
NORTH PLAINS
GROUNDWATER
Conservation District
200-12 Reduced Irrigation on
Corn Demonstration Project – 2014

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Danny Krienke - Ochiltree County Cooperator (NPGCD Director)

David Ford - Hartley County Cooperator

Brian Bezner - Dallam County Cooperator

Joe Reinart - Sherman County Cooperator

Brent Clark - Hartley County Cooperator

Dennis Buss, JBS Hartley Feeders - Hartley County Cooperator

Phil Haaland - Hartley County Cooperator

Tommy Laubhan - Lipscomb County Cooperator

Richard Schad - Hansford County Cooperator

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Additional funding provided by:

Texas Water Development Board - Agricultural Water Conservation Grant

United States Department of Agriculture Natural Resources Conservation Service - Conservation Innovation Grant

A special thanks goes out to all those not mentioned above who help to make the ""200-12"" demonstrations possible.

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Executive Summary

In 2009, the District began planning the "200-12 Reduced Irrigation on Corn Demonstration Project" ("200-12" Project). The "200-12" Project is a five year on-farm, field scale project that demonstrates how water conservation technologies and irrigation management practice adjustments can reduce groundwater use and allow agricultural irrigation producers to remain profitable and financially viable with limited and/or diminishing groundwater resources. The "200-12" Project is led by cooperating growers to implement water conservation technologies and management practices with the goal to grow 200 bushels of corn on 12 inches of irrigation per crop acre, utilizing rainfall and soil water. Corn irrigation averaged 21 inches per acre over 10 years according to the Agri-Partner field demonstrations conducted by AgriLife Extension.

In 2014, ten cooperating producers dedicated twenty demonstration fields encompassing 1471 acres. All 1471 acres dedicated to the project were harvested for corn grain. Corn yields were 200 bushels per acre or more in seven of ten "200-12" fields. Average yield in the ten fields was 198 bushels per acre. Irrigation averaged 17.59 inches. Pre-water was used in seven "200-12" fields. Average pre-water was 1.99 inches. Production averaged 11.83 bushels (662lbs) per inch of irrigation. Average Irrigation, rainfall plus net soil water totaled 28.46 inches. Production averaged 215 bushels per acre in ten "control" fields. Average Irrigation was 20.12 inches. Production was 10.97 bushels (614lbs) per inch of irrigation. Irrigation, rainfall and net soil water averaged 30.40 inches. No pre-water was applied in 4 of the 22 fields. **Appendix A** is a summary of demonstration results that describes water and corn yield for each field. **Appendix B** is a summary of corn hybrids, seeding rates and planting dates selected by the ten cooperators. **Appendix C** is a comparison of net return per acre for each "200-12" field compared to the "control" field for 2014. Net return per acre averaged $368.13 for the "200-12" fields compared to $396.74 for the "control" fields. **Appendix D** is a math polynomial that indicates that the water management and corn production practices used in eight of the ten "200-12" fields in 2014 can potentially produce more net return dollars per acre than those used in the "control" fields. Read about hail damage in growers" individual report. **Appendix E** is a comparison of net return per inch of irrigation for each "200-12" field compared to the "control" field for 2014. Net return per inch of irrigation averaged $22.21 for the "200-12" fields compared to $20.51 for the "control" fields. Results from the 2014 cooperating producers are as follows:

Harold Grall of Moore County dedicated 240 acres to the on-farm demonstration in two separate fields irrigated by different center pivots. Grall strip tilled and planted 120 acres of corn on June 4 at 28,000 seeds per acre for his "200-12" field. Grall planted 120 acres, also strip tilled, on June 12 at 28,000 seeds per acre for his "control" field. The "200-12" field produced 201 bushels per acre. Irrigation totaled 12.96 inches, that includes 1.02 inches of pre-water. Production in the "control" field was 222 bushels per acre, where in-season irrigation was 17.10 inches, pre-water 3.64 inches and total irrigation for the "control" field was 20.74 inches. Grall says "he thinks soil water was low in the "200-12" field following the 2013 crop, so he decided to pre-water to improve germination. In comparison, the "control" field produced 21 more bushels per acre than the "200-12" with 7.78 additional inches of irrigation. Net return from each

inch of irrigation was $31.58 from the “200-12” field compared to $20.59 from the “control” field. The “control” field‟s net gain was $17.86 per acre with 7.78 inches additional irrigation used compared to production from the “200-12” field. Net return from the additional 7.78 inches of irrigation applied to the “control” field is $2.29 per inch. Plants in the “200-12” field were damaged by hail in mid-July at the seven leaf stage, but recovered to make a good corn yield.

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

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

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

Plant hail damage followed by inadequate water to help recover in July significantly limited corn yield in the “200-12” field.

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

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

Hartley Feeders (Dennis Buss) of Hartley County dedicated 120 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Hartley Feeders strip tilled and planted 60 acres of corn on June 5 at 28,000 seeds per acre in the north half of the circle for their “200-12” field. Hartley Feeders planted the north half 60 acres of another circle, also strip tilled, on June 6 at 28,000 seeds per acre for their “control” field. The “200-12” field produced a 192 bushel per acre corn yield. Irrigation totaled 18.07 inches, of which pre-water was 1.82 inches. Production in the “control” field was 171 bushels per acre, where seasonal irrigation was 12.93 inches, pre-water 3.08 and total irrigation 16.01 inches. In comparison, the “200-12” field produced 21 more bushels per acre than the “control” with 2.06 inches more irrigation. The “200-12” field‟s net gain was $50.18 per acre with 2.06 inches more irrigation used compared to

production from the “control” field. Net return was $353.89 per acre for the “200-12” field compared to $303.71 from the “control”. Net return from each inch of irrigation was $19.65 for the “200-12” field compared to $18.97 from the “control” field. Net return from the additional 2.06 inches of irrigation for the “200-12” field is $24.36. Dennis Buss said, “The soil probe really helped manage and save water. I was able to periodically stop irrigation when the soil profile had good water levels. Also, “Better Harvest saved a lot of money in fertilizer and corn was less stressed”. And “The „control‟ field has an area of less productive soil that likely contributed to the reduced yield there. More beneficial rain would have helped”.

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

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

Richard Schad of Hansford County dedicated 165 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Schad strip tilled and planted 41 acres of corn May 20 at 27,400 seeds per acre in the west half circle for his “200-12” field. Schad planted 124 acres on May 20 at 32,200 seeds per acre, also strip tilled, for his “control”. Both the “200-

12” and “control” fields were damaged by a wind storm June 30 at the 7 to 8 leaf growth stage. Shad estimates 10 to 20 percent green snap damage. A bad hailstorm hit both fields July 16 at 10 leaves shredding leaves and damaging stalks. Shad said he had held water back on the “200-12” field prior to the storms, therefore the plants were not quite as far along. He said, “Ch214-00DGVT2 is a tough hybrid with great ear flex that recovered to produce a good yield following the storm damages.” He said, “The „control‟ field was damaged more than he expected and yielded far less.” The “200-12” field produced a 199 bushel per acre corn yield. Pre-Irrigation was 8.65 inches and in season 17.11 making a total of 25.76 inches. Production in the “control” field was 126 bushels per acre where pre-water was 4.26 inches, in season 10.34 and total irrigation at 14.60 inches. In comparison, the “200-12” field produced 73 more bushels per acre than the “control” with 11.16 more inches of irrigation. The “200-12” field‟s net gain was $168.77 per acre with 11.16 inches more irrigation used compared to production from the “control” field. Net return was $333.38 for the “200-12” field compared to $164.61 for the “control”. Net return from each inch of irrigation is $12.94 from the “200-12” field compared to $11.27 from the “control”.

Introduction

In 2009, the District began planning a demonstration project, dubbed the "200-12" Project, that would use the latest water conservation technologies and practices to grow 200 bushels of corn on 12 inches of irrigation water per acre. The project is based on 12 inches of irrigation, 8 inches of seasonal rainfall and 6 inches of available soil water, to establish 26 inches of total water as guidelines for achieving the goal. The District acknowledges adjustments may be necessary when rainfall and or soil water are less than the guidelines call for. Corn irrigation averaged 21 inches per acre, while irrigation, rainfall and net soil water averaged 31 inches over the 10 year 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 ""200-12"" Project demonstrates how water conservation technologies and irrigation management practices can reduce groundwater use and allow agricultural irrigation producers to remain financially viable with restricted and diminishing groundwater resources. The ""200-12"" Project is designed as a five year initiative that provides field-scale profitability and feasibility demonstrations of producing 200 bushels of corn utilizing 12 inches of irrigation water combined with seasonal rainfall and available water within the crop"s root zone. In **2010**, the ""200-12"" Projects" first year, three of the Districts" directors, Harold Grall, Phil Haaland and Danny Krienke dedicated 270 of their own irrigated acres to establish the program. In **2011**, six additional farmers joined the project: Brian Bezner dedicated 60 acres in Union County, NM; Dennis Buss "JBS Hartley Feeders" dedicated 62 acres in Hartley County; Chad Hicks dedicated 50 acres in Hartley County; Joe Reinart dedicated 75 acres in Sherman County; Steve Shields dedicated 65 acres in Hutchinson county; and James Born dedicated 115 acres in Ochiltree county. Grall and Krienke used 120 acres each again and Haaland 15, making the total 682 acres in 2011. In **2012**, 2152 acres were dedicated as follows: Joe Reinart 135 acres in Sherman county; Harold Grall 240 acres in Moore county; Tommy Laubhan 122 acres in Lipscomb county; Dennis Buss "JBS Hartley Feeders" 180 acres in Hartley county; Brent Clark 240 acres in Hartley county; Richard Schad 164 acres in Hansford county; Danny Krienke 120 acres in Ochiltree county; Phil Haaland 120 acres in Hartley county; Frische Brothers 107 acres in Moore county; David Ford 120 acres in Hartley county; Chad Hicks & 14 Mile Ranch 360 acres in Hartley county and Brian Bezner 240 acres in Dallam county. For **2013**, growers dedicated 1672 acres to the project as follows: Joe Reinart 92 acres in Sherman county; Harold Grall 240 acres in Moore county; Brent Clark 244 acres in Hartley county; Danny Krienke 120 acres in Ochiltree county; Brian Bezner 222 acres in Dallam county; Richard Schad 165 acres in Hansford county; Frische Brothers 107 acres in Moore county; Phil Haland 120 acres in Hartley county; David Ford 120 acres in Hartley county; Hartley Feeders 120 acres in Hartley county and Tommy Laubhan 122 acres in Lipscomb county. In **2014**, cooperating growers committed 1471 acres to the project. Harold Grall planted 240 acres in Moore county; Danny Krienke 120 acres in Ochiltree county; Brian Bezner 138 acres in Dallam county; Joe Reinart 102 acres in Sherman county; Brent Clark 120 acres in Hartley county; Hartley Feeders 120 acres in Hartley county; Phil Haaland 120 acres in Hartley county; David Ford 120 acres in Hartley county; Tommy Laubhan 124 acres in Lipscomb county and Richard Schad 165 acres in Hansford county. Information in this report

provides results of the field scale demonstrations conducted in 2014. Corn was produced on 6,247 acres during the five year project by thirteen growers. Additional information compiled in 2010, 2011, 2012 and 2013 can be obtained from website northplainsgcd.org/education and the District office located at 603 East 1st street, Dumas, Texas. (806) 935-6401.

Methods

Each of the ten cooperators individually selected two fields irrigated by center pivot systems for his demonstration. Irrigation was managed within the NPGCD‟s "200-12" project protocols and guidelines in one field called the "200-12". Each cooperator managed irrigation in the second field, called the "control", according to his normal practices. Each cooperator individually chose commercially available corn hybrids based on their experience as growers. Seeding and fertilizer rates, as well as pesticide and herbicide applications, were also selected by each cooperator. At each demonstration field, the District installed water meters to record and verify the amount of irrigation applied on each field, rain gauges to measure rainfall, gypsum block moisture sensors at 1, 2, 3, 4 and 5 foot depths in the crop‟s root zone to monitor soil water content, and AquaSpy® continuous soil water monitoring probes down to 60 inches. Each irrigation system was equipped with PivoTrac™ remote continuous tracking and control to monitor and manage irrigation application frequency. Each field was provided soil and plant leaf sampling four times during the growing season to monitor and guide fertility levels by Better Harvest, Inc. During the growing season, District personnel collected 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® and PivoTrac™ along with the data collected at least weekly from each demonstration field to monitor crop and soil moisture conditions, as well as to schedule irrigation frequency and volumes in the "200-12" fields. Where the "200-12" and "control" fields were both irrigated by the same center pivot system, PivoTrac™ delivered a text message to the District conservationist who recorded when irrigation stopped in one field and began in the other field. The time the irrigation system was in the "200-12" or "control" field, along with weekly gpm water meter readings, established a method to track irrigation. All demonstrations began at planting and ended at harvest, which each cooperator managed. The District compared harvest and irrigation results from the "200-12" field with that from the "control" field for each grower, and to that of other fields which the cooperator farmed. Yields for each field were adjusted to reflect 15.5% moisture content for corn based on the formula used by the National Corn Growers Association. The District analyzed production gains and losses based on a corn price of $4.00 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, $3.90 per thousand; irrigation $5.65 per inch applied and harvest $0.34 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 electrical Conductivity Mapping Dual EM subsoil layer option provided by Midwest Soil Samplers and

Crop Metrics in 2012. VRI prescriptions were written by NPGCD personnel in cooperation with cooperating growers using Crop Metrics Virtual Agronomist software. The VRI prescriptions were loaded on Pivotrac‟s™ automatic center pivot speed control system that ran the VRI. The electromagnetic (EM) instrument provides relative field specific differences to potentially improve crop production within the survey area. Resulting survey data is used primarily to guide precision agriculture practices such as variable rate seeding, fertilizer and irrigation. The survey provides seven layers of data. The layers are aspect, depressions, dual EM topsoil, dual EM subsoil, elevation, landscape and slope. The dual EM subsoil layer describes relative differences in soil texture and associated characteristics to approximately 36 inches. Dual EM Subsoil data is important to managing irrigation and writing Variable Rate Irrigation (VRI) prescriptions. Satellite imagery was initiated and used from HydroBio to monitor plant stress, soil moisture and crop water use continuously for 792 acres in eleven fields in 2013. Satellitte imagery was continued in 2014 for eighteen fields that totaled 1347 acres. The purpose was to learn more about the function of the imagery process and its‟ potential for an additional beneficial irrigation and water management tool for growers. The following discussion provides detailed growing season data, results and information for each grower‟s two fields measured and recorded in 2014, the final year for the “200-12” project.

Harold Grall's 2014 Moore County Demonstration

Planting and Crop Information: For his demonstration, Harold Grall strip tilled and planted 120 acres of corn in the northwest quarter of section 414 for his "200-12" field, "Grall 200-12". He planted the field with Pioneer 1151AM1 at a seeding rate of 28,000 seed per acre. Grall planted 120 acres, also strip tilled, in the southeast quarter of section 425 to Pioneer 33B54 at 28,000 seeds per acre for his "control" field, "Grall control". The "200-12" field was irrigated using a center pivot where seasonal water meter readings average 365 gpm and delivered an average of 1.05 inches of irrigation in a 6.5 day revolution. Water meter readings averaged 450 gpm for the center pivot that irrigated the "control" field and delivered 1.14 inches in a 5.7 day revolution. Planting and crop information for "Grall 200-12" and "Grall control" are shown in table 1 below.

Table 1: Planting and Crop Information for Harold Grall

"200-12" Demonstration Field			
Planted:	*June 12*	**Harvested:**	*November 5*
Hybrid:	*P1151AMX*	**Seeding Rate:**	*28,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*120*	**GPM Per Acre:**	*3.0*
Total Water:	*21.47 in.*	**Soil Type:**	*Sherm Silty Clay Loam*
Fertilizer:	*80-60-0*	**Insecticide:**	*None, Aproach Fungicide*
Herbicide:	*Balance Flex, Cinch ATZ, Strut, Starane, Powermax, Status, Liberate, Intensity*		

Control Demonstration Field			
Planted:	*June 5*	**Harvested:**	*November 4*
Hybrid:	*33B54*	**Seeding Rate:**	*28,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*120*	**GPM Per Acre:**	*3.75*
Total Water:	*32.74 in.*	**Soil Type:**	*Sherm Clay Loam*
Fertilizer:	*61-59-0*	**Insecticide:**	*Intrepid, Aproach Fungicide*
Herbicide:	*Balance Flex, Cinch ATZ, Rifle, Starane, Strut*		

Beginning Soil Water Profile and Growing Season Rainfall

"200-12" Demonstration Field: Gypsum block soil moisture sensors installed in early April, prior to planting, showed about one half soil water levels at 1, 2, 3, 4, and 5 feet in the profile. One inch of pre-water was applied just prior to planting to ensure good seed germination. Late May and early June rainfall improved soil moisture levels, but mid-July rainfall combined with irrigation established good soil water levels to five feet during tassel, pollination and early grain fill. The crop used significant soil moisture from especially 2 feet at the end of August and in September, plus irrigation and much improved rainfall finishing the crop. Rainfall totaled 9.19 inches from planting until harvest, which is back to more normal levels. Gypsum blocks were installed in Sherm Silty Clay Loam soil that holds approximately 2.0 inches of available water per foot for potential crop use. The gypsum blocks were installed in April prior to planting to provide pre-season soil water conditions.

Control Demonstration Field: Soil moisture sensing gypsum blocks were installed in early April. The soil profile was generally refilled to 4 feet with pre-water. A total of 3.64 inches of pre-water was applied. Moisture sensors show the profile was good to 4 feet and about half at 5 at planting. A good 2.11 inch rainfall in mid-July plus irrigation at the 8 leaf stage established a full soil profile to 5 feet. Crop water use was high in August mostly depleting soil water at 2 feet plus significant amounts from 3 and 4 feet. Overall, adequate soil water levels were maintained to produce a good corn yield. Gypsum blocks were installed in Sherm Silty Clay Loam soil that holds approximately 2.0 inches of available water per foot for potential crop use. Rainfall from planting until harvest totaled 10.71 inches. More than two inches of beneficial rainfall occurred in June, July and September that helped produce a good crop. Table 2 shows monthly rainfall recorded by a district rain gauge located at each of the two fields.

Table 2: Monthly Rainfall Data for Harold Grall

	June	July	August	September	October	Total
"200-12"	1.03"	3.64"	1.66"	2.38"	0.48"	**9.19"**
Control	2.15"	3.53"	1.10"	3.46"	0.47"	**10.71"**

Growing Season Water Tracking: The district tracked crop total water throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. A 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 "200-12" field. Another set of the same type of sensors were installed in each "control" field. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in the fields. Gypsum blocks were installed in the "200-12" field and "control" field prior to planting. Each AquaSpy® probe was installed soon after crop emergence. Installing and reading the gypsum blocks prior to planting provided advanced soil moisture conditions and information to help guide and manage irrigation. 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 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 "200-12" field are shown first, followed by the same illustrations for the "control" field.

Figure 1: Gypsum Block Readings for Harold Grall's "200-12" Demonstration Field (201 bu/ac)

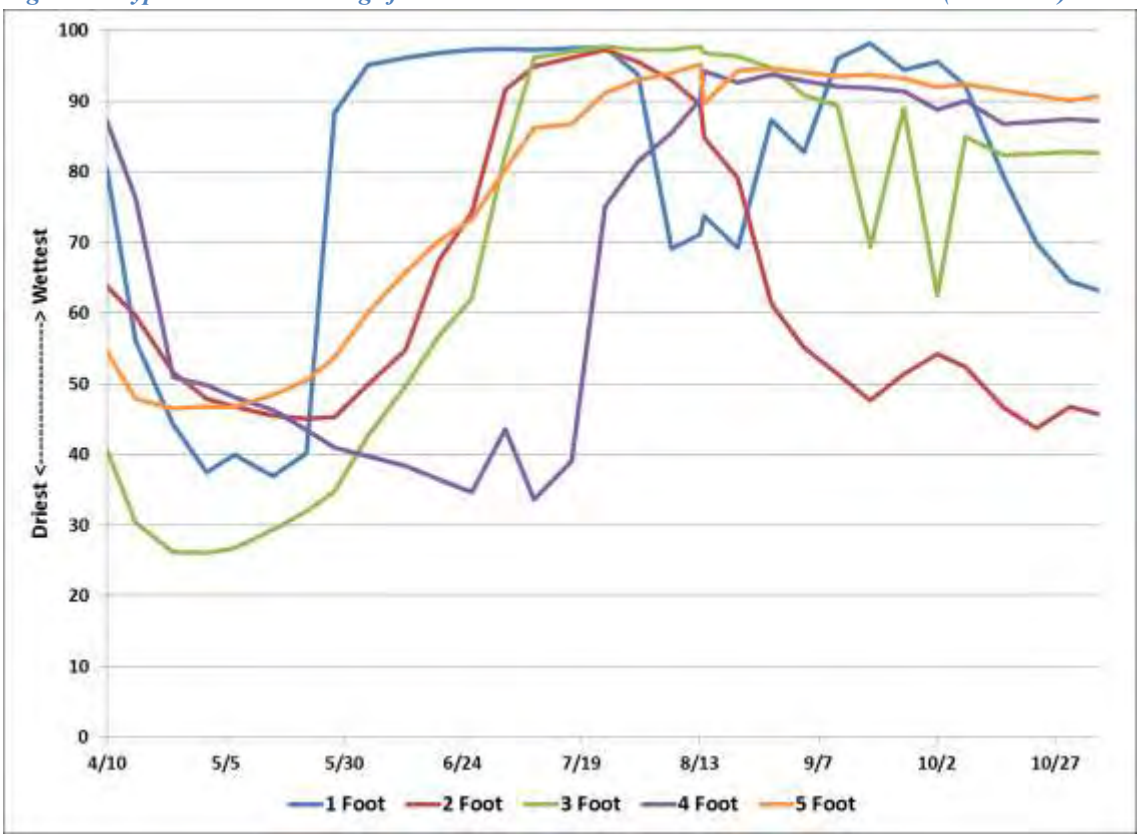


Figure 2: Growing Season Water Tracking for Harold Grall's "200-12" Demonstration Field (201 bu/ac)

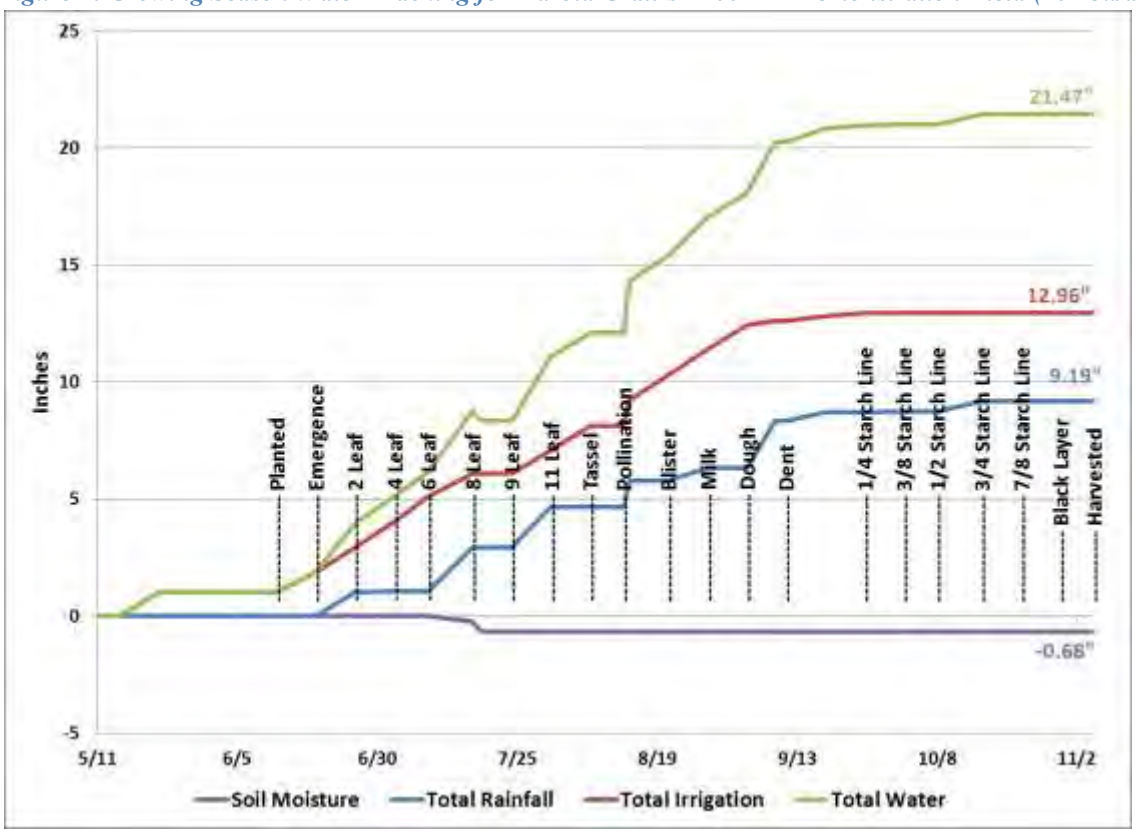


Table 3: Demonstration Field Data for Harold Grall's "200-12" Demonstration Field

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				
3/31			9958								163 N		Paul&Kari
4/3			9958		97.8	97.4	97.3	97.5	97.2		163 N		Kari&Leon
4/10	0.11		9958		80.4	63.8	40.6	87.2	54.5		163 N		Kari
4/16			9958		56.0	59.6	30.4	76.2	47.9		163 N		Kari
4/24	0.15		9958		44.3	51.6	26.2	50.9	46.5		162 N		Kari
5/1	0.02		9958		37.5	47.9	26.1	49.8	46.8		163 N		Kari
5/7			9958		40.0	46.8	26.7	48.1	46.7		163 N		Kari
5/15			14489		36.9	45.5	29.4	46.3	48.5	Prewater	228 Y	377	Kari
5/22	0.05	1.02	43307		40.2	45.1	32.0	43.5	50.5	Prewater	183 N		Kari
5/28	1.32		43307		88.3	45.3	34.8	41.0	53.8		183 N		Kari
6/4			43307		95.1	49.9	42.7	39.8	60.1		167 N		Kari/David
6/12	2.15		43307		96.1	54.8	49.7	38.4	65.9		181 N		Kari/David
6/12										Planted			Harold
6/19	0.01	0.84	70905	Emergence	96.8	67.5	56.8	36.5	70.2	200-12	128 Y	348	Kari/David
6/26	1.02	1.06	105595	2 Leaf	97.3	74.2	62.1	34.7	73.3	200-12	168 Y	351	Paul
7/3	0.04	1.10	141452	4 Leaf	97.4	91.6	82.6	43.6	80.3	200-12	216 Y	344	Paul
7/9		1.07	176523	6 Leaf	97.3	94.9	96.1	33.6	86.2	200-12	260 Y	373	Paul
7/17	1.85	1.00	209119	8 Leaf	97.5	96.1	97.0	39.1	86.8		265 N		Paul
7/24			221764	9 Leaf	97.6	97.2	97.7	75.1	91.1	200-12	33 Y	375	Paul
7/31	1.75	0.99	241307	11 Leaf	93.7	95.6	97.3	81.4	93.0		251 N		Paul
8/7		1.04	275175	Tassel	69.1	93.0	97.3	85.5	94.0	200-12	240 Y	370	Paul
8/13				Pollination	71.1	89.5	97.7	90.2	95.2	200-12	Y		Leon
8/14	1.11	1.10	310980	Silk	73.7	84.8	96.8	94.2	89.7	200-12	269 Y	368	Paul
8/21		1.09	346428	Blister	69.2	79.1	96.3	92.6	94.3	200-12	298 Y	361	Jerry
8/28	0.55	1.07	381506	Milk	87.3	61.3	94.7	93.7	94.6	200-12	318 Y	347	Paul
9/4		1.06	416099	Dough	82.8	55.1	90.8	92.8	94.1	200-12	211 Y	361	Paul
9/9	1.99	0.19	422435	Dough							72 N		Paul
9/11			422435	Dent	96.0	51.4	89.3	92.0	93.5		73 N		Paul
9/18	0.39	0.19	428810	Dent	98.1	47.6	69.3	91.8	93.8	200-12	132 Y	420	Paul
9/25		0.14	433442	1/4 ml	94.4	51.4	89.0	91.4	93.2		181 N		Paul
10/2	0.02		433442	3/8 ml	95.6	54.2	62.4	88.8	91.9		182 N		Paul
10/8			433442	1/2 ml	92.2	52.4	84.9	90.0	92.4		182 N		Paul
10/16	0.44		433442	3/4 ml	79.3	46.6	82.3	86.8	91.5		180 N		Paul
10/23	0.02		433442	7/8 ml	69.9	43.7	82.6	87.1	90.8		182 N		Paul
10/30			433442	Black Layer	64.5	46.7	82.8	87.4	90.0		181 N		Paul
11/5			433442	Harvested	63.3	45.7	82.7	87.2	90.7		174 N		Paul
Total	**9.19"**	**12.96"**			**0.90"**	**0.15"**	**-0.50"**	**-0.78"**	**-0.45"**				
Net Soil Moisture is -0.68"													
Irrigation, Rainfall Plus Net Soil Moisture is 21.47"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

200-12

Year: *2014* **County:** *Moore* **Grower:** *Harold Grall*

No. Acres: *120* **Variety/Hyb:** *P1151AMX* **Soil Type:** *Sherm Silty Clay Loam*

Meter Type: *McCrometer*

Meter Mult: *Gallons x 100* **Tillage:** *Strip Till*

Fertilizer: *80-60-0* **Seeding:** *28,000*

Planted: *June 12, 2014* **Harvest:** *November 5, 2014*

Herbicide: *Balance Flex, Cinch ATZ, Strut, Starane, Powermax, Status, Liberate, Intensity* **Insecticide:** *None, Aproach Fungicide*

Yield: *201 bu/ac* **Prev. crop:** *Corn* **Row width:** *30 Inch*

Irrigation method: *Center Pivot* **Prewater:** *1.02 in.* **Well GPM:** *3.0*

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

Application pattern: *LEPA Bubbler* **Crop row direction :** *Straight*

GPS Location of Pivot Pad

Latitude: *35.97143*

Longitude: *-102.136511*

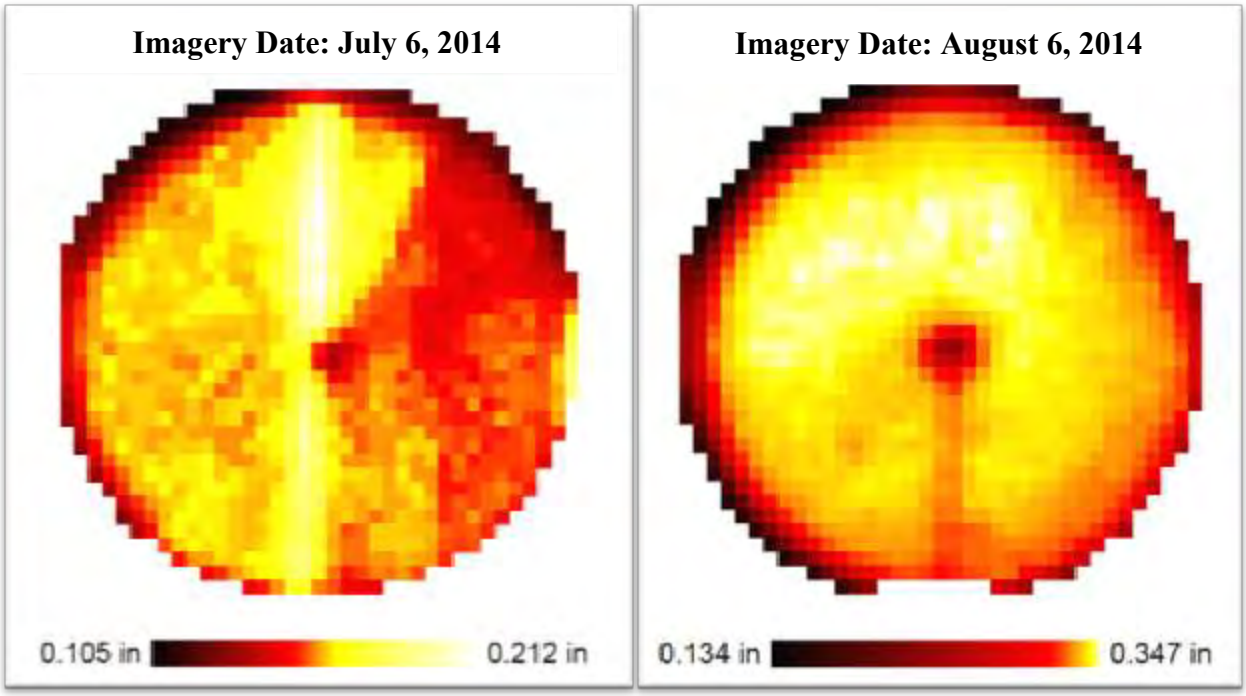
GPS Location of Gypsum Blocks

Latitude: *35.968247*

Longitude: *-102.135532*

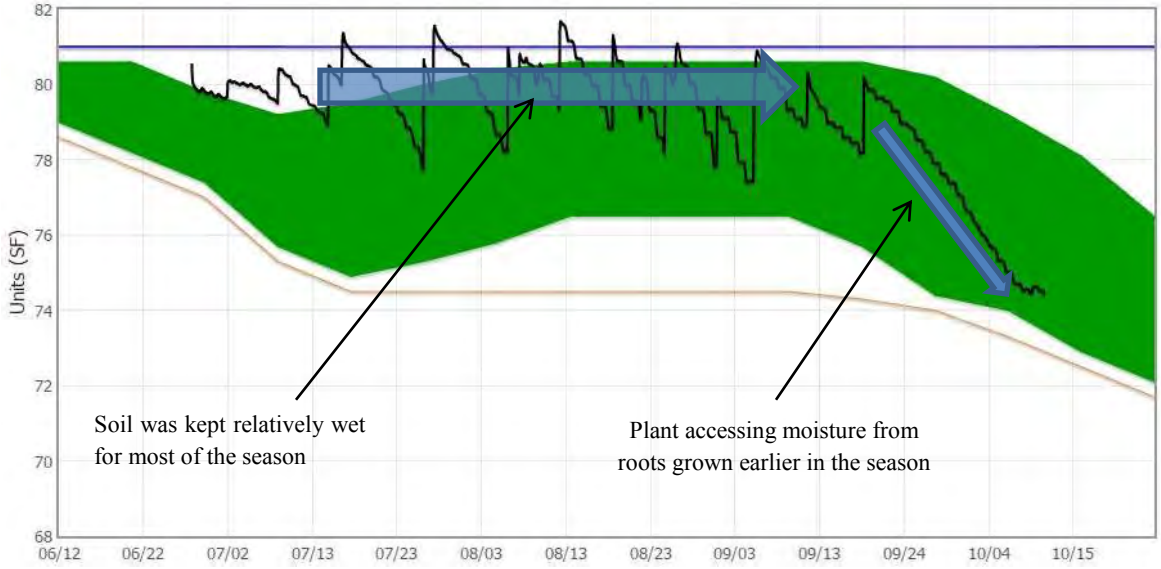
Satellite Imagery: Satellite imagery was initiated and used in 2013 to learn and evaluate its potential for an irrigation and water management tool for growers in connection with HydroBio. The use of satellite imagery was continued for the 2014 growing season. Harold Grall‟s "200-12" field was one of eighteen "200-12" Project fields included in 2014. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Harold Grall‟s "200-12" field are shown in figure 3 to illustrate examples of what is displayed on the website. The first image was on July 6 at the 4 leaf stage. The second image is on August 6 at the tassel stage. The satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 201 bushels per acre with 12.96 inches of irrigation.

Figure 3: Daily Water Use for Harold Grall's "200-12" Demonstration Field



Note: Each Square Represents 1/8 of an Acre

Harold Grall's "200-12" Field AquaSpy® Probe Summary



The exceptional water use efficiency at this site was probably due in part to excellent soil structure after years of strip tillage and good residue management. It is evident that there were roots present at 48" by mid-August but the plant didn't need to draw on moisture from these layers until later in the season. This indicates that the plants had an adequate supply of moisture to meet demand during the peak water use period, and really only tapped into the deep moisture to finish out at the end of the season. Irrigation was generally effective in penetrating to 24"-28" and there was no drainage evident.

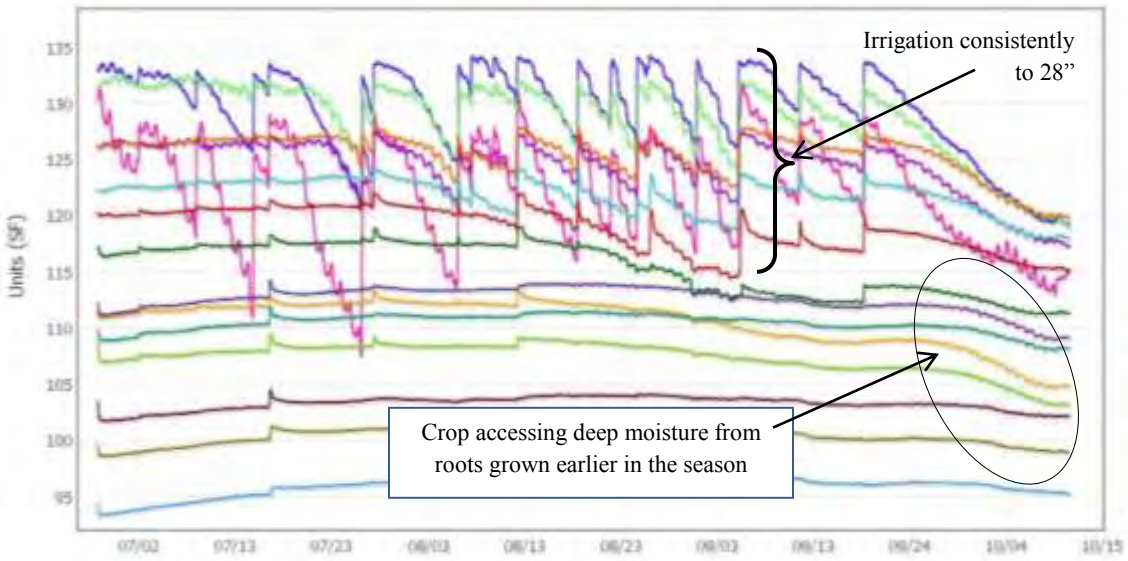


Figure 4: Gypsum Block Readings for Harold Grall's Control Demonstration Field (222 bu/ac)

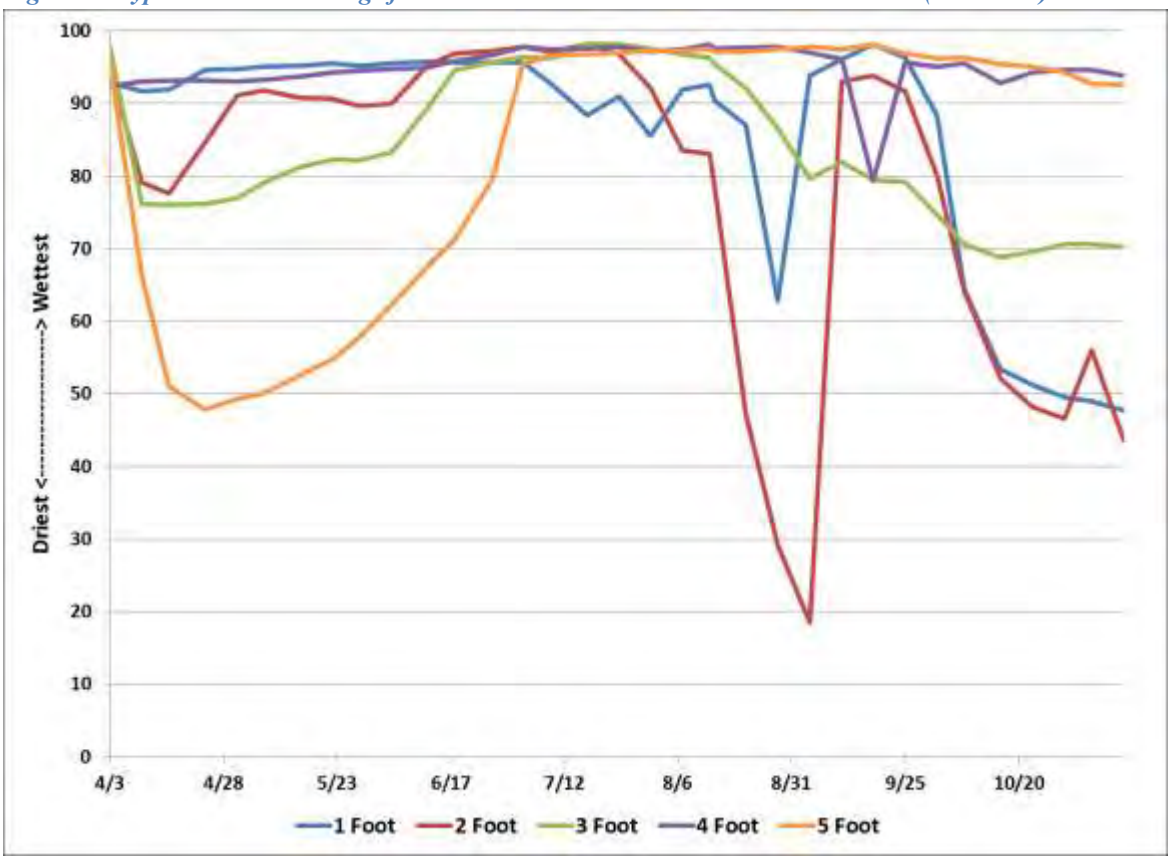


Figure 5: Growing Season Water Tracking for Harold Grall's Control Demonstration Field (222 bu/ac)

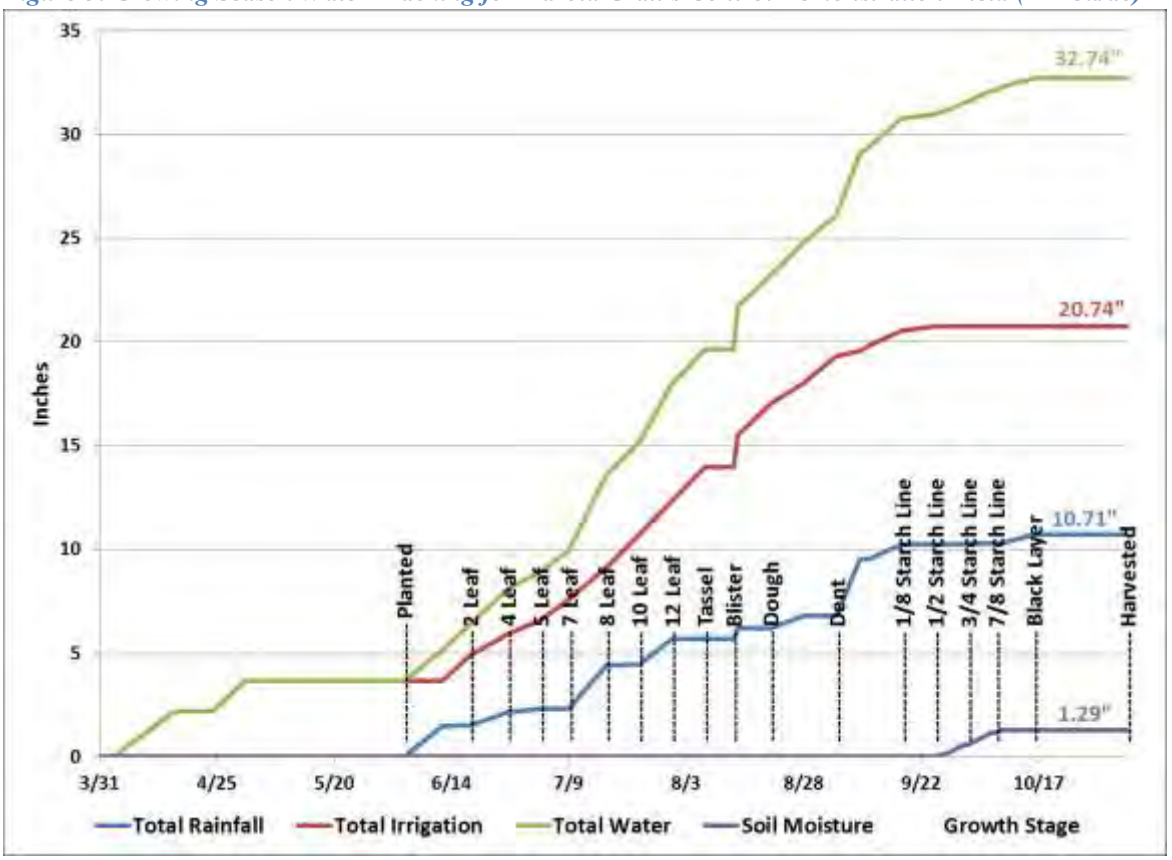


Table 4: Demonstration Field Data for Harold Grall's Control Demonstration Field

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				
3/31			2.32								80 N		Paul & Kari
4/3			4.16		92.9	94.7	97.8	92.4	95.7	Control	267 Y		Kari & Leon
4/10	0.16	1.21	14.48	Prewater	91.7	79.1	76.2	93.1	66.2	Control	33 Y	367	Kari
4/16		0.99	24.4	Prewater	91.9	77.6	76.1	93.2	51.0	Control	120 Y	357	Kari
4/24			37.36	Prewater	94.6	84.7	76.2	93.2	47.8	Control	276 Y	369	Kari
5/1	0.02	1.44	38.77	Prewater	94.8	91.1	77.0	93.1	49.3	Control	330 N		Kari
5/7			38.77		95.1	91.8	79.1	93.3	50.1		327 N		Kari
5/15			38.77		95.2	90.8	81.3	93.7	52.6		328 N		Kari
5/22	0.05		38.77		95.6	90.7	82.3	94.3	54.7		328 N		Kari
5/28	1.10		38.77		95.2	89.7	82.2	94.5	57.8		327 N		Kari
6/4										Planted			Harold
6/4			38.77		95.5	90.0	83.3	94.8	62.2		327 N		Kari & David
6/12	1.48		40.66		95.8	95.3	89.4	95.0	67.7	Control	70 Y	360	Kari & David
6/18	0.03	1.26	51.4	2 Leaf	95.7	96.9	94.6	95.9	71.3	Control	232 Y	337	Kari & David
6/26	0.64	1.03	61.71	4 Leaf	95.7	97.3	95.7	96.7	79.4	Control	303 Y	303	Paul
7/3	0.17	0.68	68.55	5 Leaf	95.7	97.8	96.5	97.8	95.6		235 N		Paul
7/9		0.98	78.37	7 Leaf	92.7	97.1	96.2	97.5	96.6	Control	270 Y	500	Paul
7/17	2.11	1.55	93.86	8 Leaf	88.4	98.1	98.3	97.6	96.8	Control	127 Y	517	Paul
7/24	0.01	1.58	109.7	10 Leaf	91.0	96.8	98.1	97.8	97.0	Control	332 Y	526	Paul
7/31	1.24	1.63	125.97	12 Leaf	85.6	92.1	97.6	97.1	97.2	Control	162 Y	535	Paul
8/7		1.60	142	Tassel	91.9	83.5	96.8	97.5	97.2	Control	11 Y	505	Paul
8/13				Pollination	92.6	83.1	96.3	98.1	97.6	Control	Y		Leon
8/14	0.50	1.57	157.74	Blister	90.5	78.5	95.4	97.6	97.1	Control	205 Y	490	Paul
8/21		1.52	172.98	Dough	87.0	47.3	92.1	97.7	97.1	Control	321 Y	505	Jerry
8/28	0.60	0.98	182.75	Dough	62.8	29.1	86.6	97.8	97.5		318 N		Paul
9/4		1.29	195.63	Dent	93.9	18.5	79.7	97.0	97.8	Control	42 Y	501	Paul
9/9	2.76	0.26	198.3								132 N		Paul
9/11		0.28	201.12	Dent	96.1	93.0	82.0	96.1	97.5	Control	221 Y	504	Paul
9/18	0.70	0.69	208.07	1/8 ml	98.1	93.8	79.4	79.3	98.1	Control	75 Y	519	Paul
9/25		0.20	210.07	1/2 ml	96.3	91.7	79.2	95.7	96.9		136 N		Paul
10/2	0.03		210.07	3/4 ml	88.3	80.0	74.7	95.1	96.2		136 N		Paul
10/8			210.07	7/8 ml	64.4	64.2	70.6	95.5	96.3		136 N		Paul
10/16	0.44		210.07	Black Layer	53.4	52.1	68.8	92.8	95.4		135 N		Paul
10/23	0.02		210.07	Black Layer	51.2	48.2	69.6	94.3	95.1		136 N		Paul
10/30			210.07	Black Layer	49.5	46.6	70.6	94.6	94.3		136 N		Paul
11/5			210.07	Harvested	49.0	56.0	70.6	94.6	92.7		135 N		Paul
11/12			210.07	Harvested	47.7	43.6	70.3	93.8	92.6		150 N		Paul
Total	**10.71"**	**20.74"**			**1.00"**	**0.87"**	**0.22"**	**-0.08"**	**-0.72"**				
Net Soil Moisture is 1.29"													
Irrigation, Rainfall Plus Net Soil Moisture is 32.74"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

Control

Year: *2014* **County:** *Hartley* **Grower:** *Harold Grall*

No. Acres: *120* **Variety/Hyb:** *33B54* **Soil Type:** *Sherm Clay Loam*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *61-59-0* **Seeding:** *28,000*

Planted: *June 5, 2014* **Harvest:** *November 4, 2014*

Herbicide: *Balance Flex, Cinch ATZ, Rifle, Starane, Strut* **Insecticide:** *Intrepid, Aproach Fungicide*

Yield: *222 bu/ac* **Prev. crop:** *Corn* **Row width:** *30 Inch*

Irrigation method: *Center Pivot* **Prewater:** *3.64 in.* **Well GPM:** *3.75*

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

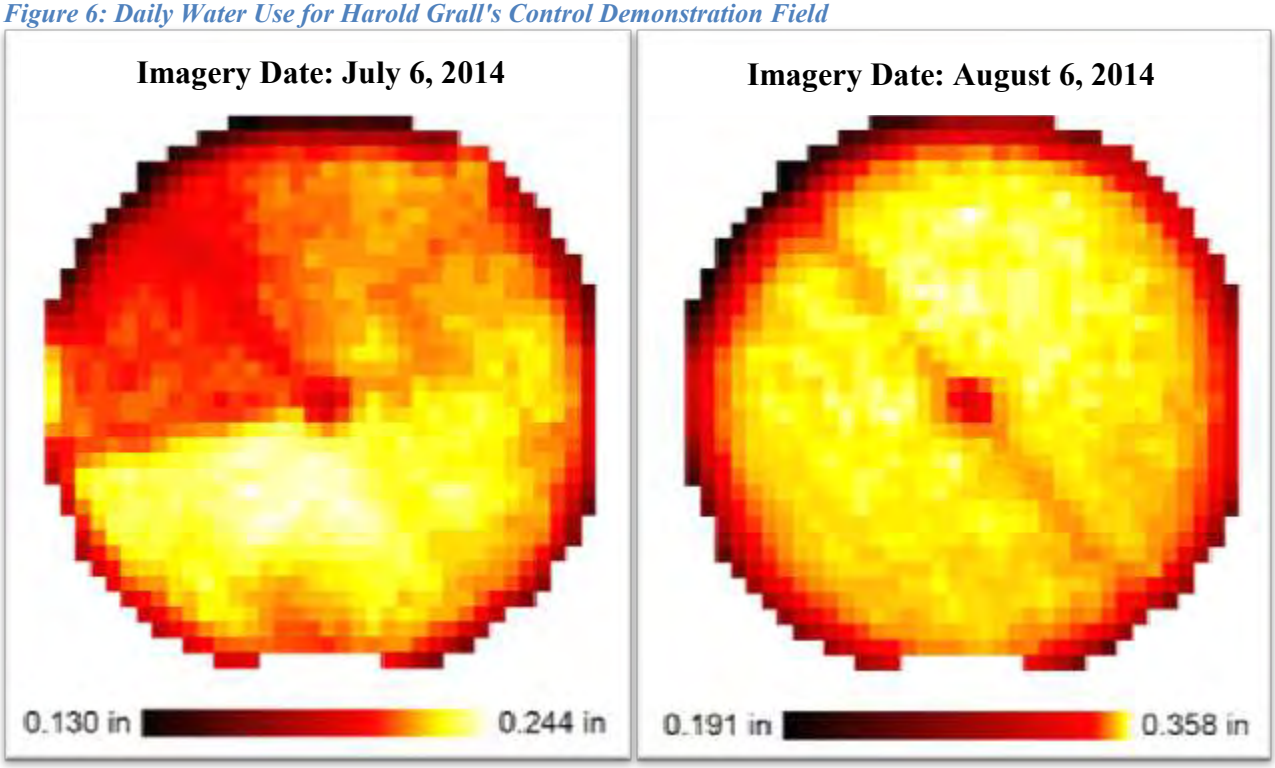
Application pattern: *LEPA Bubbler* **Crop row direction :** *Straight*

GPS Location of Pivot Pad
Latitude: *35.985965*
Longitude: *-102.163477*

GPS Location of Gypsum Blocks
Latitude: *35.98851*
Longitude: *-102.165925*

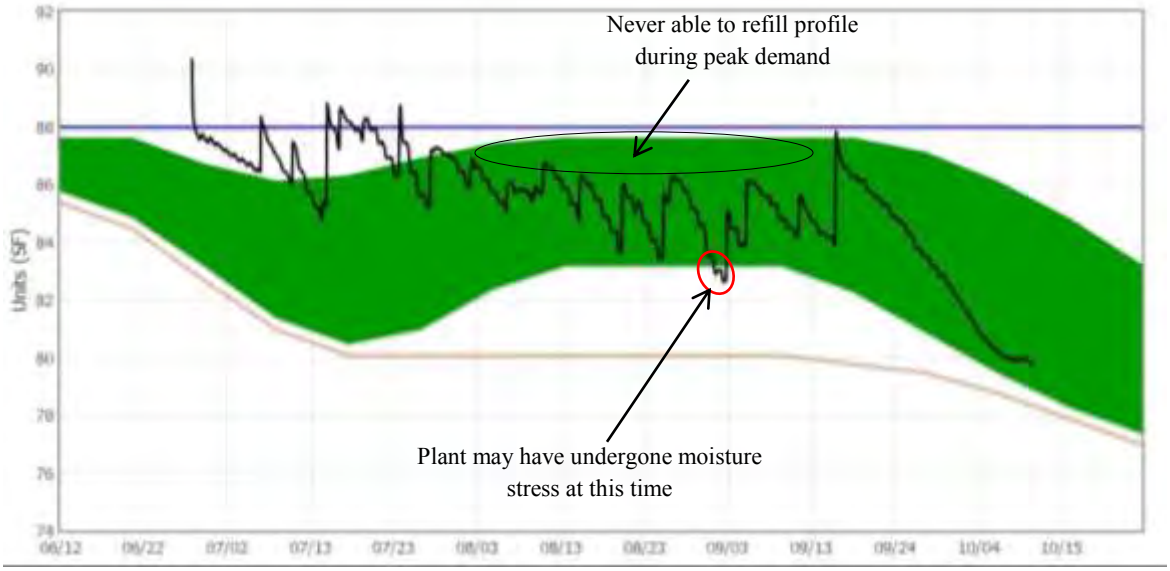
Satellite Imagery: Harold Grall‟s “control” field was one of eighteen “200-12” Project fields included in satellite imagery in 2014. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Harold Grall‟s “control” field in figure 6 illustrate examples of what is displayed on the website. The first image is on July 6 at the 5 leaf growth stage. The second image is on August 6 at the tassel stage. Satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 222 bushels per acre with 20.74 inches of irrigation.

