. There was evidence of roots reaching 60" but the majority of the water uptake was in the top 36". Almost all irrigations were successful in completely refilling the profile. This crop did not draw on sub soil moisture for grain filling and perhaps one of the late irrigations could have been eliminated.

Figure 7: Gypsum Block Readings for Danny Krienke's "5 GPM" Demonstration Site (219 bu/ac)

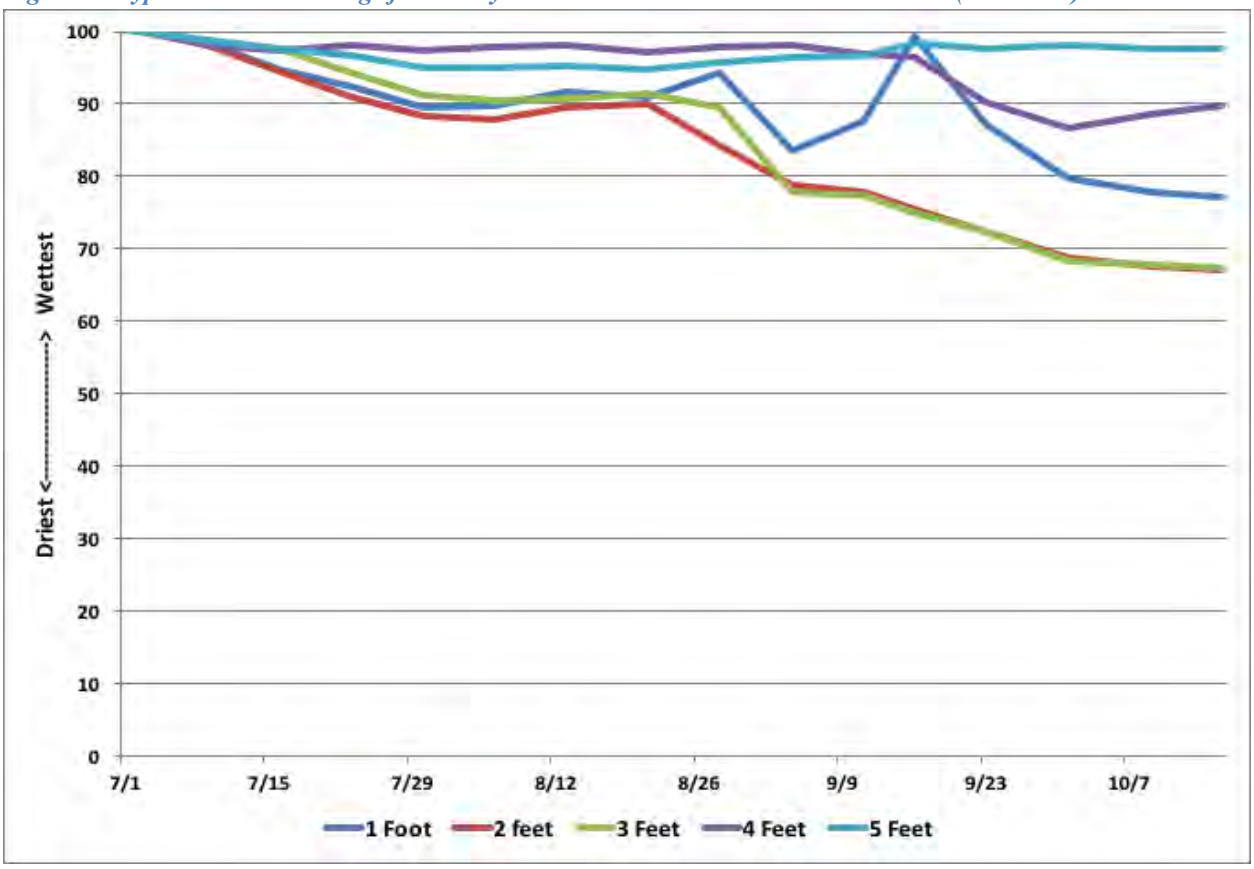


Figure 8: Growing Season Water Tracking for Danny Krienke's "5 GPM" Demonstration Site (219 bu/ac)

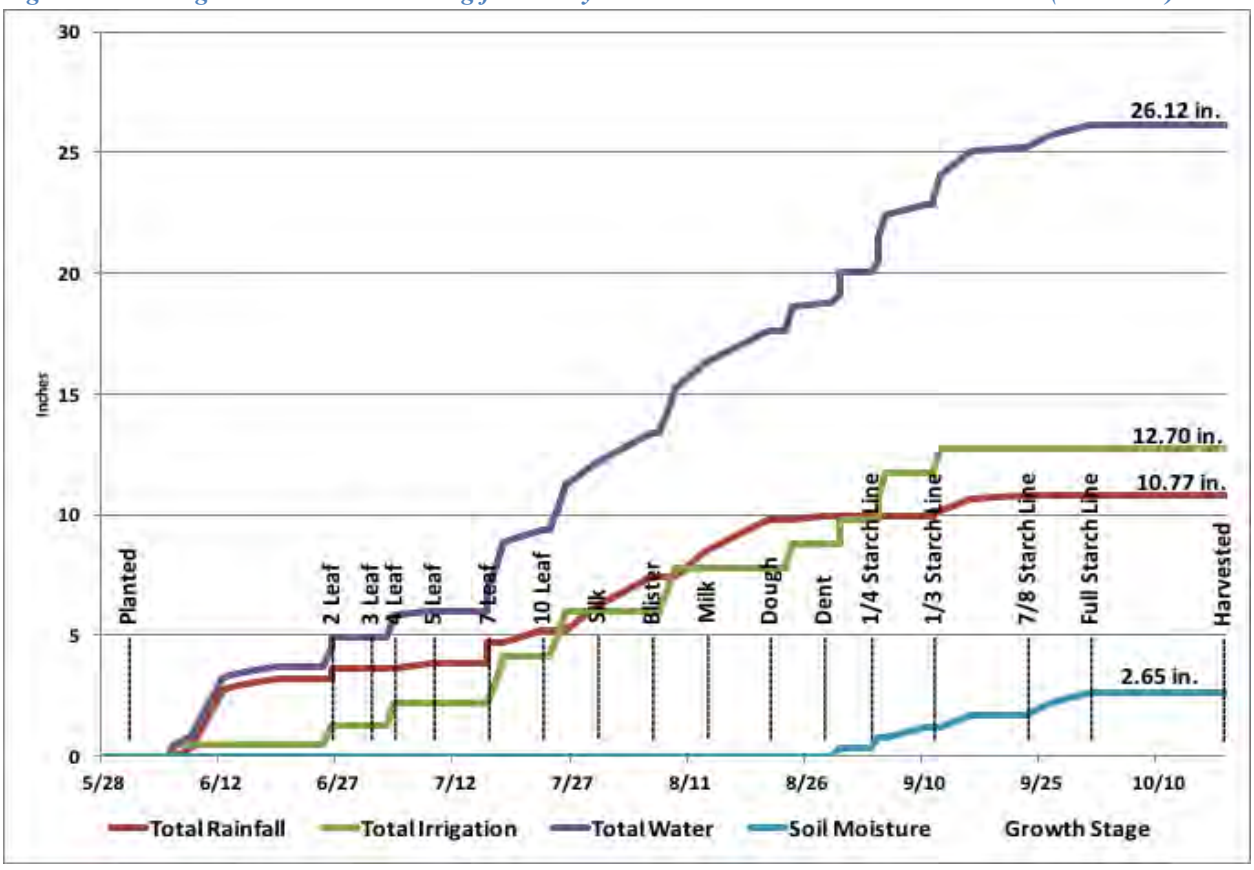


Table 5: Demonstration Field Data for Danny Krienke's "5 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
					1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/20	2.50												Danny
4/27	3.00												Danny
5/5	1.00										312 N		Danny
5/9	0.70										312 N		Danny
5/13	0.50										312 N		Danny
5/16	1.65										312 N		Danny
5/19	1.00										312 N		Danny
5/22	1.80										312 N		Danny
5/31										Planted			Danny
6/1										move dry	270		Pivotrac
6/5			664.55							5 gpm	270 Y	tart ccw	Pivotrac
6/6		0.5	666.21							split	210 Y	575	Leon
6/8	0.32										90 N		Pivotrac
6/12	2.37										90 N		Pivotrac
6/13	0.16										90 N		Pivotrac
6/15	0.17										90 N		Pivotrac
6/19	0.21										90 N		Pivotrac
6/25			674.65							split	210 Y cw		Leon
6/26		0.76	677.2							5 gpm	270 N	605	Leon
6/26	0.40		677.2	2 leaf							270 N		C & L
7/1			677.2	3 leaf	101.1	100.8	100.2	100.4	100.3		268 N		C & L
7/3			677.2	3 leaf							269 Y		Field Net
7/4		0.93	680.32	4 leaf						5 gpm	210 Y	580	Leon
7/9	0.21		684.54	5 leaf	98.4	98.2	98.4	98.1	98.8		90 N		C & L
7/16			690.49	6 leaf						split	210 Y		Field Net
7/16	0.90		691.39	7 leaf	94.8	94.6	97.5	97.3	97.5		230 Y	580	C & L
7/17		0.96	693.69	7 leaf						reverse	270 Y	580	Leon
7/18		0.97	696.93	7 leaf						5 gpm	210 Y	580	Leon
7/23	0.49		703.35	10 leaf	92.4	91	94.4	98.2	96.6	3 gpm	146 Y	565	C & L
7/24			705.75	10 leaf						5 gpm	210 Y	565	Field Net
7/25		0.93	708.85	tassel						reverse	270 Y	565	Leon
7/26		0.93	711.95	tassel						5 gpm	210 Y	565	Leon
7/30	0.98		718.64	silk	89.5	88.4	91.2	97.4	95.1		151 N		Leon
8/6	1.20		718.79	blister	89.8	87.9	90.4	97.9	95.1	3 gpm	157 Y	575	Curtis
8/7			720.67	blister						5 gpm	210 Y		Field Net
8/8		0.94	723.8	blister						reverse	270 Y	560	Leon
8/9		0.9	726.83	blister						5 gpm	210 Y	560	Leon
8/13	1.10		731.23	milk	91.6	89.6	90.6	98	95.2		90 N		Curtis
8/21	1.28		731.31	dough	91	90.1	91.5	97.2	94.8	4 gpm	90 Y	645	Curtis
8/23			735.72	dough						5 gpm	210 Y		Field Net
8/24		0.99	739.02	dough						5 gpm	270 Y	575	Leon
8/28	0.14		739.01	dent	94.3	84.2	89.4	97.8	95.6		270 N		Curtis
8/29			739.01	dent						5 gpm	270 Y		Field Net
8/30				dent							225 N		Field Net
8/30				dent						5 gpm	225 Y		Field Net
8/30		0.98	742.29	1/8 mat ln						5 gpm	210 Y	575	Leon
9/3			751.1	1/4 mat ln						5 gpm	210 Y		Field Net

Date	Rain Inches	Irrigation Inches	Water Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
					1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
9/4			753.58	1/4mat In	83.6	78.9	77.9	98.1	96.5	5 gpm	263 Y	571	Curtis
9/4		0.96	754.3	1/4mat In						reverse	270 Y	575	Leon
9/5		0.96	757.49	1/4 mat In						5 gpm	210 Y	575	Leon
9/11			765.46	1/3mat In						5 gpm	210 Y		Field Net
9/11	0.23		766.94	1/3mat In	87.6	77.9	77.3	96.8	96.7	5 gpm	230 Y	576	Curtis
9/12		0.99	768.77	1/2mat In						5 gpm	270 Y	580	Leon
9/16	0.49		769.28	1/2mat In	99.4	75.4	75.1	96.4	98.3	3 gpm	207 Y	580	Curtis
9/23	0.12		771.02	7/8mat In	87.2	72.3	72.4	90.3	97.7		150 N		C & L
10/1			771.02	1.0mat In	79.8	68.9	68.2	86.6	98.0		90 N		C & L
10/9	0.72		771.02	1.0mat In	77.8	67.7	67.8	88.5	97.6		90 N		Curtis
10/16			771.02	1.0mat In	77.2	67.2	67.4	89.7	97.6		80 N		Curtis
10/18				harvest									Danny
10/28	3.45		771.02	harvest			96.0				90 N		Curtis
Total	**10.77**	**12.70**			**0.6**	**0.8**	**0.8**	**0.4**	**0.0**				**Leon**
Net Soil Moisture is 2.65"													
Irrigation, Rainfall Plus Net Soil Moisture is 26.12"													

• Numbers in red are not counted in the total

NORTH PLAINS GROUNDWATER Conservation District

2015-Corn Demonstration
Irrigated Medium Season Corn

5 GPM

Year:	2015	**County:**	Ochiltree	**Grower:**	Danny Krienke
No. Acres:	40	**Variety/Hyb:**	P33B54	**Soil Type:**	Lazbuddie clay
Meter Type:	Seametrics				
Meter Mult:	Acre Feet x 1	**Tillage:**	Strip Till		
Fertilizer:	46-97-0-0	**Seeding:**	28,000		
Planted:	May 31,2015	**Harvest:**	October 16,2015		
Herbicide:	Cinch, Roundup	**Insecticide:**	None		
Yield:	219 bu/acre @ 15.0% moist.	**Prev. crop:**	Wheat	**Row width:**	30 inches
Irrigation method:	Center Pivot	**Prewater:**	0	**Well GPM:**	575
Distance between drops:	30 inches	**Distance from nozzle to ground:**	18 inches		
Application pattern:	LEPA Shroud	**Crop row direction :**	Planted in circle		

GPS Location of Pivot Pad		**GPS Location of Gypsum Blocks**	
Latitude:	36.402727	Latitude:	36.40117
Longitude:	-100.859866	Longitude:	-100.86559

Danny Krienke's "5 GPM" Site AquaSpy® Probe Summary

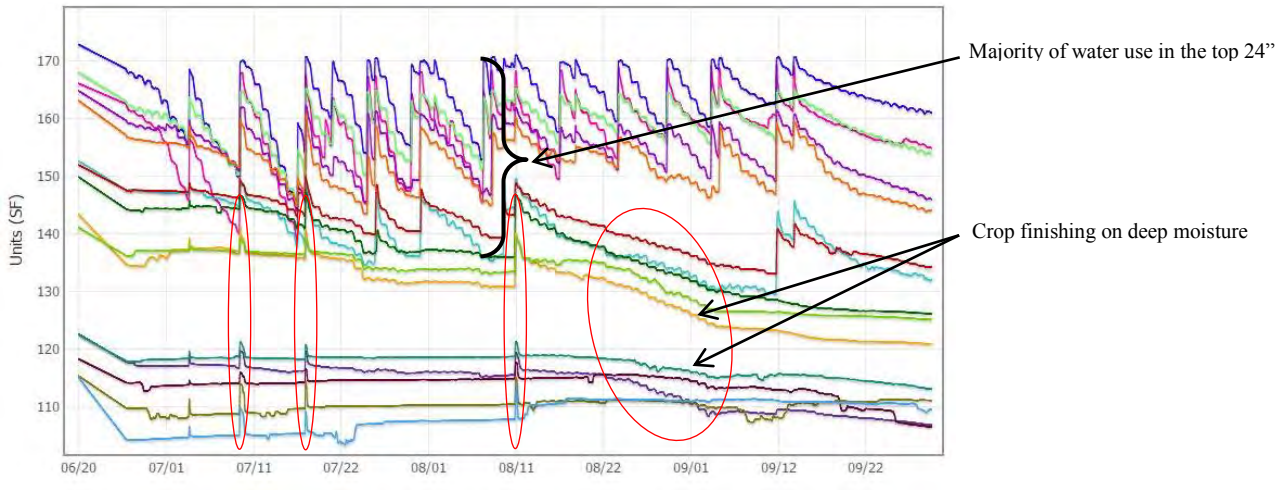


Figure 9. Krienke moisture graph (5 gpm)

It is somewhat surprising that 5 gpm treatment did not show nearly as many or as severe drainage events as the 4 gpm treatment. This could simply be due to heterogeneous infiltration patterns combined with probe placement failing to capture them as clearly. Or it could be due to something else affecting infiltration. The roots reached 36" relatively early but the wet July meant they did not need to go deeper until mid-late August, where the crop drew on deep moisture for grain filling. The majority of the water use was in the top 24"-28" and this was slightly shallower than the 3 gpm and 4 gpm treatments – presumably due to the extra water supplied.

Harvest Results: The 3 GPM field produced a 203 bushel per acre corn yield. Irrigation totaled 8.81 inches. Production in the 4 GPM field was 209 bushels per acre. Seasonal irrigation totaled 10.69 inches. Corn yield was 219 bushels per acre for the 5 GPM field. Irrigation totaled 12.70 inches. There was no pre-season irrigation. The 4 GPM field produced 6 more bushels per acre than the 3 GPM field and irrigation was 1.88 inches more. The 5 GPM field produced 16 more bushels per acre than the 3 GPM with 3.89 more inches of irrigation. The 5 GPM yield was 10 more bushels per acre than that from the 4 GPM field with 2.01 additional inches of irrigation. Corn production was 23.04 bushels (1290lbs) per inch of irrigation in the 3 GPM field compared to 19.55 bushels (1095lbs) in the 4 GPM and 17.24 bushels (965lbs) from the 5 GPM field. Production from each inch of irrigation, rainfall and net soil water that totaled 22.96 inches was 8.84 bushels (495lbs) per acre in the 3 GPM field. Irrigation, rainfall and net soil water totaled 25.14 inches in the 4 GPM field where production was 8.31 bushels (465lbs) per inch. In the 5 GPM field, irrigation, rainfall and net soil water totaled 26.12 inches where production was 8.38 bushels (469lbs) per inch of total water. Crop production costs were $20.69 per acre more for the 4 GPM field than for the 3 GPM from increased irrigation, seed, fertilizer and harvest expenses. At $3.97 per bushel, the six bushels per acre increased corn yield in the 4 GPM field amounts to $ 23.82 more per acre than from the 3 GPM field. The 4 GPM field's net gain is $3.13 per acre with 1.89 inches more irrigation used compared to production from the 3 GPM field. At $3.97 per bushel, the 16 bushel per acre increased yield from the 5 GPM field compared to the 3 GPM amounts to $63.52. Crop production costs were $46.83 more for the 5 GPM field. The 5 GPM field's net gain compared to the 3 GPM field is $16.69 per acre with 3.89 additional inches of irrigation. Value of the 10 additional bushels produced in the 5 GPM field compared to the 4 GPM field is $39.70. Production Costs were $26.14 more for the 5 GPM field than the 4 GPM. Net gain for the 5 GPM field is $13.56 per acre with 2.01 inches more irrigation. Net return from the 3 GPM field was $424.34 per acre compared to $427.47 from the 4 GPM field and $441.03 from the 5 GPM field. Net return from each inch of irrigation is $48.16 for the 3 GPM field compared to $39.99 from the 4 GPM and $34.73 for the 5 GPM field A summary of the demonstration results are shown in table 6 and Appendix B.

Table 6: Danny Krienke's 2015 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $3.97/bu		
			bu/ac	lb/ac-in Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"3 GPM"	8.81	*22.96	203	1290	$805.91	$91.47	$35.10
"4 GPM"	10.69	†25.14	209	1095	$829.73	$77.61	$33.00
"5 GPM"	12.70	‡26.12	219	965	$869.43	$68.46	$33.28

*Includes 3.38 inches of soil water removed within five feet of soil, plus rainfall, and irrigation.
†Includes 2.66 inches of soil water removed within five feet of soil, plus rainfall, and irrigation.
‡Includes 2.65 inches of soil water removed within five feet of soil, plus rainfall, and irrigation.

Stan Spain's 2015 Moore County Demonstration

Planting and Crop Information: Stan Spain strip tilled and planted 55 acres of corn in the south half of the east circle of the south half of section 47, for his "3-4-5 GPM" demonstration. The 55 acres were equally divided for his 3, 4 and 5 GPM fields. Each field was 18.33 acres. Spains'5 GPM field was located from 90 to 150 degrees on the circle, the 4 GPM at 150 to 210 and his 3 GPM from 210 to 270. Spain planted each "3-4-5 GPM" field to Dynagro D55VP77 hybrid. The seeding rate was 32,000 seeds per acre for the 3 GPM, 4 GPM and 5 GPM fields. Center pivot travel speed was by PivoTrac. The speed control prescription moved the center pivot to apply 1.10 inches on the 3 GPM field in 22.6 hours, 1.49 inches on the 4 GPM field in 30.5 hours and 1.85 inches on the 5 GPM field in 37.9 hours. The north 41.5 acres were irrigated in 76.5 hours. When irrigation was continued without stopping, travel speed was increased to 85 percent from 315 to 270 degrees in the 13.8 acres of wheat stubble that used about one hour. That was a 7.02 day revolution when irrigation was not stopped. Seasonal water meter readings averaged 400 gpm. Irrigation was with Senningers' LDN LEPA (bubble) applicator with drops spaced 30 inches apart. Timely rainfall allowed the center pivot to be stopped more than sixty hours during the growing season. Planting and crop information for "Spain 3 GPM", "Spain 4 GPM" and "Spain 5 GPM" are shown in Table 7 below.

Table 7: Planting and Crop Information for Stan Spain

3 GPM Demonstration Site: 270-210 degrees			
Planted:	*May 29*	**Harvested:**	*October 20*
Hybrid:	*Dyna-Gro D55VP77*	**Seeding Rate:**	*32,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*18.3*	**GPM Per Acre:**	*4.0*
Fertilizer:	169-26-0-0	**Soil Type:**	*Sherm Silty Clay Loam*
Herbicide::	*Makaze, Atrazine,Rifle, Diflexx, Armezon, Intensity, Firestorm, Verdict*		
Insecticide:	*Comite, Warhawk, Cide Trak, Prevathon*		
Irrigation:	9.76 inches	**Total Water**:	26.33 inches

4 GPM Demonstration Site: 210-150 degrees			
Planted:	*May 29*	**Harvested:**	*October 20*
Hybrid:	*Dynagro D55VP77*	**Seeding Rate:**	*32,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*18.3*	**GPM Per Acre:**	*4.0*
Fertilizer:	*224-26-0-0*	**Soil Type:**	*Sherm Silty Clay Loam*
Herbicide:	*Makaze,Atrazine,Rifle,Intensity, Firestorm,Verdict,Armezon, Diflexx*		
Insecticide:	*Prevathon,Warhawk,Rifle, Cide Trak*		
Irrigation:	*12.77 inches*	**Total Water:**	26.79 inches

5 GPM Demonstration Site: 90-150 degrees

Planted:	*May 29*	**Harvested:**	*October 20*
Hybrid:	*Dynagro D55VP77*	**Seeding Rate:**	*32,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*18.3*	**GPM Per Acre:**	*4.0*
Fertilizer:	*246-26-0-0*	**Soil Type:**	*Sherm Silty Clay Loam*
Herbicide:	*Makaze,Atrazine,Rifle,Intensity, Firestorm,Verdict,Armezon, Diflexx*		
Insecticide:	*Prevathon, Warhawk,Rifle, Cide Trak*		
Irrigation:	*13.61 inches*	***Total Water*:**	27.09 inches

Soil Water Profile and Growing Season Rainfall

"3 GPM" Demonstration Site: Preseason soil water was good at 1, 2, 3, 4 and 5 feet following 7.26 inches of rainfall measured in April and May, prior to planting. Weekly gypsum block readings indicate the crop rooted through 3 and into 4 feet in July and August. The crop used 3.80 inches of soil water from 1, 2, 3 and 4 feet in August and September, plus 2.19 inches of irrigation and .81 inches of rainfall to finish the crop. Only limited soil water was used from 5 feet in September when the crop used lots of water to produce 227 bushels per acre. Soil moisture sensors show the crop had adequate soil water during the growing season. The soil profile was refilled by more than four inches of rainfall in October during harvest. The crop was produced in Sherm silty clay loam soil that can store approximately 2.0 inches of available water per foot for potential crop use. Timely beneficial rainfall significantly contributed to producing a good corn yield with only 9.76 inches of irrigation. Total rainfall from planting until grain black layer totaled 12.77 inches, and was more normal for this location. Gypsum blocks were installed in early-June following planting, due to wet soil conditions prior to planting.

"4 GPM" Demonstration Site: Soil water was good at 1, 2, 3, 4 and 5 feet from abundant rainfall during April and May prior to planting. Weekly gypsum block readings show good soil moisture levels were maintained at 1, 2, 3, 4 and 5 feet during the growing season from timely beneficial rainfall and periodic irrigation as needed. The crop used approximately 2.31 inches of soil water mostly from 1, 2 and 3 feet, in addition to rainfall and irrigation in August and September. Soil moisture sensors show the crop had sufficient soil water during the growing season. Gypsum block moisture sensors were installed in June following planting. Timely rainfall significantly contributed to producing the 239 bushel per acre corn yield, with only 11.71 inches of irrigation. Total rainfall from planting thru black layer totaled 12.77 inches. The crop was produced in Sherm silty clay loam soil that holds approximately 2.0 inches available water per foot for potential crop use.

"5 GPM" Demonstration Site: Beginning soil water was good at 1, 2, 3, 4 and 5 feet at planting due to more than 7 inches of rain in April and May. Weekly gypsum block moisture sensors show the crop had sufficient available soil water during the entire growing season. The sensors show that crop roots extracted .71 inches of soil water from 3 and 4 feet plus irrigation and rainfall producing the 260 bushel per acre corn yield. Soil water depletion occurred primarily in September, finishing the crop. Total rainfall was 12.77 inches. Irrigation totaled 13.61 inches.

This shows a 250 to 260 bushel per acre corn yield can be produced with 27 inches of total water. The crop was produced in Sherm silty clay loam soil that holds 2.0 inches of available water per foot for potential crop use.

Table 8: Monthly Rainfall Data for Stan Spain

	June	July	August	September	Total
"3 GPM"	1.21"	5.19"	3.92"	2.45"	**12.77"**
"4 GPM"	1.21"	5.19"	3.92"	2.45"	**12.77"**
"5 GPM"	1.21"	5.19"	3.92"	2.45"	**12.77"**

Growing Season Water Tracking: The district tracked total water and crop growth throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. One set of five gypsum block soil moisture sensors was installed at 1, 2, 3, 4 and 5 feet and an AquaSpy® soil moisture probe was installed down to five feet in the root zone at one location to monitor soil water levels in the "3 GPM" field. Another set of the same type of sensors were installed in both the "4 GPM" and "5 GPM" fields. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in each field. Due to wet soils from abundant April and May rainfall, all Gypsum blocks were installed following planting. Gypsum blocks, water meter, rain gauges and crop growth are read, recorded and utilized weekly by district personnel. Each AquaSpy® probe was installed following crop emergence. A 24/7 AquaSpy® probe website shows soil moisture at four inch increments to 60 inches and monitors plant root growth. The website lists all AquaSpy® soil probes in the "3-4-5 GPM" project and is available to all cooperators and district personnel. Another 24/7 PivoTrac™ website tracks each center pivot system and monitors and controls irrigation. Each center pivot travel speed prescription written to apply 1.10 inches ("3 GPM"), 1.49 inches ("4 GPM") and 1.85 inches ("5 GPM") is managed from the PivoTrac™ website. Both the cooperating grower and district "3-4-5 GPM" project leader collectively monitor, control and manage irrigation from the PivoTrac™ website. Following this paragraph, a series of graphs and tables shows weekly gypsum block readings for the season; growing season water, including rainfall, irrigation, and soil moisture at various growth stages; and the order of irrigation and rainfall events for each "3-4-5 GPM" field. Finally, a form describes the protocols for each field. "Total Water," as shown on the graph for growing season water, is the sum of seasonal irrigation, rainfall and net soil water. Graphs and tables for the 3 GPM acres are shown first, followed by the same illustrations for each 4 GPM and 5 GPM.

Figure 10: Gypsum Block Readings for Stan Spain's "3 GPM" Demonstration Site (227 bu/ac)

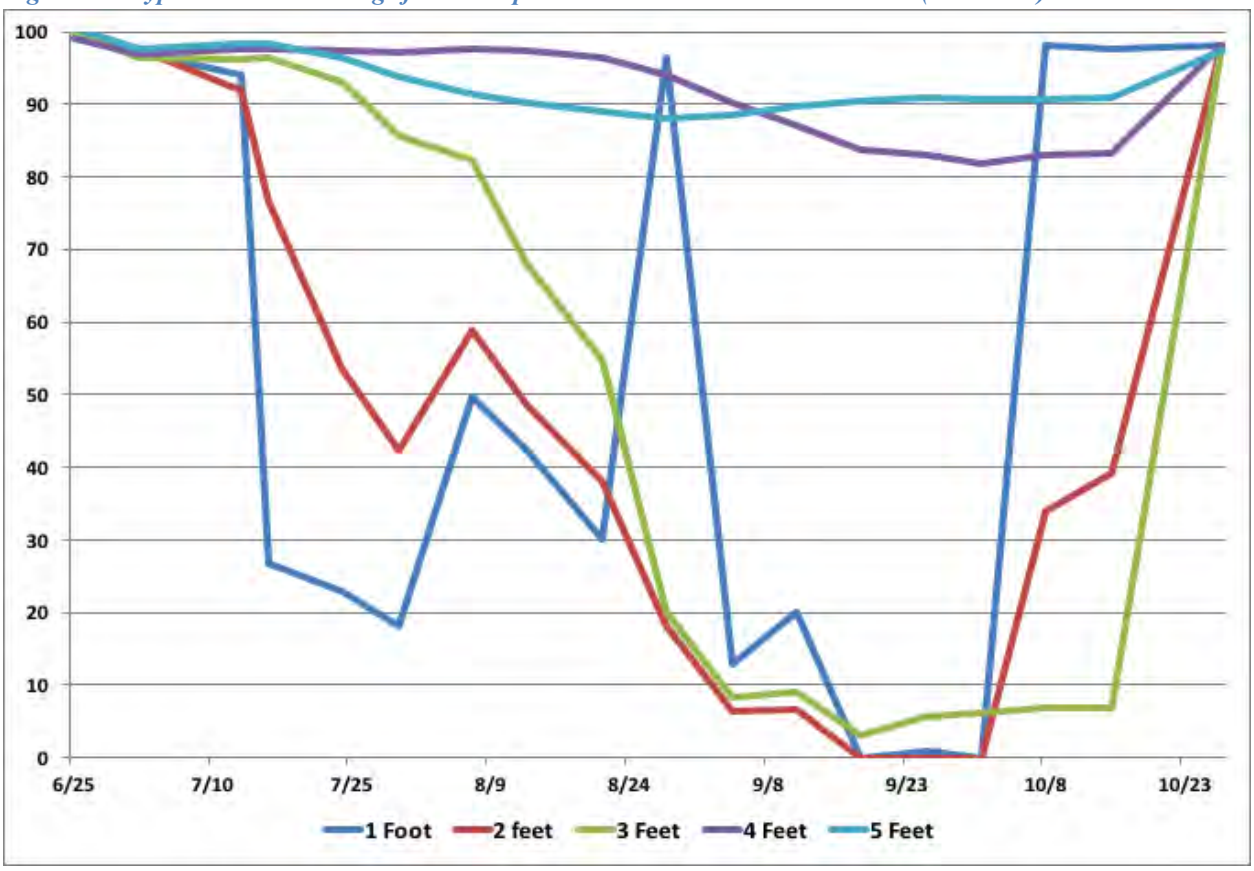


Figure 11: Growing Season Water Tracking for Stan Spain's "3 GPM" Demonstration Site (227 bu/ac)

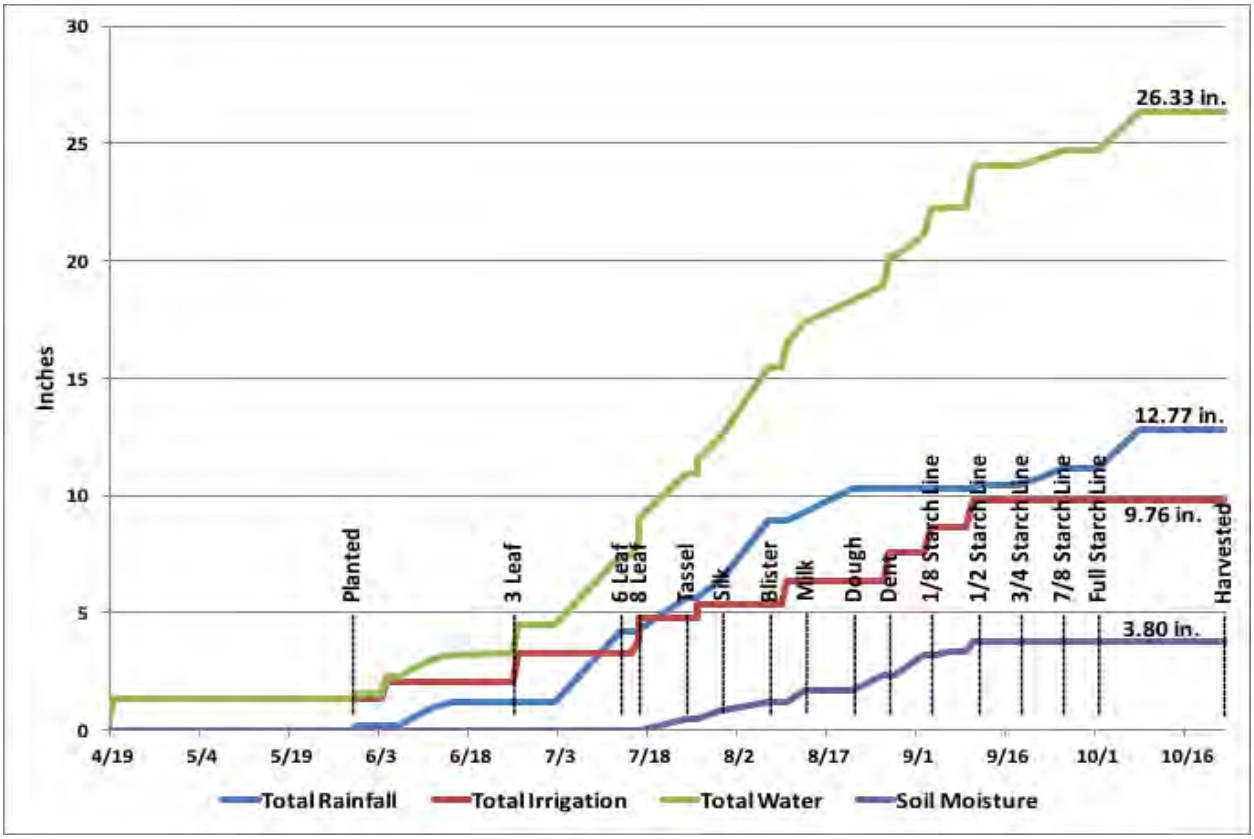


Table 9: Demonstration Field Data for Stan Spain's "3 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Hour Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
						1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
2/23	0.52													Curtis
4/18			6.27								pre-wtr	270	554	Leon
4/19		1.31	8.27								pre-wtr	210	560	Leon
4/27	2.10													Curtis
5/6	1.42													Curtis
5/9	0.42													Curtis
5/14	0.40													Curtid
5/17	0.33													Curtis
5/19	1.06													Curtis
5/22	0.68													Curtis
5/23	0.85													Curtis
5/28			19.49	284.10								314		Curtis
5/29											Planted			Stan
5/30	0.22													Pivotrac
6/3			20.01								3 gpm	270 Y		Leon
6/3			20.02	295.30							3 gpm	268 Y	552	Leon
6/4		0.76	21.17								4 gpm	210 Y	555	Leon
6/4											4 gpm	188 Y		Pivotrac
6/4											4 gpm	150		Leon
6/5											split	90 Y		Leon
6/6			26.11	292.30							North	59 Y		Pivotrac
6/8	0.25													Curtis
6/12	0.54													Curtis
6/15	0.15													Curtis
6/25	0.05		26.67	382.70	3 leaf	100.3	99.9	99.8	99.1	100.4		269 N		C & L
6/25			26.67								3 gpm	269 Y		Leon
6/26		1.18	28.47		4 leaf						3 gpm	210 Y	560	Leon
7/2			36.13	509.70	4 leaf	97.1	97.5	96.4	97.0	97.7		150 N	tan mar	C & L
7/13	2.99		37.70	549.50	6 leaf	93.9	91.9	96.1	97.5	98.3		43 N		C & L
7/15			41.84		7 leaf						3 gpm	268 Y		Leon
7/16		0.60	42.75		8 leaf						3 gpm	229 Y	560	reverse
7/16	0.05		42.87	595.90	8 leaf	26.8	76.6	96.4	97.5	98.4	3 gpm	239 Y	537	C & L
7/16					8 leaf						3 gpm	268 Y		reverse
7/16		0.52	43.67								3 gpm	230 Y	560	Leon
7/16		0.41	44.31								3 gpm	210 Y	555	Leon
7/24	1.42		53.03	700.60	tassel	23.0	53.6	93.0	97.3	96.4		295 N		C & L
7/26			53.03								3 gpm	269 Y		Leon
7/26		0.54	53.85		pollinate						3 gpm	210 Y	400	Leon
7/30	0.73		60.16	796.70	silk	18.1	42.3	85.7	97.1	93.7	north	59 Y	390	Leon
8/7	2.50		63.84	849.00	blister	49.8	58.9	82.2	97.6	91.4		305 N		C & L
8/9			63.84								3 gpm	270 Y		Leon
8/10		1.05	65.44								3 gpm	210 Y	400	Leon
8/13	0.40		72.07	959.50	milk	42.3	48.6	67.9	97.4	90.2	north	52 Y	402	Curtis
8/21	0.97		75.81	1010.70	dough	30.1	37.9	54.7	96.3	89.1		315 N		Curtis
8/26			75.81								3 gpm	269 Y		Leon
8/27		1.20	77.65		dent						3 gpm	210 Y	400	Leon
8/28	0.05		79.07	1055.20	dent	96.3	18.2	20.0	94.1	88.1	4 gpm	170 Y	402	Curtis
9/2			88.07								3 gpm	270 Y		Leon
9/3		1.07	89.70		1/8 mat ln						3 gpm	210 Y		Leon
9/4			91.24	1223.20	1/8mat ln	12.9	6.3	8.4	90.3	88.4	4 gpm	158 Y	395	Curtis
9/9			100.28								3 gpm	269 Y		Leon
9/10		1.12	101.99								3 gpm	210 Y	420	Leon
9/11	0.15		104.42	1388.50	1/2mat ln	20.1	6.6	9.0	87.0	89.7		150 N		Curtis
9/18			109.43	1457.20	3/4mat ln	0.0	0.0	3.1	83.6	90.4	north	31 Y	387	Curtis

Date	Rain Inches	Irrigation Inches	Water Meter	Hour Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
						1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
9/25	0.66		112.33	1498.30	7/8mat In	0.9	0.0	5.6	83.1	90.8		302 N		C & L
10/1			112.33	1498.30	1.0mat In	0.0	0.0	6.2	81.9	90.6		302 N		C & L
10/8	1.64		112.33	1498.30	1.0mat In	98.0	33.8	6.8	82.9	90.7		302 N		C & L
10/15			112.33	1498.30	1.0mat In	97.6	39.3	6.8	83.3	90.8		302 N		Curtis
10/22	-4.97				harvest									Curtis
10/27			112.33	1498.40	harvest	98.0	98.1	97.8	98.2	97.3		298 N		C & L
Total	**12.77**	**9.76**				**-0.1**	**1.2**	**1.9**	**0.5**	**0.3**				**Leon**
Net Soil Moisture is 3.80"														
Irrigation, Rainfall Plus Net Soil Moisture is 26.33"														

• Numbers in red are not counted in the total

2015-Corn Demonstration
Irrigated Medium Season Corn

3 GPM

Year:	2015	**County:**	Moore	**Grower:**	Stan Spain
No. Acres:	18.3	**Variety/Hyb:**	D55VP77	**Soil Type:**	Sherm Silty Clay Loam
Meter Type:	Seametrics				
Meter Mult:	Acre Feet x 1	**Tillage:**	Strip Till		
Fertilizer:	169-26-0	**Seeding:**	32,000		
Planted:	May 29, 2015	**Harvest:**	October 20, 2015		
Herbicide:	Makaze, Atrazine,Diflexx, Rifle, Armezon, Firestorm, Intensity, Verdict	**Insecticide:**	***CideTrak*** Prevathon, Comite, Warhawk		
Yield:	227 bu/acre @ 15.0% Moist.	**Prev. crop:**	Corn	**Row width:**	30 inches
Irrigation method:	Center Pivot	**Prewater:**	1.31"	**Well GPM:**	400
Distance between drops:	30 inches	**Distance from nozzle to ground:**	12 inches		
Application pattern:	LEPA	**Crop row direction :**	Planted in circle		

GPS Location of Pivot Pad		**GPS Location of Gypsum Blocks**	
Latitude:	35.99941	Latitude:	35.99668
Longitude:	-101.979	Longitude:	-101.98121

Stan Spain's "3 GPM" Site AquaSpy® Probe Summary

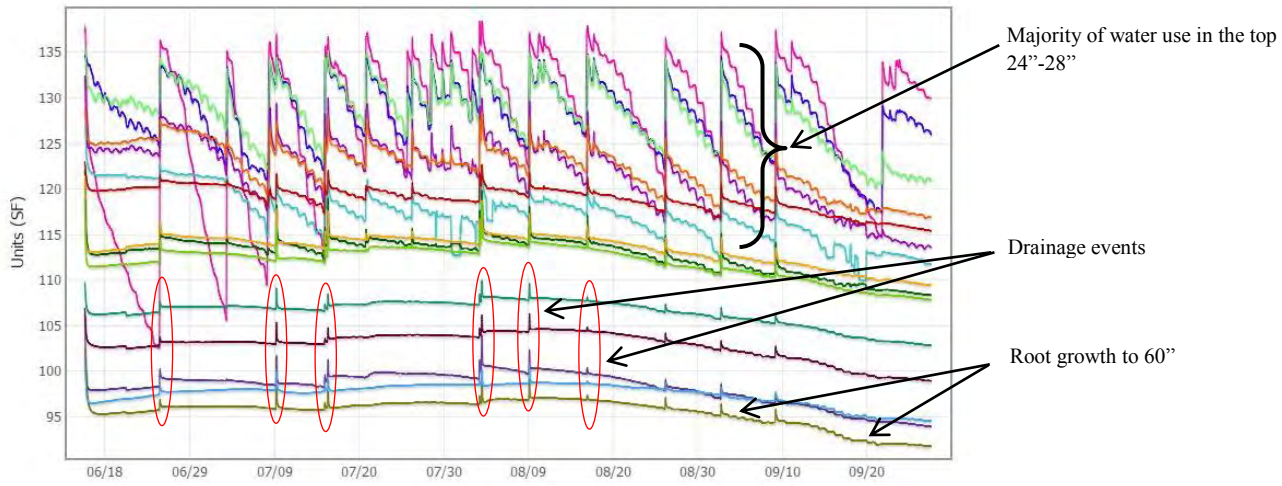


Figure 12. WCC Moisture graph (3 gpm)

This site showed evidence of water reaching 60" on several occasions but these were brief and any drainage would have been fairly minimal. Roots were very quick to reach 32" but the majority of water use was in the top 24". Irrigations were very effective at refilling the profile on every pass and the top 16" was kept quite wet through late July and early August. This would have greatly helped in yield formation and would have ensured the very high water use efficiency experienced at this site.