Figure 6: Daily Water Use for Harold Grall's Control Demonstration Field

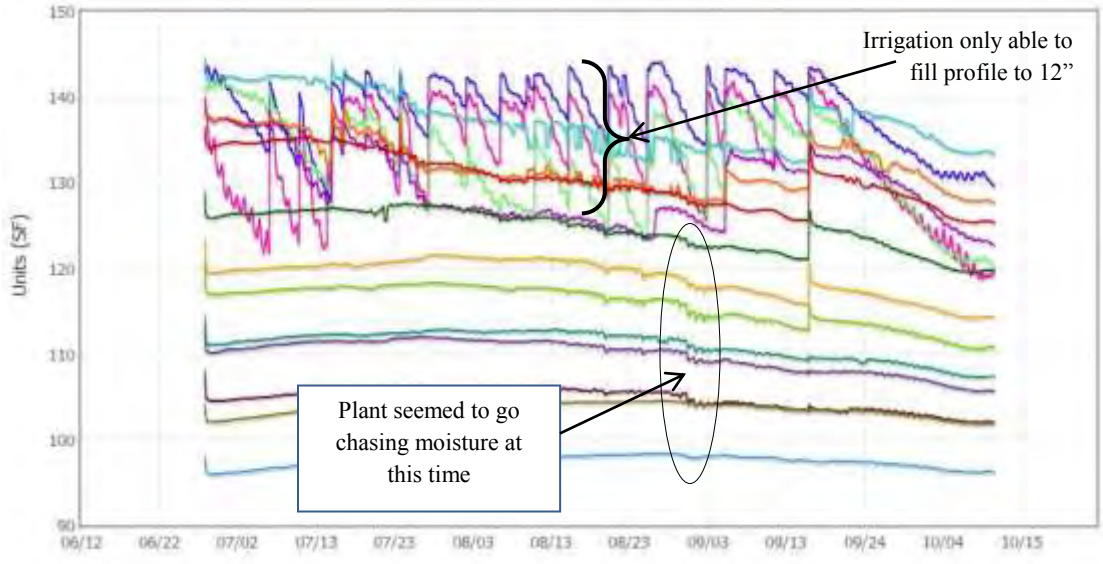


Note: Each Square Represents 1/8 of an Acre

Harold Grall's Control Field AquaSpy® Probe Summary



The biggest difference between this site and the "200-12" treatment was that irrigation was never able to penetrate deeply on the "control" site. The profile appeared to start full and there was no evidence of drainage. Most irrigations were only able to penetrate to 12" and so the plant was forced to chase moisture from the subsoil. It is evident that there was deep root activity at this site with roots to 48" by mid-August and to 60" by the end of August. However, unlike the "200-12" treatment, this crop was actually forced to use some of the deep moisture to supplement peak demand. The lower water use efficiency of this site compared to the "200-12" treatment was obviously due to the almost 8" more irrigation used without a corresponding yield increase. It is likely that the inability to get deep penetration from irrigation (below 12") was a contributing factor.



Harvest Results: The "200-12" field produced a 201 bushel per acre corn yield. Irrigation totaled 12.96 inches that includes 1.02 inches of pre-water. Production in the "control" field was 222 bushels per acre where pre-water was 3.64 inches, seasonal 17.10 and total irrigation 20.74 inches. In comparison, the "control" field produced 21 more bushels per acre than the "200-12" with 7.78 more inches of irrigation. Corn production was 15.51 bushels (868 lbs) per inch of irrigation in the "200-12" field compared to 10.70 bushels (599 lbs) in the "control". Production from each inch of irrigation, rainfall and net soil water that totaled 21.47 inches was 9.36 bushels (524 lbs) per acre in the "200-12" field. Irrigation, rainfall and net soil water totaled 32.74 inches in the "control" field where production was 6.78 bushels (379 lbs) per inch. Crop production costs were $66.14 per acre more for the "control" field than for the "200-12" primarily from increased irrigation and fertilizer expenses. At $4.00 per bushel, the additional 21 bushel per acre corn yield in the "control" field amounts to $84.00 more per acre. The "control" field"s net gain was $17.86 per acre with 7.78 inches more irrigation used compared to production from the "200-12" field. Net return from the "200-12" field was $409.25 per acre compared to $427.11 from the "control". Net return from each inch of irrigation was $62.04 from the "200-12" field compared to $42.81 from the "control" field. Net return from the additional 7.78 inches of irrigation applied to the "control" field is $2.29 per inch. A summary of the demonstration results are shown in table 5 below.

Table 5: Harold Grall's 2014 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $4.00/bu		
			bu/ac	lb/ac-in Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"200-12"	12.96	*21.47	201	868	$804.00	$62.04	$37.44
Control	20.74	†32.74	222	599	$888.00	$42.81	$27.12

*Includes -0.68 inches of water added to five feet of soil, plus rainfall, and irrigation.
†Includes 1.29 inches of water removed from five feet of soil, plus rainfall, and irrigation.

Danny Krienke's 2014 Ochiltree County Demonstration

Planting and Crop Information: Danny Krienke strip tilled and planted 60 acres of corn in the NE quarter circle (0-90 degrees) of the north half of section 47, for his "200-12" field, "Krienke 200-12". Krienke planted the "200-12" field to Golden Acres 24V61 at a seeding rate of 26,000 seeds per acre. He planted the northeast quarter circle (270 to 360 degrees) 60 acres, also strip tilled, to Golden Acres 24V61at 28,000 seeds per acre for his "control" field, "Krienke Control". Both the "200-12" and "control" fields were irrigated by the same center pivot. Seasonal water meter readings averaged 620 gpm and delivered an average of 1.25 inches of irrigation in a 9.1 day revolution. Planting and crop information for "Krienke 200-12" and "Krienke Control" are shown in the table 6 below.

Table 6: Planting and Crop Information for Danny Krienke

"200-12" Demonstration Field			
Planted:	*June 16*	**Harvested:**	*November 7*
Hybrid:	*Golden Acres 24V61*	**Seeding Rate:**	*26,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*60*	**GPM Per Acre:**	*5.0*
Total Water:	*25.52 in.*	**Soil Type:**	*Sherm Clay Loam*
Fertilizer:	*23-0-0*	**Insecticide:**	*None*
Herbicide:	*Cinch ATZ, Roundup*		
Control Demonstration Field			
Planted:	*June 16*	**Harvested:**	*November 7*
Hybrid:	*Golden Acres 24V61*	**Seeding Rate:**	*28,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*60*	**GPM Per Acre:**	*5.0*
Total Water:	*25.57 in.*	**Soil Type:**	*Sherm Clay Loam, Sunray Silty Clay Loam*
Fertilizer:	*38-0-0*	**Insecticide:**	*None*
Herbicide:	*Cinch ATZ*		

Beginning Soil Water Profile and Growing Season Rainfall

"200-12" Demonstration Field: Preseason soil water was generally good at 1, 4 and 5 feet but only about 30 percent at 2 and 3 feet in April, prior to planting. More than two inches of rain in late May and early June refilled the root zone at two feet, prior to planting June 16. Weekly gypsum block readings indicate the crop rooted deep and used remaining soil water from 4 feet and most from 2 feet in August during tassel, pollination and early grain fill, plus irrigation and approximately 1.25 inches of rainfall. Seasonal irrigation and rainfall did not reach the 3 feet root zone during the growing season. Plants used most water from 2 and 3 feet, about half from 1 and 4 feet and dipped into the 5 feet root zone in October finishing the crop. The crop was produced on Sherm Silty Clay Loam soil that can store approximately 2.0 inches of available water per foot for potential crop use. Rainfall was 2.56 inches in n July and 1.25 inches in August that helped produce a good yield. Total rainfall for the season was 7.76 inches, and more normal for this location. Gypsum blocks were installed in early-April prior to planting to obtain advanced soil water conditions to guide early season water management.

Control Demonstration Field: Late May and early June rainfall helped refill the 1, 2 and 3 feet root zone prior to planting. Also, soil water was good at 5 feet but only 35 percent at 4 feet prior to planting. Weekly gypsum block readings show good soil moisture levels were maintained at 1, 2, 3 and 5 feet during the primary growing season from irrigation and periodic rainfall. Only limited amounts of rainfall and irrigation penetrated to 4 feet in the plant root zone. Soil water was depleted from 1 foot, about 75 percent from 2 feet and approximately 40 percent from 3 and 4 feet in finishing the crop in October. Periodic timely rainfall helped produce the crop, especially 1.79 inches July 30 at the 10 leaf stage. The crop was produced on Sherm Silty Clay Loam soil, which holds approximately 2.0 inches available water per foot for potential crop use.

Table 7: Monthly Rainfall Data for Danny Krienke

	May	June	July	August	September	October	Total
"200-12"	0.00"	1.97"	3.76"	1.25"	0.78"	0.00"	**7.76"**
Control	0.00"	1.97"	3.76"	1.25"	0.78"	0.00"	**7.76"**

Growing Season Water Tracking: The district tracked crop total water throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. A 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 "200-12" field. Another set of the same type of sensors were installed in each "control" field. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in the field. Gypsum blocks were installed in both the "200-12" field and "control" fields prior to planting. Each AquaSpy® probe was installed following crop emergence. Installing and reading the gypsum blocks prior to planting provided advanced soil moisture conditions and information to help guide and manage irrigation. 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 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 "200-12" field are shown first, followed by the same illustrations for the "control" field.

Figure 7: Gypsum Block Readings for Danny Krienke's "200-12" Demonstration Field (217 bu/ac)

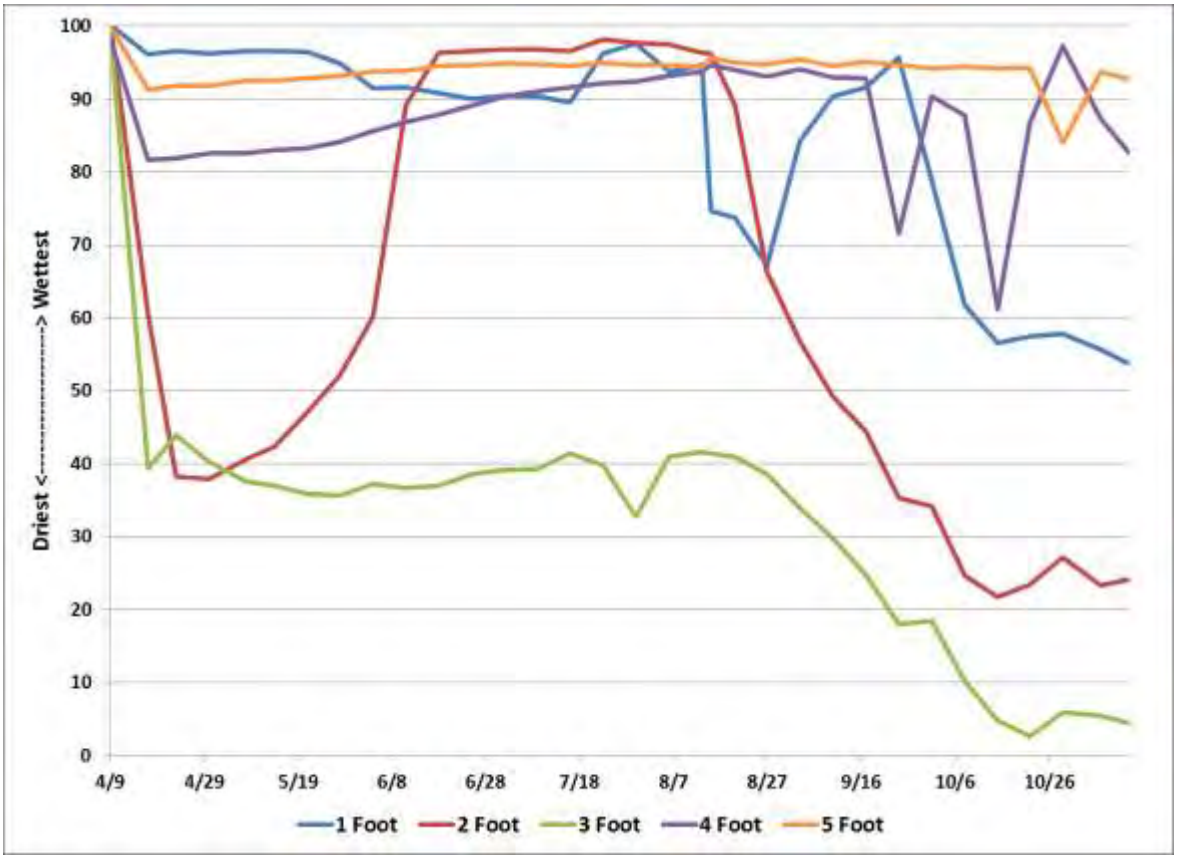


Figure 8: Growing Season Water Tracking for Danny Krienke's "200-12" Demonstration Field (217 bu/ac)

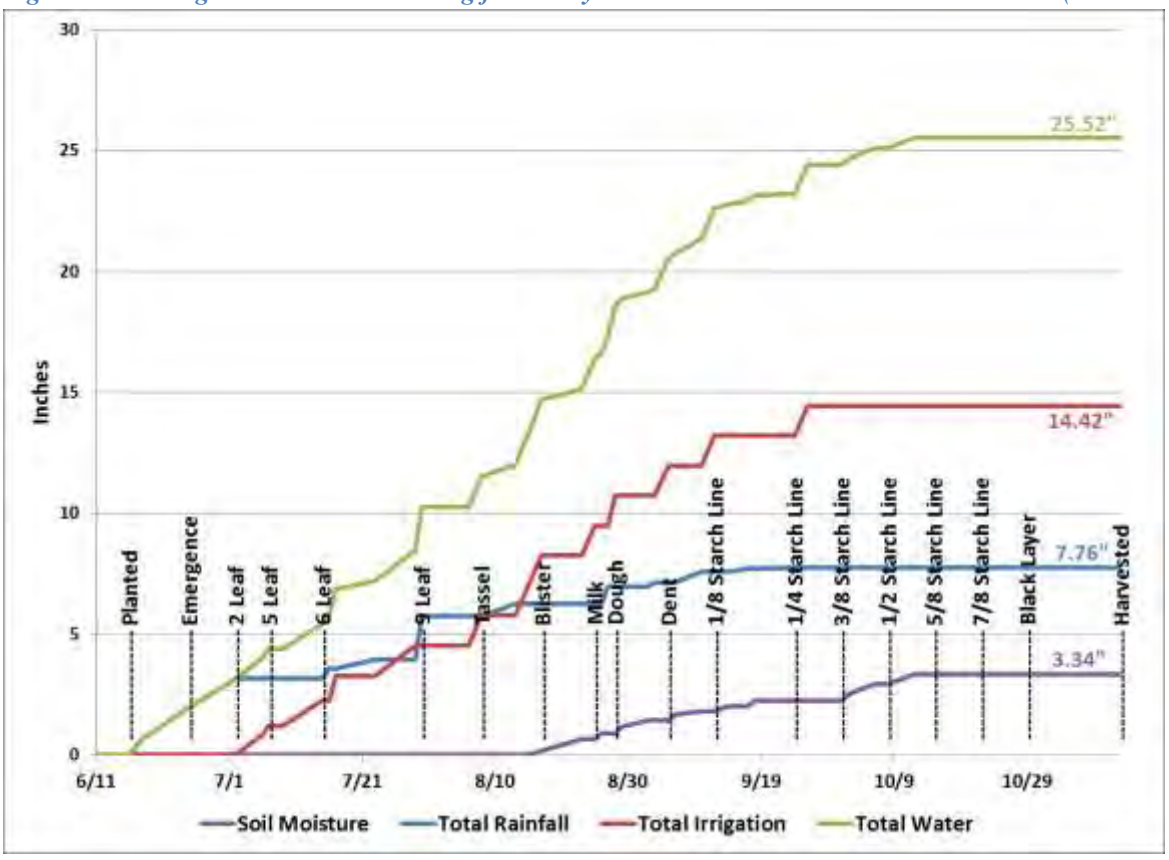


Table 8: Demonstration Field Data for Danny Krienke's "200-12" Demonstration Field

Date mm/dd	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			275.44		100.2	100.5	99.5	98.3	100.0	Wheat	230 Y	622	Kari
4/17			290.48		96.1	60.4	39.4	81.7	91.3	Wheat	199 Y	643	Kari & Paul
4/23	0.57		307.21		96.6	38.2	43.9	81.9	91.8	Wheat	126 Y	623	Kari
4/30	0.06		327.17		96.2	37.9	40.3	82.5	91.8	Wheat	103 Y	634	Kari
5/8			346.6		96.6	40.6	37.5	82.5	92.5	Wheat	119 Y	639	Kari
5/13			360.36							Control	270 Y		Danny
5/14			363.24		96.6	42.3	37.0	83.0	92.5	Control	320 Y	624	Kari
5/15			365.89							Split	360 Y		Danny
5/21			381.42		96.5	47.1	35.9	83.2	92.8	Wheat	184 Y	619	Kari
5/28	0.60		400.65		94.9	52.1	35.6	84.1	93.2	Wheat	214 Y	612	Kari
6/4	0.32		419.76		91.5	60.2	37.2	85.6	93.7	Wheat	247 Y	623	Kari & David
6/11	1.28		427.62		91.6	89.2	36.7	86.9	93.9		114 N		Kari & David
6/16										Planted			Danny
6/18	0.66		427.62		90.8	96.4	37.0	87.9	94.5		113 N		Kari & David
6/25	1.31		428.2	Emergence	90.0	96.6	38.6	89.1	94.7	200-12	75 N		Paul
7/2	1.20		428.2	2 Leaf	90.5	96.8	39.1	90.3	94.9		74 N		Paul
7/4		0.41	Pivotrac	3 Leaf						200-12	360 Y	625	Leon
7/6		0.42	Pivotrac	4 Leaf						200-12	90 Y	625	Leon
7/7		0.37	Pivotrac	5 Leaf						200-12	0 Y	625	Leon
7/9			441.16	4 Leaf	90.4	96.8	39.3	91.0	94.8		4 N		Paul
7/15		1.05	Pivotrac	6 Leaf						200-12	90 Y	625	Leon
7/16	0.40		453.85	6 Leaf	89.6	96.6	41.4	91.6	94.5	200-12	53 Y	624	Paul
7/17		1.03	Pivotrac	7 Leaf						200-12	0 Y	625	Leon
7/23	0.37		462.34	7 Leaf	96.2	98.2	39.8	92.2	95.0		270 N		Paul
7/29		1.24	Pivotrac	8 Leaf						200-12	90 Y	625	Leon
7/30	1.79		475.36	9 Leaf	97.6	97.7	32.7	92.4	94.7		82 N		Paul
8/6			475.54	11 Leaf	93.8	97.5	41.0	93.2	94.6	200-12	81 Y	636	Paul
8/8		1.26	Pivotrac	Tassel						200-12	0 Y	625	Leon
8/13	0.53		494.79	Silk	94.7	96.3	41.6	93.8	94.4	200-12	20 Y	612	Paul
8/15		1.23	Pivotrac	Pollination						200-12	90 Y	610	Leon
8/15			not read	Pollination	74.6	96.2	41.4	94.7	95.7	200-12	Y		Leon
8/17		1.23	Pivotrac	Blister						Control	0 Y	610	Leon
8/20			513.56	Blister	73.7	89.2	40.9	94.0	95.0	Control	294 Y	605	Jerry
8/25		1.25	Pivotrac	Milk						200-12	90 Y	610	Leon
8/27	0.72		528.22	Milk	67.2	66.3	38.6	93.1	94.8	200-12	31 Y	609	Paul
8/28		1.23	Pivotrac	Dough						Control	0 Y	610	Leon
9/3	0.16		542.5	Dough	84.2	56.8	33.9	94.1	95.4	Control	354 Y	608	Paul
9/5		1.24	Pivotrac	Dent						Stop	90 N	610	Leon
9/10	0.44		549.62	Dent	90.4	49.2	29.7	92.9	94.5	200-12	82 Y	633	Paul
9/12		1.25	Pivotrac	1/8 ml						200-12	0 N	625	Leon
9/17	0.12		568.18	1/8 ml	91.6	44.4	24.8	92.8	95.1		1 N		Paul

Date mm/dd	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				
9/24	0.06		573.66	1/4 ml	95.7	35.3	18.0	71.6	94.6	200-12	79 Y	617	Paul
9/24		1.21	Pivotrac	1/4ml						200-12	90 Y	610	Leon
10/1			577.6	3/8 ml	78.8	34.2	18.5	90.4	94.2		360 N		Paul
10/8			577.6	1/2 ml	61.7	24.7	10.2	87.8	94.4		360 N		Paul
10/15			577.6	5/8 ml	56.6	21.7	4.8	61.2	94.2		360 N		Paul
10/22			577.6	7/8 ml	57.4	23.4	2.6	86.7	94.3		360 N		Paul
10/29			577.6	Black Layer	57.8	27.2	5.9	97.2	84.0		360 N		Paul
11/6			577.6	Black Layer	55.6	23.3	5.4	87.3	93.8		92 N		Paul
11/12			577.6	Harvested	53.7	24.1	4.4	82.7	92.7		92 N		Paul
Total	**7.76**	**14.42**			**0.89"**	**1.55"**	**0.70"**	**0.10"**	**0.10"**				
Net Soil Moisture is 3.34"													
Irrigation, Rainfall Plus Net Soil Moisture is 25.52"													

• Numbers in red are not counted in the total

NORTH PLAINS GROUNDWATER Conservation District

2014-Corn Demonstration
Irrigated Medium Season Corn

200-12

Year: *2014* **County:** *Ochiltree* **Grower:** *Danny Krienke*

No. Acres: *60* **Variety/Hyb:** *Golden Acres 24V61* **Soil Type:** *Sherm Clay Loam*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *23-0-0* **Seeding:** *26,000*

Planted: *June 16, 2014* **Harvest:** *November 7, 2014*

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

Yield: *217 bu/ac* **Prev. crop:** *Corn* **Row width:** *30"*

Irrigation method: *Center Pivot* **Prewater:** *None* **Well GPM:** *5.0*

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

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

GPS Location of Pivot Pad

Latitude: *36.402727*

Longitude: *-100.859866*

GPS Location of Gypsum Blocks

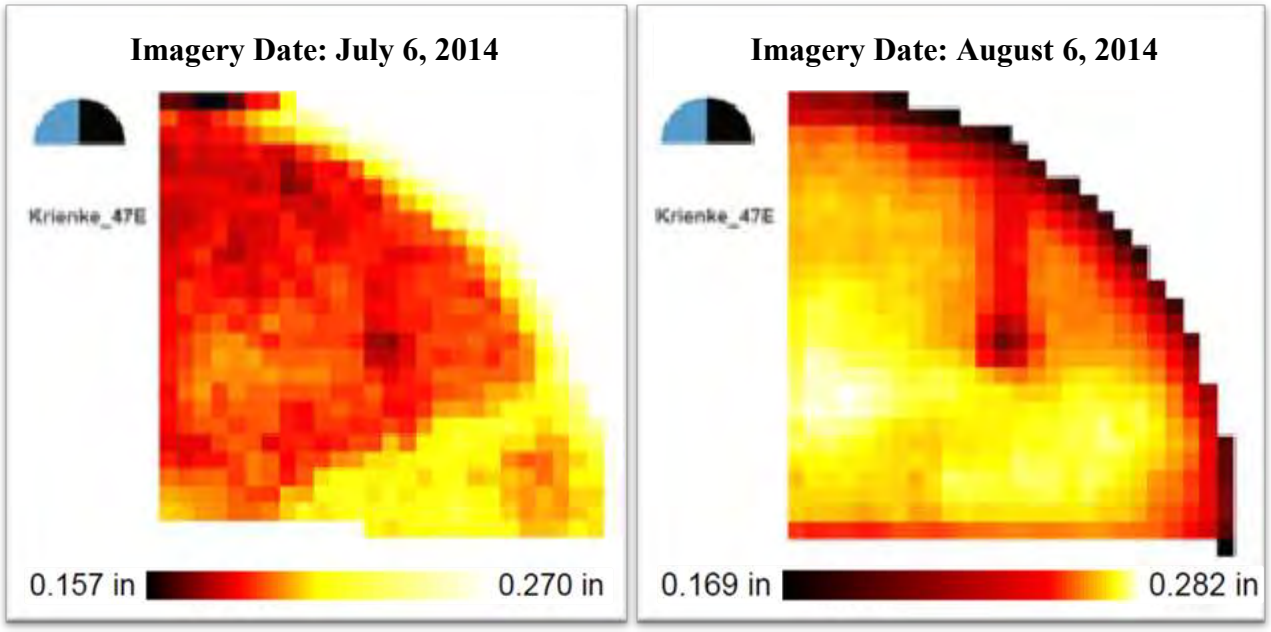
Latitude: *36.40742*

Longitude: *-100.85848*

Elevation: *2940 Feet*

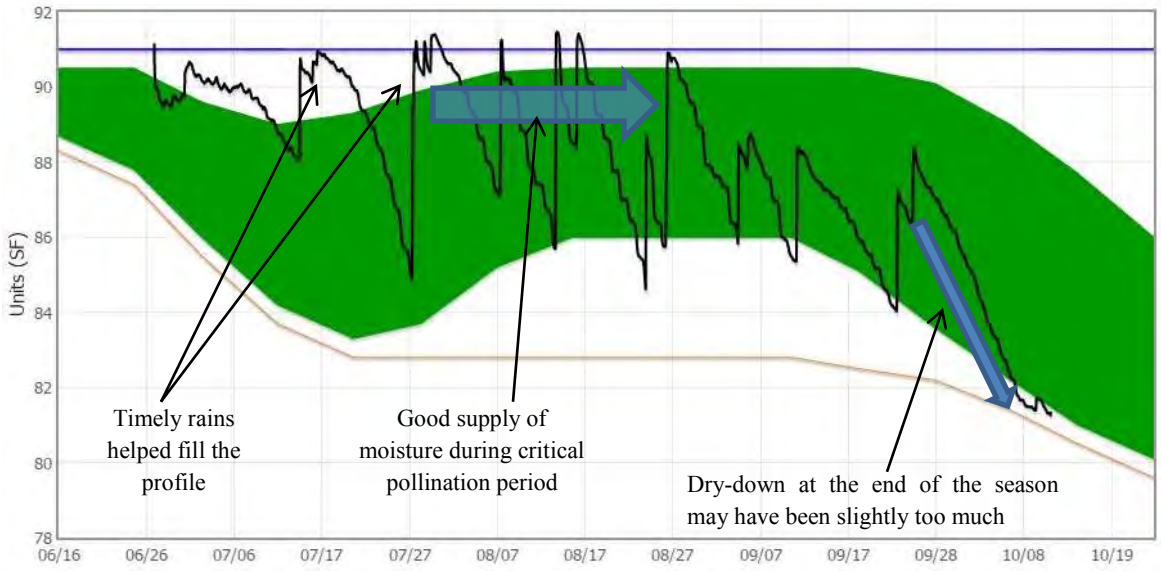
Satellite Imagery: Satellite imagery was initiated and used in 2013 to learn and evaluate its potential for an irrigation and water management tool for growers in connection with HydroBio. The use of satellite imagery was continued for the 2014 growing season. Danny Krienke"s "200-12" field was one of eighteen "200-12" project fields included in 2014. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Danny Krienke"s "200-12" field are shown in figure 9 to illustrate examples of what is displayed on the website. The first image was on July 6 at the 4 leaf stage. The second image is on August 6 at the 11 leaf stage. The satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 217 bushels per acre with 14.42 inches of irrigation.

Figure 9: Daily Water Use for Danny Krienke's ""200-12"" Demonstration Field



Note: Each Square Represents 1/8 of an Acre

Danny Krienke's "200-12" Field AquaSpy® Probe Summary



It would appear that the excellent water use efficiency results obtained on this site was largely due to being able to hold off irrigation at the start of the season. While it is true that this field seemed to enjoy good early rain, the decision to hold off irrigating early paid dividends. The profile was completely full going into tassel and the irrigation during pollination seemed to be effective re-filling the profile. Irrigation in the latter part of the season was still able to penetrate to 20" but the sub-soil seemed to dry out a little below that depth. Root activity was mainly in the top 28" although there was evidence of roots to 48". At the tail end of the season, the crop was allowed to dry the soil completely; however the late root growth in the 4th foot might suggest that the crop was actually looking for moisture at the end. Indeed, there may have been some benefit in one final (albeit small) irrigation during early October.

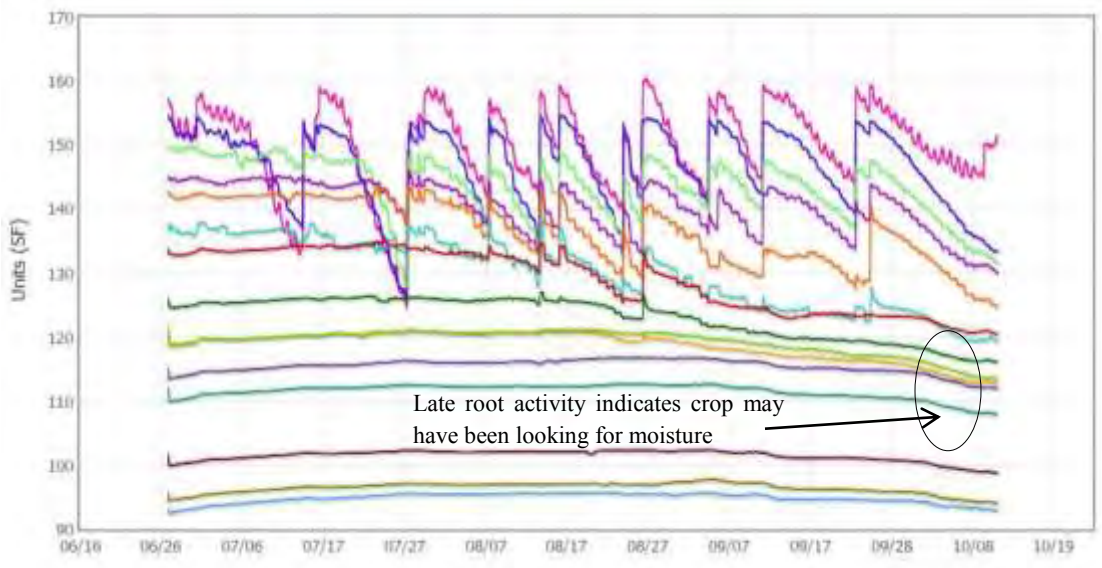


Figure 10: Gypsum Block Readings for Danny Krienke's Control Demonstration Field (219 bu/ac)

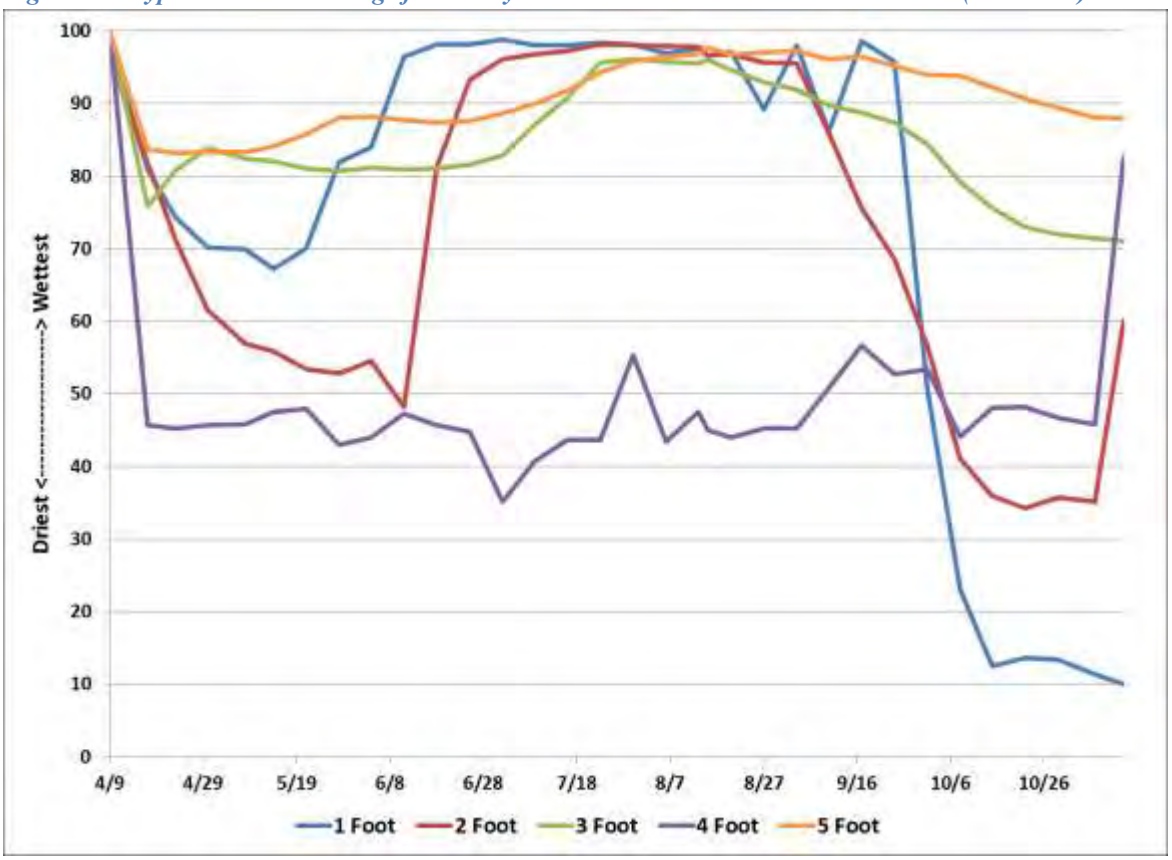


Figure 11: Growing Season Water Tracking for Danny Krienke's Control Demonstration Field (219 bu/ac)

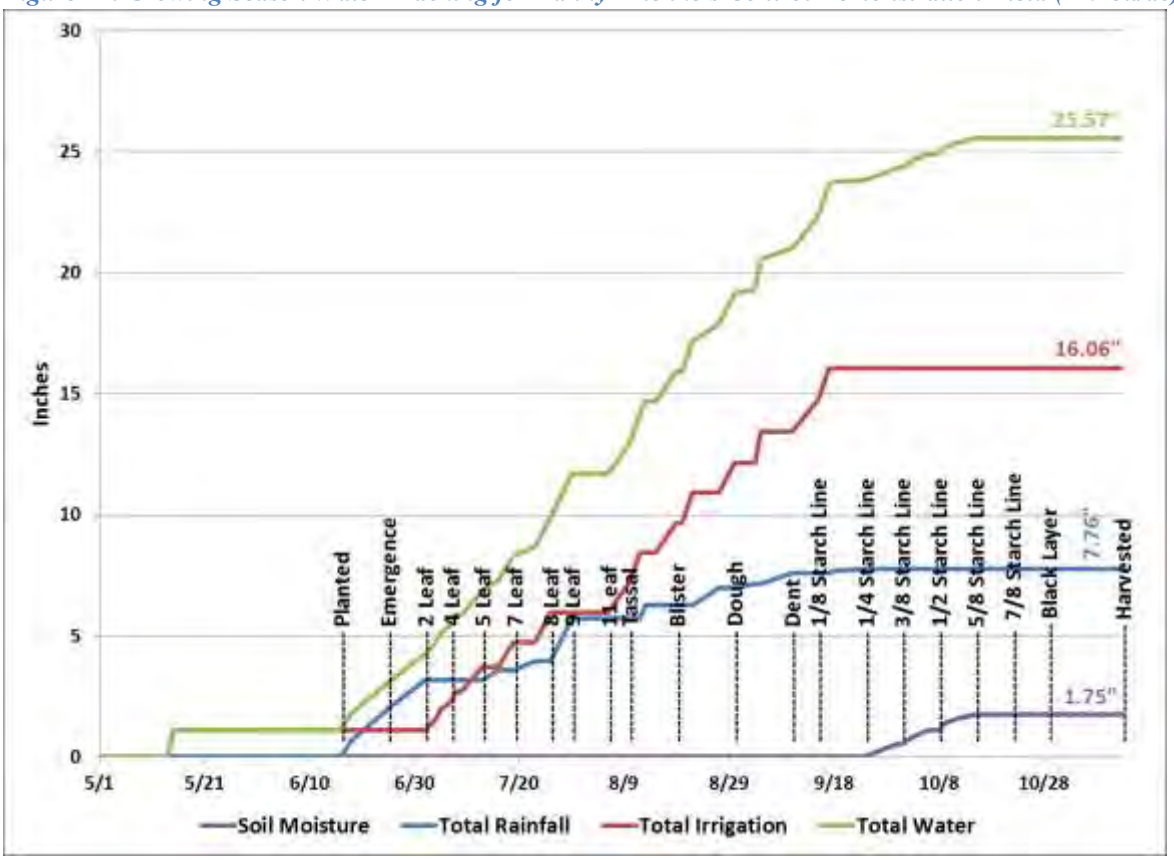


Table 9: Demonstration Field Data for Danny Krienke's Control Demonstration Field

Date mm/dd	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			275.44		98.3	96.5	99.8	99.9	99.8	Wheat		622	Kari
4/17			290.48		80.9	81.8	75.8	45.7	83.6	Wheat	199 Y	643	Kari & Paul
4/23	0.57		307.21		74.4	71.2	80.8	45.2	83.2	Wheat	126 Y	623	Kari
4/30	0.06		327.17		70.2	61.6	83.9	45.7	83.3	Wheat	103 Y	634	Kari
5/8			346.6		69.9	56.9	82.4	45.8	83.3	Wheat	119 Y	639	Kari
5/13			360.36							Prewater	270 Y		Danny
5/14			363.24		67.2	55.9	82.1	47.5	84.1		320 Y	624	Kari
5/15		1.10	365.85							Prewater	90 Y		Danny
5/21			381.42		70.0	53.4	81.0	48.0	85.8	Wheat	184 Y	619	Kari
5/28	0.60		400.65		82.0	52.8	80.7	43.0	88.1	Wheat	214 Y	612	Kari
6/4	0.32		419.76		84.0	54.5	81.2	44.0	88.2	Wheat	247 Y	623	Kari & David
6/11	1.28		427.62		96.5	48.2	80.9	47.3	87.7		114 N		Kari & David
6/16										Planted			Danny
6/18	0.66		427.62		98.1	81.3	81.0	45.7	87.4		113 N		Kari & David
6/25	1.31		428.2	Emergence	98.1	93.3	81.6	44.8	87.6	200-12	75 N		Paul
7/2	1.20		428.2	2 Leaf	98.8	96.1	82.8	35.1	88.6		74 N		Paul
7/4		0.41	Pivotrac	3 Leaf						Control	270 Y	625	Leon
7/5		0.42	Pivotrac	3 Leaf						Control	360 Y	625	Leon
7/7		0.37	Pivotrac	4 Leaf						Control	271 Y	625	Leon
7/8		0.38	Pivotrac	4 Leaf						Control	1 N	625	Leon
7/9			441.15	4 Leaf	98.0	96.8	87.1	40.7	90.0		4 N		Paul
7/13		1.03	Pivotrac	5 Leaf						Control	360 Y	625	Leon
7/16	0.40		453.85	6 Leaf	98.0	97.2	90.8	43.6	91.8	200-12	53 Y	624	Paul
7/19		1.03	Pivotrac	7 Leaf						Control	270 N	625	Leon
7/23	0.37		462.34	7 Leaf	98.4	98.1	95.7	43.6	94.3		270 N		Paul
7/26		1.23	Pivotrac	8 Leaf						Control	360 Y	625	Leon
7/30	1.79		475.36	9 Leaf	98.2	98.0	96.1	55.3	95.9		82 N		Paul
8/6			475.54	11 Leaf	96.9	97.9	95.8	43.4	96.5	200-12	81 Y	636	Paul
8/10		1.23	Pivotrac	Tassel						Control	270 Y	625	Leon
8/12		1.24	Pivotrac	Silk						Control	360 Y	610	Leon
8/13	0.53		494.79	Silk	97.6	97.8	95.6	47.5	96.8	200-12	20 Y	612	Paul
8/15				Pollination	96.6	96.7	96.0	45.0	97.7		Y		Leon
8/19		1.23	Pivotrac	Blister						Control	270 Y	610	Leon
8/20			513.56	Blister	97.1	96.8	94.6	44.0	96.8	Control	294 Y	605	Jerry
8/22		1.25	Pivotrac	Milk						200-12	360 Y	610	Leon
8/27	0.72		528.22	Milk	89.2	95.7	92.9	45.2	97.0	200-12	31 Y	609	Paul
8/30		1.24	Pivotrac	Dough						Control	270 Y	610	Leon
9/3	0.16		542.5	Dough	98.0	95.5	91.9	45.2	97.3	Control	354 Y	608	Paul
9/3		1.28	Pivotrac	Dough						Control	360 Y	610	Leon
9/10	0.44		549.62	Dent	86.1	85.9	89.8	50.8	96.1	200-12	82 Y	633	Paul
9/15		1.33	Pivotrac	1/8 ml						Control	270 Y	625	Leon
9/17		1.29	Pivotrac	1/8 ml						Control	360 Y	610	Leon
9/17	0.12		568.18	1/8 ml	98.6	75.6	88.7	56.7	96.4		1 N		Paul

Date mm/dd	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				
9/24	0.06		573.66	1/4 ml	95.8	68.6	87.4	52.7	95.2	200-12	79 Y	617	Paul
10/1			577.6	3/8 ml	50.7	56.6	84.4	53.4	94.0		360 N		Paul
10/8			577.6	1/2 ml	23.0	41.1	79.2	44.1	93.8		360 N		Paul
10/15			577.6	5/8 ml	12.5	36.0	75.6	48.1	92.3		360 N		Paul
10/22			577.6	7/8 ml	13.6	34.2	73.0	48.2	90.7		360 N		Paul
10/29			577.6	Black Layer	13.4	35.7	72.0	46.7	89.4		360 N		Paul
11/6			577.6	Black Layer	11.4	35.1	71.4	45.8	88.1		92 N		Paul
11/12			577.6	Harvested	10.0	60.1	71.1	82.6	87.9		92 N		Paul
Total	**7.76**	**16.06**			**1.78"**	**0.34"**	**0.17"**	**-0.54"**	**0.00"**				
Net Soil Moisture is 1.75"													
Irrigation, Rainfall Plus Net Soil Moisture is 25.57"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

Control

Year: *2014* **County:** *Ochiltree* **Grower:** *Danny Krienke*

No. Acres: *60* **Variety/Hyb:** *Golden Acres 24V61* **Soil Type:** *Sherm Clay Loam, Sunray Silty Clay Loam*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *38-0-0* **Seeding:** *28,000*

Planted: *June 16, 2014* **Harvest:** *November 7, 2014*

Herbicide: *Cinch ATZ* **Insecticide:** *None*

Yield: *219 bu/ac* **Prev. crop:** *Corn* **Row width:** *30"*

Irrigation method: *Center Pivot* **Prewater:** *1.10 in.* **Well GPM:** *5.0*

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

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

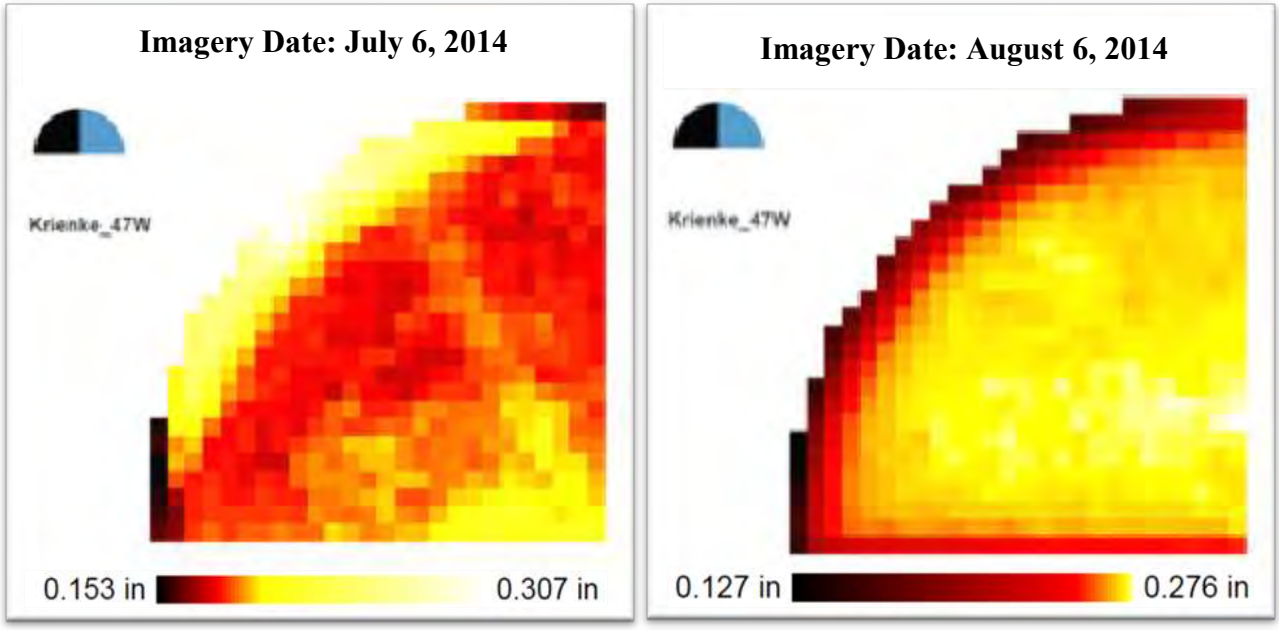
GPS Location of Pivot Pad
Latitude: *36.402727*
Longitude: *-100.859866*

GPS Location of Gypsum Blocks
Latitude: *36.40736*
Longitude: *-100.86125*

Elevation: *2940 Feet*

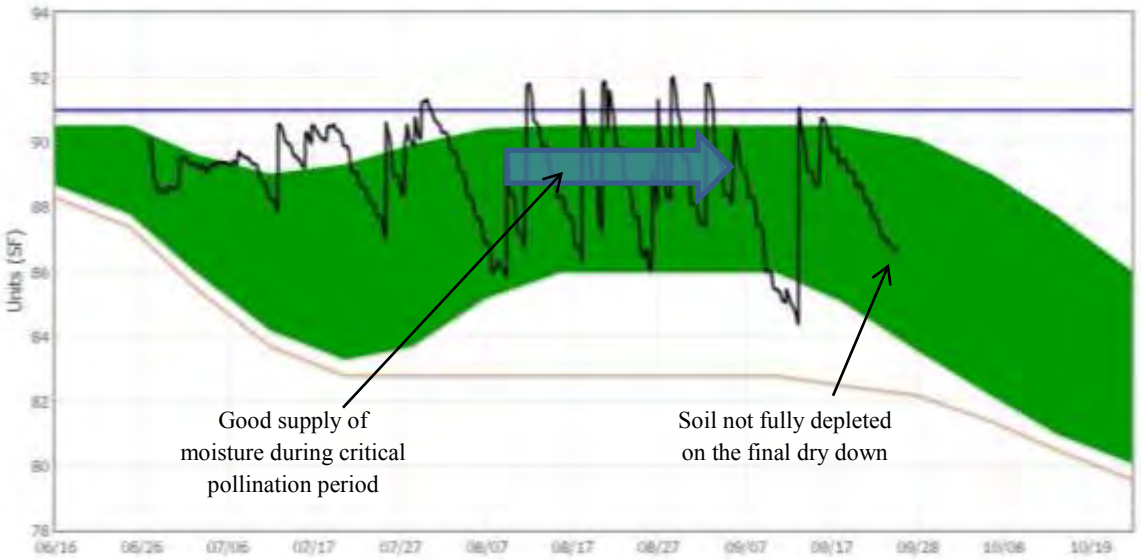
Satellite Imagery: Danny Krienke‟s “control” field was one of eighteen “200-12” Project fields included in satellite imagery in 2014. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Danny Krienke‟s “control” field in figure 12 illustrate examples of what is displayed on the website. The first image is on July 6 at the 4 leaf stage. The second image is on August 6 at the 11 leaf stage. Satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 219 bushels per acre with 16.06 inches of irrigation.

Figure 12: Daily Water Use for Danny Krienke's Control Demonstration Field

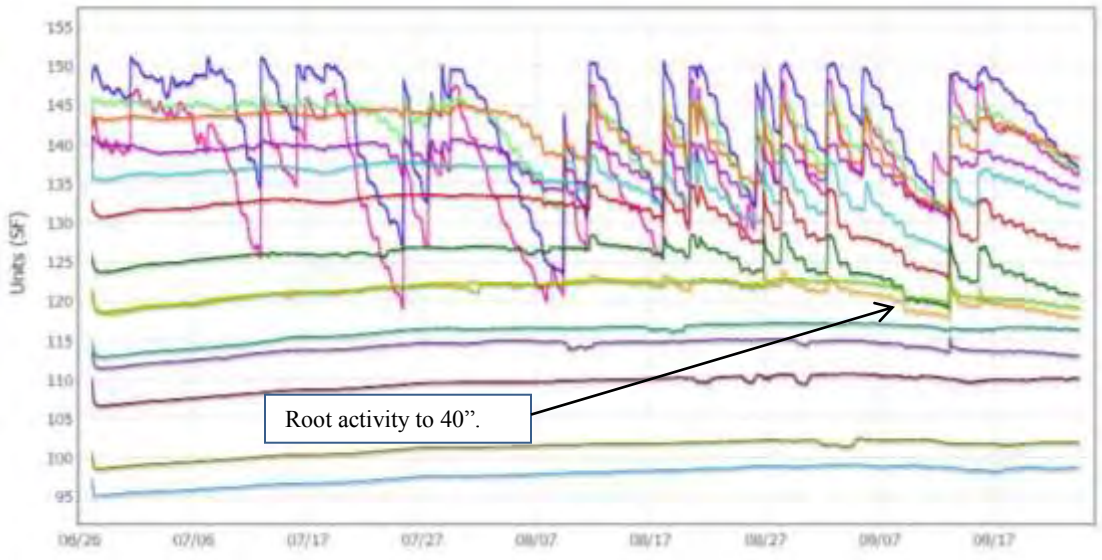


Note: Each Square Represents 1/8 of an Acre

Danny Krienke's Control Field AquaSpy® Probe Summary



The yield of the "control" and the "200-12" treatment were only 2 bushels apart despite the "control" getting 1.6" more irrigation. The main differences that are evident between the two sites is that the "control" had shallower root activity and had slightly more frequent irrigation. While the soil was dried out at the end of the season on the "control", it seemed to finish with more stored soil moisture than the "200-12". This is backed up by the 1.5" difference in the measured soil moisture extraction between the two sites over the course of the season. It would appear that most irrigation was effective at penetrating to 32" depth but there was no evidence of deep drainage. It appears that the difference in the water use efficiency between the two sites was largely due to the additional irrigation that reduced soil moisture extraction of the "control" site.



Harvest Results: The "200-12" field produced a 217 bushel per acre corn yield. Irrigation totaled 14.42 inches. Production in the "control" field was 219 bushels per acre. Seasonal irrigation totaled 16.06 inches. There was 1.10 inches of pre-season irrigation on only the "control" field. The "control" field produced 2 more bushels per acre than the "200-12" and irrigation was 1.64 inches more. Corn production was 15.04 bushels (842 lbs) per inch of irrigation in the "200-12" field compared to 13.64 (764 lbs) in the "control". Production from each inch of irrigation, rainfall and net soil water that totaled 25.52 inches was 8.50 bushels (476 lbs) per acre in the "200-12" field. Irrigation, rainfall and net soil water totaled 25.57 inches in the "control" field where production was 8.56 bushels (479 lbs) per inch. Crop production costs were $19.20 per acre less for the "200-12" field than for the "control" from reduced irrigation, seed, fertilizer and harvest expenses. At $4.00 per bushel, the two bushel per acre increased corn yield in the "control" field amounts to $8.00 more per acre. The "200-12" field‟s net gain was $11.20 per acre with 1.64 inches less irrigation used compared to production from the "control" field. Net return from the additional 1.64 inches of irrigation for the "control" field was negative (lost) $6.83 per inch. Net return from the "200-12" field was $455.90 per acre compared to $444.70 from the "control" field. A summary of the demonstration results are shown in table 10.

Table 10: Danny Krienke's 2014 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $4.00/bu		
			bu/ac	lb/ac-in of Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"200-12"	14.42	*25.52	217	842	$868.00	$60.19	$34.01
Control	16.06	†25.57	219	764	$876.00	$54.54	$34.26

*Includes 3.34 inches of water removed from five feet of soil, plus rainfall, and irrigation.
†Includes 1.75 inches of water removed from five feet of soil, plus rainfall, and irrigation.

David Ford's 2014 Hartley County Demonstration

Planting and Crop Information: For his demonstration, David Ford strip tilled and planted 60 acres of corn in the east half circle of the northwest quarter of section 206, for his "200-12" field, "Ford 200-12". The "200-12" field was from 0 to 180 degrees in the circle. Ford planted the east half circle with Pioneer 1151AM at a seeding rate of 30,000 seeds per acre. He planted the west half 60 acres, also strip tilled, in the northwest quarter of section 206 to P1151AM at 30,000 seeds per acre for his "control" field, "Ford Control". The "control" field was from 180 to 360 degrees. Both the "200-12" east half circle field and west "control" field were irrigated using the same center pivot, circle 1. Pivotrac™ sent a text message when the center pivot entered and departed the "200-12" field. Irrigation for each field was then calculated using time (hours) each field was irrigated also using the water meter gpm flow rate. Seasonal water meter readings averaged 500 gpm and delivered an average of 1.0 inch of irrigation in a 4.5 day revolution. Planting and crop information for "Ford 200-12" and "Ford Control" are shown in table 11 below.

Table 11: Planting and Crop Information for David Ford

"200-12" Demonstration Field			
Planted:	*May 29*	**Harvested:**	*October 20*
Hybrid:	*P1151AM*	**Seeding Rate:**	*30,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*60*	**GPM Per Acre:**	*4.1*
Total Water:	*28.06 in.*	**Soil Type:**	*Sherm Clay Loam, Gruver Loam*
Fertilizer:	*220-50-0-2s*	**Insecticide:**	*None*
Herbicide:	*Balance Flex*		
Control Demonstration Field			
Planted:	*May 29*	**Harvested:**	*October 20*
Hybrid:	*P1151AM*	**Seeding Rate:**	*30,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*60*	**GPM Per Acre:**	*4.1*
Total Water:	*27.93 in.*	**Soil Type:**	*Gruver Loam, Dumas Loam*
Fertilizer:	*220-50-0-2s*	**Insecticide:**	*None*
Herbicide:	*Balance Flex*		

Beginning Soil Water Profile and Growing Season Rainfall

"200-12" Demonstration Field: Preseason gypsum block sensor readings show soil water was good at 1, 2, 3, 4 and 5 feet in the profile prior to planting. Ford chose to apply 2.04 inches of pre-water to the "200-12" field. Additional gypsum block soil moisture sensor readings show good soil water levels at all depths through July. Plants used water from 1, 2, 3, 4 and 5 feet in August during pollination, silk and early grain development plus irrigation. There was only limited rainfall in August and daily temperatures were higher. Beneficial rainfall was better earlier in the growing season. 2.60 inches was measured May 29 to help maintain good early season soil water levels followed by 1.20 inches June 12 and 1.58 inches June 26. Timely rainfall continued in July when 1.49 inches was measured July 17 and 0.87 July 31. More rain

September 11 and 18 totaled 1.34 inches and helped finish the crop and partially refill the soil profile. Rainfall totaled 10.96 inches from planting until harvest. Gypsum block sensors were installed in Gruver Loam in April prior to planting. Gruver Loam soil holds approximately 2.00 inches of available water per foot for potential crop use.

Control Demonstration Field: Gypsum block sensors were installed in Gruver loam April 1 prior to planting. Sensor readings indicate good pre-season soil water at 1 and 2 feet, only 10 percent at 3 feet and 50 percent at 4 and 5 feet. A beneficial 2.60 inch rainfall recorded May 29 following planting brought 1 and 2 feet to full field capacity and refilled the profile at 3 feet. An additional timely 1.20 inch rainfall June 12, followed by irrigation, stored water to 4 feet. Good soil water levels were maintained with irrigation plus 1.58 inches of rainfall June 26 at the 5 leaf growth stage. Plant roots used significant water from 2, 3, 4 and 5 feet in August during silk and pollination growth stages when rainfall totaled only 0.66 inches. The crop emptied soil water from 2 and 3 feet, about 70 percent from 4 feet and 60 percent from 5 feet, finishing the crop. There was significant root growth and water use from the soil profile to 5 feet in the "control" field. Beneficial rainfall in mid-September totaled 1.34 inches and helped finish the crop. Rainfall totaled 10.96 inches for the growing season. Soil moisture sensors indicate superior water management using irrigation as needed to maintain adequate soil water levels when rainfall did not. Gypsum block soil moisture sensors were installed in Gruver Loam soil that holds 2.0 inches of available water per foot for crop use. Rainfall recorded during the growing season for the "200-12" and "control" fields is listed in table 12.

Table 12: Monthly Rainfall Data for David Ford

	May	June	July	August	September	October	Total
"200-12"	2.60"	3.12"	2.63"	0.66"	1.34"	0.61"	**10.96"**
Control	2.60"	3.12"	2.63"	0.66"	1.34"	0.61"	**10.96"**

Growing Season Water Tracking: The district tracked crop total water throughout the growing season using rain gauges, water meters and both gypsum block sensors and AquaSpy® soil moisture probes and Pivotrac™. A 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 "200-12" field. Another set of the same type of sensors were installed in the "control" field. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in the field. Gypsum block sensors were installed in the "200-12" and most "control" fields prior to planting. Each AquaSpy® probe was installed following crop emergence. Installing and reading the gypsum blocks prior to planting provided advanced soil moisture conditions and information to help guide and manage irrigation. 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 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 "200-12" field are shown first, followed by the same illustrations for the "control" field.

Figure 13: Gypsum Block Readings for David Ford's "200-12" Demonstration Field (206 bu/ac)

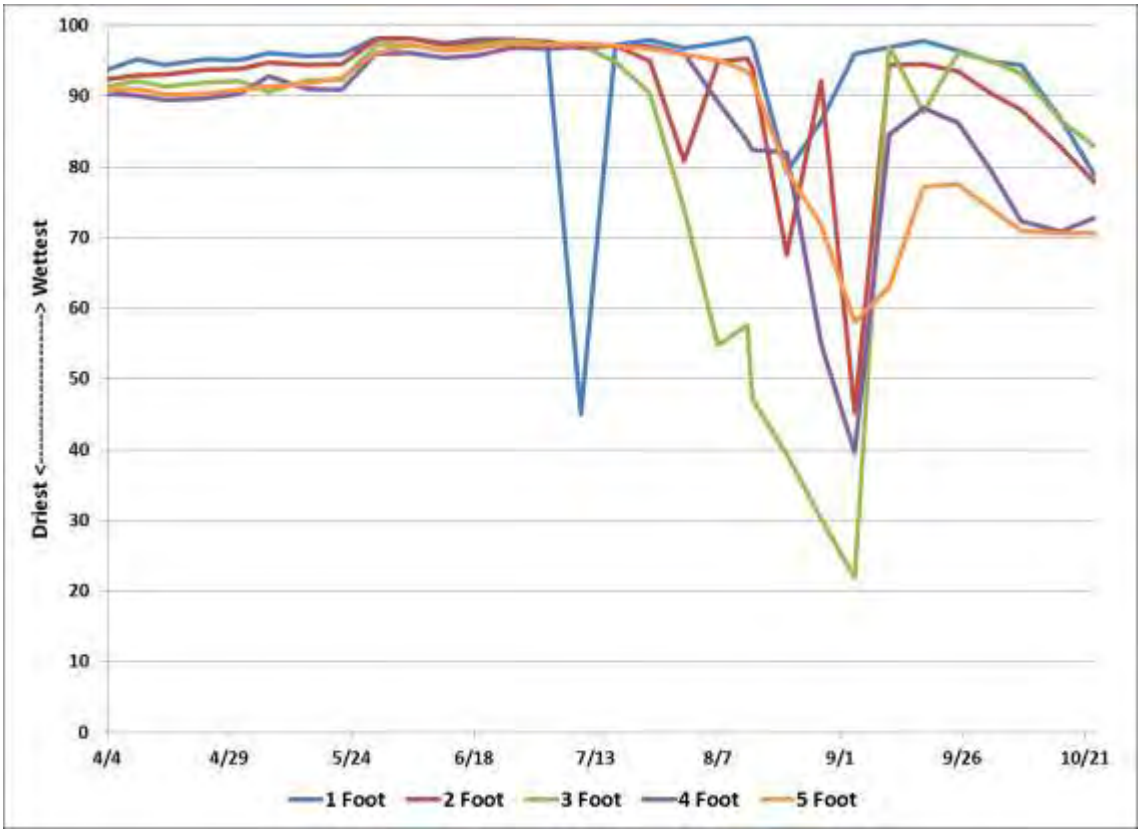


Figure 14: Growing Season Water Tracking for David Ford's "200-12" Demonstration Field (206 bu/ac)

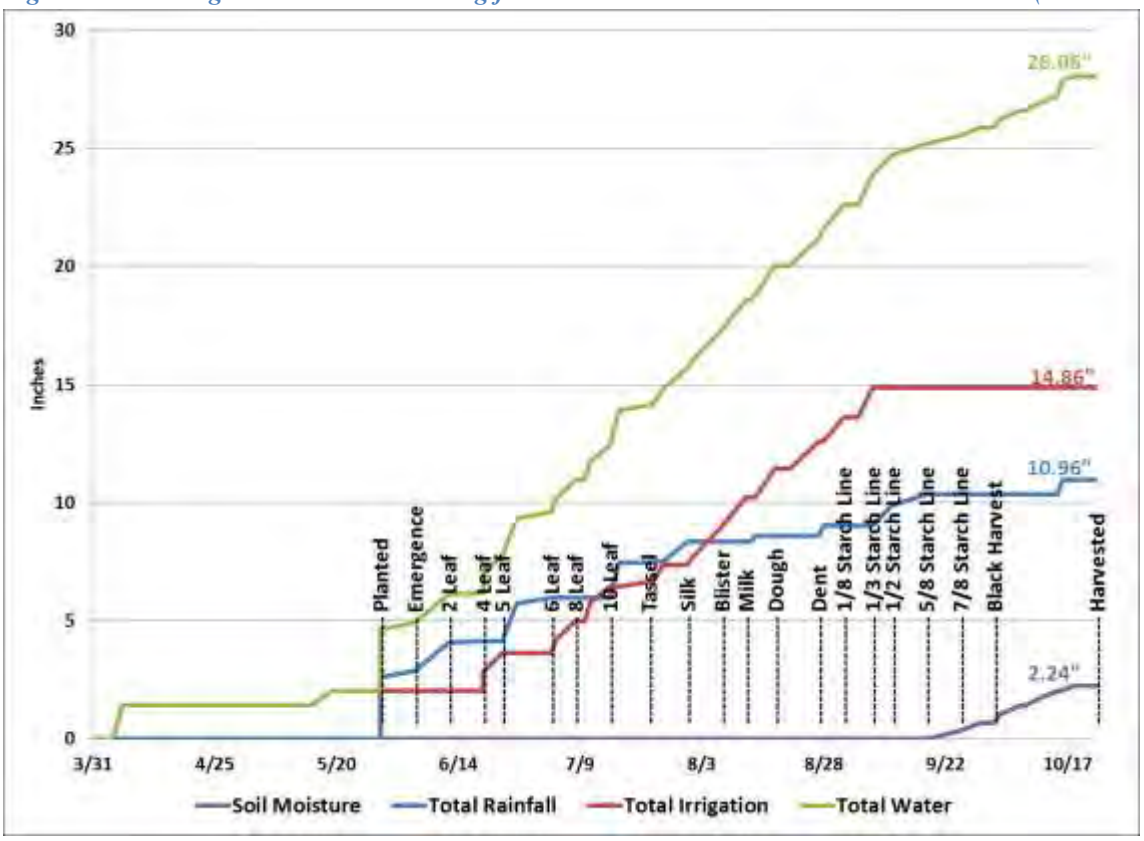


Table 13: Demonstration Field Data for David Ford's ""200-12"" Demonstration Field

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				
3/31			258.18								316 N		K & P
4/4			264.74	Prewater	93.7	92.4	91.4	90.3	90.8	200-12	145 Y	575	Kari
4/6		1.41	Pivotrac	Prewater						200-12	0 Y	575	Leon
4/10	0.15		273.53	Prewater	95.2	92.9	92.1	90.1	91.0	200-12	262 N		Kari
4/16			273.53		94.4	93.0	91.4	89.4	90.2		263 N		Kari
4/24	0.01		273.53		95.2	93.7	91.9	89.6	90.3		262 N		Kari
5/1			273.53		95.1	93.9	92.2	90.3	90.9		262 N		Kari
5/7			273.53		96.1	94.7	90.6	92.8	91.4		263 N		Kari
5/15			273.53		95.7	94.4	92.3	91.0	91.8		258 N		Kari
5/19		0.63	Pivotrac	Prewater						200-12	0 Y	575	Leon
5/22	0.10		279.78		95.9	94.5	92.3	90.9	92.6		165 N		Kari
5/29										Planted			
5/29	2.60		279.78		98.1	98.0	97.3	96.0	96.1		185 N		Kari
6/5	0.27		279.78	Emergence	98.1	98.1	97.3	96.1	97.2		191 N		Kari
6/12	1.20		279.78	2 Leaf	97.5	97.3	96.5	95.4	96.5		191 N		Kari & David
6/19	0.07		283.16	4 Leaf	98.0	97.8	97.2	95.8	96.8		52 N		Kari & David
6/19		0.78	Pivotrac	4 Leaf						200-12	0 Y	575	Leon
6/23		0.79	Pivotrac	5 Leaf						200-12	0 Y	550	Leon
6/26	1.58		291.27	5 Leaf	98.0	97.9	97.8	96.9	97.5		324 N		Paul
7/3	0.26		291.27	6 Leaf	97.0	97.7	97.4	96.7	97.2		55 N		Paul
7/4		0.6	Pivotrac	7 Leaf						200-12	180 Y	550	Leon
7/8		0.76	Pivotrac	8 Leaf						200-12	180 Y	500	Leon
7/10			305.63	8 Leaf	45.0	96.8	97.3	97.0	97.5	200-12	37 Y	505	Paul
7/11		0.75	Pivotrac	9 Leaf						200-12	180 Y	500	Leon
7/15		0.73	Pivotrac	10 Leaf						200-12	180 Y	500	Leon
7/17	1.49		320.03	11 Leaf	97.3	97.1	94.9	97.1	97.1		26 N		Paul
7/23		0.21	Pivotrac	Tassel						200-12	0 Y	500	Leon
7/24	0.01		323.73	Tassel	97.9	95.0	90.4	97.0	96.7	Control	210 Y	507	Paul
7/26		0.7	Pivotrac	Tassel						200-12	0 Y	500	Leon
7/31	0.87		332.1	Silk	96.8	80.8	73.9	96.0	95.9		138 N		Paul
8/1		0.31	Pivotrac	Silk						200-12	180 Y	500	Leon
8/7		1.31	Pivotrac	Blister						200-12	180 Y	500	Leon
8/7			345.41	Blister	97.5	94.9	54.8	89.2	95.1	Control	192 Y	530	Paul
8/12		1.23	Pivotrac	Milk						200-12	180 Y	500	Leon
8/13				Milk	98.3	95.3	57.6	83.7	93.5				Leon
8/14	0.24		361.96	Milk	97.6	94.1	47.2	82.4	92.4	Control	285 Y	494	Paul
8/18		1.22	Pivotrac	Dough						200-12	180	500	Leon
8/21			371.03	Dough	79.2	67.6	39.4	82.1	79.4		191 N		Jerry
8/27		1.16	Pivotrac	Dent						200-12	150 N	500	Leon
8/28	0.42		382.54	Dent	86.5	92.1	30.2	55.0	71.7		150 N		Paul
9/1		1.02	Pivotrac	1/8 ml						200-12	380 Y	500	Leon
9/4			393.18	1/4 ml	96.0	45.2	21.9	39.6	58.0	Control	181 Y	477	Paul
9/7		1.25	Pivotrac	1/3 ml						200-12	0 Y	500	Leon
9/11	0.85		399.43	1/2 ml	96.9	94.4	97.0	84.5	63.0		353 N		Paul

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				
9/18	0.49		399.43	5/8 ml	97.8	94.5	87.7	88.3	77.2		353 N		Paul
9/25			399.43	7/8 ml	96.4	93.5	96.1	86.2	77.5		353 N		Paul
10/2	0.01		399.43	Black Layer	94.9	90.3	95.0	79.3	74.0		353 N		Paul
10/8			399.43	Black Layer	94.4	88.1	93.2	72.3	71.0		352 N		Paul
10/16	0.60		399.43	Black Layer	86.8	82.8	86.6	70.8	70.6		353 N		Paul
10/23	0.01		399.43	Harvested	78.8	77.7	82.8	72.8	70.6		5 N		Paul
Total	**10.96**	**14.86**			**0.47"**	**0.56"**	**0.30"**	**0.41"**	**0.50"**				
Net Soil Moisture is 2.24"													
Irrigation, Rainfall Plus Net Soil Moisture is 28.06"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

NORTH PLAINS GROUNDWATER Conservation District

200-12

Year: *2014* **County:** *Hartley* **Grower:** *David Ford*

No. Acres: *60* **Variety/Hyb:** *P1151AM* **Soil Type:** *Sherm Clay Loam & Gruver Loam*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *220-50-0-2s* **Seeding:** *30,000*

Planted: *May 29, 2014* **Harvest:** *October 20, 2014*

Herbicide: *Balance Flex* **Insecticide:** *None*

Yield: *206 bu/ac* **Prev. crop:** *Corn* **Row width:** *30 Inch*

Irrigation method: *Center Pivot* **Prewater:** *2.04 in.* **GPM/acre:** *4.1*

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

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

GPS Location of Pivot Pad

Latitude: *35.833828*

Longitude: *-102.173067*

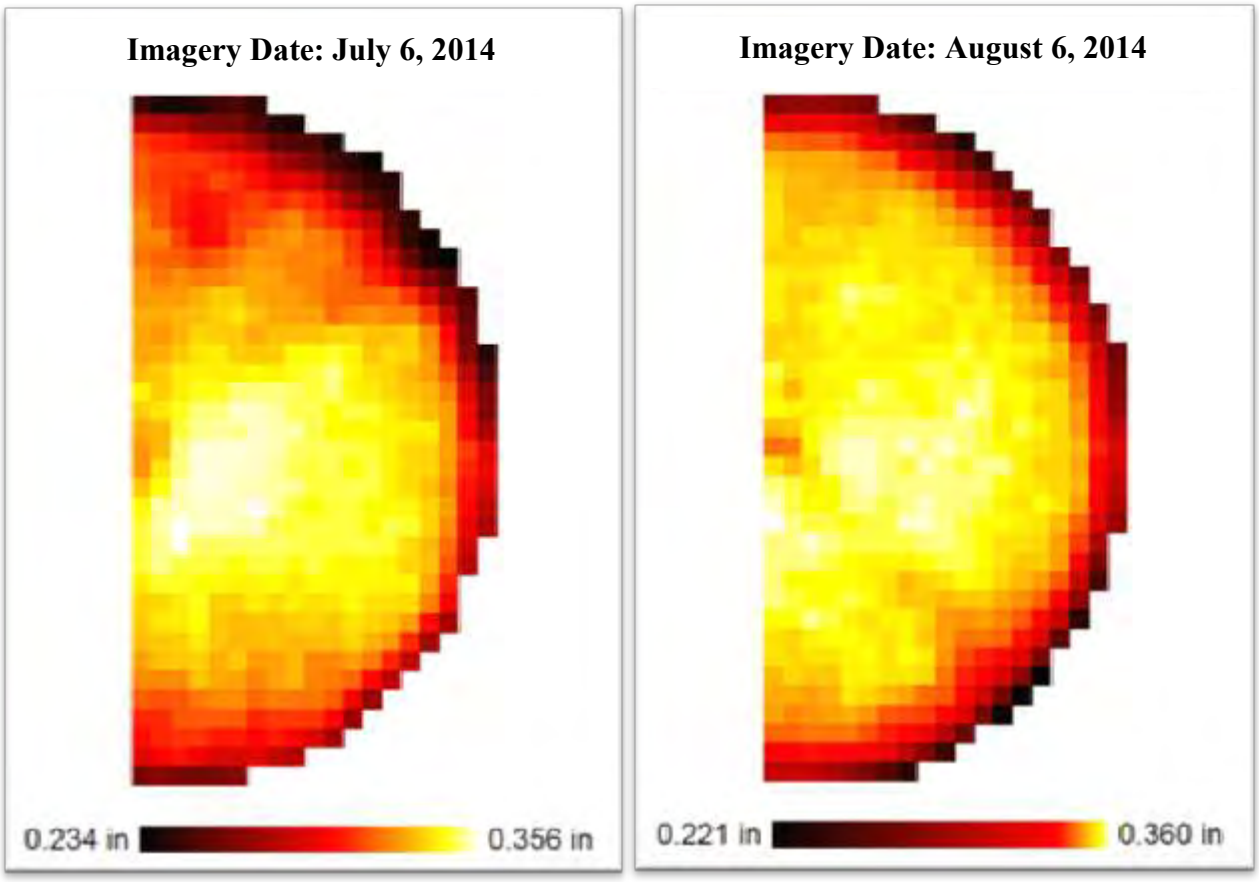
GPS Location of Gypsum Blocks

Latitude: *35.83706*

Longitude: *-102.172763*

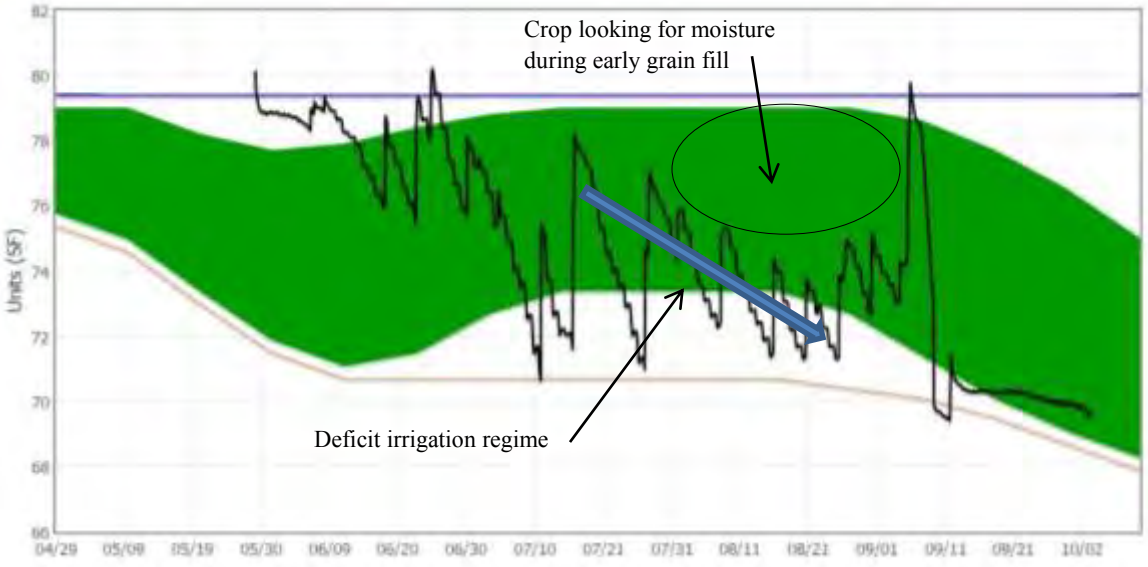
Satellite Imagery: Satellite imagery was initiated and used in 2013 to learn and evaluate its potential for an irrigation and water management tool for growers in connection with HydroBio. The use of satellite imagery was continued for the 2014 growing season. David Ford"s "200-12" field was one of eighteen "200-12" project fields included in 2014. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of David Ford"s "200-12" field are shown in figure 15 to illustrate examples of what is displayed on the website. The first image was on July 6 at the 7 leaf stage. The second image is on August 6 at the blister stage. The satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 206 bushels per acre with 14.86 inches of irrigation.

Figure 15: Daily Water Use for David Ford's "200-12" Demonstration Field



Note: Each Square Represents 1/8 of an Acre

David Ford's "200-12" Field AquaSpy® Probe Summary



This crop showed good early deep root development which was aided by a good soil moisture profile that allowed the roots to chase moisture. Roots were evident at 60" and they grew quickly to 56". Irrigation was generally not able to penetrate much beyond 12" and as such, the sub-soil dried out and was not replenished until rain late in the season. Rains in the middle and the end of June were timely and these were effective in wetting the subsoil to 24". There were no wetting events that were able to replenish the soil below 24". No drainage was evident.

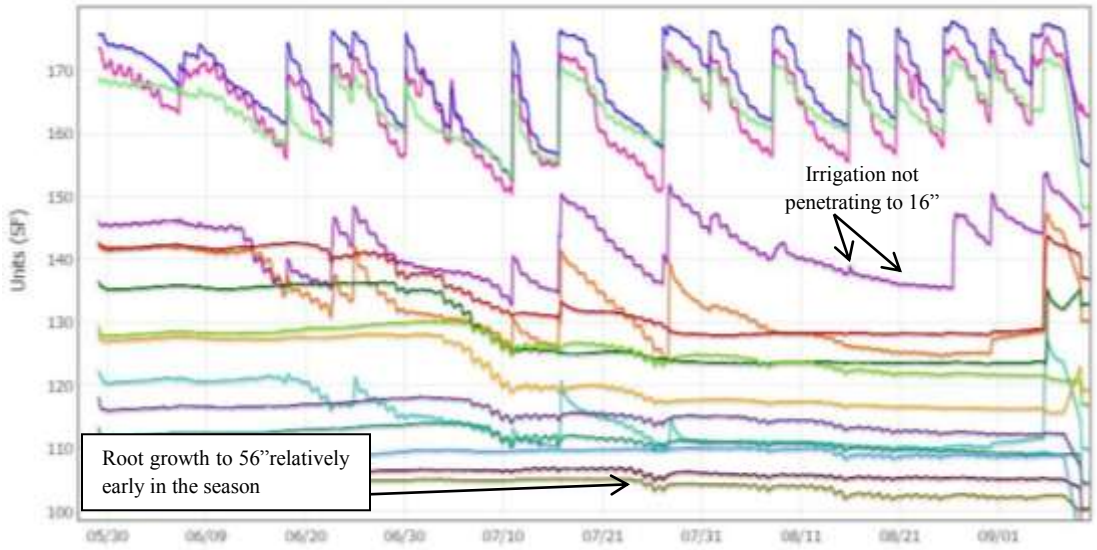


Figure 16: Gypsum Block Readings for David Ford's Control Demonstration Field (199 bu/ac)

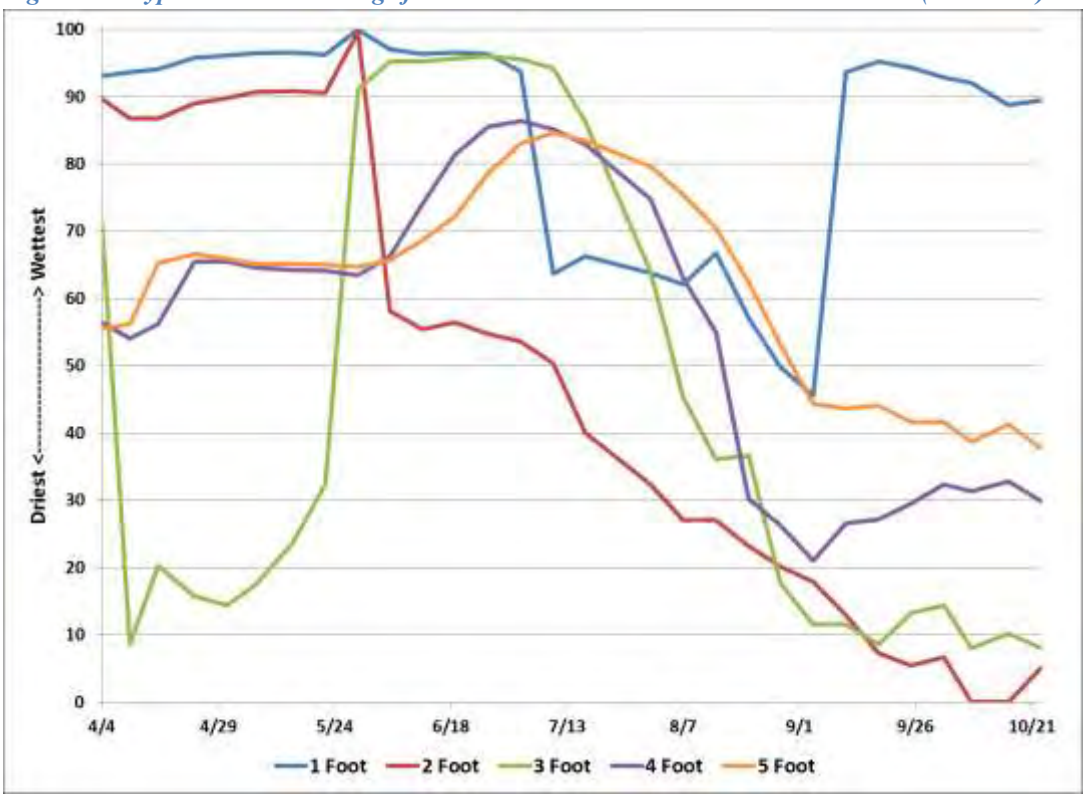


Figure 17: Growing Season Water Tracking for David Ford's Control Demonstration Field (199 bu/ac)

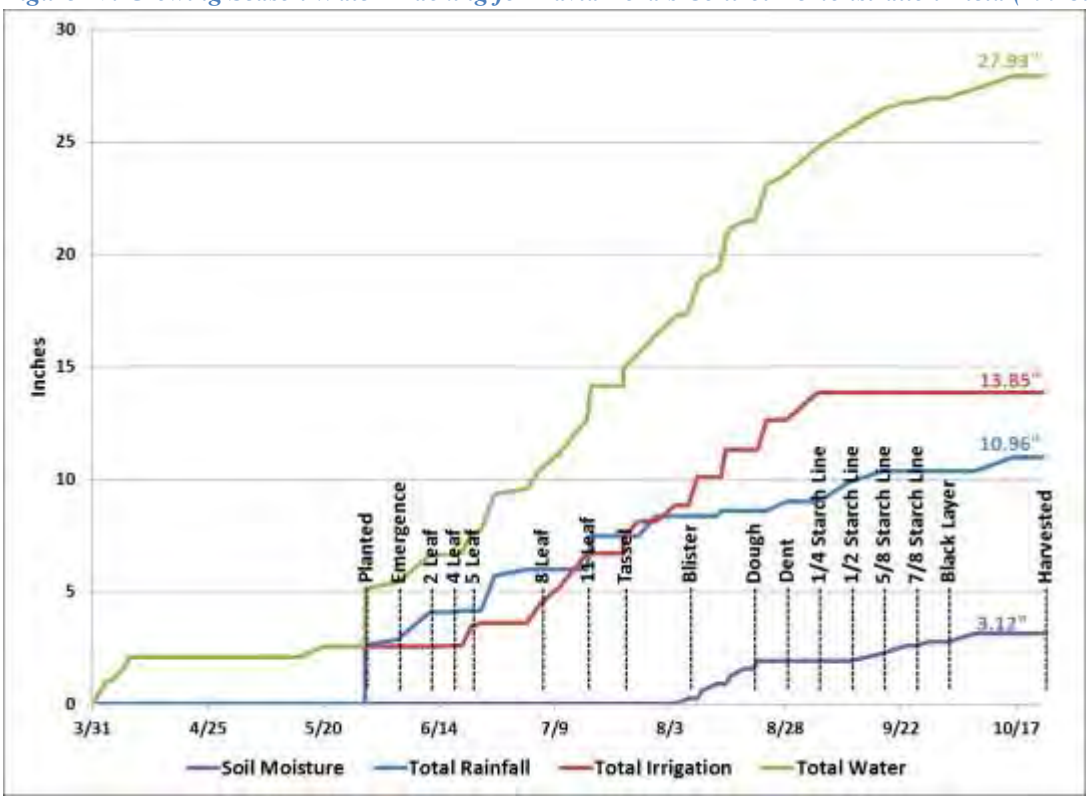


Table 14: Demonstration Field Data for David Ford's Control Demonstration Field

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				
3/31			258.18								316 N		Kari & Paul
4/3		1.03	Pivotrac	Prewater						Control	180 Y	575	Leon
4/4			264.74	Prewater	93.1	89.7	71.2	56.4	55.5	200-12	145 Y	575	Kari
4/7		0.62	Pivotrac	Prewater						Control	288 N	575	Leon
4/8		0.42	Pivotrac	Prewater						Control	180 Y	575	Leon
4/10	0.15		273.53	Prewater	93.6	86.7	8.7	54.1	56.2	Control	262 N		Kari
4/16			273.53		94.1	86.7	20.3	56.2	65.2		263 N		Kari
4/24	0.01		273.53		95.8	89.0	15.7	65.5	66.6		262 N		Kari
5/1			273.53		96.1	89.8	14.4	65.5	65.9		262 N		Kari
5/7			273.53		96.5	90.7	17.4	64.6	65.1		263 N		Kari
5/15			273.53		96.6	90.8	23.7	64.2	65.1		258 N		Kari
5/20		0.47	Pivotrac	Prewater						Control	225 Y	575	Leon
5/22	0.10		279.78		96.2	90.6	32.3	64.1	65.0		165 N		Kari
5/29										Plant			David
5/29	2.60		279.78		100.0	99.6	91.0	63.5	64.7		185 N		Kari
6/5	0.27		279.78	Emergence	97.0	58.1	95.2	66.3	65.7		191 N		Kari
6/12	1.20		279.78	2 Leaf	96.3	55.4	95.2	74.1	68.7		191 N		Kari & David
6/17		0.05	Pivotrac	4 Leaf						Control	180 Y	575	Leon
6/19	0.07		283.16	4 Leaf	96.6	56.4	95.7	81.4	72.3		52 N		Kari & David
6/21		0.83	Pivotrac	5 Leaf						Control	180 Y	575	Leon
6/23		0.18	Pivotrac	5 Leaf						Control	322 N	575	Leon
6/26	1.58		291.27	5 Leaf	96.4	54.7	96.0	85.5	78.6		324 N		Paul
7/3	0.26		291.27	6 Leaf	93.8	53.6	95.5	86.4	83.0		55 N		Paul
7/6		0.84	Pivotrac	8 Leaf						Control	360 Y	550	Leon
7/10		0.74	Pivotrac	8 Leaf	63.7	50.3	94.2	85.2	84.6	Control	360 Y	500	Leon
7/10			305.63	8 Leaf	63.7	50.3	94.2	85.2	84.6	200-12	37 Y	505	Paul
7/13		0.76	Pivotrac	9 Leaf						Control	360 Y	500	Leon
7/16		0.74	Pivotrac	11 Leaf						Control	360 Y	500	Leon
7/17	1.49		320.03	11 Leaf	66.3	40.0	86.3	82.9	83.5		26 N		Paul
7/24	0.01		323.73	Tassel	67.5		75.5	79.2	81.7	Control	210 Y	507	Paul
7/24		0.73	Pivotrac	Tassel						Control	180 Y	500	Leon
7/27		0.69	Pivotrac	Silk						Control	180 Y	500	Leon
7/31	0.87		332.1	Silk	63.8	32.3	64.0	74.7	79.6		138 N		Paul
8/4		0.74	Pivotrac	Silk						Control	360 Y	500	Leon
8/7			345.41	Blister	62.1	27.0	45.2	63.0	75.4	Control	192 Y	530	Paul
8/9		1.23	Pivotrac	Milk						Control	360 Y	500	Leon
8/14	0.24		361.96	Milk	66.7	27.0	36.1	55.0	70.5	Control	285 Y	494	Paul
8/15		1.24	Pivotrac	Milk						Control	360 Y	500	Leon
8/21			371.03	Dough	57.1	23.2	36.7	30.2	62.4		191 N		Jerry
8/24		1.32	Pivotrac	Dough						Control	360 Y	500	Leon
8/28	0.42		382.54	Dent	49.8	20.1	17.6	26.2	53.1		150 N		Paul
9/4		1.22	Pivotrac	1/4 ml						Control	180 Y	500	Leon

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			393.18	1/4 ml	45.6	17.9	11.5	21.0	44.3	Control	181 Y	477	Paul
9/11	0.85		399.43	1/2 ml	93.6	12.9	11.5	26.6	43.7		353 N		Paul
9/18	0.49		399.43	5/8 ml	95.2	7.2	8.6	27.1	44.1		353 N	.	Paul
9/25			399.43	7/8 ml	94.3	5.4	13.3	29.5	41.6		353 N		Paul
10/2	0.01		399.43	Black Layer	92.8	6.7	14.4	32.4	41.6		353 N		Paul
10/8			399.43	Black Layer	92.1	0.0	8.0	31.3	38.7		352 N		Paul
10/16	0.60		399.43	Black Layer	88.8	0.0	10.2	32.8	41.3		353 N		Paul
10/23	0.01		399.43	Harvested	89.4	5.1	8.1	29.9	37.7		5 N		Paul
Total	**10.96**	**13.85**			**0.24"**	**1.53"**	**0.52"**	**0.36"**	**0.47"**				
Net Soil Moisture is 3.12"													
Irrigation, Rainfall Plus Net Soil Moisture is 27.93"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

Control

Year: *2014* **County:** *Hartley* **Grower:** *David Ford*

No. Acres: *60* **Variety/Hyb:** *P1151AM* **Soil Type:** *Gruver & Dumas Loam*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *220-50-0-2s* **Seeding:** *30,000*

Planted: *May 29, 2014* **Harvest:** *October 20, 2014*

Herbicide: *Balance Flex* **Insecticide:** *None*

Yield: *199 bu/ac* **Prev. crop:** *Corn* **Row width:** *30 Inch*

Irrigation method: *Center Pivot* **Prewater:** *2.54 in.* **Well GPM:** *4.1*

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

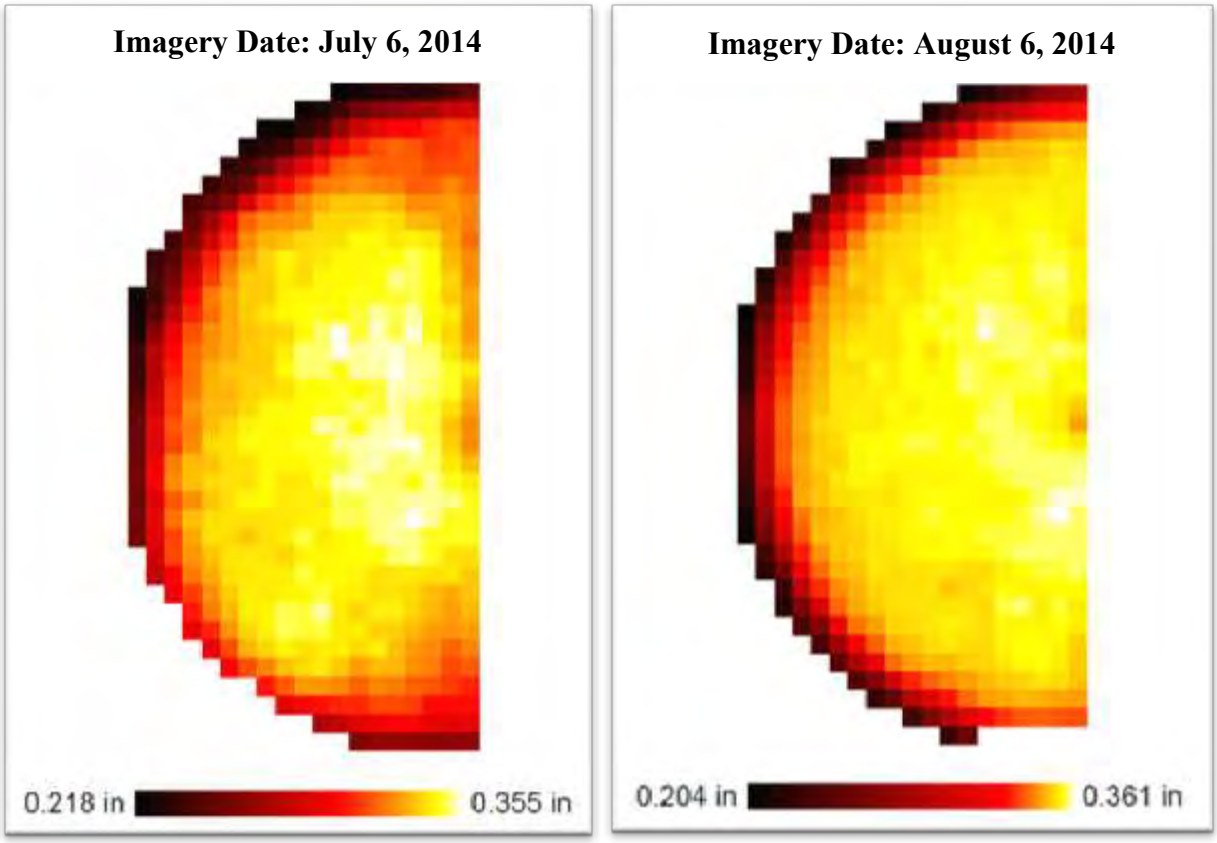
Application pattern: *Spray* **Crop row direction :** *Straight*

GPS Location of Pivot Pad
Latitude: *35.833828*
Longitude: *-102.173067*

GPS Location of Gypsum Blocks
Latitude: *35.837032*
Longitude: *-102.173847*

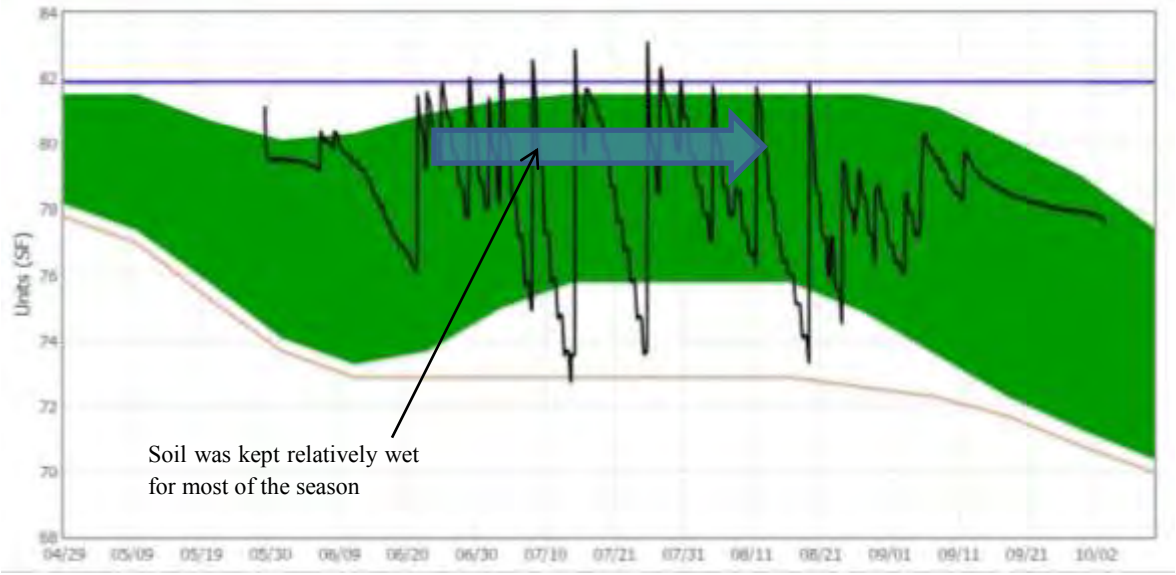
Satellite Imagery: David Ford's "control" field was one of eighteen "200-12" Project fields included in satellite imagery in 2014. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of David Ford's "control" field in figure 18 illustrate examples of what is displayed on the website. The first image is on July 6 at the 8 leaf growth stage. The second image is on August 6 at the blister stage. Satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 199 bushels per acre with 13.85 inches of irrigation.