Figure 13: Gypsum Block Readings for Stan Spain's "4 GPM" Demonstration Site (239 bu/ac)

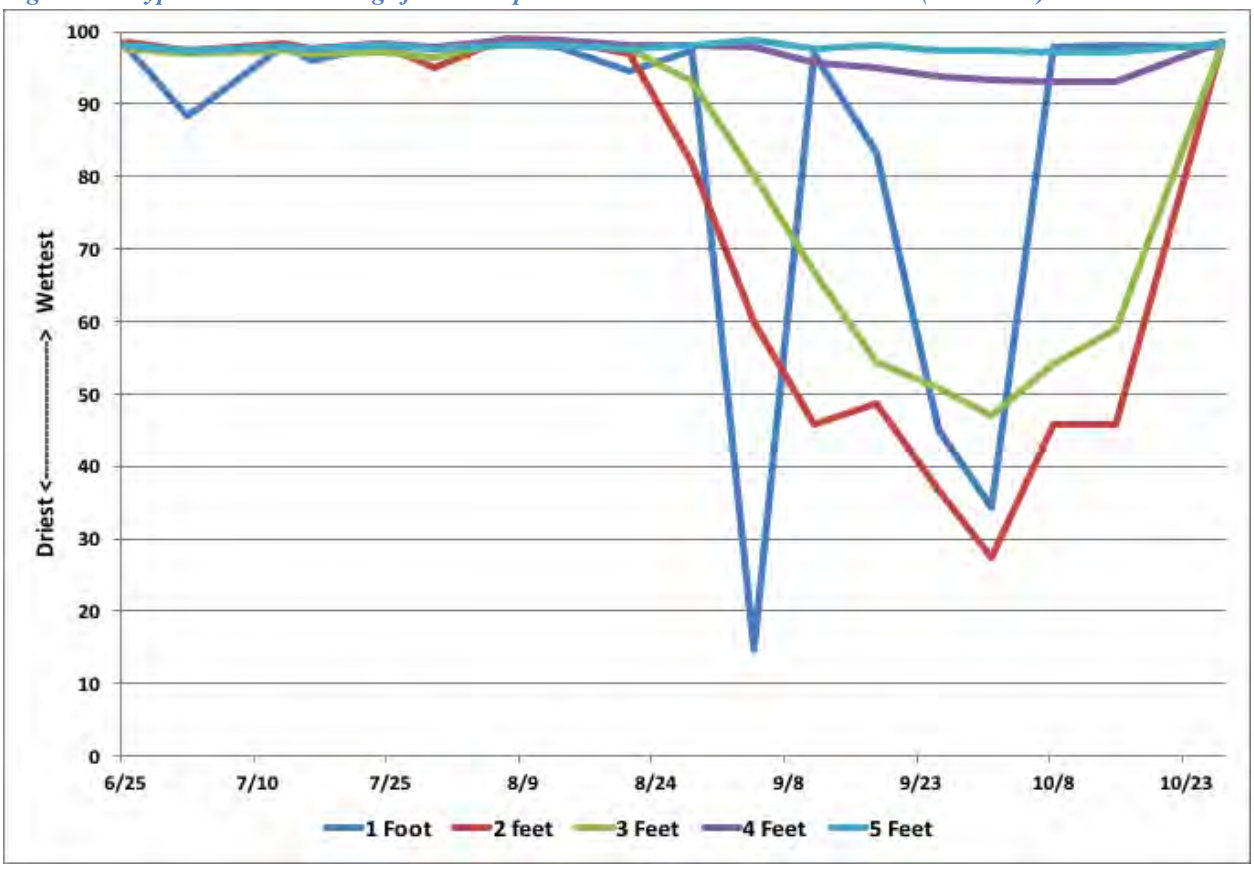


Figure 14: Growing Season Water Tracking for Stan Spain's "4 GPM" Demonstration Site (239 bu/ac)

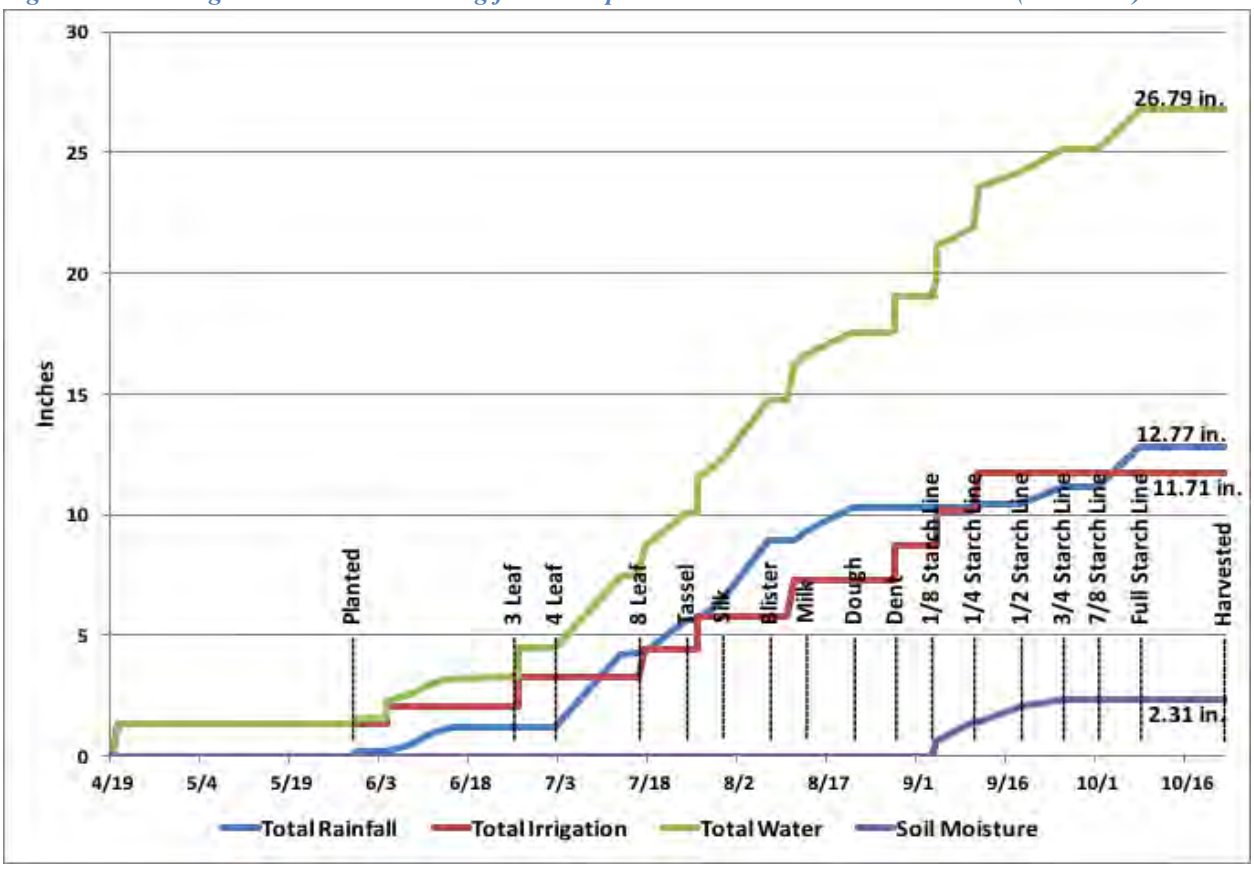


Table 10: Demonstration Field Data for Stan Spain's "4 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Hour Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
						1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
2/23	0.52													Curtis
4/19			8.27									210		Leon
4/20		1.31	10.27								pre-wtr	150	555	Leon
4/27	2.10													Curtis
5/6	1.42													Curtis
5/9	0.42													Curtis
5/14	0.40													Curtis
5/17	0.33													Curtis
5/19	1.06													Curtis
5/22	0.68													Curtis
5/23	0.85													Curtis
5/28			19.49	284.1								314		Curtis
5/29											planted			Stan
5/30	0.22													Pivotrac
6/3			20.02	295.3							3 gpm	268 Y	552	Leon
6/4											4 gpm	188 Y		Pivotrac
6/4											4 gpm	210 Y		Leon
6/4		0.76	22.33								4 gpm	150 Y	555	Leon
6/8	0.25													Curtis
6/12	0.54													Curtis
6/15	0.15													Curtis
6/25	0.05		26.67	382.7	3 leaf	98.1	98.6	97.7	98.1	98.2		269 N		C & L
6/26			28.47								4 gpm	210 Y		Leon
6/26		1.18	30.27								4 gpm	150 Y	560	Leon
7/2			36.13	509.7	4 leaf	88.4	97.3	96.9	97.3	97.3		150 N	tan mar	C & L
7/13	2.99		37.70	549.5	7 leaf	98.2	98.3	97.3	98.2	97.9		43 N		C & L
7/16	0.05		42.39	595.9	8 leaf	95.9	97.6	96.8	97.7	97.5	3 gpm	239 Y	537	C & L
7/16			44.31								4 gpm	210 Y		Leon
7/17		1.17	46.09		8 leaf						4 gpm	150 Y	545	Leon
7/24	1.42		53.03	700.6	tassel	98.0	98.3	97.1	98.3	98.0		295 N		C & L
7/26			53.85		pollinate						4 gpm	210 Y	400	Leon
7/26		1.39	55.95		pollinate						4 gpm	150 Y	400	Leon
7/30	0.73		60.16	796.7	silk	97.7	94.9	96.5	97.9	97.6	north	59 Y	390	Leon
8/7	2.50		63.84	849	blister	98.4	99.0	98.5	98.9	98.0		305 N		C & L
8/10			65.44								4 gpm	210 Y	400	Leon
8/11		1.47	67.68		tassel						4 gpm	150 Y	400	Leon
8/13	0.40		72.07	959.5	milk	97.8	98.7	98.4	98.8	98.0	north	52 Y	402	Curtis
8/21	0.97		75.81	1010.7	dough	94.4	96.8	97.7	98.2	97.7		315 N		Curtis
8/27			77.65								4 gpm	210 Y		Leon
8/28	0.05		79.07	1055.2	dent	97.4	81.8	93.0	98.1	98.1	4 gpm	170 Y	402	Curtis
8/28		1.44	79.86		dent						4 gpm	150 Y	400	Leon
9/3			89.70		1/8 mat ln						4 gpm	210 Y		Leon
9/4			91.24	1223.2	1/8mat ln	14.8	59.8	80.1	97.9	98.7	4 gpm	158 Y	395	Curtis
9/4		1.44	91.91		1/8 mat ln						4 gpm	150 Y	400	Leon
9/10			101.99		1/4 mat ln							210 Y		Leon
9/11		1.55	104.35		1/4 mat ln						4 gpm	150 Y	420	Leon
9/11	0.15		104.42	1388.5	1/4mat ln	96.9	45.8	66.9	95.8	97.6		150 N		Curtis
9/18			109.43	1457.2	1/2mat ln	83.2	48.7	54.4	95.0	98.0	north	31 Y	387	Curtis
9/25	0.66		112.33	1498.3	3/4mat ln	45.1	36.6	50.7	93.8	97.4		302 N		C & L
10/1			112.33	1498.3	7/8mat ln	34.2	27.5	46.9	93.2	97.4		302 N		C & L
10/8	1.64		112.33	1498.3	1.0mat ln	97.9	45.7	54.2	93.1	97.2		302 N		C & L
10/15			112.33	1498.3	1.0mat ln	98.1	45.9	59.0	93.1	97.1		302 N		Curtis
10/22	4.97				harvest									Curtis
10/27			112.33	1498.4	harvest	97.8	98.1	98.2	98.6	98.3		298 N		C & L
Total	**12.77**	**11.71**				**0.0**	**1.1**	**0.9**	**0.3**	**0.0**				**Leon**
Net Soil Moisture is 2.31"														
Irrigation, Rainfall Plus Net Soil Moisture is 26.79"														

* Numbers in red are not counted in the total

NORTH PLAINS GROUNDWATER Conservation District

2015-Corn Demonstration
Irrigated Medium Season Corn

4 GPM

Year:	2015	**County:**	Moore	**Grower:**	Stan Spain
No. Acres:	18.3	**Variety/Hyb:**	D55VP77	**Soil Type:**	Sherm Silty Clay Loam
Meter Type:	Seametrics				
Meter Mult:	Acre Feet x 1	**Tillage:**	Strip Till		
Fertilizer:	224-26-0	**Seeding:**	32,000		
Planted:	May 29, 2015	**Harvest:**	October 20, 2015		
Herbicide:	Makaze,Atrazine, Diflexx, Rifle, Armezon,Firestorm, Intensity, Verdict	**Insecticide:**	CideTrak Prevathon, Comite, Warhawk		
Yield:	239 bu/acre @ 15.0% Moist.	**Prev. crop:**	Corn	**Row width:**	30"
Irrigation method:	Center Pivot	**Prewater:**	1.31"	**Well GPM:**	400
Distance between drops:	30 inches	**Distance from nozzle to ground:**	12 inches		
Application pattern:	LEPA	**Crop row direction :**	Planted in circle		

GPS Location of Pivot Pad		**GPS Location of Gypsum Blocks**	
Latitude:	35.99941	Latitude:	35.99624
Longitude:	-101.979	Longitude:	-101.97862

Stan Spain's "4 GPM" Site AquaSpy® Probe Summary

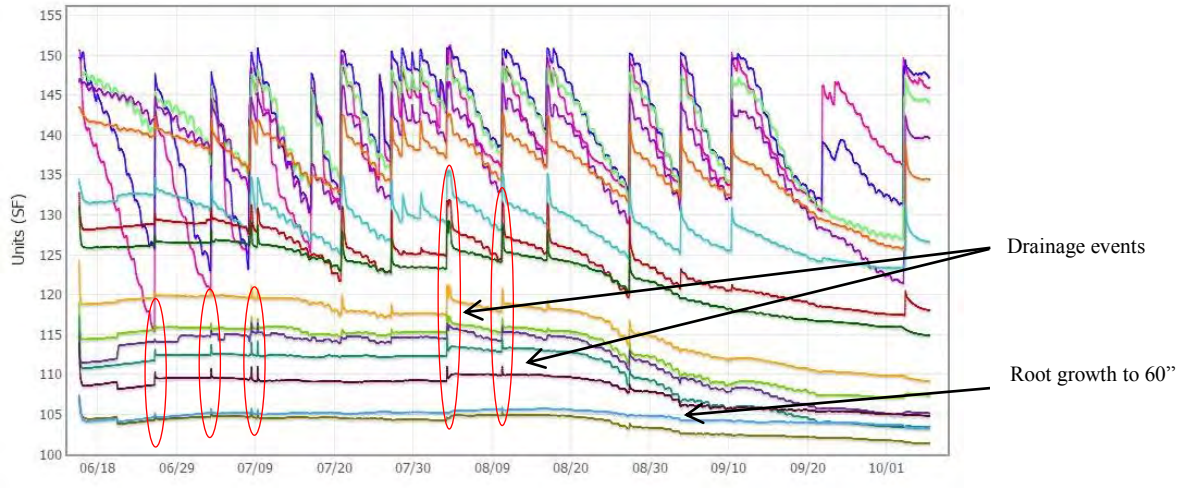


Figure 15. WCC moisture graph (4 gpm)

This site was similar to the 3 gpm treatment where many irrigations made it to 60", and while there was some evidence of drainage, this would have been fairly minor in comparison to the 5 gpm treatment. It appears that this site had greater and deeper root activity than the 3 gpm treatment - especially during late August. The maximum root activity was observed at 60" for both 3 gpm and 4 gpm treatments, but the 4 gpm site was able to extract more sub-soil moisture late in the season and this may have contributed to the higher yield.

Figure 16: Gypsum Block Readings for Stan Spain's "5 GPM" Demonstration Site (260 bu/ac)

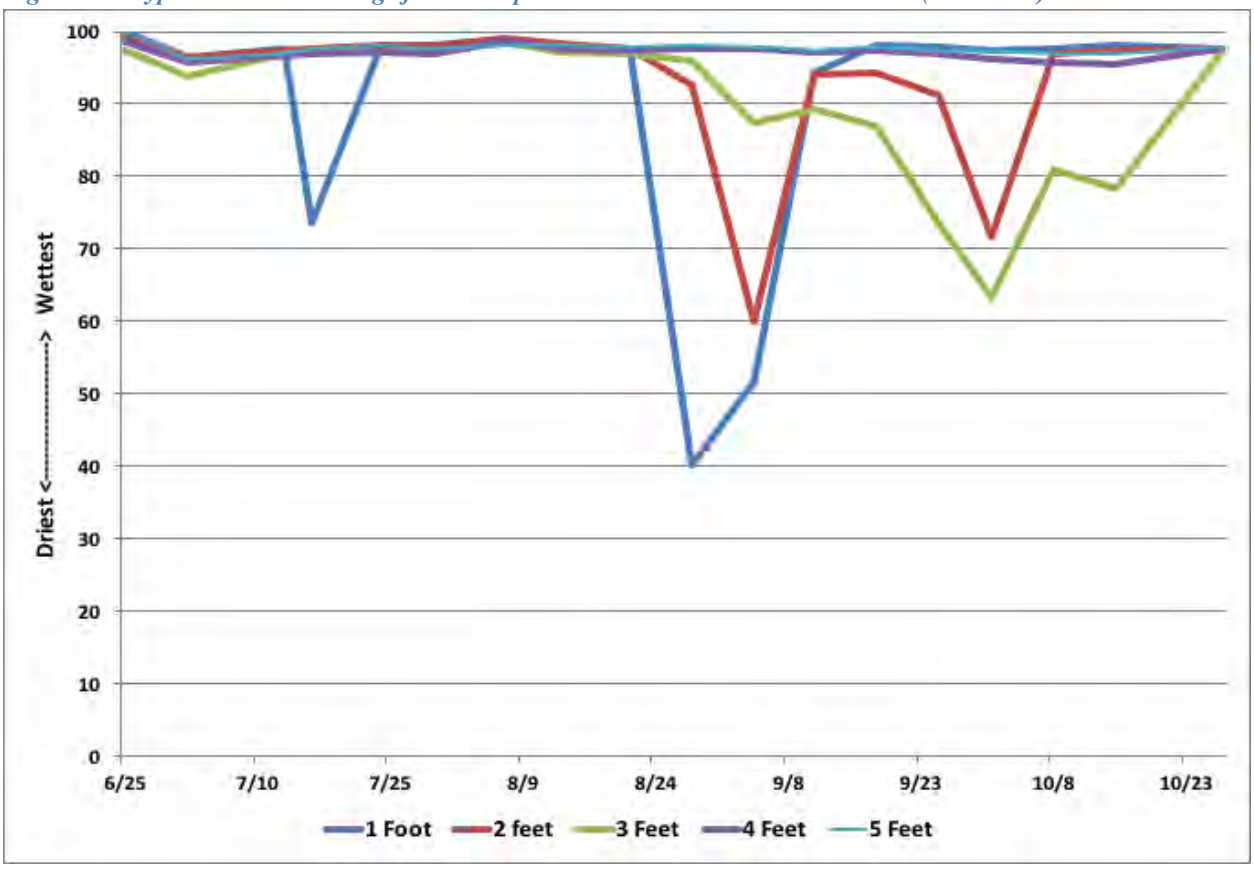


Figure 17: Growing Season Water Tracking for Stan Spain's "5 GPM" Demonstration Site (260 bu/ac)

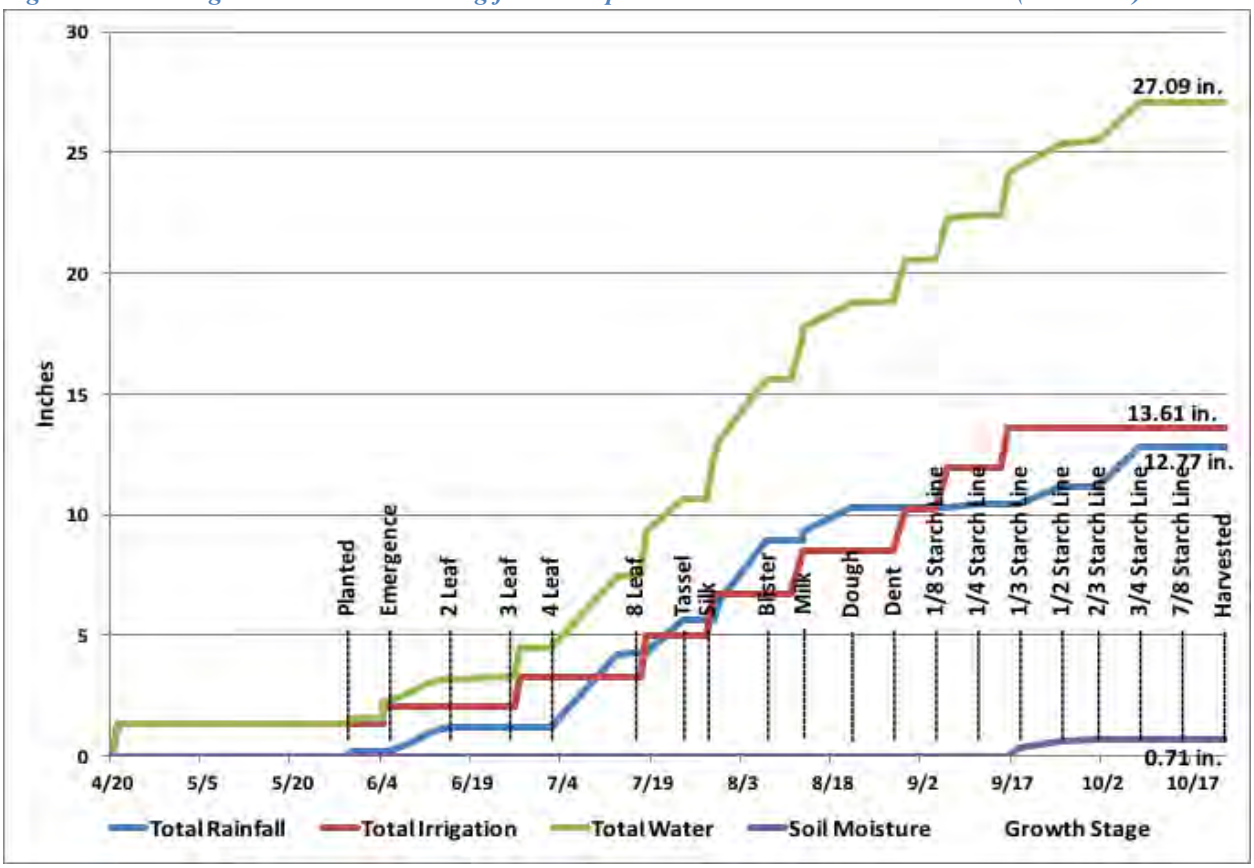


Table 11: Demonstration Field Data for Stan Spain's "5 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Hour Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
						1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
2/23	0.52													Curtis
4/20			10.27								pre-wtr	150		Leon
4/21		1.31	12.28								pre-wtr	90	555	Leon
4/27	2.10													Curtis
5/6	1.42													Curtis
5/9	0.42													Curtis
5/14	0.40													Curtis
5/17	0.33													Curtis
5/19	1.06													Curtis
5/22	0.68													Curtis
5/23	0.85													Curtis
5/28			19.49	284.1								314		Curtis
5/29											planted			Stan
5/30	0.22													Pivotrac
6/3			20.02	295.3							3 gpm	288 Y	552	Leon
6/4											4 gpm	188 Y		Pivotrac
6/4											5 gpm	150 Y		Leon
6/4		0.76	23.49								5 gpm	90 Y	555	Leon
6/5			26.67	362.3	emerged							6 N		Leon
6/8	0.25													Curtis
6/12	0.54													Curtis
6/15	0.15				2 leaf									Curtis
6/25	0.05		26.67	382.7	3 leaf	99.9	99.4	97.4	98.6	100.0		269 N		C & L
6/26			30.27		3 leaf						5 gpm	150 Y		Leon
6/27		1.18	32.07		3 leaf						5 gpm	90 Y	560	Leon
7/2			36.13	509.7	4 leaf	96.4	96.5	93.9	95.6	96.2		150 N	tan mar	C & L
7/13	2.99		37.70	549.5	7 leaf	97.7	97.3	96.8	96.6	97.0		43 N		C & L
7/16	0.05		42.39	595.9	8 leaf	73.6	97.6	97.2	97.0	97.5	3 gpm	239 Y	537	Curtis
7/17			46.09		8 leaf						5 gpm	150 Y		Leon
7/18		1.76	48.78		9 leaf						5 gpm	90 Y	545	Leon
7/24	1.42		53.03	700.6	tassel	98.0	98.2	97.2	97.1	98.0		295 N		C & L
7/28			55.95		silk						5 gpm	150 Y		Leon
7/29		1.71	58.56		silk						5 gpm	90 Y	400	Leon
7/30	0.73		60.16	796.7	silk	97.8	98.0	96.9	96.8	97.6	north	59 Y	390	Leon
8/7	2.50		63.84	849	blister	98.4	99.0	98.5	98.9	98.0		305 N		C & L
8/11			67.68		blister						5 gpm	150 Y		Leon
8/13		1.75	70.35		blister						5 gpm	90 Y	400	Leon
8/13	0.40		72.07	959.5	milk	98.2	98.4	97.2	97.7	98.2	north	52 Y	402	Curtis
8/21	0.97		75.81	1010.7	dough	97.6	97.7	96.9	97.4	97.8		315 N		Curtis
8/28	0.05		79.07	1055.2	dent	40.2	92.7	95.9	97.5	98.0	4 gpm	170 Y	402	Curtis
8/28			79.86		dent							150 Y		Leon
8/30		1.74	82.53		dent						5 gpm	90 Y	400	Leon
9/4			91.24	1223.2	1/8mat ln	51.6	60.1	87.3	97.6	97.8	4 gpm	158 Y	395	Curtis
9/4			91.91		1/8 mat ln						5 gpm	150 Y		Leon
9/6		1.71	94.52		1/8 mat ln						5 gpm	90 Y	400	Leon
9/11	0.15		104.42	1385.5	1/4mat ln	94.3	94.1	89.2	97.1	97.4		150 N		Curtis
9/15			104.42		1/4 mat ln						5 gpm	150 Y		Leon
9/16		1.69	106.93		1/4 mat ln						5 gpm	90 Y	390	Leon
9/18			109.43	1457.2	1/3mat ln	98.1	94.2	86.9	97.4	97.9	north	31 Y	387	Curtis
9/25	0.66		112.33	1498.3	1/2mat ln	97.9	91.2	73.5	96.8	97.4		302 N		C & L
10/1			112.33	1498.3	2/3mat ln	97.3	71.7	63.2	96.3	97.4		302 N		C & L
10/8	1.64		112.33	1498.3	3/4mat ln	97.6	97.0	80.9	95.7	96.9		302 N		C & L
10/15			112.33	1498.3	7/8mat ln	98.0	97.3	78.3	95.4	96.8		302 N		Curtis
10/22	4.97				harvest									Curtis
10/27			112.33	1498.4	harvest	97.7	97.5	97.1	97.6	97.8		298 N		C & L
Total	**12.77**	**13.61**				**0.0**	**0.0**	**0.6**	**0.1**	**0.0**				**Leon**
Net Soil Moisture is 0.71"														
Irrigation, Rainfall Plus Net Soil Moisture is 27.09"														

• Numbers in red are not counted in the total

NORTH PLAINS GROUNDWATER Conservation District

2015-Corn Demonstration
Irrigated Medium Season Corn

5 GPM

Year:	2015	**County:**	Moore	**Grower:**	Stan Spain
No. Acres:	18.3	**Variety/Hyb:**	D55VP77	**Soil Type:**	Sherm Silty Clay Loam
Meter Type:	Seametrics				
Meter Mult:	Acre Feet x 1	**Tillage:**	Strip Till		
Fertilizer:	246-26-0	**Seeding:**	32,000		
Planted:	May 29, 2015	**Harvest:**	October 20, 2015		
Herbicide:	Makaze, Atrazine, Diflexx, Rifle, Verdict, Firestorm, Intensity, Armezon	**Insecticide:**	***CideTrak*** Prevathon, Comite, Warhawk		
Yield:	260 bu/acre @ 15.0% Moist.	**Prev. crop:**	Corn	**Row width:**	30"
Irrigation method:	Center Pivot	**Prewater:**	1.31"	**Well GPM:**	400
Distance between drops:	30 inches	**Distance from nozzle to ground:**	12 inches		
Application pattern:	LEPA	**Crop row direction :**	Planted in Circle		

GPS Location of Pivot Pad		**GPS Location of Gypsum Blocks**	
Latitude:	35.99941	Latitude:	35.99857
Longitude:	-101.979	Longitude:	-101.97523

Stan Spain's "5 GPM" Site AquaSpy® Probe Summary

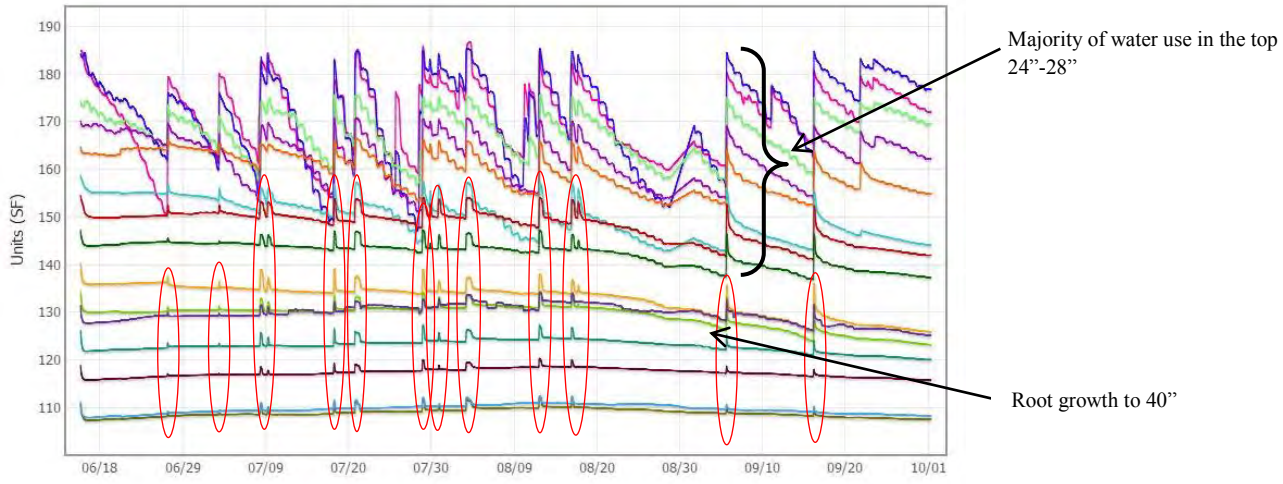


Figure 18. WCC moisture graph (5 gpm)

This site had a higher yield than the other two treatments but a lower water use efficiency. This would be due largely to the large amounts of drainage highlighted by the red circles in figure 18. Many of the drainage events were prolonged in nature and this could have caused some leaching of fertilizer as well as water loss. The maximum observed root depth was 40" and the root activity of this treatment was not as vigorous as the 3 gpm or the 4 gpm treatment. This shallower observed root depth would probably be due to the larger amount of irrigation supplied. It may have been possible to encourage a deeper root system and reduce the amount of drainage by increasing the irrigation interval and possibly eliminating one of the early irrigations.

Harvest Results: The 3 GPM field produced a 227 bushel per acre corn yield. Irrigation totaled 9.76 inches. Production in the 4 GPM field was 239 bushels per acre. Seasonal irrigation totaled 11.71 inches. Corn yield was 260 bushels per acre for the 5 GPM field. Irrigation totaled 13.61 inches. There was 1.31 inches of pre-season irrigation, primarily to germinate volunteer corn and penetrate herbicide. The 4 GPM field produced 12 more bushels per acre than the 3 GPM field. Irrigation was 1.95 inches more. The 5 GPM field produced 33 more bushels per acre than the 3 GPM with 3.85 more inches of irrigation. The 5 GPM yield was 21 more bushels per acre than that from the 4 GPM field with 1.90 additional inches of irrigation. Corn production was 23.26 bushels (1302lbs) per inch of irrigation in the 3 GPM field compared to 20.41 bushels (1143lbs) in the 4 GPM and 19.10 bushels (1070lbs) from the 5 GPM field. Production from each inch of irrigation, rainfall and net soil water that totaled 26.33 inches was 8.62 bushels (483lbs) per acre in the 3 GPM field. Irrigation, rainfall and net soil water totaled 26.79 inches in the 4 GPM field where production was 8.92 bushels (499lbs) per inch. In the 5 GPM field, irrigation, rainfall and net soil water totaled 27.09 inches where production was 9.59 bushels (537lbs) per inch of total water. Crop production costs were $24.60 per acre more for the 4 GPM field than for the 3 GPM from increased irrigation, fertilizer and harvest expenses. At $3.97 per bushel, the 12 bushels per acre increased corn yield in the 4 GPM field amounts to $47.64 more per acre than from the 3 GPM field. The 4 GPM field's net gain is $23.04 per acre with 1.95 inches more irrigation used compared to production from the 3 GPM field. At $3.97 per bushel, the 33 bushel per acre increased yield from the 5 GPM field compared to the 3 GPM amounts to $131.01 per acre. Crop production costs were $59.63 per acre more for the 5 GPM field. The 5 GPM fields' net gain compared to the 3 GPM field is $71.38 per acre with 3.85 additional inches of irrigation. Value of the 21 additional bushels produced in the 5 GPM field compared to the 4 GPM field is $83.37. Production Costs were $35.03 more for the 5 GPM field than the 4 GPM. Net gain for the 5 GPM field is $48.34 per acre with 1.90 inches more irrigation. Net return from the 3 GPM field was $464.46 per acre compared to $487.50 from the 4 GPM field and $535.84 from the 5 GPM field. Net return from each inch of irrigation is $47.59 for the 3 GPM field compared to $41.64 from the 4 GPM and $39.37 for the 5 GPM field. A summary of the demonstration results are shown in table 12 and Appendix B.

Table 12: Stan Spain's 2015 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $3.97/bu		
			bu/ac	lb/ac-in Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"3 GPM"	9.76	*26.33	227	1302	$901.19	$92.33	$34.22
"4 GPM"	11.71	†26.79	239	1143	$948.33	$81.03	$35.42
"5 GPM"	13.61	#27.09	260	1070	$1032.20	$75.84	$38.10

*Includes 3.80 inches of soil water removed within five feet of soil, plus rainfall, and irrigation.
†Includes 2.31 inches of soil water removed within five feet of soil, plus rainfall, and irrigation.
#Includes .71 inches of soil water removed within five feet of soil, plus rainfall and irrigation.

Additional Corn Hybrids Irrigated Within "3-4-5 GPM" & East Center Pivot North Management Strategy

Table 13: Stan Spain Other & "3-4-5 GPM" Corn Hybrid Yields, Seeding Rate, Irrigation and Rainfall

Field	Corn Hybrid	Seeding Rate	Planting Date	Irrigation (in)	Rainfall (in)	Total Rainfall & Irrigation (in)	Harvest Date	Yield (bu/ac)
3 GPM	D54DC94RIB	32000	29-May	9.76	12.77	22.53	20-Oct	237
4 GPM	D54DC94RIB	32000	29-May	11.71	12.77	24.48	20-Oct	267
5 GPM	D54DC94RIB	32000	29-May	13.61	12.77	26.38	20-Oct	255
North	D54DC94RIB	32000	29-May	13.85	12.77	26.62	28-Oct	264
3 GPM	P1690AM	32000	29-May	9.76	12.77	22.53	20-Oct	233
4 GPM	P1690AM	32000	29-May	11.71	12.77	24.48	20-Oct	269
5 GPM	P1690AM	32000	29-May	13.61	12.77	26.38	20-Oct	232
North	P1690AM	32000	29-May	13.85	12.77	26.62	28-Oct	254
3 GPM	D53VC47RIB	32000	29-May	9.76	12.77	22.53	20-Oct	229
4 GPM	D53VC47RIB	32000	29-May	11.71	12.77	24.48	20-Oct	261
5 GPM	D53VC47RIB	32000	29-May	13.61	12.77	26.38	20-Oct	241
North	D53VC47RIB	32000	29-May	13.85	12.77	26.62	28-Oct	256
3 GPM	D55VP77RIB	32000	29-May	9.76	12.77	22.53	20-Oct	227
4 GPM	D55VP77RIB	32000	29-May	11.71	12.77	24.48	20-Oct	239
5 GPM	D55VP77RIB	32000	29-May	13.61	12.77	26.38	28-Oct	260
North	D55VP77RIB	32000	29-May	13.85	12.77	26.62	28-Oct	253
3 GPM	DK66-40	32000	29-May	9.76	12.77	22.53	20-Oct	226
4 GPM	DK66-40	32000	29-May	11.71	12.77	24.48	20-Oct	244
5 GPM	DK66-40	32000	29-May	13.61	12.77	26.38	28-Oct	253
North	DK66-40	32000	29-May	13.85	12.77	26.62	28-Oct	239
3 GPM	DK62-98	32000	29-May	9.76	12.77	22.53	20-Oct	226
4 GPM	DK62-98	32000	29-May	11.71	12.77	24.48	20-Oct	246
5 GPM	DK62-98	32000	29-May	13.61	12.77	26.38	28-Oct	238
North	DK62-98	32000	29-May	13.85	12.77	26.62	28-Oct	249
3 GPM	N785-3111	32000	29-May	9.76	12.77	22.53	20-Oct	225
4 GPM	N785-3111	32000	29-May	11.71	12.77	24.48	20-Oct	235
5 GPM	N785-3111	32000	29-May	13.61	12.77	26.38	28-Oct	253
North	N785-3111	32000	29-May	13.85	12.77	26.62	28-Oct	246
3 GPM	D52SS91RIB	32000	29-May	9.76	12.77	22.53	20-Oct	225
4 GPM	D52SS91RIB	32000	29-May	11.71	12.77	24.48	20-Oct	221
5 GPM	D52SS91RIB	32000	29-May	13.61	12.77	26.38	20-Oct	257
North	D52SS91RIB	32000	29-May	13.85	12.77	26.62	28-Oct	253
3 GPM	85VT3RIB	32000	29-May	9.76	12.77	22.53	20-Oct	220
4 GPM	85VT3RIB	32000	29-May	11.71	12.77	24.48	20-Oct	234
5 GPM	85VT3RIB	32000	29-May	13.61	12.77	26.38	28-Oct	251
North	85VT3RIB	32000	29-May	13.85	12.77	26.62	28-Oct	235
3 GPM	P1266AM	32000	29-May	9.76	12.77	22.53	20-Oct	218
4 GPM	P1266AM	32000	29-May	11.71	12.77	24.48	20-Oct	194
5 GPM	P1266AM	32000	29-May	13.61	12.77	26.38	28-Oct	206
North	P1266AM	32000	29-May	13.85	12.77	26.62	28-Oct	247
3 GPM	N75H-5122	32000	29-May	9.76	12.77	22.53	20-Oct	207
4 GPM	N75H-5122	32000	29-May	11.71	12.77	24.48	20-Oct	227
5 GPM	N75H-5122	32000	29-May	13.61	12.77	26.38	28-Oct	248
North	N75H-5122	32000	29-May	13.85	12.77	26.62	28-Oct	234
3 GPM	D58QC72	32000	29-May	9.76	12.77	22.53	20-Oct	196
4 GPM	D58QC72	32000	29-May	11.71	12.77	24.48	20-Oct	231
5 GPM	D58QC72	32000	29-May	13.61	12.77	26.38	20-Oct	229
North	D58QC72	32000	29-May	13.85	12.77	26.62	28-Oct	238
3 GPM	D55QC73	32000	29-May	9.76	12.77	22.53	20-Oct	195
4 GPM	D55QC73	32000	29-May	11.71	12.77	24.48	20-Oct	225
5 GPM	D55QC73	32000	29-May	13.61	12.77	26.38	20-Oct	216
North	D55QC73	32000	29-May	13.85	12.77	26.62	28-Oct	227

Zac Yoder's 2015 Dallam County Demonstration

Planting and Crop Information: Zac Yoder strip tilled and planted 105 acres of corn in the SE ¼ circle of section 64, Y6, for his "3-4-5 GPM" demonstration. Span 5 of the center pivot was renozzled at 3 GPM per acre to apply 1.10 inches each revolution, span 4 for 4 GPM to apply 1.49 inches and span 3 for 5 GPM per acre to apply 1.85 inches for his 3, 4 and 5 GPM fields. Yoder planted each "3-4-5 GPM" field to Pioneer 33Y74 hybrid. Seeding rate was 32,000 for the 3 GPM, 4 GPM and 5 GPM fields. Center pivot travel and position was monitored by PivoTrac™. Seasonal water meter readings averaged 390 gpm. Irrigation was with Senninger LDN LESA spray pads with drops spaced 60 inches apart. Timely rainfall allowed the center pivot to be stopped more than during recent growing seasons. Planting and crop information for "Yoder 3 GPM", "Yoder 4 GPM" and "Yoder 5 GPM" are shown in the table 14 below.

Table 14: Planting and Crop Information for Zac Yoder

3 GPM Demonstration Site: Center Pivot Span 5			
Planted:	*May 12*	**Harvested:**	*November 7*
Hybrid:	*Pioneer P33Y74*	**Seeding Rate:**	*32,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*13.3*	**GPM Per Acre:**	*3.74*
Total Water:	*28.07 inches*	**Soil Type:**	*Perico fine sandy loam*
Irrigation:	*13.51inches*	**Insecticide:**	*Poncho 250*
Herbicide:	*Laudis, Atrazine*	**Fertilizer**:	306-117-105-48s
4 GPM Demonstration Site: Center Pivot Span 4			
Planted:	*May 12*	**Harvested:**	*November 7*
Hybrid:	*Pioneer P33Y74*	**Seeding Rate:**	*32,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*9.1*	**GPM Per Acre:**	*3.74*
Total Water:	*30.72 inches*	**Soil Type:**	*Perico fine sandy loam*
Irrigation:	*17.62 inches*	**Insecticide:**	*Poncho 250*
Herbicide:	*Laudis, Atrazine*	**Fertilizer:**	366-117-105-48s
5 GPM Demonstration Site: Center Pivot Span 3			
Planted:	*May 12*	**Harvested:**	*November 7*
Hybrid:	*Pioneer P33Y74*	**Seeding Rate:**	*32,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*6.5*	**GPM Per Acre:**	*3.74*
Total Water:	*34.87 inches*	**Soil Type:**	*Perico fine sandy loam*
Irrigation:	*21.79 inches*	**Insecticide:**	*Poncho 250*
Herbicide:	*Laudis, Atrazine*	**Fertilizer:**	426-117-105-48s

Soil Water Profile and Growing Season Rainfall

"3 GPM" Demonstration Site: Gypsum block soil water sensors were installed June 5 following planting. They show good soil moisture at 1, 2 and 3 feet but about 15 percent at 4 feet and 75 percent at 5 feet. Initial sensor readings indicate soil water was low following the 2014 crop. And, that 3.12 inches of rainfall in May boosted soil water levels at 1, 2 and 3 feet, but did not reach 4 and 5 feet. June rainfall and irrigation improved soil water at 4 feet and the crop

rooted deep to use it in July. Weekly gypsum block readings indicate the crop depleted soil water at 2 and 3 feet, plus 70 percent from 4 feet in September, finishing the crop. Soil water was good at 1 foot in September, indicating no crop stress. Only limited soil water was used from 5 feet. Gypsum block moisture sensors show the crop had adequate soil water during the growing season. The soil profile was refilled to water holding capacity by late September and October rainfall at grain maturity black layer. Soil water sensors show 2.04 more inches of soil water is stored at 4 and 5 feet at grain maturity than beginning in June. The crop was produced in Perico fine sandy loam soil that can store approximately 1.8 inches of available water per foot for potential crop use. Timely beneficial rainfall significantly contributed to producing a good corn yield. Total rainfall from planting until grain black layer totaled 16.60 inches, and was more than normal for this location. Gypsum blocks were installed in early June following planting, due to wet soil conditions prior to planting.

"4 GPM" Demonstration Site: Initial gypsum block moisture sensor readings show soil water was good at 1 and 2 feet but only approximately 10 percent at 3, 4 and 5 feet. The sensors were installed June 5 following planting and crop emergence. Weekly gypsum block readings show good soil moisture levels were maintained at 1 and 2 for early plant growth and that the potential root profile was refilled to water holding capacity at 3, 4 and 5 feet by beneficial rainfall and irrigation in early August. The crop depleted soil water at 2 and 3 feet plus rainfall and irrigation in September finishing the crop. Soil moisture sensors show the crop had sufficient soil water during the growing season. Timely rainfall significantly contributed to producing the 276 bushel per acre corn yield. Soil water sensors show the soil profile was refilled to 5 feet by late September and early October rainfall during grain maturity. Sensors show 3.50 more inches of soil water at black layer grain maturity than beginning June 5, mostly at 3, 4 and 5 feet. Total rainfall from planting thru black layer totaled 16.60 inches, which was more than normal for this location. The crop was produced in Perico fine sandy loam soil that holds approximately 1.8 inches available water per foot for potential crop use.

"5 GPM" Demonstration Site: Beginning soil water sensor readings show soil moisture was 50 to 60 percent at 3, 4 and 5 feet, and 70 to 80 percent at 1 and 2 foot depths. Weekly gypsum block moisture sensors show the crop root soil profile was refilled to water holding capacity at 1, 2 and 3 feet in late June and early July by combined rainfall and irrigation. Additional rainfall and irrigation in July refilled the soil profile at 4 and 5 feet. There was a full profile of soil water to 5 feet at pollination and initial grain development. The crop depleted soil water at 3 feet, used about 75 percent from 4 feet and 50 percent plus rainfall and in September finishing the crop. Good soil water was available at one foot during heavy crop use in September. Limited water was extracted from 5 feet in September indicating a massive plant root system which is highly desirable in corn production. Moisture sensors show the crop had sufficient available soil water during the entire growing season. The sensors show there was 3.52 more inches of soil water at 1, 2, 3, 4 and 5 feet at grain maturity than on June 5 when the gypsum block sensors were installed. The soil profile was refilled to water holding capacity by 4.54 inches of rainfall in late September and October during grain maturity stages. Beneficial rainfall significantly contributed to producing the 307 bushel per acre corn yield. Total rainfall was 16.60 inches. Irrigation

totaled 21.79 inches. The crop was produced in Perico fine sandy loam that holds approximately 1.8 inches of available water per foot for potential crop use.