Figure 18: Daily Water Use for David Ford's Control Demonstration Field

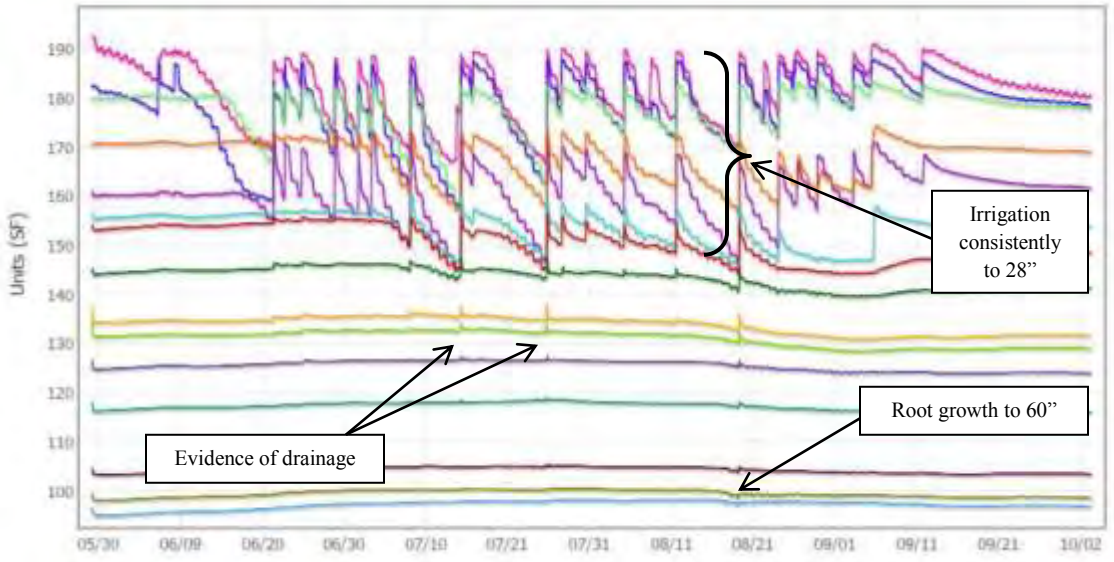


Note: Each Square Represents 1/8 of an Acre

David Ford's Control Field AquaSpy® Probe Summary



This field showed less aggressive root growth compared to the "200-12" field and it appeared that this probe site remained much wetter through the whole season. This is probably due to the much more frequent irrigation events early in the season. Irrigation was effective to 28" on most occasions and there was some evidence of drainage on multiple events (possibly due to rainfall). Even frequent irrigations late in the season were able to penetrate to 20" as the soil was kept wet. There is evidence that roots grew to 60" by mid-August, although the majority of the root activity was in the top 28". This site appeared not to suffer any moisture stress compared to the "200-12" site.



Harvest Results: The "200-12" field produced a 206 bushel per acre corn yield. Irrigation totaled 14.86 inches, of which 2.04 inches were pre-water. Production in the "control" field was 199 bushels per acre. Total irrigation was 13.85 inches. Pre-season irrigation was 2.54 inches and is included in total irrigation. In comparison, the "200-12" field produced 7 bushels per acre more than the "control" and irrigation was 1.01 inches more. Corn production was 13.86 bushels (766 lbs) per inch of irrigation in the "200-12" field compared to 14.36 (804 lbs) in the "control". Production from each inch of irrigation, rainfall and net soil water that totaled 28.06 inches was 7.34 bushels (411 lbs) per acre in the "200-12" field. Irrigation, rainfall and net soil water totaled 27.93 inches in the "control" field where production was 7.12 bushels (399 lbs) per inch. Crop production costs were $13.10 per acre more for the "200-12" field than for the "control" from increased irrigation and harvest expenses. At $4.00 per bushel, the 7 bushel per acre additional corn yield in the "200-12" field amounts to $28.00 more per acre. The "200-12" field"s net gain was $14.90 per acre with 1.01 inches more irrigation used compared to production from the "control" field. Net return per acre was $405.43 from the "200-12" field compared to $390.53 from the "control". Net return from each inch of irrigation was $27.28 for the "200-12" field compared to $28.19 for the "control". A summary of the demonstration results are shown in table 15.

Table 15: David Ford's 2014 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $4.00/bu		
			bu/ac	lb/ac-in Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"200-12"	14.86	*28.06	206	776	$824.00	$55.45	$29.36
Control	13.85	†27.93	199	805	$796.00	$57.47	$28.50

*Includes 2.24 inches of water removed from five feet of soil, plus rainfall, and irrigation.
†Includes 3.12 inches of water removed from five feet of soil, plus rainfall, and irrigation.

Brain Bezner's 2014 Dallam County Demonstration

Planting and Crop Information: For his demonstration, Brian Bezner strip tilled and planted 110 acres of corn in the southwest quarter of section 67 (L11) for his "200-12" field, "Bezner 200-12". Bezner planted the field with NK Syngenta N72D-3111 at a seeding rate of 27,000 seeds per acre. Bezner planted 128 acres, also strip tilled, in the southeast quarter of section 67 (L2) to NK Syngenta N72D-3111 at 32,000 seeds per acre for his "control" field, "Bezner Control". The "200-12" field (L11) was irrigated using a center pivot where seasonal water meter readings average 380 gpm and delivered an average of 0.70 inches of irrigation in a 3.8 day revolution. The "200-12" field received significant hail damage June 25 at the seven leaf stage. Water meter readings averaged 565 gpm for the center pivot that irrigated the "control" field (L2) and delivered 1.22 inches in a 5.2 day revolution. Planting and crop information for "Bezner 200-12" (L11) and "Bezner Control" (L2) are shown in the table 16 below.

Table 16: Planting and Crop Information for Brain Bezner

"200-12" Demonstration Field (L11)			
Planted:	*May 21*	**Harvested:**	*November 5*
Hybrid:	*N72D-311*	**Seeding Rate:**	*27,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*110*	**GPM Per Acre:**	*3.45*
Total Water:	*24.32 in.*	**Soil Type:**	*Dallam Fine Sandy Loam*
Fertilizer:	*91-72-24-12.5s-1.75zn*	**Insecticide:**	*Besiege, Prevathon*
Herbicide:	*Vision, Traxion, LumaxEZ, HalexGT*		
Control Demonstration Field (L2)			
Planted:	*May 21*	**Harvested:**	*November 6*
Hybrid:	*N72D-3111*	**Seeding Rate:**	*32,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*128*	**GPM Per Acre:**	*4.45*
Total Water:	*34.76 in.*	**Soil Type:**	*Dallam Loamy Fine Sand*
Fertilizer:	*91-72-24-12.5s-1.75zn*	**Insecticide:**	*Besiege, Prevathon*
Herbicide:	*Traxion, LumaxEZ, HalexGT, Vision*		

Beginning Soil Water Profile and Growing Season Rainfall

"200-12" Demonstration Field: Beginning soil water was about 80 percent at 1, 2, 3, 4 and 5 feet prior to panting on May 21. 1.28 inches of pre-water was applied for uniform seed germination. A 1.42 inch rainfall helped the crop and refilled the soil profile to 5 feet. All was underway for a good crop until the field received significant hail damage June 25 at the seven leaf stage. Following the hail, Irrigation in July totaled only 2.61 inches. July rainfall totaled .98 inches. The crop depleted water stored at 1, 2 and 3 and about half from 4 feet. August rainfall totaled 1.73 inches and irrigation was 3.99 to help the stressed crop recover. Daily plant water use was then much less. The crop finished using water available in the first foot from late season irrigation and rainfall. Early September rainfall at the dent and grain maturity stages was 2.25 inches and maintained remaining production potential. Total rainfall measured and recorded was 10.71 inches from planting until harvest. Dallam Fine Sandy Loam soil holds approximately 1.6

inches of available water in the first foot and 1.9 inches at 2, 3, 4, and 5 feet for potential crop use. The gypsum blocks were installed in early April prior to planting to guide water management.

Control Demonstration Field: Beginning soil water was good at 1, 2, 3, 4 and 5 feet. 1.17 inches of pre-water was applied prior to planting for uniform seed germination. Good soil water levels were maintained Plants water use was high from mid-July thru mi-d August using all rainfall, and irrigation plus 80 percent of water stored at 2 feet, 60 percent of that at 3 feet and dipped into 4 and 5 feet. The profile was refilled by timely early September beneficial rainfall and late season irrigation at the dent and early grain maturity stages. The crop finished on that water depleting 60 to 70 percent stored at 2, 3 and 4 feet and about half from 5 feet. Rainfall totaled 10.71 inches from planting until harvest and contributed to the 275 bushel per acre corn yield. Monthly rainfall is listed in table 17. Dallam Loamy Fine Sand holds approximately 1.0 inches at 1 foot, 1.60 at 2 feet, 1.90 inches at 3 and 4 feet and 2.0 inches at 5 feet for potential plant use. Gypsum blocks were installed in early April to help guide management.

Table 17: Monthly Rainfall Data for Brian Bezner

	May	June	July	August	September	October	Total
"200-12"	1.42"	2.83"	0.98"	1.73"	2.36"	1.39"	**10.71"**
Control	1.42"	2.83"	0.98"	1.73"	2.36"	1.39"	**10.71"**

Growing Season Water Tracking: The District tracked crop total water throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. A 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 "200-12" field. Another set of the same type of sensors were installed in each "control" field. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in each field. Gypsum blocks were installed in the "200-12" (L11) and "control" (L2) field prior to planting. Each AquaSpy® probe was installed following crop emergence. Installing and reading the gypsum blocks prior to planting provided advanced soil moisture conditions and information to help guide and manage irrigation. 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 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 "200-12" field are shown first, followed by the same illustrations for the "control" field.

Figure 19: Gypsum Block Readings for Brian Bezner's "200-12" Demonstration Field (168 bu/ac)

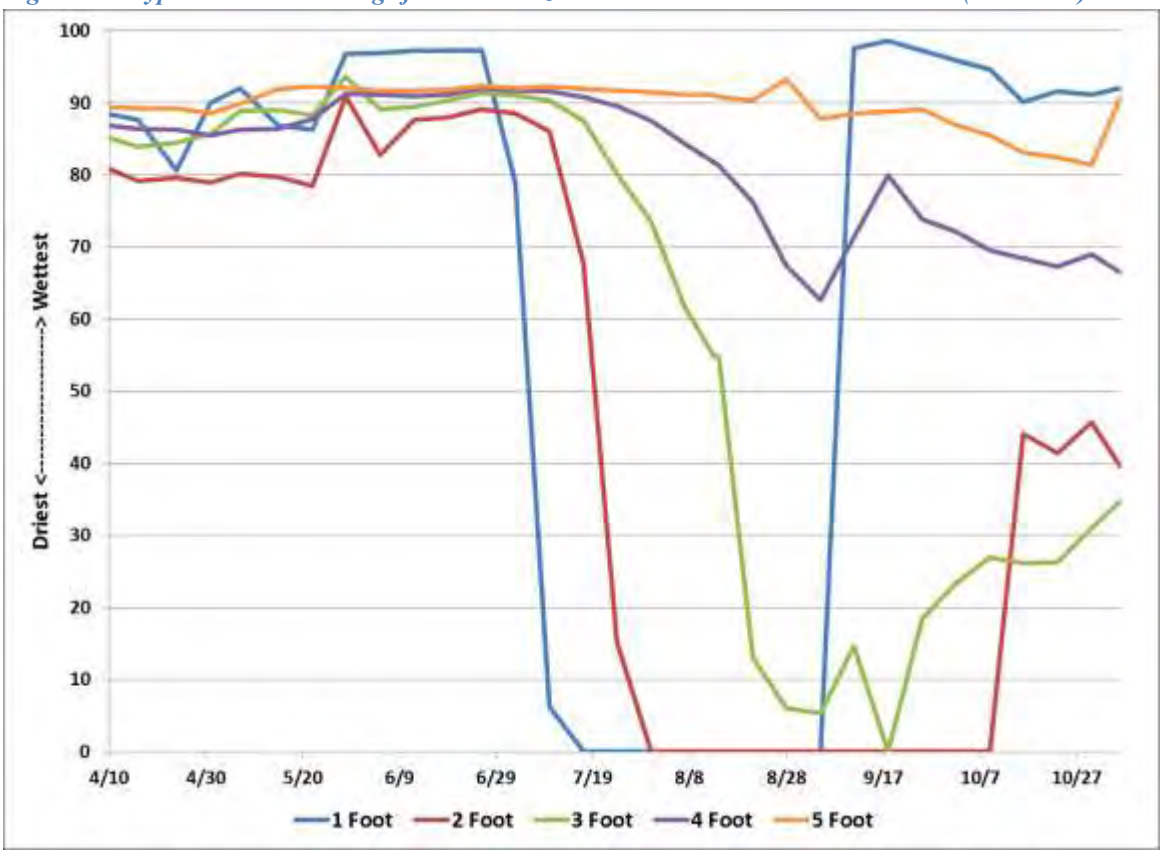


Figure 20: Growing Season Water Tracking for Brian Bezner's "200-12" Demonstration Field (168 bu/ac)

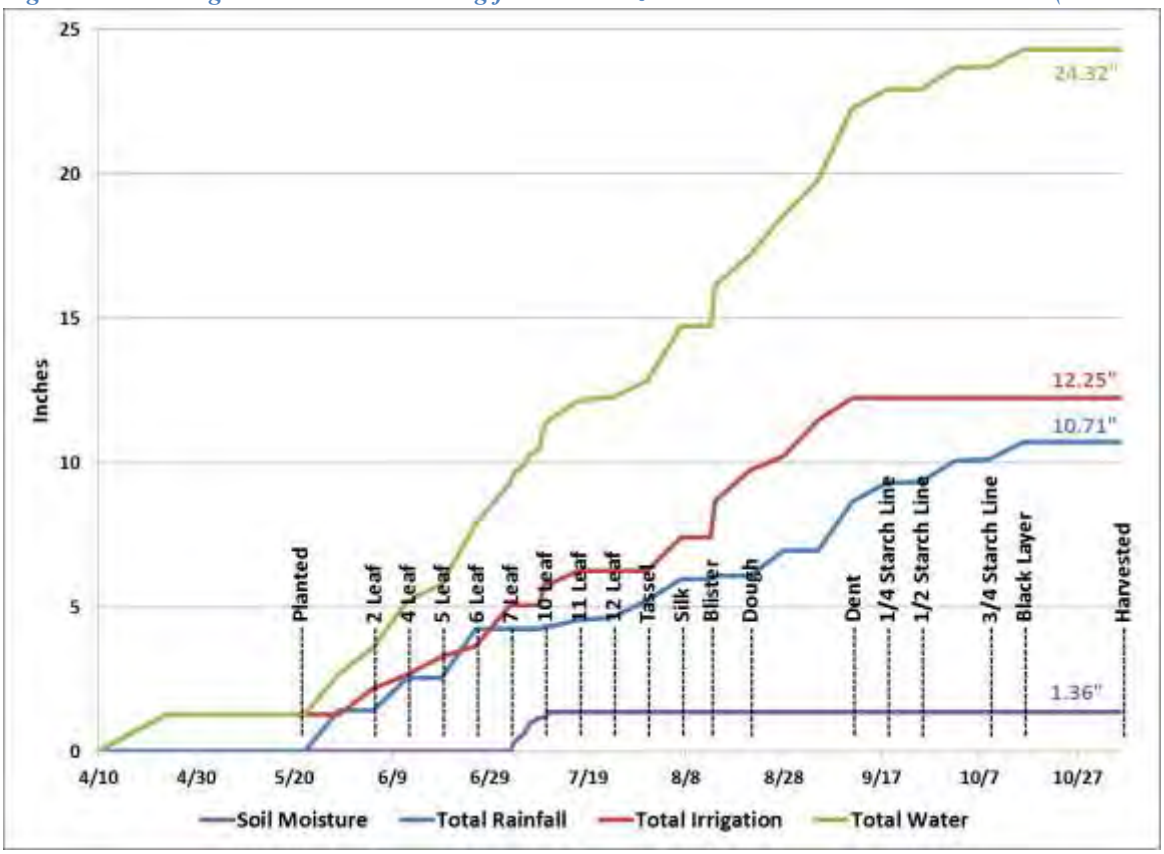


Table 18: Demonstration Field Data for Brian Bezner's "200-12" Demonstration Field

Date mm/dd	Rain Inches	Irrigation Inches	Water Meter	Growth Stage	Soil Moisture 1 Foot	2 Feet	3 Feet	4 Feet	5 Feet	Crop Status	Pivot Position	Well GPM	Source
4/3			no meter		97.4	97.5	97.4	97.6	97.2		330 N		Kari & Leon
4/10			3.5		88.4	80.8	85.1	86.8	89.5	Prewater	56 Y	340	Kari
4/16		0.56	5.16		87.6	79.2	83.9	86.4	89.2		318 N		Kari
4/24		0.72	11.79		80.6	79.6	84.5	86.3	89.2	Prewater	298 N		Kari
5/1			11.79		90.0	78.9	85.7	85.5	88.5		299 N		Kari
5/7			11.79		92.1	80.2	88.9	86.3	89.9		299 N		Kari
5/15			11.79		86.9	79.7	89.0	86.4	91.9		298 N		Kari
5/21										Plant			Brian
5/22			11.79		86.3	78.5	88.3	87.8	92.3		345 N		Kari
5/29	1.42		17.32		96.8	90.9	93.6	91.3	92.0	200-12	106 Y	299	Kari
6/5		0.89	19.99	2 Leaf	96.9	82.8	89.1	91.2	91.7	200-12	9 N		Kari
6/12	1.12	0.49	24.52	4 Leaf	97.2	87.6	89.4	90.9	91.7	200-12	12 N		Kari & David
6/19		0.61	30.12	5 Leaf	97.3	88.0	90.3	91.2	91.8		24 N		Kari & David
6/26	1.71	0.38	33.58	6 Leaf	97.3	89.1	91.4	92.0	92.4	200-12	174 Y	430	Paul
7/3		1.41	46.53	7 Leaf	79.0	88.6	91.0	91.7	92.1	200-12	115 Y	360	Paul
7/10	0.08	0.73	53.2	10 Leaf	6.2	86.1	90.3	91.6	92.3		139 N		Paul
7/17	0.22	0.47	57.5	11 Leaf	0.0	67.6	87.5	90.8	91.9	200-12	59 Y	355	Paul
7/24	0.10		58.91	12 Leaf	0.0	15.2	80.2	89.6	91.7		156 N		Paul
7/31	0.58		66.23	Tassel	0.0	0.0	73.5	87.5	91.5	200-12	180 Y	320	Paul
8/7	0.75	1.14	68.02	Silk	0.0	0.0	61.8	84.4	91.1	200-12	258 Y	387	Paul
8/13				Blister	0.0	0.0	54.8	81.8	91.2	200-12	280 Y		Leon
8/14	0.11	1.29	79.86	Blister	0.0	0.0	54.8	81.3	90.8	200-12	68 Y	399	Paul
8/21		1.05	89.55	Dough	0.0	0.0	13.0	76.2	90.3		229 N		Jerry
8/28	0.87	0.51	94.26	Dough	0.0	0.0	6.0	67.4	93.3	200-12	154 Y	365	Paul
9/4		1.23	105.53	Dough	0.0	0.0	5.3	62.7	87.8	200-12	83 Y	429	Paul
9/11	1.70	0.77	112.61	Dent	97.6	0.0	14.6	71.4	88.5		91 N		Paul
9/18	0.65		112.61	1/4 ml	98.6	0.0	0.0	79.9	88.8		91 N		Paul
9/25	0.01		112.61	1/2 ml	97.2	0.0	18.4	73.9	89.1		91 N		Paul
10/2	0.76		112.61	1/2 ml	95.9	0.0	23.3	72.1	87.0		90 N		Paul
10/9	0.03		112.61	3/4 ml	94.6	0.0	26.9	69.6	85.5		90 N		Paul
10/16	0.60		112.61	Black Layer	90.1	44.1	26.1	68.4	83.1		91 N		Paul
10/23	0.16		112.61	Black Layer	91.6	41.4	26.3	67.3	82.4		91 N		Paul
10/30			112.61	Black Layer	91.1	45.7	31.0	69.0	81.4		90 N		Paul
11/5	0.56		112.61	Harvested	92.0	39.6	34.7	66.5	90.7		3 N		Paul
Total	**10.71**	**12.25**			**-0.29"**	**0.45"**	**0.78"**	**0.38"**	**0.04"**				
Net Soil Moisture is 1.36"													
Irrigation, Rainfall Plus Net Soil Moisture is 24.32"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

200-12

Year:	*2014*	**County:**	*Dallam*	**Grower:**	*Brian Bezner*
No. Acres:	*110*	**Variety/Hyb:**	*Syngenta NK N72D-3111*	***Soil Type:***	*Dallam Fine Sandy Loam*

Meter Type: *Seametrics*

Meter Mult:	*Ac Ft x 1*	**Tillage:**	*Strip Till*
Fertilizer:	*91-72-24-12.5s-1.75zn*	**Seeding:**	*27,000*
Planted:	*May 21, 2014*	**Harvest:**	*November 5, 2014*
Herbicide:	*Vision, Traxion, LumaxEZ, HalexGT*	**Insecticide:**	*Besiege, Prevathon*
Yield:	*168 Bu/Acre*	**Prev. crop:**	*Wheat*

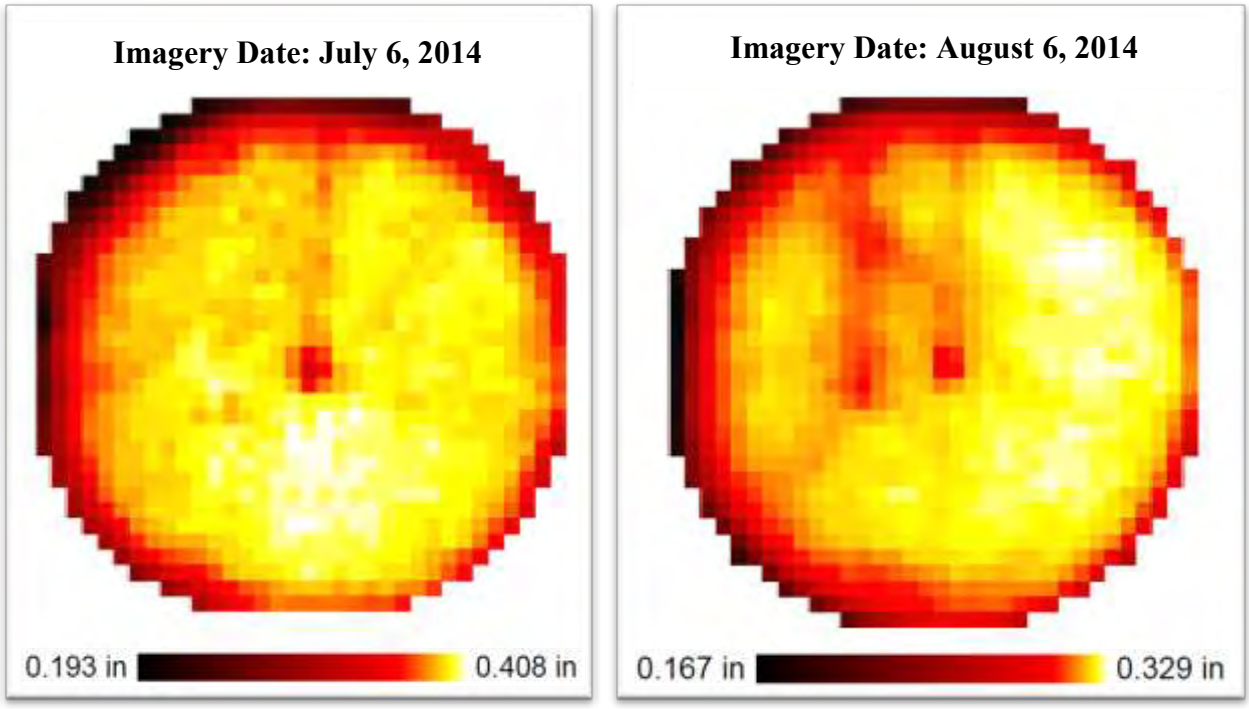
Row width: *30 Inch*

Irrigation method:	*Center Pivot*	**Prewater:**	*1.28 in.*	**Well GPM:**	*3.45*
Distance between drops:	*60"*	**Distance from nozzle to ground:**		*16"*	
Application pattern:	*Spray*	**Crop row direction :**		*Straight*	

GPS Location of Pivot Pad		**GPS Location of South Gypsum Blocks**	
Latitude:	*36.115703*	Latitude:	*36.118485*
Longitude:	*-103.021122*	Longitude:	*-103.021958*

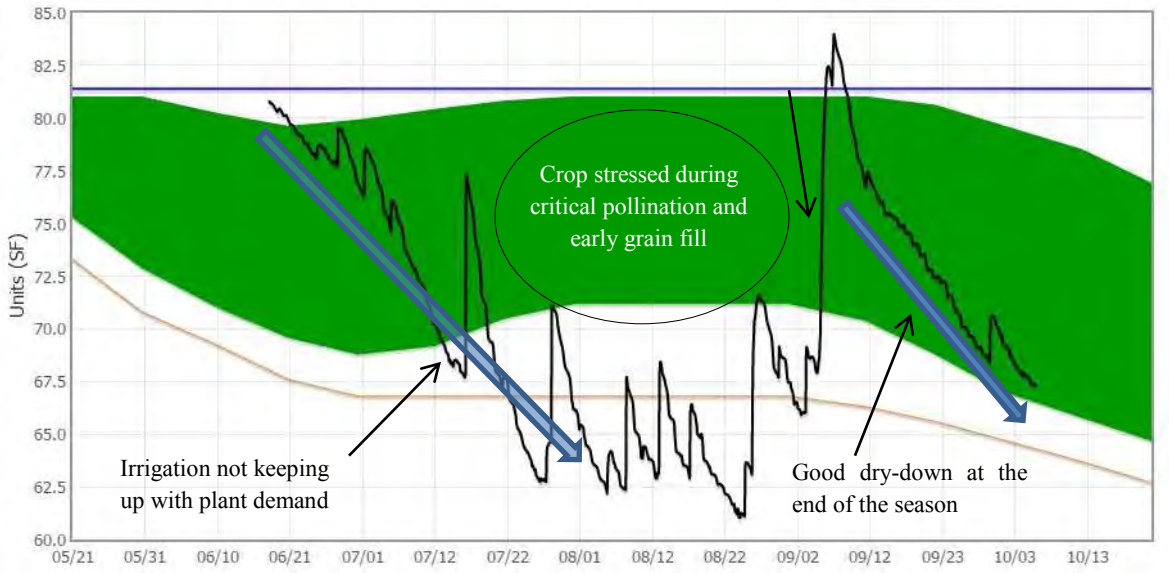
Satellite Imagery: Satellite imagery was initiated and used in 2013 to learn and evaluate its potential for an irrigation and water management tool for growers in connection with HydroBio. The use of satellite imagery was continued for the 2014 growing season. Brian Bezner"s "200-12" field was one of eighteen "200-12" project fields included in 2014. The field received significant hail damage June 25 at the 7 to 8 leaf stage. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Brian Bezner"s ""200-12"" field are shown in figure 21 to illustrate examples of what is displayed on the website. The first image was on July 6 at the 7 leaf stage. The second image is on August 6 at the silk stage. The satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 168 bushels per acre with 12.25 inches of irrigation.

Figure 21: Daily Water Use for Brian Bezner's "200-12" Demonstration Field



Note: Each Square Represents 1/8 of an Acre

Brian Bezner's "200-12" Field AquaSpy® Probe Summary



This field seemed to go into moisture stress quite early and never recovered. The crop experienced deficit irrigation almost from the start and there were several periods of quite severe moisture stress during the time of peak demand. This would certainly be responsible for the low yield on this site. There was evidence of root activity down to 52" and I suspect that the layers below this were dry and had little deep moisture to give up. There was good root activity in the top 32" but most of the water uptake was confined to the top 16-20" as this was the depth that rainfall and irrigation was mostly able to penetrate.

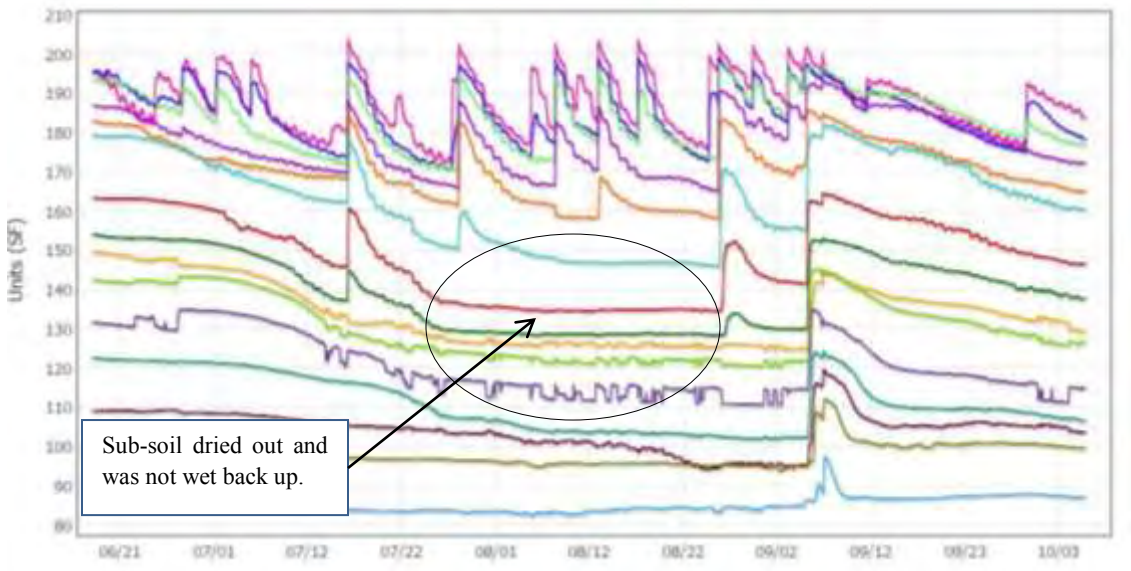


Figure 22: Gypsum Block Readings for Brian Bezner's Control Demonstration Field (275 bu/ac)

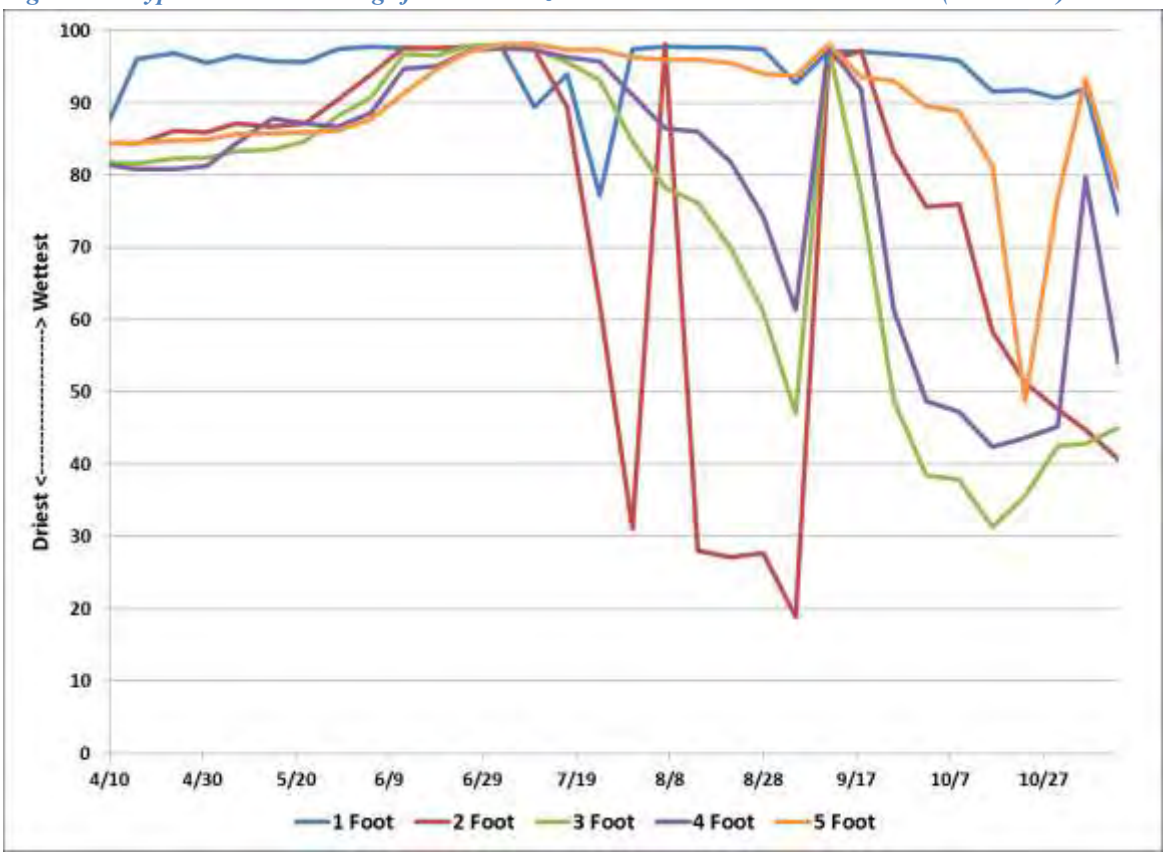


Figure 23: Growing Season Water Tracking for Brian Bezner's Control Demonstration Field (275 bu/ac)

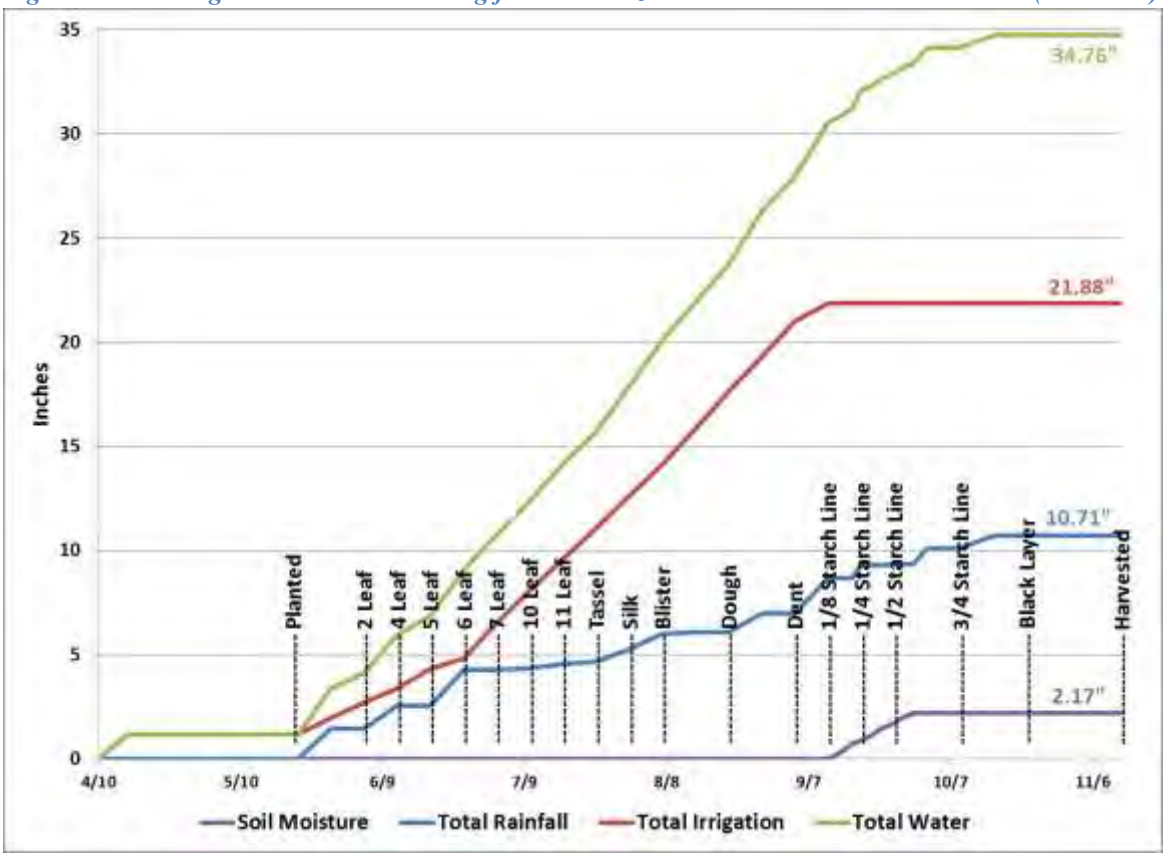


Table 19: Demonstration Field Data for Brian Bezner's Control Demonstration Field

Date mm/dd	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				
4/3			no meter		97.0	96.8	96.7	96.2	96.0		255 N		Kari & Leon
4/10			4.48		87.5	84.5	81.8	81.4	84.5	Prewater	126 Y	560	Kari
4/16		1.17	12.51		96.1	84.4	81.6	80.9	84.5	Prewater	217 N		Kari
4/24			12.51		96.9	86.2	82.3	80.9	84.8		218 N		Kari
5/1			12.51		95.6	86.0	82.4	81.3	84.9		217 N		Kari
5/7			12.51		96.6	87.2	83.3	84.4	85.7		218 N		Kari
5/15			12.51		95.8	86.7	83.6	87.9	85.8		217 N		Kari
5/21										Plant			Brian
5/22			12.51		95.7	87.2	84.7	87.2	85.9		163 N		Kari
5/29	1.42	0.78	20.88		97.5	90.5	88.2	86.7	86.2	Control	203 Y	555	Kari
6/5		0.73	28.73	2 Leaf	97.8	94.0	90.8	88.7	87.8		219 N		Kari
6/12	1.12	0.69	36.13	4 Leaf	97.6	97.7	96.8	94.8	91.4	Control	232 N		Kari & David
6/19		0.95	46.24	5 Leaf	97.6	97.6	96.6	95.1	94.7		253 N		Kari & David
6/26	1.71	0.48	51.44	6 Leaf	97.8	97.8	97.9	97.3	97.1	Control	356 Y	616	Paul
7/3		1.71	69.68	7 Leaf	97.7	98.0	98.0	97.6	98.1	Control	233 Y	533	Paul
7/10	0.08	1.56	86.3	10 Leaf	89.5	97.4	97.5	97.4	98.1	Control	151 Y	535	Paul
7/17	0.22	1.49	102.21	11 Leaf	94.0	89.5	95.7	96.4	97.4	Control	283 Y	565	Paul
7/24	0.1	1.49	118.08	Tassel	77.2	62.2	93.2	95.8	97.4	Control	48 Y	490	Paul
7/31	0.58	1.56	134.71	Silk	97.5	31.1	84.7	91.2	96.3	Control	178 Y	570	Paul
8/7	0.75	1.50	150.77	Blister	97.8	98.2	78.2	86.5	96.0	Control	302 Y	584	Paul
8/14	0.11	1.75	169.51	Blister	97.7	28.1	76.2	86.1	96.0	Control	64 Y	598	Paul
8/21		1.75	188.17	Dough	97.7	27.1	70.0	81.9	95.5	Control	230 Y	560	Jerry
8/28	0.87	1.72	206.58	Dough	97.5	27.7	61.2	74.4	94.1	Control	316 Y	646	Paul
9/4		1.67	224.41	Dent	92.7	18.9	47.1	61.4	93.8	Control	27 Y	556	Paul
9/11	1.7	0.88	233.77	1/8 ml	97.1	95.8	97.8	97.8	98.1		117 N		Paul
9/18	0.65		233.77	1/4 ml	97.1	97.3	77.5	91.9	93.6		117 N		Paul
9/25	0.01		233.77	1/2 ml	96.8	83.2	48.9	61.4	93.1		117 N		Paul
10/2	0.76		233.77	1/2 ml	96.5	75.7	38.5	48.8	89.6		117 N		Paul
10/9	0.03		233.77	3/4 ml	95.9	76.0	37.9	47.3	88.9		117 N		Paul
10/16	0.6		233.77	3/4 ml	91.6	58.4	31.3	42.4	81.3		117 N		Paul
10/23	0.16		233.77	Black Layer	91.8	51.4	35.6	43.7	48.7		117 N		Paul
10/30			233.77	Black Layer	90.7	47.6	42.5	45.2	76.9		117 N		Paul
11/5	0.56		233.77	Black Layer	92.1	44.8	42.9	79.7	93.4		116 N		Paul
11/12			233.77	Harvested	74.7	40.7	45.0	54.2	78.2		195 N		Paul
Total	**10.71**	**21.88**			**0.33"**	**0.55"**	**0.53"**	**0.59"**	**0.17"**				
Net Soil Moisture is 2.17"													
Irrigation, Rainfall Plus Net Soil Moisture is 34.76"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

Control

Year: *2014* **County:** *Dallam* **Grower:** *Brian Bezner*

No. Acres: *128* **Variety/Hyb:** *Syngenta NK N72D-3111* **Soil Type:** *Dallam Loamy Fine Sand*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *91-72-24-12.5s-1.75zn* **Seeding:** *32,000*

Planted: *May 21, 2014* **Harvest:** *November 6, 2014*

Herbicide: *Traxion, Lumax EZ, Halex GT, Vision* **Insecticide:** *Besiege, Prevathon*

Yield: *275 bu/ac* **Prev. crop:** *Wheat* **Row width:** *30 Inch*

Irrigation method: *Center Pivot* **Prewater:** *1.17 in.* **Well GPM:** *4.45*

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

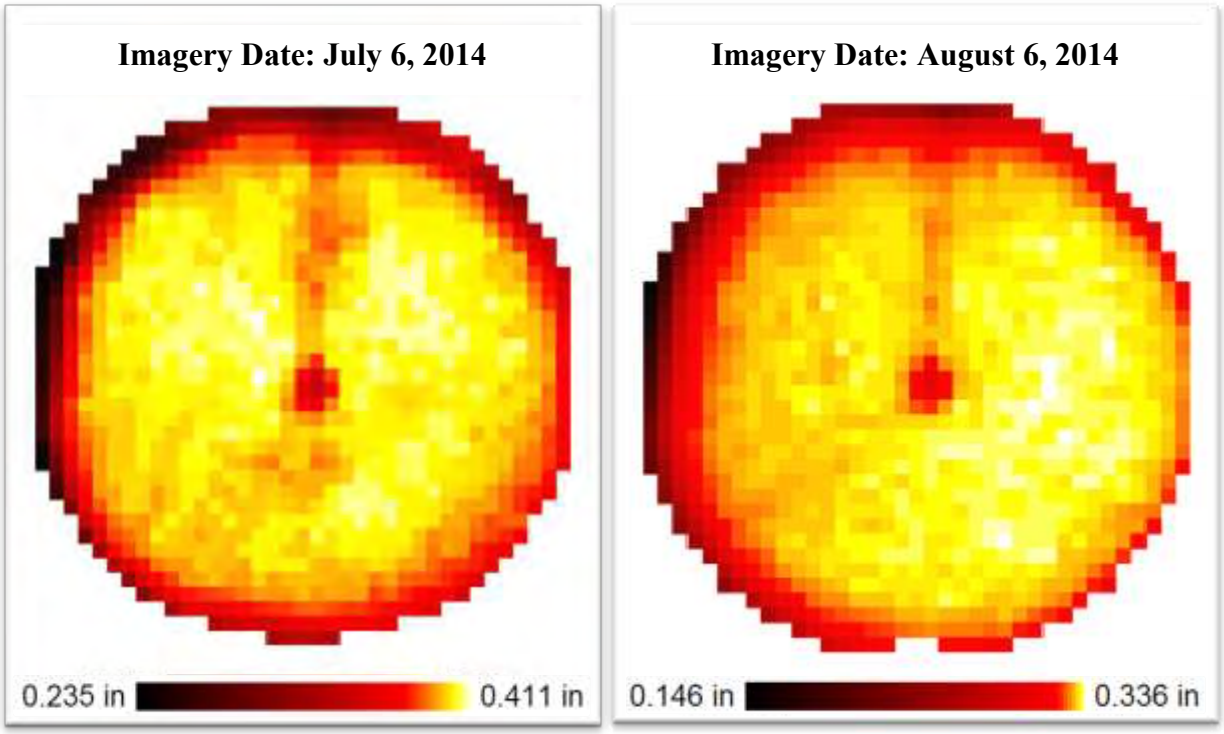
Application pattern: *Spray* **Crop row direction :** *Straight*

GPS Location of Pivot Pad
Latitude: *36.130305*
Longitude: *-102.985698*

GPS Location of Gypsum Blocks
Latitude: *36.128794*
Longitude: *-102.989454*

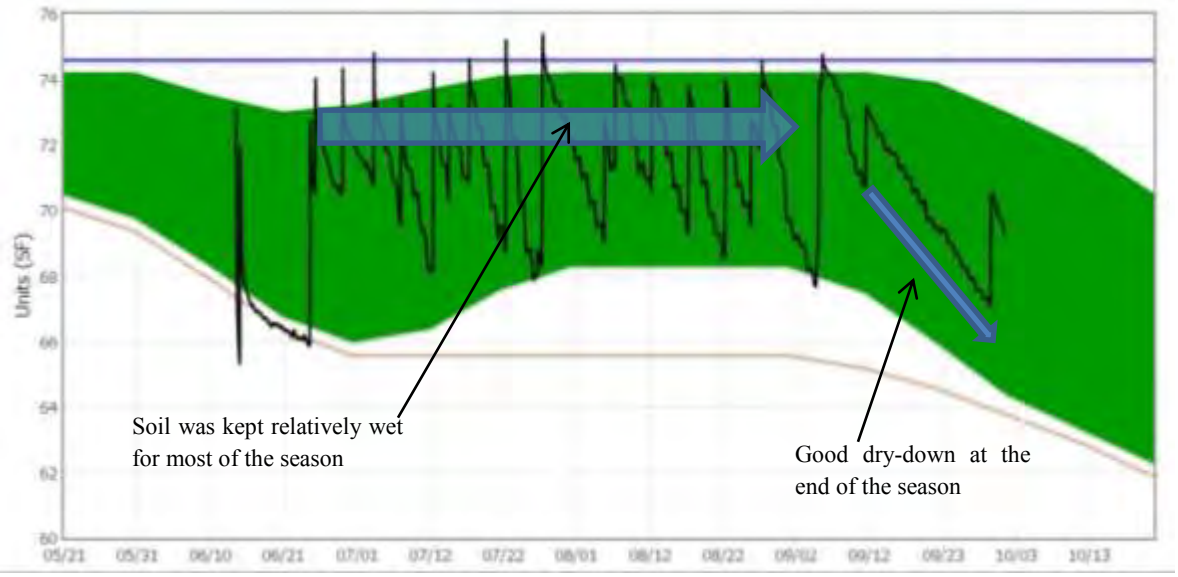
Satellite Imagery: Brian Bezner"s "control" field was one of eighteen "200-12" project fields included in satellite imagery in 2014. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Brian Bezner"s "control" field in figure 24 illustrate examples of what is displayed on the website. The first image is on July 6 at the 7 leaf growth stage. The second image is on August 6 at the blister stage. Satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 275 bushels per acre with 21.88 inches of irrigation.

Figure 24: Daily Water Use for Brian Bezner's Control Demonstration Field

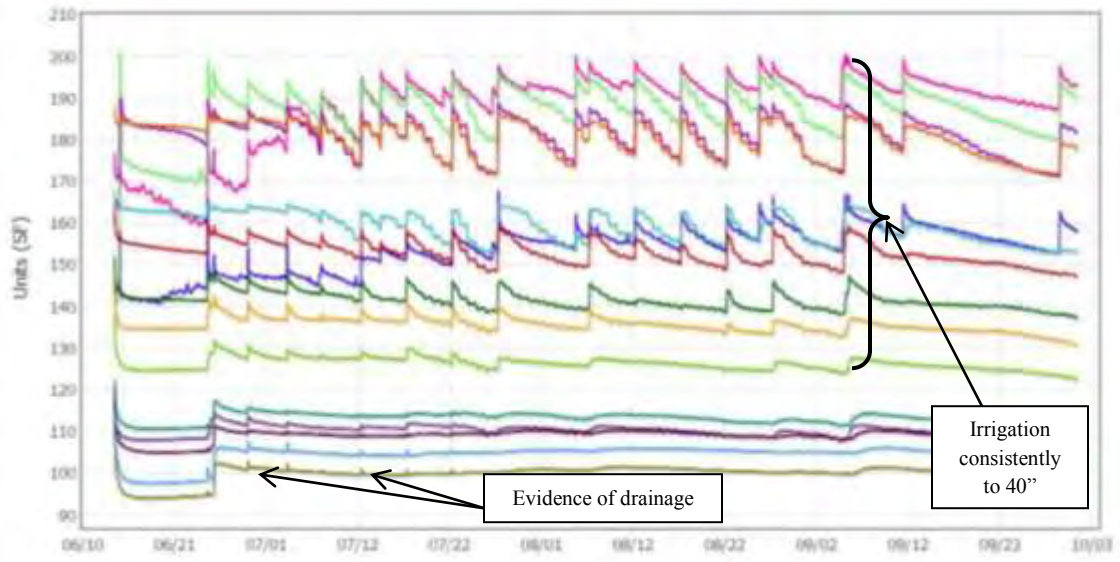


Note: Each Square Represents 1/8 of an Acre

Brian Bezner's Control Field AquaSpy® Probe Summary



This field enjoyed sufficient moisture throughout the season. Irrigation was highly effective at wetting to 40" although there was evidence of drainage below 60" early in the season. There was no evidence of drainage after 7/22 and roots were evident at 60" from the beginning of August onwards. As such, this crop enjoyed a very large root system and effective (deep) irrigation, allowing it to utilize most of the roots for most of the season. The fact that roots were present at lower levels but water uptake was not great at these depths, suggests the crop was never water limited, but instead enjoyed good access to moisture throughout the season. The soil was allowed to dry down at the end of the season but there was no evidence of any moisture stress, making the final irrigation well-timed.



Harvest Results: The "200-12" field produced a 168 bushel per acre corn yield. Irrigation totaled 12.25 inches that includes 1.28 inches of pre-water. Production in the "control" field was 275 bushels per acre, where seasonal irrigation was 20.71 inches, pre-water 1.17 and total irrigation 21.88 inches. In comparison, production from the "control" field was 107 bushels more with 9.63 more inches of irrigation. Corn production was 13.71 bushels (768 lbs) per inch of irrigation in the "200-12" field. Grain production was 12.57 bushels (704 lbs) per inch in the "control". Grain production from each inch of irrigation, rainfall and net soil water that totaled 24.32 inches was 6.90 bushels (387 lbs) per acre in the "200-12" field. Irrigation, rainfall and net soil water totaled 34.76 inches in the "control" field where production was 7.91 bushels (443 lbs) per inch. Crop production costs were $155.53 per acre more for the "control" field than for the "200-12" from additional seed, fertilizer, irrigation and harvest expenses. At $4.00 per bushel for corn grain, the value for 107 bushels per acre more in the "control" field amounts to $428.00 per acre. Production expenses for seed, fertilizer, irrigation and harvest costs totaled $572.57 for the "control" field compared to $372.28 for the "200-12" field. The "control" field"s net gain is $227.71 per acre with 9.63 inches more irrigation used compared to production from the "200-12" field. Net return was $299.72 per acre from the "200-12" field compared to $527.43 from the "control". Hail damage followed by limited available water in July significantly limited potential corn yield in the "200-12" field. A summary of the demonstration results are shown in table 20.

Table 20: Brian Bezner's 2014 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $4.00/bu		
			bu/ac	lb/ac-in of Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"200-12"	12.25	*24.32	168	768	$672.00	$54.84	$27.63
Control	21.88	†34.76	275	704	$1,100.00	$50.28	$31.65

*Includes 1.36 inches of water remove from five feet of soil, plus rainfall, and irrigation.
†Includes 2.17 inches of water removed from five feet of soil, plus rainfall, and irrigation.

Joe Reinart's 2014 Sherman County Demonstration

Planting and Crop Information: For his demonstration, Joe Reinart strip-tilled and planted 27 acres of corn in the northwest quarter of section 217, S1, for his "200-12" field, "Reinart 200-12". He planted the field with Channel Ch198-00 at a seeding rate of 32,000 seeds per acre. Cotton was planted on 26 acres in the circle and 12 acres were within acreage irrigated by the adjoining center pivot. Reinart planted 75 acres, also strip tilled, in the southwest quarter of section 217, S3, to Channel Ch217-08 at 32,000 seeds per acre for his "control" field, "Reinart Control". One well was rotated between the two center pivots to irrigate the "control" field then the "200-12" field as selected. Table 21 shows when the "200-12" field was irrigated. Water meter readings made when the "200-12" field was being irrigated averaged 400 gpm. In a 4.3 day revolution, 1.41 inches of irrigation was applied. Meter readings average 425 gpm and delivered an average of 1.66 inches of irrigation in a 5.5 day revolution when the "control" field was irrigated. Planting and crop production information for "Reinart 200-12" and "Reinart Control" are shown in table 21 below.

Table 21: Planting and Crop Information for Joe Reinart

"200-12" Demonstration Field			
Planted:	*June 4*	**Harvested:**	*October 29*
Hybrid:	*CH198-00*	**Seeding Rate:**	*32,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*27*	**GPM Per Acre:**	*3.0 Share with Cotton*
Total Water:	*19.51 in.*	**Soil Type:**	*Sunray Clay Loam*
Fertilizer:	*103-48-0-10.3s-1.03zn*	**Insecticide:**	*None*
Herbicide:	*Atrazine, DicambaHD, Metoachor, Glyphosate*		
Control Demonstration Field			
Planted:	*April 25*	**Harvested:**	*October 9*
Hybrid:	*CH217-08*	**Seeding Rate:**	*32,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*75*	**GPM Per Acre:**	*3.0*
Total Water:	*29.76 in.*	**Soil Type:**	*Sherm and Sunray Clay Loam*
Fertilizer:	*205-43-0-10-1.12micro*	**Insecticide:**	*None*
Herbicide:	*Aatrex, Balance Flex, Glyphosate, Charity*		

Beginning Soil Water Profile and Growing Season Rainfall

"200-12" Demonstration Field: Preseason soil water was low to none at 1, 2, 3 and 4 feet when gypsum blocks were installed in April. Approximately 40 percent was stored at 5 feet. The corn crop followed cotton in 2013. A combination of timely rainfall in early June and limited irrigation got the seed germinated and crop started. Additional timely rainfall in early July plus irrigation partially refilled soil water at 1, 2 and 3 feet to keep the crop growing. It was difficult to refill the soil profile because it was so dry. The crop depleted available water at 1, 2 and three feet in late July and early August. Irrigation was increased in August at tassel, pollination and the grain development growth stages. The crop basically lived on available water at 1 and 2 feet provided by periodic beneficial rainfall and limited irrigation. Timely rainfall in late August and

early September provided water to partially refill the soil profile to the best levels during the growing season. The crop finished on that water leaving the soil profile much wetter than at planting resulting in a net gain of 4.27 inches. Gypsum blocks were installed in Sunray clay loam soil which holds approximately 2.0 inches of available water per foot for potential crop use. The gypsum blocks were installed in early April prior to planting to obtain advanced soil water conditions. Rainfall totaled 8.95 inches from planting until harvest. Timely rainfall in July and August helped maintain the crop. An additional 1.99 inches in September finished the June 4 planted crop.

Control Demonstration Field: The soil profile was basically depleted at 2, 3 and 5 feet and about 40 percent at 4 feet, beginning the season. There was good soil water at 1 foot provided by 2.85 inches of pre-water. Rainfall and irrigation in May and June following planting refilled the profile to 5 feet. Weekly gypsum block readings show the crop had adequate available water throughout the growing season, and that the soil profile gained 4.68 inches of available water from seasonal irrigation and rainfall by harvest. The result was more water in the soil profile at harvest than at planting. Gypsum blocks were installed in Sunray clay loam that holds approximately 2.0 inches of available water per foot for potential crop use. Rainfall totaled 9.93 inches, with timely beneficial rains of more than one inch occurring in May, June, July, August, and September. Gypsum blocks were installed in early April to guide early season water management as well as seasonal levels.

Table 22: Monthly Rainfall Data for Joe Reinart

	May	June	July	August	September	October	Total
"200-12"	0.00"	1.38"	3.19"	1.51"	1.62"	1.19"	**8.95"**
Control	1.61"	1.38"	2.99"	1.64"	1.80"	0.51"	**9.93"**

Growing Season Water Tracking: The District tracked crop total water throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. A 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 "200-12" field. Another set of the same type of sensors were installed in each "control" field. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in the field. Gypsum blocks were installed in the "200-12" field and "control" field prior to planting. Each AquaSpy® probe was installed following crop emergence. Installing and reading the gypsum blocks prior to planting provided advanced soil moisture conditions and information to help guide and manage pre-water and early season irrigation. 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 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 "200-12" field are shown first, followed by the same illustrations for the "control" field.

Figure 25: Gypsum Block Readings for Joe Reinart's "200-12" Demonstration Field (177 bu/ac)

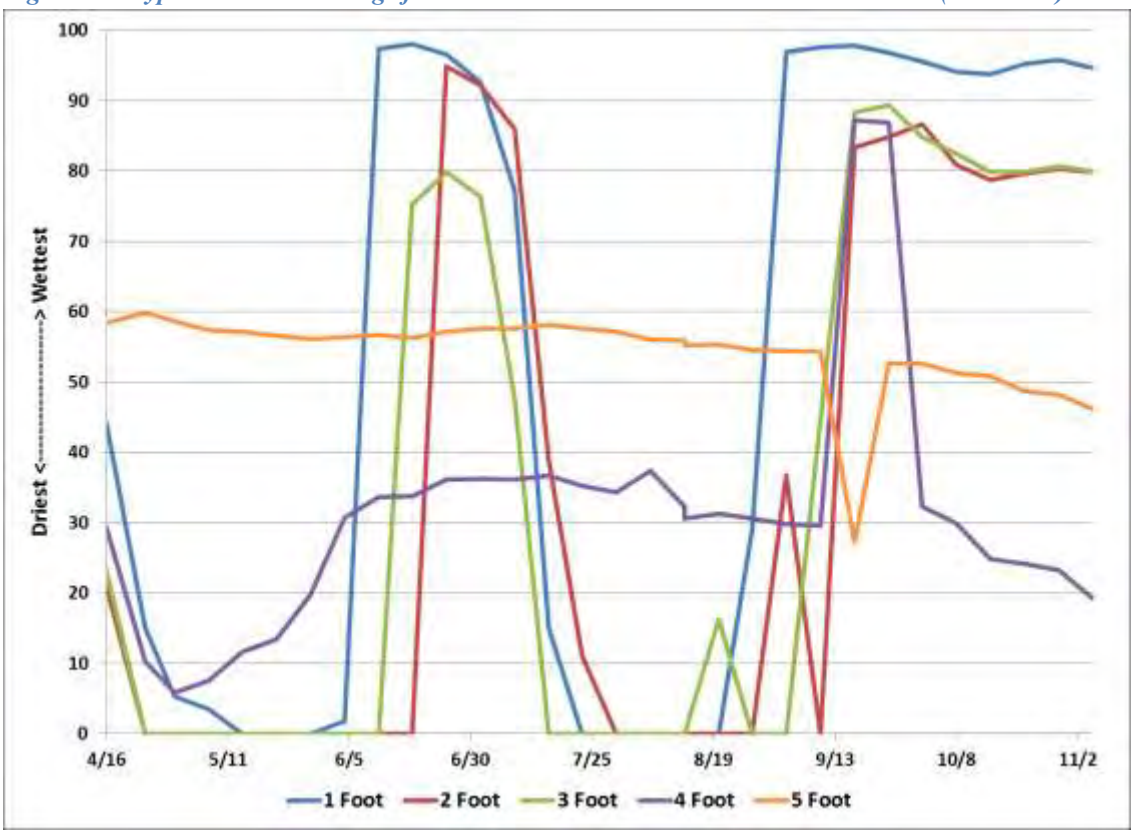


Figure 26: Growing Season Water Tracking for Joe Reinart's "200-12" Demonstration Field (177 bu/ac)

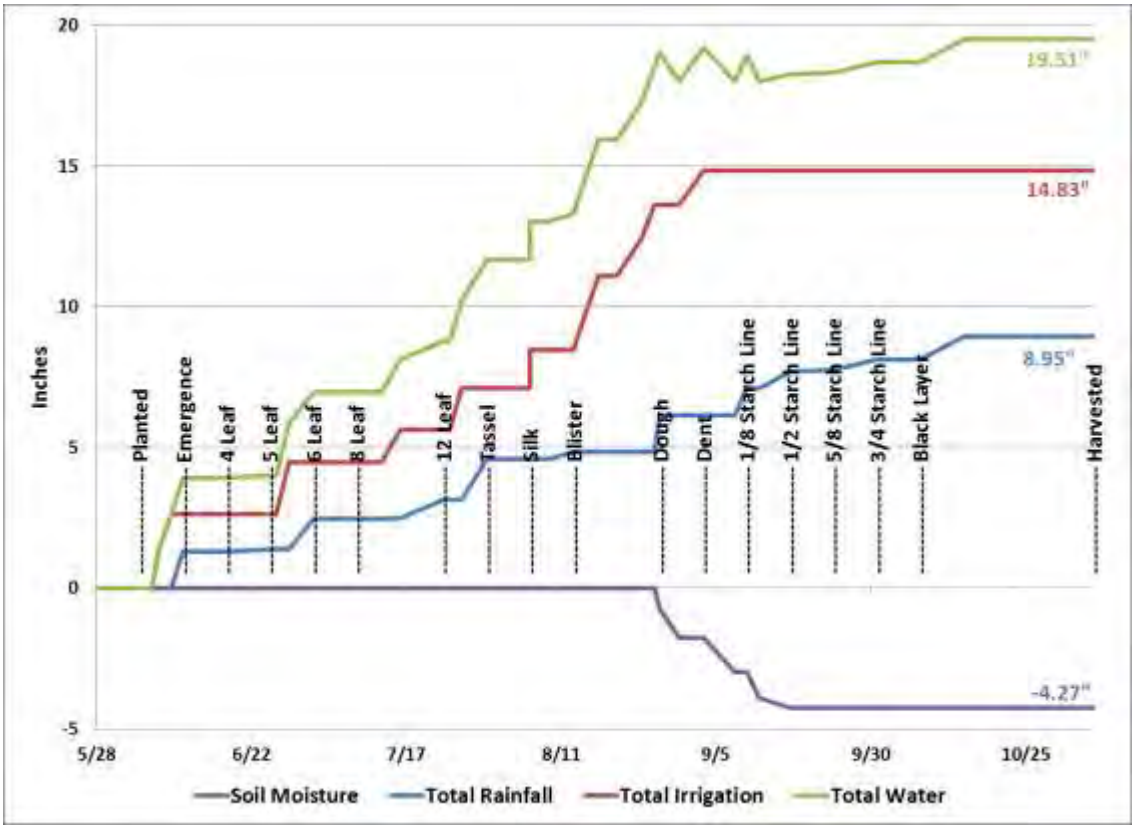


Table 23: Demonstration Field Data for Joe Reinart's "200-12" Demonstration Field

Date mm/dd	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				
3/31			39.04		96.4	87.4	52.1	28.2	48.0		293 N		Paul & Kari
4/4			39.04		83.8	41.2	No Blocks				294 N		Kari
4/10			39.04		0.0	6.0	No Blocks				295 N		Kari
4/16			39.04		44.2	21.0	23.3	29.3	58.4		294 N		Kari
4/24			39.04		15.0	0.0	0.0	10.3	59.9		295 N		Kari
4/30			39.04		5.3	0.0	0.0	5.8	58.6		293 N		Kari
5/7			39.04		3.5	0.0	0.0	7.6	57.4		314 N		Kari
5/14			41.32		0.0	0.0	0.0	11.6	57.2		1 N		Kari
5/21			41.74		0.0	0.0	0.0	13.4	56.6		120 N		Kari
5/28	1.61		blank		0.0	0.0	0.0	19.8	56.1		120 N		Kari
6/4										Plant			Joe
6/4			blank		1.8	0.0	0.0	30.7	56.3		130 N		Kari & David
6/5			Pivotrac							200-12	130 Y		start ccw
6/6												380	Sherry
6/7		1.30	Pivotrac							Reverse	341	380	Leon
6/9		1.32	Pivotrac							200-12	128 Y	380	Leon
6/11	1.29		blank	Emergence	97.4	0.0	0.0	33.7	56.7		129 N		Kari & David
6/14			replaced										Pivotrac
6/18	0.01		0	4 Leaf	98.0	0.0	75.2	33.8	56.2		130 N		Kari & David
6/25	0.08		0	5 Leaf	96.6	94.9	79.9	36.1	57.2		130 N		Paul
6/26			Pivotrac							200-12	130 Y ccw	380	Leon
6/27		0.92	Pivotrac							Reverse	343 Y	380	Leon
6/28		0.94	Pivotrac	5 Leaf						Stop	129 N	380	Leon
7/2	1.09		4.36	6 Leaf	92.6	92.2	76.4	36.2	57.6		128 N		Paul
7/9			4.36	8 Leaf	77.3	86.0	47.6	36.1	57.6		128 N		Paul
7/12			Pivotrac	9 Leaf						Start ccw	128 Y ccw	408	Edwin
7/13			Pivotrac	10 Leaf						Stop	341	380	Leon
7/16	0.02	1.16	7.03	10 Leaf	15.0	38.8	0.0	36.7	58.2		342 N		Paul
7/23	0.65		7.03	12 Leaf	0.0	11.1	0.0	35.2	57.6		341 N		Paul
7/24			Pivotrac	12 Leaf						Start cw	341 Y		Leon
7/26		1.45	10.36	12 Leaf						Stop	129 N		Leon
7/30	1.43		10.36	Tassel	0.0	0.0	0.0	34.3	57.2		127 N		Paul
8/4			Pivotrac							Start ccw	129 Y		Leon
8/6			Pivotrac	Silk						Stop	341 N		Leon
8/6		1.36	13.49	Silk	0.0	0.0	0.0	37.4	56.0		341 N		Paul
8/6			13.52							Cotton	341 Y	414	Edwin
8/9			18.15							Cotton	343 Y	384	Edwin
8/13	0.28		18.17	Blister	0.0	0.0	0.0	32.3	55.9		343 N		Paul
8/13				Blister	0.0	0.0	0.0	30.6	55.2		343 N		Leon
8/13			Pivotrac							Start cw	343 Y		Leon

Date mm/dd	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				
8/15		1.33	Pivotrac							Reverse	129 Y		Leon
8/17		1.31	Pivotrac							Split	343 Y		Leon
8/20			24.44		0.0	0.0	16.2	31.3	55.3		360 N		Jerry
8/24		1.33	Pivotrac							Reverse	126 Y		Leon
8/26		1.21	30.06								344 Y	368	Edwin
8/27	1.29		30.07	Dough	29.0	0.0	0.0	30.6	54.5		342 N		Paul
9/3		1.20	32.82	Dent	96.9	36.7	0.0	29.8	54.4		129 N		Paul
9/10	0.95		32.82	1/8 ml	97.6	0.0	44.7	29.6	54.3		129 N		Paul
9/17	0.62		32.82	1/2 ml	97.8	83.3	88.3	87.2	27.2		129 N		Paul
9/24	0.05		32.82	5/8 ml	96.8	84.8	89.3	86.9	52.6		128 N		Paul
10/1	0.37		32.82	3/4 ml	95.6	86.6	84.8	32.3	52.6		129 N		Paul
10/8			32.82	Black Layer	94.1	80.9	82.4	29.9	51.3		129 N		Paul
10/15	0.82		32.82	Black Layer	93.7	78.7	79.9	24.8	50.8		121 N		Paul
10/22			32.82	Black Layer	95.2	79.6	79.9	24.1	48.7		120 N		Paul
10/29			32.82	Black Layer	95.8	80.3	80.6	23.3	48.2		120 N		Paul
11/5			32.82	Harvested	94.7	79.9	80.0	19.3	46.2		151 N		Paul
Total	**8.95**	**14.83**			**-1.80"**	**-1.30"**	**-1.30"**	**0.00"**	**0.13"**				
Net Soil Moisture is -4.27"													
Irrigation, Rainfall Plus Net Soil Moisture is 19.51"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

200-12

Year: *2014* **County:** *Sherman* **Grower:** *Joe Rienart*

No. Acres: *27* **Variety/Hyb:** *CH198-00* **Soil Type:** *Sunray Clay Loam*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *103-48-0-10.3s-1.03zn* **Seeding:** *32,000*

Planted: *June 4, 2014* **Harvest:** *October 29, 2014*

Herbicide: *Atrazine, DicambaHD, Metolachor, Glyphosate* **Insecticide:** *none*

Yield: *177 bu/ac* **Prev. crop:** *Cotton* **Row width:** *30 Inch*

Irrigation method: *Center Pivot* **Prewater:** *None* **Well GPM:** *3.0*

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

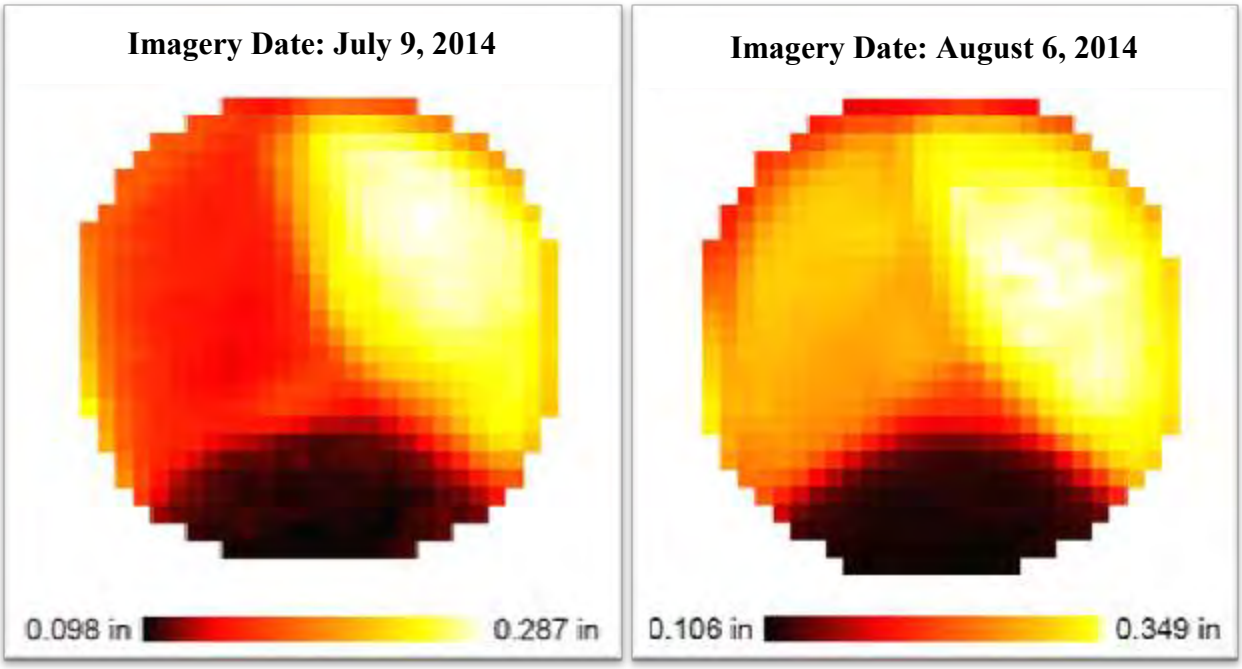
Application pattern: *Spray* **Crop row direction :** *Straight*

GPS Location of Pivot Pad
Latitude: *36.310763*
Longitude: *-102.148887*

GPS Location of Gypsum Blocks
Latitude: *36.31165*
Longitude: *-102.14624*

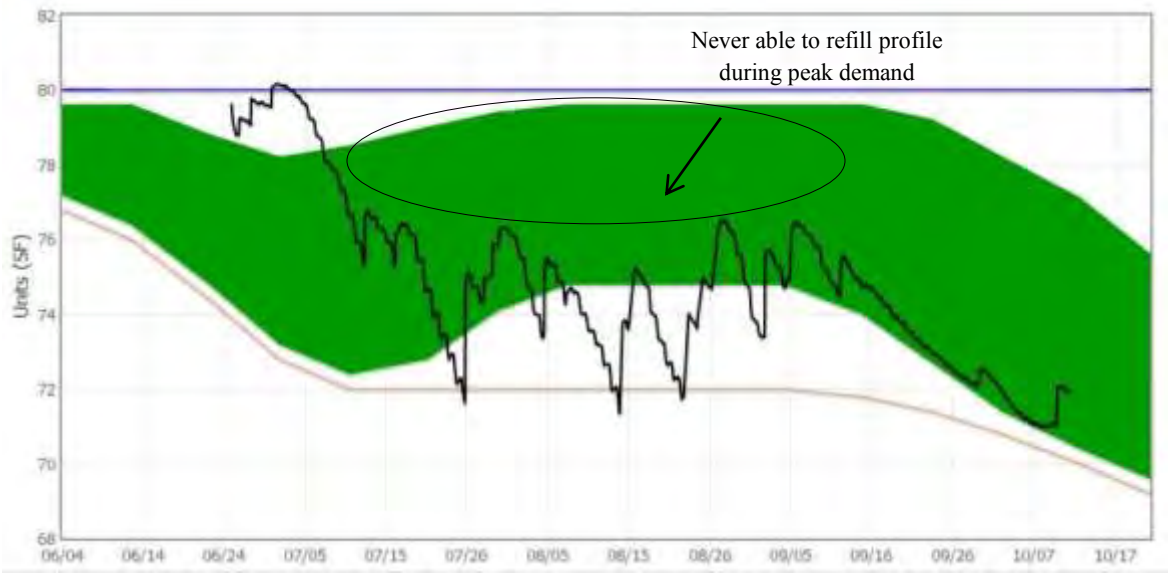
Satellite Imagery: Satellite imagery was initiated and used in 2013 to learn and evaluate its potential for an irrigation and water management tool for growers in connection with HydroBio. The use of satellite imagery was continued for the 2014 growing season. Joe Reinart‟s “200-12” field was one of eighteen “200-12” project fields included in 2014. His corn field was from 343 to 131 degrees in the circle. Cotton was grown in the west half of the circle. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Joe Reinart‟s “200-12” field are shown in figure 27 to illustrate examples of what is displayed on the website. The first image was on July 9 at the 8 leaf stage. The second image is on August 6 at the silk stage. The satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 177 bushels per acre following cotton with 14.83 inches of irrigation.

Figure 27: Daily Water Use for Joe Reinart's “200-12” Demonstration Field



Note: Each Square Represents 1/8 of an Acre

Joe Reinart's "200-12" Field AquaSpy® Probe Summary



This field seemed to dry out early and was never able to be wet back up. It is a classic case of "getting behind" with a low capacity irrigation well and not having the flow rate to get adequate infiltration into the soil during peak season. It appears that the irrigation system was run very slowly in order to put on larger volumes for deeper penetration, but the system was only capable of getting irrigation to penetrate 16"-20". The site had a very large and aggressive root system, with roots penetrating to 56" by the end of June, but the subsoil dried out early and remained that way for the rest of the season. The crop really went chasing moisture as demand picked up in late July and perhaps an irrigation a couple of days earlier might have paid dividends.

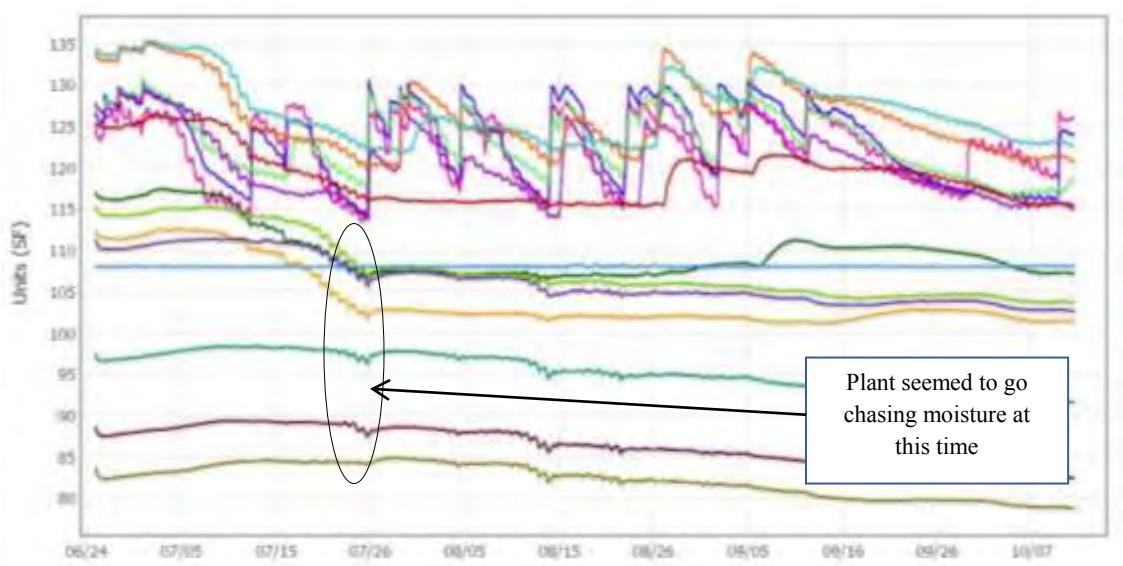


Figure 28: Gypsum Block Readings for Joe Reinart's Control Demonstration Field (255 bu/ac)

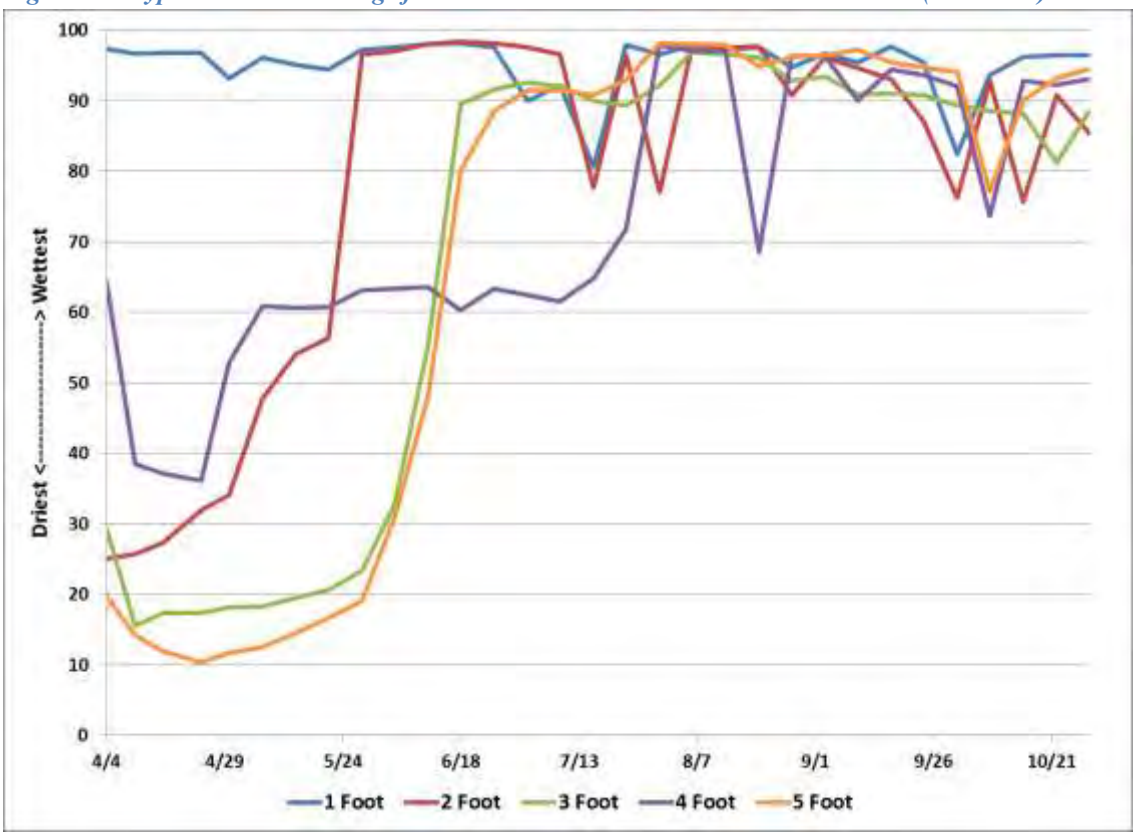


Figure 29: Growing Season Water Tracking for Joe Reinart's Control Demonstration Field (255 bu/ac)

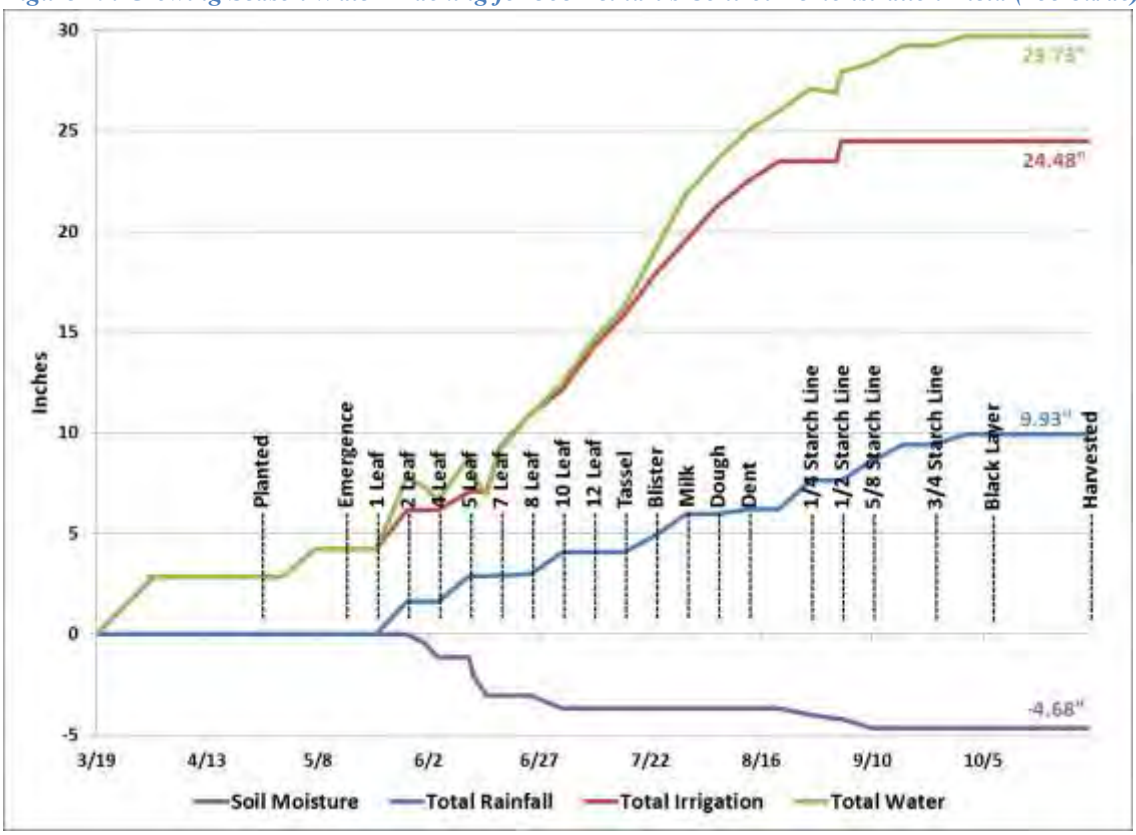


Table 24: Demonstration Field Data for Joe Reinart's Control Demonstration Field

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				
3/19										Prewater			Leon
4/1		2.85	232 Hrs							Prewater		415	Leon
3/31			888852							Prewater	? Y	415	Paul & Kari
4/4			895988		97.4	25.1	29.3	64.3	19.7		3N		Kari
4/10			895988		96.7	25.7	15.6	38.5	14.2		4 N		Kari
4/16			895988		96.8	27.3	17.4	37.2	12.0		4 N		Kari
4/24			895988		96.8	31.9	17.4	36.1	10.4		17 N		Kari
4/25										Planted			Joe
4/30			910080		93.2	34.1	18.2	52.9	11.7		115 Y	425	Kari
5/7		1.39	924388		96.1	47.8	18.3	60.9	12.5	Control	300 N		Kari
5/14			933862	Emergence	95.1	54.1	19.5	60.7	14.6		281 N		Kari
5/21			961475	1 Leaf	94.4	56.3	20.7	60.8	16.7	Control	125 Y	438	Kari
5/28	1.61	1.93	963759	2 Leaf	97.3	96.6	23.4	63.1	19.1		62 N		Kari
6/4			973854	4 Leaf	97.6	97.0	32.7	63.4	30.9	Control	206 Y	395	Kari & David
6/11	1.29	0.90	982097	5 Leaf	98.0	98.0	55.2	63.6	48.0		30 N		Kari & David
6/18	0.01	2.23	1027550	7 Leaf	98.2	98.4	89.6	60.3	80.1	Control	333 Y	407	Kari & David
6/25	0.08	1.67	1061490	8 Leaf	97.6	98.1	91.6	63.4	88.6	Control	25 Y	429	Paul
7/2	1.06	1.17	1085340	10 Leaf	90.0	97.6	92.6	62.4	91.5	Control	144 Y	420	Paul
7/9		2.09	1127942	12 Leaf	92.2	96.6	92.1	61.6	91.5	Control	59 Y	451	Paul
7/16	0.02	1.63	1161210	Tassel	80.6	77.7	90.0	64.8	90.8	Control	72 Y	435	Paul
7/23	0.82	2.02	1202341	Blister	97.9	96.5	89.3	71.8	93.0	Control	15 Y	458	Paul
7/30	1.09	1.69	1236780	Milk	96.6	77.0	92.2	97.9	98.1	Control	22 Y	444	Paul
8/6		1.70	1271492	Dough	97.9	97.8	96.9	97.0	98.0	Control	214 Y	429	Paul
8/13	0.22	1.25	1296928	Dent	97.3	97.6	96.6	97.0	97.9	Control	242 Y	438	Paul
8/20		0.96	1316448	Dent	97.6	97.7	96.1	68.6	94.9	Control	350 Y	392	Jerry
8/27	1.42		1336498	1/4 ml	94.8	90.8	92.8	96.4	96.2	Control	9 Y	429	Paul
9/3		1.00	1336937	1/2 ml	96.7	96.1	93.4	96.3	96.5		313 N		Paul
9/10	1.00		1336938	5/8 ml	95.5	94.6	90.9	90.0	97.3		314 N		Paul
9/17	0.80		1336938	3/4 ml	97.7	93.1	91.0	94.4	95.5		316 N		Paul
9/24			1336938	7/8 ml	95.5	87.1	90.8	93.6	94.8		313 N		Paul
10/1	0.51		1336938	Black Layer	82.5	76.2	89.4	92.1	94.1		314 N		Paul
10/8			1336938	Black Layer	93.6	92.9	88.6	73.6	77.1		314 N		Paul
10/15			1336938	1/2 Harvest	96.2	75.7	88.2	92.8	90.1		314 N		Paul
10/22	0.01		1336938	1/2 Harvest	96.5	90.8	81.2	92.3	93.2		314 N		Paul
10/29			1336938	Harvested	96.5	85.4	88.6	93.1	94.5		314 N		Paul
Total	**9.93**	**24.48**			**0.00"**	**-0.79"**	**-1.15"**	**-1.1"**	**-1.64"**				
Net Soil Moisture is -4.68"													
Irrigation, Rainfall Plus Net Soil Moisture is 29.73"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

Control

Year: *2014* **County:** *Sherman* **Grower:** *Joe Rienart*

No. Acres: *75* **Variety/Hyb:** *Ch217-08* **Soil Type:** *Sunray Clay Loam*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *195-41-0-10.3s-1.03zn* **Seeding:** *32,000*

Planted: *April 25, 2014* **Harvest:** *October 9, 2014*

Herbicide: *Atrazine, Balance Flex, Dicamba HD, Comet, LV-6* **Insecticide** *None*

Yield: *255 Bu/Acre* **Prev. crop:** *Wheat* **Row width:** *30 inch*

Irrigation method: *Center Pivot* **Prewater:** *2.85 in.* **Well GPM:** *3.0*

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

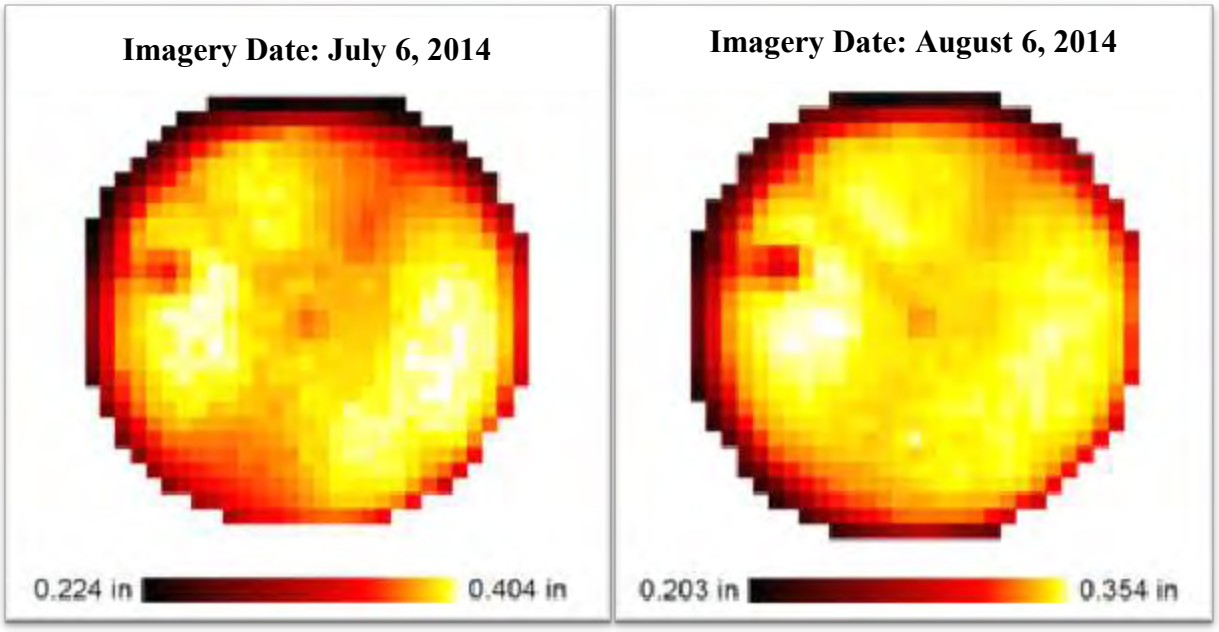
Application pattern: *Spray* **Crop row direction :** *Straight*

GPS Location of Pivot Pad
Latitude: *36.301726*
Longitude: *-102.148136*

GPS Location of Gypsum Blocks
Latitude: *36.303795*
Longitude: *-102.146485*

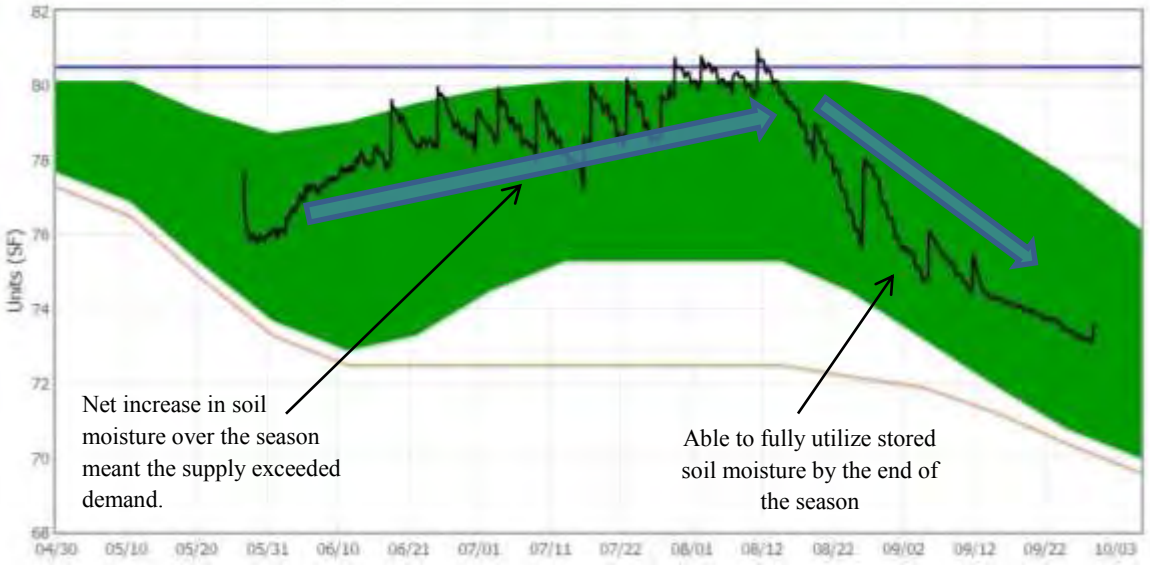
Satellite Imagery: Joe Reinart‟s “control” field was one of eighteen “200-12” project fields included in satellite imagery in 2014. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Joe Reinart‟s “control” field in figure 30 illustrate examples of what is displayed on the website. The first image is on July 6 at the 10 leaf growth stage. The second image is on August 6 at the dough stage. Satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 255 bushels per acre with 24.48 inches of irrigation.

Figure 30: Daily Water Use for Joe Reinart's Control Demonstration Field

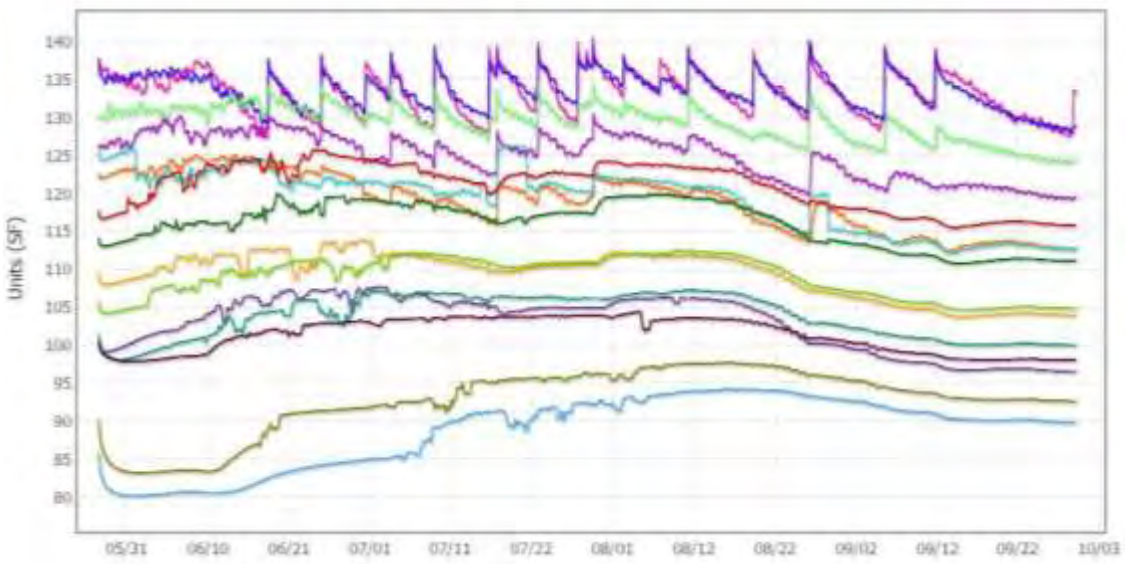


Note: Each Square Represents 1/8 of an Acre

Joe Reinart's Control Field AquaSpy® Probe Summary



This site began with dry subsoil but this was able to be wet up through the course of the season and a very deep root system (to 60") was then able to utilize all the stored soil moisture by the end of the season. Unlike the "200-12" site, which was deficit irrigated early, irrigation on this field was able to keep up with or exceed plant demand. This resulted in the very good yield result and was probably helped to a large degree by the almost 10" of rainfall experienced at this site. There was no evidence of drainage, despite the deep percolation of moisture and this helped make all the moisture available for crop growth. Unfortunately the noisy soil moisture probe data makes it difficult to fully view the sub-soil wetting up, but I suspect that it was largely due to rainfall.