Table 15: Monthly Rainfall Data for Zac Yoder

	May	June	July	August	September	October	Total
"3 GPM"	3.12"	0.84"	2.78"	5.06"	2.58"	2.22"	**16.60"**
"4 GPM"	3.12"	0.84"	2.78"	5.06"	2.58"	2.22"	**16.60"**
"5 GPM"	3.12"	0.84"	2.78"	5.06"	2.58"	2.22"	**16.60"**

Growing Season Water Tracking: The district tracked total water and crop growth throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. One set of five gypsum block soil moisture sensors was installed at 1, 2, 3, 4 and 5 feet and an AquaSpy® soil moisture probe was installed down to five feet in the root zone at one location to monitor soil water levels in the "3 GPM" field. Another set of the same type of sensors were installed in both the "4 GPM" and "5 GPM" fields. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in each field. Due to wet soils from abundant April and May rainfall, all Gypsum blocks were installed following planting. Gypsum blocks, water meter, rain gauges and crop growth are read, recorded and utilized weekly by district personnel. Each AquaSpy® probe was installed following crop emergence. A 24/7 AquaSpy® probe website shows soil moisture at four inch increments to 60 inches and monitors plant root growth. The website lists all AquaSpy® soil probes in the "3-4-5 GPM" project and is available to all cooperators and district personnel. Another 24/7 PivoTrac™ website tracks each center pivot system and monitors and controls irrigation. Each center pivot travel speed prescription written to apply 1.10 inches ("3 GPM"), 1.49 inches ("4 GPM") and 1.85 inches ("5 GPM") is managed from the PivoTrac™ website. Both the cooperating grower and district "3-4-5 GPM" project leader collectively monitor, control and manage irrigation from the PivoTrac™ website. Following this paragraph, a series of graphs and tables shows weekly gypsum block readings for the season; growing season water, including rainfall, irrigation, and soil moisture at various growth stages; and the order of irrigation and rainfall events for each "3-4-5 GPM" field. Finally, a form describes the protocols for each field. "Total Water," as shown on the graph for growing season water, is the sum of seasonal irrigation, rainfall and net soil water. Graphs and tables for the 3 GPM acres are shown first, followed by the same illustrations for each 4 GPM and 5 GPM.

Figure 19: Gypsum Block Readings for Zac Yoder's "3 GPM" Demonstration Site (251 bu/ac)

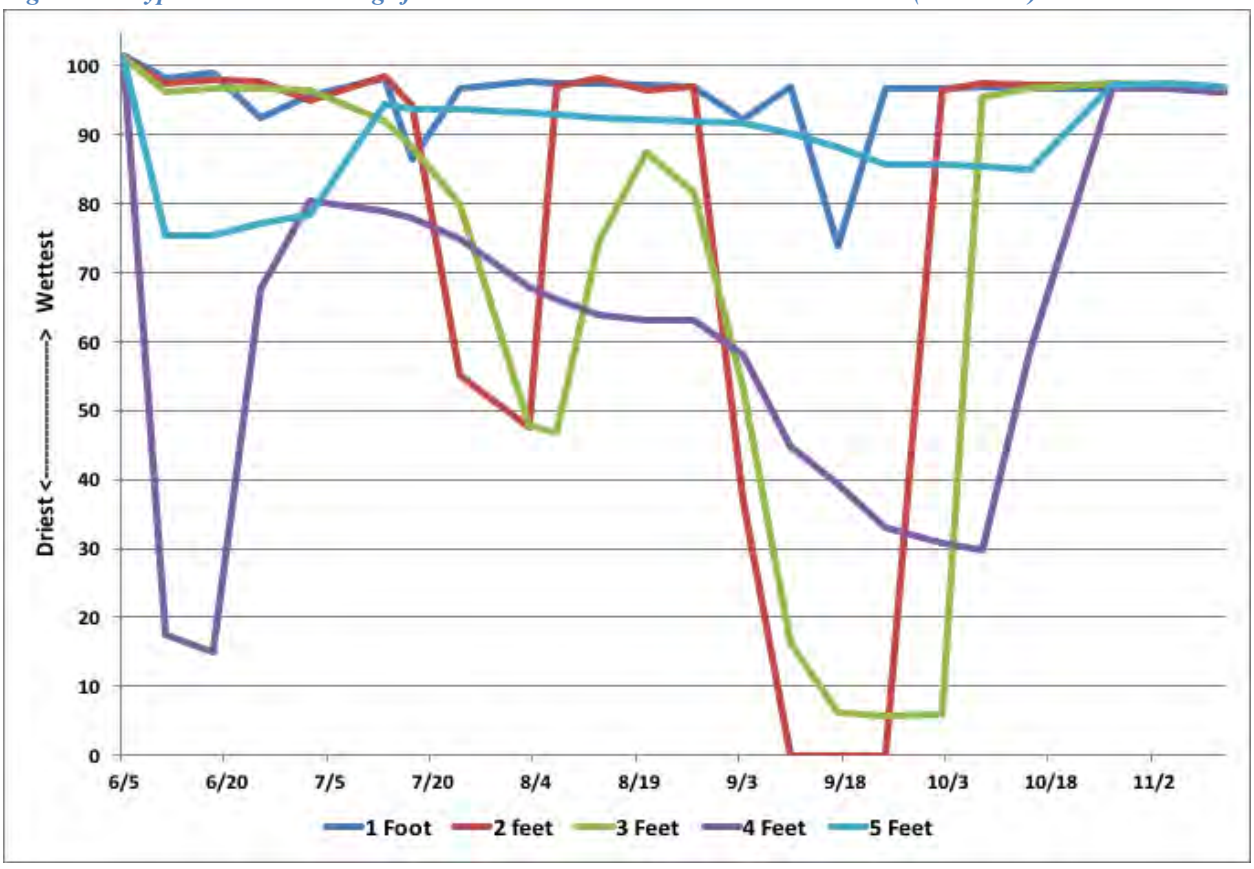


Figure 20: Growing Season Water Tracking for Zac Yoder "3 GPM" Demonstration Site (251 bu/ac)

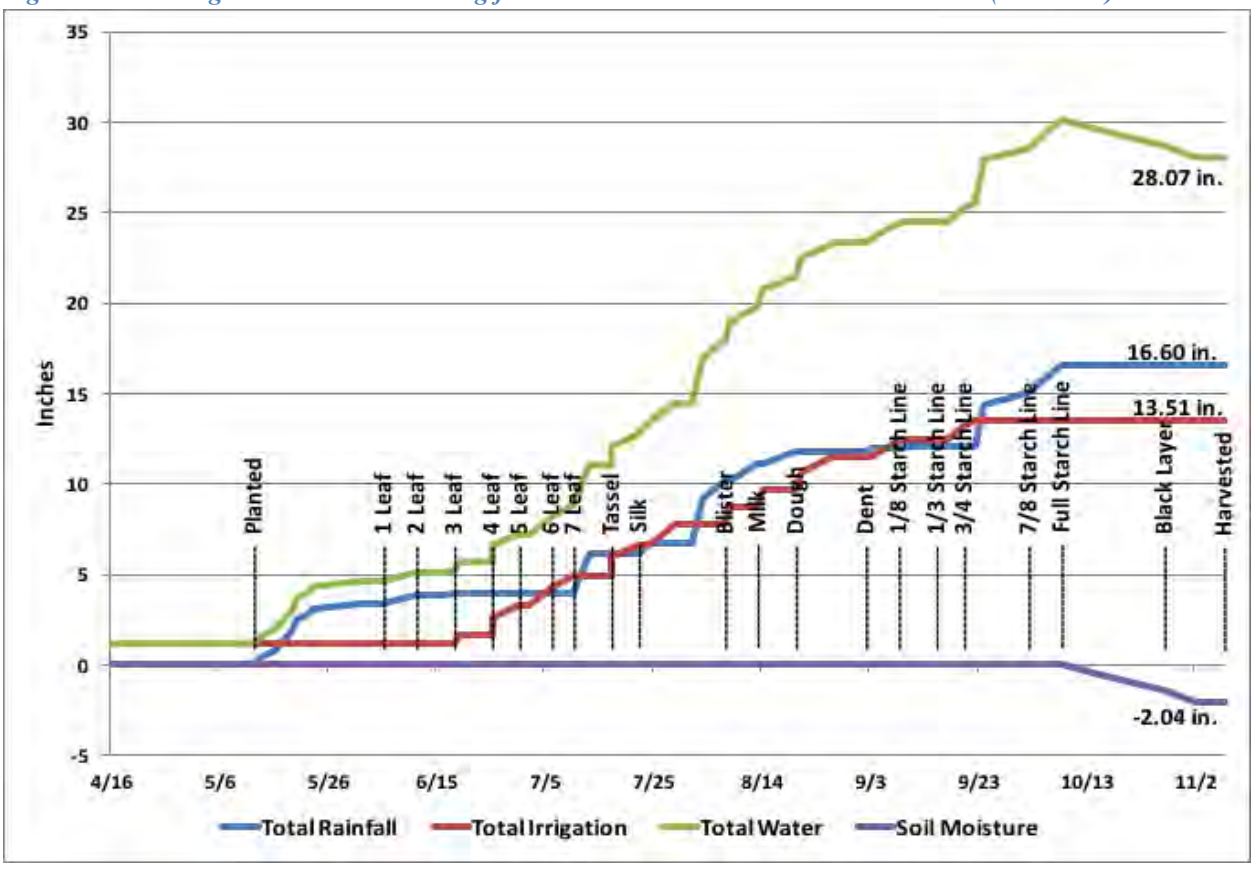


Table 16: Demonstration Field Data for Zac Yoder's "3 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Hour Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
						1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/16		1.22	126.4 hrs								pre-wtr	475	475	Pivotrac
5/5	0.42													Pivotrac
5/6	0.13													Pivotrac
5/9	0.10													Pivotrac
5/12											plant			Zac
5/14	0.48													Pivotrac
5/16	0.27													Pivotrac
5/19	1.07													Pivotrac
5/20	0.65													Pivotrac
5/22	0.32													Pivotrac
5/23	0.33													Pivotrac
6/1	0.25													Pivotrac
6/5			0.00	11392.7	1 leaf	101.6	101.2	101.3	100.7	100.9				C & L
6/11	0.50		0.00	11392.6	2 leaf	98.2	97.6	96.2	17.5	75.4				C & L
6/16			0.00	11392.6	2 leaf									Pivotrac
6/18	0.09		3.26 af	11437.1	3 leaf	98.9	98.0	96.6	15.0	75.3	3,4,5	382	382	Curtis
6/19		0.45	5.32		3 leaf						3 gpm	400	400	Leon
6/25					4 leaf									Pivotrac
6/25			15.79	11602.7	4 leaf	92.5	97.7	96.8	67.6	77.2				C & L
6/25			15.79		4 leaf						3,4,5			Pivotrac
6/25		0.96	16.59		4 leaf						3 gpm	400	400	Leon
6/30		0.62	23.80		5 leaf						3 gpm	400	400	Leon
7/2			27.94	11771.4	5 leaf	95.6	95.0	96.4	80.3	78.4	3,4,5	400	400	C & L
7/6		0.99	35.38		6 leaf						3 gpm	400	400	Leon
7/10		0.65	42.95		7 leaf						3 gpm	400	400	Leon
7/13	2.15		46.53	12032.4	9 leaf	98.2	98.6	92.0	78.9	94.4	3,4,5	403	403	C & L
7/17			53.38	12125.7	10 leaf	86.5	94.3	88.1	77.8	93.6	3,4,5	386	386	C & L
7/17		1.06	55.33		tassel						3 gpm	400	400	Leon
7/22		0.68	63.27		silk						3 gpm	400	400	Leon
7/24	0.63		65.55	12296.1	pollinate	96.8	55.0	79.9	74.9	93.7	3,4,5	396	396	C & L
7/29		1.11	76.24		pollinate						3 gpm	400	400	Leon
7/29			76.24								none			Zac
8/1			76.24								3,4,5			Pivotrac
8/3	2.50		77.93	12533.6	silk	97.7	47.6	47.8	68.0	93.2	3,4,5	420	420	C & L
8/7	0.92		85.09	12627.7	blister	97.6	97.0	46.9	66.1	92.9	3,4,5	392	392	C & L
8/8		1.03	88.34		blister						3 gpm	390	390	Leon
8/13	0.92		95.64	12771.8	milk	97.6	98.2	74.3	63.8	92.5	3,4,5	411	411	Curtis
8/14		0.89	98.72		milk						3 gpm	400	400	Leon
8/20	0.72		107.45	12933.8	dough	97.3	96.5	87.4	63.1	92.2	3,4,5	386	386	Curtis
8/21		1.00	110.48		dough						3 gpm	385	385	Leon
8/27		0.83			dough						3 gpm	375	375	Leon
8/27		0.05	120.71		dough						3 gpm	350	350	Pivotrac
8/27			119.38	13099.5	dough	97.1	97.1	81.7	63.1	92.0	3,4,5			Curtis
9/2			119.38		dent						3,4,5			Pivotrac
9/3	0.20		121.33	13125.9	dent	92.3	37.0	53.3	58.0	91.7	3,4,5	361	361	Curtis
9/8		0.86	130.81		1/8mat ln						3 gpm	350	350	Leon
9/9		0.05	131.27		1/8mat ln						3 gpm	350	350	Pivotrac
9/9			131.27		1/4mat ln									Pivotrac
9/10	0.06		131.27	13267.5	1/4mat ln	97.0	0.0	16.3	44.8	90.3				Curtis
9/15			131.27		1/3mat ln						3,4,5			Pivotrac
9/17			134.88	13314.4	1/2mat ln	73.8	0.0	6.2	39.2	88.2	3,4,5	390	390	Curtis
9/20		0.78	140.59		3/4mat ln						3 gpm	380	380	Leon
9/22		0.28	143.76		3/4mat ln						3 gpm	380	380	Pivotrac
9/24	2.32		143.76	13442.4	3/4mat ln	96.7	0.0	5.7	33.1	85.6				C & L
10/2	0.61		143.76	13442.4	7/8mat ln	96.7	96.5	6.0	30.7	85.6				C & L
10/8	1.61		143.76	13442.4	1.0mat ln	96.9	97.4	95.5	29.8	85.4				C & L
10/15			143.76	13442.4	1.0mat ln	96.7	97.2	96.6	58.7	84.9				Curtis
10/27	1.53		143.76	13442.4	blk layer	96.8	97.2	97.4	96.8	97.3				C & L
11/4	0.33		143.76	13442.4	blk layer	96.7	97.1	97.2	96.8	97.6				Curtis
11/7			143.76		harvest									Zac
11/12	0.03		143.76	13442.4	harvested	96.1	96.5	96.8	96.2	97.0				Curtis
Total	**16.60**	**13.51**				**0.0**	**0.0**	**0.0**	**-1.4**	**-0.6**				
Net Soil Moisture is -2.04"														
Irrigation, Rainfall Plus Net Soil Moisture is 28.07"														

* Numbers in red are not counted in the total

2015-Corn Demonstration
Irrigated Medium Season Corn

3 GPM

Year: *2015* **County:** *Dallam* **Grower:** *Zac Yoder*

No. Acres: *13.3* **Variety/Hyb:** *P33Y74* **Soil Type:** *Perico Fine Sandy Loam*

Meter Type: *Seametrics*

Meter Mult: *Acre Feet x 1* **Tillage:** *Strip Till*

Fertilizer: *306-117-105-48s* **Seeding:** *32,000*

Planted: *May 12, 2015* **Harvest:** *November 7, 2015*

Herbicide: *Laudis, Atrazine* **Insecticide:** *Poncho 250*

Yield: *251 bu/acre @ 15.0% Moist* **Prev. crop:** *Wheat* **Row width:** *30 inches*

Irrigation method: *Center Pivot* **Prewater:** *1.22"* **Well GPM:** *390*

Distance between drops: *60 inches* **Distance from nozzle to ground:** *16 inches*

Application pattern: *LESA Spray* **Crop row direction :** *Planted in circle*

GPS Location of Pivot Pad
Latitude: *36.115802*
Longitude: *-102.968042*

GPS Location of Gypsum Blocks
Latitude: *36.116225*
Longitude: *-102.96562*

Zac Yoder's "3 GPM" Site AquaSpy® Probe Summary

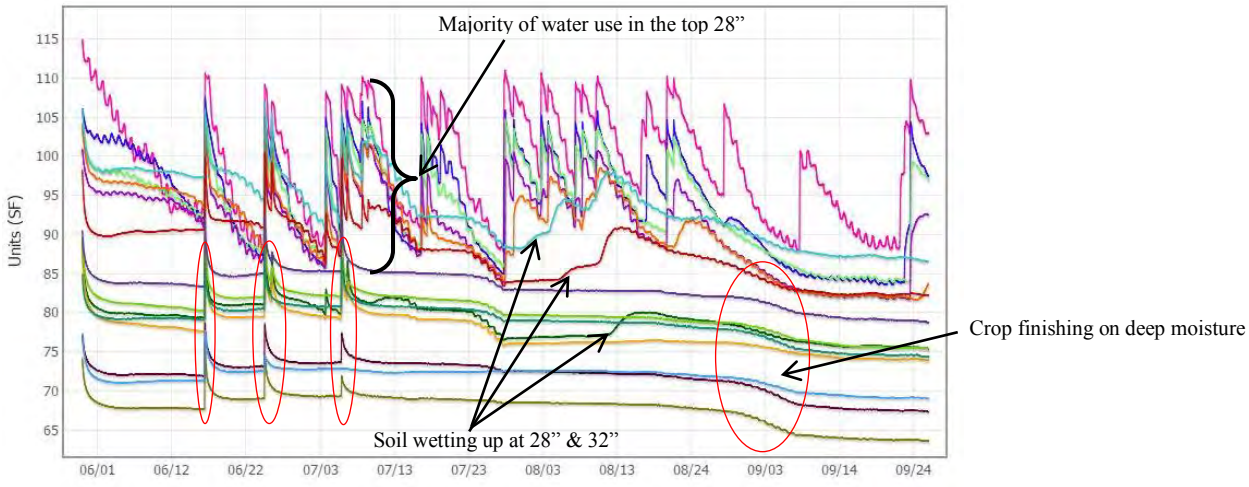


Figure 21. Yoder moisture graph (3 gpm)

The first 3 major irrigation or rainfall events at this site went all the way to 60" and beyond. There was evidence of significant drainage during these initial wetting events and this may have produced leaching of nutrients. Root activity was outstanding, with roots reaching 48" in late July and 60" during August. The crop was able to utilize subsoil moisture during grain filling, which undoubtedly would have assisted in the very high yield at this site. Late rain largely filled the top 16" which contributed to the negative soil moisture balance in this treatment.

Figure 22: Gypsum Block Readings for Zac Yoder's "4 GPM" Demonstration Site (276 bu/ac)

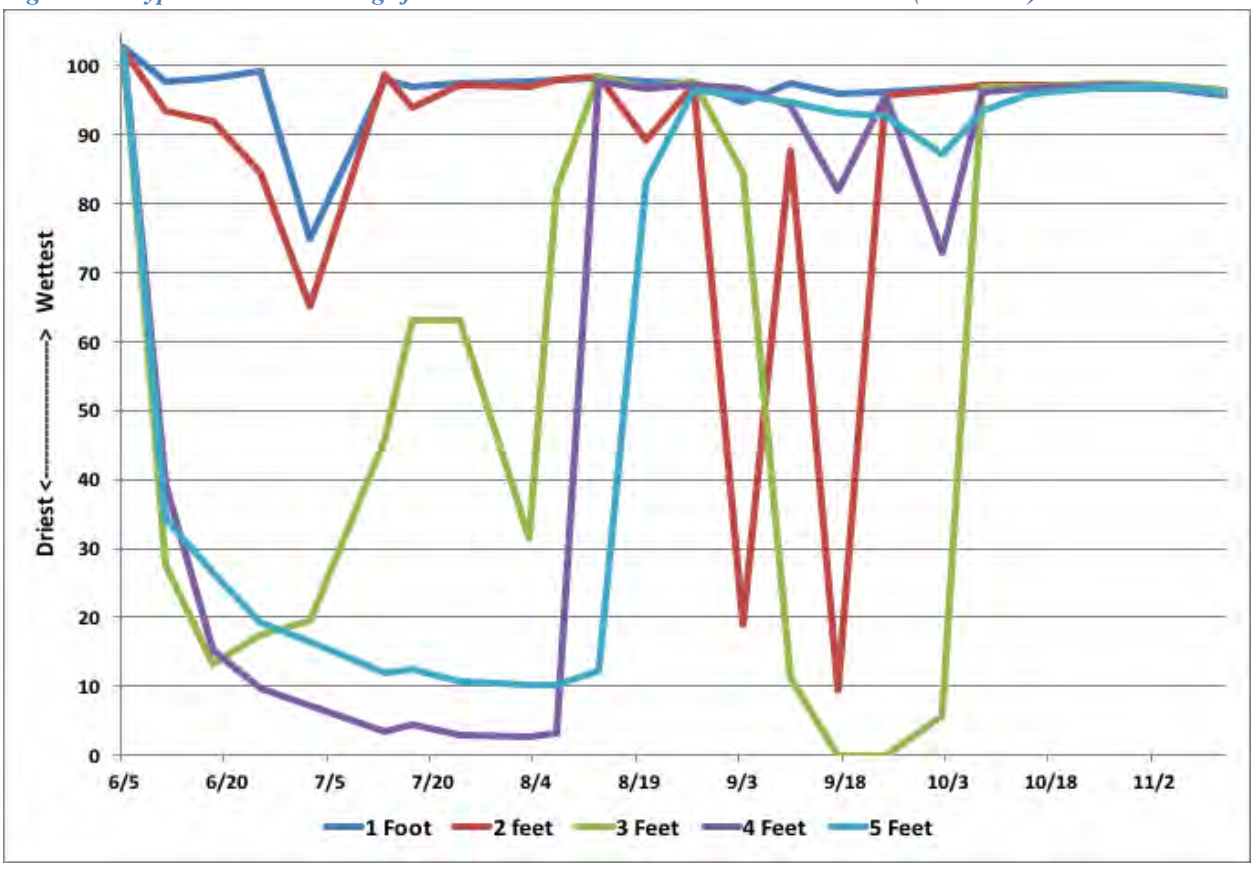


Figure 23: Growing Season Water Tracking for Zac Yoder's "4 GPM" Demonstration Site (276 bu/ac)

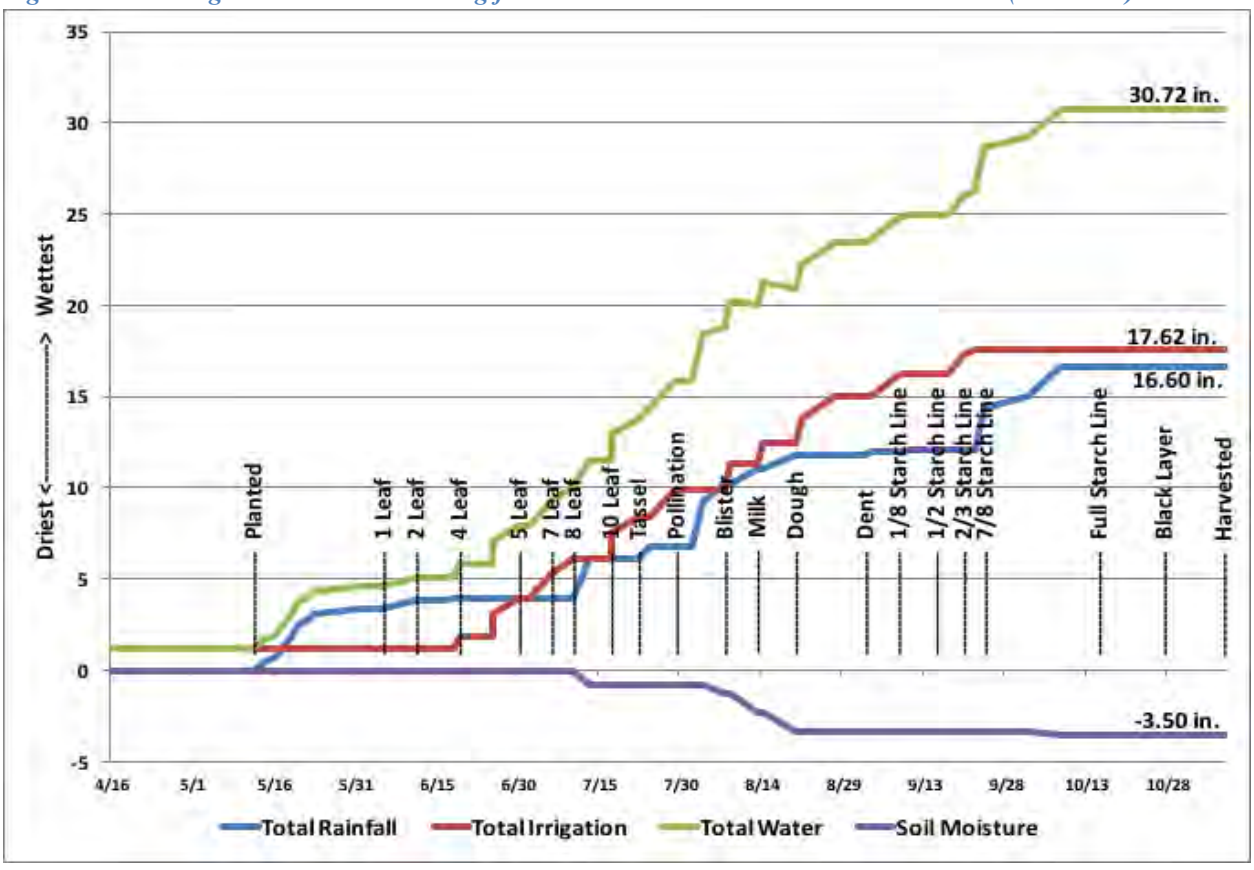


Table 17: Demonstration Field Data for Zac Yoder's "4 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
					1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/16		1.22	126.4 hrs							pre-wtr	475	475	Pivotrac
5/5	0.42												Pivotrac
5/6	0.13												Pivotrac
5/9	0.10												Pivotrac
5/12										plant			Zac
5/14	0.48												Pivotrac
5/16	0.27												Pivotrac
5/19	1.07												Pivotrac
5/20	0.65												Pivotrac
5/22	0.32												Pivotrac
5/23	0.33												Pivotrac
6/1	0.25												Pivotrac
6/5			0.00	1 leaf	102.7	102.2	102.2	102.0	102.0				C & L
6/11	0.50		0.00	2 leaf	97.7	93.5	27.4	39.2	34.2				C & L
6/16			0.00	3 leaf						all			Pivotrac
6/18	0.09		3.26 af	3 leaf	98.3	92.0	13.3	15.2	26.6	all	382	382	Curtis
6/19		0.61	5.32	4 leaf						4 gpm	400	400	Leon
6/25				4 leaf									Pivotrac
6/25			15.79	4 leaf	99.3	84.4	17.5	9.6	19.3				C & L
6/25				4 leaf						3,4,5			Pivotrac
6/25		1.29	16.59	4 leaf						4 gpm	400	400	Pivotrac
6/30		0.82	23.80	5 leaf						4 gpm	400	400	Leon
7/2			27.94	5 leaf	74.8	65.0	19.6	7.1	16.4	3,4,5	400	400	C & L
7/6		1.32	35.38	7 leaf						4 gpm	400	400	Leon
7/10		0.86	42.95	8 leaf						4 gpm	400	400	Leon
7/13	2.15		46.53	9 leaf	97.9	98.8	45.8	3.4	12.0	3,4,5	403	403	C & L
7/17			53.38	10 leaf	96.9	94.0	53.0	4.4	12.5	3,4,5	386	386	C & L
7/17		1.41	55.33	10 leaf						4 gpm	400	400	Leon
7/22		0.90	63.27	tassel						4 gpm	400	400	Leon
7/24	0.63		65.55	silk	97.4	97.2	63.2	2.9	10.6	3,4,5	396	396	C & L
7/29		1.48	76.24	pollinate						4 gpm	400	400	Leon
7/29			76.24	pollinate						3,4,5			Zac
8/1			76.24	silk						3,4,5			Pivotrac
8/3	2.50		77.93	silk	97.7	97.1	31.5	2.7	10.1	3,4,5	420	420	C & L
8/7	0.92		85.09	blister	97.9	98.1	82.2	3.1	10.1	3,4,5	392	392	C & L
8/8		1.38	88.34	blister						4 gpm	390	390	Leon
8/13	0.92		95.64	milk	98.2	98.4	98.4	97.7	12.2	3,4,5	411	411	Curtis
8/14		1.18	98.72	milk						4 gpm	400	400	Leon
8/20	0.72		107.45	dough	97.7	89.1	96.8	96.7	83.3	3,4,5	386	386	Curtis
8/21		1.34	110.48	dough						4 gpm	385	385	Leon
8/27		1.10	120.13	hd dough						4 gpm	375	375	Leon
8/27		0.08	120.71	hd dough									Pivotrac
8/27			119.38	hd dough	97.5	97.2	97.7	97.2	96.4				Curtis
9/2			120.71	dent						3,4,5			Pivotrac
9/3	0.20		121.33	dent	94.8	19.0	84.5	96.6	95.8	3,4,5	361	361	Curtis
9/8		1.15	130.81	1/8mat ln						4 gpm	350	350	Leon
9/9		0.07	131.27	1/8mat ln						4 gpm	350	350	Leon
9/9			131.27	1/8mat ln						move dry			Pivotrac
9/10	0.06		131.27	1/4mat ln	97.5	87.7	11.2	94.3	94.7				Curtis
9/15			131.27	1/2mat ln						3,4,5			Pivotrac
9/17			134.88	1/2mat ln	95.9	9.5	0.0	82.0	93.2	3,4,5	390	390	Curtis
9/20		1.04	140.59	2/3mat ln						4 gpm	380	380	Leon
9/22		0.37	143.76	2/3mat ln						4 gpm	380	380	Leon
9/24	2.32		143.76	7/8mat ln	96.3	95.7	0.0	95.7	92.8				C & L
10/2	0.61		143.76	7/8mat ln	96.7	96.4	5.8	72.9	87.3				C & L
10/8	1.61		143.76	7/8mat ln	97.0	97.3	97.0	96.2	93.5				C & L
10/15			143.76	1.0mat ln	97.0	97.3	97.1	96.8	96.0				Curtis
10/27	1.53		143.76	blk layer	96.8	97.3	97.4	97.2	97.1				C&L
11/4	0.33		143.76	blk layer	96.6	97.1	97.2	96.9	96.9				Curtis
11/7			143.76	harvest									Zac
11/12	0.03		143.76	harvested	95.8	96.4	96.5	96.3	96.2				Curtis
Total	**16.60**	**17.62**			**0.0**	**-0.2**	**-1.2**	**-1.1**	**-1.1**				
Net Soil Moisture is -3.50"													
Irrigation, Rainfall Plus Net Soil Moisture is 30.72"													

• Numbers in red are not counted in the total

2015-Corn Demonstration
Irrigated Medium Season Corn

4 GPM

Year: *2015* **County:** *Dallam* **Grower:** *Zac Yoder*

No. Acres: *9.1* **Variety/Hyb:** *P33Y74* **Soil Type:** *Perico Fine Sandy Loam*

Meter Type: *Seametrics*

Meter Mult: *Acre Feet x 1* **Tillage:** *Strip Till*

Fertilizer: *366-117-105-48s* **Seeding:** *32,000*

Planted: *May 12, 2015* **Harvest:** *November 7, 2015*

Herbicide: *Laudis, Atrazine* **Insecticide:** *Poncho 250*

Yield: *276 bu/acre @ 15.0% Moist.* **Prev. crop:** *Wheat* **Row width:** *30 inches*

Irrigation method: *Center Pivot* **Prewater:** *1.22"* **Well GPM:** *390*

Distance between drops: *60 inches* **Distance from nozzle to ground:** *16 inches*

Application pattern: *LESA Spray* **Crop row direction :** *Planted in circle*

GPS Location of Pivot Pad
Latitude: *36.115802*
Longitude: *-102.968042*

GPS Location of Gypsum Blocks
Latitude: *36.11631*
Longitude: *-102.966263*

Zac Yoder's "4 GPM" Site AquaSpy® Probe Summary

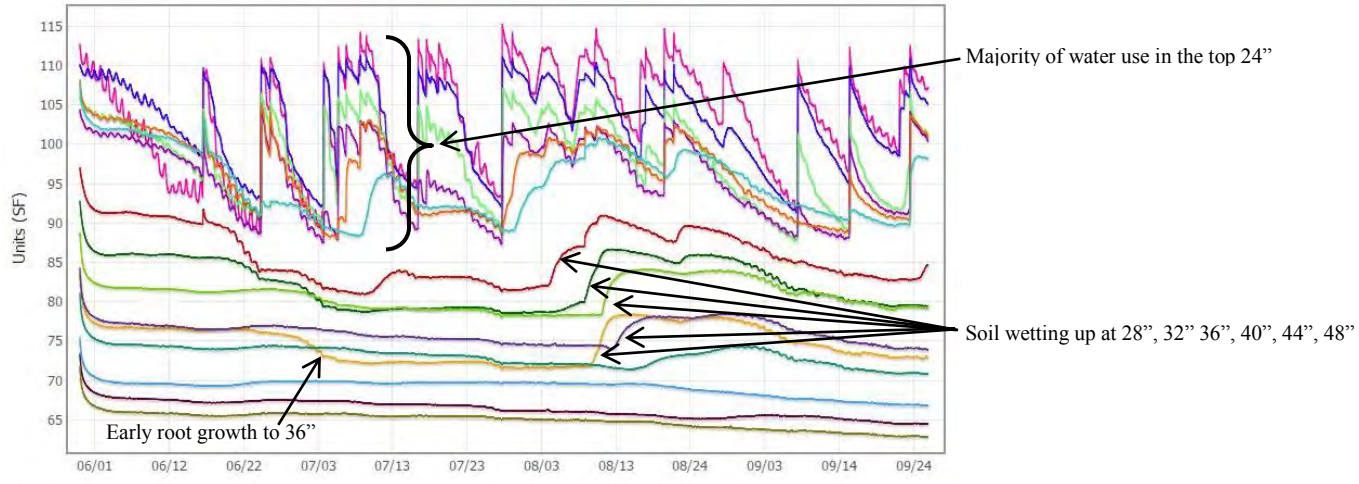


Figure 24. Yoder moisture graph (4 gpm)

This treatment has extremely good early root growth, reaching 36" by late June. There was no drainage observed and it seemed that, with the exception of late rain at the very end of the season, all water that this treatment received was used by the crop. The maximum root activity was 48" and this was largely due to the fact that so much mid-season moisture was caught in the 2nd, 3rd and 4th foot and was able to be utilized without the plant needing to go deeper. This crop received a lot of moisture which produced the relatively low water use efficiency despite the high yield, however it is hard to see where water was wasted from this this data set. The crop did finish with the top 24" fully wet at harvest.

Figure 25: Gypsum Block Readings for Zac Yoder's "5 GPM" Demonstration Site (307 bu/ac)

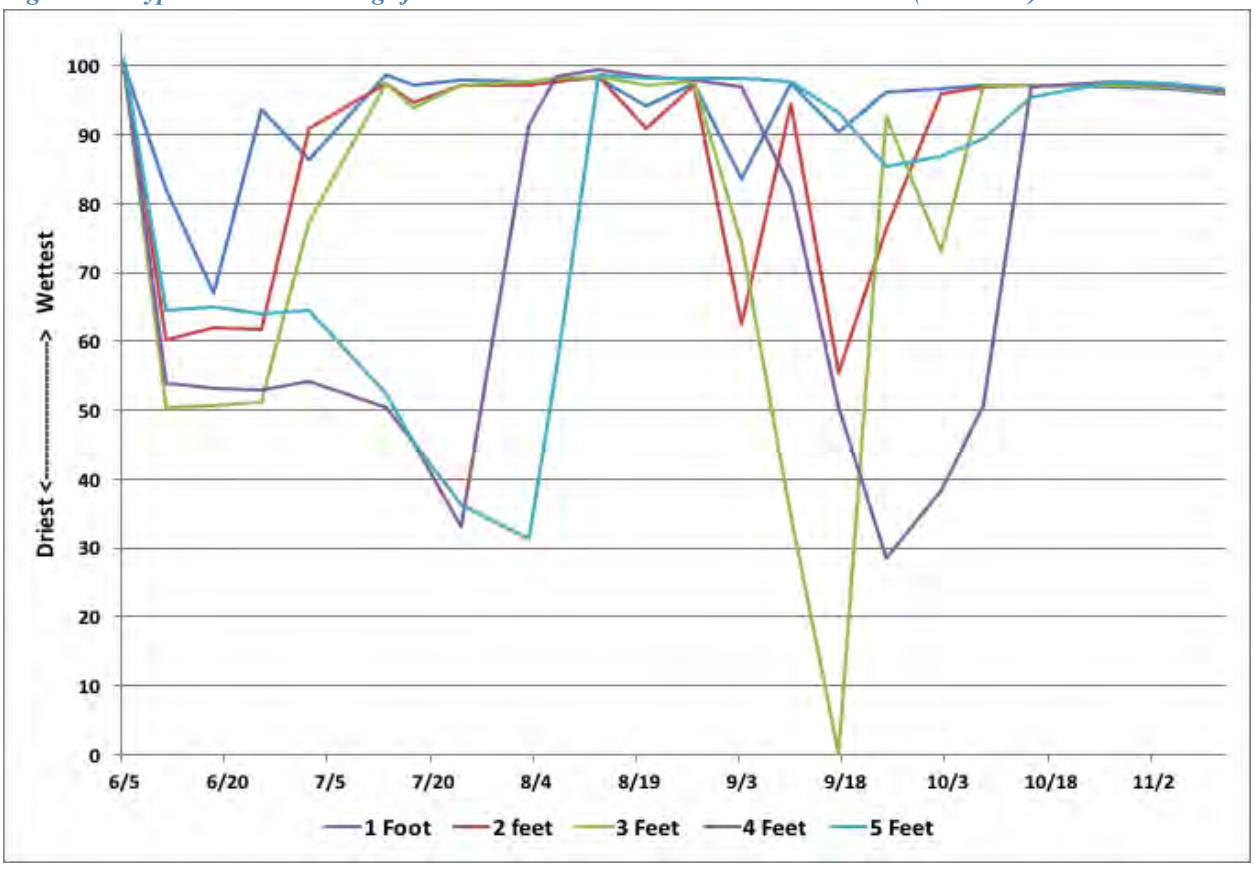


Figure 26: Growing Season Water Tracking for Zac Yoder's "5 GPM" Demonstration Site (307 bu/ac)

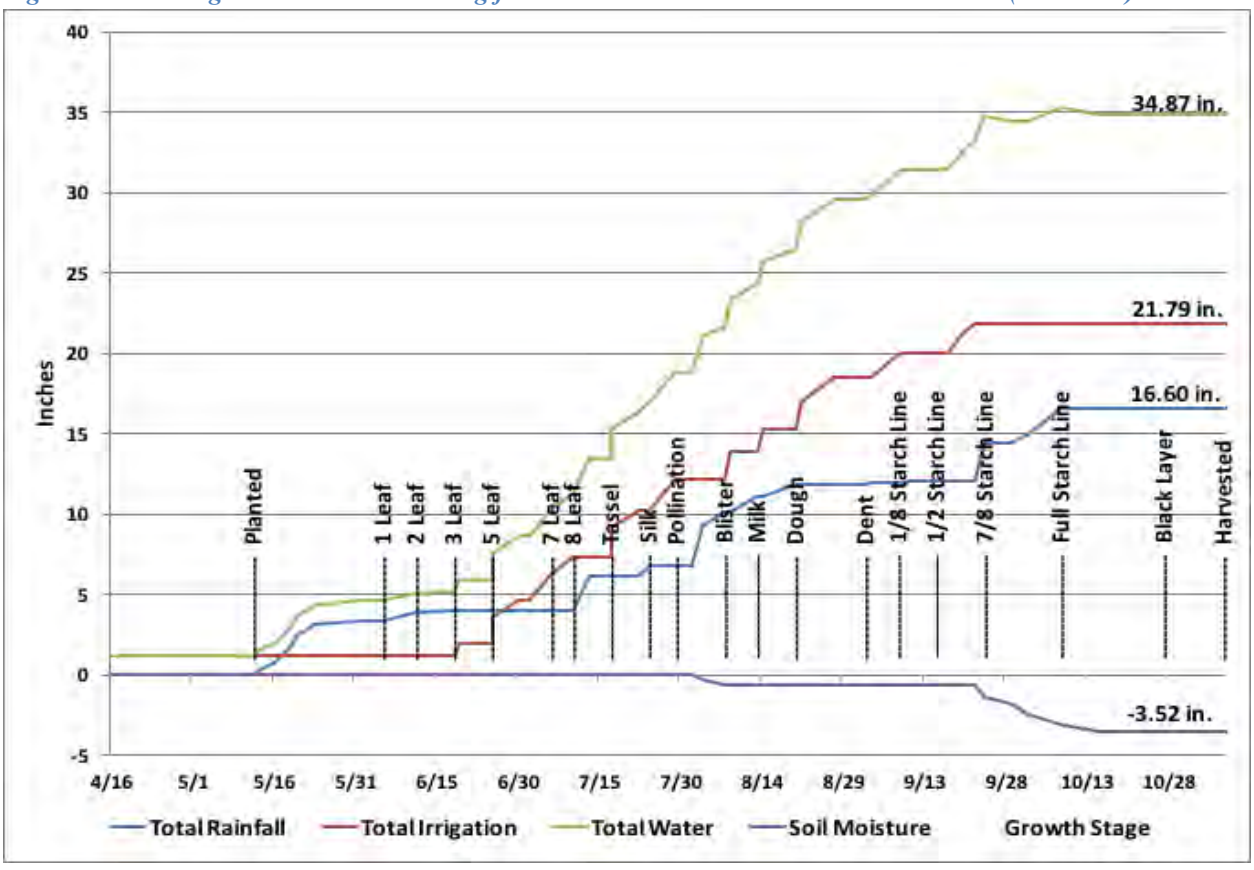


Table 18: Demonstration Field Data for Zac Yoder's "5 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Hour Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
						1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/16		1.22	126.4 hrs								pre-wtr	141	475	Pivotrac
5/5	0.42													Pivotrac
5/6	0.13													Pivotrac
5/9	0.10													Pivotrac
5/12											plant			Zac
5/14	0.48													Pivotrac
5/16	0.27													Pivotrac
5/19	1.07													Pivotrac
5/20	0.65													Pivotrac
5/22	0.32													Pivotrac
5/23	0.33													Pivotrac
6/1	0.25													Pivotrac
6/5			0.00	11392.7	1 leaf	100.3	100.7	99.8	100.3	101.1		84 N		C & L
6/11	0.50		0.00	11392.7	2 leaf	82.1	60.3	50.3	53.9	64.4		84 N		C & L
6/18	0.09		3.26 af	11437.1	3 leaf	67.0	62.1	50.7	53.2	64.9	3,4,5	255 Y ccw	382	Curtis
6/19		0.76	5.32		4 leaf						5 gpm	135 rev	400	Leon
6/25					4 leaf							71 N		Pivotrac
6/25			15.79	11602.7	4 leaf	93.7	61.7	51.3	52.9	64.0		71 N		C & L
6/25			15.79		4 leaf						3,4,5	71 Y		Pivotrac
6/25		1.61	16.59		5 leaf						5 gpm	89 rev	400	Leon
6/30		1.05	23.80		5 leaf						5 gpm	135 rev	400	Leon
7/2			27.94	11771.4	5 leaf	86.3	90.9	77.3	54.2	64.4	3,4,5	265 Y	400	C & L
7/6		1.65	35.38		7 leaf						5 gpm	90 rev	400	Leon
7/10		1.08	42.95		8 leaf						5 gpm	135 rev	400	Leon
7/13	2.15		46.53	12032.4	9 leaf	98.7	97.4	97.5	50.4	52.4	3,4,5	261 Y	403	C & L
7/17			53.38	12125.7	11 leaf	97.3	94.6	94.0	45.3	45.3	3,4,5	78 Y	386	C & L
7/17		1.77	55.33		tassel						5 gpm	90 rev	400	Leon
7/22		1.13	63.27		tassel						5 gpm	135 rev	400	Leon
7/24	0.63		65.55	12296.1	silk	97.9	97.3	97.3	33.1	36.4	3,4,5	229 Y	396	C & L
7/29		1.85	76.24		pollinate						5 gpm	89 rev	400	Leon
7/29			76.24		silk							move dry		Zac
8/1			76.24		silk						3,4,5	135 Y		Pivotrac
8/3	2.50		77.93	12533.6	silk	97.8	97.3	97.8	91.4	31.3	3,4,5	234 Y	420	C & L
8/7	0.92		85.09	12627.7	blister	98.0	97.7	98.1	98.4	55.9	3,4,5	52 Y	392	C & L
8/8		1.73	88.34		blister						5 gpm	89 rev	390	Leon
8/13	0.92		95.64	12771.8	milk	98.2	98.4	98.4	99.5	98.8	3,4,5	174 Y	411	Curtis
8/14		1.48	98.72		milk						5 gpm	135 rev	400	Leon
8/20	0.72		107.45	12933.8	sof dough	94.3	91.0	97.1	98.4	98.1	3,4,5	57 Y	386	Curtis
8/21		1.68	110.48		sof dough						5 gpm	89 rev	385	Leon
8/27		1.38	120.13		hrd dough						5 gpm	135 rev	375	Leon
8/27		0.10	120.71		dough						5 gpm	151 N	350	Leon
8/27			119.38	13099.5	dough	97.5	97.2	97.8	97.9	98.1		151 N		Curtis
9/2			119.38	13099.5	dent						3,4,5	151 Y		Pivotrac
9/3	0.20		121.33	13125.9	dent	83.5	62.6	74.4	96.9	98.2	3,4,5	204 Y	361	Curtis
9/8		1.44	130.81		1/8mat ln						5 gpm	90 rev	350	Leon
9/9		0.09	131.27		1/8mat ln						5 gpm	66 Y	350	Pivotrac
9/9			131.27		1/8mat ln						move dry	61 N		Pivotrac
9/10	0.06		131.27		1/3mat ln	97.5	94.4	34.7	82.0	97.6		61 N		Curtis
9/15			131.27		1/2mat ln							61 Y		Pivotrac
9/17			134.88		1/2mat ln	90.3	55.5	0.1	50.3	93.3	3,4,5	314 Y	390	Curtis
9/20		1.31	140.59		1/2mat ln						5 gpm	135 rev	380	Leon
9/22		0.46	143.76		2/3mat ln						5 gpm	80 N	380	Pivotrac
9/24	2.32		143.76		7/8mat ln	96.2	76.4	92.6	28.6	85.4		80 N		C & L
10/2	0.61		143.76		7/8mat ln	96.6	96.0	73.1	38.4	87.0		80 N		C & L
10/8	1.61		143.76	13442.4	1.0mat ln	97.1	96.9	97.1	50.6	89.4		80 N		C & L
10/15			143.76	13442.4	1.0mat ln	97.1	97.1	97.2	96.9	95.4		80 N		Curtis
10/27	1.53		143.76	13442.4	blk layer	97.0	97.3	97.3	97.6	97.8		80 N		C & L
11/4	0.33		143.76	13442.4	blk layer	96.7	97.0	97.0	97.2	97.5		90 N		Curtis
11/7			143.76		harvest							90 N		Zac
11/12	0.03		143.76	13442.4	harvested	95.9	96.2	96.3	96.5	96.8		90 N		Curtis
Total	**16.60**	**21.79**				**-0.5**	**-0.8**	**-0.7**	**-0.9**	**-0.7**				**Leon**
Net Soil Moisture is -3.52"														
Irrigation, Rainfall Plus Net Soil Moisture is 34.87"														

* Numbers in red are not counted in the total

2015-Corn Demonstration
Irrigated Medium Season Corn

5 GPM

Year: *2015* **County:** *Dallam* **Grower:** *Zac Yoder*

No. Acres: *6.5* **Variety/Hyb:** *P33Y74* **Soil Type:** *Perico Fine Sandy Loam*

Meter Type: *Seametrics*

Meter Mult: *Acre Feet x 1* **Tillage:** *Strip Till*

Fertilizer: *426-117-105-48s* **Seeding:** *32,000*

Planted: *May 12, 2015* **Harvest:** *November 7, 2015*

Herbicide: *Laudis, Atrazine* **Insecticide:** *Poncho 250*

Yield: *307 bu/acre @ 15.0% Moist.* **Prev. crop:** *Wheat* **Row width:** *30 inches*

Irrigation method: *Center Pivot* **Prewater:** *1.22"* **Well GPM:** *390*

Distance between drops: *60 inches* **Distance from nozzle to ground:** *16 inches*

Application pattern: *LESA Spray* **Crop row direction :** *Planted in circle*

GPS Location of Pivot Pad
Latitude: *36.115802*
Longitude: *-102.968042*

GPS Location of Gypsum Blocks
Latitude: *36.11629*
Longitude: *-102.966842*

Zac Yoder's "5 GPM" Site AquaSpy® Probe Summary

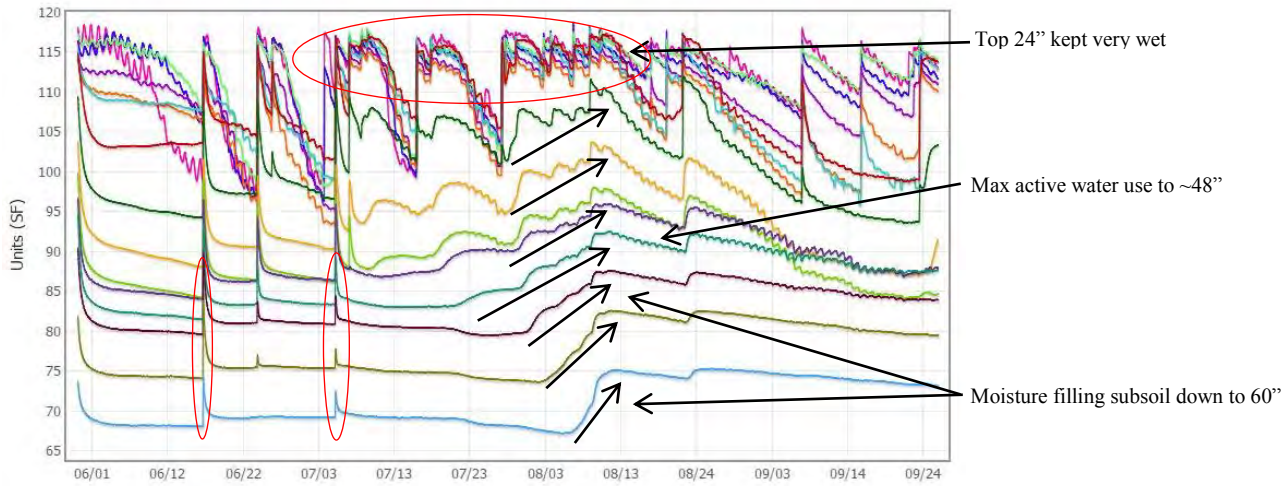


Figure 27. Yoder moisture graph (5 gpm)

This treatment had that highest yield in the whole trial and it is probably due to the fact that roots grew to 40" by mid-July and the top 40" was kept very wet for the entire reproductive period. This would have meant that water was non-limiting and the plant could grow to its potential. It is evident from the fact that the subsoil was sequentially being wet up with every irrigation, that more water was being applied than the plant was using. This caused the top 32" to be pretty wet by the end of the season and may have contributed to compaction issues due to harvest. Despite the very high yield, it should have been possible to reduce the irrigation total by several inches without negatively impacting yield. This would have helped increase the very low water use efficiency observed in this treatment.

Harvest Results: The 3 GPM field produced a 251 bushel per acre corn yield. Irrigation totaled 13.51 inches. Production in the 4 GPM field was 276 bushels per acre. Irrigation was 17.62 inches. Corn yield was 307 bushels per acre for the 5 GPM field. Irrigation totaled 21.79 inches. Total irrigation includes 1.22 inches of pre-season irrigation in each field prior to beginning 3, 4, and 5GPM variable rate irrigation. The 4 GPM field produced 25 more bushels per acre than the 3 GPM field and irrigation was 4.11 inches more. The 5 GPM field produced 56 more bushels per acre than the 3 GPM with 8.28 more inches of irrigation. The 5 GPM yield was 31 more bushels per acre than that from 4 GPM field with 4.17 additional inches of irrigation. Corn production was 18.58 bushels (1040lbs) per inch of irrigation in the 3 GPM field compared to 15.66 bushels (877 lbs.) in the 4 GPM and 14.09 bushels (789 lbs.) from the 5 GPM field. Production from each inch of irrigation, rainfall and net soil water that totaled 28.07 inches was 8.94 bushels (500 lbs.) per acre in the 3 GPM field. Irrigation, rainfall and net soil water totaled 30.72 inches in the 4 GPM field where production was 8.98 bushels (503 lbs.) per inch. In the 5 GPM field, irrigation, rainfall and net soil water totaled 34.87 inches where production was 8.80 bushels (493 lbs.) per inch of total water. Crop production costs were $51.60 per acre more for the 4 GPM field than for the 3 GPM from increased irrigation, fertilizer and harvest expenses. At $3.97 per bushel, the 25 bushels per acre increased corn yield in the 4 GPM field amounts to $99.25 more per acre than from the 3 GPM field. The 4 GPM field's net gain is $47.65 per acre with 4.11 inches more irrigation used compared to production from the 3 GPM field. At $3.97 per bushel, the 56 bushel per acre increased yield from the 5 GPM field compared to the 3 GPM amounts to $222.32. Crop production costs were $110.34 more for the 5 GPM field. The 5 GPM fields' net gain compared to the 3 GPM field is $111.98 per acre with 8.28 additional inches of irrigation. Value of the 31 additional bushels produced in the 5 GPM field compared to the 4 GPM field is $123.07. Production Costs were $58.74 more for the 5 GPM field than the 4 GPM. Net gain for the 5 GPM field is $64.33 per acre with 4.17 inches more irrigation. Net return from the 3 GPM field was $511.34 per acre compared to $558.99 from the 4 GPM field and $623.32 from the 5 GPM field. Net return from each inch of irrigation is $37.84 for the 3 GPM field compared to $31.72 from the 4 GPM and $28.60 for the 5 GPM field. Net return from each inch of irrigation, rainfall and net soil water is $18.21 for the 3 GPM field, $18.19 from the 4 GPM and $17.87 for the 5 GPM field. A summary of the demonstration results are shown in table 19 and Appendix B.

Table 19: Zac Yoder's 2015 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $3.97/bu		
			bu/ac	lb/ac-in Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"3 GPM"	13.51	*28.07	251	1040	$996.47	$73.76	$35.00
"4 GPM"	17.62	†30.72	276	877	$1095.72	$62.18	$35.67
"5 GPM"	21.79	#34.87	307	789	$1218.79	$55.93	$34.95

*Includes -2.04 inches of net soil water deducted from rainfall and irrigation.
†Includes -3.50 inches of net soil water deducted from rainfall and irrigation.
#Includes -3.52 inches of net soil water deducted from rainfall and irrigation.

Harold Grall's 2015 Hartley County Demonstration

Planting and Crop Information: Harold Grall strip tilled and planted 121 acres of corn in the NE 1/4 of a section, for his "3-4-5 GPM" demonstration. The 121 acres were divided in 30.3 acres for his 3 and 5 GPM fields and 60.6 acres for his 4 GPM field. His 4 GPM field was located from 0 to 180 degrees on the circle, the 5 GPM 180 to 270 and his 3 GPM field 270 to 360. Grall planted each "3-4-5 GPM" field to Pioneer 33B54 hybrid. Seeding rate for the 3 GPM, 4 GPM and 5 GPM fields was 26,000 seeds per acre. Center pivot travel speed was by PivoTrac™. The speed control prescription moved the center pivot to apply 1.10 inches on the 3 GPM field in 33.7 hours, 1.49 inches on the 4 GPM field in 89.6 hours and 1.85 inches on the 5 GPM field in 55.9 hours. That is a 7.47 day circle revolution. Seasonal water meter readings averaged 490 gpm. Irrigation was with Senningers' LDN (LESA) spray with drops spaced 60 inches apart. Timely rainfall allowed the center pivot to be stopped more than in recent years. The same two wells were used to irrigate an adjacent 120 acre circle of grain sorghum as selected, also. Planting and crop information for "Grall 3 GPM", "Grall 4 GPM" and "Grall 5 GPM" are shown in the table 20 below.

Table 20: Planting and Crop Information for Harold Grall

"3 GPM" Demonstration Site: 270-360 degrees			
Planted:	*May 12*	**Harvested:**	*September 30*
Hybrid:	*Pioneer 33B54*	**Seeding Rate:**	*26,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*30.3*	**GPM Per Acre:**	*4.0*
Total Water:	*30.05 inches*	**Soil Type:**	*Sherm Clay Loam*
Irrigation:	*14.47 inches*	**Insecticide:**	*Zeal*
Herbicide:	*Cinch, Rifle, Powerma, Balance Flex, Starane, Strut*	**Fertilizer**:	*127-58-0-0*

"4 GPM" Demonstration Site: 0-180 degrees			
Planted:	*May 12*	**Harvested:**	*September 30*
Hybrid:	*Pioneer 33B54*	**Seeding Rate:**	*26,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*60.6*	**GPM Per Acre:**	*4.0*
Total Water:	*30.66 inches*	**Soil Type:**	*Sherm Clay Loam*
Irrigation:	*17.22 inches*	**Insecticide:**	*Zeal*
Herbicide:	*Cinch, Rifle, Powerma, Balance Flex, Starane, Strut*	**Fertilizer**:	*163-58-0-0*

"5 GPM" Demonstration Site: 180-270 degrees

Planted:	*May 12*	**Harvested:**	*September 30*
Hybrid:	*Pioneer 33B54*	**Seeding Rate:**	*26,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*30.3*	**GPM Per Acre:**	*4.0*
Total Water:	*33.89 inches*	**Soil Type:**	*Sherm Clay Loam*
Irrigation:	*19.83 inches*	**Insecticide:**	*Zeal*
Herbicide:	*Cinch, Rifle, Powerma, Balance Flex, Starane*	**Fertilizer**:	*200-58-0-0*

Soil Water Profile and Growing Season Rainfall

"3 GPM" Demonstration Site: Preseason soil water was good at 1, 2, 3, 4 and 5 feet from 2.63 inches of pre-water in April followed by 3.61 inches of rainfall in April and May prior to planting. Soil moisture sensors show the crop had adequate soil water during the growing season Weekly gypsum block readings indicate extensive crop roots to 3 feet and limited root growth into 4 feet. The sensors show the crop used 3.56 inches of soil water from 1, 2 and 3 and feet and .41 inch from 4 feet plus 1.11 inches of irrigation in September to finish the crop. Only limited soil water was used from 4 and none from 5 feet, likely because sufficient water was available from the upper root zone. The crop was produced in Sherm clay loam soil that can store approximately 2.0 inches of available water per foot for potential crop use. Timely beneficial rainfall contributed to producing a 222 bushel per acre corn yield, also allowing irrigation to be routed to the grain sorghum circle. Total rainfall from planting until grain black layer totaled 11.61 inches, and was more normal for this location. Gypsum blocks were installed in early June following planting, due to wet soil conditions prior to planting.

"4 GPM" Demonstration Site: Soil water was good at 1, 2, 3, 4 and 5 feet from 2.63 inches of pre-water in April followed by 3.61 inches of rainfall in late April and May prior to planting. Weekly gypsum block readings show good soil moisture levels were maintained at 1, 2, 3, 4 and 5 feet during the growing season from beneficial rainfall and irrigation. The crop used approximately 1.83 inches of soil water mostly from 2 and 3 feet in addition to rainfall and irrigation in August and September. Soil moisture sensors show the crop had sufficient soil water during the growing season. Gypsum block moisture sensors were installed in June following planting. Timely rainfall contributed to producing the 230 bushel per acre corn yield. Total rainfall from planting thru black layer totaled 11.61 inches. The crop was produced in Sherm silty clay loam soil that holds approximately 2.0 inches available water per foot for potential crop use.

"5 GPM" Demonstration Site: Beginning soil water was good at 1, 2, 3, 4 and 5 feet at planting from 2.63 inches of pre-water in April prior to 3.61 inches of rainfall in late April and May. Weekly gypsum block moisture sensors show the crop had sufficient available soil water during the entire growing season. The sensors show that crop roots extracted 2.65 inches of soil water primarily from 1, 2 and 3 feet plus irrigation and rainfall producing the 233 bushel per acre corn yield. Soil water depletion occurred in September to finish the crop. Total rainfall was 11.61

inches. Irrigation totaled 19.83 inches. The crop was produced in Sherm Clay Loam soil that holds 2.0 inches of available water per foot for potential crop use.

Table 21: Monthly Rainfall Data for Harold Grall

	May	June	July	August	September	Total
"3 GPM"	2.18"	0.89"	3.97"	2.80"	1.77"	**11.61"**
"4 GPM"	2.18"	0.89"	3.97"	2.80"	1.77"	**11.61"**
"5 GPM"	2.18"	0.89"	3.97"	2.80"	1.77"	**11.61"**

Growing Season Water Tracking: The district tracked total water and crop growth throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. One set of five gypsum block soil moisture sensors was installed at 1, 2, 3, 4 and 5 feet and an AquaSpy® soil moisture probe was installed down to five feet in the root zone at one location to monitor soil water levels in the "3 GPM" field. Another set of the same type of sensors were installed in both the "4 GPM" and "5 GPM" fields. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in each field. Due to wet soils from abundant April and May rainfall, all Gypsum blocks were installed following planting. Gypsum blocks, water meter, rain gauges and crop growth are read, recorded and utilized weekly by district personnel. Each AquaSpy® probe was installed following crop emergence. A 24/7 AquaSpy® probe website shows soil moisture at four inch increments to 60 inches and monitors plant root growth. The website lists all AquaSpy® soil probes in the "3-4-5 GPM" project and is available to all cooperators and district personnel. Another 24/7 PivoTrac™ website tracks each center pivot system and monitors and controls irrigation. Each center pivot travel speed prescription written to apply 1.10 inches ("3 GPM"), 1.49 inches ("4 GPM") and 1.85 inches ("5 GPM") is managed from the PivoTrac™ website. Both the cooperating grower and district "3-4-5 GPM" project leader collectively monitor, control and manage irrigation from the PivoTrac™ website. Following this paragraph, a series of graphs and tables shows weekly gypsum block readings for the season; growing season water, including rainfall, irrigation, and soil moisture at various growth stages; and the order of irrigation and rainfall events for each "3-4-5 GPM" field. Finally, a form describes the protocols for each field. "Total Water," as shown on the graph for growing season water, is the sum of seasonal irrigation, rainfall and net soil water. Graphs and tables for the 3 GPM acres are shown first, followed by the same illustrations for each 4 GPM and 5 GPM.

Figure 28: Gypsum Block Readings for Harold Grall's "3 GPM" Demonstration Site (222 bu/ac)

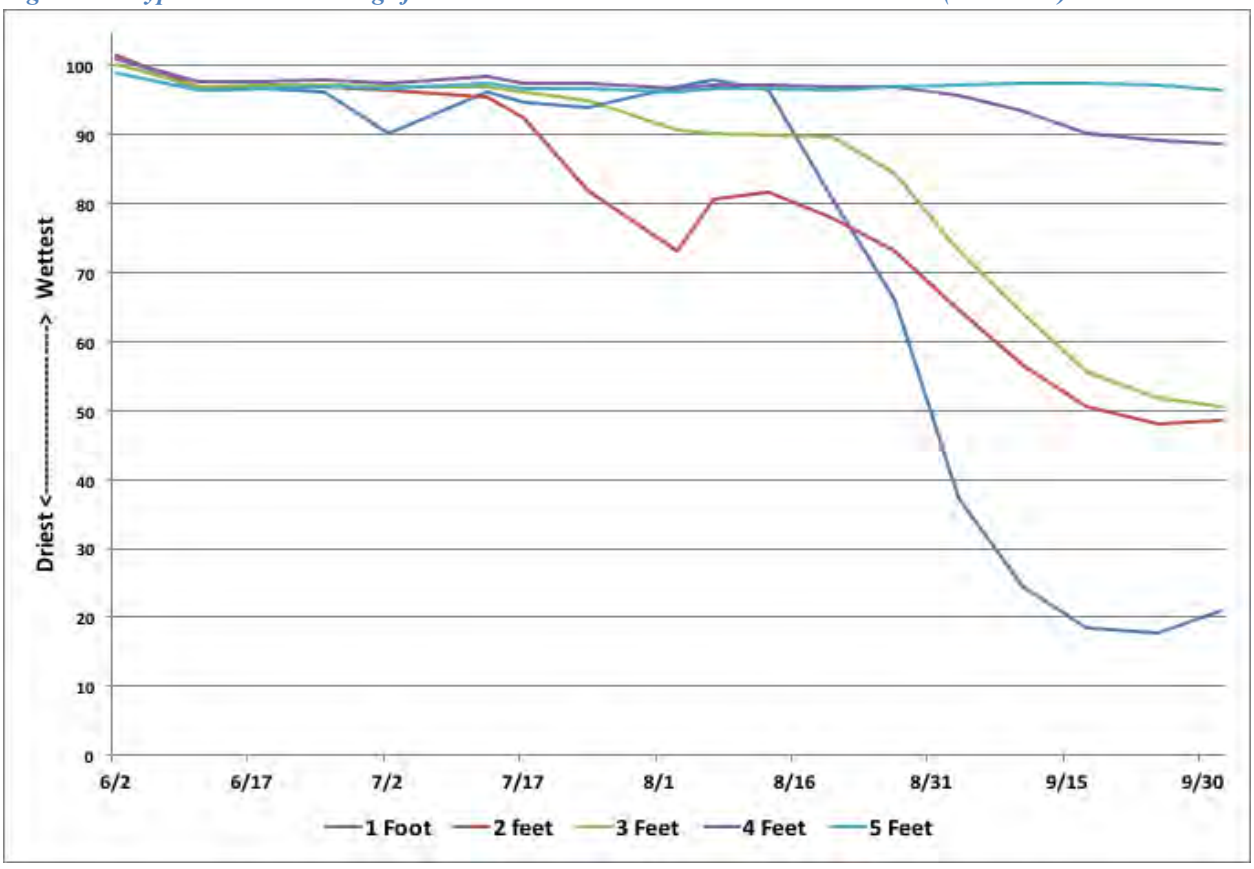


Figure 29: Growing Season Water Tracking for Harold Grall's "3 GPM" Demonstration Site (222 bu/ac)

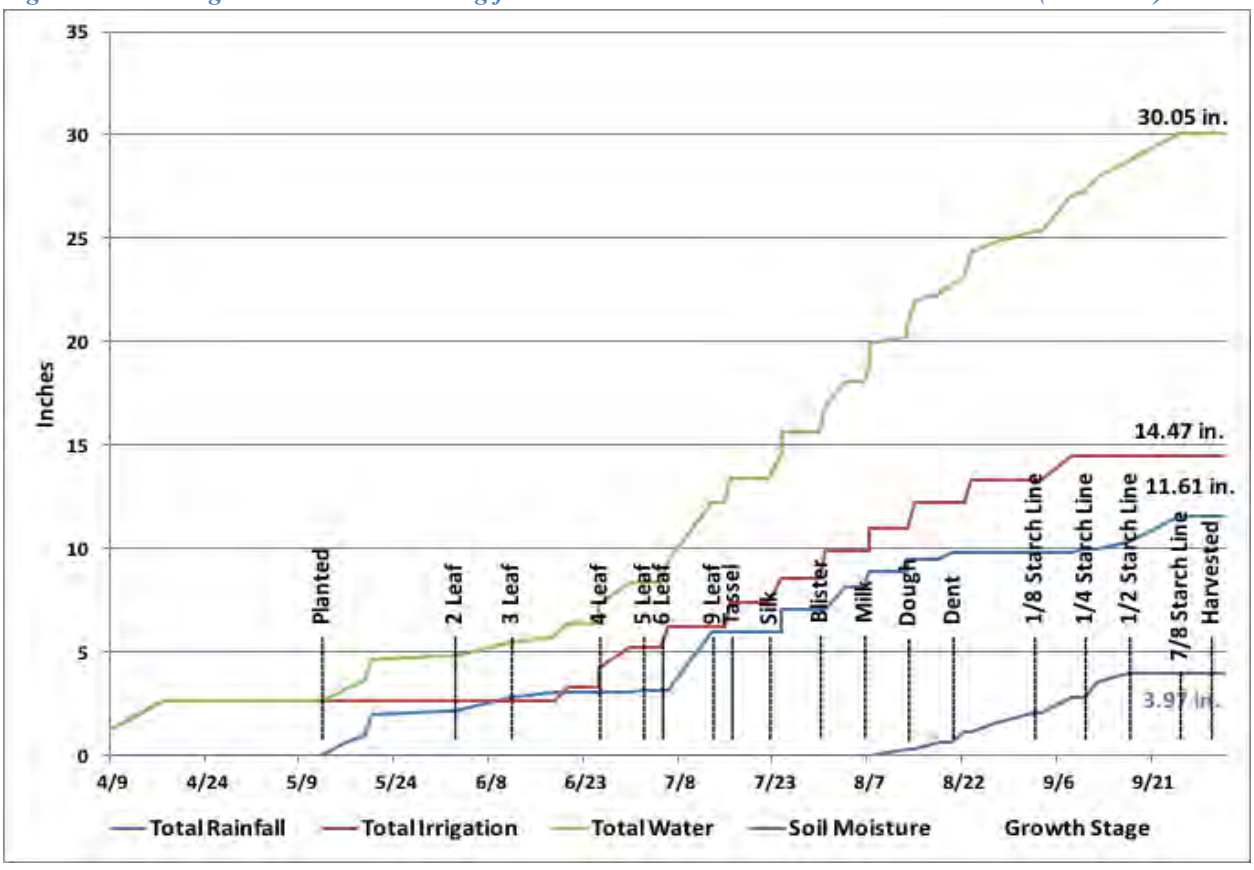


Table 22: Demonstration Field Data for Harold Grall's "3 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Hour Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
						1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/9		1.35	162.9 hrs								pre-wtr	209	450	Pivotrac
4/17		1.28	154.2 hrs								pre-wtr	304	450	Pivotrac
4/28	2.19													Pivotrac
5/9	0.45													Pivotrac
5/12											planted			Harold
5/14	0.31													Pivotrac
5/16	0.31													Pivotrac
5/19	0.38													Pivotrac
5/20	0.99													Pivotrac
6/1	0.19													Pivotrac
6/2			0.00	13963	2 leaf	101.6	101.6	100.2	101.0	99.0		154 N		C & L
6/11	0.67		0.00	13963	3 leaf	96.5	97.0	97.1	97.7	96.4		154 N		C & L
6/18	0.22		0.00	13963	3 leaf	96.6	97.0	97.2	97.8	96.7		166 N		Curtis
6/20		0.71	7.16		3 leaf						3 gpm	329 Y	500	Pivotrac
6/25			15.51 af	13964	4 leaf	96.2	97.1	97.2	97.9	96.9	4 gpm	113 Y cw	513	C & L
6/25		0.88	16.05		4 leaf						all	166 Y	500	Pivotrac
6/30		1.02	26.34		4 leaf						all	180 Y	500	Pivotrac
7/2	0.11		26.88	13971	5 leaf	90.3	96.5	96.9	97.5	96.7	sorghum	194 N		C & L
7/5			30.36		6 leaf						3 gpm	270 Y	550	Pivotrac
7/6		1.00	32.89		6 leaf						3 gpm	360 Y	550	Leon
7/13	2.84		39.48	13993	9 leaf	96.1	95.4	97.1	98.4	97.4	5 gpm	197 Y	533	C & L
7/15			43.74		10 leaf						3 gpm	270 Y	525	Pivotrac
7/16		1.15	46.64		tassel						3 gpm	360 Y	475	Leon
7/17			48.08	14009	tassel	94.8	92.5	96.2	97.5	96.7	4 gpm	41 Y	486	C & L
7/22			58.60		silk						3 gpm	270 Y		Pivotrac
7/24		1.19	61.60		silk						3 gpm	360 Y	475	Leon
7/24	1.02		63.05	14033	silk	93.9	82.0	94.9	97.5	96.7	4 gpm	23 Y	508	C & L
7/30			74.69		blister						3 gpm	270 Y		Pivotrac
7/31		1.30	77.98		blister						3 gpm	360 Y	500	Leon
8/3	1.15		84.42	14067	blister	96.9	73.2	90.6	96.7	96.2	4	149 Y	497	C & L
8/6			90.52		milk						3 gpm	270 Y		Pivotrac
8/7	0.71		93.11	14084	milk	97.9	80.6	90.1	97.3	96.7	3 gpm	353 Y	479	C & L
8/7		1.15	93.42		milk						3 gpm	360 Y	475	Leon
8/13			105.59		dough						3 gpm	270 Y		Pivotrac
8/13	0.55		106.08	14102	dough	96.5	81.7	89.9	97.3	96.6	3 gpm	277 Y	489	Curtis
8/14		1.20	108.62		dough						3 gpm	360 Y	480	Leon
8/20	0.39		118.60	14115	dent	80.6	77.8	89.6	96.9	96.4		218 N		Curtis
8/22			121.01		dent						3 gpm	270 Y		Pivotrac
8/23		1.13	123.88		dent						3 gpm	360 Y	460	Leon
8/27			132.13	14126	dent	66.1	73.2	84.4	96.9	97.0	sorghum	196 N		Curtis
9/2			135.90		1/8mat ln						3 gpm	270 Y		Pivotrac
9/3	0.01		137.57	14128	1/8mat ln	37.4	64.5	73.2	95.7	97.3	3 gpm	333 Y	505	Curtis
9/3		1.11	138.70		1/8mar						3 gpm	360 Y	460	Leon
9/10	0.13		146.74	14130	1/4mat ln	24.4	56.5	64.0	93.4	97.5		197 N		Curtis
9/17	0.32		146.74	14130	1/2mat ln	18.4	50.6	55.6	90.1	97.6		197 N		Curtis
9/25	1.31		146.74	14130	7/8mat ln	17.6	48.1	51.8	89.1	97.2		197 N		C & L
9/30					harvest									Harold
10/2			146.74	14130	harvest	20.9	48.6	50.6	88.8	96.5		156 N		C & L
Total	**11.61**	**14.47**				**1.5**	**1.1**	**1.0**	**0.4**	**0.0**				**Leon**
Net Soil Moisture is 3.97"														
Irrigation, Rainfall Plus Net Soil Moisture is 30.05"														

• Numbers in red are not counted in the total

2015-Corn Demonstration
Irrigated Medium Season Corn

3 GPM

Year: *2015* **County:** *Hartley* **Grower:** *Harold Grall*

No. Acres: *30.3* **Variety/Hyb:** *P33B54* **Soil Type:** *Sherm Clay Loam*

Meter Type: *Seametrics*

Meter Mult: *Acre Feet x 1* **Tillage:** *Strip Till*

Fertilizer: *127-58-0-0* **Seeding:** *26,000*

Planted: *May 12, 2015* **Harvest:** *September 30, 2015*

Herbicide: *Balance Flex, Cinch, Rifle, Starane, Strut, Powermax* **Insecticide:** *1.8 oz. Zeal*

Yield: *222 bu/acre @ 15.0% Moist.* **Prev. crop:** *Milo* **Row width:** *30 inches*

Irrigation method: *Center Pivot* **Prewater:** *2.63"* **Well GPM:** *485*

Distance between drops: *60 inches* **Distance from nozzle to ground:** *18 inches*

Application pattern: *LESA Spray* **Crop row direction :** *Straight*

GPS Location of Pivot Pad
Latitude: *35.99318*
Longitude: *-102.16335*

GPS Location of Gypsum Blocks
Latitude: *35.99569*
Longitude: *-102.165767*

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Harold Grall's "3 GPM" Site AquaSpy® Probe Summary

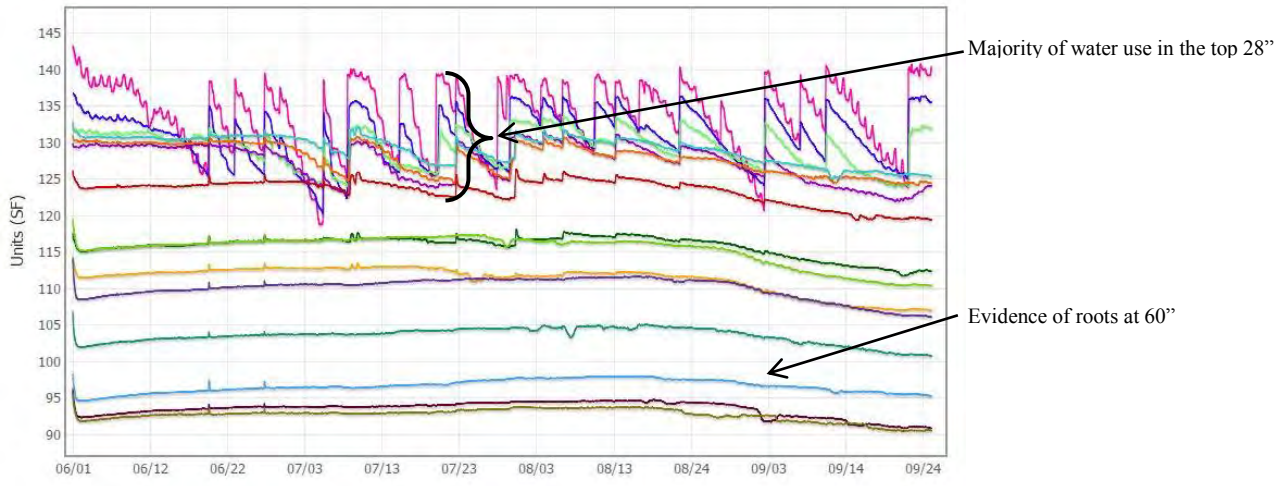


Figure 30. Grall moisture graph (3 gpm)

This treatment showed fairly poor root vigor and water uptake. While there was evidence of roots at 60", the majority of the water use took place in the top 24". Irrigation and rainfall was effective at filling the profile at each event but the lack of root vigor seemed to contribute heavily to the relatively low yield. Knowing a little about this site, it is possible that the water (and roots) followed previous season root channels and grew away from the site of the probe installation, somewhat masking the root activity.

Figure 31: Gypsum Block Readings for Harold Grall's "4 GPM" Demonstration Site (230 bu/ac)

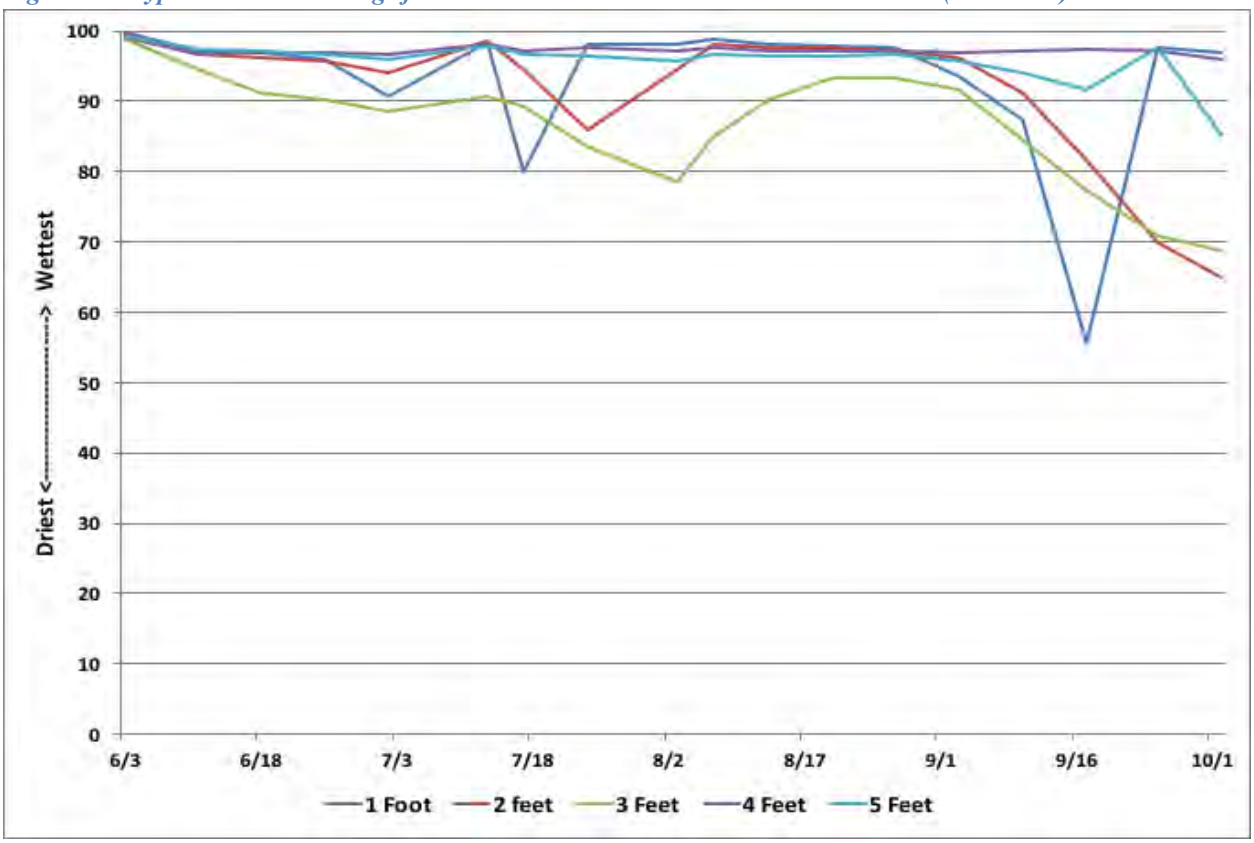


Figure 32: Growing Season Water Tracking for Harold Grall's "4 GPM" Demonstration Site (230 bu/ac)

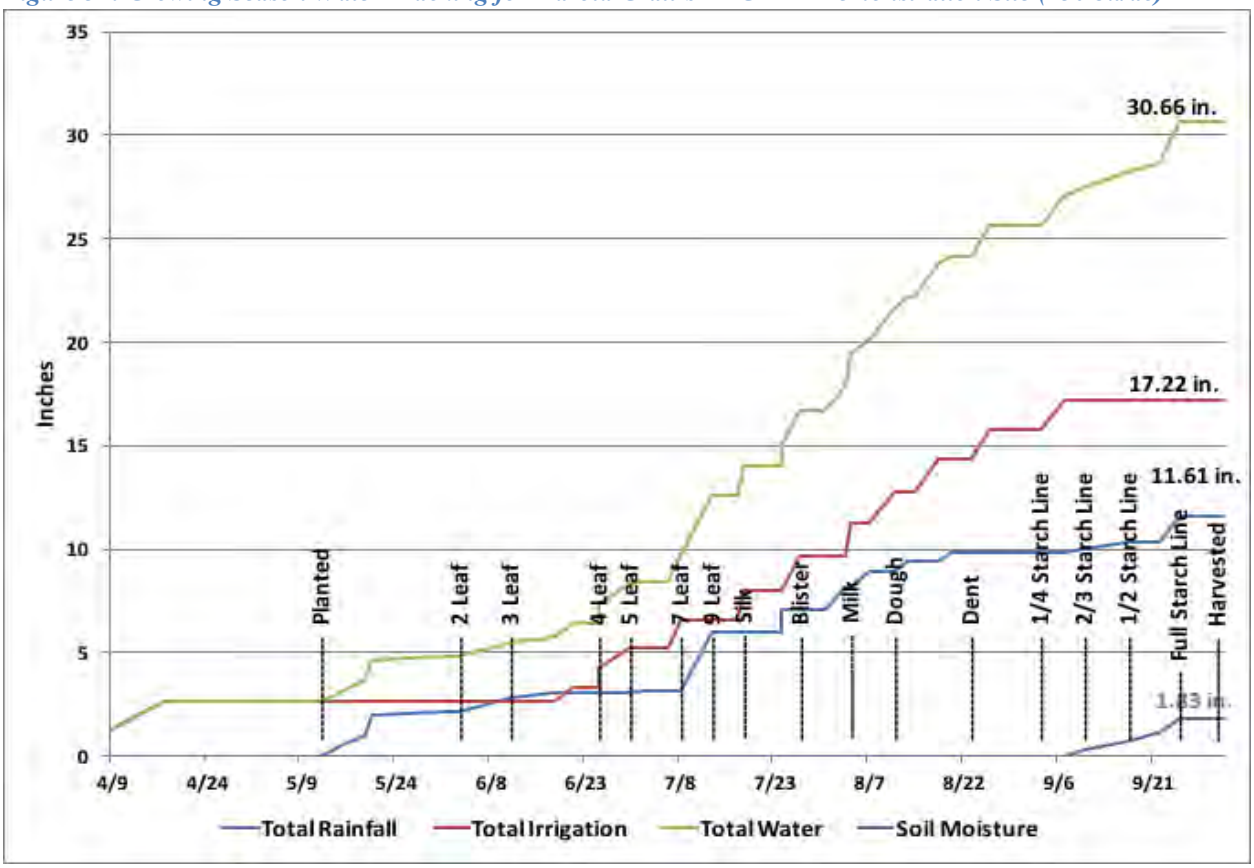


Table 23: Demonstration Field Data for Harold Grall's "4 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter		Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
						1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/9		1.35	162.9 hrs								pre-wtr	209	450	Pivotrac
4/17		1.28	154.2 hrs								pre-wtr	304	450	Pivotrac
4/28	2.19													Pivotrac
5/9	0.45													Pivotrac
5/12											Planted			Harold
5/14	0.31													Pivotrac
5/16	0.31													Pivotrac
5/19	0.38													Pivotrac
5/20	0.99													Pivotrac
6/1	0.19													Pivotrac
6/3			0.00	13963	2 leaf	99.7	99.5	98.9	99.1	99.2		154 N		C & L
6/11	0.67		0.00	13963	3 leaf	97.1	96.6	94.4	96.7	97.3		154 N		C & L
6/18	0.22		0.00	13963	3 leaf	96.8	96.1	91.1	96.8	97.1		166 N		Curtis
6/21		0.71	7.16 af		3 leaf						4 gpm	166 Y		Pivotrac
6/25			15.51	13964	4 leaf	96.0	95.6	90.2	96.9	96.7	4 gpm	113 Y cw	513	C & L
6/25		0.88	16.05		4 leaf						4 gpm	150 Y		Pivotrac
6/30		1.02	26.34		5 leaf						4 gpm	180 Y		Pivotrac
7/2	0.11		26.88	13971	5 leaf	90.6	94.0	88.6	96.7	96.0	sorghum	194 N		C & L
7/6			32.89		5 leaf						4 gpm	360 Y		Pivotrac
7/8		1.30	39.46		7 leaf						4 gpm	180 Y	550	Leon
7/13	2.84		39.48	13993	9 leaf	98.4	98.5	90.7	98.0	97.9	5 gpm	197 Y	533	C & L
7/16			46.64		tassel						4 gpm	360 Y		Pivotrac
7/17			48.08	14009	tassel	79.9	94.5	89.3	97.1	96.7	4 gpm	41 Y	486	C & L
7/18		1.48	54.1		silk						4 gpm	180 Y	475	Leon
7/24			61.6		silk						4 gpm	360 Y		Pivotrac
7/24	1.02		63.05	14033	silk	98.1	86.0	83.5	97.5	96.5	4 gpm	23 Y	508	C & L
7/27		1.63	69.85		blister						4 gpm	180 Y	500	Leon
7/31			77.98		blister						4 gpm	360 Y		Pivotrac
8/3	1.15		84.42	14067	blister	98.2	94.6	78.5	97.1	95.7	4 gpm	149 Y	497	C & L
8/4		1.58	85.96		milk						4 gpm	180 Y	500	Leon
8/7	0.71		93.11	14084	milk	98.7	98.0	85.0	97.5	96.6	3 gpm	353 Y	479	C & L
8/7			93.42		milk						4 gpm	360 Y		Pivotrac
8/11		1.50	100.98		dough						4 gpm	180 Y	475	Leon
8/13	0.55		106.08	14102	dough	98.2	97.7	90.1	97.2	96.4	3 gpm	277 Y	490	C & L
8/14			108.62		dough						4 gpm	360 Y		Pivotrac
8/18		1.58	116.58		dough						4 gpm	180 Y	475	Leon
8/20	0.39		118.6	14115	dough	97.9	97.5	93.3	97.1	96.5	5 gpm	218 N		Curtis
8/23			123.88		dent						4 gpm	360 Y		Pivotrac
8/26		1.45	131.21		dent						4 gpm	180 Y		Leon
8/27			132.13	14126	dent	97.6	97.2	93.3	97.1	96.7	sorghum	196 N		Curtis
9/3	0.01		137.57	14128	1/4mat ln	93.6	96.1	91.7	97.0	95.7	3 gpm	333 Y	505	Curtis
9/3			138.7		1/4mat ln						4 gpm	360 Y		Pivotrac
9/7		1.46	146.05		2/3mat ln						4 gpm	180 Y	460	Leon
9/10	0.13		146.74	14130	1/2mat ln	87.4	91.2	84.4	97.2	94.1		197 N		Curtis
9/17	0.32		146.74	14130	3/4mat ln	55.5	81.5	77.3	97.3	91.6		197 N		Curtis
9/25	1.31		146.74	14130	1.0mat ln	97.5	69.8	70.8	97.1	97.5		197 N		C & L
10/1			146.74		harvest		64.8					156 N		Harold
10/2			146.74	14130	harvest	97.0	64.8	68.8	95.9	85.2		156 N		C & L
Total	11.61	17.22				0.0	0.8	0.6	0.0	0.4				Leon
Net Soil Moisture is 1.83"														
Irrigation, Rainfall Plus Net Soil Moisture is 30.66"														

• Numbers in red are not counted in the total

NORTH PLAINS GROUNDWATER Conservation District

2015-Corn Demonstration
Irrigated Medium Season Corn

4 GPM

Year: *2015* **County:** *Hartley* **Grower:** *Harold Grall*

No. Acres: *60.6* **Variety/Hyb:** *P33B54* **Soil Type:** *Sherm Clay Loam*

Meter Type: *Seametrics*

Meter Mult: *Acre Feet x 1* **Tillage:** *Strip Till*

Fertilizer: *163-58-0-0* **Seeding:** *26,000*

Planted: *May 12, 2015* **Harvest:** *September 30, 2015*

Herbicide: *Balance Flex, Cinch, Rifle, Starane, Strut, Powermax* **Insecticide:** *1.8 oz. Zeal*

Yield: *230 Bu/acre @ 15.0% Moist.* **Prev. crop:** *Milo* **Row width:** *30 inches*

Irrigation method: *Center Pivot* **Prewater:** *2.63"* **Well GPM:** *485*

Distance between drops: *60 inches* **Distance from nozzle to ground:** *18 inches*

Application pattern: *LESA Spray* **Crop row direction :** *Straight*

GPS Location of Pivot Pad

Latitude: *35.99318*

Longitude: *-102.16335*

GPS Location of Gypsum Blocks

Latitude: *35.990514*

Longitude: *-102.160748*

Harold Grall's "4 GPM" Site AquaSpy® Probe Summary

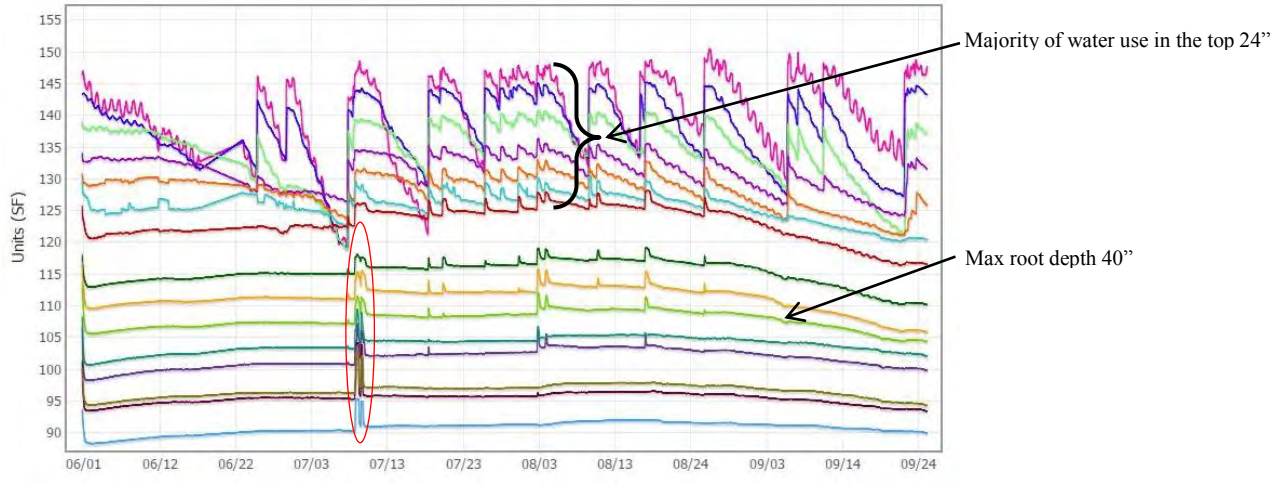


Figure 33. Grall moisture graph (4 gpm)

This treatment showed similar root activity patterns to the 3 gpm treatment, with most water use being in the top 24". It is evident that this site was kept wetter than the 3 gpm treatment and the top 24" was kept very wet during July and early August. There was a major drainage event that occurred during early July and it is possible that it caused some leaching. There were several other drainage events to about 44" but this was below the effective root zone. It looked like late rainfall largely filled the profile and this may have impacted harvest and/or soil compaction.