Harvest Results: The "200-12" field produced a 177 bushel per acre corn yield. Irrigation totaled 14.83 inches. No pre-water was applied. Production in the "control" field was 255 bushels per acre, where seasonal irrigation was 21.63, pre-water 2.85 inches to establish a total of 24.48 inches. In comparison, the "control" field produced 78 more bushels per acre than the "200-12" with 9.65 additional inches of irrigation. Corn production was 11.93 bushels (668lbs) per inch of irrigation in the "200-12" field compared to 10.41 bushels (583lbs) in the "control". Production from each inch of irrigation, rainfall and net soil water that totaled 19.51 inches for the "200-12" field was 9.07 bushels (508lbs) per inch. Irrigation, rainfall and net soil water totaled 29.73 inches in the "control" field where production was 8.58 bushels (480lbs) per inch. Crop production costs were $175.09 per acre more for the "control" field than for the "200-12" from increased fertilizer, irrigation and harvest expenses. Net gain for the "200-12" field was $312.43 per acre compared to $487.52 for the "control". At $4.00 per bushel, gross value for the additional 78 bushel per acre corn yield amounts to $312.00 more per acre. The "control" field"s net gain was $175.09 per acre with 9.65 inches more irrigation used compared to production from the "200-12" field. Net return per inch of irrigation was $21.06 from the "200-12" field compared to $19.91 from the "control". Net return from the additional 9.65 inches of irrigation applied on the "control" field is $18.14 per acre inch compared to $21.06 per inch for the "200-12" field. Reinart stated, "I think stalk issues in the „200-12" field cost us a few bushels per acre. Where we had Ch198-00 in other fields, different hybrids were out-yielding Ch198-00 by about 10 bushels per acre." He added, "…still a good outcome for a year that started so poorly, especially following cotton. Again in 2014, we had this same practice on lots of other circles with similar or maybe better results. Splitting planting dates for better use of available water has become a must on our farm. We will continue to plant early and late corn using the strategies learned from the "200-12" project". A summary of the demonstration results for Reinart are shown in table 25.

Table 25: Joe Reinart's 2014 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $4.00/bu		
			bu/ac	lb/ac-in Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"200-12"	14.83	*19.51	177	668	$708.00	$47.74	$36.28
Control	24.48	†29.73	255	583	$1,020.00	$41.66	$34.31

*Includes -4.27 inches of water added to five feet of soil, plus rainfall, and irrigation.
†Includes -4.68 inches of water added to five feet of soil, plus rainfall, and irrigation.

Brent Clark's 2014 Moore County Demonstration

Planting and Crop Information: For his demonstration, Brent Clark strip tilled and planted 61 acres of corn in the east half circle of the northeast quarter of section 206, for his "200-12" field, "Clark 200-12". Clark planted the field with Channel Ch214-14 at a seeding rate of 27,000 seeds per acre. Clark planted 61 acres, also strip tilled, in the west half circle of the northeast quarter of section 206 to Ch214-14 at 27,000 seeds per acre for his "control" field, "Clark Control". Both the "200-12" and "control" fields were irrigated using the same center pivot. Seasonal water meter readings averaged 575 gpm. An average of 1.20 inches of irrigation was delivered to the circle in a 4.8 day revolution. The "200-12" field was from 18 to 198 degrees in the circle. The "control" was from 198 to 18 degrees. The previous crop was corn in both fields. Planting and crop information for "Clark 200-12" and "Clark Control" are shown in table 26 below.

Table 26: Planting and Crop Information for Brent Clark

"200-12" Demonstration Field			
Planted:	*April 29*	**Harvested:**	*October 9*
Hybrid:	*CH214-14*	**Seeding Rate:**	*27,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*61*	**GPM Per Acre:**	*4.71*
Total Water:	*29.85 in.*	**Soil Type:**	*Dumas Loam*
Fertilizer:	*170-47-0*	**Insecticide:**	*Comite*
Herbicide:	*Roundup, Halex GT*		
Control Demonstration Field			
Planted:	*April 29*	**Harvested:**	*October 10*
Hybrid:	*CH214-14*	**Seeding Rate:**	*27,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*61*	**GPM Per Acre:**	*4.71*
Total Water:	*28.08 in.*	**Soil Type:**	*Dumas Loam*
Fertilizer:	*200-47-0*	**Insecticide:**	*Comite*
Herbicide:	*Roundup, Halex GT*		

Beginning Soil Water Profile and Growing Season Rainfall

"200-12" Demonstration Field: Preseason soil water was good at 1, 2, 3, 4 and 5 feet prior to planting. Gypsum block sensors were installed in early April to obtain advanced soil moisture levels. Early growing season irrigation provided good soil profile levels in May. Irrigations were applied to supplement timely rainfall of 1.5 to 2.0 inches in June, July and limited rainfall in August. The crop used most of the water stored at 1 foot, approximately 60 percent from 2 feet and 40 percent from 3 feet in July and early August during the tassel, pollination and early grain development growth stages. Irrigation was required to provide adequate soil water in August when rainfall totaled only 0.66 inches. 1.34 inches of rainfall in early to mid-September provided water to finish the crop, also to establishing a 0.19 inch net gain in soil water from planting until harvest. Generally, soil moisture was adequate during the growing season. Soil moisture sensor readings show limited root activity and water use at 4 and 5 feet in the root zone in late

September finishing the crop. Rainfall amounts were 3.12 inches in June, 2.63 in July and 1.34 in September which helped produce the crop. Total rainfall was 10.45 inches from planting until harvest. The crop was grown in Dumas loam soil that holds 1.85 inches of available water per foot for potential crop use.

Control Demonstration Field: Preseason soil water was good to five feet. Gypsum blocks were installed in early April to identify soil moisture levels prior to planting. Irrigations were applied between timely beneficial rainfall events to provide good soil water levels through-out the growing season. Rainfall totaled 2.70 inches in May, 3.12 in June, 2.63 in July and 1.34 in September to help produce a good corn yield. August rainfall totaled 0.66 inches from two events. Soil moisture sensors show the root zone was 1.38 inches wetter at harvest than at planting. Seasonal rainfall was 10.45 inches, which helped produce a good corn yield. Gypsum blocks were installed in Dumas loam that holds 1.85 inches of available water per foot for potential crop use. Seasonal rainfall for the "200-12" and "control" fields are shown in table 27.

Table 27: Monthly Rainfall Data for Brent Clark

	May	June	July	August	September	Total
"200-12"	2.70"	3.12"	2.63"	0.66"	1.34"	**10.45"**
Control	2.70"	3.12"	2.63"	0.66"	1.34"	**10.45"**

Growing Season Water Tracking: The district tracked crop total water throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. A 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 "200-12" field. Another set of the same type of sensors were installed in each "control" field. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in the field. Gypsum blocks were installed in the "200-12" and "control" fields prior to planting. Each AquaSpy® probe was installed following crop emergence. Installing and reading the gypsum blocks prior to planting provided advanced soil moisture conditions and information to help guide and manage irrigation. 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 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 "200-12" field are shown first, followed by the same illustrations for the "control" field.

Figure 31: Gypsum Block Readings for Brent Clark's "200-12" Demonstration Field (223 bu/ac)

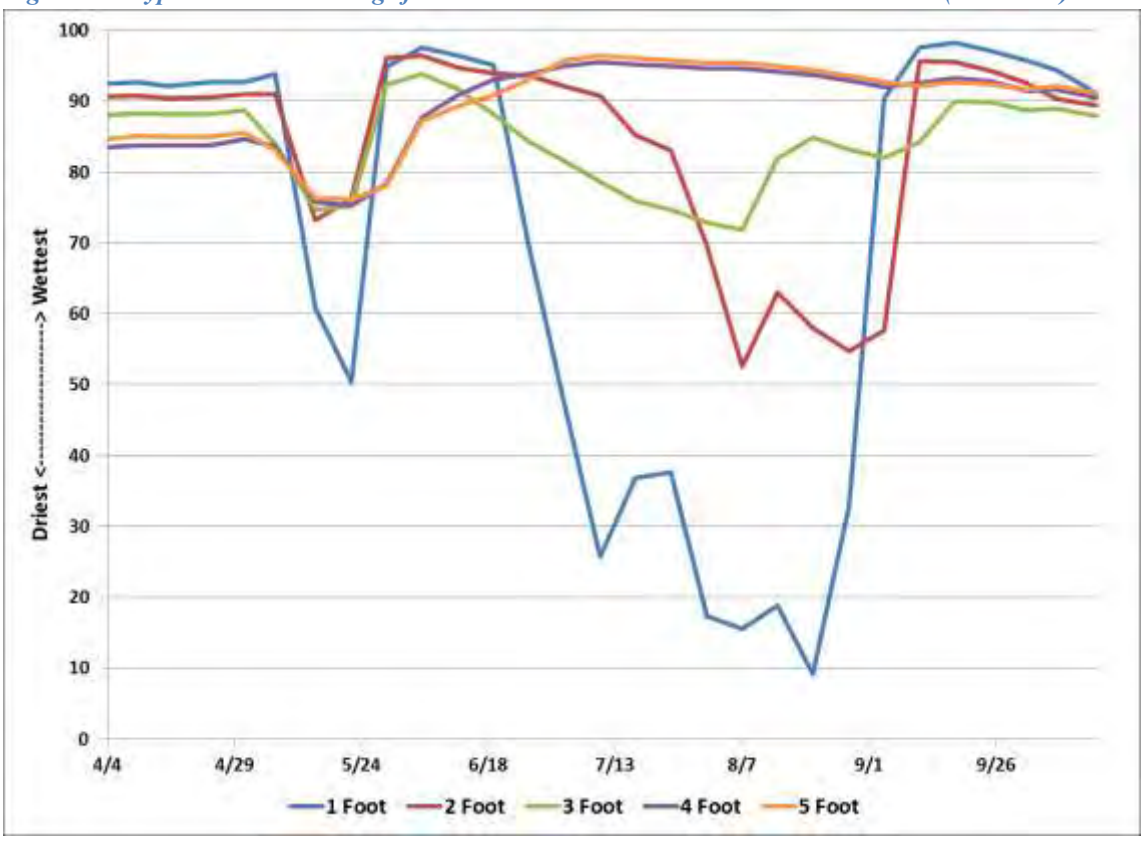


Figure 32: Growing Season Water Tracking for Brent Clark's "200-12" Demonstration Field (223 bu/ac)

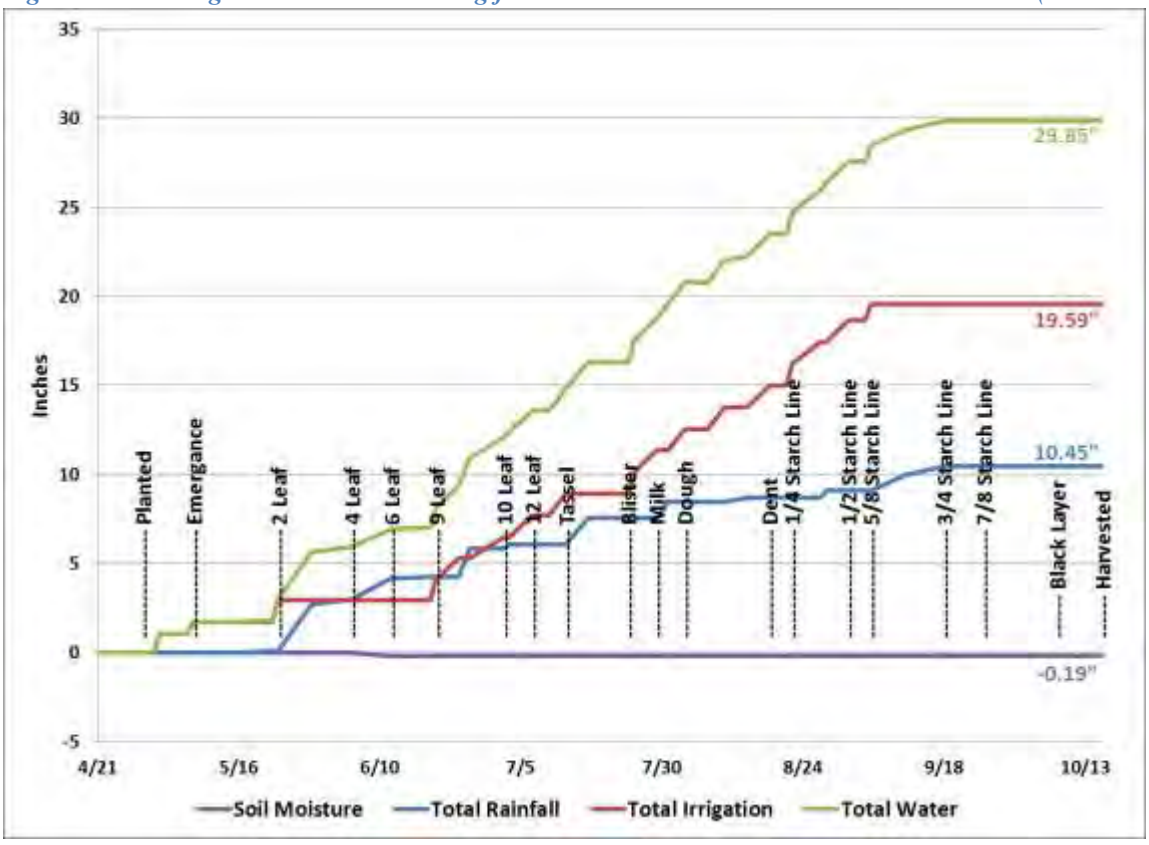


Table 28: Demonstration Field Data for Brent Clark's "200-12" Demonstration Field

Date mm/dd	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				
3/31			392.55								14 N		Kari & Paul
4/4			392.55		92.5	90.7	88.1	83.5	84.7		14 N		Kari
4/10	0.15		392.57		92.7	90.8	88.3	83.8	85.1		14 N		Kari
4/16			392.58		92.2	90.4	88.2	83.8	85.0		14 N		Kari
4/24	0.01		392.58		92.7	90.6	88.2	83.8	85.0		13 N		Kari
4/29										Plant			Leon
5/1			394.82		92.7	91.0	88.8	84.7	85.6	200-12	83 Y	589	Kari
5/2		1.03	Pivotrac							200-12	198 Y	590	Leon
5/7			403.04		93.8	91.0	84.0	83.6	83.1	200-12	34 Y	635	Kari
5/8		0.70	Pivotrac	Emergence						200-12	198 Y	635	Leon
5/15			410.56	Emergence	60.9	73.2	74.7	75.8	76.4		50 N		Kari
5/22	0.10		416.14	1 Leaf	50.4	76.3	75.3	75.3	76.2	200-12	188 Y	572	Kari
5/22		1.22	Pivotrac	2 Leaf						200-12	198 Y	575	Leon
5/29	2.60		423.73	2 Leaf	94.9	96.1	92.4	78.4	78.1		20 N		Kari
6/5	0.27		423.77	4 Leaf	97.6	96.5	93.8	87.7	87.3		4 N		Kari
6/12	1.20		423.77	6 Leaf	96.5	94.7	91.7	90.9	89.3		359 N		Kari & David
6/19	0.07		429.58	7 Leaf	95.1	94.0	88.2	93.0	90.9	200-12	160 Y	575	Kari & David
6/19		1.17	Pivotrac	9 Leaf						200-12	198 Y	575	Leon
6/24		1.17	Piv0trac							200-12	198 Y	575	Leon
6/26	1.58		444.67	9 Leaf	69.6	93.6	84.3	93.9	93.0		259 N		Paul
7/2		1.17	Pivotrac	10 Leaf						200-12	198 Y	575	Leon
7/3	0.26		456.41	10 Leaf	47.5	92.2	81.6	95.0	95.8	Control	277 Y	533	Paul
7/7		1.25	Pivotrac	12 Leaf						200-12	198 Y	575	Leon
7/10			471.43	12 Leaf	25.8	90.8	78.7	95.5	96.4		28 N		Paul
7/13		1.20	Pivtrac	Tassel						200-12	198 Y	575	Leon
7/17	1.49		485.99	Tassel	36.9	85.2	75.9	95.2	96.1		112 N	98 ?	Paul
7/21			486.65										Pivotrac
7/24	0.01		489.22	Blister	37.6	83.1	74.7	95.0	95.8	200-12	186 Y	580	Paul
7/24		1.22	Pivotrac	Blister						200-12	198 Y	575	Leon
7/29		1.23	Pivotrac	Milk						200-12	198 Y	575	Leon
7/31	0.87		507.47	Milk	17.4	69.6	72.9	94.6	95.4	Control	339 Y	586	Paul
8/3		1.20	Pivotrac	Dough						200-12	198	575	Leon
8/7			521.35	Dough	15.6	52.6	71.9	94.6	95.4		7 N		Paul
8/10		1.20	Pivotrac	hd Dough						200-12	198 Y		Leon
8/14	0.24		534.69	hd Dough	18.8	63.0	81.9	94.2	95.0		20 N		Paul
8/18		1.25	Pivotrac	Dent						200-12	198 Y	575	Leon
8/21			549.24	Dent	9.2	58.0	84.9	93.7	94.4	200-12	22 Y	580	Jerry
8/22		1.21	Pivotrac	1/4 ml						200-12	198 Y	575	Leon
8/27		1.23	Pivotrac	1/4 ml						200-12	198 Y	575	Leon
8/28	0.42		566.8	1/4 ml	32.8	54.7	83.2	92.9	93.6	200-12	163 Y	560	Paul
9/1		1.21	Pivotrac	1/2 ml						200-12	198 Y	575	Leon

Date mm/dd	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			584.26	1/2 ml	90.4	57.7	82.1	92.0	92.7	Control	350 Y	574	Paul
9/5		0.93	Pivotrac	5/8 ml						200-12	198 Y	575	Leon
9/11	0.85		587.75	5/8 ml	97.6	95.7	84.2	92.6	92.1		201 N		Paul
9/18	0.49		587.75	3/4 ml	98.3	95.6	90.0	93.3	92.7		201 N		Paul
9/25			587.75	7/8 ml	97.1	94.3	89.9	92.8	92.4		201 N		Paul
10/2	0.01		587.75	7/8 ml	95.8	92.6	88.7	91.5	91.7		201 N		Paul
10/8			587.75	Black Layer	94.4	90.3	89.0	91.7	92.2		202 N		Paul
10/16	0.60		587.75	Harvested	91.0	89.4	88.0	90.5	91.1		190 N		Paul
Total	**10.45**	**19.59**			**0.05"**	**0.05"**	**0.00"**	**-0.15"**	**-0.14"**				
Net Soil Moisture is -0.19"													
Irrigation, Rainfall Plus Net Soil Moisture is 29.85"													

• Numbers in red are not counted in the total

NORTH PLAINS GROUNDWATER Conservation District

2014-Corn Demonstration
Irrigated Medium Season Corn

200-12

Year: *2014* **County:** *Hartley* **Grower:** *Brent Clark*

No. Acres: *61* **Variety/Hyb:** *CH214-14* **Soil Type:** *Dumas Loam*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *170-47-0* **Seeding:** *27,000*

Planted: *April 29, 2014* **Harvest:** *October 9, 2014*

Herbicide: *Roundup, Halex GT* **Insecticide:** *Comite*

Yield: *223 bu/ac* **Prev. crop:** *Corn* **Row width:** *30 Inch*

Irrigation method: *Center Pivot* **Prewater:** *None* **GPM/acre** *4.71*

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

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

GPS Location of Pivot Pad

Latitude: *35.833831*

Longitude: *-102.16263*

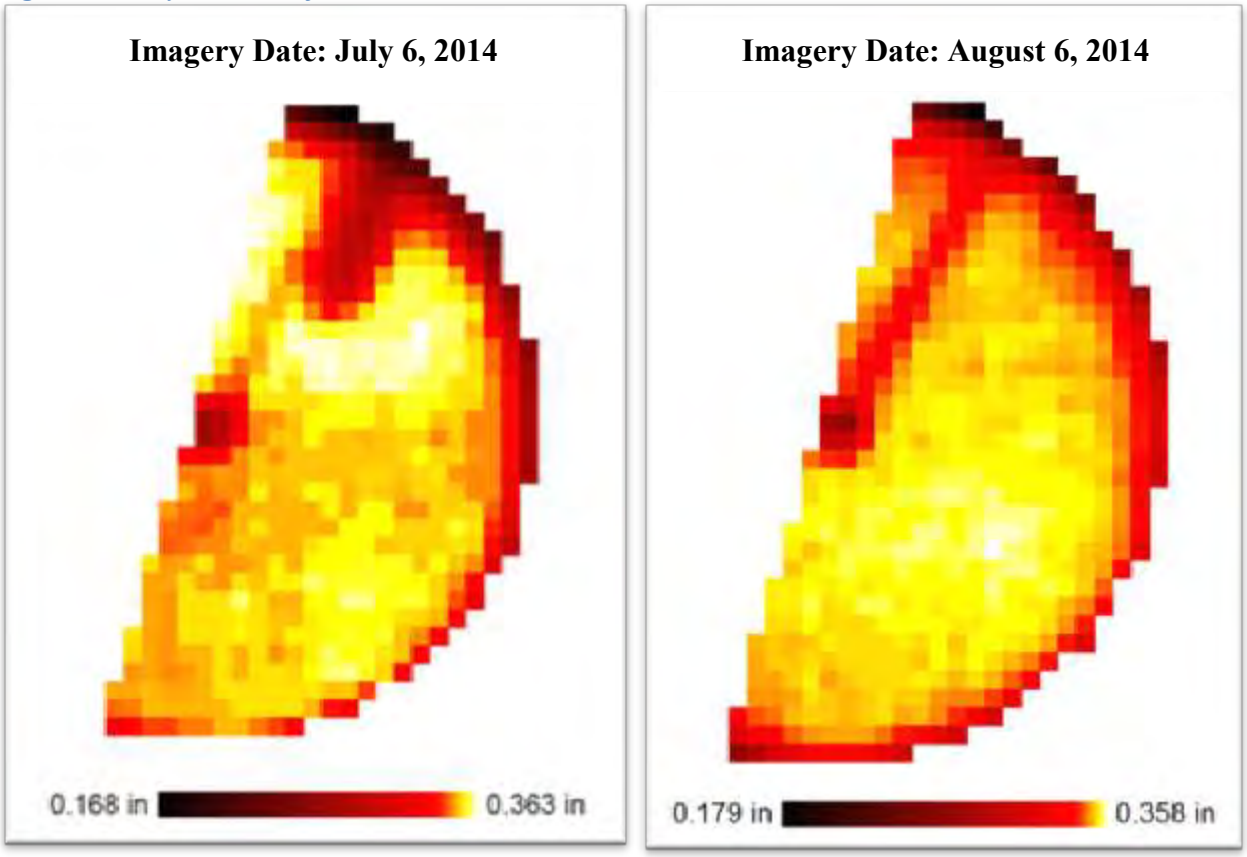
GPS Location of Gypsum Blocks

Latitude: *35.83641*

Longitude: *-102.16174*

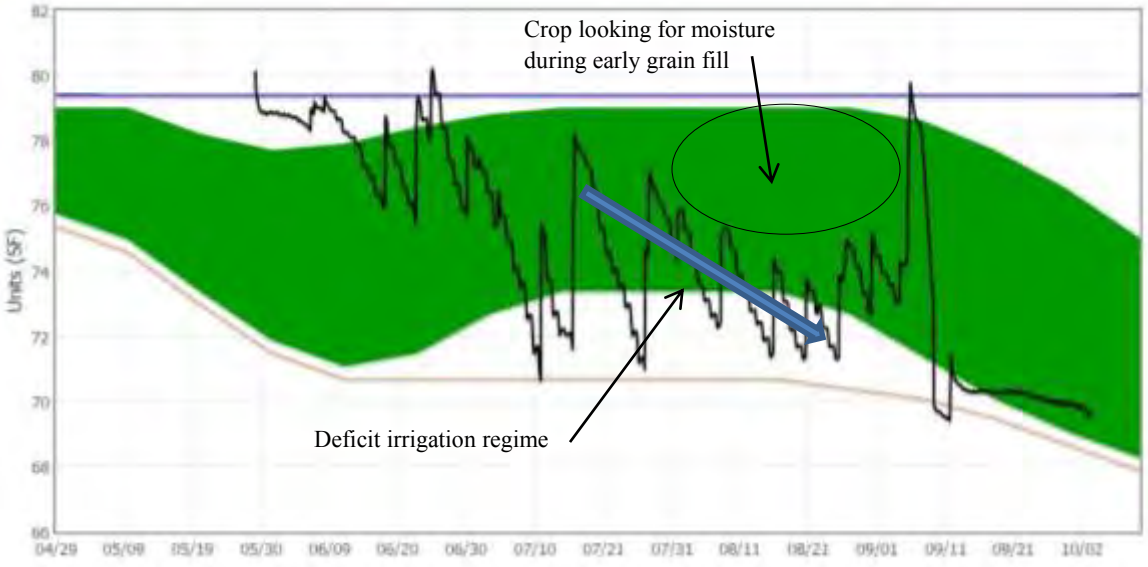
Satellite Imagery: Satellite imagery was initiated and used in 2013 to learn and evaluate its potential for an irrigation and water management tool for growers in connection with HydroBio. The use of satellite imagery was continued for the 2014 growing season. Brent Clark's "200-12" field was one of eighteen "200-12" project fields included in 2014. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Brent Clark's "200-12" field are shown in figure 33 to illustrate examples of what is displayed on the website. The first image was on July 6 at the 12 leaf stage. The second image is on August 6 at the dough stage. The satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 223 bushels per acre with 19.59 inches of irrigation.

Figure 33: Daily Water Use for Brent Clark's ""200-12"" Demonstration Field



Note: Each Square Represents 1/8 of an Acre

Brent Clark's "200-12" Field AquaSpy® Probe Summary



This crop showed good early deep root development which was aided by a good soil moisture profile that allowed the roots to chase moisture. Roots were evident at 60" and they grew quickly to 56". Irrigation was generally not able to penetrate much beyond 12" and as such, the sub-soil dried out and was not replenished until rain late in the season. Rains in the middle and the end of June were timely and these were effective in wetting the subsoil to 24". There were no wetting events that were able to replenish the soil below 24". No drainage was evident.

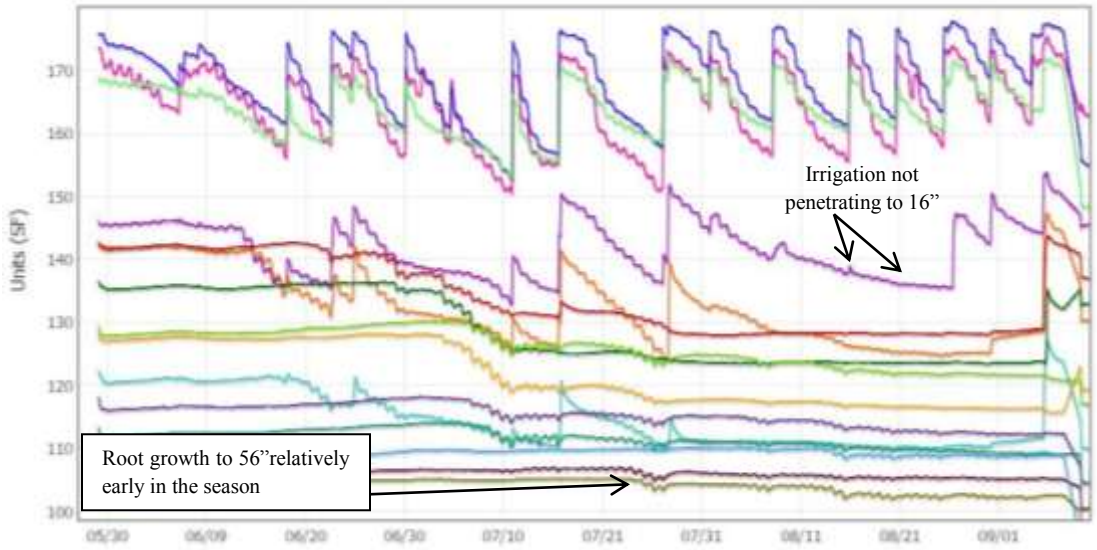


Figure 34: Gypsum Block Readings for Brent Clark's Control Demonstration Field (227 bu/ac)

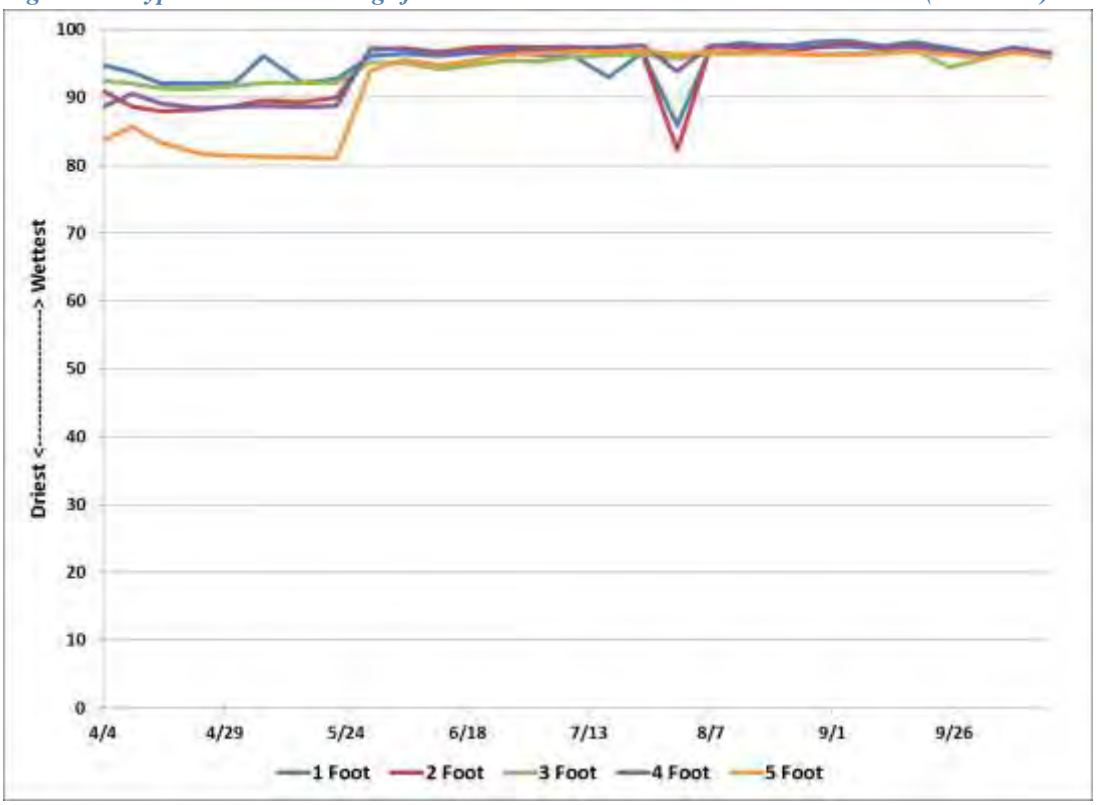


Figure 35: Growing Season Water Tracking for Brent Clark's "control" Demonstration Field (227 bu/ac)

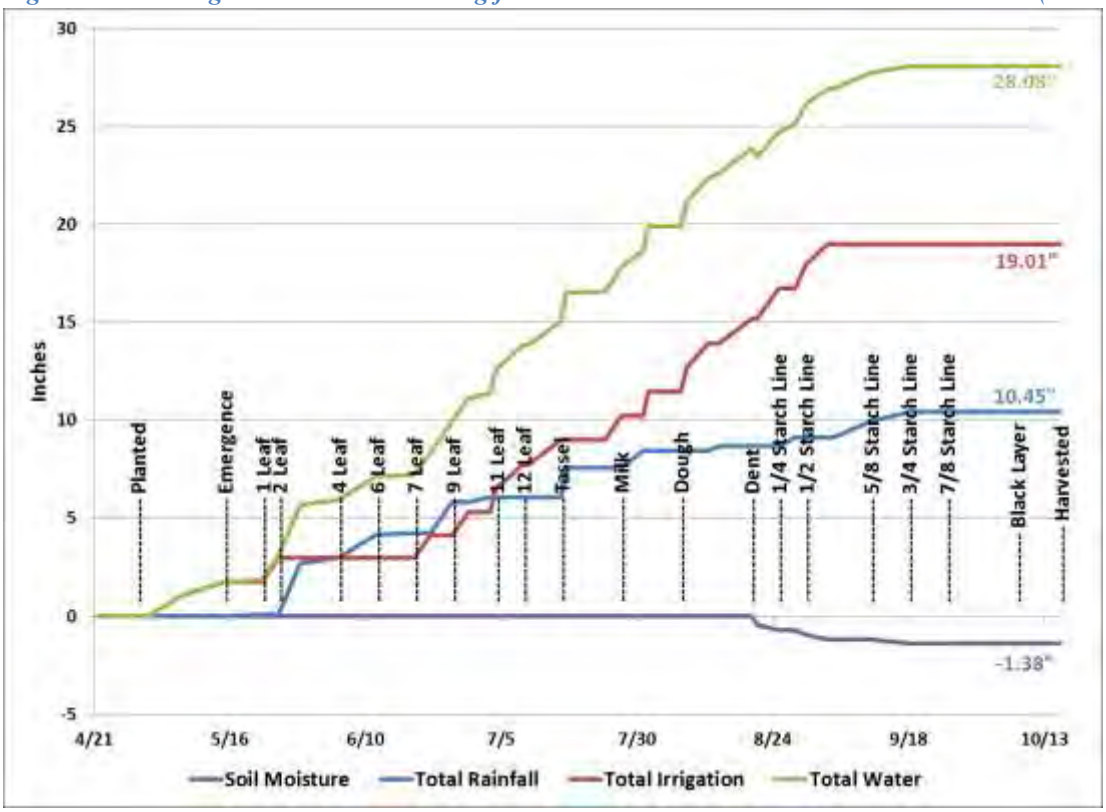


Table 29: Demonstration Field Data for Brent Clark's Control Demonstration Field

Date mm/dd	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				
3/31			392.55								14 N		Kari & Paul
4/4			392.55		94.8	91.0	92.5	88.6	83.6		14 N		Kari
4/10	0.15		392.57		93.7	88.6	92.0	90.6	85.7		14 N		Kari
4/16			392.58		92.0	87.9	91.3	89.1	83.3		14 N		Kari
4/24	0.01		392.58		92.0	88.2	91.2	88.4	81.7		13 N		Kari
4/29										Plant			Leon
5/1			394.82		92.1	88.7	91.7	88.6	81.4	200-12	83 Y	589	Kari
5/7		1.03	403.04		96.1	89.5	92.2	88.8	81.3	200-12	34 Y	635	Kari
5/15		0.74	410.56	Emergence	92.1	89.3	92.1	88.6	81.1		50 N		Kari
5/22	0.10		416.14	1 Leaf	92.7	90.0	92.2	88.7	81.0	200-12	188 Y	572	Kari
5/25		1.21	Pivotrac	2 Leaf						Control	18 Y	575	Leon
5/29	2.60		423.73	2 Leaf	96.1	97.0	95.2	97.2	94.0		20 N		Kari
6/5	0.27		423.77	4 Leaf	96.5	97.2	95.1	97.1	95.5		4 N		Kari
6/12	1.20		423.77	6 Leaf	96.1	96.7	94.2	96.3	94.8		359 N		Kari & David
6/19	0.07		429.58	7 Leaf	96.6	97.4	94.7	96.8	95.4	200-12	160 Y	575	Kari & David
6/22		1.16	Pivotrac	8 Leaf						Control	18 Y	575	Leon
6/26	1.58		444.67	9 Leaf	96.7	97.5	95.4	97.2	96.3		259 N		Paul
6/29		1.18	Pivotrac	10 Leaf						Control	18 Y	575	Leon
7/3	0.26		456.41	10 Leaf	96.2	97.4	95.3	97.0	96.4	Control	277 Y	533	Paul
7/4		1.19	Pivotrac	11 Leaf						Control	18 Y	575	Leon
7/9		1.24	Pivotrac	12 Leaf						Control	18 Y	575	Leon
7/10			471.43	12 Leaf	96.0	97.5	96.0	97.4	96.8		28 N		Paul
7/16		1.24	Pivotrac	Tassel						Control	18 Y	575	Leon
7/17	1.49		485.99	Tassel	92.9	96.2	96.2	97.4	96.8		112 N		Paul
7/21			486.65										Pivotrac
7/24	0.01		489.22	Blister	96.7	96.5	96.3	97.7	96.9	200-12	186 Y	580	Paul
7/27		1.24	Pivotrac	Milk						Control	18 Y	575	Leon
7/31	0.87		507.47	Milk	85.9	82.3	95.7	93.9	96.3	Control	339 Y	586	Paul
7/31		1.25	Pivotrac	Milk						Control	18 Y	575	Leon
8/7			521.35	Dough	97.5	97.6	96.5	97.7	96.8		7 N		Paul
8/7		1.22	Pivotrac	Dough						Control	18 Y	575	Leon
8/12		1.23	Pivotrac	Dough						Control	18 Y	575	Leon
8/14	0.24		534.69	hd Dough	98.0	97.4	96.5	97.6	96.7		20 N		Paul
8/20		1.27	Pivotrac	Dent						Control	18 Y	575	Leon
8/21			549.24	Dent	97.4	96.6	96.5	97.7	96.6	200-12	22 Y	580	Jerry
8/25		1.54	Pivotrac	1/4 ml						Control	18 Y	575	Leon
8/28	0.42		566.8	1/4 ml	98.2	97.4	96.3	97.4	96.2	200-12	163 Y	560	Paul
8/30		1.25	Pivotrac	1/2 ml						Control	18 Y	575	Leon
9/3		1.02	Pivotrac	1/2 ml						Control	18 Y	575	Leon
9/4			584.26	1/2 ml	98.4	98.0	96.5	97.6	96.2	Control	350 Y	574	Paul
9/11	0.85		587.75	5/8 ml	97.6	97.3	96.6	97.3	96.5		201 N		Paul

Date mm/dd	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				
9/18	0.49		587.75	3/4 ml	98.2	97.8	97.0	97.6	96.8		201 N		Paul
9/25			587.75	7/8 ml	97.2	96.7	94.4	96.6	96.3		201 N		Paul
10/2	0.01		587.75	7/8 ml	96.5	96.3	95.7	96.3	95.8		201 N		Paul
10/8			587.75	Black Layer	96.9	97.2	96.9	97.4	96.7		202 N		Paul
10/16	0.60		587.75	Harvested	95.9	96.1	96.0	96.6	95.9		190 N		Paul
Total	**10.45**	**19.01**			**-0.18"**	**-0.30"**	**-0.22"**	**-0.26"**	**-0.42"**				
Net Soil Moisture is -1.38"													
Irrigation, Rainfall Plus Net Soil Moisture is 28.08"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

Control

Year: *2014* **County:** *Hartley* **Grower:** *Brent Clark*

No. Acres: *61* **Variety/Hyb:** *CH214-14* **Soil Type:** *Dumas Loam*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *200-47-0* **Seeding:** *27,000*

Planted: *April 29, 2014* **Harvest:** *October 10, 2014*

Herbicide: *Roundup, Halex GT* **Insecticide:** *Comite*

Yield: *227 bu/ac* **Prev. crop:** *Corn* **Row width:** *30"*

Irrigation method: *Center Pivot* **Prewater:** *None* **GPM/acre** *4.71*

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

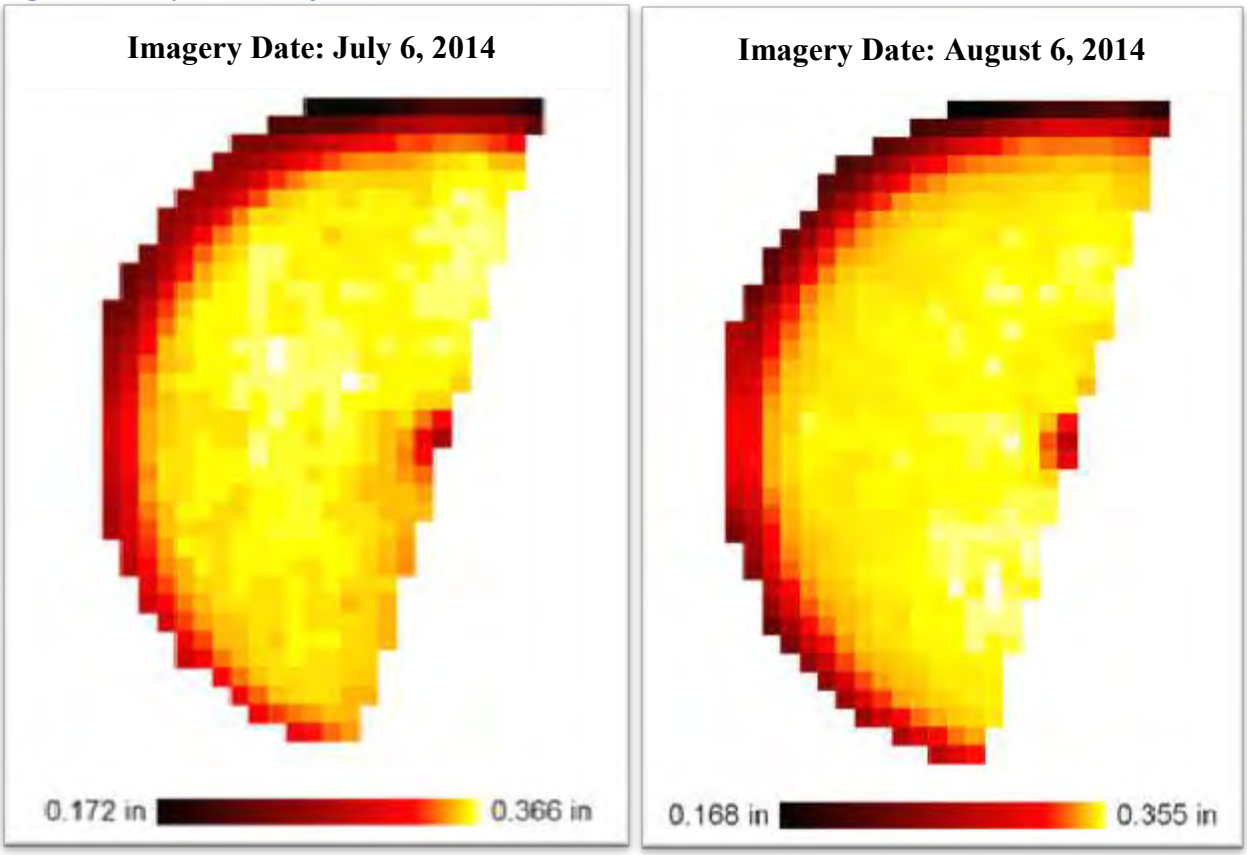
Application pattern: *Spray* **Crop row direction :** *Straight*

GPS Location of Pivot Pad
Latitude: *35.833831*
Longitude: *-102.16263*

GPS Location of Gypsum Blocks
Latitude: *35.837017*
Longitude: *-102.163887*

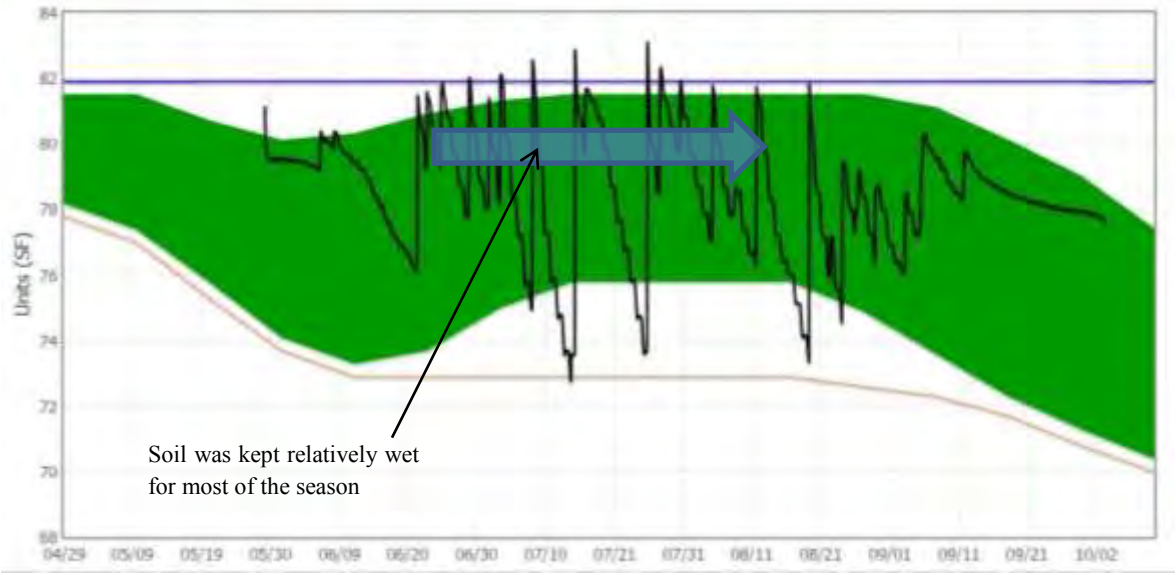
Satellite Imagery: Brent Clark‟s “control” field was one of eighteen “200-12” project fields included in satellite imagery in 2014. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Brent Clark‟s “control” field in figure 36 illustrate examples of what is displayed on the website. The first image is on July 6 at the 11 leaf stage. The second image is on August 6 at the dough stage. Satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 227 bushels per acre with 19.01 inches of irrigation.

Figure 36: Daily Water Use for Brent Clark's “control” Demonstration Field

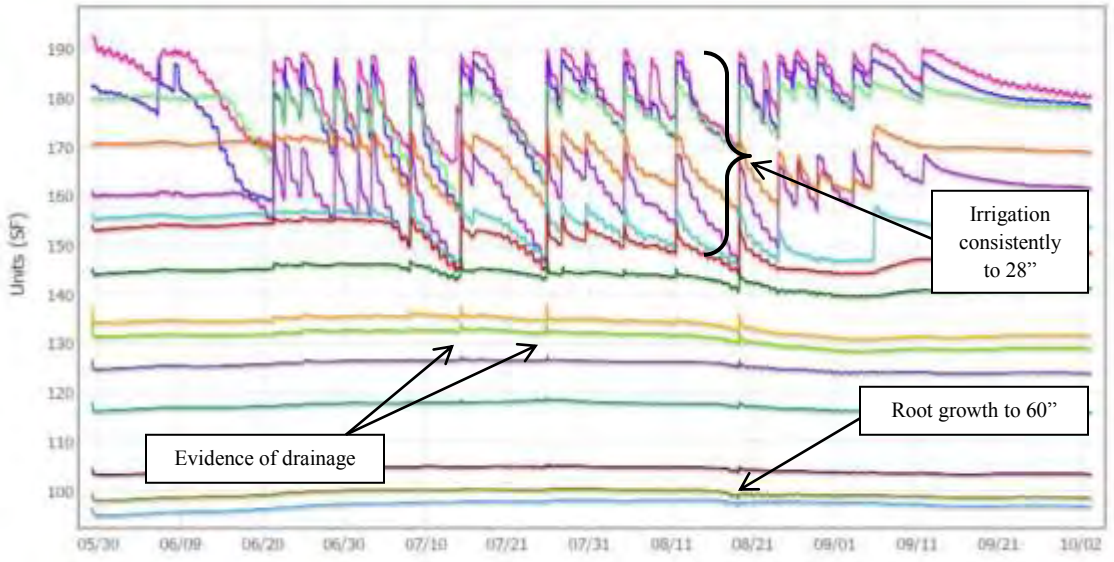


Note: Each Square Represents 1/8 of an Acre

Brent Clark's Control Field AquaSpy® Probe Summary



This field showed less aggressive root growth compared to the "200-12" field and it appeared that this probe site remained much wetter through the whole season. This is probably due to the much more frequent irrigation events early in the season. Irrigation was effective to 28" on most occasions and there was some evidence of drainage on multiple events (possibly due to rainfall). Even frequent irrigations late in the season were able to penetrate to 20" as the soil was kept wet. There is evidence that roots grew to 60" by mid-August, although the majority of the root activity was in the top 28". This site appeared not to suffer any moisture stress compared to the "200-12" site.