Figure 34: Gypsum Block Readings for Harold Grall's "5 GPM" Demonstration Site (233 bu/ac)

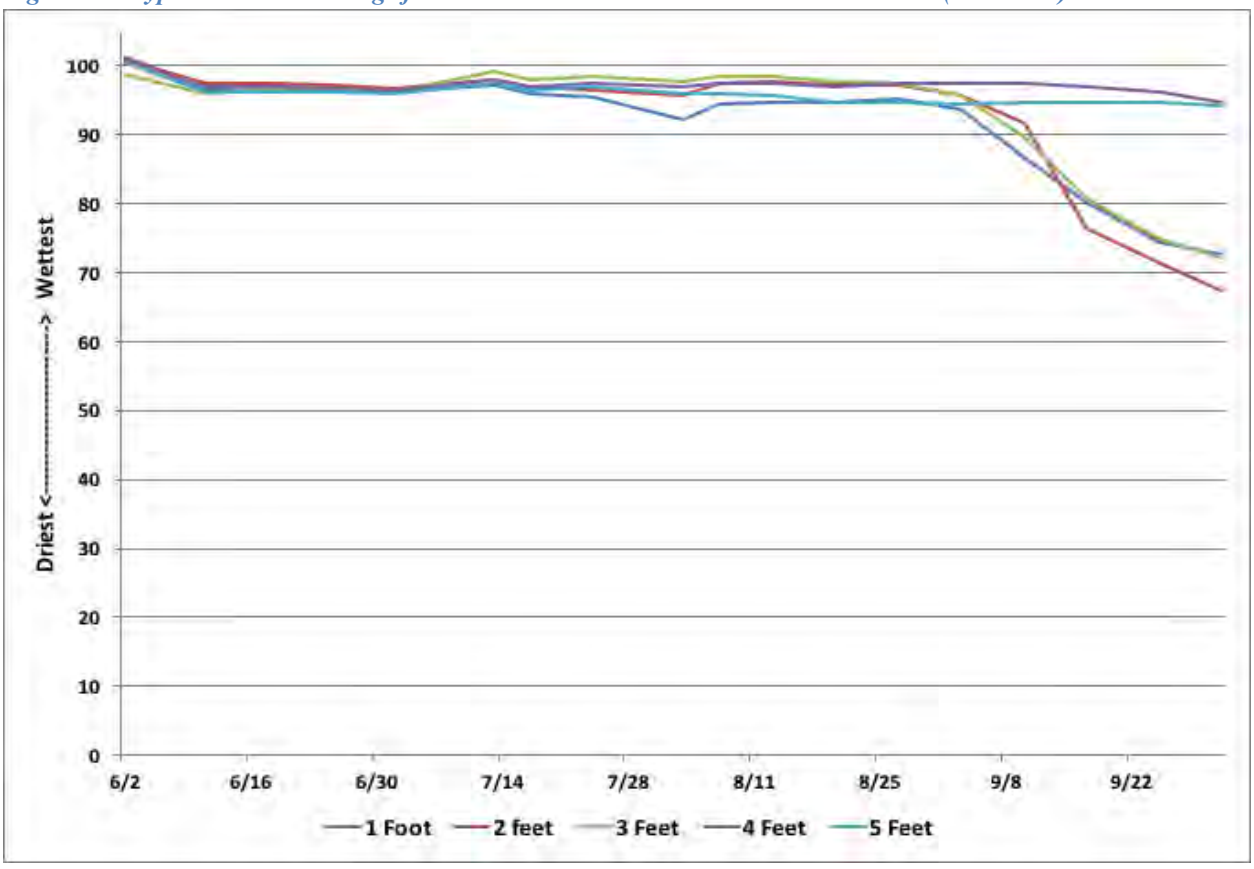


Figure 35: Growing Season Water Tracking for Harold Grall's "5 GPM" Demonstration Site (233 bu/ac)

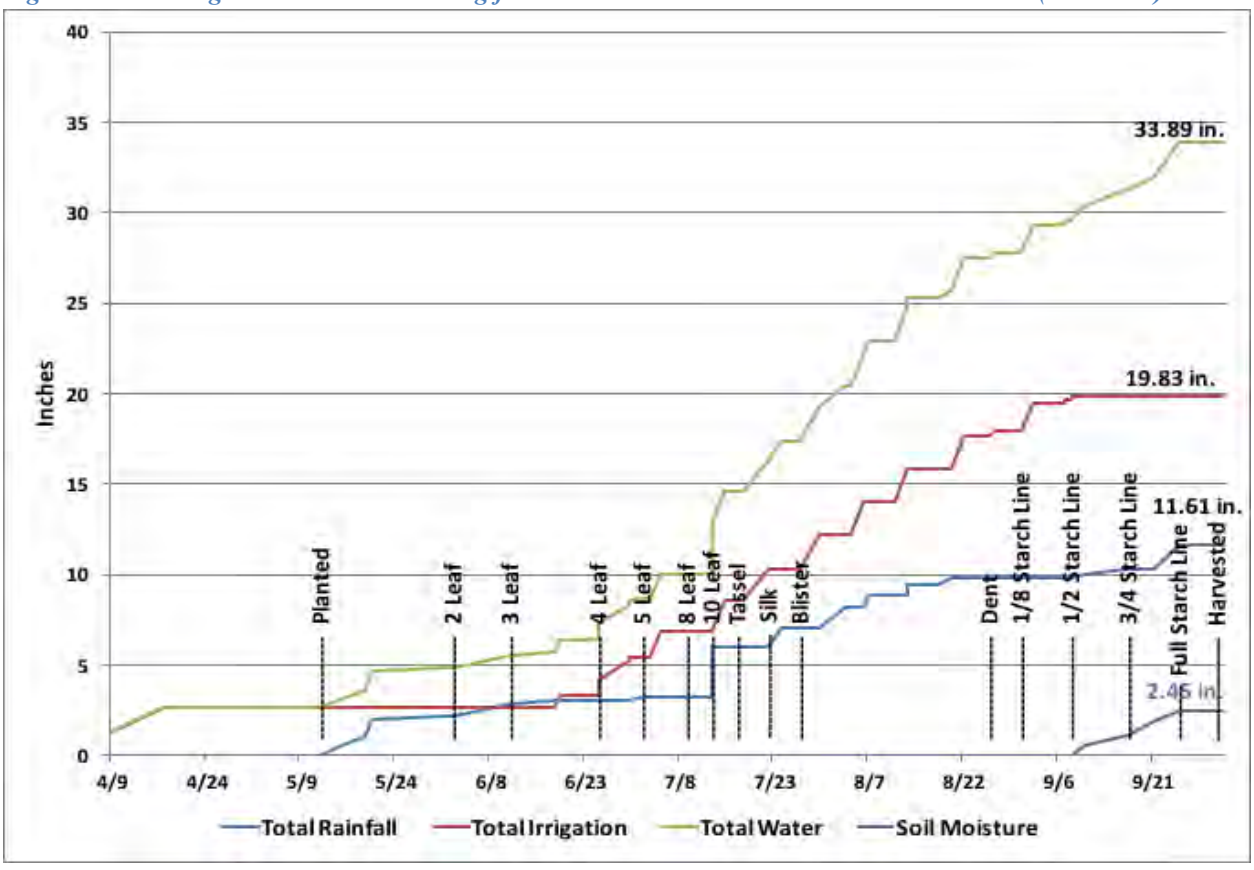


Table 24: Demonstration Field Data for Harold Grall's "5 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Hour Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
						1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/9		1.35	162.9 hrs								pre-wtr	209	450	Pivotrac
4/17		1.28	154.2 hrs								pre-wtr	304	450	Pivotrac
4/28	2.19													Pivotrac
5/5	0.97													Pivotrac
5/9	0.45													Pivotrac
5/12											planted			Harold
5/14	0.31													Pivotrac
5/16	0.31													Pivotrac
5/19	0.38													Pivotrac
5/20	0.99													Pivotrac
6/1	0.19													Pivotrac
6/2			0.00	13963	2 leaf	101.3	100.8	98.8	101.1	100.6		154 N		C & L
6/11	0.67		0.00	13963	3 leaf	97.0	97.5	96.0	96.8	96.3		154 N		C & L
6/18	0.22		0.00	13963	3 leaf	96.9	97.4	96.6	96.9	96.3		154 N		Curtis
6/19		0.71	7.16 af								all	225 Y		Pivotrac
6/25			15.51	13964	4 leaf	96.7	97.2	96.8	96.6	96.1	4 gpm	113 Y cw	513	C & L
6/25		0.88	16.05		4 leaf						all			Leon
6/30		1.02	26.34		4 leaf						all	180 Y		Leon
6/30		0.21	26.88		4 leaf						5 gpm	194 N		Pivotrac
7/2	0.11		26.88	13971	5 leaf	96.3	96.6	96.3	96.4	95.9	sorghum	194 N		C & L
7/3			26.88								5 gpm	194 Y		Pivotrac
7/5		1.38	30.36		6 leaf						5 gpm	270 Y		Leon
7/8			39.46		7 leaf						5 gpm	180 Y		Pivotrac
7/9			39.46		8 leaf						move dry	194 N		Pivotrac
7/13			39.46		10 leaf						5 gpm	194 Y		Pivotrac
7/13	2.84		39.48	13993	10 leaf	97.2	97.9	99.2	98.0	97.4	5 gpm	197 Y	533	C & L
7/15		1.7	43.74		11 leaf						5 gpm	270 Y	525	Leon
7/17			48.08	14009	tassel	96.0	96.9	97.9	96.9	96.4	4 gpm	41 Y	486	C & L
7/18			54.1		tassel						5 gpm	180 Y		Pivotrac
7/22		1.78	58.6		silk						5 gpm	270 Y	475	Leon
7/24	1.02		63.05	14033	silk	95.4	96.5	98.4	97.5	97	4 gpm	23 Y	508	C & L
7/27			69.85		blister						5 gpm	180 Y		Pivotrac
7/30		1.92	74.69		milk						5 gpm	270 Y	500	Leon
8/3	1.15		84.42	14067	blister	92.1	95.8	97.8	96.9	95.9	4 gpm	149 Y	497	C & L
8/4			85.96		milk						5 gpm	180 Y		Pivotrac
8/6		1.81	90.52		dough						5 gpm	270 Y	475	Leon
8/7	0.71		93.11	14084	milk	94.4	97.6	98.6	97.4	96.0	3 gpm	353 Y	479	C & L
8/11			100.98		dough						5 gpm	180 Y		Pivotrac
8/13		1.83	105.59		dough						5 gpm	270 Y	480	Leon
8/13	0.55		106.08	14102	dough	94.6	97.7	98.5	97.4	95.7	3 gpm	277 Y	489	C & L
8/18			116.58		dough						5 gpm	180 Y		Pivotrac
8/20	0.39		118.6	14115	dough	94.8	97.2	97.7	97.1	94.8		218 N		Curtis
8/22		1.75	121.01		dough						5 gpm	270 Y	460	Leon
8/26			131.21		dent						5 gpm	180 Y	460	Pivotrac
8/27		0.33	132.05		dent						5 gpm	196 N		Leon
8/27			132.13	14126	dent	95.1	97.3	97.6	97.4	94.8	sorghum	196 N		Curtis
8/31			132.13		1/8 mat In						5 gpm	196 Y		Pivotrac
9/2		1.53	135.9		1/8 mat In						5 gpm	270 Y	490	Leon
9/3	0.01		137.57	14128	1/4mat In	93.7	95.7	95.8	97.5	94.5	3 gpm	333 Y	505	Curtis
9/7			146.05		1/4mat In						5 gpm	180 Y		Pivotrac
9/7		0.14	146.4		1/4mat In						5 gpm	186 N	460	Pivotrac
9/8			146.4		1/2mat In						5 gpm	186 Y		Pivotrac
9/8		0.21	146.94		1/2mat In						5 gpm	197 N	460	Leon
9/10	0.13		146.74	14130	1/2mat In	86.8	91.6	89.8	97.4	94.6		197 N		Curtis
9/17	0.32		146.74	14130	3/4mat In	80.2	76.4	80.7	96.9	94.7		197 N		Curtis
9/25	1.31		146.74	14130	1.0mat In	74.4	71.5	74.8	96.1	94.6		197 N		C & L
Oct 1					harvest							156 N		Harold
10/2			146.74	14130	harvest	72.6	67.3	72.1	94.6	94.1		156 N		C & L
Total	**11.61**	**19.83**				**0.7**	**0.8**	**0.7**	**0.1**	**0.1**				
Net Soil Moisture is 2.46"														
Irrigation, Rainfall Plus Net Soil Moisture is 33.89"														

• Numbers in red are not counted in the total

2015-Corn Demonstration
Irrigated Medium Season Corn

5 GPM

Year: *2015* **County:** *Hartley* **Grower:** *Harold Grall*

No. Acres: *30.3* **Variety/Hyb:** *P33B54* **Soil Type:** *Sherm Clay Loam*

Meter Type: *Seametrics*

Meter Mult: *Acre Feet x 1* **Tillage:** *Strip Till*

Fertilizer: *200-58-0-0* **Seeding:** *26,000*

Planted: *May 12, 2015* **Harvest:** *September 30, 2015*

Herbicide: *Balance Flex, Cinch, Rifle, Starane, Strut, Powermax* **Insecticide:** *1.8 oz. Zeal*

Yield: *233 bu/acre @ 15.0% Moist* **Prev. crop:** *Milo* **Row width:** *30 inches*

Irrigation method: *Center Pivot* **Prewater:** *2.63"* **Well GPM:** *485*

Distance between drops: *60 inches* **Distance from nozzle to ground:** *18 inches*

Application pattern: *LESA Spray* **Crop row direction :** *Straight*

GPS Location of Pivot Pad
Latitude: *35.99318*
Longitude: *-102.16335*

GPS Location of Gypsum Blocks
Latitude: *35.990617*
Longitude: *-102.165727*

Harold Grall's "5 GPM" Site AquaSpy® Probe Summary

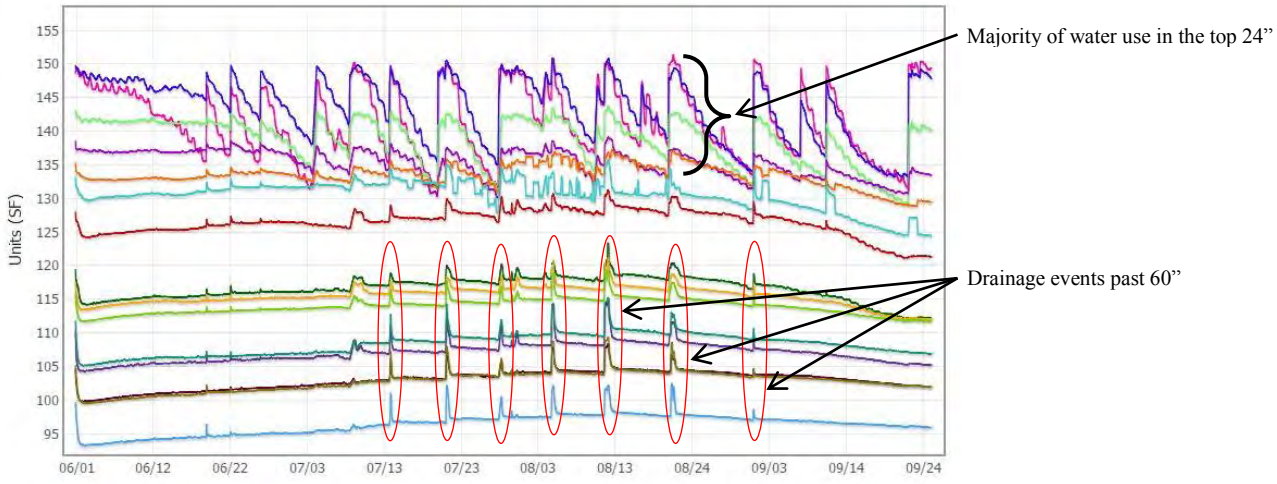


Figure 36. Grall moisture graph (5 gpm)

The 5 gpm treatment had many large drainage events past 60". This would certainly have reduced the water use efficiency at this site and probably caused leaching which would have negatively impacted yield. Root activity was relatively shallow, with the active root zone in the top 24". Reducing or eliminating some early irrigations should have produced a larger root zone and a better water use efficiency. It is not surprising that this treatment had the lowest water use efficiency in terms of bu/ac and also in terms of economics. Too much water went out the bottom of the profile and probably took fertilizer with it.

Harvest Results: The 3 GPM field produced a 222 bushel per acre corn yield. Irrigation totaled 14.47 inches. Production in the 4 GPM field was 230 bushels per acre. Seasonal irrigation totaled 17.22 inches. Corn yield was 233 bushels per acre for the 5 GPM field. Irrigation totaled 19.83 inches. There was 2.63 inches of pre-season irrigation on all fields. The 4 GPM field produced 8 more bushels per acre than the 3 GPM field and irrigation was 2.75 inches more. The 5 GPM field produced 11 more bushels per acre than the 3 GPM with 5.36 more inches of irrigation. The 5 GPM yield was 3 more bushels per acre than that from the 4 GPM field with 2.61 additional inches of irrigation. Corn production was 15.34 bushels (859lbs) per inch of irrigation in the 3 GPM field compared to 13.35 bushels (747lbs) in the 4 GPM and 11.75 bushels (658lbs) from the 5 GPM field. Production from each inch of irrigation, rainfall and net soil water that totaled 30.05 inches was 7.38 bushels (413lbs) per acre in the 3 GPM field. Irrigation, rainfall and net soil water totaled 30.66 inches in the 4 GPM field where production was 7.50 bushels (420lbs) per inch. In the 5 GPM field, irrigation, rainfall and net soil water totaled 33.89 inches where production was 6.87 bushels (385lbs) per inch of total water. Crop production costs were $24.08 per acre more for the 4 GPM field than for the 3 GPM from increased irrigation, fertilizer and harvest expenses. At $3.97 per bushel, the eight bushels per acre increased corn yield in the 4 GPM field amounts to $ 31.76 more per acre than from the 3 GPM field. The 4 GPM field's net gain is $7.68 per acre with 2.75 inches more irrigation used compared to production from the 3 GPM field. At $3.97 per bushel, the 11 bushel per acre increased yield from the 5 GPM field compared to the 3 GPM amounts to $43.67. Crop production costs were $41.48 more for the 5 GPM field. The 5 GPM fields' net gain compared to the 3 GPM field is $2.19 per acre with 5.36 additional inches of irrigation. Value of the 3 additional bushels produced in the 5 GPM field compared to the 4 GPM field is $11.91. Production Costs were $17.40 more for the 5 GPM field than the 4 GPM. Net gain for the 5 GPM field is minus (lost $5.49) per acre with 2.61 inches more irrigation. Net return from the 3 GPM field was $447.19 per acre compared to $454.87 from the 4 GPM field and $449.38 from the 5 GPM field. Net return from each inch of irrigation is $30.90 for the 3 GPM field compared to $26.41 from the 4 GPM and $22.66 for the 5 GPM field. A summary of the demonstration results are shown in table 25 and Appendix A.

Table 25: Harold Grall's 2015 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $3.97/bu		
			bu/ac	lb/ac-in Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"3 GPM"	14.47	*30.05	222	859	$881.34	$60.91	$29.33
"4 GPM"	17.22	†30.66	230	747	$913.10	$53.02	$29.78
"5 GPM"	19.83	#33.89	233	658	$925.01	$46.64	$27.29

*Includes 3.97 inches of soil water removed within five feet of soil, plus rainfall, and irrigation.
†Includes 1.83 inches of soil water removed within five feet of soil, plus rainfall, and irrigation.
#Includes 2.45 inches of soil water removed within five feet of soil, plus rainfall and irrigation.

Dennis Buss's 2015 Hartley County Demonstration

Planting and Crop Information: Dennis Buss strip tilled and planted 60 acres of corn in the north half of the NW 1/4 circle of a section, for his "3-4-5 GPM" demonstration. The 60 acres were equally divided in 20 acre plots for his 3, 4 and 5 GPM fields. His 3 GPM field was located from 90 to 30 degrees, the 4 GPM at 30 to 330 and 5 GPM at 330 to 270. Buss planted each "3-4-5 GPM" field to Pioneer 1498HR hybrid. Seeding rate for the 3 GPM acres, 4 GPM and 5 GPM was 28,000 seeds per acre. Center pivot travel speed was by PivoTrac™. When needed, the center pivot ran 23.7 hours each week to apply 1.10 inches on the 3 GPM field, 32.0 hours to apply 1.49 inches on the 4 GPM field and 41.2 hours to apply 1.85 inches on the 5 GPM field. That is equivalent to an 8.07 day revolution. Seasonal water meter readings averaged 375 gpm. Irrigation was with the Senninger LDN LESA spray with drops spaced 60 inches apart. Timely rainfall allowed the center pivot to be stopped more than sixty hours during the growing season. Seeding was muddied in between rainfall. Germination and stand count was irregular and not good. Volunteer corn was another problem. Planting and crop information for "Buss 3 GPM", "Buss 4 GPM" and "Buss 5 GPM" are shown in the table 26 below.

Table 26: Planting and Crop Information for Dennis Buss

3 GPM Demonstration Site: 90-30 degrees			
Planted:	*June 18*	**Harvested:**	*November 25*
Hybrid:	*Pioneer 1498HR*	**Seeding Rate:**	*28,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*20*	**GPM Per Acre:**	*3.1*
Total Water:	*23.74 inches*	**Soil Type:**	*Sherm Clay*
Irrigation:	*9.27inches*	**Insecticide:**	*none*
Herbicide:	*Dual, Roundup*	**Fertilizer**:	85-14-5-5s-2Zn
4 GPM Demonstration Site: 30-330 degrees			
Planted:	*June 18*	**Harvested:**	*November 25*
Hybrid:	*Pioneer 1498HR*	**Seeding Rate:**	*28,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*20*	**GPM Per Acre:**	*3.1*
Total Water:	*26.04 inches*	**Soil Type:**	*Dumas Loam*
Irrigation:	*10.97 inches*	**Insecticide:**	*none*
Herbicide:	*Dual, Round Up*	**Fertilizer:**	85-14-5-5s-2Zn
5 GPM Demonstration Site: 330- 270 degrees			
Planted:	*June 18*	**Harvested:**	*October 18*
Hybrid:	*Pioneer 1498HR*	**Seeding Rate:**	*28,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*20*	**GPM Per Acre:**	*3.1*
Total Water:	*27.25 inches*	**Soil Type:**	*Sherm Clay Loam*
Irrigation:	*12.18 inches*	**Insecticide:**	*none*
Herbicide:	*Dual, Round Up*	**Fertilizer:**	85-14-5-5s-5Zn

Soil Water Profile and Growing Season Rainfall

"3 GPM" Demonstration Site: Preseason soil water was good at 1, 2, 3, 4 and 5 feet following periodic rainfall in May and June, prior to planting. Seed bed soil was too wet at planting on June 18 following 3.15 inches of rain. Weekly gypsum block readings indicate the crop rooted to 4 feet and used significant soil water from 1, 2, 3 and 4 feet in September, plus irrigation and rainfall growing the crop. Only limited soil water was used from 5 feet, likely because sufficient water was available from the upper root zone. Soil moisture sensors show the crop had adequate soil water during the growing season. The soil profile was refilled by more than four inches of rainfall in October, prior to harvest. The crop was produced in Sherm clay loam soil that can store approximately 2.0 inches of available water per foot for potential crop use. Timely beneficial rainfall significantly contributed to producing the crop with only 9.27 inches of irrigation. Total rainfall from planting until grain black layer totaled 14.47 inches, and was more normal for this location. Gypsum blocks were installed in July, following planting, due to wet soil conditions prior to planting.

"4 GPM" Demonstration Site: Soil water was good at 1, 2, 3, 4 and 5 feet from abundant rainfall during May and June prior to planting. Weekly gypsum block readings show adequate soil moisture levels were maintained at 1, 2, 3, 4 and 5 feet during the growing season from timely beneficial rainfall and periodic irrigation as needed. The crop used significant soil water mostly from 1 and 2 feet and limited amounts from 3 feet in addition to rainfall and irrigation in August and September. Gypsum block moisture sensors were installed in July following planting on June 18. Periodic timely rainfall significantly contributed to producing the crop, with only 10.97 inches of irrigation applied. Rainfall from planting thru black layer totaled 15.07 inches. The crop was produced in Dumas loam soil that holds approximately 2.0 inches available water per foot for potential crop use.

"5 GPM" Demonstration Site: Beginning soil water was good at 1, 2, 3, 4 and 5 feet at planting from 8.63 inches of rain in May and June prior to planting. Seed bed soil was too wet at planting but there was no time remaining to get the crop planted. As a result, seed germination and plant emergence was not good. Weekly gypsum block moisture sensors show the crop had sufficient available soil water during the entire growing season. The sensors show that crop roots extracted soil water from 1, 2, 3 and 4 feet plus irrigation and rainfall producing the crop. Soil water depletion occurred primarily in September to finish the crop. The soil profile was refilled to water holding capacity from rainfall in October prior to harvest. Total rainfall was 15.07 inches. Irrigation totaled 12.18 inches. The crop was produced in Dumas loam soil that holds approximately 2.0 inches of available water per foot for potential crop use.

Table 27: Monthly Rainfall Data for Dennis Buss

	July	August	September	October	Total
"3 GPM"	3.31"	4.41"	2.46"	4.29"	**14.47"**
"4 GPM"	3.67"	4.35"	2.66"	4.39	**15.07"**
"5 GPM"	3.67"	4.35"	2.66"	4.39	**15.07"**

Growing Season Water Tracking: The district tracked total water and crop growth throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. One set of five gypsum block soil moisture sensors was installed at 1, 2, 3, 4 and 5 feet and an AquaSpy® soil moisture probe was installed down to five

feet in the root zone at one location to monitor soil water levels in the “3 GPM” field. Another set of the same type of sensors were installed in both the “4 GPM” and “5 GPM” fields. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in each field. Due to wet soils from abundant April and May rainfall, all Gypsum blocks were installed following planting. Gypsum blocks, water meter, rain gauges and crop growth are read, recorded and utilized weekly by district personnel. Each AquaSpy® probe was installed following crop emergence. A 24/7 AquaSpy® probe website shows soil moisture at four inch increments to 60 inches and monitors plant root growth. The website lists all AquaSpy® soil probes in the “3-4-5 GPM” project and is available to all cooperators and district personnel. Another 24/7 PivoTrac™ website tracks each center pivot system and monitors and controls irrigation. Each center pivot travel speed prescription written to apply 1.10 inches (“3 GPM”), 1.49 inches (“4 GPM”) and 1.85 inches (“5 GPM”) is managed from the PivoTrac™ website. Both the cooperating grower and district “3-4-5 GPM” project leader collectively monitor, control and manage irrigation from the PivoTrac™ website. Following this paragraph, a series of graphs and tables shows weekly gypsum block readings for the season; growing season water, including rainfall, irrigation, and soil moisture at various growth stages; and the order of irrigation and rainfall events for each “3-4-5 GPM” field. Finally, a form describes the protocols for each field. “Total Water,” as shown on the graph for growing season water, is the sum of seasonal irrigation, rainfall and net soil water. Graphs and tables for the 3 GPM acres are shown first, followed by the same illustrations for each 4 GPM and 5 GPM.

Figure 37: Gypsum Block Readings for Dennis Buss' "3 GPM" Demonstration Site (112 bu/ac)

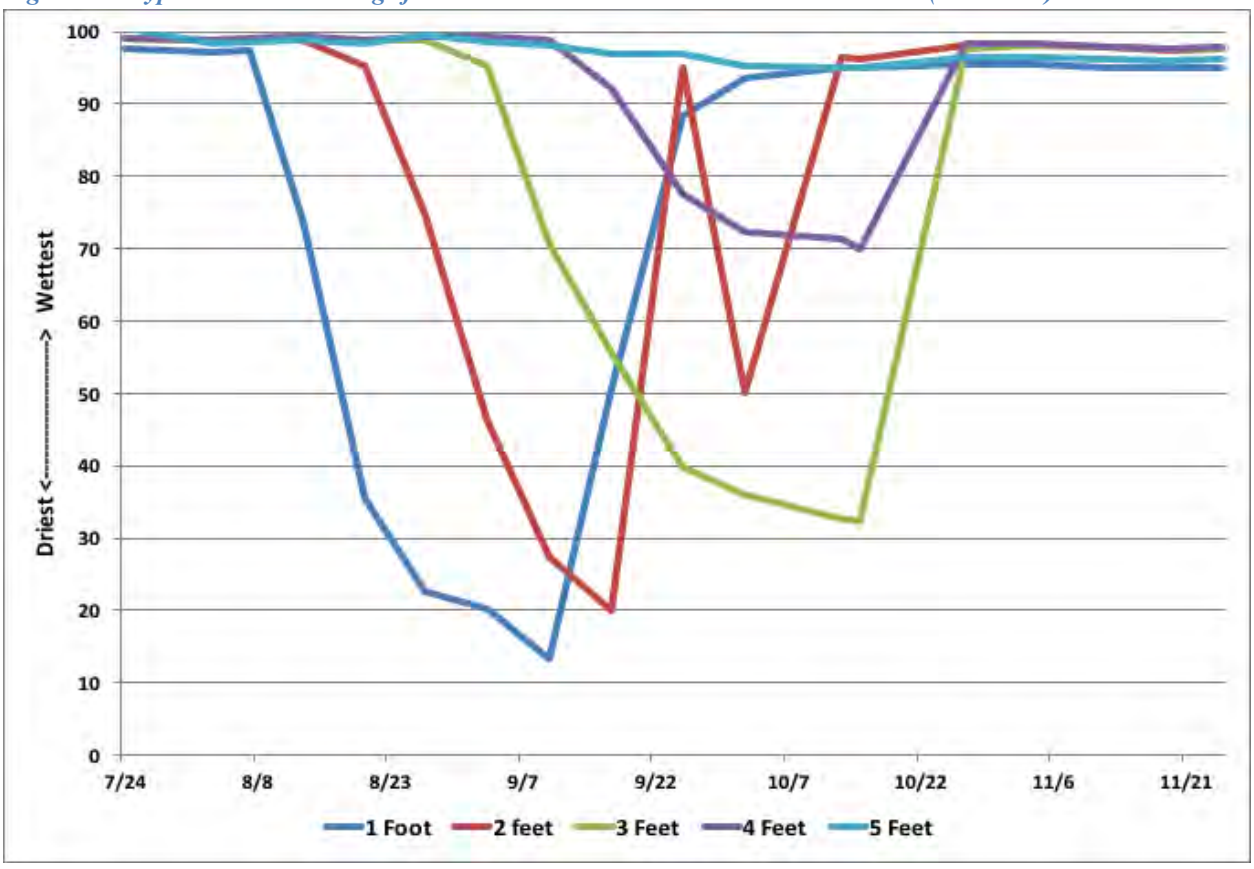


Figure 38: Growing Season Water Tracking for Dennis Buss' "3 GPM" Demonstration Site (112 bu/ac)

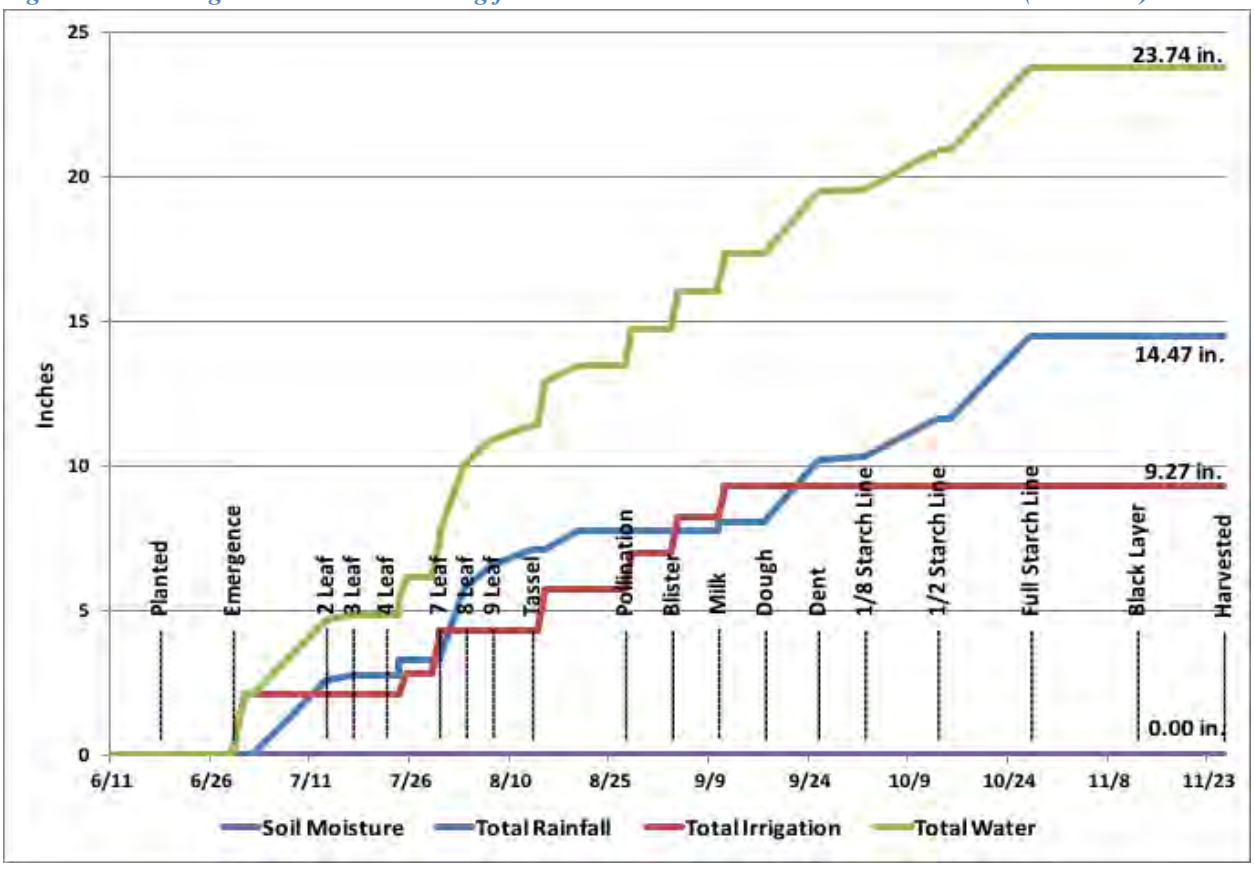


Table 28: Demonstration Field Data for Dennis Buss' "3 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Hour Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
						1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/28	1.16													Pivotrac
5/5	0.86													Pivotrac
5/6	0.14													Pivotrac
5/9	0.11													Pivotrac
5/14	0.41													Pivotrac
5/16	0.15													Pivotrac
5/17	0.67													Pivotrac
5/19	0.84													Pivotrac
5/20	0.57													Pivotrac
5/22	0.47													Pivotrac
5/23	0.63											269 N		Pivotrac
6/1	0.49											258 N		Pivotrac
6/4	1.09		589.54	27061.9								258 N		C & L
6/11	2.63		589.54	27061.9								258 N		C & L
6/18	0.08		589.54	27061.9	planted							258 N		Dennis
6/25			589.54	27061.9								258 N		C & L
6/29			594.01		emerging						3 gpm	30 Y		Pivotrac
6/30		1.20	596.07		emerging						3 gpm	90 rev	465	Leon
7/1		0.88	597.53		emerging						3 gpm	30 Y	465	Leon
7/2			600.36	27191.5							split	330 Y	475	C & L
7/13	2.57		601.94	27208.3	2 leaf							291 N		C & L
7/17	0.16		601.94	27208.3	3 leaf	100.2	99.8	99.8				289 N		C & L
7/22			601.94		4 leaf						move dry	112 N		Pivotrac
7/24			601.94		4 leaf						move dry	90 N		Pivotrac
7/24			601.94		4 leaf						3 gpm	90 Y		Pivotrac
7/24	0.58		602.25	27220.3	4 leaf	97.5	99.0	99.0	99.1	100.4	3 gpm	72 Y	400	C & L
7/25		0.76	603.21		4 leaf						3 gpm	30 Y	465	Leon
7/29			611.62		6 leaf						3 gpm	30 Y	465	Leon
7/30		1.19	613.61		7 leaf						3 gpm	90 rev	465	Leon
7/30		0.28	614.08		7 leaf						3 gpm	75 N	465	Leon
8/3	2.46		614.01	27357.5	8 leaf	97.1	98.7	98.7	98.8	98.3		75 N		C & L
8/7	0.81		614.01	27357.5	9 leaf	97.3	98.9	99.0	99.1	98.5		75 N		C & L
8/13	0.51		614.01	27357.5	Tassel	74.0	98.9	99.2	99.3	98.8		75 N		Curtis
8/14			614.01		Tassel						3 gpm	75 Y		Pivotrac
8/14					silk						3 gpm	90 rev		Pivotrac
8/15		1.44	616.43		silk						3 gpm	30 Y	450	Leon
8/20	0.63		622.19	27456.6	silk	35.4	95.2	98.7	98.9	98.3		273 N		Curtis
8/27			627.48		pollinate						3 gpm	30 Y	410	Pivotrac
8/27			628.17	27536	pollinate	22.6	74.7	98.8	99.3	99.5	3 gpm	54 Y	318	Curtis
8/28		1.05	629.22		pollinate						3 gpm	90 rev	410	Leon
8/28		0.16	629.25		pollinate						3 gpm	83 N	410	Pivotrac
9/3			629.25		blister						3 gpm	83 Y		Pivotrac
9/3					blister						3 gpm	90 rev		Pivotrac
9/3	0.04		629.78	27,557.36	blister	20.3	46.2	95.2	99.2	98.5	3 gpm	87 Y	373	Curtis
9/4		1.29	631.41		blister						3 gpm	30 Y	450	Leon
9/10			642.52		milk						3 gpm	30 Y		Pivotrac
9/10	0.27		642.72	27725.6	milk	13.4	27.5	70.6	98.7	98.1	3 gpm	65 Y	338	Curtis
9/11		0.75	643.78		milk						3 gpm	90 rev	300	Pivotrac
9/11		0.27	644.09		milk						3 gpm	52 rev	200	Pivotrac
9/11			644.09		milk						move dry	85 N		Pivotrac
9/17	0.04		644.09	27758.1	dough	50.5	20.1	55.6	92.0	96.9		85 N		Curtis
9/25	2.11		644.09	27758.1	dent	88.2	94.9	39.9	77.6	96.8		85 N		C & L
10/2	0.10		644.09	27758.1	1/8mat ln	93.6	50.1	36.0	72.3	95.3		85 N		C & L
10/13	1.32		644.09	27758.1	1/2mat ln	95.0	96.5	32.7	71.3	95.1		85 N		Curtis
10/15			644.09	27758.1	2/3mat ln	94.9	96.2	32.5	69.9	94.9		85 N		Curtis
10/27	2.87		644.09	27758.1	1.0mat ln	95.4	98.2	97.7	98.4	96.4		85 N		C & L
11/4	0.47		644.09	27758.1	1.0mat ln	95.4	98.2	98.2	98.3	96.3		85 N		Curtis
11/12			644.09	27758.1	bm layer	95.1	97.8	97.8	97.9	96.1		85 N		Curtis
11/19	0.18		644.09	27758.1	bm layer	94.9	97.4	97.5	97.6	96.0		85 N		C & L
11/24											move dry	109 N		Pivotrac
11/25			644.09	27759.5	harvest	95.0	97.5	97.6	97.8	96.1		109 N		Curtis
Total	**14.47**	**9.27**				**0.0**	**0.0**	**0.0**	**0.0**	**0.0**				
Net Soil Moisture is 0.00"														
Irrigation, Rainfall Plus Net Soil Moisture is 23.74"														

• Numbers in red are not counted in the total

NORTH PLAINS GROUNDWATER Conservation District

2015-Corn Demonstration
Irrigated Medium Season Corn

3 GPM

Year:	2015	**County:**	Hartley	**Grower:**	Hartley Feeders
No. Acres:	20	**Variety/Hyb:**	P1498 HR	**Soil Type:**	Sherm Clay Loam
Meter Type:	Seametrics				
Meter Mult:	Acre Feet x 1	**Tillage:**	Strip Till		
Fertilizer:	65-14-5-5s-2Zn	**Seeding:**	28,000		
Planted:	June 18, 2015	**Harvest:**	November 25, 2015		
Herbicide:	Dual, Roundup	**Insecticide:**	None		
Yield:	112 bu/acre @ 15.0% Moist.	**Prev. crop:**	Corn	**Row width:**	30 inches
Irrigation method:	Center Pivot	**Prewater:**	None	**Well GPM:**	375
Distance between drops:	60 inches	**Distance from nozzle to ground:**	16 inches		
Application pattern:	LESA Spray	**Crop row direction :**	Planted in circle		

GPS Location of Pivot Pad		**GPS Location of Gypsum Blocks**	
Latitude:	35.888303	Latitude:	35.88936
Longitude:	-102.455757	Longitude:	-102.4519

Figure 39: Gypsum Block Readings for Dennis Buss' "4 GPM" Demonstration Site (115 bu/ac)

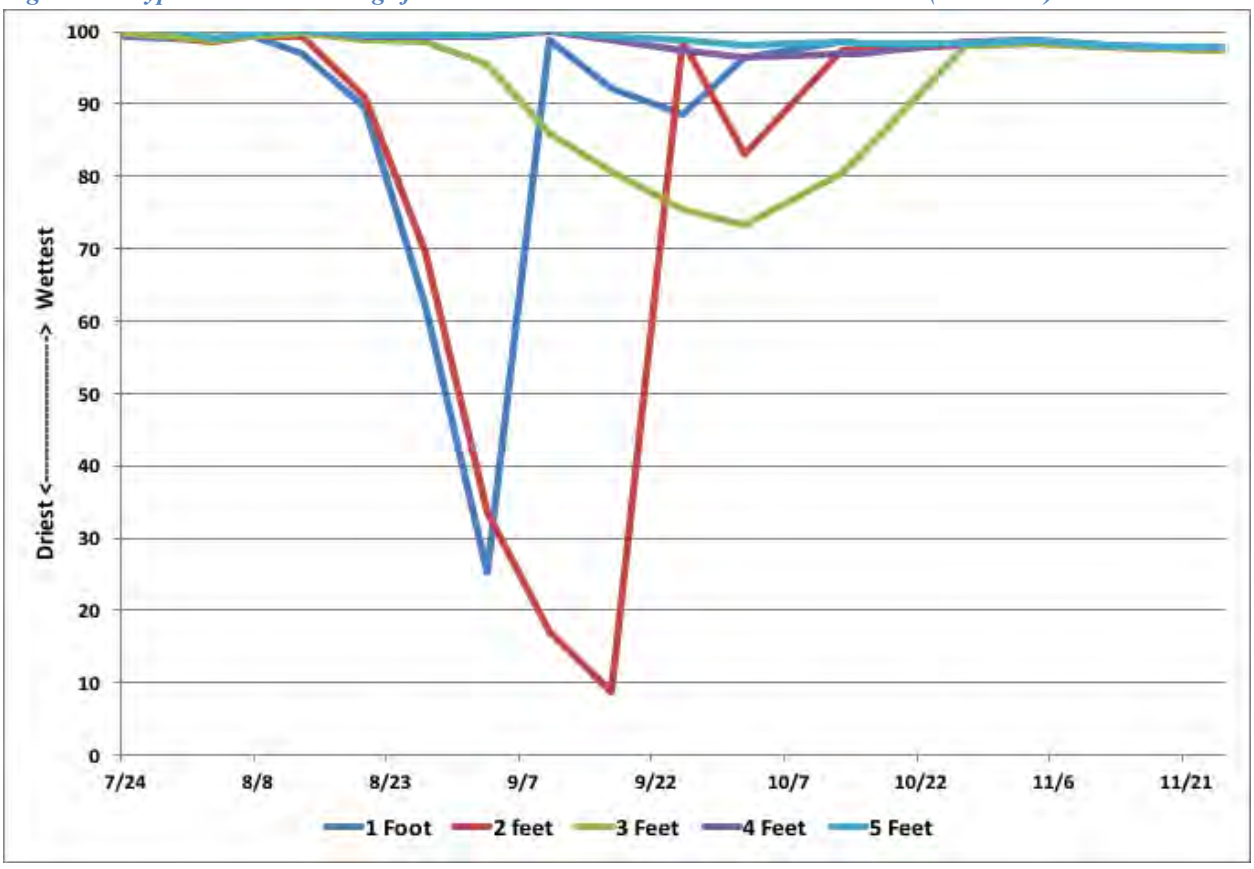


Figure 40: Growing Season Water Tracking for Dennis Buss' "4 GPM" Demonstration Site (115 bu/ac)