Harvest Results: The "200-12" field produced a 223 bushel per acre corn yield. Irrigation totaled 19.59 inches. Production in the "control" field was 227 bushels per acre, where seasonal irrigation totaled 19.01 inches. No pre-season irrigation was applied in either field. In comparison, the "control" field produced 4 bushels more per acre than the "200-12" with 0.58 inches less irrigation. Corn production was 11.38 bushels (637 lbs) per inch of irrigation in the "200-12" field compared to 11.94 (669 lbs) in the "control". Production from each inch of irrigation, rainfall and net soil water that totaled 29.85 inches was 7.47 bushels (418 lbs) per acre in the "200-12" field. Irrigation, rainfall and net soil water totaled 28.08 inches in the "control" field where production was 8.08 bushels (453 lbs) per inch. Crop production costs were $0.96 per acre more for the "control" field than for the "200-12" from increased harvest expenses. At $4.00 per bushel, the additional corn yield amounts to $16.00 more per acre. Net return is $440.45 from the "200-12" field compared to $455.49 from the "control". The "control" field"s net gain was $15.04 per acre with 0.58 inches less irrigation used compared to production from the "200-12" field. Net return per inch of irrigation from the "200-12" field is $22.48 compared to $23.96 for the "control". A summary of the demonstration results are shown in table 30 below.

Table 30: Brent Clark's 2014 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $4.00/bu		
			bu/ac	lb/ac-in of Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"200-12"	19.59	*29.85	223	637	$892.00	$45.53	$29.88
Control	19.01	†28.08	227	669	$908.00	$47.76	$32.33

*Includes -0.19 inches of water added to five feet of soil, plus rainfall, and irrigation.
†Includes -1.38 inches of water added to five feet of soil, plus rainfall, and irrigation.

Hartley Feeders' 2014 Hartley County Demonstration

Planting and Crop Information: For their demonstration, Hartley Feeders strip tilled and planted 60 acres of corn in the north half of the northwest quarter of section 2, for their "200-12" field, "Hartley Feeders 200-12". They planted the field with Pioneer 1498HR at a seeding rate of 28,000 seeds per acre. Hartley Feeders planted 60 acres, also strip tilled, in the northeast quarter of section 3 to Pioneer 1498HR at 28,000 seeds per acre for their "control" field, "Hartley Feeders Control". The "200-12" field was irrigated using a center pivot where seasonal water meter readings average 450 gpm. The center pivot delivered an average of 1.00 inches of irrigation in a 5.0 day revolution. The center pivot also irrigated wheat in the south half of the circle. Water meter readings averaged 425 gpm for the center pivot that irrigated the "control" field and delivered 1.00 inches in a 5.3 day revolution. Planting and crop information for "Hartley Feeders 200-12" and "Hartley Feeders Control" are shown in the table 31 below. Dennis Buss is Farm Manager for Hartley Feeders.

Table 31: Planting and Crop Information for Hartley Feeders

"200-12" Demonstration Field			
Planted:	*June 5*	**Harvested:**	*November 18 thru December 1*
Hybrid:	*P1498HR*	**Seeding Rate:**	*28,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*60*	**GPM Per Acre:**	*3.75*
Total Water:	*28.61 in.*	**Soil Type:**	*Dumas Loam, Gruver Loam, and Sherm Clay Loam*
Fertilizer:	*110-14-5-5s-2zn*		
Herbicide:	*Harness Xtra, Balance Flex, Dicamba, Roundup*	**Insecticide:**	*Root Worm "control" w/Seed*
Control Demonstration Field			
Planted:	*June 6*	**Harvested:**	*December 2*
Hybrid:	*P1498HR*	**Seeding Rate:**	*28,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*60*	**GPM Per Acre:**	*3.54*
Total Water:	*25.69 in.*	**Soil Type:**	*Dumas Loam, Sunray Clay Loam*
Fertilizer:	*100N Effluent+10-14-5-5s-2zn*	**Insecticide:**	*Root Worm "control" w/Seed*
Herbicide:	*Harness Xtra, Balance Flex, Dicamba, Laudis, Roundup*		

Beginning Soil Water Profile and Growing Season Rainfall

"200-12" Demonstration Field: Due to late tillage, early season irrigation and rainfall, gypsum blocks were not installed until June, which was late for the project. Initial soil sensor readings show good soil moisture at 1, 2, 3 and 4 feet. Soil water was about 40 percent at 5 feet and remained at that level until October when roots used water from that depth to finish the crop. Plants used soil water from 1, 2 and 3 feet in August at the early grain development stage plus irrigation when there was no rainfall to help. Rainfall of 1.14 inches on August 27, plus irrigation at the milk stage, provided sufficient water to maintain yield potential. Irrigation that followed

plus a timely 0.96 inch rainfall in mid-September at grain fill was used by the crop. Weekly gypsum block readings show soil water was depleted at 1 and 2 feet and limited amounts from 3, 4 and 5 feet in October, finishing the crop. Rainfall totaled 6.59 inches during the growing season. Soil moisture sensors were installed in Sherm silty clay loam soil that holds approximately 2.0 inches of available water per foot for potential crop use.

Control Demonstration Field: Soil moisture sensors show good water levels at 1, 2, 3, 4 and 5 feet when installed in June following crop emergence. Good soil water levels were maintained in the profile during July and August by irrigation and limited beneficial rainfall. The sensors indicate good root activity at 3, 4 and 5 feet in October, finishing the crop. The soil moisture graph indicates extensive plant root development at 1, 2, 3, 4 and 5 feet. Rainfall in June totaled 1.37 inches, 1.37 in July, 1.32 in August and 1.20 inches in September. Total was 6.49 inches. Four rainfall events of 2/3 inch or more, helped produce the crop. Beneficial rainfall was generally 2 to 3 inches less than at other demonstration locations. Soil moisture sensors were installed in Dumas loam soil that holds about 2.0 inches of available water per foot for potential plant use. Monthly rainfall is listed in table 32.

Table 32: Monthly Rainfall Data for Hartley Feeders

	June	July	August	September	October	Total
"200-12"	1.37"	1.37"	1.32"	1.20"	1.23"	**6.49"**
Control	1.37"	1.37"	1.32"	1.20"	1.23"	**6.49"**

Growing Season Water Tracking: The District tracked crop total water throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. A 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 "200-12" field. Another set of the same type of sensors were installed in each "control" field. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in the field. Due to late tillage, Gypsum blocks as well as the two Aquaspy soil probes were installed in the "200-12" and "control" fields following crop emergence. 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 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 "200-12" field are shown first, followed by the same illustrations for the "control" field.

Figure 37: Gypsum Block Readings for Hartley Feeders' "200-12" Demonstration Field (192 bu/ac)

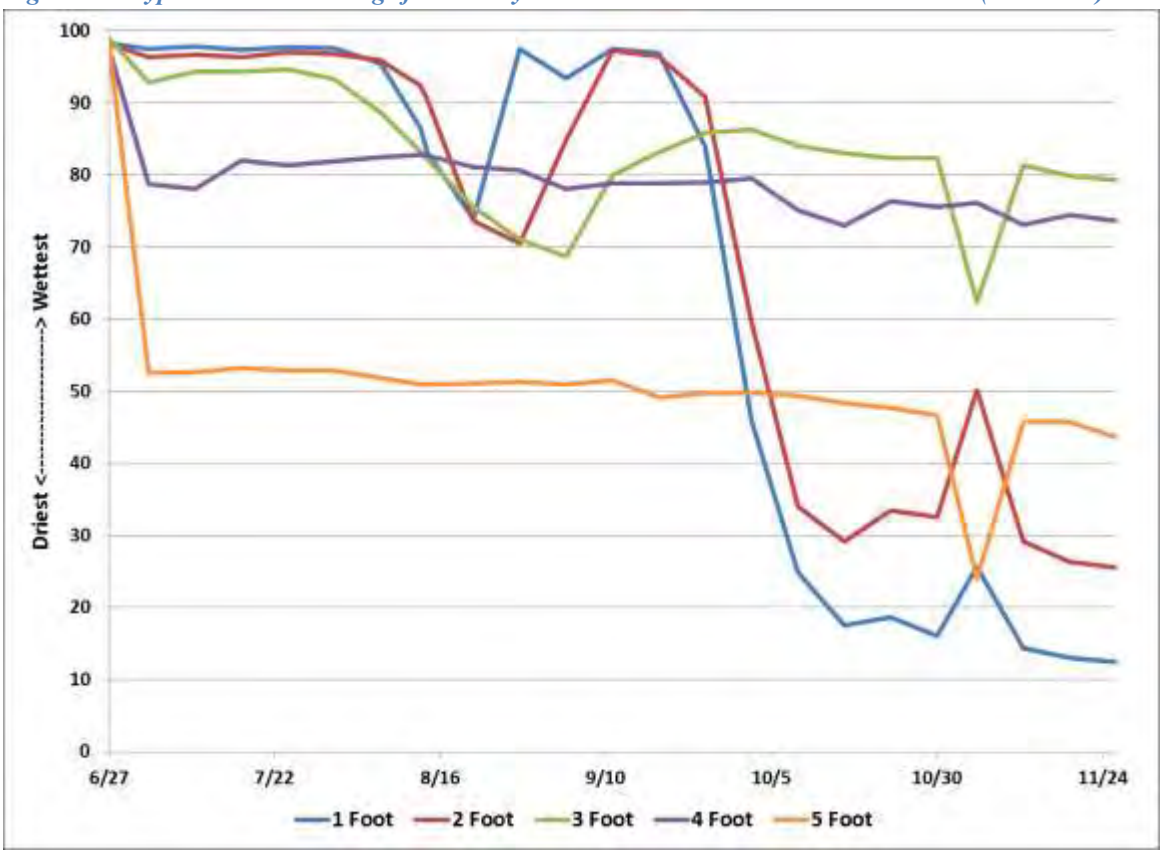


Figure 38: Growing Season Water Tracking for Hartley Feeders' "200-12" Demonstration Field (192 bu/ac)

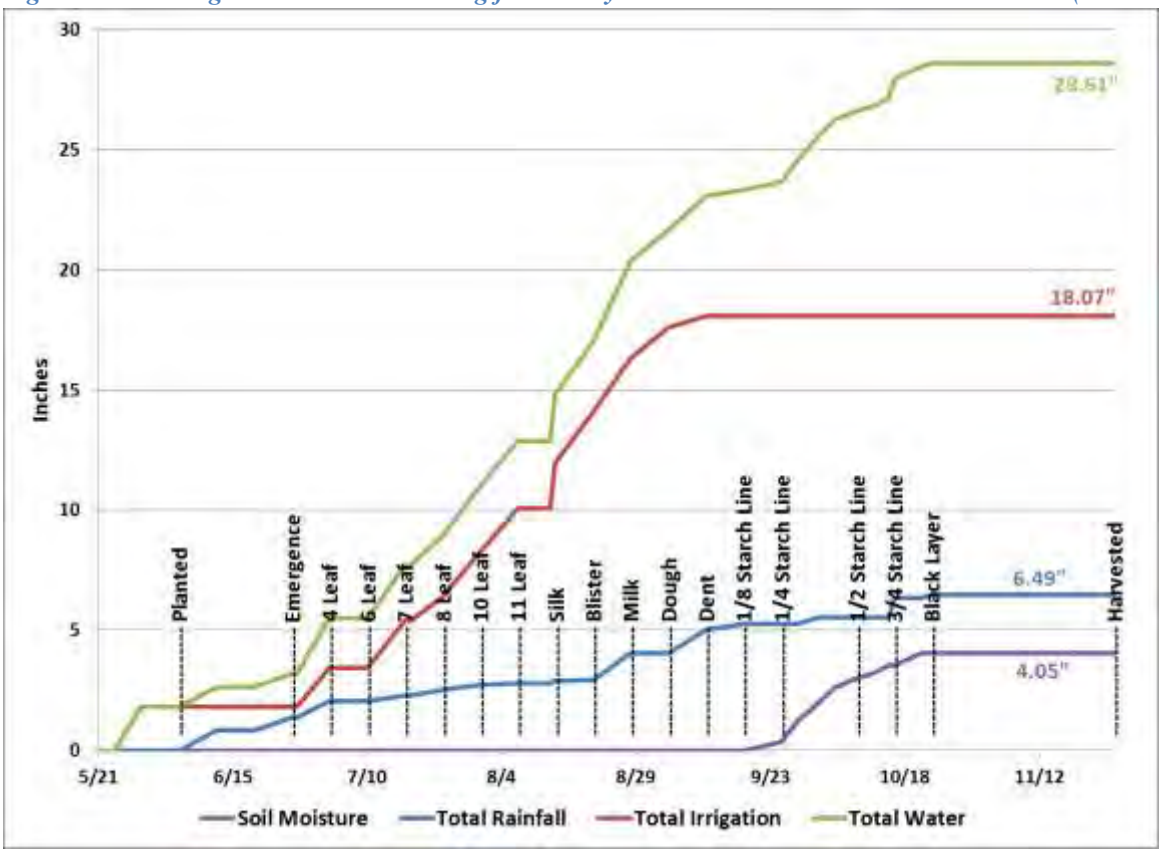


Table 33: Demonstration Field Data for Hartley Feeders' "200-12" Demonstration Field

Date mm/dd	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				
3/31			463.68		No Gypsum Blocks						221 N		Kari & Paul
4/10			463.68		No Gypsum Blocks						217 N		Kari
4/16			463.68		No Gypsum Blocks						218 N		Kari
4/24	0.02		463.68		No Gypsum Blocks						218 N		Kari
5/1			463.68		No Gypsum Blocks						218 N		Kari
5/7			463.68		No Gypsum Blocks						218 N		Kari
5/15			463.68		No Gypsum Blocks						218 N		Kari
5/19			Pivotrac		No Gypsum Blocks					Prewater	90 Y		Leon
5/22	0.06		469.22		No Gypsum Blocks					Prewater	291 Y	451	Kari
5/22			Pivotrac		No Gypsum Blocks					Prewater	270 Y	450	Leon
5/24			Pivotrac		No Gypsum Blocks					Prewater	21 N	450	Leon
5/29	1.75	1.82	472.8		No Gypsum Blocks						23 N		Kari
6/5	0.29		472.8		No Gypsum Blocks						108 N		Kari
6/5					No Gypsum Blocks					Plant			Dennis
6/12	0.82		472.8		No Gypsum Blocks						116 N		Kari & David
6/19	0.01		472.8		No Gypsum Blocks						117 N		Kari & David
6/26	0.54		472.8	Emergence	No Gypsum Blocks						117 N		Paul
6/27					98.3	98.1	98.9	97.6	98.3				Paul
7/3	0.67	1.63	480.99	4 Leaf	97.5	96.3	92.9	78.7	52.5		46 N		Paul
7/10			486.79	6 Leaf	97.8	96.7	94.3	78.1	52.6	200-12	335 Y	530	Paul
7/17	0.25	1.95	490.73	7 Leaf	97.4	96.3	94.3	82.0	53.2		331 N		Paul
7/18										Move Dry	270		Leon
7/24	0.25	0.99	495.68	8 Leaf	97.7	97.0	94.6	81.3	52.9	200-12	4 Y	air	Paul
7/31	0.20	1.90	505.21	10 Leaf	97.6	96.8	93.3	81.9	52.9		99 N		Paul
8/7	0.06	1.79	514.16	11 Leaf	95.5	95.9	88.7	82.5	51.8	200-12	86 Y	478	Paul
8/13				Pollination	86.5	92.4	83.2	82.8	50.9				Leon
8/14	0.08	1.89	523.64	Silk	83.2	90.6	82.2	82.7	51.0	200-12	31 Y	544	Paul
8/21	0.04	2.12	534.23	Blister	73.9	73.6	75.6	81.1	51.1		267 N		Jerry
8/28	1.14	2.24	545.44	Milk	97.5	70.5	71.0	80.6	51.3		276 N		Paul
9/4		1.28	551.87	Dough	93.4	84.8	68.7	78.1	51.0	200-12	352 Y	455	Paul
9/11	0.96	0.46	554.18	Dent	97.5	97.3	80.0	78.8	51.5		227 N		Paul
9/18	0.24		554.18	1/8 ml	96.9	96.5	83.1	78.8	49.1		226 N		Paul
9/25			554.18	1/4 ml	83.9	90.8	85.9	78.9	49.7		244 N		Paul
10/2	0.29		554.18	1/4 ml	45.9	59.5	86.3	79.5	49.8		259 N		Paul
10/9			559.83	1/2 ml	24.8	34.0	84.0	75.1	49.4	Wheat	97 Y	485	Paul
10/16	0.79		560.01	3/4 ml	17.5	29.1	83.0	73.0	48.3		91 N		Paul
10/23	0.15		560.01	Black Layer	18.6	33.4	82.3	76.4	47.7		93 N		Paul
10/30			560.01	Black Layer	16.1	32.5	82.3	75.6	46.6		93 N		Paul
11/5	0.08		562.6	Black Layer	25.6	50.2	62.4	76.1	24.0		94 N		Paul
11/12			562.6	Black Layer	14.3	29.2	81.3	73.1	45.7		276 N		Paul
11/19			562.6	Black Layer	13.0	26.3	79.9	74.4	45.8		276 N		Paul
11/26			562.6	Harvested	12.4	25.5	79.3	73.6	43.6		238 N		Paul
Total	**6.49**	**18.07**			**1.75"**	**1.54"**	**0.55"**	**0.10"**	**0.11"**				
Net Soil Moisture is 4.05"													
Irrigation, Rainfall Plus Net Soil Moisture is 28.61"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

200-12

Year: *2014* **County:** *Hartley* **Grower:** *Hartley Feeders*

No. Acres: *60* **Variety/Hyb:** *P1498HR* **Soil Type:** *Dumas Loam, Gruver Loam, Sherm Loam*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *110-14-5-5s-2zn* **Seeding:** *28,000*

Planted: *June 5, 2014* **Harvest:** *November 18, 2014 thru December 1, 2014*

Herbicide: *Harness Xtra, Balance Flex, Dicamba, Roundup* **Insecticide:** *Root Worm Control w/Seed*

Yield: *192 bu/ac* **Prev. crop:** *Corn* **Row width:** *30 Inch*

Irrigation method: *Center Pivot* **Prewater:** *1.82 in.* **Well GPM:** *3.75 gpm/acre*

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

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

GPS Location of Pivot Pad

Latitude: *35.888194*

Longitude: *-102.455695*

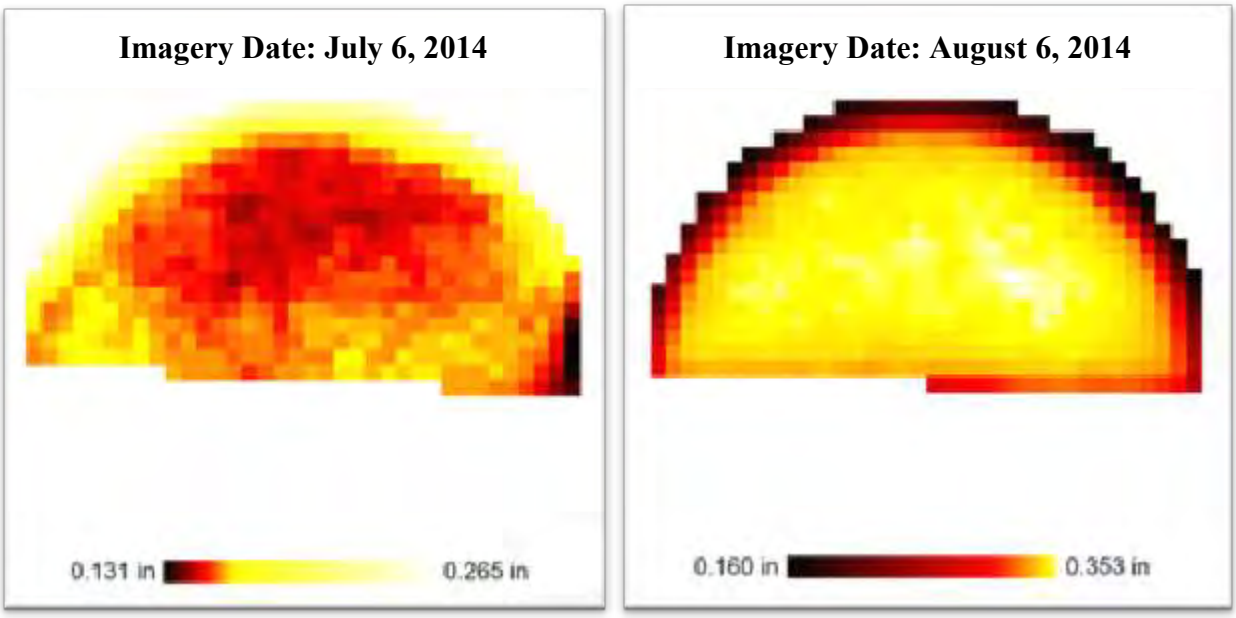
GPS Location of Gypsum Blocks

Latitude: *35.89102*

Longitude: *-102.45352*

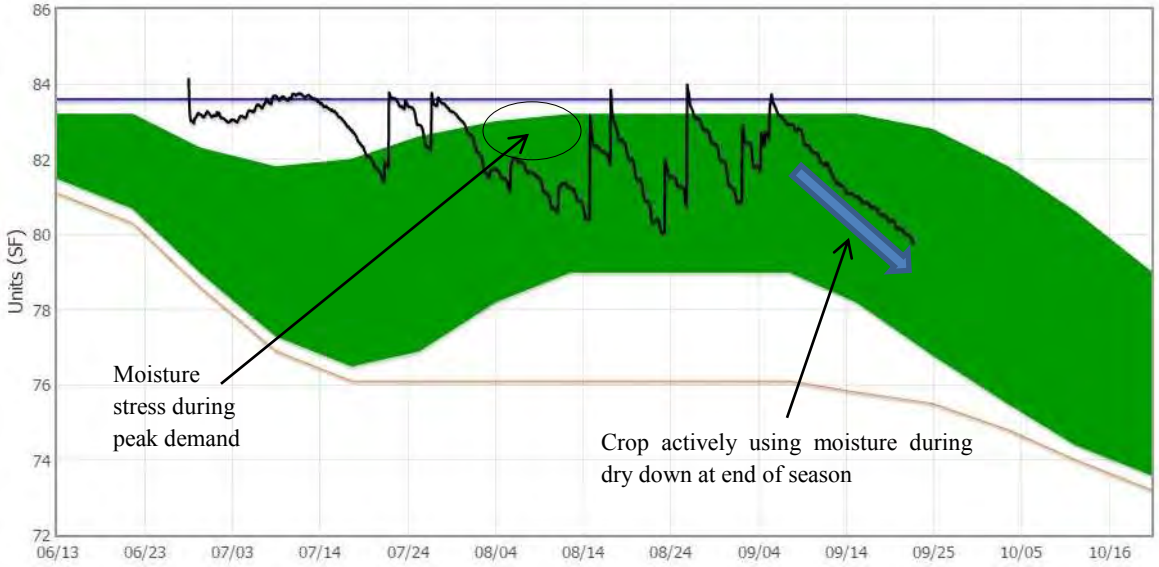
Satellite Imagery: Satellite imagery was initiated and used in 2013 to learn and evaluate its potential for an irrigation and water management tool for growers in connection with HydroBio. The use of satellite imagery was continued for the 2014 growing season. Hartley Feeders‟ “200-12” field was one of eighteen “200-12” project fields included in 2014. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Hartley Feeders‟ “200-12” field are shown in figure 39 to illustrate examples of what is displayed on the website. The first image was on July 6 at the 4 leaf stage. The second image is on August 6 at the 11 leaf stage. The satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 192 bushels per acre with 18.07 inches of irrigation.

Figure 39: Daily Water Use for Hartley Feeders' “200-12” Demonstration Field



Note: Each Square Represents 1/8 of an Acre

Hartley Feeders' "200-12" Field AquaSpy® Probe Summary



The relatively low yield at this site must be due to the relatively dry conditions experienced during tassel. During the period of greatest water use, irrigation was not able to penetrate much below 8" and the crop had to go chasing moisture. Roots grew to a depth of 40" but the activity below 28" was not significant. The root growth to 28" and beyond was also relatively late in the season (middle of August onwards) suggesting that the plants were trying to supplement water availability during peak demand. The evidence does not suggest that the subsoil was dry, so there may be other factors contributing to a lack of deep root activity. This site received less rainfall than other sites and so this would probably contribute to the relatively low yield and lower water use efficiency.

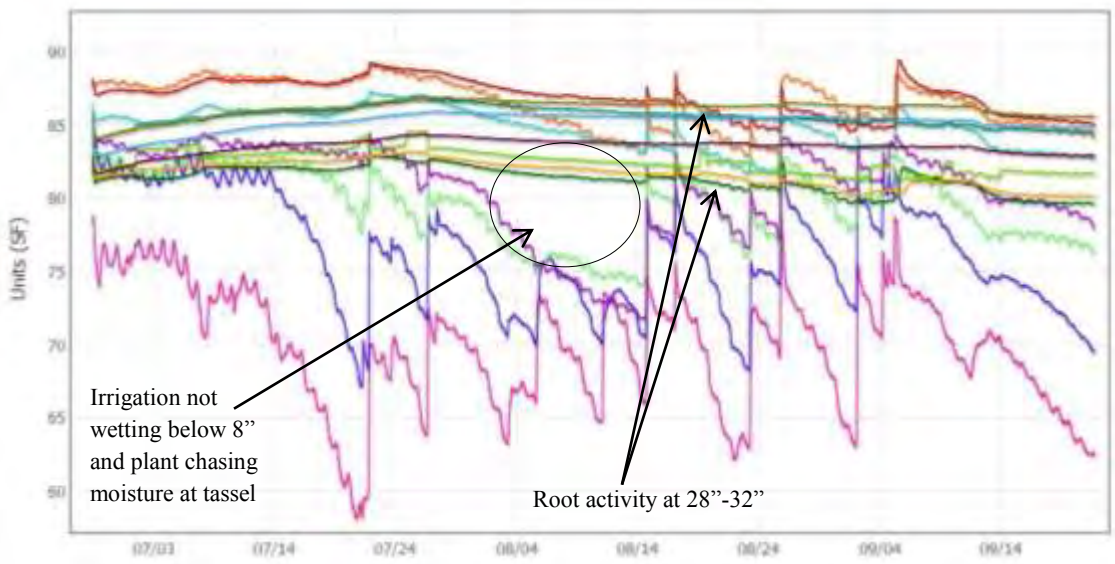


Figure 40: Gypsum Block Readings for Hartley Feeders'Ccontrol Demonstration Field (192 bu/ac)

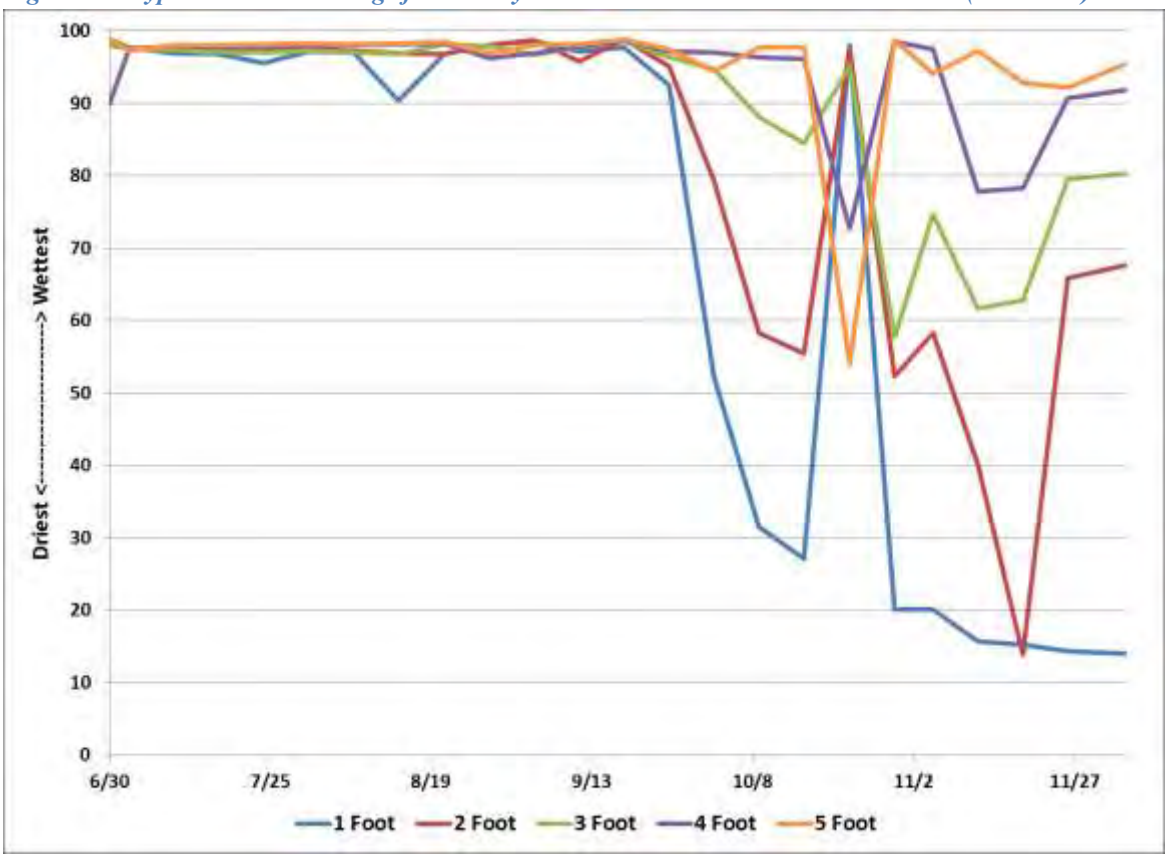


Figure 41: Growing Season Water Tracking for Hartley Feeders' Control Demonstration Field (192 bu/ac)

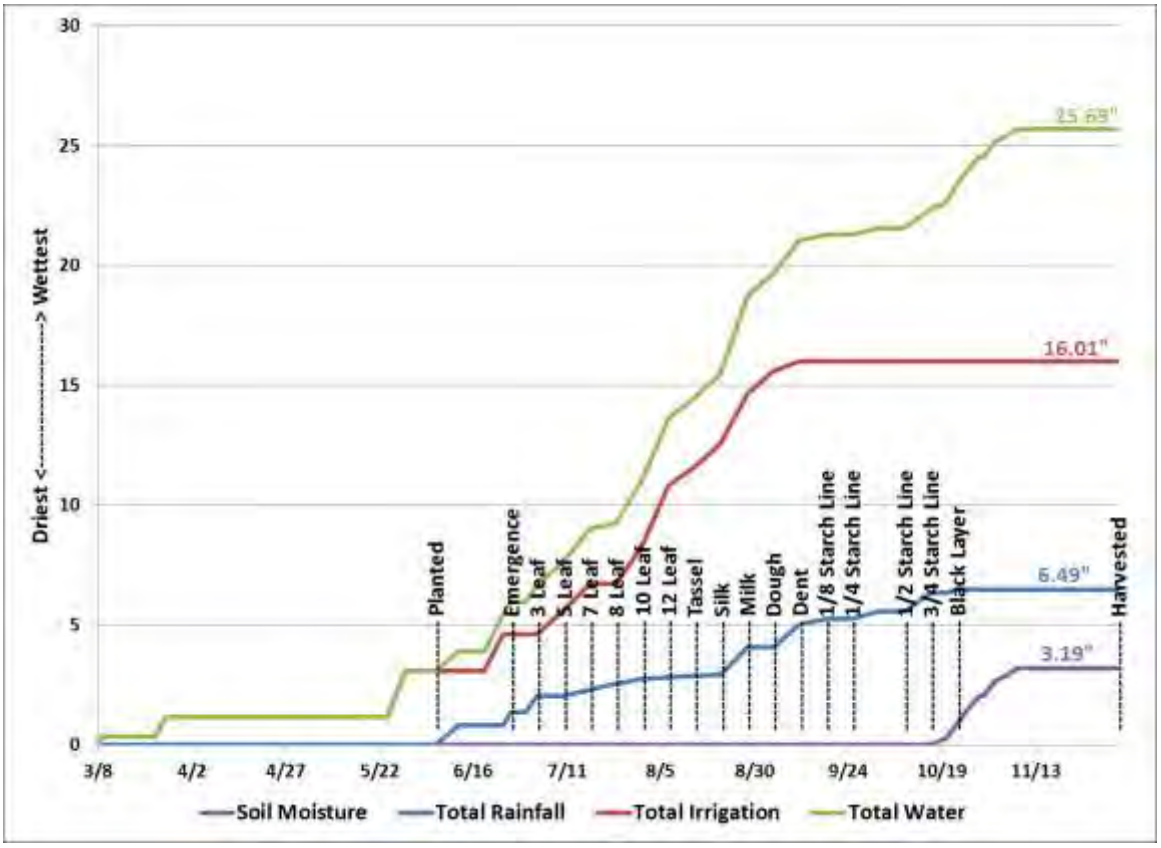


Table 34: Demonstration Field Data for Hartley Feeders' Control Demonstration Field

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				
3/8			Pivotrac								90 Y		Leon
3/9		0.33	Pivotrac								19 N	425	Leon
3/23			Pivotrac								90 Y		Leon
3/26		0.84	Pivotrac								270 Y	425	Leon
3/31			480.66								89 N		Paul & Kari
4/10			482.6		No Gypsum Blocks					Wheat	158 Y	438	Kari
4/16			486.78		No Gypsum Blocks						269 N		Kari
4/24	0.02		490.59		No Gypsum Blocks					Wheat	140 Y	385	Kari
5/1			492.15		No Gypsum Blocks						80 N		Kari
5/7			497.74		No Gypsum Blocks					Wheat	263 N		Kari
5/15			497.74		No Gypsum Blocks						282 N		Kari
5/19			Pivotrac		No Gypsum Blocks					Prewater	282 Y		Leon
5/22	0.06		503.57		No Gypsum Blocks					Prewater	71 Y	429	Kari
5/22			Pivotrac		No Gypsum Blocks					Reverse	90 Y	425	Leon
5/24			Pivotrac		No Gypsum Blocks					Prewater	353 N	425	Leon
5/29	1.75	1.91	507.28		No Gypsum Blocks					Prewater	353 N		Kari
6/5	0.29		507.28		No Gypsum Blocks						267 N		Kari
6/6					No Gypsum Blocks					Plant			Dennis
6/12	0.82		507.28		No Gypsum Blocks						267 N		Kari & David
6/19	0.01		507.28		No Gypsum Blocks						117 N		Kari & David
6/24		1.52	514.87		No Gypsum Blocks						281 N		Kari
6/26	0.54		514.87	Emergence	No Gypsum Blocks						281 N		Paul
6/30					98.1	99.0	98.0	89.9	99.0				Paul
7/3	0.67		514.87	3 Leaf	97.7	97.6	97.5	97.4	97.3		281 N		Paul
7/10		0.98	519.79	5 Leaf	96.9	97.8	97.4	97.9	98.0	Control	49 Y	481	Paul
7/17	0.25	1.13	525.46	7 Leaf	96.8	97.6	97.0	97.7	98.0		31 N		Paul
7/24	0.25		525.46	8 Leaf	95.6	97.5	97.0	97.8	98.1	Move dry	96 N		Paul
7/31	0.20	1.57	533.33	10 Leaf	97.1	97.6	97.2	98.0	98.3		10 N		Paul
8/7	0.06	2.54	546.04	12 Leaf	97.0	97.3	97.0	98.0	98.2	Control	26 Y	434	Paul
8/14	0.08	0.76	549.83	Tassel	90.4	96.9	96.8	98.1	98.3	Control	328 Y	473	Paul
8/21	0.04	0.98	554.74	Silk	96.8	96.8	98.1	98.3	98.5		266 N		Jerry
8/28	1.14	2.07	565.11	Milk	98.0	98.0	97.9	96.2	96.9	Control	283 Y	444	Paul
9/4		0.95	569.85	Dough	98.6	98.7	96.7	96.9	98.0	Control	25 Y	516	Paul
9/11	0.96	0.43	571.97	Dent	97.1	95.8	97.8	97.8	98.1		79 N		Paul
9/18	0.24		571.97	1/8 ml	97.7	98.8	98.6	98.6	98.8		79 N		Paul
9/25			572.29	1/4 ml	92.5	95.1	96.4	97.1	97.5	Wheat	101 N		Paul
10/2	0.29		575.3	1/4 ml	52.2	79.3	94.8	97.0	94.4		266 N		Paul
10/9			577.64	1/2 ml	31.5	58.3	88.1	96.4	97.7	Wheat	211 Y	542	Paul
10/16	0.79		579.98	3/4 ml	27.1	55.5	84.5	96.1	97.7		95 Y dry	0	Paul
10/23	0.15		580.2	Black Layer	98.0	97.6	95.1	72.7	54.1	Wheat	90 Y	348	Paul
10/30			588.4	Black Layer	20.1	52.3	57.7	98.5	98.7		90 N		Paul
11/5	0.08		588.4	Black Layer	20.1	58.3	74.7	97.5	94.1		163 N		Paul
11/12			588.4	Black Layer	15.7	40.1	61.7	77.8	97.3		94 N		Paul
11/19			588.4	Black Layer	15.3	13.9	62.8	78.3	92.8		94 N		Paul
11/26			588.4	Black Layer	14.3	65.8	79.5	90.7	92.2		94 N		Paul
12/5			588.4	Harvested	14.0	67.7	80.3	91.8	95.5		94 N		Paul
Total	**6.49**	**16.01**			**1.50"**	**0.79"**	**0.61"**	**0.27"**	**0.02"**				
Net Soil Moisture is 3.19"													
Irrigation, Rainfall Plus Net Soil Moisture is 25.69"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

Control

Year: *2014* **County:** *Hartley* **Grower:** *Hartley Feeders*

No. Acres: *60* **Variety/Hyb:** *P1498HR* **Soil Type:** *Dumas Loam, Sunray Loam*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *100N Effluent+10-14-5-5s-2zn* **Seeding:** *28,000*

Planted: *June 6, 2014* **Harvest:** *December 2, 2014*

Herbicide: *Harness Xtra, Balance Flex, Dicamba, Laudix, Roundup* **Insecticide:** *Root Worm Control w/Seed*

Yield: *171 bu/ac* **Prev. crop:** *Corn* **Row width:** *30 Inch*

Irrigation method: *Center Pivot* **Prewater:** *0.72 in.* **Well GPM:** *3.54*

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

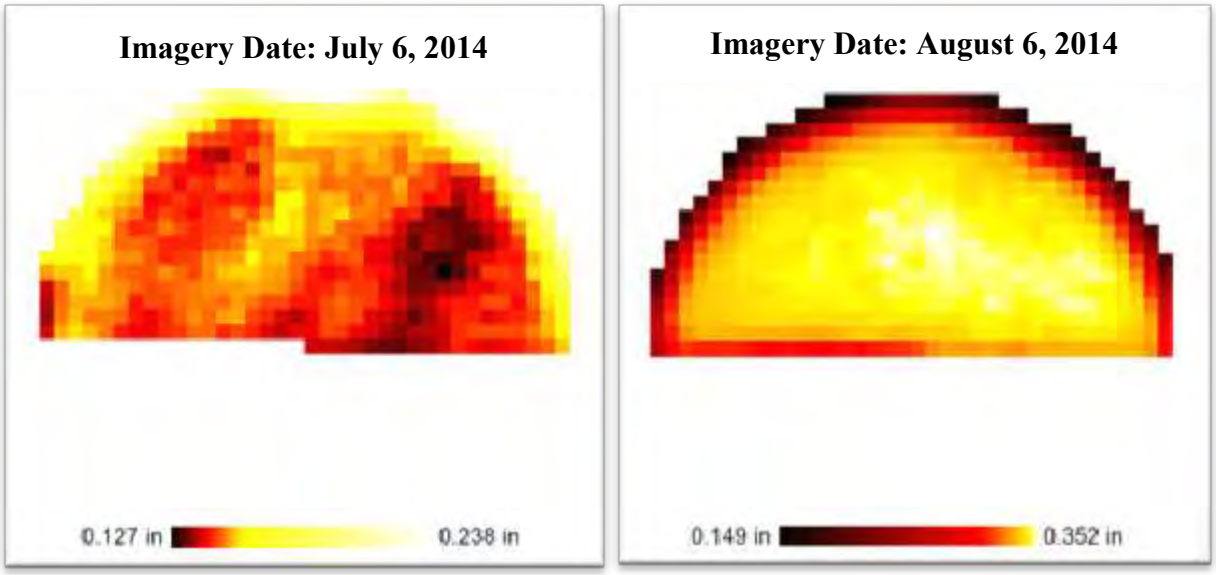
Application pattern: *Spray* **Crop row direction :** *Straight*

GPS Location of Pivot Pad
Latitude: *35.888173*
Longitude: *-102.464733*

GPS Location of Gypsum Blocks
Latitude: *35.89002*
Longitude: *-102.46821*

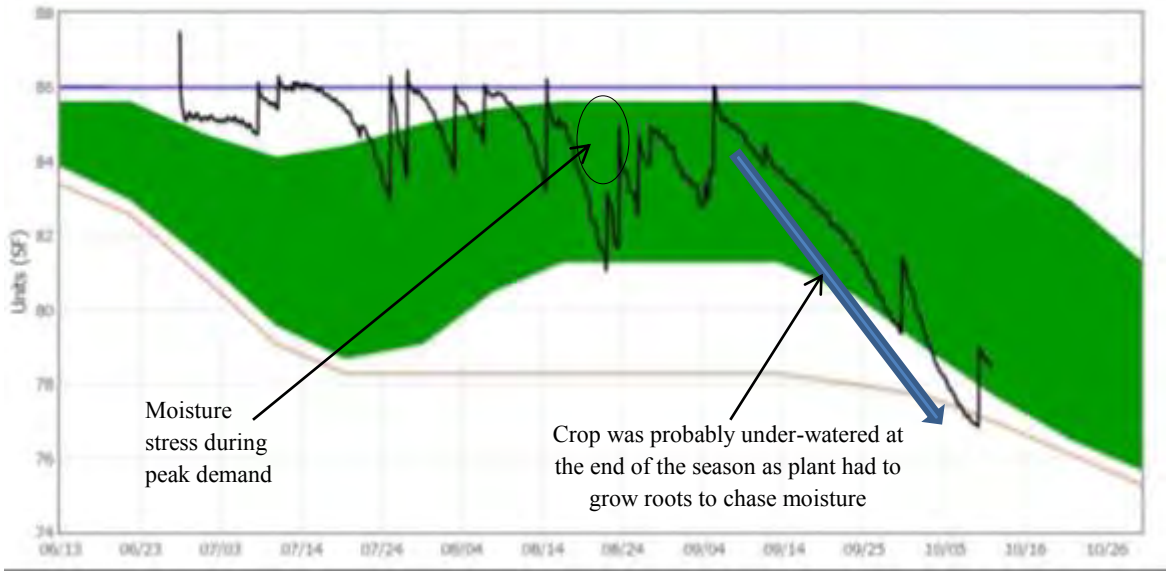
Satellite Imagery: Hartley Feeders‟ “control” field was one of eighteen “200-12” project fields included in satellite imagery in 2014. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Hartley Feeders‟ “control” field in figure 42 illustrate examples of what is displayed on the website. The first image is on July 6 at the 3 leaf stage. The second image is on August 6 at the 12 leaf stage. Satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 171 bushels per acre with 16.01 inches of irrigation.

Figure 42: Daily Water Use for Hartley Feeders' “control” Demonstration Field

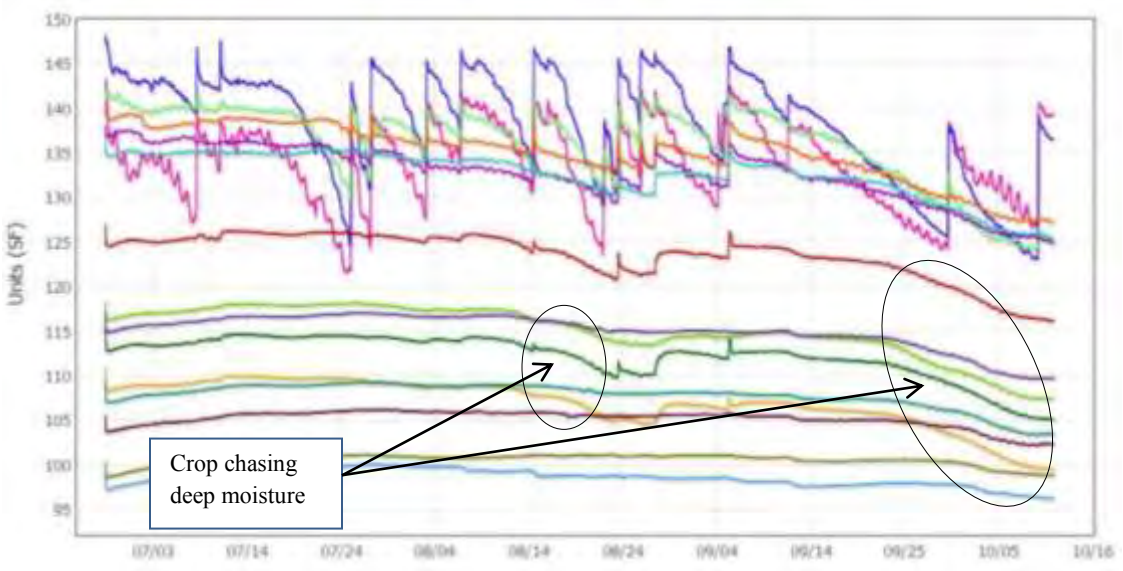


Note: Each Square Represents 1/8 of an Acre

Hartley Feeders' Control Field AquaSpy® Probe Summary



This site appeared to start with a full soil profile and it was evident that the plants went chasing moisture during mid-August at time of peak demand. The fact that the plants had to chase deeper for moisture at this time and again at the end of the season, compared to the 200/12 treatment, may have accounted for the 21 bushel lower yield at this site. This site had to chase significant sub-soil moisture to finish the season and it is likely that the yield would have benefited from an additional irrigation at the end of the season. Water use was still very active in late September and the plant had to direct significant resources into growing roots rather than filling grain.



Harvest Results: The "200-12" field produced a 192 bushel per acre corn yield. Irrigation totaled 18.07 inches, of which 1.82 was pre-water. Production in the "control" field was 171 bushels per acre, where irrigation totaled 16.01 inches. Pre -season irrigation was 3.08 inches for the "control" field and seasonal irrigation 12.93. In comparison, the "200-12" field produced 21 more bushels per acre than the "control" with 2.06 inches more irrigation. Corn production was 10.62 bushels (595lbs) per inch of irrigation in the "200-12" field compared to 10.68 (598lbs) in the "control". Production from each inch of irrigation, rainfall and net soil water that totaled 28.61 inches was 6.71 bushels (376lbs) per acre in the "200-12" field. Irrigation, rainfall and net soil water totaled 25.69 inches in the "control" field where production was 6.65 bushels (373lbs) per inch. Crop production costs were $33.82 per acre more for the "200-12" field than for the "control" from additional irrigation and harvest expenses. At $4.00 per bushel, the additional 21 bushel corn yield amounts to $84.00 more per acre. The "200-12" field"s net gain was $50.18 per acre with 2.06 inches more irrigation used compared to production from the "control" field. Net return from the "200-12" field was $353.89 compared to $303.71 from the "control" field. Net return from the additional 2.06 inches of irrigation was $24.36 per inch. Net return for each inch of irrigation was $19.58 for the "200-12" field compared to $18.97 for the "control" field. Soil moisture sensors indicate plant roots may not have developed into 3 and 4 feet in the soil profile during rapid vegetative, tassel and pollination growth stages in the "control" field when adequate soil water is essential. Dennis Buss said, "The soil probe really helped manage and save water, and the plant tissue tests by Better Harvest saved a lot of money for fertilizer. Plants were less stressed from not over applying nitrogen fertilizer." A summary of the demonstration results for Hartley Feeders and Dennis Buss are shown in table 35.

Table 35: Hartley Feeders' 2014 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $4.00/bu		
			bu/ac	lb/ac-in of Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"200-12"	18.07	*28.61	192	595	$768.00	$42.50	$26.84
Control	16.01	†25.69	171	598	$684.00	$42.72	$26.63

*Includes 4.05 inches of water removed from five feet of soil, plus rainfall, and irrigation.
†Includes 3.19 inches of water removed from five feet of soil, plus rainfall, and irrigation.

Phil Haaland's 2014 Hartley County Demonstration

Planting and Crop Information: For his demonstration, Phil Haaland strip tilled and planted 2.7 acres (284 to 292 degrees) of corn in the northeast quarter of his 120 acre circle (L4) located in the southeast quarter of section 44, for his "200-12" field, "Haaland 200-12". Haaland planted the 2.7 acres with Pioneer 1151AM at a seeding rate of 30,000 seed per acre. He planted the remaining 117 acres of the circle (292 to 284 degrees), also strip tilled, to P1151AM at 37,000 seeds per acre for his "control" field, "Haaland Control". Both the "200-12" 2.7 acre field and 117 acre "control" field were irrigated by the same center pivot. Seasonal water meter readings averaged 600 gpm. The center pivot delivered an average of 2.00 inches of irrigation in a normal 7.5 day revolution. Pivotrac™ provided a text message when the irrigation system entered and departed the "200-12" field. Time (hours) the center pivot irrigated the "200-12" field along with the associated flow rate registered by the water meter was used to calculate irrigation amounts. Planting and crop information for "Haaland 200-12"" and "Haaland Control" are shown in table 36 below.