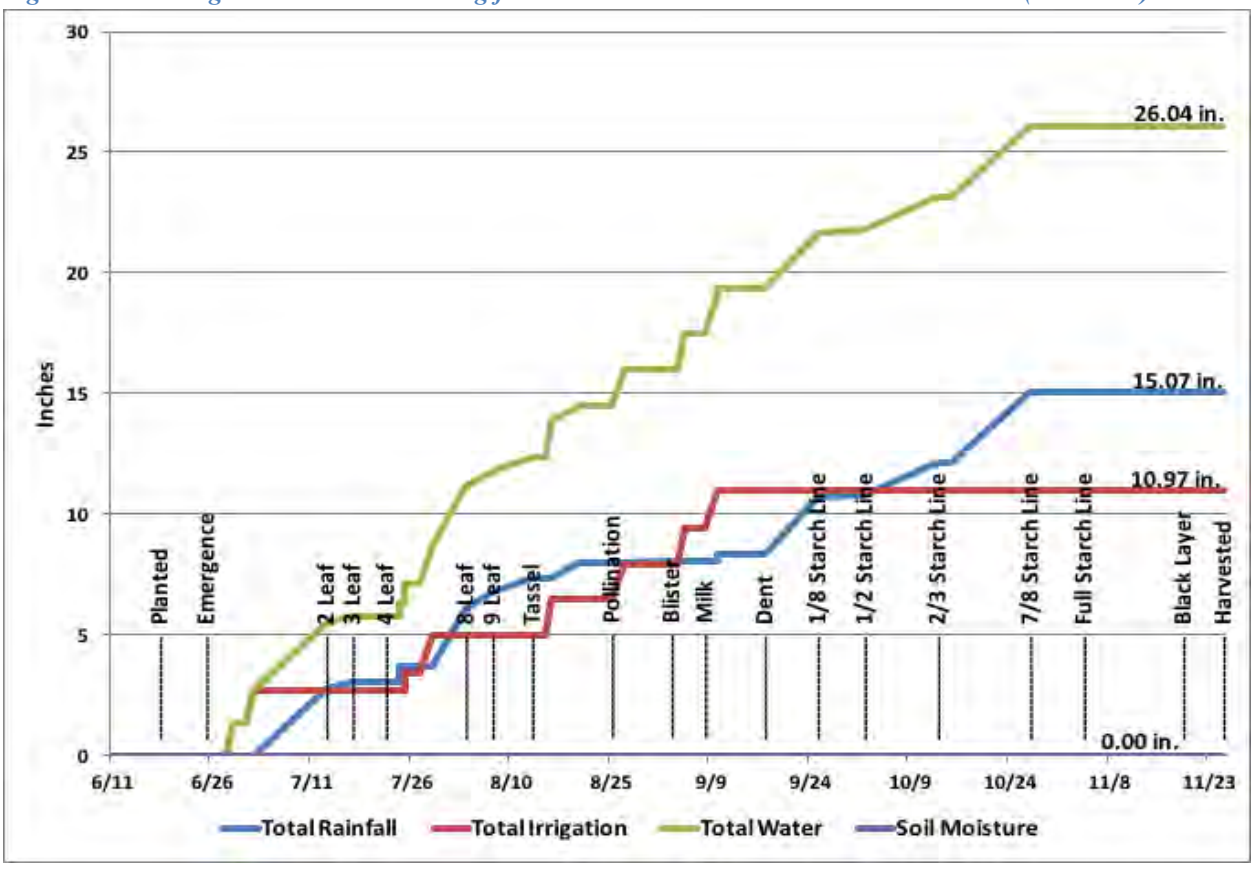


Table 29: Demonstration Field Data for Dennis Buss' "4 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Hour Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
						1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/28	1.16													Pivotrac
5/5	0.86													Pivotrac
5/6	0.14													Pivotrac
5/9	0.11													Pivotrac
5/14	0.41													Pivotrac
5/16	0.15													Pivotrac
5/17	0.67													Pivotrac
5/19	0.84													Pivotrac
5/20	0.57													Pivotrac
5/22	0.47													Pivotrac
5/23	0.63													Pivotrac
6/1	0.49													Pivotrac
6/4	1.03		589.54									258 N		C & L
6/6	0.43											258 N		Pivotrac
6/7	0.25											258 N		Pivotrac
6/11	2.20		589.54									258 N		C & L
6/18											planted			Dennis
6/18	0.06		589.54									258 N		Curtis
6/25			589.54	emerge								258 N		C & L
6/28			591.79	emerging							4 gpm	330 Y		Pivotrac
6/29		1.36	594.01	emerging							4 gpm	30 Y	465	Leon
7/1			597.53	emerging							4 gpm	30 Y		Pivotrac
7/2		1.33	599.75	emerged							4 gpm	330 Y	465	Leon
7/2			600.36	emerged							5 gpm	331 Y	475	C & L
7/13	2.77		601.94	2 leaf								291 N		C & L
7/17	0.32		601.94	3 leaf	99.7	100.0	100.1			100.4		289 N		C & L
7/22			601.94	4 leaf							move dry	112 N		Pivotrac
7/24			601.94	4 leaf							move dry	90 N		Pivotrac
7/24	0.58		602.25	4 leaf	99.2	99.7	99.8	102.0	101.8		3 gpm	72 Y	400	C & L
7/25			603.21	4 leaf							4 gpm	30 Y		Pivotrac
7/25		0.76	604.49	5 leaf						98.3	4 gpm	330 Y	465	Leon
7/27			609	6 leaf						98.5	4 gpm	330 Y		Pivotrac
7/29		1.56	611.62	7 leaf						98.8	4 gpm	30 Y	465	Leon
8/3	2.42		614.01	8 leaf	98.7	98.6	98.7	99.1	99.0			75 N		C & L
8/7	0.69		614.01	9 leaf	99.5	99.4	99.4	99.7	99.8			75 N		C & L
8/13	0.54		614.01	tassel	97	99.3	99.8	100.2	100.2			75 N		C & L
8/15			616.43	silk						98.3	4 gpm	30 Y		Pivotrac
8/16		1.49	618.93	silk							4 gpm	330 Y	450	Leon
8/20	0.70		622.19	silk	89.4	91.0	98.8	99.3	99.5	99.5		273 N		Curtis
8/25			625.08	pollinate							4 gpm	330 Y	410	Pivotrac
8/27		1.44	627.48	pollinate							4 gpm	30 Y	410	Leon
8/27			628.17	pollinate	62.3	69.6	98.5	99.3	99.5		3 gpm	54 Y	318	Curtis
9/3	0.05		629.78	blister	25.2	33.6	95.5	99.3	99.5		3 gpm	87 Y	373	Curtis
9/4			631.41	blister						98.5	4 gpm	30 Y		Pivotrac
9/5		1.50	633.91	blister							4 gpm	330 Y	450	Leon
9/8			639.97	milk							4 gpm	330 y		Pivotrac
9/10		1.53	642.52	milk						98.1	4 gpm	30 Y	450	Leon
9/10	0.30		642.72	milk	98.9	17.1	85.9	100.0	100.2		3 gpm	65 Y	338	Curtis
9/17			644.09	dent	92.2	8.8	80.7	98.9	99.4			85 N		Curtis
9/17														
9/25	2.31		644.09	1/8mat ln	88.6	98.5	75.5	97.4	98.9	96.9		85 N		C & L
9/25										96.8				
10/2	0.11		644.09	1/2mat ln	96.5	83.0	73.3	96.5	98.2	95.3		85 N		C & L
10/13	1.37		644.09	2/3mat ln	98.5	97.4	80.4	97.0	98.6	95.1		85 N		Curtis
10/15			644.09	3/4mat ln	98.4	97.4	82.9	96.8	98.4	94.9		85 N		Curtis
10/27	2.91		644.09	7/8mat ln	98.2	98.0	98.2	98.5	98.4	96.4		85 N		C & L
11/4	0.50		644.09	1.0mat ln	98.5	98.4	98.4	98.8	98.8	96.3		85 N		Curtis
11/12			644.09	1.0mat ln	98	97.8	97.8	98.1	98.1	96.1		85 N		Curtis
11/19	0.19		644.09	blk layer	97.6	97.5	97.5	97.9	97.8	96.0		85 N		C & L
11/24											move dry	109		Pivotrac
11/25			644.09	harvest	97.5	97.3	97.4	97.8	97.8	96.1		109 N		Curtis
Total	**15.07**	**10.97**			**0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**				**Leon**
Net Soil Moisture is 0.00"														
Irrigation, Rainfall Plus Net Soil Moisture is 26.04"														

• Numbers in red are not counted in the total

NORTH PLAINS GROUNDWATER Conservation District

2015-Corn Demonstration
Irrigated Medium Season Corn

4 GPM

Year:	2015	**County:**	Hartley	**Grower:**	Hartley Feeders
No. Acres:	20	**Variety/Hyb:**	P1498 HR	**Soil Type:**	Dumas Loam
Meter Type:	Seametrics				
Meter Mult:	Acre Feet x 1	**Tillage:**	Strip Till		
Fertilizer:	65-14-5-5s-5Zn	**Seeding:**	28,000		
Planted:	June 16, 2015	**Harvest:**	November 25, 2015		
Herbicide:	Dual, Roundup	**Insecticide:**	None		
Yield:	115 bu/acre @ 15.0% Moist.	**Prev. crop:**	Corn	**Row width:**	30 inches
Irrigation method:	Center Pivot	**Prewater:**	None	**Well GPM:**	375
Distance between drops:	60 inches	**Distance from nozzle to ground:**	16 inches		
Application pattern:	LESA Spray	**Crop row direction :**	Planted in circle		

GPS Location of Pivot Pad		**GPS Location of Gypsum Blocks**	
Latitude:	35.888303	Latitude:	35.89159
Longitude:	-102.455757	Longitude:	-102.45606

Figure 41: Gypsum Block Readings for Dennis Buss' "5 GPM" Demonstration Site (116 bu/ac)

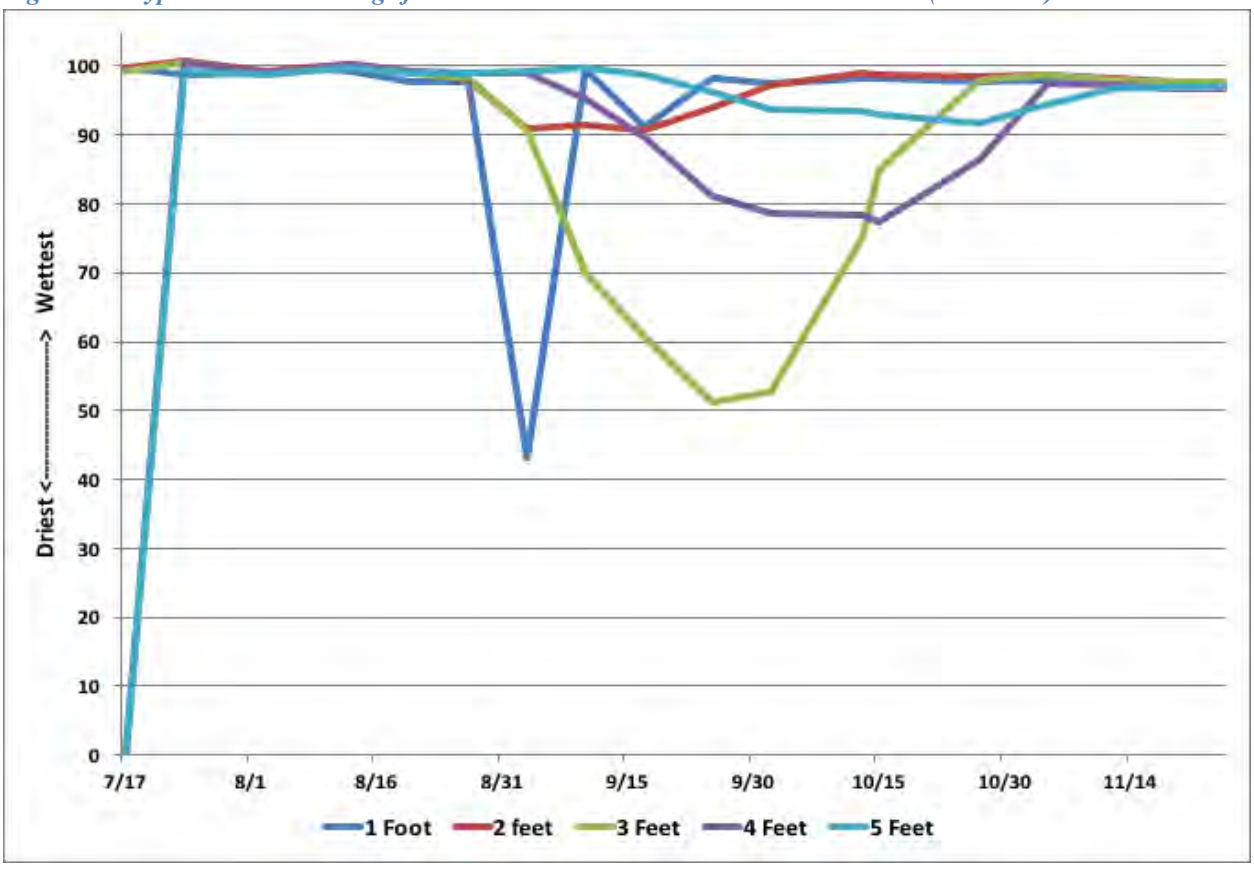


Figure 42: Growing Season Water Tracking for Dennis Buss' "5 GPM" Demonstration Site (116 bu/ac)

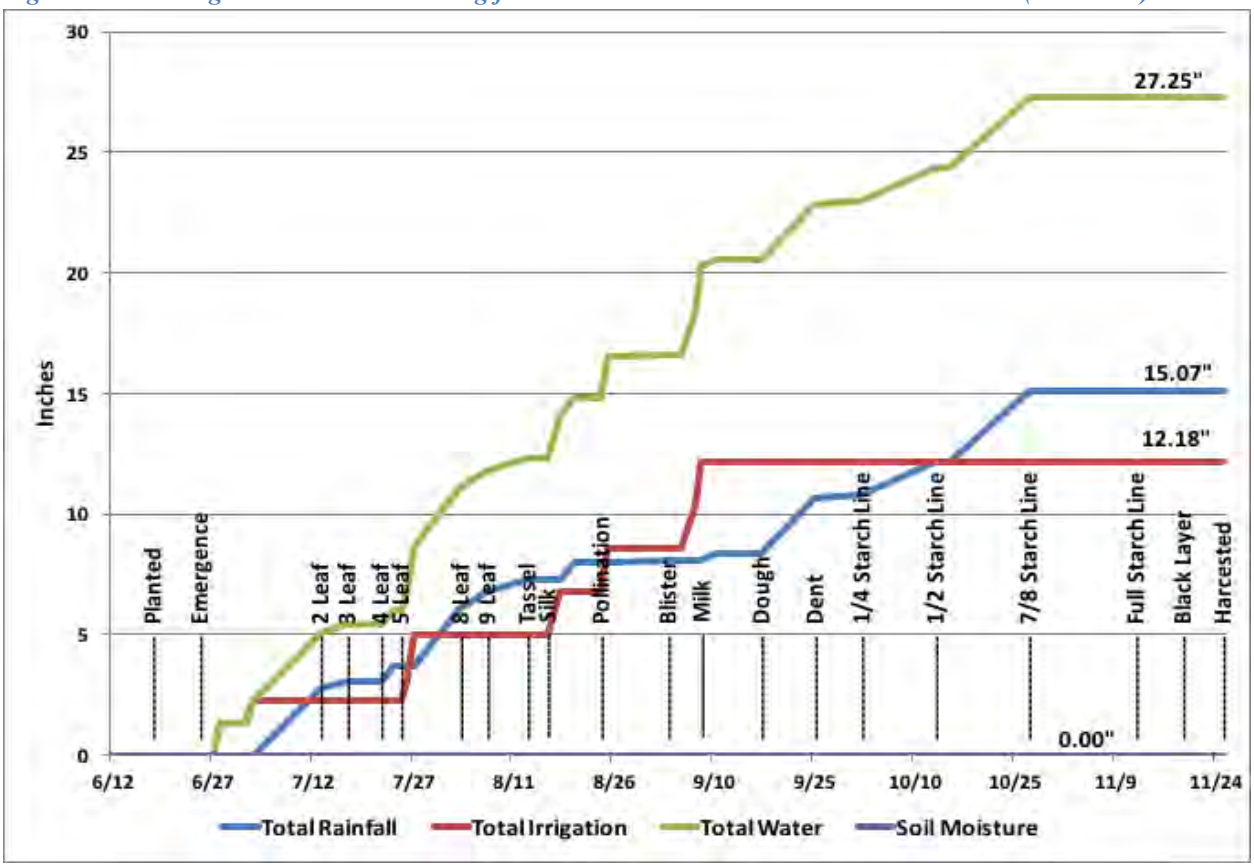


Table 30: Demonstration Field Data for Dennis Buss' "5 GPM" Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
					1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/28	1.16												Pivotrac
5/5	0.86												Pivotrac
5/6	0.14												Pivotrac
5/9	0.11												Pivotrac
5/14	0.41												Pivotrac
5/16	0.15												Pivotrac
5/17	0.67												Pivotrac
5/19	0.84												Pivotrac
5/20	0.57												Pivotrac
5/22	0.47												Pivotrac
5/23	0.63												Pivotrac
6/1	0.49												Pivotrac
6/4	1.03		589.54								258 N		C & L
6/11	2.10		589.54								258 N		C & L
6/18	0.06		589.54	planted							258 N		Curtis
6/25			589.54	emerging							258 N		C & L
6/27			589.54	emerging						5 gpm	270 Y		Pivotrac
6/28		1.35	591.79	emerging						5 gpm	330 Y	465	Leon
7/2			599.75	emerged						5 gpm	330 Y	465	Leon
			600.36	emerged						5 gpm	331 Y	475	C & L
7/3		0.95	601.35	emerged						5 gpm	291 N	465	Leon
7/13	2.77		601.94	2 leaf							291 N		C & L
7/17	0.32		601.94	3 leaf	99.6	99.6	99.2	No gen	no gen		289 N		C & L
7/22			601.94	4 leaf						move dry	112 N		Pivotrac
7/24	0.58		601.94	4 leaf						move dry	90 N		Pivotrac
			601.94	4 leaf						3 gpm	90 Y		Pivotrac
			602.25	4 leaf	98.6	100.8	100.4	100.5	99.2	3 gpm	72 Y	400	C & L
7/25			604.49	5 leaf						5 gpm	330 Y		Pivotrac
7/26		0.79	605.82	5 leaf						5 gpm	270 rev	465	Pivotrac
7/27		1.92	609	6 leaf						5 gpm	330 Y	465	Leon
8/3	2.42		614.01	8 leaf	99.0	99.2	98.7	98.9	98.7		75 N		C & L
8/7	0.69		614.01	9 leaf	99.6	99.8	99.3	99.5	99.3		75 N		C & L
8/13	0.54		614.01	tassel	99.3	100.3	99.8	100.1	99.7		75 N		Curtis
8/16			618.93	silk						5 gpm	330 Y	450	Pivotrac
8/18		1.79	621.93	silk						5 gpm	273 N	450	Leon
8/20	0.70		622.19	silk	97.7	99.3	99.0	99.3	98.9		273 N		Curtis
8/24			622.19	pollinate						5 gpm	273 Y		Pivotrac
8/25		1.74	625.08	pollinate						5 gpm	330 Y	410	Leon
8/27			628.17	pollinate	97.8	97.9	98.1	99.0	98.9	3 gpm	54 Y	318	Curtis
9/3	0.05		629.78	blister	43.2	90.8	90.7	99.0	99.2	3 gpm	87 Y	373	Curtis
9/5			633.91	blister						5 gpm	330 Y		Pivotrac
9/7		1.8	636.91	blister						5 gpm	270 rev	450	Pivotrac
9/8		1.84	639.97	milk						5 gpm	330 Y	450	Leon
9/10	0.30		642.72	milk	99.5	91.5	69.8	95.2	99.7	3 gpm	65 Y	338	Curtis
9/17			644.09	dough	91.2	90.7	60.7	89.6	98.7		85 N		Curtis
9/25	2.31		644.09	dent	98.3	93.9	51.3	81.0	96.3		85 N		C & L
10/2	0.11		644.09	1/4mat ln	97.5	97.3	52.6	78.6	93.7		85 N		C & L
10/13	1.37		644.09	1/2mat ln	98.3	98.9	75.2	78.3	93.4		85 N		Curtis
10/15			644.09	3/4mat ln	98.2	98.8	84.8	77.4	93.0		85 N		Curtis
10/27	2.91		644.09	7/8mat ln	97.6	98.4	98.0	86.4	91.8		85 N		C & L
11/4	0.50		644.09	7/8mat ln	97.9	98.8	98.7	97.4	94.4		85 N		Curtis
11/12			644.09	1.0mat ln	97.2	98.2	98.0	97.1	96.6		85 N		Curtis
11/19	0.19		644.09	bm layer	96.8	97.7	97.6	96.7	96.9		85 N		C & L
11/24										move dry	109		Pivotrac
11/25			644.09	harvest	96.7	97.7	97.7	96.7	97.0		109 N		Curtis
Total	**15.07**	**12.18**			**0.0**	**0.0**	**0.0**	**0.0**	**0.0**				**Leon**
Net Soil Moisture is 0.00"													
Irrigation, Rainfall Plus Net Soil Moisture is 27.25"													

• Numbers in red are not counted in the total

NORTH PLAINS GROUNDWATER Conservation District

2015-Corn Demonstration
Irrigated Medium Season Corn

5 GPM

Year:	2015	**County:**	Hartley	**Grower:**	Hartley Feeders
No. Acres:	20	**Variety/Hyb:**	P1498 HR	**Soil Type:**	Sherm Clay Loam
Meter Type:	Seametrics				
Meter Mult:	Acre Feet x 1	**Tillage:**	Strip Till		
Fertilizer:	65-14-5-5s-2Zn	**Seeding:**	28,000		
Planted:	June 16, 2015	**Harvest:**	November 25, 2015		
Herbicide:	Dual, Roundup	**Insecticide:**	None		
Yield:	116 bu/acre @ 15.0% Moist.	**Prev. crop:**	Corn	**Row width:**	30 inches
Irrigation method:	Center Pivot	**Prewater:**	None	**Well GPM:**	375
Distance between drops:	60 inches	**Distance from nozzle to ground:**	16 inches		
Application pattern:	LESA Spray	**Crop row direction :**	Planted in circle		

GPS Location of Pivot Pad		**GPS Location of Gypsum Blocks**	
Latitude:	35.888303	Latitude:	35.88928
Longitude:	-102.455757	Longitude:	-102.45967

Harvest Results: There were potential corn production problems in the demonstration fields beginning at planting. The seed was muddied in within the best weather opening. Seed germination and plant emergence were not good to establish needed plant populations. Volunteer corn was plowed out the best possible, but too much remained. The 3 GPM field produced a 112 bushel per acre corn yield. Irrigation totaled 9.27 inches. Production in the 4 GPM field was 115 bushels per acre. Seasonal irrigation totaled 10.97 inches. Corn yield was 116 bushels per acre for the 5 GPM field. Irrigation totaled 12.18 inches. There was no pre-season irrigation. The 4 GPM field produced 3 more bushels per acre than the 3 GPM field and irrigation was 1.70 inches more. The 5 GPM field produced 4 more bushels per acre than the 3 GPM with 2.91 more inches of irrigation. The 5 GPM yield was 1 more bushel per acre than that from the 4 GPM field with 1.21 additional inches of irrigation. Corn production was 12.08 bushels (676lbs) per inch of irrigation in the 3 GPM field compared to 12.48 bushels (587lbs) in the 4 GPM and 9.52 bushels (533lbs) from the 5 GPM field. Production from each inch of irrigation, rainfall and net soil water that totaled 23.74 inches was 4.72 bushels (264lbs) per acre in the 3 GPM field. Irrigation, rainfall and net soil water totaled 26.04 inches in the 4 GPM field where production was 4.41 bushels (247lbs) per inch. In the 5 GPM field, irrigation, rainfall and net soil water totaled 27.25 inches where production was 4.25 bushels (238lbs) per inch of total water. Irrigation and total water was managed well. Corn yields are not representative of past production in this field due to the problems encountered in 2015. Therefore, corn yields are not included in appendix and other summaries because of the field and environmental problems encountered. A summary of the demonstration results are shown in table 31 below.

Table 31: Dennis Buss' 2015 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $3.97/bu		
			bu/ac	lb/ac-in Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"3 GPM"	9.27	*23.74	112	676	$444.64	$47.96	$18.73
"4 GPM"	10.97	†26.04	115	587	$456.55	$41.62	$17.53
"5 GPM"	12.18	#27.25	116	533	$460.52	$37.80	$16.90

*Includes 0 inches of soil water removed within five feet of soil
†Includes 0 inches of soil water removed within five feet of soil
#Includes 0 inches of soil water removed within five feet of soil

Harold Grall's 2015 LEPA Shroud and T-L Precision Mobile Drip Irrigation (PMDI) Demonstration

Planting and Crop Information: Harold Grall strip tilled and planted 120 acres of corn in the NW 1/4 of a circle for the "LEPA Shroud and T-L PMDI System" demonstration. Senninger LEPA Shroud applicators were installed 30 inches apart in spans 2, 3, 4, 5, 7, 8 and the end section prior to the 2015 growing season. T-L PMDI drag lines were installed 30 inches apart in span 6. LDN LESA spray applicators remain in span 1. Grall planted the LEPA Shroud and PMDI fields with Pioneer 1151amx hybrid. Seeding rate for the LEPA Shroud and PMDI fields was 30,000 seeds per acre. Center pivot travel was tracked by PivoTrac™. Seasonal water meter readings averaged 320 gpm. Irrigation was approximately 1.01 inches in a 7.2 day revolution. Timely rainfall allowed the center pivot to be stopped more than in recent years. Planting and crop information for "Grall LEPA Shroud" and "Grall T-L PMDI" are shown in the table 32 below.

Table 32: Planting and Crop Information for Harold Grall LEPA and PMDI

LEPA Shroud Demonstration Site: Spans 2,"3-4-5 GPM",7,8,end section			
Planted:	*May 27*	**Harvested:**	*November 2*
Hybrid:	*Pioneer P1151 amx*	**Seeding Rate:**	*30,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*102.7*	**GPM/Acre:**	*2.67*
Total Water:	*26.18 inches*	**Soil Type:**	*Sherm Silty Clay Loam*
Irrigation:	*11.58 inches*	**Fertilizer**:	90-59-0-0
Herbicide:	*Cinch, Powermax* Balance Flex, Intensity		
Insecticide:	*Comite, Stratego fungicide*		

T-L PMDI Demonstration Site: Span 6			
Planted:	*May 27*	**Harvested:**	*November 2*
Hybrid:	*Pioneer P1151amx*	**Seeding Rate:**	*30,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*17.3*	**GPM Per Acre:**	*2.67*
Total Water:	*26.18 inches*	**Soil Type:**	*Sherm Clay Loam*
Irrigation:	*11.58 inches*	**Fertilizer:**	90-59-0-0
Herbicide:	*Cinch, Powermax* Balance Flex, Intensity		
Insecticide:	*Comite, Stratego fungicide*		

Soil Water Profile and Growing Season Rainfall

"LEPA Shroud Demonstration Site": Preseason soil water was good at 1, 2, 3, 4 and 5 feet from more than nine inches of rainfall in late April and May prior to planting. Soil moisture sensors show the crop had adequate soil water during the growing season. Weekly gypsum block readings indicate a full profile of soil water was maintained until September when rainfall was less and irrigation had stopped. Crop roots used significant water from 1 and 2 feet plus limited amounts from 3 and 4 feet to finish the crop. The sensors show more than five inches of rainfall

on October 27 refilled the soil profile to capacity to five feet. The crop was produced in Sherm silty clay loam soil that can store approximately 2.0 inches of available water per foot for potential crop use. Timely beneficial rainfall contributed to producing a 244 bushel per acre corn yield, also allowing irrigation to be less than in recent years. Total rainfall from planting until grain maturity black layer totaled 14.60 inches, and was more normal for this location. Gypsum blocks were installed in late June, following planting, due to wet soil conditions prior to planting.

"T-L PMDI Demonstration Site": Soil water was good at 1, 2, 3, 4 and 5 feet from nine inches of rainfall in late April and May prior to planting. Weekly gypsum block readings show good soil moisture levels were maintained at 1, 2, 3, 4 and 5 feet during the growing season. Moisture sensors show the crop used slightly more soil water from 1 and 3 feet than the LEPA field and similar amounts from 2, 4 and 5 feet, in addition to rainfall and irrigation in September to finish the crop. Soil moisture sensors show the crop had sufficient soil water during the growing season. Gypsum block moisture sensors were installed in June following planting. Timely rainfall contributed to producing the 244 bushel per acre corn yield. Total rainfall from planting through black layer was 14.60 inches. The crop was produced in Sherm silty clay loam soil that holds approximately 2.0 inches available water per foot for potential crop use.

Table 33: Monthly Rainfall Data for Harold Grall LEPA Shroud & T-L PMDI

	June	July	August	September	October	Total
LEPA	0.60"	6.21"	4.73"	1.24"	1.82"	**14.60"**
PMDI	0.60"	6.21"	4.73"	1.24"	1.82"	**14.60"**

Growing Season Water Tracking: The district tracked total water and crop growth throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. One set of five gypsum block soil moisture sensors was installed at 1, 2, 3, 4 and 5 feet and an AquaSpy® soil moisture probe was installed down to five feet in the root zone at one location to monitor soil water levels in the "3 GPM" field. Another set of the same type of sensors were installed in both the "4 GPM" and "5 GPM" fields. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in each field. Due to wet soils from abundant April and May rainfall, all Gypsum blocks were installed following planting. Gypsum blocks, water meter, rain gauges and crop growth are read, recorded and utilized weekly by district personnel. Each AquaSpy® probe was installed following crop emergence. A 24/7 AquaSpy® probe website shows soil moisture at four inch increments to 60 inches and monitors plant root growth. The website lists all AquaSpy® soil probes in the "3-4-5 GPM" project and is available to all cooperators and district personnel. Another 24/7 PivoTrac™ website tracks each center pivot system and monitors and controls irrigation. Each center pivot travel speed prescription written to apply 1.10 inches ("3 GPM"), 1.49 inches ("4 GPM") and 1.85 inches ("5 GPM") is managed from the PivoTrac™ website. Both the cooperating grower and district "3-4-5 GPM" project leader collectively monitor, control and manage irrigation from the PivoTrac™ website. Following this paragraph, a series of graphs and tables shows weekly gypsum block readings for the season; growing season water, including rainfall, irrigation, and soil moisture at various growth stages; and the order of irrigation and rainfall events for each "3-4-5 GPM" field. Finally, a form describes the protocols for each field. "Total Water," as shown on the graph for growing season water, is the sum of seasonal irrigation, rainfall and net soil

water. Graphs and tables for the 3 GPM acres are shown first, followed by the same illustrations for each 4 GPM and 5 GPM.

Figure 43: Gypsum Block Readings for Harold Grall's LEPA Demonstration Site (244 bu/ac)

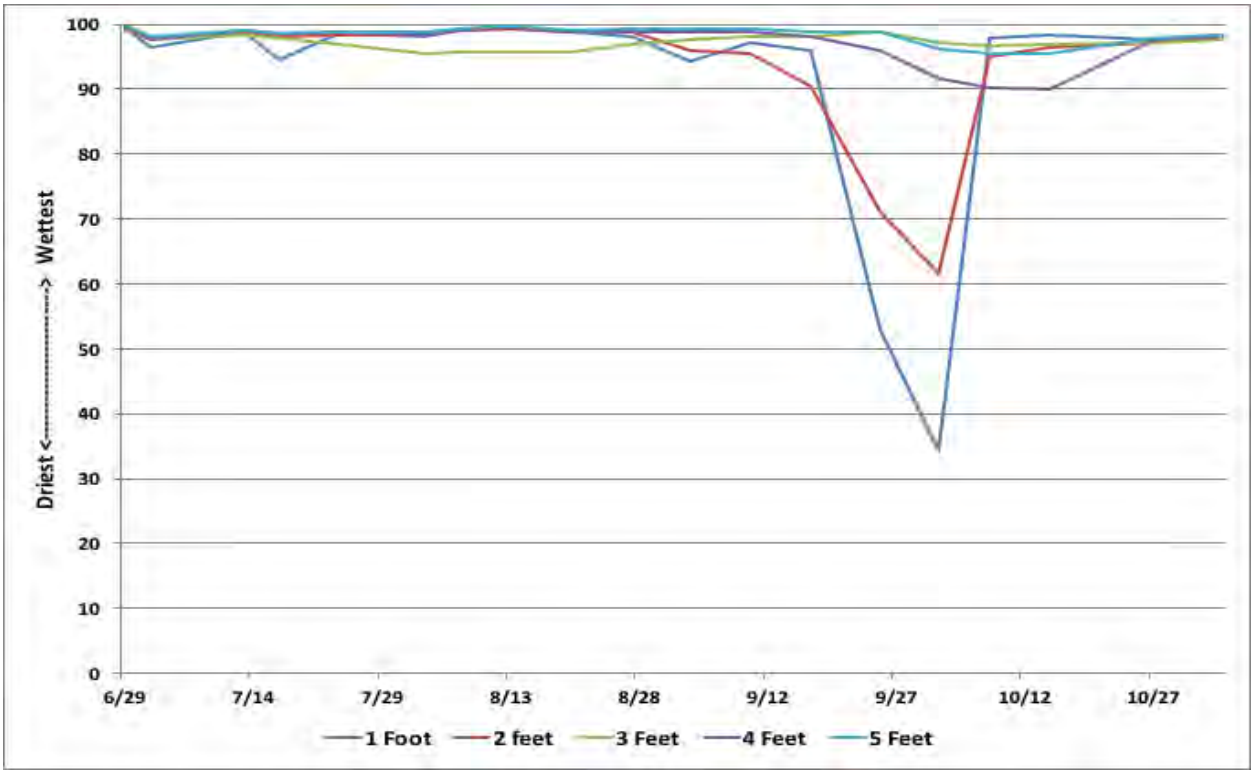


Figure 44: Growing Season Water Tracking for Harold Grall's LEPA Demonstration Site (244 bu/ac)

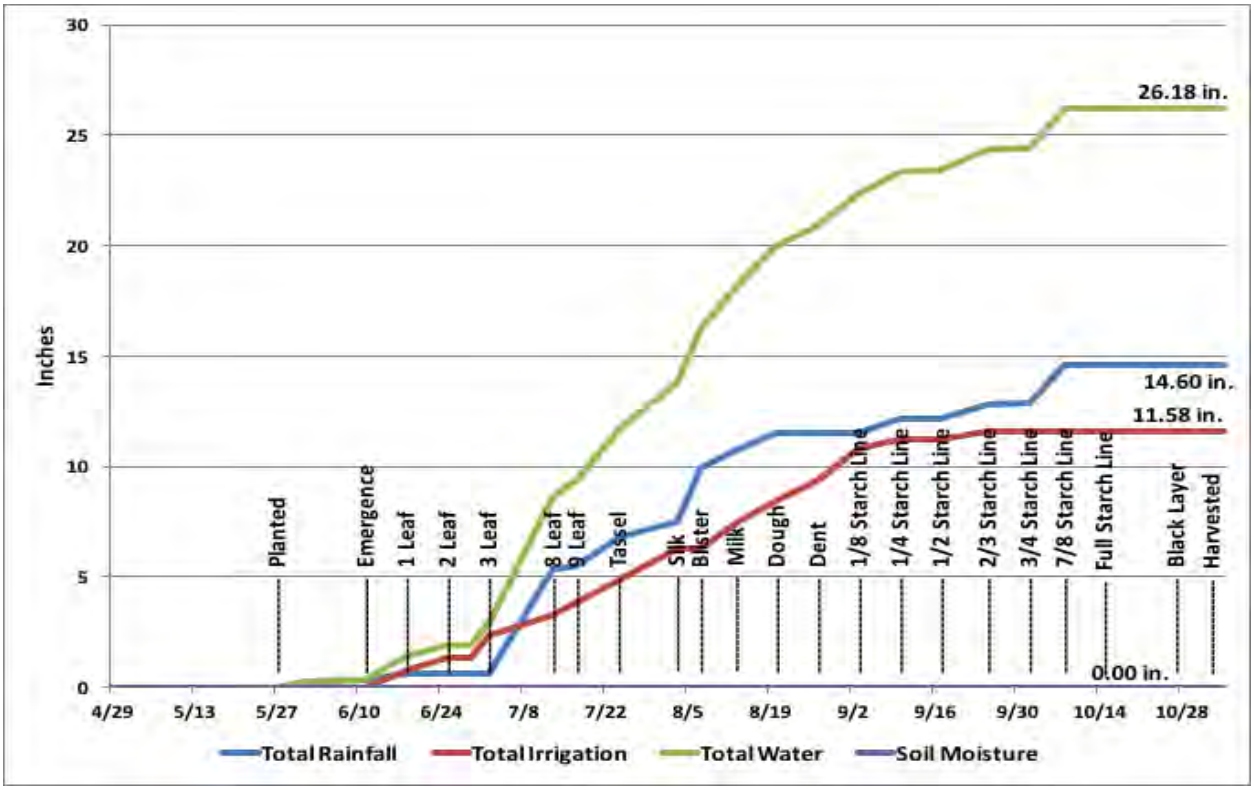


Table 34: Demonstration Field Data for Harold Grall's LEPA Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Hour Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
						1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/29	1.97													Pivotrac
5/5	1.28													Pivotrac
5/6	0.52													Pivotrac
5/9	0.88													Pivotrac
5/14	0.58													Pivotrac
5/16	0.58													Pivotrac
5/19	0.61													Pivotrac
5/20	1.20													Pivotrac
5/22	0.66													Pivotrac
5/23	1.04													Pivotrac
5/24	0.10													Pivotrac
5/27											plant			Harold
6/1	0.26													Pivotrac
6/2			0.000	25959.7								201 N		C & L
6/11	0.06		0.000	25978.1	emerged							2 N		C, L, Pivot
6/18	0.28	0.78	7.867	26024.5	1 leaf						LEPA&MPDI	177 Y cw	334	Curtis
6/25		0.53	13.162	26192.5	2 leaf						LEPA&MPDI	24.5 Y cw	329	C & L
6/29					3 leaf	99.5	99.1	99.4	99.5	99.8				C & L
7/2		1.02	23.424	26359.1	3 leaf	96.3	97.8	97.6	97.5	98	LEPA&MPDI	66 Y	334	C & L
7/13	4.77	0.97	33.116	26517.7	8 leaf	98.7	98.8	98.4	99.1	99.1	LEPA&MPDI	56 Y	329	C & L
7/17	0.15	0.57	38.851	26612.4	9 leaf	94.6	98.1	97.8	98.6	98.5	LEPA&MPDI	259 Y	325	C & L
7/24	1.29	0.96	48.483	26772.7	tassel	98.6	98.4	96.9	98.9	98.9	LEPA&MPDI	247 Y	322	C & L
8/3	0.69	1.46	63.132	27018.2	silk	98.1	98.3	95.4	98.4	98.7	LEPA&MPDI	49 Y	322	C & L
8/7	2.45		66.058	27066.9	blister	99.0	99	95.8	99.3	99.4	LEPA&MPDI	152 Y	325	C & L
8/13	0.75	1.15	74.680	27211.1	milk	99.2	99.4	95.8	99.5	99.8	LEPA&MPDI	95 Y	322	Curtis
8/20	0.84	0.97	84.444	27376.5	dough	98.8	98.7	95.8	98.9	99.1	LEPA&MPDI	86 Y	318	Curtis
8/27		0.97	94.119	27544.5	dent	98.0	98.7	96.8	98.9	99.2	LEPA&MPDI	79 Y	310	Curtis
9/3		1.40	108.083	27700.7	1/8mat ln	94.3	96	97.5	98.9	99.2	LEPA&MPDI	48 Y	308	Curtis
9/10	0.60	0.45	112.531	27868.9	1/4mat ln	97.2	95.5	98.1	98.8	99.3	LEPA&MPDI	44 Y	291	Curtis
9/17	0.05		116.076	27933.3	1/2mat ln	96.0	90.5	98.1	98.1	98.7	LEPA&MPDI	177 N		Curtis
9/25	0.59	0.35	116.078	27933.3	2/3mat ln	52.9	71.2	98.7	95.9	98.8	LEPA&MPDI	178 N		C & L
10/2	0.06		116.078	27933.3	3/4mat ln	34.3	61.6	97.1	91.6	96.2	LEPA&MPDI	178 N		C & L
10/8	1.76		116.078	27933.3	7/8mat ln	97.9	95	96.7	90.2	95.5		178 N		C & L
10/15			116.078	27933.3	1.0mat ln	98.3	96.4	97.0	90.0	95.4		178 N		Curtis
10/27	5.18		116.078	27933.3	blk layer	97.7	97.2	97.1	97.7	97.8		178 N		C & L
11/2					harvest						move dry	187 N		Harold
11/4	0.31		116.078	27933.8	harvested	98.3	97.8	97.6	98.1	98.3		187 N		Curtis
Total	**14.60**	**11.58**				**0**	**0**	**0**	**0**	**0**			**320**	**Leon**
Net Soil Moisture is 0.00"														
Irrigation, Rainfall Plus Net Soil Moisture is 26.18"														

* Numbers in red are not counted in the total

NORTH PLAINS GROUNDWATER Conservation District

2015-Corn Demonstration
Irrigated Medium Season Corn

328 LEPA

Year:	2015	**County:**	Moore	**Grower:**	Harold Grall
No. Acres:	101.2	**Variety/Hyb:**	P1151AM	**Soil Type:**	Sherm Silty Clay Loam
Meter Type:	McCrometer				
Meter Mult:	Acre Feet x 1	**Tillage:**	Strip Till		
Fertilizer:	90-59-0-0	**Seeding:**	30,000		
Planted:	May 27, 2015	**Harvest:**	November 2, 2015		
Herbicide:	Powermax, Cinch, Intensity, Balance Flex			**Insecticide:**	Comite, Stratego Fungicide
Yield:	244 bu/acre @ 15.0% Moist.	**Prev. crop:**	Milo	**Row width:**	30 inches
Irrigation method:	Center Pivot	**Prewater:**	0	**Well GPM:**	320
Distance between drops:	30 inches	**Distance from nozzle to ground:**	16 inches		
Application pattern:	LEPA Shroud	**Crop row direction :**	Straight		

GPS Location of Pivot Pad		**GPS Location of Gypsum Blocks**	
Latitude:	35.92046	Latitude:	35.9237
Longitude:	-102.101227	Longitude:	-102.10146

Harold Grall's LEPA Site AquaSpy® Probe Summary

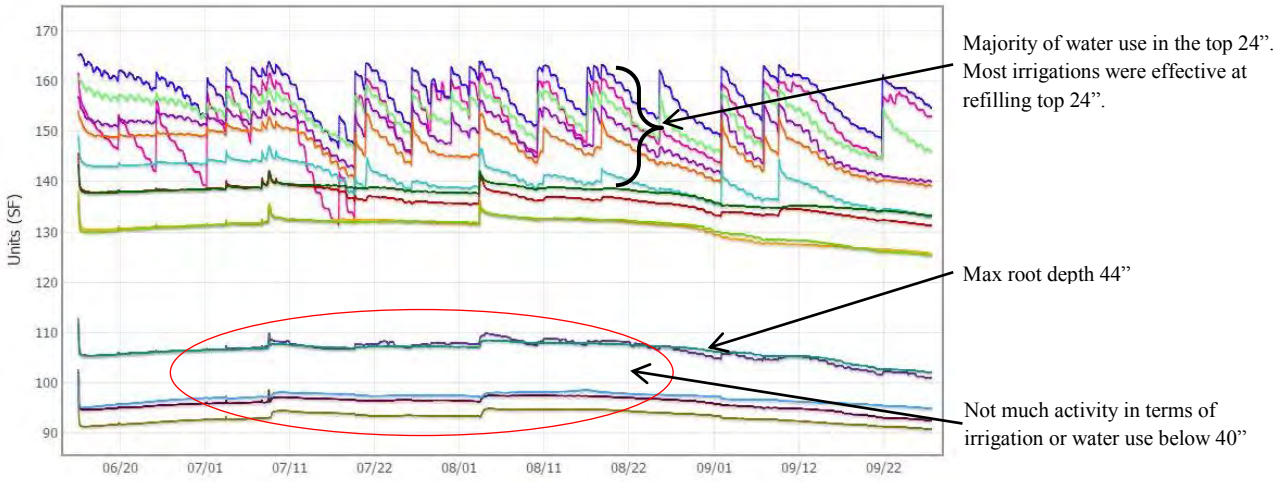


Figure 45. Grall Field 328 LEPA

The treatments in this field had much more active roots than the treatments in other LEPA fields. It is possible that this was due to soil type or variety, or it could be due to irrigation. It is evident that there was quite active water use in the top 24" and that the maximum root depth was to 44". Most irrigations were effective at refilling the soil and the irrigation was able to keep up with demand. This produced the high yield and water use efficiency observed. There was also no evidence of drainage at this site.

Figure 46: Gypsum Block Readings for Harold Grall's PMDI Demonstration Site (244 bu/ac)

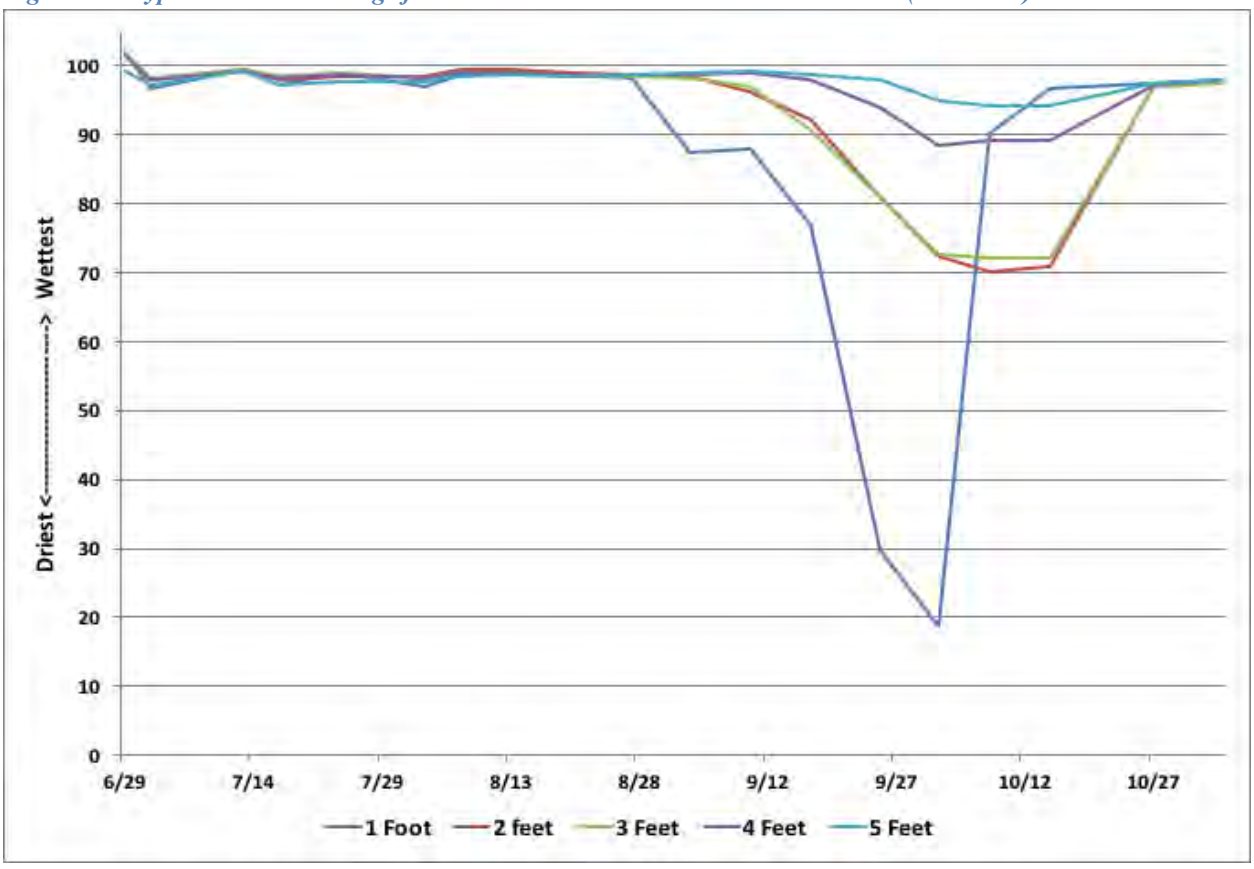


Figure 47: Growing Season Water Tracking for Harold Grall's PMDI Demonstration Site (244 bu/ac)

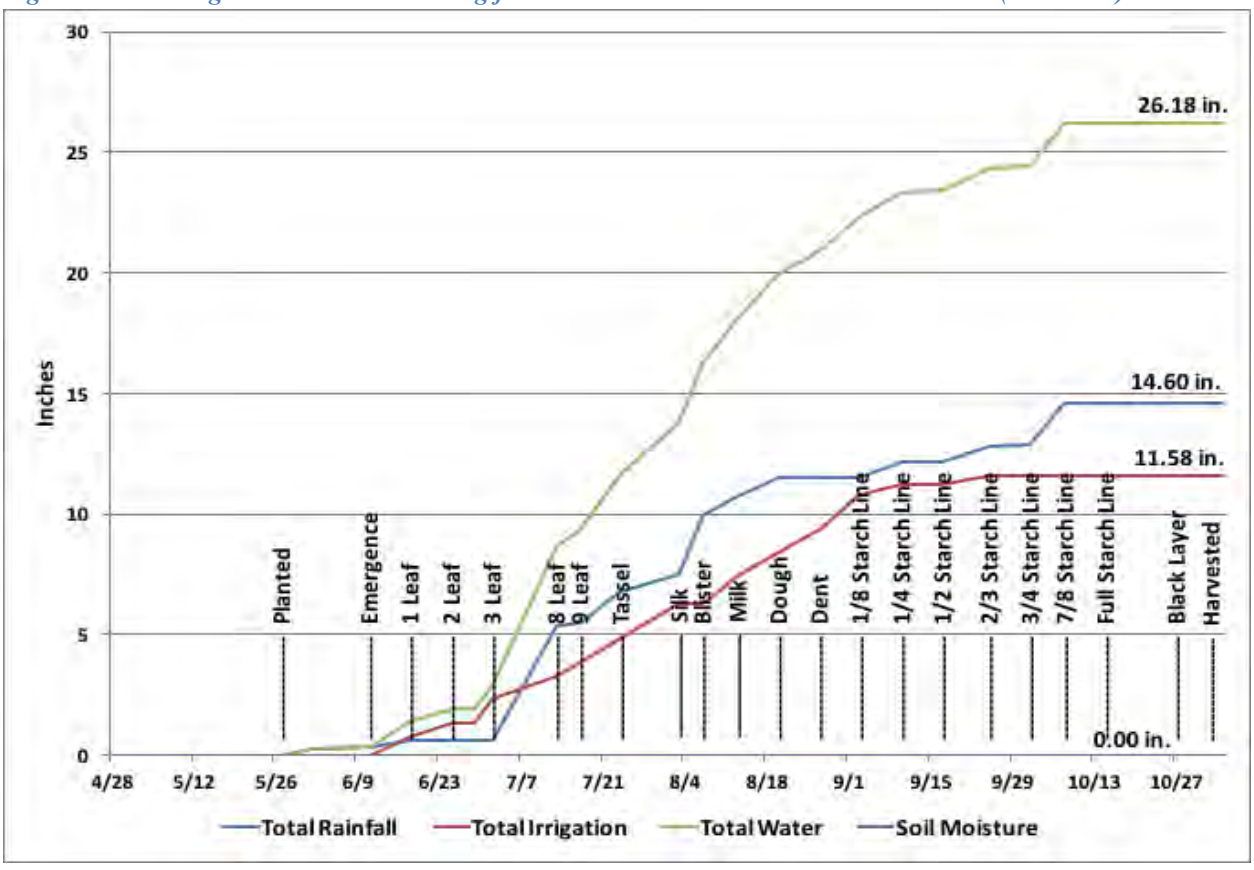


Table 35: Demonstration Field Data for Harold Grall's PMDI Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Hour Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
						1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/28	2.97													Pivotrac
5/5	1.28													Pivotrac
5/6	0.52													Pivotrac
5/9	0.48													Pivotrac
5/14	0.38													Pivotrac
5/16	0.38													Pivotrac
5/19	0.61													Pivotrac
5/20	1.20													Pivotrac
5/22	0.66													Pivotrac
5/23	1.04													Pivotrac
5/24	0.10													Pivotrac
5/27											plant			Harold
6/1	0.26													Pivotrac
6/2			0.00	25969.7								201 N		C & L
6/11	0.06		0.00	25978.1	emerged							2 N		C, L, Pivot
6/18	0.28	0.78	7.867	26024.5	1 leaf						all	177 Y cw	334	Curtis
6/25		0.53	13.162	26192.5	2 leaf						all	25 Y cw	329	C & L
6/29						102.0	101.8	101.7	101.5	99.2				C & L
7/2		1.02	23.424	26359.1	3 leaf	96.7	98.1	98.3	98.0	97.2	all	66 Y cw	334	C & L
7/13	4.77	0.97	33.116	26517.7	8 leaf	99.4	99.4	99.6	99.3	99.2	all	56 Y cw	329	C & L
7/17	0.15	0.57	38.851	26612.4	9 leaf	97.3	98.0	98.4	98.2	97.3	all	259 Y cw	325	C & L
7/24	1.29	0.96	48.483	26772.7	tassel	99.0	98.5	98.9	98.8	97.7	all	247 Y cw	322	C & L
8/3	0.69	1.46	63.132	27018.2	silk	97.1	98.6	98.3	98.3	97.7	all	49 Y cw	322	C & L
8/7	2.45		66.058	27066.9	blister	98.7	99.4	99.1	99.0	98.4	all	152 Y cw	325	C & L
8/13	0.75	1.15	74.680	27211.1	milk	99.0	99.5	99.1	99.1	98.8	all	95 Y cw	322	Curtis
8/20	0.84	0.97	84.444	27376.5	dough	98.7	99.0	98.6	98.6	98.6	all	86 Y cw	318	Curtis
8/27		0.97	94.119	27544.5	dent	98.2	98.8	98.4	98.8	98.7	all	79 Y cw	310	Curtis
9/3		1.40	108.083	27700.7	1/8mat ln	87.5	98.6	98.2	98.8	98.9	all	48 Y cw	308	Curtis
9/10	0.60	0.45	112.531	27868.9	1/4mat ln	88.0	96.2	97.1	99.0	99.2	all	43 Y cw	291	Curtis
9/17	0.05		116.076	27933.3	1/2mat ln	77.0	92.1	90.6	98.1	98.7		178 N		Curtis
9/25	0.59	0.35	116.078	27733.3	2/3mat ln	29.7	80.8	81.0	94.0	98.0		178 N		C & L
10/2	0.06		116.078	27733.3	3/4mat ln	18.7	72.4	72.7	88.5	95.0		178 N		C & L
10/8	1.76		116.078	27933.3	7/8mat ln	90.2	70.1	72.1	89.1	94.1		178 N		C & L
10/15			116.078	27933.3	1.0mat ln	96.7	70.9	72.1	89.3	94.3		178 N		Curtis
10/27	5.18		116.078	27933.3	blk layer	97.4	97.3	96.9	97.3	97.4		178 N		C & L
11/2					harvest						move dry	187 N		Pivotrac
11/4	0.31		116.078	27933.8	harvested	98.1	97.8	97.5	97.9	98.1		187 N		Curtis
Total	**14.60**	**11.58**				**0.0**	**0.0**	**0.0**	**0.0**	**0.0**			**320**	**Leon**
Net Soil Moisture is 0.00"														
Irrigation, Rainfall Plus Net Soil Moisture is 26.18"														

• Numbers in red are not counted in the total

NORTH PLAINS GROUNDWATER Conservation District

2015-Corn Demonstration
Irrigated Medium Season Corn

328 PMDI

Year:	2015	**County:**	Moore	**Grower:**	Harold Grall
No. Acres:	20.3	**Variety/Hyb:**	P1151AM	**Soil Type:**	Sherm Silty Clay Loam
Meter Type:	McCrometer				
Meter Mult:	Acre Feet x 1	**Tillage:**	Strip Till		
Fertilizer:	90-59-0-0	**Seeding:**	30,000		
Planted:	May 27, 2015	**Harvest:**	November 2, 2015		
Herbicide:	Powermax, Cinch, Balance Flex, Intensity	**Insecticide:**	Comite, Stratego Fungicide		
Yield:	244 bu/acre @ 15.0% Moist.	**Prev. crop:**	Milo	**Row width:**	30 inches
Irrigation method:	Center Pivot	**Prewater:**	0	**Well GPM:**	320
Distance between drops:	30 inches	**Distance from nozzle to ground:**	Rides Plants		
Application pattern:	PMDI Drag Drip	**Crop row direction :**	Straight		

GPS Location of Pivot Pad		**GPS Location of Gypsum Blocks**	
Latitude:	35.92046	Latitude:	35.92299
Longitude:	-102.101227	Longitude:	-102.10137

Harold Grall's PMDI Site AquaSpy® Probe Summary

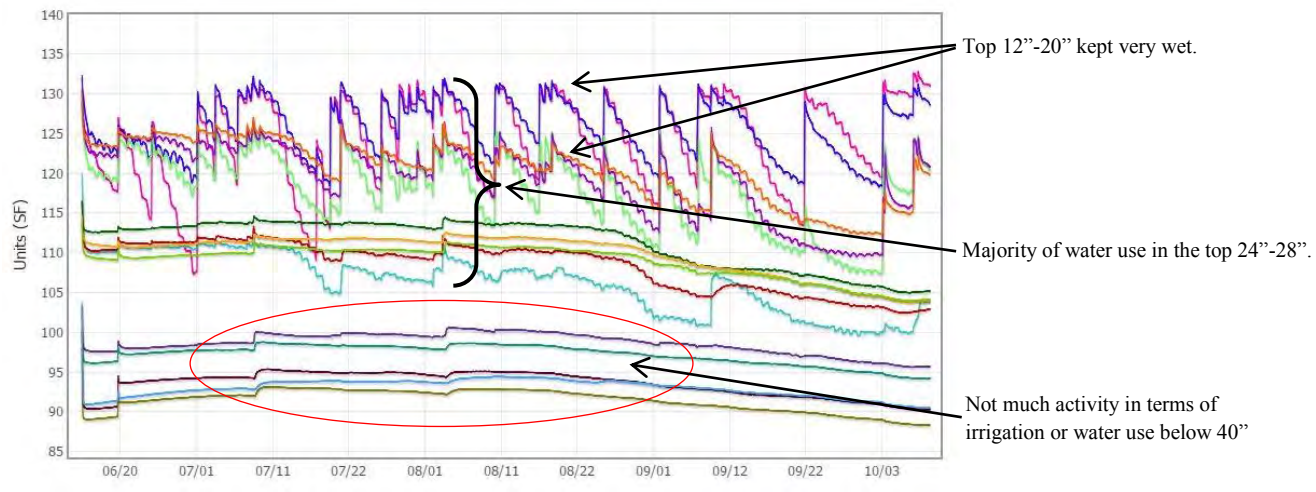


Figure 48. Grall Field 328 PMDI Drip

The drag drip line seemed to produce results that were very consistent with LEPA irrigation. If anything, infiltration was slightly shallower and the topsoil was kept wetter for longer. The LEPA was better able to get water to penetrate to 24", which is where the majority of the active roots were located. There was no evidence of drainage and the maximum root depth was about 40". The yield of this treatment was not split from the LEPA treatment but judging from the water use data, it is my opinion that the LEPA would have out-performed the drag drip – if only slightly.

Harvest Results: The LEPA Shroud field produced a 244 bushel per acre corn yield. Irrigation totaled 11.58 inches. Production in the T-L PMDI field was 244 bushels per acre also. Seasonal irrigation totaled 11.58 inches as well. No difference in corn yields produced by the two irrigation systems was identified. There was no pre-season irrigation on either field. Corn production was 21.07 bushels (1180lbs) per inch of irrigation in both the LEPA Shroud and T-L PMDI fields. Production from each inch of irrigation, rainfall and net soil water that totaled 26.18 inches was 9.32 bushels (522lbs) per acre in the LEPA Shroud and T-L PMDI fields. Crop production costs for irrigation, seed, fertilizer and harvest costs were $459.36 per acre for the LEPA Shroud and T-L PMDI fields. At $3.97 per bushel, gross value of the 244 bushel per acre yield is $968.68 per acre. Net return from the LEPA Shroud and T-L PMDI fields was $509.30 per acre. Net return from each inch of irrigation is $43.98 for both fields. Net return from each inch of irrigation, rainfall and net soil water that totaled 26.18 inches is $19.45 per inch for the LEPA Shroud and T-L PMDI fields. The 2015 LEPA Shroud and T-L PMDI demonstration is an excellent initial comparison of two high efficiency water application center pivot irrigation systems. Both current existing center pivot systems, when properly equipped and managed, can extend the profitability of irrigated crop production in combination with advanced management tools and technology utilized and demonstrated by the "3-4-5" project. Current plans are to conduct the "3-4-5" variable rate irrigation at this site in 2016 to develop additional information for potential ready grower adoption. A summary of the 2015 LEPA Shroud and T-L PMDI demonstration results are shown in table 36 below and Appendix A.

Table 36: Harold Grall's 2015 LEPA Shroud and T-L PMDI 2015 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $3.97/bu		
			bu/ac	lb/ac-in Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"LEPA"	11.58	*26.18	244	1180	$968.68	$83.65	$37.00
PMDI	11.58	†26.18	244	1180	$968.68	$83.65	$37.00

*Includes 0 inches of soil water removed within five feet of soil, plus rainfall, and irrigation.
†Includes 0 inches of soil water removed within five feet of soil, plus rainfall, and irrigation.

Harold Grall's 2015 PMDI Irrigation Systems Demonstration

Planting and Crop Information: Harold Grall strip tilled and planted 120 acres of corn in the SW 1/4 of a section for his "PMDI Irrigation Systems" demonstration. The T-L center pivot was equipped with T-L PMDI drag lines prior to the 2015 growing season. PMDI drag lines were installed 30 inches apart on all of the ¼ mile center pivot, except span 1 where Senninger LDN LESA applicators remain. The PMDI field was planted to Pioneer 1151amx hybrid. Seeding rate for the PMDI field was 28,000 seeds per acre. Center pivot tracking was by PivoTrac™. Center pivot travel speed was approximately a 7 day circle that applied about 1.0 inch each revolution. Seasonal water meter readings averaged 320 gpm. Timely rainfall allowed the center pivot to be stopped more than in recent years. Planting and crop information for "Grall PMDI Irrigation System" demonstration is in table 37 below.

Table 37: Planting and Crop Information for Harold Grall PMDI Irrigation System

PMDI Demonstration Site:			
Planted:	*June 5*	**Harvested:**	*November 10*
Hybrid:	*Pioneer 1151amx*	**Seeding Rate:**	*28,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*120*	**GPM/Acre:**	*2.67*
Total Water:	*26.08 inches*	**Soil Type:**	*Sherm Silty Clay Loam*
Irrigation:	*14.27 inches*	**Fertilizer**:	92-58-0-0
Herbicide:	*Cinch, Intensity, Powermax,* Balance Flex, Starane		
Insecticide:	*Zeal, Stratego (fungicide)*		

Soil Water Profile and Growing Season Rainfall

"PMDI Irrigation System" Demonstration Site: Pre-water was underway in April due to drier than wanted soil conditions and to test the recently installed PMDI system performance, when 2.50 inches of rainfall fell. Additional rainfall prior to planting totaled 5.31 inches. Pre-water applied on a portion of the field averaged .89 inches. Therefore, beginning soil water was good at 1, 2, 3, 4 and 5 feet from 7.81 inches of rainfall in April and May prior to planting. Soil moisture sensors show the crop had good soil water during the growing season. Weekly gypsum block readings indicate good crop root growth and water use from 1, 2, 3 4 and a dip into 5 feet in September to finish the crop. Sensors show a 4.39 inch rainfall in October refilled the soil profile to 5 feet. Timely beneficial rainfall contributed to producing the crop. Rainfall from planting until grain maturity totaled 11.81 inches, and back to more normal for this location. Gypsum blocks were installed in early-June following planting due to wet soil conditions prior to planting. The crop was produced in Sherm silty clay loam soil that can store approximately 2.0 inches of available water per foot for potential crop use.

Table 38: Monthly Rainfall Data for Harold Grall's PMDI

	June	July	August	September	October	Total
PMDI	0.62"	4.46"	3.45"	1.26"	2.02	**11.81"**

Growing Season Water Tracking: The district tracked total water and crop growth throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. One set of five gypsum block soil moisture sensors was installed at 1, 2, 3, 4 and 5 feet and an AquaSpy® soil moisture probe was installed down to five feet in the root zone at one location to monitor soil water levels in the "3 GPM" field. Another set of the same type of sensors were installed in both the "4 GPM" and "5 GPM" fields. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in each field. Due to wet soils from abundant April and May rainfall, all Gypsum blocks were installed following planting. Gypsum blocks, water meter, rain gauges and crop growth are read, recorded and utilized weekly by district personnel. Each AquaSpy® probe was installed following crop emergence. A 24/7 AquaSpy® probe website shows soil moisture at four inch increments to 60 inches and monitors plant root growth. The website lists all AquaSpy® soil probes in the "3-4-5 GPM" project and is available to all cooperators and district personnel. Another 24/7 PivoTrac™ website tracks each center pivot system and monitors and controls irrigation. Each center pivot travel speed prescription written to apply 1.10 inches ("3 GPM"), 1.49 inches ("4 GPM") and 1.85 inches ("5 GPM") is managed from the PivoTrac™ website. Both the cooperating grower and district "3-4-5 GPM" project leader collectively monitor, control and manage irrigation from the PivoTrac™ website. Following this paragraph, a series of graphs and tables shows weekly gypsum block readings for the season; growing season water, including rainfall, irrigation, and soil moisture at various growth stages; and the order of irrigation and rainfall events for each "3-4-5 GPM" field. Finally, a form describes the protocols for each field. "Total Water," as shown on the graph for growing season water, is the sum of seasonal irrigation, rainfall and net soil water. Graphs and tables for the 3 GPM acres are shown first, followed by the same illustrations for each 4 GPM and 5 GPM.

Figure 49: Gypsum Block Readings for Harold Grall's PMDI Demonstration Site (180 bu/ac)

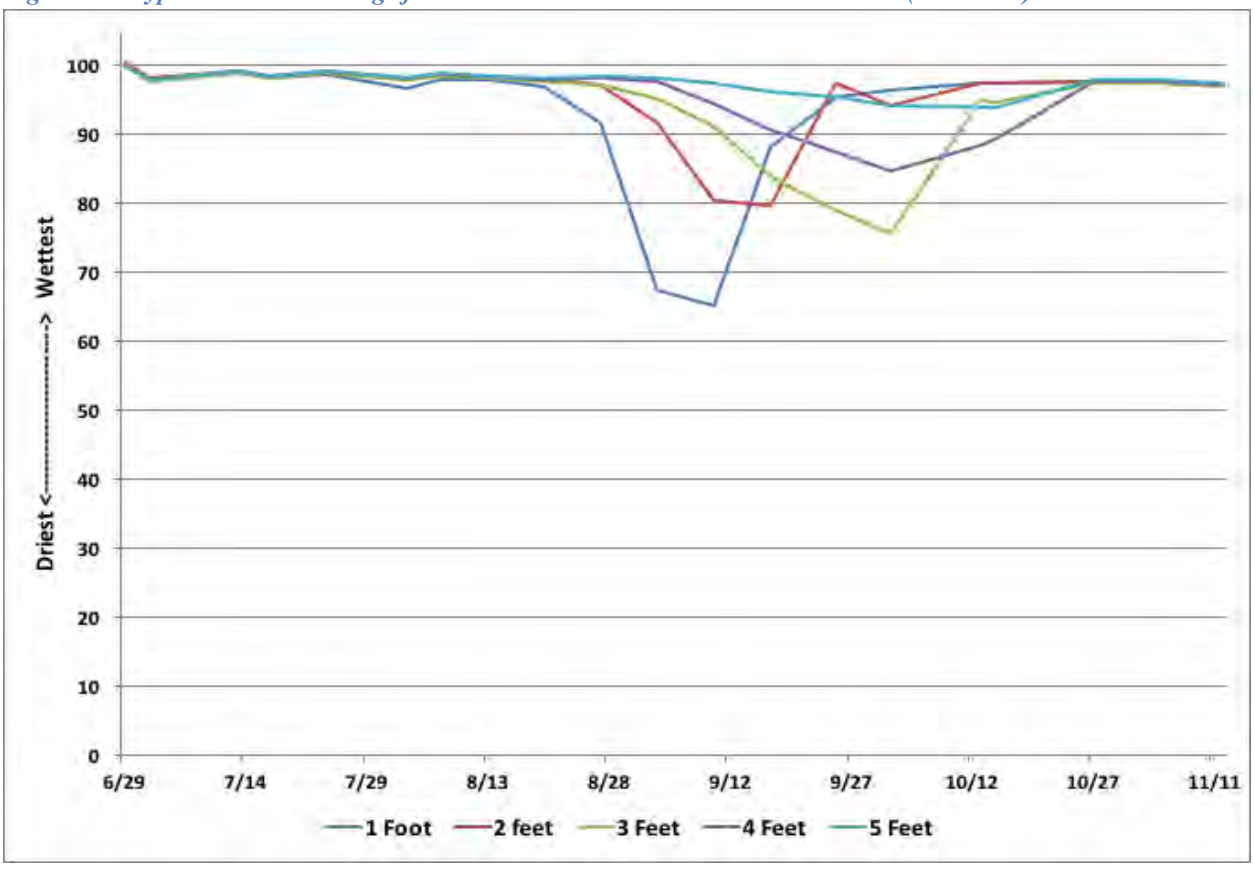


Figure 50: Growing Season Water Tracking for Harold Grall's PMDI Demonstration Site (180 bu/ac)

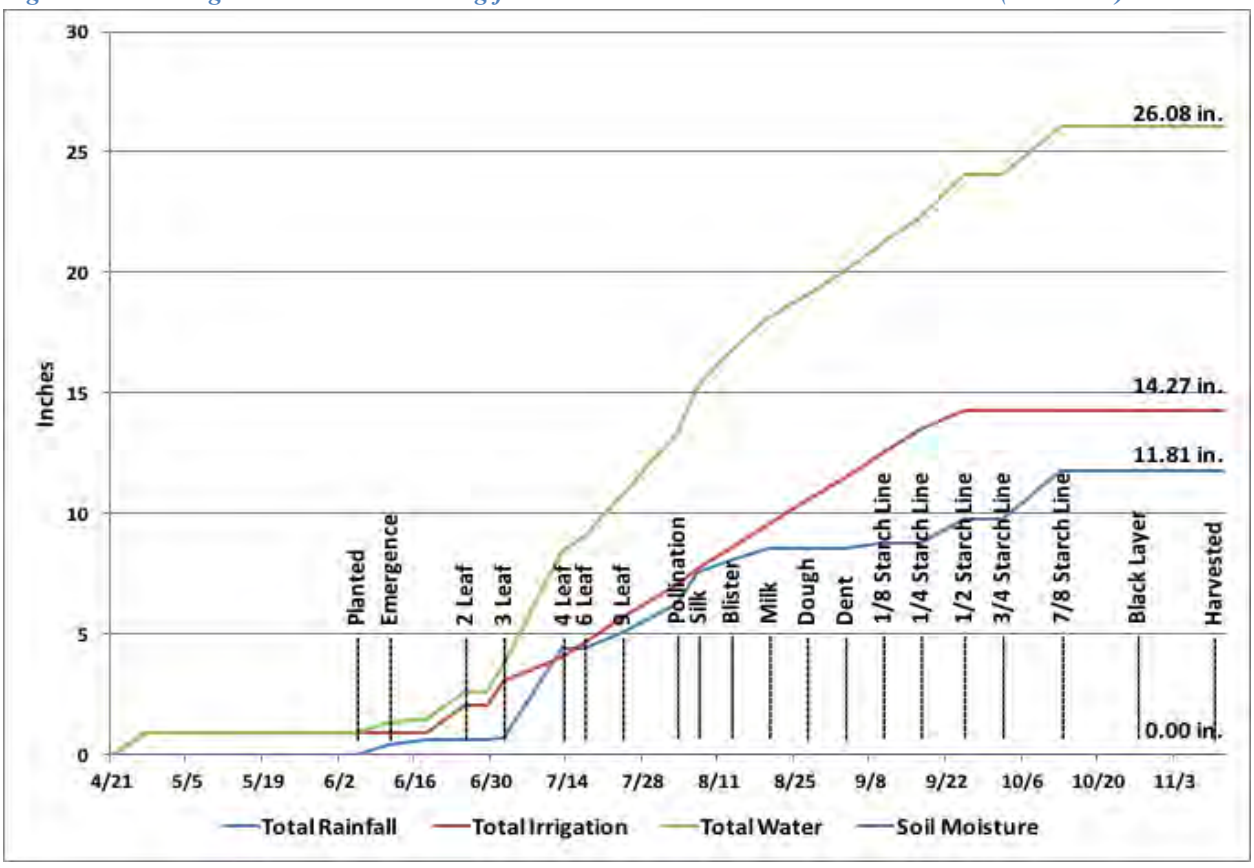


Table 39: Demonstration Field Data for Harold Grall's PMDI Demonstration Field

Date	Rain Inches	Irrigation Inches	Water Meter	Growth Stage	Soil Moisture					Crop Status	Pivot Position	Well GPM	Source
					1 Foot	2 Feet	3 Feet	4 Feet	5 Feet				
4/21			433442							pre wtr	326		Harold
4/27		0.89	462625							pre wtr	163		Leon
4/28	2.50												Pivotrac
5/6	0.38												Pivotrac
5/9	0.50												Pivotrac
5/14	0.34												Pivotrac
5/16	0.60												Pivotrac
5/19	0.44												Pivotrac
5/20	1.18												Pivotrac
5/22	0.64												Pivotrac
5/23	0.90												Pivotrac
6/1	0.33												Pivotrac
6/2			462625								163 N		C & L
6/5										planted			Harold
6/11	0.42		462625	emerging							218 N		C & L
6/18	0.20		466096	emerged						PMDI	44 Y cw	300	Curtis
6/25		1.14	499980	2 leaf						PMDI	140 Y cw	318	C & L
6/29					100.6	100.6	100.2	100.1	100.0				C & L
7/2	0.07	1.05	534135	3 leaf	97.7	98.2	97.8	98.0	98.0	PMDI	142 Y	342	C & L
7/13	3.73	0.95	565284	4 leaf	99.0	99.2	98.9	99.2	99.2	PMDI	105 Y	242	C & L
7/17		0.58	584100	6 leaf	98.3	98.4	98.2	98.4	98.5	PMDI	279 Y	346	C & L
7/24	0.66	1.11	620460	9 leaf	98.8	99.1	99.0	99.2	99.3	PMDI	244 Y	324	C & L
8/3	1.17	1.35	664620	pollinate	96.7	98.1	98.0	98.2	98.3	PMDI	291 Y	340	C & L
8/7	1.34	0.61	684680	silk	98.0	98.8	98.6	98.8	98.9	PMDI	98 Y	345	C & L
8/13	0.50	0.91	714452	blister	98.1	98.3	98.2	98.4	98.6	PMDI	353 Y	355	Curtis
8/20	0.44	1.00	747205	milk	97.0	97.9	97.7	98.1	98.2	PMDI	237 Y	314	Curtis
8/27		0.97	778819	dough	91.8	97.3	97.3	98.2	98.4	PMDI	192 Y	315	Curtis
9/3	0.02	0.96	810214	dent	67.6	91.8	95.2	97.7	98.3	PMDI	163 Y	305	Curtis
9/10	0.19	0.97	841973	1/8mat ln	65.3	80.5	91.2	94.6	97.6	PMDI	116 Y	320	Curtis
9/17	0.06	1.01	874860	1/4mat ln	88.2	79.8	84.0	90.7	96.2	PMDI	60 Y	332	Curtis
9/25	0.99	0.77	899963	1/2mat ln	95.5	97.4	78.9	87.4	95.5		336 N		C & L
10/2			899963	3/4mat ln	96.4	94.3	75.7	84.7	94.2		336 N		C & L
10/13	2.02		899963	7/8mat ln	97.6	97.5	94.9	88.5	94.1		336 N		Curtis
10/15			899963	1.0mat ln	97.5	97.4	94.8	89.4	94.1		336 N		Curtis
10/27	4.39		899963	blk lyr	97.7	97.7	97.5	97.7	97.9		336 N		C & L
11/4	0.44		899963	blk lyr	97.8	97.6	97.4	97.8	97.9		336 N		Curtis
11/10				Harvest						move dry	7 Y		Pivotrac
11/12			899963	Harvested	97.3	97.2	96.9	97.3	97.5		7 N		Curtis
Total	**11.81**	**14.27**			**0.0**	**0.0**	**0.0**	**0.0**	**0.0**			**321**	**Leon**
Net Soil Moisture is 0.00"													
Irrigation, Rainfall Plus Net Soil Moisture is 26.08"													

• Numbers in red are not counted in the total

NORTH PLAINS GROUNDWATER Conservation District

2015-Corn Demonstration
Irrigated Medium Season Corn

414 PMDI

Year:	2015	**County:**	Moore	**Grower:**	Harold Grall
No. Acres:	120	**Variety/Hyb:**	P1151AM	**Soil Type:**	Sherm Silty Clay Loam
Meter Type:	McCrometer				
Meter Mult:	Gallons x 100	**Tillage:**	Strip Till		
Fertilizer:	92-58-0-0	**Seeding:**	28,000		
Planted:	June 5, 2015	**Harvest:**	November 10, 2015		
Herbicide:	Balance Flex, Cinch, Starane, Intensity, Powermax	**Insecticide:**	Zeal, Stratego Fungicide		
Yield:	160 bu/acre @ 15.0% Moist.	**Prev. crop:**	Corn	**Row width:**	30 inches
Irrigation method:	Center Pivot	**Prewater:**	0.89"	**Well GPM:**	320
Distance between drops:	30 inches	**Distance from nozzle to ground:**	Sides Plants		
Application pattern:	PMDI Drag Drip	**Crop row direction :**	Straight		

GPS Location of Pivot Pad		**GPS Location of Gypsum Blocks**	
Latitude:	35.97143	Latitude:	35.96824
Longitude:	-102.136511	Longitude:	-102.13586

Harold Grall's PMDI Site AquaSpy® Probe Summary

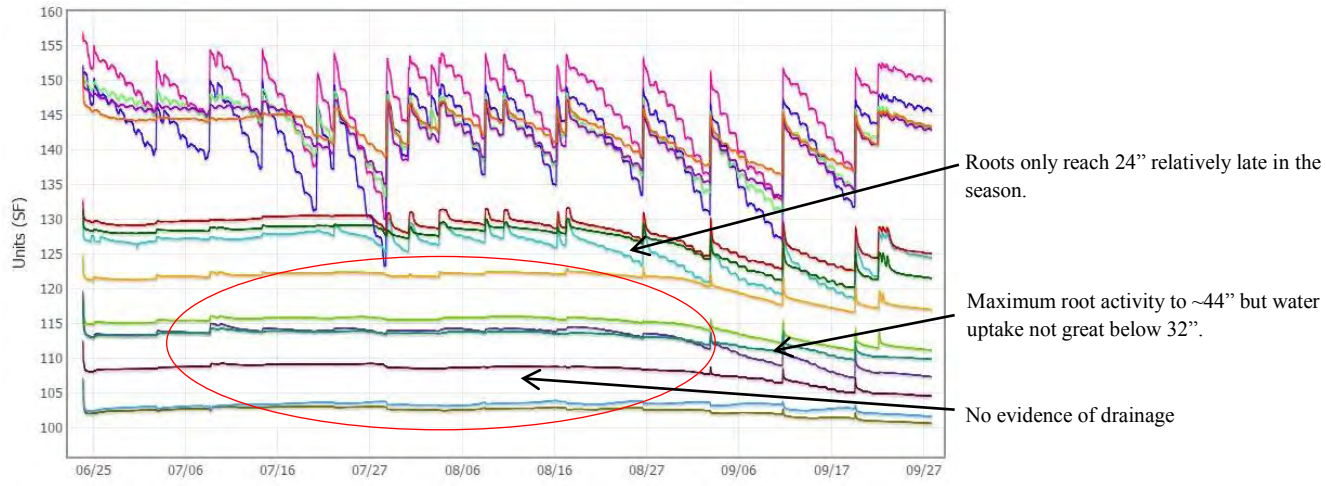


Figure 51. Grall Field 414 PMDI Drip

This field had an extremely late plant date and the yield may have suffered because of it. It seems that the top 32" was kept extremely wet throughout July and early August and probably delayed root development. Roots did eventually reach about 44" but most of the effective water use was in the top 20"-24". The very low water use efficiency was a function of the very low yield and (as suggested) this may not be caused solely by irrigation but by plant date and other factors. There was no evidence of any drainage.

Harvest Results: The PMDI field produced a 180 bushel per acre corn yield. Irrigation totaled 14.27 inches. Production from each inch of irrigation, rainfall and net soil water that totaled 26.08 inches was 6.90 bushels (386lbs) per acre. Crop production costs were $391.27 per acre for irrigation, fertilizer, seed and harvest expenses. At $3.97 per bushel, the 180 bushels per acre amounts to $714.60. Net return for the PMDI field is $323.33 per acre with 14.27 inches of irrigation. Net return from each inch of irrigation is $22.66. Net return from each inch of irrigation, rainfall and net soil water is $12.40. Corn yield was less than anticipated without a clear reason why. There was sufficient available water throughout the growing season. The yield monitor indicates normal uniform yield within the circle. One speculation is that the 58, 54 and 56 degree overnight temperatures on July 7, 8 and 9 stopped plant growth at the 3 to 4 leaf stage at a previous fast rate. It then required too much time for plants to recover resulting in reduced corn yields. The demonstration will be continued in 2016 to learn more. A summary of the PMDI Irrigation System demonstration results are shown in table 40 and in Appendix A. Results from another PMDI drag line demonstration are in Harold Grall LEPA and PMDI Irrigation systems report.

Table 40: Harold Grall's 2015 PMDI Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $3.97/bu		
			bu/ac	lb/ac-in Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
PMDI	14.27	*26.08	180	706	$714.60	$50.08	$27.40

*Includes 0 inches of soil water removed within five feet of soil

Conclusion

Summary: Corn production averaged 20.06 bushels (1123lbs) per acre inch of irrigation in the 3 GPM fields compared to 17.24 bushels (965lbs) in the 4 GPM and 15.55 bushels (871lbs) per inch in the 5 GPM fields. Net return from each inch of irrigation averaged $41.12 in the 3 GPM fields, $34.93 in the 4 GPM and $31.30 per inch in the 5 GPM fields. Irrigation averaged 11.16 inches in the 3 GPM fields compared to 13.64 inches in the 4 GPM and 16.02 inches in the 5 GPM. Corn production averaged 226 bushels (12642lbs) per acre in the 3 GPM fields, 238 bushels (13356lbs) in the 4 GPM and 255 bushels (14266lbs) per acre in the 5 GPM fields. Net return averaged $461.83 per acre from the 3 GPM fields, $482.21 from the 4 GPM and $512.39 per acre from the 5 GPM. Average net return from the additional 2.48 inches of irrigation applied to the 4 GPM fields compared to the 3 GPM is $8.21 per inch. Average net return from the additional 4.86 inches of irrigation applied to the 5 GPM fields compared to the 3 GPM is $10.40 per inch. Average net return from the additional 2.38 inches of irrigation applied to the 5 GPM fields compared to the 4 GPM is $12.68 per inch. Average net increase on return from the 4 GPM fields compared to the 3 GPM with 2.48 inches more irrigation is $20.38 per acre. The average net increase on return from the 5 GPM fields, where irrigation was 4.86 inches more than the 3 GPM, is $50.56 per acre. Average net increase on return from the 5 GPM fields compared to the 4 GPM, where irrigation was 2.38 inches more, is $30.18 per acre.

Irrigation, rainfall plus net soil water averaged 26.23 inches in the 3 GPM fields, 27.87 inches in the 4 GPM and 29.84 for the 5 GPM fields. Rainfall averaged 13.24 inches at the 3 GPM fields, 13.57 inches at the 4 GPM and 13.36 inches at the 5 GPM fields. Average net soil water used by the crop is 2.28 inches in the 3 GPM fields, .83 inches in the 4 GPM and .57 inches in the 5 GPM fields. Average net return from each inch of irrigation, rainfall and net soil water is $17.30 for the 3 GPM field, $17.06 for the 4 GPM and $16.95 for the 5 GPM field. Average net return per bushel of corn produced in the 3 GPM fields is $2.0458, $2.0219 in the 4 GPM and $2.0113 for the 5 GPM fields. Considering marketing my entire 2015 900,000 bushel corn crop at a net return of $2.0458 per bushel (3 GPM), my net return for the 2015 crop is $21,510 more than at the 4 GPM net return of $2.0219 per bushel (4 GPM) and $31,050 more than at $2.0113 per bushel (5GPM). Marketing the 900,000 2015 crop at $2.0219 net return per bushel (4 GPM), my net return is $9,540 more than at $2.0113 (5 GPM).

Ap**pendix A** is a summary of demonstration water and harvest results**. Appendix B** shows corn yield per inch of irrigation applied by all cooperating growers in each "3-4-5" field. **Appendix C** describes net return from each inch of irrigation for "3-4-5" fields and by grower. **Appendix D** lists water and harvest data and net return from each inch of irrigation by grower and "3-4-5 GPM" field. **Appendix E** describes net return from each inch of irrigation, rainfall and soil water for all growers and for the "3-4-5 GPM" fields. **Appendix F** is a water and yield summary for each "3-4-5 GPM" field that lists net return from each inch of irrigation, rainfall and soil water for each grower. **Appendix G** describes net return per acre for each grower and "3-4-5 GPM" field. **Appendix H** lists corn hybrids, seeding rates, planting dates, irrigation systems and other demonstration site information for each grower and "3-4-5 GPM" field. **Appendix I** is a graph

that shows corn yield vs. net return per acre for all "3-4-5 GPM" fields**. Appendix J** describes corn yield vs. total inches of irrigation, rainfall and net soil water for each "3-4-5 GPM" field (total water).

The "3-4-5" Project: In **Stan Spain's** demonstration "3-4-5 GPM" fields**,** irrigation totaled 9.76 inches per acre in the 3 GPM field, 11.71 inches in the 4 GPM and 13.61 inches in the 5 GPM field. There was 1.31 inches of pre-season irrigation, primarily to germinate volunteer corn and penetrate herbicide. Net return from each inch of irrigation is $47.59 for the 3 GPM field compared to $41.64 for the 4 GPM and $39.37 for the 5 GPM field. Irrigation, rainfall and net soil water totaled 26.33 inches per acre in the 3 GPM field, 26.79 inches in the 4 GPM and 27.09 inches in the 5 GPM field. Net return from each inch of total water is $17.64 for his 3 GPM field, $18.20 for the 4 GPM and $19.78 for the 5 GPM field. Net return from the 3 GPM field was $464.46 per acre compared to $487.50 from the 4 GPM field and $535.84 from the 5 GPM field. Net return per bushel of corn produced is $2.0461 for the 3 GPM field, $2.0398 for the 4 GPM and $2.0610 for the 5 GPM field.

For **Danny Krienke,** irrigation totaled 8.81 inches per acre in the 3 GPM field, 10.69 inches for the 4 GPM field and 12.70 inches in his 5 GPM field. There was no pre-season irrigation. Net return from each inch of irrigation is $48.16 for the 3 GPM field compared to $39.99 from the 4 GPM and $34.73 for the 5 GPM field. Irrigation, rainfall and net soil water totaled 22.96 inches per acre in the 3 GPM field, 25.14 inches in the 4 GPM field and 26.12 inches of total water for his 5 GPM field. Net return from each inch is $18.48 for the 3 GPM field, $17.00 for the 4 GPM and $16.88 for his 5 GPM field. Net return from the 3 GPM field was $424.34 per acre compared to $427.47 from the 4 GPM field and $441.03 from the 5 GPM field. Net return per bushel of corn produced in the 3 GPM field is $2.0904, $2.0454 in the 4 GPM and $2.0139 in the 5 GPM.

In **Zac Yoder's** demonstration fields, irrigation totaled 13.51 inches per acre in his 3 GPM field, 17.62 inches in the 4 GPM and 21.79 inches in the 5 GPM field. Total irrigation includes 1.22 inches of pre-season irrigation in each field prior to beginning the "3-4-5 GPM" variable rate irrigation (VRI). Net return from each inch of irrigation is $37.84 for the 3 GPM field compared to $31.72 from the 4 GPM and $28.60 for the 5 GPM field. Irrigation, rainfall and net soil water totaled 28.07 inches per acre in the 3 GPM field, 30.72 inches in the 4 GPM field and 34.87 inches of total water in the 5 GPM field. Net return from each inch of irrigation, rainfall and net soil water is $18.21 for the 3 GPM field, $18.19 from the 4 GPM and $17.87 for the 5 GPM field. Net return from the 3 GPM field was $511.34 per acre compared to $558.99 from the 4 GPM field and $623.32 from the 5 GPM field. Net return per bushel of corn produced in the 3 GPM field is $2.0373, $2.0254 in the 4 GPM and $2.0304 in the 5 GPM field.

For **Harold Grall,** irrigation totaled 14.47 inches per acre in his 3 GPM field 17.22 inches in the 4 GPM and 19.83 inches for his 5 GPM field. There was 2.63 inches of pre-season irrigation on all fields. Net return from each inch of irrigation is $30.90 for the 3 GPM field compared to $26.41 from the 4 GPM and $22.66 for the 5 GPM field. Irrigation, rainfall and net soil water totaled 30.05 inches per acre in the 3 GPM field, 30.66 inches in the 4 GPM field, and 33.89 inches in the 5 GPM field. Net return from each inch of irrigation, rainfall and net soil water is

$14.88 per acre for the 3 GPM field, $14.83 for the 4 GPM and $13.26 per acre for his 5 GPM field. Net return from the 3 GPM field was $447.19 per acre compared to $454.87 from the 4 GPM field and $449.38 from the 5 GPM field. Net return from each bushel of corn produced in the 3 GPM field is $2.0144, $1.9777 from the 4 GPM and $1.9287 from the 5 GPM field.

Irrigation Systems: In Harold Grall's LEPA Shroud vs. T-L PMDI drag line irrigation systems demonstration fields, irrigation was 11.58 inches in each field. There was no pre-season irrigation. Net return was $43.98 from each inch for both the LEPA Shroud and T-L PMDI drag line fields. Irrigation, rainfall and net soil water totaled 26.18 inches per acre in each field. Net return per acre is $509.30 for the LEPA Shroud and T-L PMDI drag line field. Net return from each bushel of corn produced in the LEPA shroud and PMDI fields is $2.087. The demonstration fully shows that 240 to 250 bushels of corn per acre can be produced with 26 inches of total water.

For **Harold Grall's** T-L PMDI drag line demonstration, irrigation is 14.27 inches per acre, including .89 inches of pre-water. Net return from each inch of irrigation is $22.68. Irrigation, rainfall and net soil water totaled 26.08 inches. Net return from each inch of total water is $12.40. Net return for the PMDI field is $323.33 per acre. Net return per bushel of corn produced is $1.7963. Corn yield was less than anticipated and disappointing without a clear reason why. There was sufficient available water throughout the growing season.

The NPGCD's "3-4-5 GPM" project demonstrates how water conservation technologies and irrigation management strategies, combined with high-efficiency irrigation systems and improved plant genetics, can reduce groundwater use and allow agricultural irrigation producers to remain financially viable with both restricted and diminishing groundwater resources.

We learned that adjustments can be made to existing center pivots, especially in conjunction with NRCS cost share funding, to improve water application efficiency that gets more of the water pumped to the crop. Also, that soil health is improved from crop residue and strip or no till practices. We learned it is easy to over water corn with four and especially five gpm per acre when rainfall is more normal and that soil moisture sensors can help manage that. Also, we learned that drought tolerant hybrids were commonly planted, mostly in May and early June, performed well and reduced seasonal irrigation. 2015 was a much improved corn production year with more rainfall and cooler temperatures. Beginning soil moisture was superior following abundant rainfall in April and May.

When the **technologies and methods** utilized by the "3-4-5 GPM" demonstrations can be translated into three inches of reduced irrigation over the one million acres of corn and other crops in the district, groundwater savings will be 250,000 acre-feet of water per year. This water savings can prolong the viability of agriculture irrigation in the area.

Appendix A: Summary of Water and Yield Demonstration Results

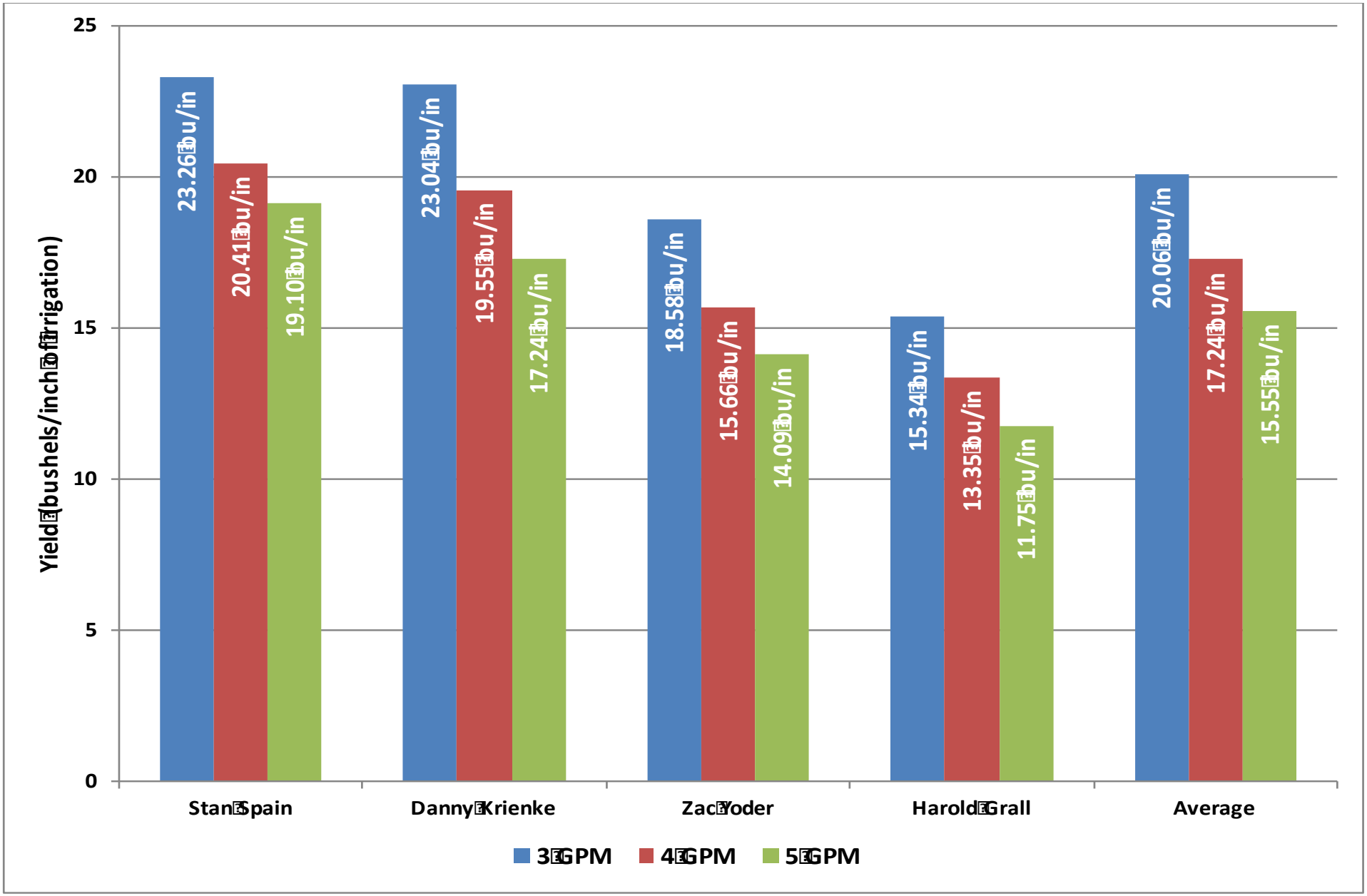
Producer	Field	Planted	Pre-Water (in.)	Irrigation (in.)	Total Irrigation (in.)	Rainfall (in.)	Total Rainfall & Irrigation (in.)	Net Soil Water (in.)	Total Water (in.)	Yield (bu/ac)	bu/ac-in of Irrigaton	bu/ac-in of Total Water	Net Return ($/ac)	Net Return Per Ac-In of Irrigation ($)
Danny Krienke	3 gpm	May 31	0.00	8.81	8.81	10.77	19.58	3.38	22.96	203.00	23.04	8.84	$ 424.34	$ 48.16
	4 gpm	May 31	0.00	10.69	10.69	11.79	22.48	2.66	25.14	209.00	19.55	8.31	$ 427.47	$ 39.99
	5 gpm	May 31	0.00	12.70	12.70	10.77	23.47	2.65	26.12	219.00	17.24	8.38	$ 441.03	$ 34.53
Stan Spain	3 gpm	May 29	1.31	8.45	9.76	12.77	22.53	3.80	26.33	227.00	23.26	8.62	$ 464.46	$ 47.59
	4 gpm	May 29	1.31	10.40	11.71	12.77	23.31	2.31	26.79	239.00	20.41	8.92	$ 487.50	$ 41.63
	5 gpm	May 29	1.31	12.30	13.61	12.77	26.38	0.71	27.09	260.00	19.10	9.59	$ 535.84	$ 39.37
Zac Yoder	3 gpm	May 12	1.22	12.29	13.51	16.60	30.11	-2.04	28.07	251.00	18.58	8.94	$ 511.34	$ 37.84
	4 gpm	May 12	1.22	16.40	17.62	16.60	34.22	-3.50	30.72	276.00	15.66	8.98	$ 558.99	$ 31.68
	5 gpm	May 12	1.22	20.57	21.79	16.60	38.39	-3.52	34.87	307.00	14.09	8.80	$ 623.32	$ 28.63
Harold Grall	3 gpm	May 12	2.63	11.84	14.47	11.61	26.08	3.97	30.05	222.00	15.34	7.38	$ 447.19	$ 30.90
	4 gpm	May 12	2.63	14.59	17.22	11.61	28.83	1.83	30.66	230.00	13.35	7.50	$ 454.87	$ 26.41
	5 gpm	May 12	2.63	17.20	19.83	11.61	31.44	2.45	33.89	233.00	11.75	6.87	$ 449.38	$ 22.66
Hartley Feeders †	3 gpm	Jun 18	0.00	9.27	9.27	14.47	23.74	0.00	23.74	-	-	-	-	-
	4 gpm	Jun 18	0.00	10.97	10.97	15.07	26.04	0.00	26.04	-	-	-	-	-
	5 gpm	Jun 18	0.00	12.18	12.18	15.07	27.25	0.00	27.25	-	-	-	-	-
Average ‡	**3 gpm**	**May 26**	**1.03**	**10.13**	**11.16**	**13.24**	**24.41**	**1.82**	**26.23**	**225.75**	**20.06**	**8.45**	**$ 461.83**	**$ 41.12**
	4 gpm	**May 26**	**1.03**	**12.61**	**13.64**	**13.57**	**26.98**	**0.66**	**27.87**	**238.50**	**17.24**	**8.43**	**$ 482.21**	**$ 34.93**
	5 gpm	**May 26**	**1.03**	**14.99**	**16.02**	**13.36**	**29.39**	**0.46**	**29.84**	**254.75**	**15.55**	**8.41**	**$ 512.39**	**$ 31.30**
Irrigation Systems														
Harold Grall	**LEPA (2.67 gpm)**	May 27	0.00	11.58	11.58	14.60	26.18	0.00	26.18	244.00	21.07	9.32	$ 509.30	$ 43.98
	Drag Drip (2.67 gpm)	May 27	0.00	11.58	11.58	14.60	26.18	0.00	26.18	244.00	21.07	9.32	$ 509.30	$ 43.98
	Drag Drip (2.67 gpm)	Jun 05	0.89	13.38	14.27	11.81	26.08	0.00	26.08	180.00	12.61	6.90	$ 323.33	$ 22.66

Notes: The producer order is from highest to lowest net return per acre inch of irrigation for the producer's 3 GPM field.

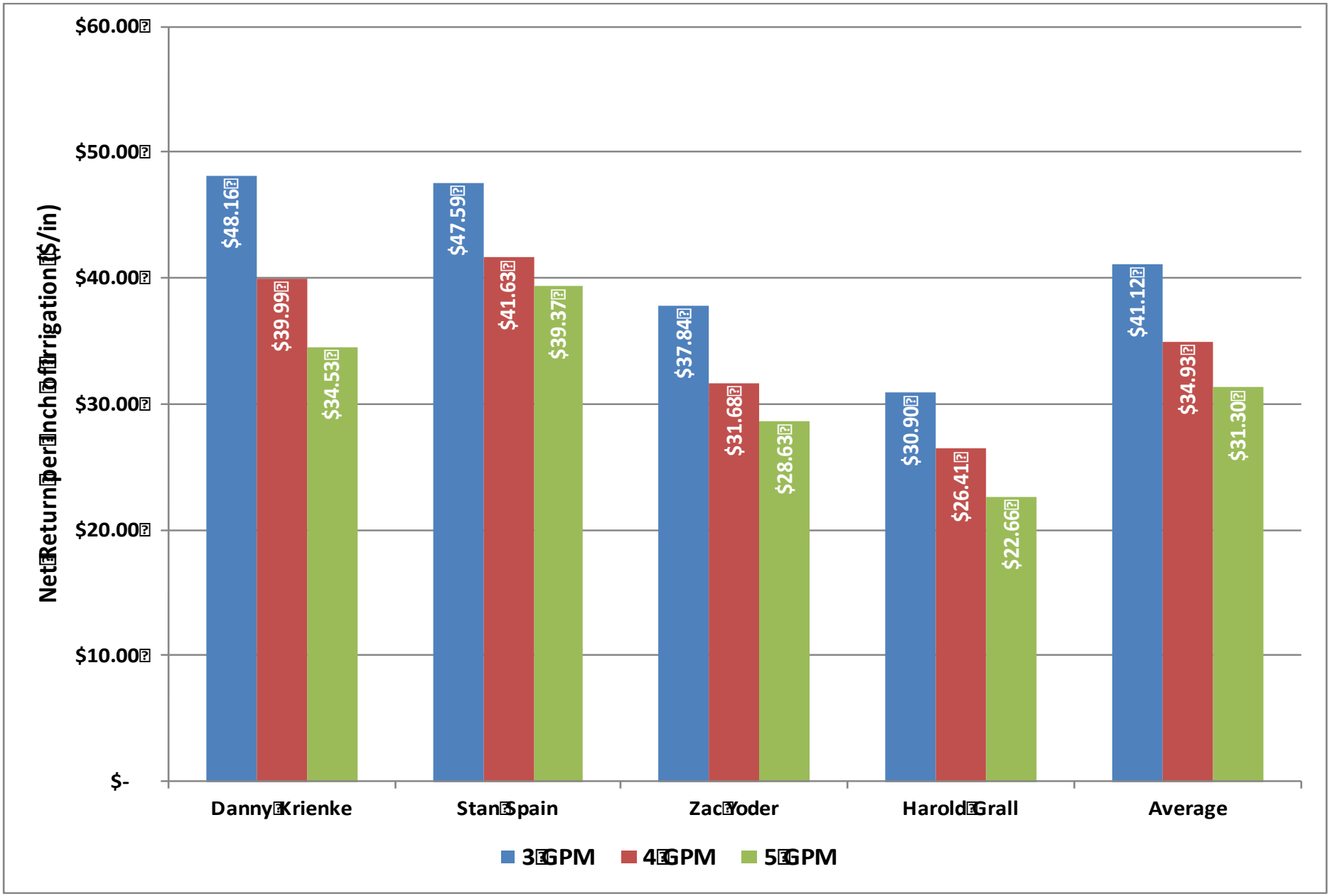
† Hartley Feeders' yields were not viable due to multiple factors that include volunteer corn, poor emergence, poor stand and wet soils.

‡ All average yield and net return results were based on the four producers with viable yields.

Appendix B: Corn Yield by Inch of Irrigation for Each Grower



Appendix C: Net Return from Each Inch of Irrigation by Grower

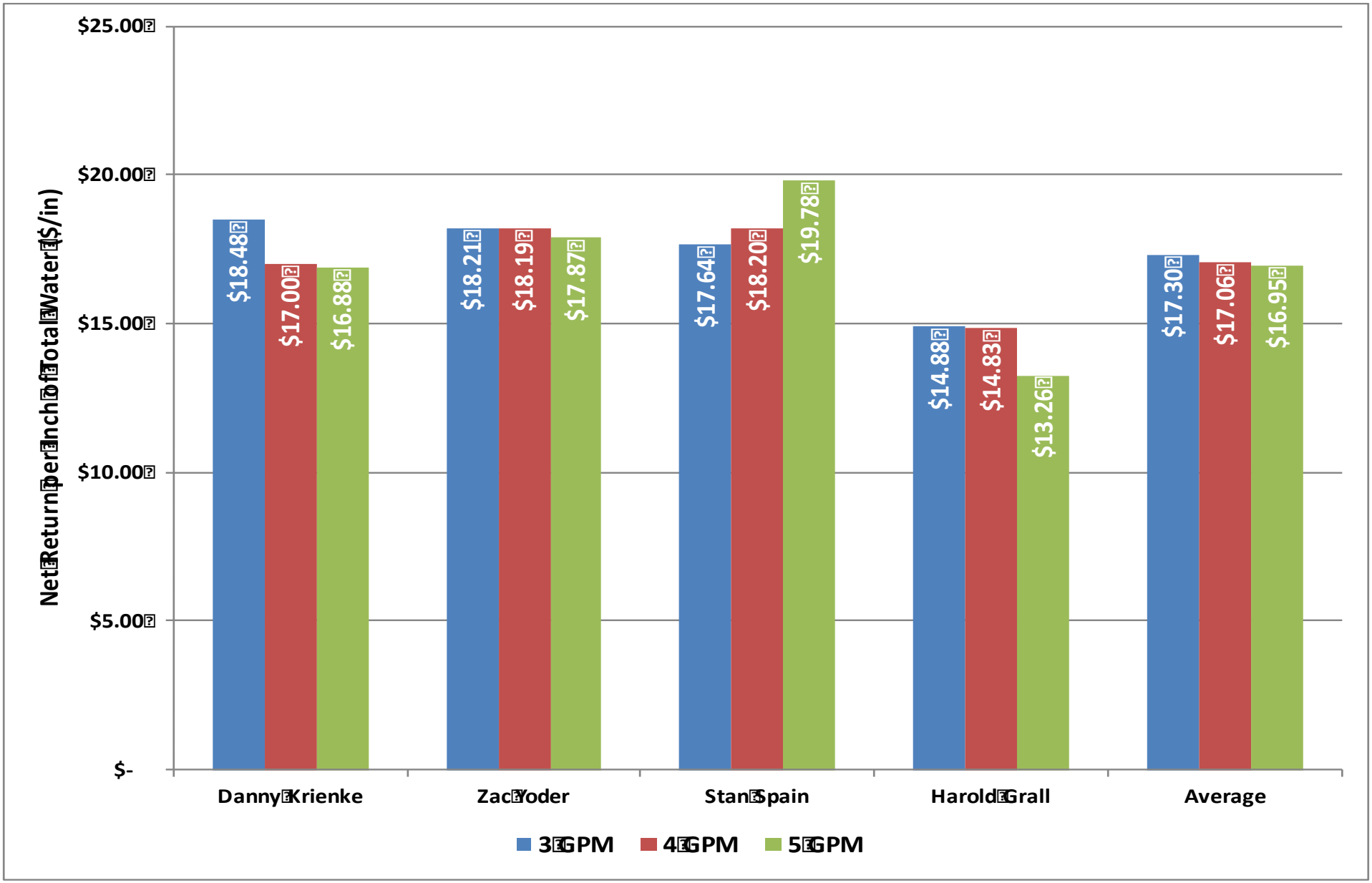


Appendix D: Summary of Net Return from Each Inch of Irrigation by Grower and 3, 4, 5 Field

Producer	Field	Planted	Pre-Water (in.)	Irrigation (in.)	Total Irrigation (in.)	Rainfall (in.)	Total Rainfall & Irrigation (in.)	Net Soil Water (in.)	Total Water (in.)	Yield (bu/ac)	bu/ac-in of Irrigaton	bu/ac-in of Total Water	Net Return ($/ac)	Net Return Per Ac-In of Irrigation ($)
Danny	3 gpm	May 31	0.00	8.81	8.81	10.77	19.58	3.38	22.96	203.00	23.04	8.84	$ 424.34	$ 48.16
Stan	3 gpm	May 29	1.31	8.45	9.76	12.77	22.53	3.80	26.33	227.00	23.26	8.62	$ 464.46	$ 47.59
Stan	4 gpm	May 29	1.31	10.40	11.71	12.77	23.31	2.31	26.79	239.00	20.41	8.92	$ 487.50	$ 41.63
Danny	4 gpm	May 31	0.00	10.69	10.69	11.79	22.48	2.66	25.14	209.00	19.55	8.31	$ 427.47	$ 39.99
Stan	5 gpm	May 29	1.31	12.30	13.61	12.77	26.38	0.71	27.09	260.00	19.10	9.59	$ 535.84	$ 39.37
Zac	3 gpm	May 12	1.22	12.29	13.51	16.60	30.11	-2.04	28.07	251.00	18.58	8.94	$ 511.34	$ 37.84
Danny	5 gpm	May 31	0.00	12.70	12.70	10.77	23.47	2.65	26.12	219.00	17.24	8.38	$ 441.03	$ 34.53
Zac	4 gpm	May 12	1.22	16.40	17.62	16.60	34.22	-3.50	30.72	276.00	15.66	8.98	$ 558.99	$ 31.68
Harold	3 gpm	May 12	2.63	11.84	14.47	11.61	26.08	3.97	30.05	222.00	15.34	7.38	$ 447.19	$ 30.90
Zac	5 gpm	May 12	1.22	20.57	21.79	16.60	38.39	-3.52	34.87	307.00	14.01	8.80	$ 623.32	$ 28.63
Harold	4 gpm	May 12	2.63	14.59	17.22	11.61	28.83	1.83	30.66	230.00	13.35	7.50	$ 454.87	$ 26.41
Harold	5 gpm	May 12	2.63	17.20	19.83	11.61	31.44	2.45	33.89	233.00	11.75	6.87	$ 449.38	$ 22.66
Average	**3 gpm**	**May 21**	**1.29**	**10.35**	**11.64**	**12.94**	**24.58**	**2.28**	**26.85**	**225.75**	**20.06**	**8.45**	**$ 461.83**	**$ 41.12**
	4 gpm	**May 21**	**1.29**	**13.02**	**14.31**	**13.19**	**27.21**	**0.83**	**28.33**	**238.50**	**17.24**	**8.43**	**$ 482.21**	**$ 34.93**
	5 gpm	**May 21**	**1.29**	**15.69**	**16.98**	**12.94**	**29.92**	**0.57**	**30.49**	**254.75**	**15.53**	**8.41**	**$ 512.39**	**$ 31.30**
Irrigation Systems														
Harold	**LEPA (2.67 gpm)**	May 27	0.00	11.58	11.58	14.60	26.18	0.00	26.18	244.00	21.07	9.32	$ 509.30	$ 43.98
Harold	**Drag Drip (2.67 gpm)**	May 27	0.00	11.58	11.58	14.60	26.18	0.00	26.18	244.00	21.07	9.32	$ 509.30	$ 43.98
Harold	**Drag Drip (2.67 gpm)**	Jun 05	0.89	13.38	14.27	11.81	26.08	0.00	26.08	180.00	12.61	6.90	$ 323.33	$ 22.66

Note: The producer order is ranked highest to lowest by net return per acre-inch of irrigation.

Appendix E: Net Return from each Inch of Total Water by Grower

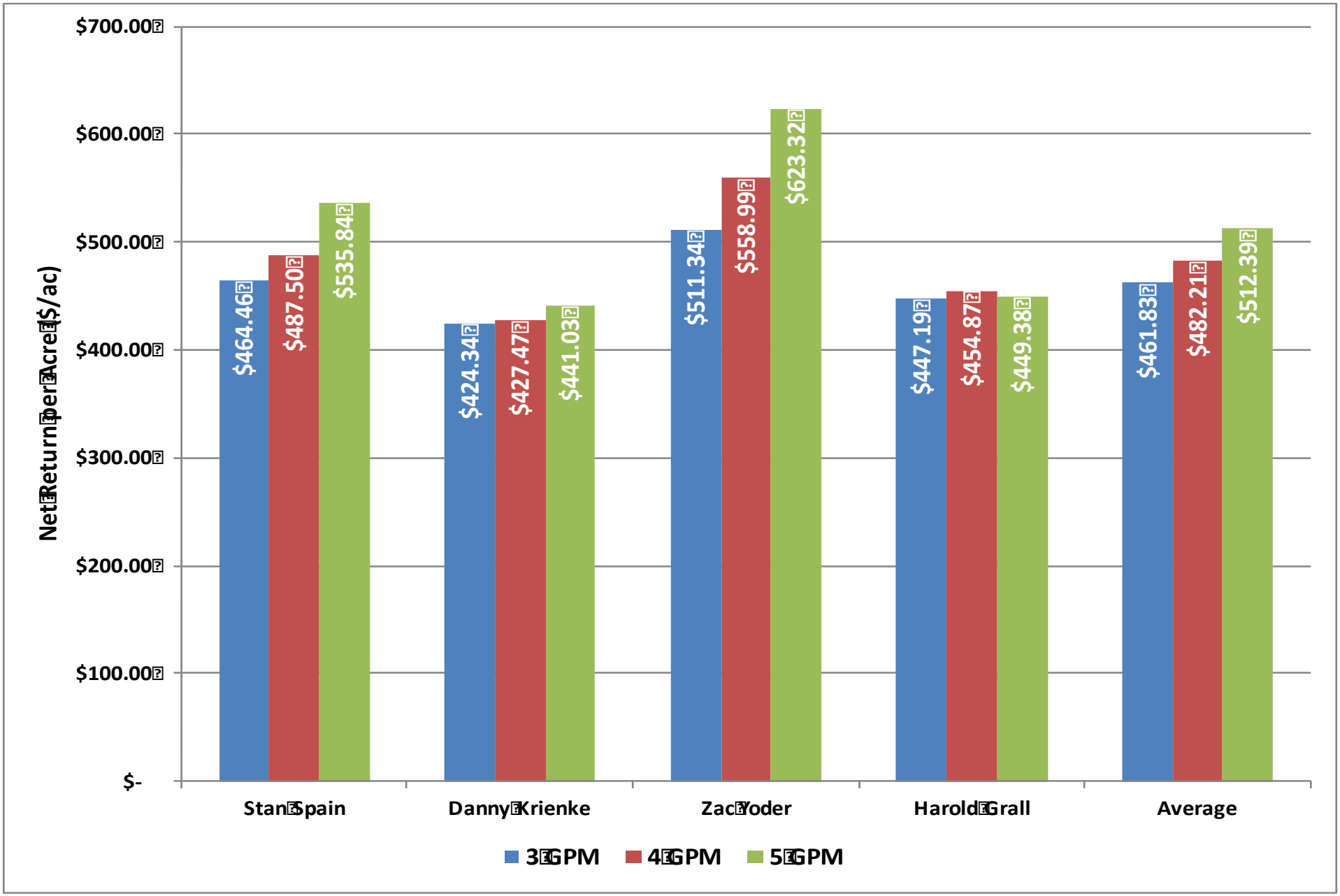


Appendix F: Summary of Net Return from Each Inch of Total Water by Grower and 3, 4, 5 Field

Producer	Field	Planted	Pre-Water (in.)	Irrigation (in.)	Total Irrigation (in.)	Rainfall (in.)	Net Soil Water (in.)	Total Water (in.)	Yield (bu/ac)	bu/ac-in of Irrigation	bu/ac-in of Total Water	Net Return ($/ac)	Net Return Per Ac-In of Irrigation ($)	Net Return Per Ac-In of Total Water ($)
Stan	5 gpm	May 29	1.31	12.30	13.61	12.77	0.71	27.09	260	19.10	9.59	$535.84	$ 39.37	$ 19.78
Danny	3 gpm	May 31	0.00	8.81	8.81	10.77	3.38	22.96	203	23.04	8.84	$424.34	$ 48.16	$ 18.48
Zac	3 gpm	May 12	1.22	12.29	13.51	16.60	-2.04	28.07	251	18.58	8.94	$511.34	$ 37.84	$ 18.21
Stan	4 gpm	May 29	1.31	10.40	11.71	12.77	2.31	26.79	239	20.41	8.92	$487.50	$ 41.63	$ 18.20
Zac	4gpm	May 12	1.22	16.40	17.62	16.60	-3.50	30.72	276	15.66	8.98	$558.99	$ 31.68	$ 18.19
Zac	5gpm	May 12	1.22	20.57	21.79	16.60	-3.52	34.87	307	14.09	8.80	$623.32	$ 28.63	$ 17.87
Stan	3 gpm	May 29	1.31	8.45	9.76	12.77	3.80	26.33	227	23.26	8.62	$464.46	$ 47.59	$ 17.64
Danny	4 gpm	May 31	0.00	10.69	10.69	11.79	2.66	25.14	209	19.55	8.31	$427.47	$ 39.99	$ 17.00
Danny	5 gpm	May 31	0.00	12.70	12.70	10.77	2.65	26.12	219	17.24	8.38	$441.03	$ 34.53	$ 16.88
Harold	3 gpm	May 12	2.63	11.84	14.47	11.61	3.97	30.05	222	15.34	7.38	$447.19	$ 30.90	$ 14.88
Harold	4 gpm	May 12	2.63	14.59	17.22	11.61	1.83	30.66	230	13.35	7.50	$454.87	$ 26.41	$ 14.83
Harold	5 gpm	May 12	2.63	17.20	19.83	11.61	2.45	33.89	233	11.75	6.87	$449.38	$ 22.66	$ 13.26
Average	**3 gpm**	May 21	1.29	10.35	11.64	12.94	2.28	26.85	226	20.06	8.45	$461.83	$ 41.12	$ 17.30
	4 gpm	May 21	1.29	13.02	14.31	13.19	0.83	28.33	239	17.24	8.43	$482.21	$ 34.93	$ 17.06
	5 gpm	May 21	1.29	15.69	16.98	12.94	0.57	30.49	255	15.55	8.41	$512.39	$ 31.30	$ 16.95
Irrigation Systems														
Harold	**LEPA (2.67 gpm)**	May 27	0.00	11.58	11.58	14.60	0.00	26.18	244	21.07	9.32	$509.30	$ 43.98	$ 19.45
Harold	**Drag Drip (2.67 gpm)**	May 27	0.00	11.58	11.58	14.60	0.00	26.18	244	21.07	9.32	$509.30	$ 43.98	$ 19.45
Harold	**Drag Drip (2.67 gpm)**	Jun 05	0.89	13.38	14.27	11.81	0.00	26.08	180	12.61	6.90	$323.33	$ 22.66	$ 12.40

Note: The producer order is ranked highest to lowest by net return per acre-inch of total water.

Appendix G: Net Return per Acre by Grower and "3, 4, 5" GPM Field

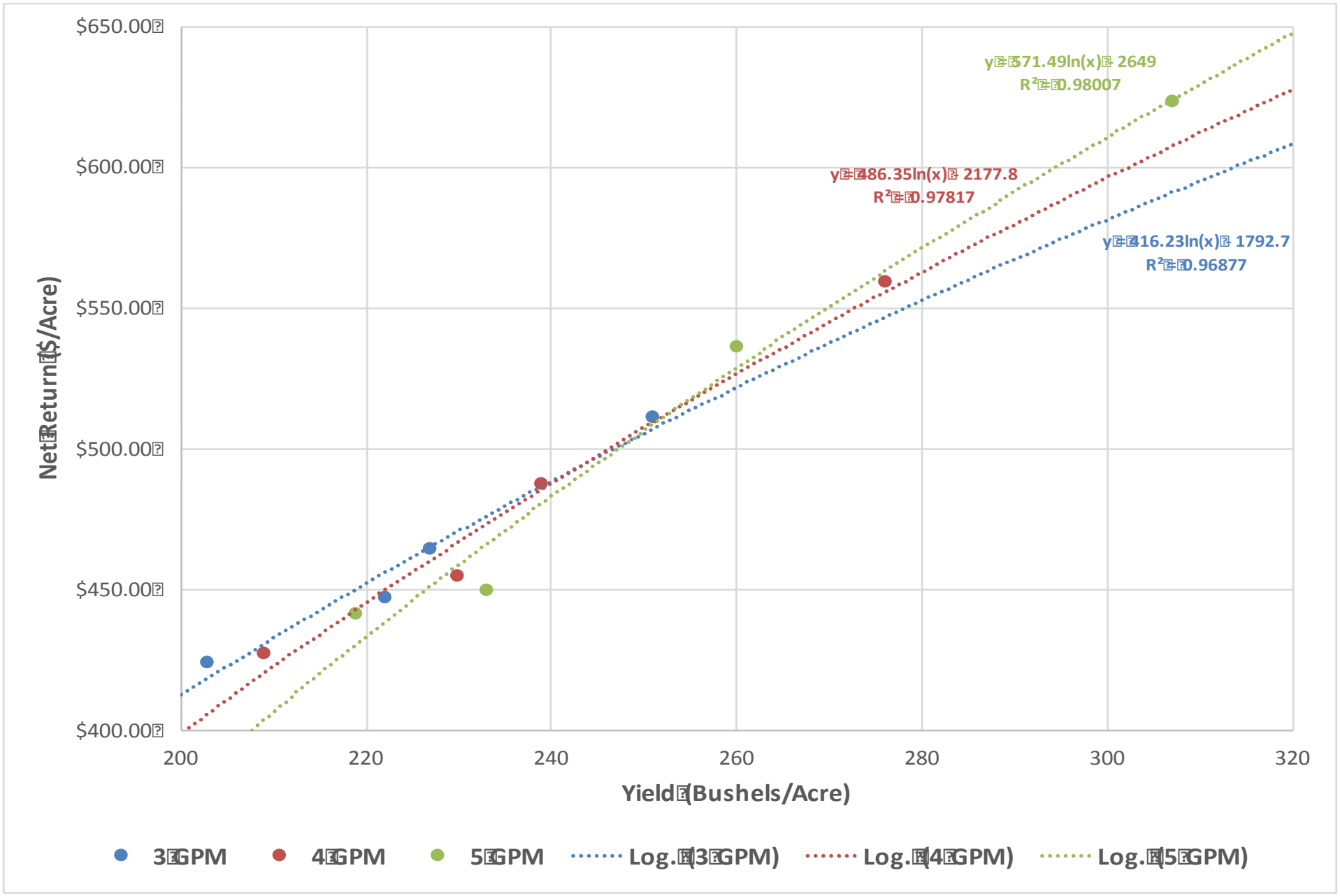


Appendix H: Corn Hybrid and Planting Information for the 2015 "3, 4, 5" Project

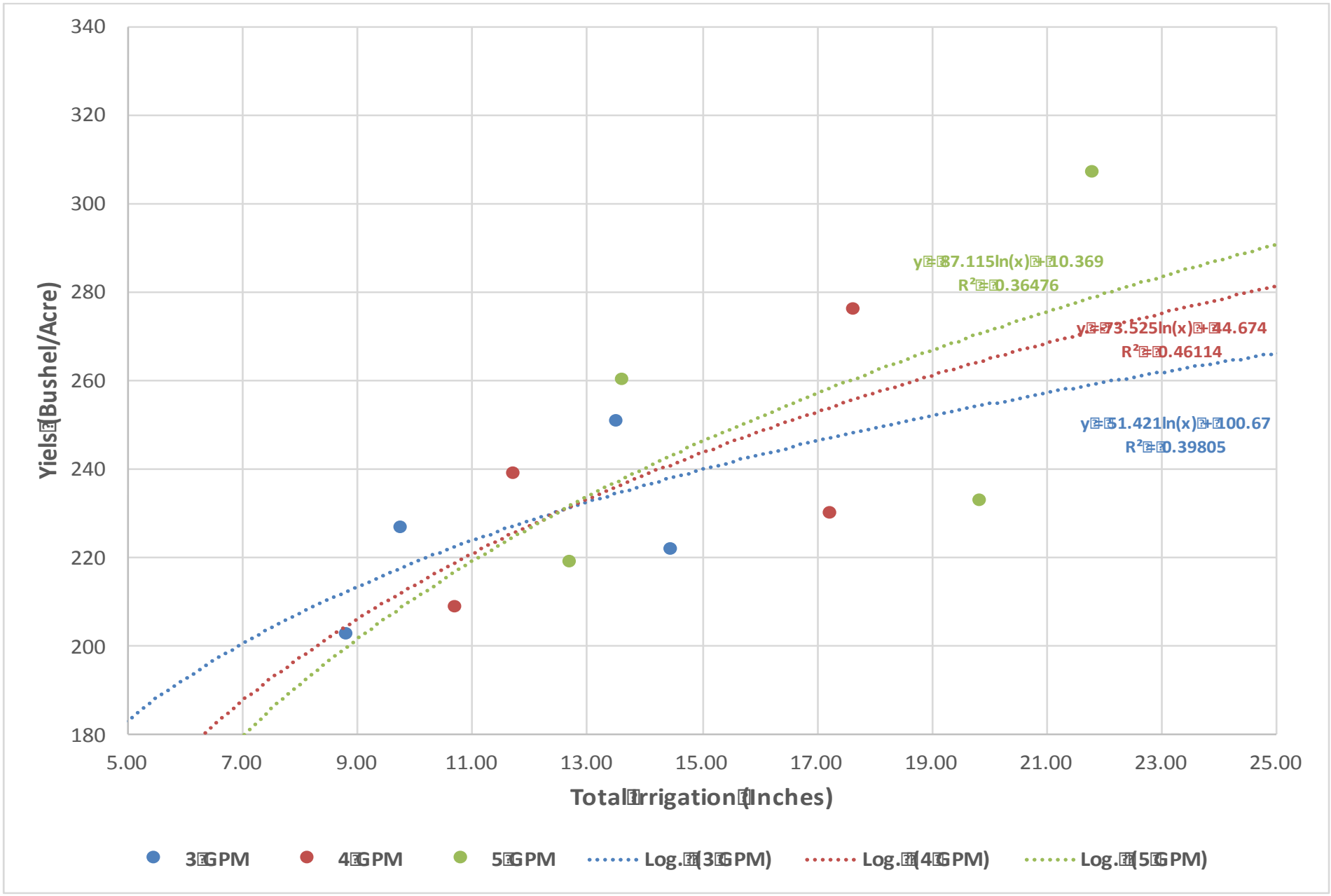
Producer	County	Field	Planted	Corn Hybrid	Seeding Rate	Yield (bu/ac)	Total Irrigation (in.)	bu/ac-in of Irrigation	Acres	Previous Crop	Irrigation by
Stan Spain	Moore	3 gpm	29-May	D55VP77	32,000	227	9.76	23.26	18.3	Corn	LEPA
		4 gpm	29-May	D55VP77	32,000	239	11.71	20.41	18.3	Corn	LEPA
		5 gpm	29-May	D55VP77	32,000	260	13.61	19.10	18.3	Corn	LEPA
Danny Krienke	Ochiltree	3 gpm	31-May	P33B54	26,000	203	8.81	23.04	40.0	Wheat	LEPA
		4 gpm	31-May	P33B54	27,000	209	10.69	19.55	40.0	Wheat	LEPA
		5 gpm	31-May	P33B54	28,000	219	12.70	17.24	40.0	Wheat	LEPA
Zac Yoder	Dallam	3 gpm	12-May	P33Y74	32,000	251	13.51	18.58	13.3	Wheat	LESA
		4 gpm	12-May	P33Y74	32,000	276	17.62	15.66	9.1	Wheat	LESA
		5 gpm	12-May	P33Y74	32,000	307	21.79	14.09	6.5	Wheat	LESA
Harold Grall	Hartley	3 gpm	12-May	P33B54	26,000	222	14.47	15.34	30.3	Milo	LESA
		4 gpm	12-May	P33B54	26,000	230	17.22	13.35	60.6	Milo	LESA
		5 gpm	12-May	P33B54	26,000	233	19.83	11.75	30.3	Milo	LESA
Harold Grall	Moore	**LEPA (2.67 gpm)**	27-May	P1151AM	30,000	244	11.58	21.07	101.2	Milo	LEPA
		PMDI (2.67 gpm)	27-May	P1151AM	30,000	244	11.58	21.07	20.3	Milo	Drag Drip
Harold Grall	Moore	**PMDI (2.67 gpm)**	5-Jun	P1151AM	28,000	180	14.27	12.61	120.0	Corn	Drag Drip

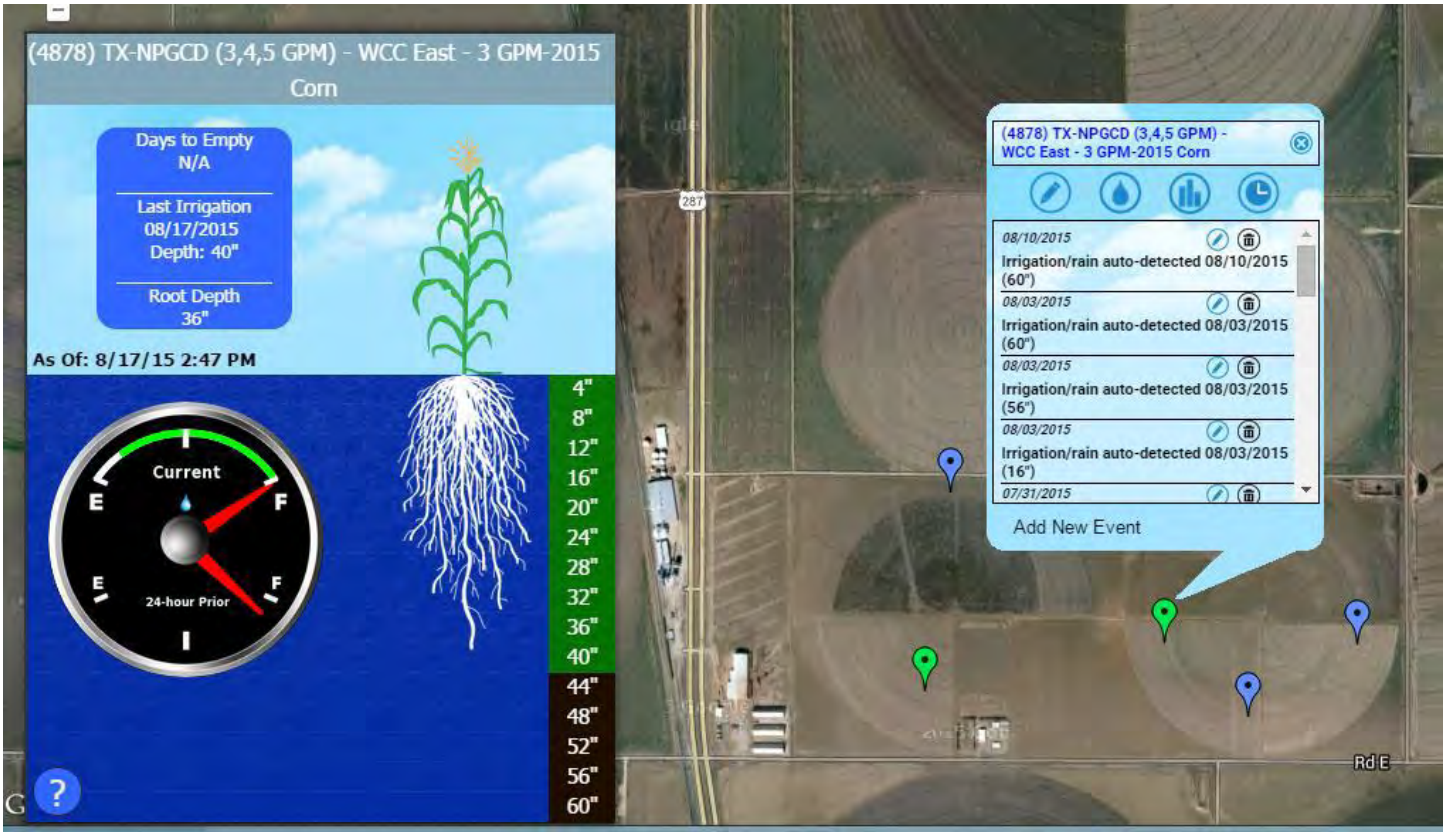
Note: The producer order is ranked highest to lowest by bushels per acre-inch of irrigation for the producer's three gallon per minute field. LEPA with Senninger Shroud and Bubble, LESA with LDN and Drag Drip with T-L System.

Appendix I: Corn Yield vs. Net Return per Acre



Appendix J: Total Irrigation vs. Corn Yield





Aquaspy Website shows snapshot of soil moisture and plant root growth in Stan Spain's 3 GPM field at 2:47 pm August 17, 2015, prior to reading summary and separate graphs shown in individual grower reports.

NORTH PLAINS GROUNDWATER Conservation District

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