Table 36: Planting and Crop Information for Phil Haaland

"200-12" Demonstration Field			
Planted:	*May 19*	**Harvested:**	*October 25*
Hybrid:	*P1151AM*	**Seeding Rate:**	*30,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*2.7*	**GPM Per Acre:**	*5.0*
Total Water:	*35.87 in.*	**Soil Type:**	*Dallam Fine Sandy Loam*
Fertilizer:	*191-19-0-2.5s-0.5zn*	**Insecticide:**	*Comite*
Herbicide:	*Cinch ATZ, Balance Flex, Roundup, Atrazine, Basis Blend, Status*		
Control Demonstration Field			
Planted:	*May 19*	**Harvested:**	*October 24*
Hybrid:	*P1151AM*	**Seeding Rate:**	*37,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*117*	**GPM Per Acre:**	*5.0*
Total Water:	*38.24 in.*	**Soil Type:**	*Gruver Loam, Dallam Fine Sandy Loam*
Fertilizer:	*191-19-0-2.5s-0.5zn*	**Insecticide:**	*Comite*
Herbicide:	*Cinch ATZ, Balance Flex, Roundup, Basis Blend, Roundup*		

Beginning Soil Water Profile and Growing Season Rainfall

"200-12" Demonstration Field: Preseason irrigation totaled 3.0 inches in April prior to the gypsum blocks being installed. Weekly readings following installation and planting show soil water was good at 1, 2 and 3 feet about 20 percent at 4 feet and 60 percent at 5 feet. For the demonstration, Phil chose to periodically skip irrigations on the "200-12" field. Irrigations were skipped July 2 at 6 leaves, July 9 at 9 leaves, August 29 at the dent stage and September 5 at ¼ maturity line. Gypsum block soil moisture sensors show the crop used most water from 1 foot and 2 feet plus 1.39 inches of rainfall after irrigations were not applied July 2 and July 9. The crop then used water from 3 and 4 feet in the soil profile plus 5.5 inches of irrigation and 1.43

inches of beneficial rain during tassel, pollination and silk. Plant roots continued to use soil water to five feet in the root zone plus 5.6 inches of irrigation and 0.96 and 1.08 inches of August rainfall by the dent growth stage. Irrigations were not applied August 29 and September 5 during grain maturity. Timely rainfall of 1.45 inches September 11 and 0.61 inches September 18 helped finish the crop, leaving good soil moisture at 1 foot, about 50 percent at 5 feet and the 2, 3 and 4 feet depths mostly depleted. A 219 bushel per acre yield was harvested using reduced irrigation strategies, drought tolerant corn hybrids, planting dates and management tools and technology. Rainfall totaled 11.68 inches from planting until harvest, which was fully welcomed. Dallam fine sandy loam soil holds approximately 1.0 inch of available water from 1foot for potential crop use. The soil‟s available water from 2 feet is 1.6 inches and 1.9 inches from 3, 4 and 5 feet in the crop root zone. Weekly gypsum block readings generally show adequate available water from timely beneficial rainfall, managed irrigation and soil water.

Control Demonstration Field: Beginning soil water was good at 1 foot following installation of the gypsum blocks in early April, apparently from 3 inches of pre-water that followed. The profile was dry at 2 and 3, about 30 percent at 4 and 70 percent at 5 feet after the gypsum blocks were installed prior to planting and following 3.0 inches of pre-water. Soil moisture sensors indicate 3.0 inches of pre-water did not reach 2 feet in the soil profile. Irrigation that totaled 5.61 inches plus 1.42 inches of rainfall May 25 and 2.42 inches June 9 refilled the soil profile to 5 feet by the 4 leaf growth stage. Weekly gypsum block readings that followed show the soil profile was full the remainder of the growing season, leaving it 5.16 inches wetter than at planting. Rainfall totaled 11.68 inches from planting until harvest. Beneficial rainfall amounts were 1.42 inches in May, 2.42 and 1.39 inches in June, 1.43 inches in July, 0.96 and 1.08 inches in August and 1.45 inches in September. Superior rainfall compared to the previous three years. Gypsum blocks were installed in Dallam fine sandy loam soil that holds about 1.0 inch of available water for potential plant use in the first foot, 1.6 in the second foot and 1.9 inches in 3, 4 and 5 feet in the root zone.

Table 37: Monthly Rainfall Data for Phil Haaland

	May	June	July	August	September	Total
"200-12"	1.52"	3.90"	1.98"	2.22"	2.06"	**11.68"**
Control	1.52"	3.90"	1.98"	2.22"	2.06"	**11.68"**

Growing Season Water Tracking: The District tracked crop total water throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. A 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 "200-12" field. Another set of the same type of sensors were installed in each "control" field. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in the field. Gypsum blocks and the Aquaspy® probe were installed in the "200-12" field following crop emergence. Gypsum blocks were installed in the "control" field in early April to help guide and manage pre-season irrigation. The Aquaspy® soil probe was installed in the "control" field following crop emergence. 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 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 “200-12” field are shown first, followed by the same illustrations for the “control” field.

Figure 43: Gypsum Block Readings for Phil Haaland's "200-12" Demonstration Field (219 bu/ac)

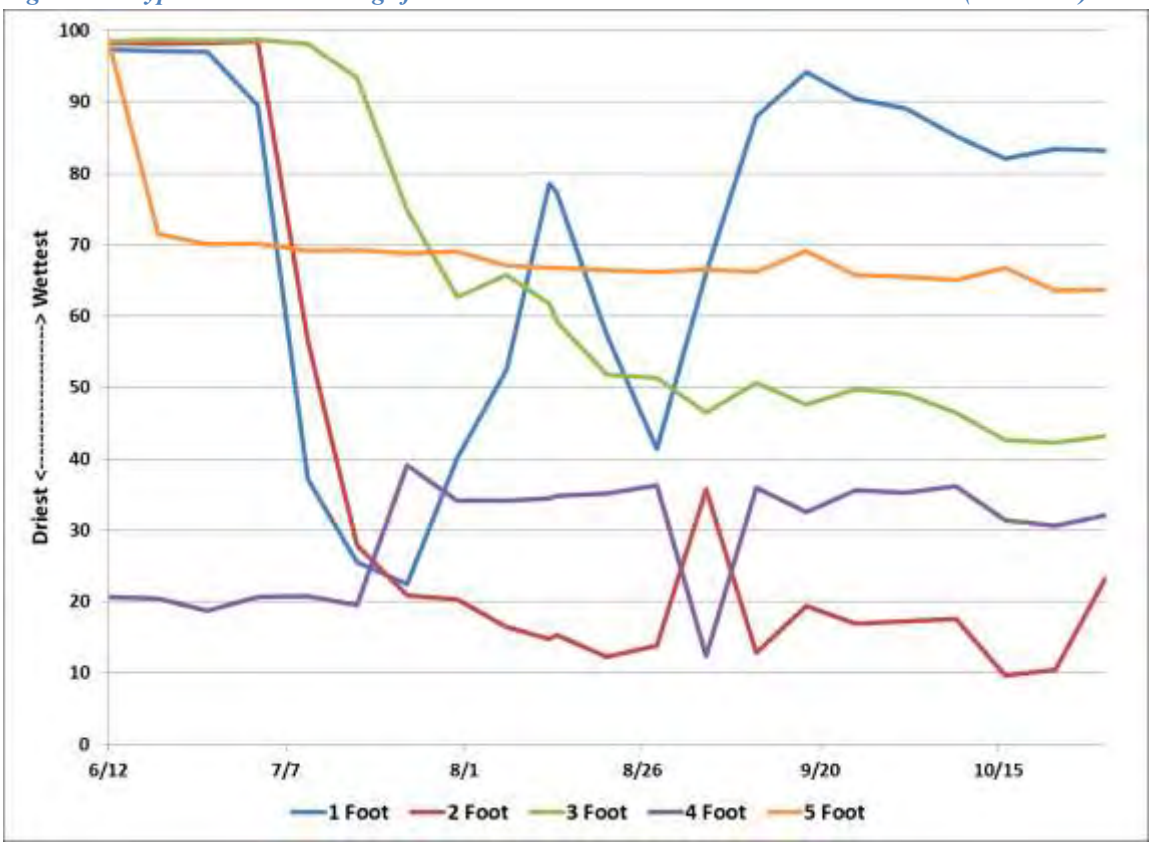


Figure 44: Growing Season Water Tracking for Phil Haaland's "200-12" Demonstration Field (219 bu/ac)

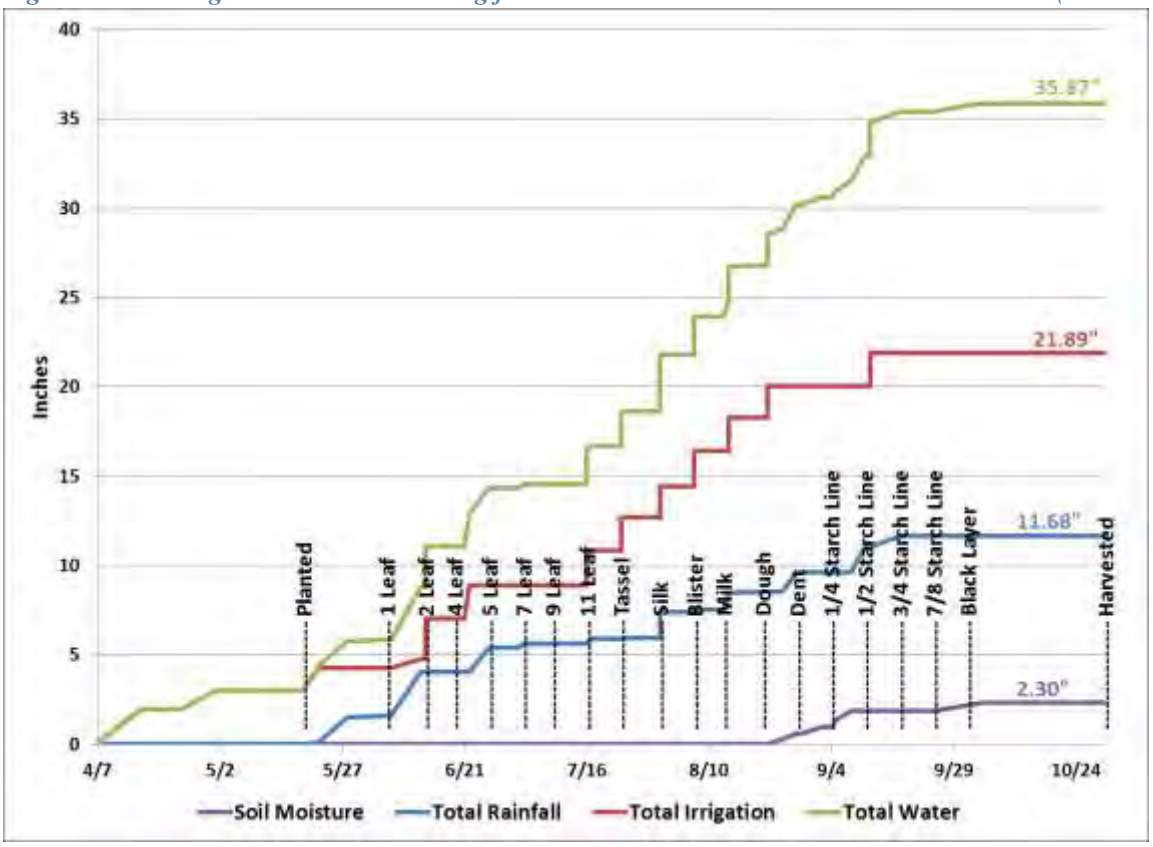


Table 38: Demonstration Field Data for Phil Haaland's "200-12" Demonstration Field

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				
4/7			0.02										Pivotrac
4/10	0.04	0.78	7.83							Prewater	68 Y	620	Kari
4/16		1.18	19.62		No Gypsum Blocks					Prewater	157 Y	616	Kari
4/24			20.51		No Gypsum Blocks						310 N		Kari
5/1		1.04	30		No Gypsum Blocks					Prewater	325 N		Kari
5/7			30		No Gypsum Blocks						325 N		Kari
5/15			30		No Gypsum Blocks						325 N		Kari
5/19					No Gypsum Blocks					Plant			Phil
5/22	0.10	1.25	42.58		No Gypsum Blocks					200-12	92 Y	609	Kari
5/28	1.42		59.2		No Gypsum Blocks					Control	258 Y	609	Kari
6/5	0.09		80.92	1 Leaf	No Gypsum Blocks					Control	187 Y	617	Kari
6/6					Installed Gypsum Blocks								Kari & David
6/12	2.42	0.53	86.26		97.4	98.3	98.5	20.7	98.8	Control	280 N		Kari & David
6/13			Pivotrac	2 Leaf						200-12	284 Y		Leon
6/13		2.27	Pivotrac	2 Leaf						Split	292 Y	600	Leon
6/19			103.07	4 Leaf	97.1	98.2	98.7	20.4	71.5	Control	160 Y	617	Kari & David
6/21			Pivotrac	4 Leaf						Split	284 Y		Leon
6/22		1.85	Pivotrac	4 Leaf						200-12	292 Y	600	Leon
6/26	1.39		117.74	5 Leaf	97.0	98.3	98.6	18.7	70.1	Control	115 Y	590	Paul
7/2			Pivotrac	6 Leaf						Split	284 Y		Leon
7/2		skip	Pivotrac	6 Leaf						200-12	292 Y		Leon
7/3	0.23		129.25	7 Leaf	89.5	98.5	98.7	20.6	70.2	Control	3 Y	635	Paul
7/9			Pivotrac	9 Leaf						Split	284 Y		Leon
7/9		skip	Pivotrac	9 Leaf						200-12	292 Y		Leon
7/10			147.81	10 Leaf	37.2	56.6	98.1	20.8	69.2	Control	358 Y	608	Paul
7/16			Pivotrac	11 Leaf						Split	284 Y		Leon
7/16		1.92	Pivotrac	11 Leaf						200-12	292 Y	600	Leon
7/17	0.24		165.68	11 Leaf	25.5	27.9	93.4	19.5	69.3	Control	334 Y	631	Paul
7/23			Pivotrac	Tassel						Split	284 Y		Leon
7/23		1.87	Pivotrac	Tassel						200-12	292 Y	600	Leon
7/24	0.08		184.49	Tassel	22.5	20.9	74.8	39.1	68.8	Control	328 Y	594	Paul
7/31			Pivotrac	Silk						Split	284 Y		Leon
7/31		1.73	Pivotrac	Silk						200-12	292 Y	600	Leon
7/31	1.43		202.6	Silk	40.1	20.3	62.7	34.1	69.0	Control	310 Y	597	Paul
8/7			Pivotrac	Blister						Split	284 Y		Leon
8/7	0.12		220.65	Blister	52.5	16.4	65.8	34.1	67.1	200-12	291 Y	593	Paul
8/7		2.02	Pivotrac	Blister						200-12	292 Y	600	Leon
8/13				Milk	78.6	14.8	61.8	34.5	66.8	Control			Leon
8/14	0.96		239.35	Milk	77.3	15.3	59.3	34.8	66.8	Control	275 Y	623	Paul
8/14			Pivotrac	Milk						Split	284 Y		Leon
8/14		1.82	Pivotrac	Milk						200-12	292 Y	600	Leon
8/21	0.06		258.35	Dough	57.4	12.3	51.8	35.2	66.4	Control	257 Y	600	Jerry
8/22			Pivotrac	Dough						Split	284 Y		Leon
8/22		1.78	Pivotrac	Dough						200-12	292 Y	600	Leon

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				
8/28	1.08		276.63	Dent	41.4	13.8	51.4	36.3	66.2	Control	241 Y	594	Paul
8/29			Pivotrac	Dent						Split	284 Y		Leon
8/29		skip	Pivotrac	Dent						200-12	292 Y		
9/4			299.65	1/4 ml	66.1	35.7	46.5	12.4	66.5	Control	244 Y	588	Paul
9/5			Pivotrac							Split	284 Y		Leon
9/5		skip	Pivotrac							200-12	292 Y		Leon
9/11	1.45		312.36	1/2 ml	87.9	12.8	50.7	36.0	66.2	Control	242 Y	543	Paul
9/12			Pivotrac	1/2 ml						Split	284 Y	550	Leon
9/12		1.85	Pivotrac	1/2 ml						200-12	292 Y	550	Leon
9/18	0.61		314.86	3/4 ml	94.2	19.4	47.6	32.5	69.1		294 N		Paul
9/25			314.86	7/8 ml	90.5	16.9	49.8	35.6	65.7		294 N		Paul
10/2	0.26		314.86	Black Layer	89.1	17.2	49.1	35.3	65.5		294 N		Paul
10/9	0.06		314.86	Black Layer	85.2	17.6	46.5	36.2	65.1		294 N		Paul
10/16	0.73		314.86	Black Layer	82.1	9.7	42.6	31.4	66.8		293 N		Paul
10/23	0.09		314.86	Black Layer	83.4	10.5	42.3	30.6	63.6		294 N		Paul
10/30			314.86	Harvested	83.2	23.2	43.2	32.1	63.7		289 N		Paul
Total	**11.68**	**21.89**			**0.27"**	**1.20"**	**0.13"**	**-0.22"**	**0.92"**				
Net Soil Moisture is 2.30"													
Irrigation, Rainfall Plus Net Soil Moisture is 35.87"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

200-12

Year: *2014* **County:** *Hartley* **Grower:** *Phil Haaland*

No. Acres: *2.7* **Variety/Hyb:** *P1151AM* **Soil Type:** *Dallam Fine Sandy Loam*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *191-19-0-2.5s-0.5zn* **Seeding:** *30,000*

Planted: *May 19, 2014* **Harvest:** *October 25, 2014*

Herbicide: *Cinch ATZ, Balance Flex, Atrazine, Basis Blend, Roundup, Status* **Insecticide:** *3 Pints Comite*

Yield: *219 bu/ac* **Prev. crop:** *Wheat* **Row width:** *30 Inch*

Irrigation method: *Center Pivot* **Prewater:** *3.00 in.* **Well GPM:** *5.0*

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

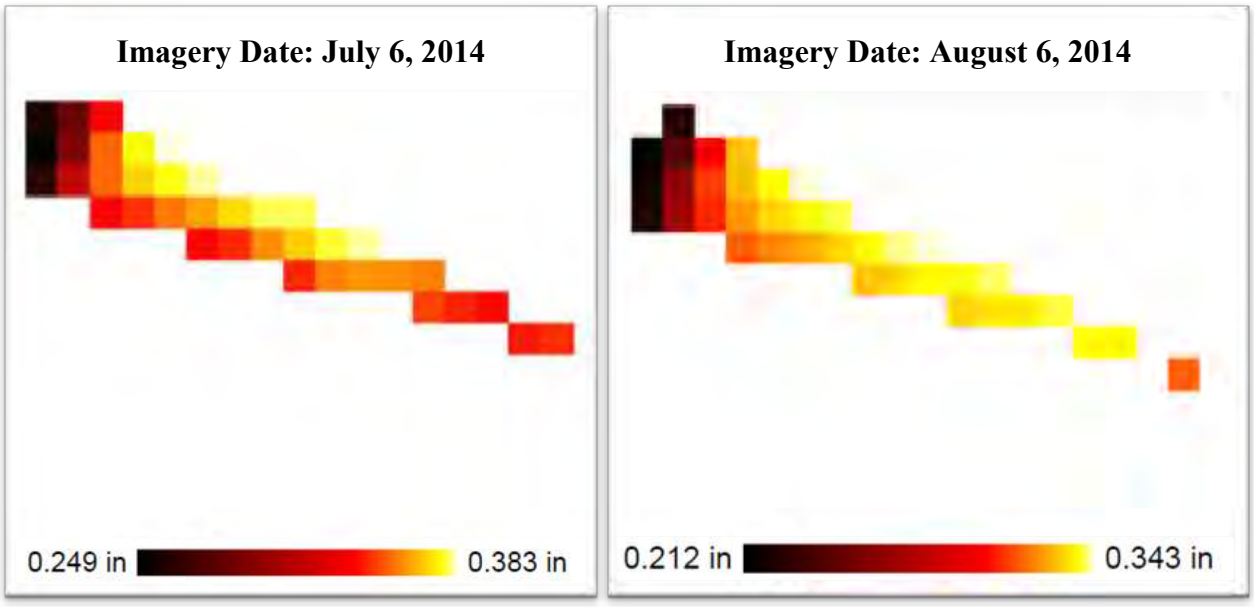
Application pattern: *Spray* **Crop row direction :** *Straight*

GPS Location of Pivot Pad
Latitude: *36.040321*
Longitude: *-102.437642*

GPS Location of Gypsum Blocks
Latitude: *36.038132*
Longitude: *-102.434607*

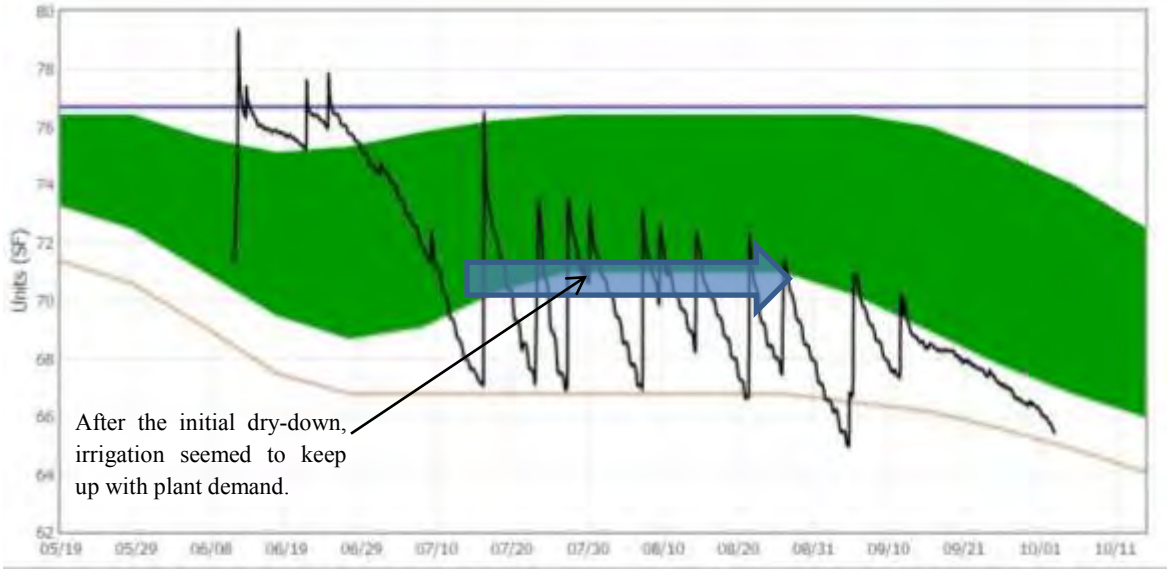
Satellite Imagery: Satellite imagery was initiated and used in 2013 to learn and evaluate its potential for an irrigation and water management tool for growers in connection with HydroBio. The use of satellite imagery was continued for the 2014 growing season. Phil Haaland"s "200-12" field was one of eighteen "200-12" project fields included in 2014. It was from 284 to 292 degrees in the circle. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Phil Haaland"s "200-12" field are shown in figure 45 to illustrate examples of what is displayed on the website. The first image was on July 6 at the 7 leaf stage. The second image is on August 6 at the blister stage. The satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 219 bushels per acre with 21.89 inches of irrigation.

Figure 45: Daily Water Use for Phil Haaland's ""200-12"" Demonstration Field



Note: Each Square Represents 1/8 of an Acre

Phil Haaland's "200-12" Field AquaSpy® Probe Summary



This site began with a full soil profile and there was some evidence of drainage early on. There was then very good deep early root growth were the soil dried down in the first 3 ft before consistent deep irrigation was able to keep the soil wet in the top 2 ft for the remainder of the season. There was evidence of root growth to 48" by the end of the season and the crop was able to make good use of all stored soil moisture by the end. The relatively low water use efficiency was mainly due to the large amount of irrigation water applied to keep the topsoil wet throughout the season. However, apart from the early drainage events, it is hard to see where things could be greatly improved through changes in irrigation management.

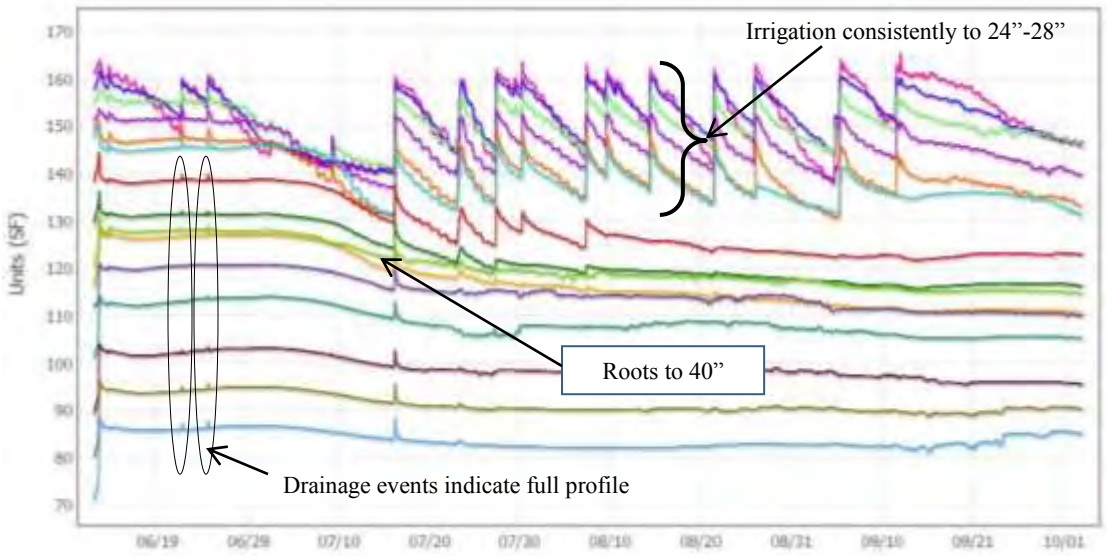


Figure 46: Gypsum Block Readings for Phil Haaland's Control Demonstration Field (266 bu/ac)

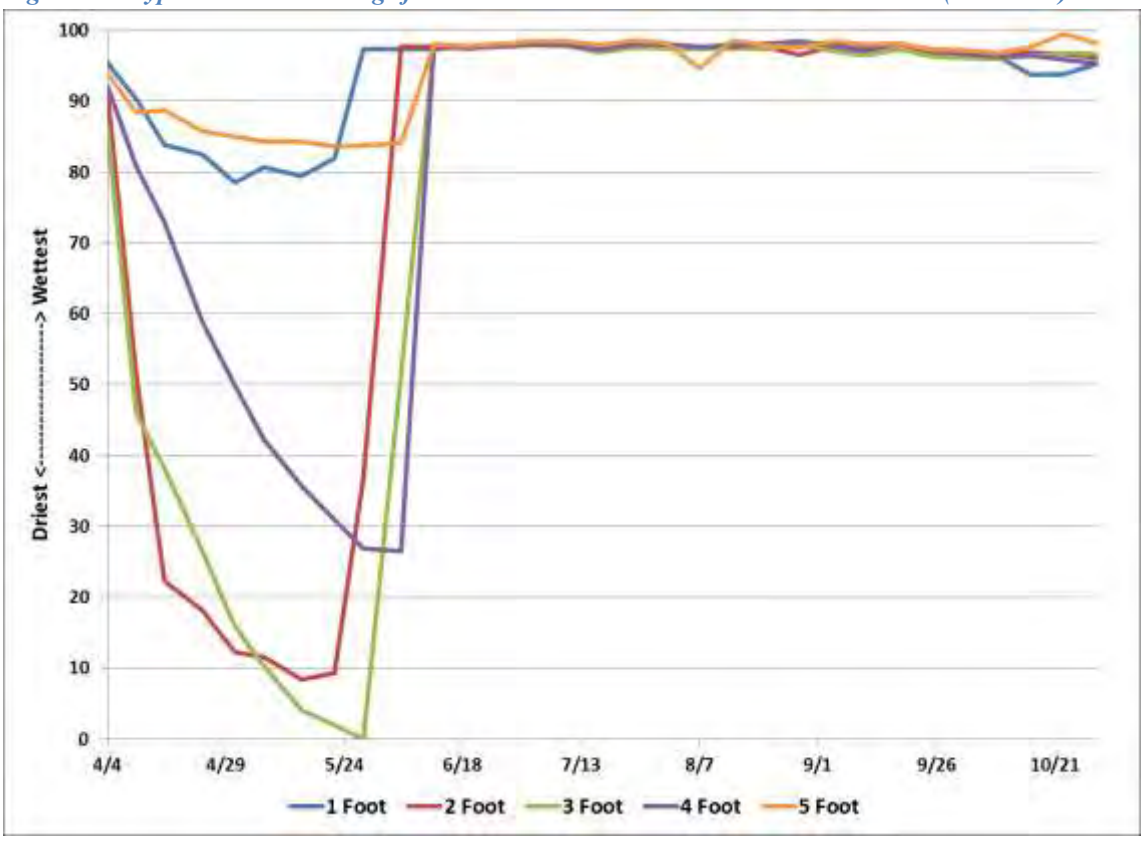


Figure 47: Growing Season Water Tracking for Phil Haaland's Control Demonstration Field (266 bu/ac)

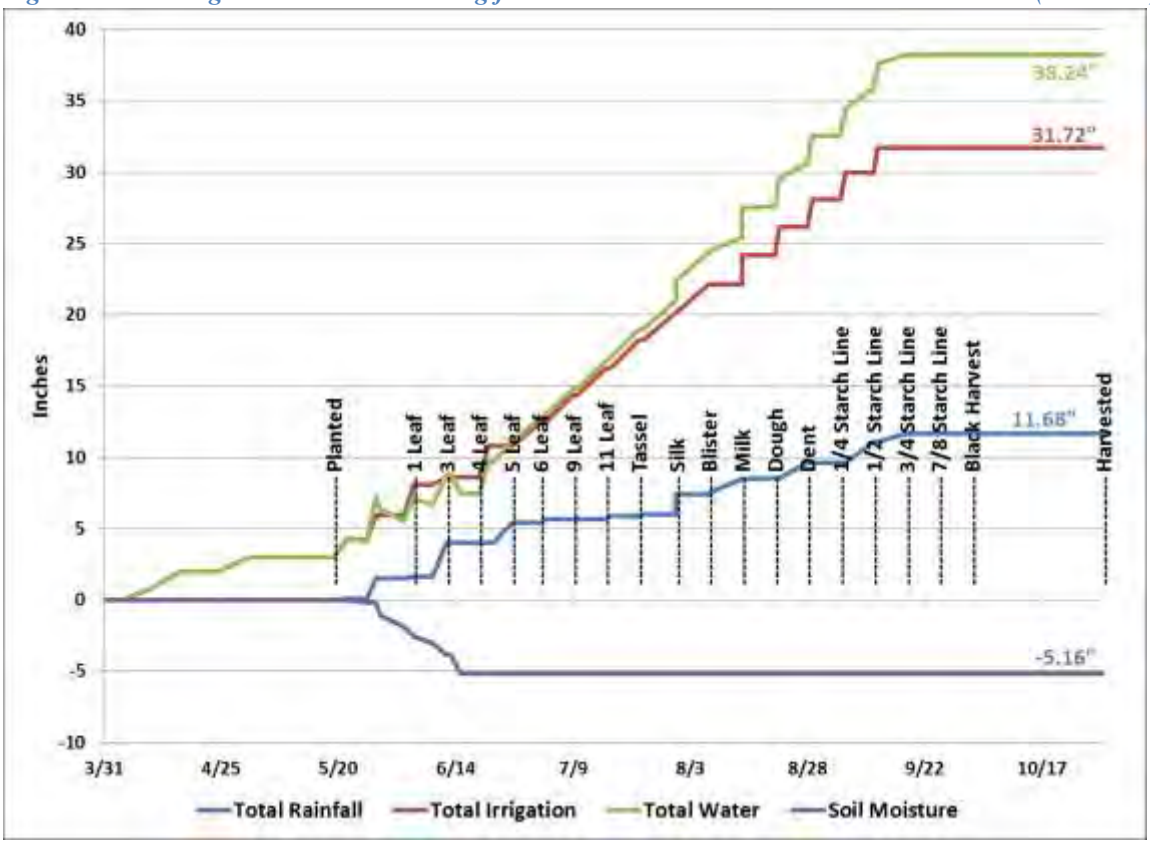


Table 39: Demonstration Field Data for Phil Haaland's Control Demonstration Field

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				
3/31			No Meter								289 N		Paul & Kari
4/4			No Meter		95.4	91.2	86.2	92.2	94.0		290 N		Kari
4/10	0.04	0.78	7.83		90.3	51.3	45.9	80.8	88.4	Prewater	68 Y	620	Kari
4/16		1.18	19.62		83.9	22.3	38.2	73.0	88.8	Prewater	157 Y	616	Kari
4/24			20.51		82.5	18.2	26.6	59.0	85.8		310 N		Kari
5/1		1.04	30		78.6	12.3	15.9	49.9	85.0	Prewater	325 N		Kari
5/7			30		80.7	11.6	10.3	42.3	84.3		325 N		Kari
5/15			30		79.5	8.4	4.1	35.7	84.3		325 N		Kari
5/19										Plant			Phil
5/22	0.10	1.25	42.58		81.9	9.3	1.9	31.0	83.7	Control	92 Y	609	Kari
5/28	1.42	1.66	59.2		97.4	36.9	0.0	26.9	83.8	Control	258 Y	609	Kari
6/5	0.09	2.17	80.92	1 Leaf	97.4	97.7	51.6	26.5	84.1	Control	187 Y	617	Kari
6/12	2.42	0.53	86.26	3 Leaf	97.4	97.7	98.0	98.0	98.0	Control	280 N		Kari & David
6/13			Pivotrac	3 Leaf						Control	279 Y		Leon
6/13			Pivotrac	3 Leaf						Split	284 Y		Leon
6/13			Pivotrac	3 Leaf						200-12	292 Y		Leon
6/19			103.07	4 Leaf	97.8	97.5	97.6	97.6	97.8	Control	160 Y	617	Kari & David
6/21		2.21	Pivotrac	4 Leaf						Split	284 Y	600	Leon
6/22			Pivotrac	4 Leaf						200-12	292 Y		Leon
6/26	1.39		117.74	5 Leaf	98.0	97.7	97.7	97.8	98.1	Control	115 Y	590	Paul & Kari
7/2		1.63	Pivotrac	6 Leaf						Split	284 Y	600	Leon
7/2			Pivotrac	6 Leaf						200-12	292 Y		Leon
7/3	0.23		129.25	7 Leaf	98.1	98.0	97.9	98.0	98.5	Control	3 Y	635	Paul
7/9		1.91	Pivotrac	9 Leaf						Split	284 Y	600	Leon
7/9			Pivotrac	9 Leaf						200-12	292 Y		Leon
7/10			147.81	10 Leaf	98.1	97.9	97.8	97.9	98.5	Control	358 Y	608	Paul
7/16		1.91	Pivotrac	11 Leaf						Split	284 Y	600	Leon
7/16			Pivotrac	11 Leaf						200-12	292 Y		Leon
7/17	0.24		165.68	11 Leaf	97.4	97.2	96.9	97.3	97.9	Control	334 Y	631	Paul
7/23		1.96	Pivotrac	Tassel						Split	284 Y	600	Leon
7/23			Pivotrac	Tassel						200-12	292 Y		Leon
7/24	0.08		184.49	Tassel	98.1	97.8	97.6	98.0	98.6	Control	328 Y	594	Paul
7/31		1.94	Pivotrac	Silk						Split	284 Y	600	Leon
7/31			Pivotrac	Silk						200-12	292 Y		Leon
7/31	1.43		202.6	Silk	97.8	97.7	97.5	98.0	98.3	Control	310 Y	597	Paul
8/7		1.95	Pivotrac	Blister						Split	284 Y	600	Leon
8/7			Pivotrac	Blister						200-12	292 Y		Leon
8/7	0.12		220.65	Blister	97.6	97.6	97.4	97.7	94.6	Control	291 Y	593	Paul
8/14	0.96		239.35	Milk	98.0	97.9	97.5	97.8	98.6	Control	275 Y	623	Paul
8/14		2.08	Pivotrac	Milk						Split	284 Y	600	Leon
8/14			Pivotrac	Milk						200-12	292 Y		Leon
8/21	0.06		258.35	Dough	98.0	97.7	97.4	98.1	97.9	Control	257 Y	600	Jerry

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				
8/22		1.95	Pivotrac	Dough						Split	284 Y	600	Leon
8/22			Pivotrac	Dough						200-12	292 Y		Leon
8/28	1.08		276.63	Dent	98.5	96.6	98.2	98.4	97.6	Control	241 Y	594	Paul
8/29		1.95	Pivotrac	Dent						Split	284 y	600	Leon
8/29			Pivotrac	Dent						200-12	292 Y		Leon
9/4			299.65	1/4 ml	97.9	97.7	97.1	97.9	98.5	Control	244 Y	588	Paul
9/5		1.87	Pivotrac	1/4 ml						Split	284 Y		Leon
9/5			Pivotrac	1/4 ml						200-12	292 Y		Leon
9/11	1.45		312.36	1/2 ml	97.4	97.1	96.4	97.1	98.0	Control	242 Y	543	Paul
9/12		1.75	Pivotrac	1/2 ml						Split	284 Y	550	Leon
9/12			Pivotrac	1/2 ml						200-12	292 Y		Leon
9/18	0.61		314.86	3/4 ml	98.1	98.2	97.4	98.1	98.1		294 N		Paul
9/25			314.86	7/8 ml	97.2	96.7	96.3	97.2	97.4		294 N		Paul
10/2	0.26		314.86	Black Layer	96.6	96.6	96.1	96.7	97.2		294 N		Paul
10/9	0.06		314.86	Black Layer	96.3	96.4	96.0	96.3	96.8		294 N		Paul
10/16	0.73		314.86	Black Layer	93.7	96.9	96.5	96.4	97.7		293 N		Paul
10/23	0.09		314.86	Black Layer	93.8	96.7	96.8	95.9	99.5		294 N		Paul
10/30			314.86	Harvested	95.3	96.1	96.7	95.3	98.1		289 N		Paul
Total	**11.68**	**31.72**			**-0.21"**	**-1.38"**	**-1.78"**	**-1.23"**	**-0.56"**				
Net Soil Moisture is -5.16"													
Irrigation, Rainfall Plus Net Soil Moisture is 38.24"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

Control

Year: *2014* **County:** *Hartley* **Grower:** *Phil Haaland*

No. Acres: *117* **Variety/Hyb:** *P1151AM* **Soil Type:** *Gruver Loam, Dallam Fine Sandy Loam*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *191-19-0-2.5s-0.5zn* **Seeding:** *37,000*

Planted: *May 19, 2014* **Harvest:** *October 24, 2014*

Herbicide: *Cinch ATZ, Balance Flex, Basis Blend, Weedmaster, Roundup* **Insecticide:** *3 Pints Comite*

Yield: *266 bu/ac* **Prev. crop:** *Wheat* **Row width:** *30 inch*

Irrigation method: *Center Pivot* **Prewater:** *3.00 in.* **Well GPM:** *5.0*

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

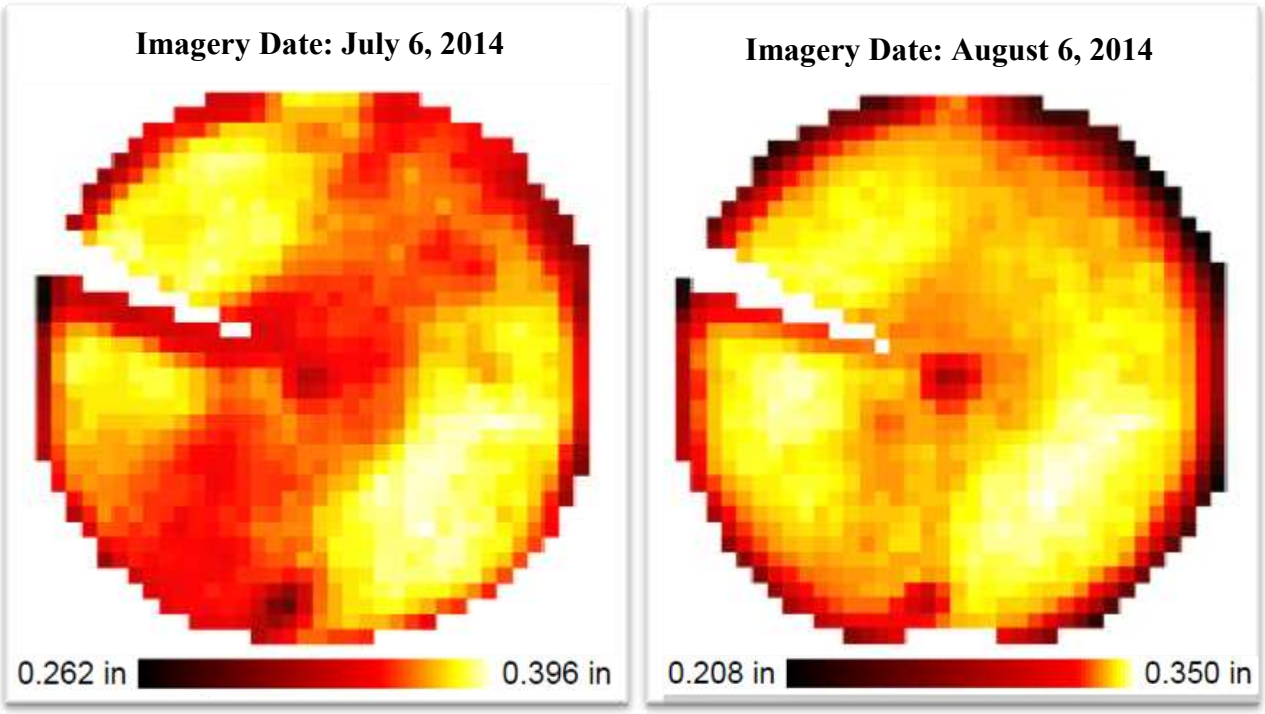
Application pattern: *Spray* **Crop row direction :** *Streight*

GPS Location of Pivot Pad
Latitude: *36.040346*
Longitude: *-102.428769*

GPS Location of Gypsum Blocks
Latitude: *36.037621*
Longitude: *-102.42956*

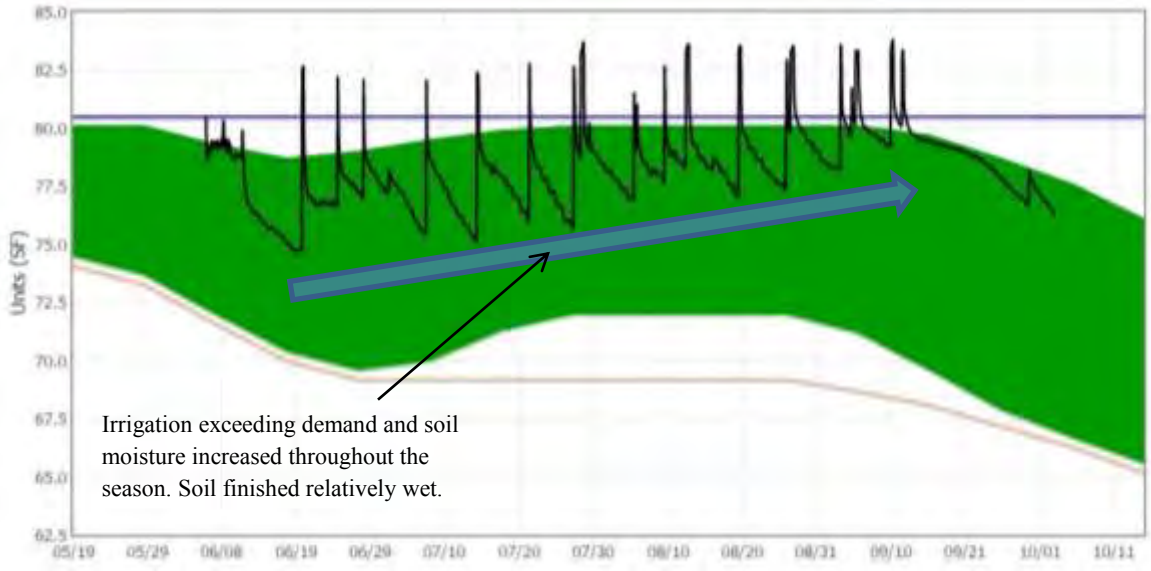
Satellite Imagery: Phil Haaland"s "control" field was one of eighteen "200-12" project fields included in satellite imagery in 2014. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Phil Haaland"s "control" field in figure 48 illustrate examples of what is displayed on the website. The first image is on July 6 at the 7 leaf stage. The second image is on August 6 at the blister stage. Satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 266 bushels per acre with 31.72 inches of irrigation.

Figure 48: Daily Water Use for Phil Haaland's "control" Demonstration Field

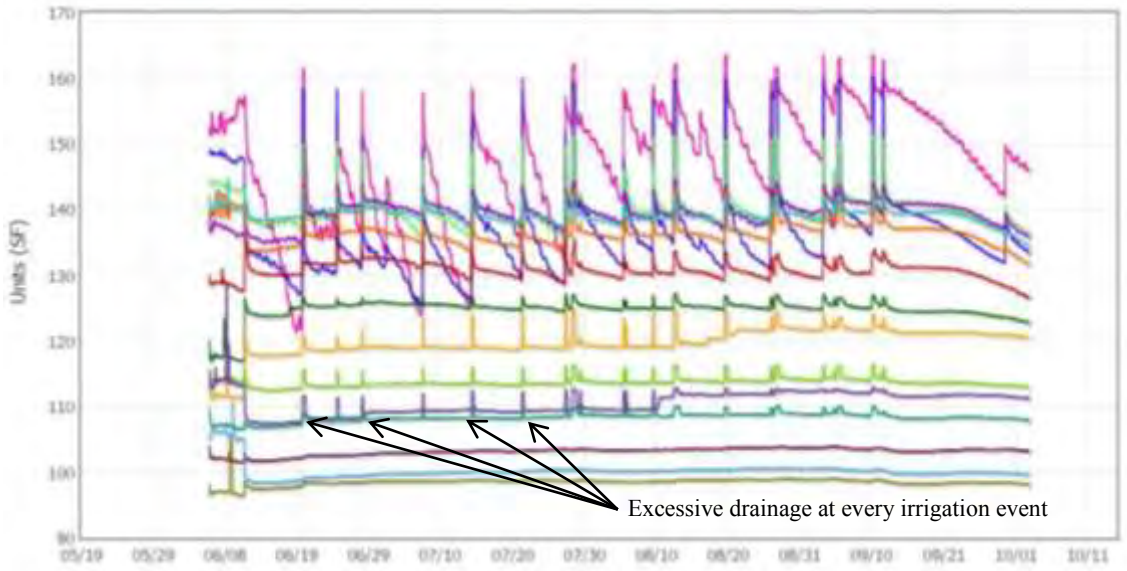


Note: Each Square Represents 1/8 of an Acre

Phil Haaland's Control Field AquaSpy® Probe Summary



There is little wonder that this field had the lowest irrigation efficiency of any field. There was evidence of significant drainage at every irrigation event and the soil moisture actually increased over the course of the season. While it is true that this field had a high yield, this was due to the fact that water was non-limiting through over irrigation. The root activity was evident at 40" by the very end of the season, but the majority of water uptake was in the top 28" for the most of the season. It is likely that significant amounts of fertilizer may also have been necessary due to the excessive drainage encountered at this site. Net profit may have been harmed as a result of the high input costs.



Harvest Results: The "200-12" field produced a 219 bushel per acre corn yield. Irrigation totaled 21.89 inches, of which 3.00 were pre-water. Production in the "control" field was 266 bushels per acre. Total irrigation was 31.72 that included 3.00 inches of pre-water. Seasonal irrigation was 28.72 inches. In comparison, the "control" field produced 47 bushels per acre more than the "200-12" and irrigation was 9.83 inches more. Corn production was 10.0 bushels (560lbs) per inch of irrigation in the "200-12" field compared to 8.38 bushels (469lbs) in the "control". Production from each inch of irrigation, rainfall and net soil water that totaled 35.87 inches was 6.11 bushels (342lbs) per acre in the "200-12" field. Irrigation, rainfall and net soil water totaled 38.24 inches in the "control" field where production was 6.95 bushels (389lbs) per inch. Crop production costs were $110.85 per acre less for the "200-12" field than for the "control" from reduced seed, irrigation and harvest expenses. At $4.00 per bushel, the 47 more bushels per acre corn yield in the "control" field amounts to $188.00 more per acre. The "control" field"s net gain was $76.15 per acre with 9.83 inches more irrigation used compared to production from the "200-12" field. Net return was $481.12 from the "control" field compared to $403.97 from the "200-12". Net return from the additional 9.83 inches of irrigation was $7.74 per inch. Net return from each inch of irrigation was $18.45 for the "200-12" field compared to $15.16 from the "control". A summary of the demonstration results are shown in table 40 below.

Table 40: Phil Haaland's 2014 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $4.00/bu		
			bu/ac	lb/ac-in Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"200-12"	21.89	*35.87	219	560	$876.00	$40.02	$24.42
Control	31.72	†38.24	266	469	$1,064.00	$33.54	$27.82

*Includes 2.30 inches of water removed from five feet of soil, plus rainfall, and irrigation.
†Includes -5.16 inches of water added to five feet of soil, plus rainfall, and irrigation.

Tommy Laubhan's 2014 Lipscomb County Demonstration

Planting and Crop Information: For his demonstration, Tommy Laubhan strip tilled and planted 62 acres of corn in the south half circle of the northwest quarter of section 1062, for his "200-12" field, "Laubhan 200-12". Laubhan planted his "200-12" field with Pioneer P1266AM at a seeding rate of 32,000 seeds per acre. He planted the north half circle 62 acres, also strip tilled, to Pioneer P1266AM at 32,000 seeds per acre for his "control" field, "Laubhan Control". Both the "200-12" and "control" fields were irrigated using the same center pivot. The "200-12" field was from 98 to 278 degrees in the circle. The "control" field was from 278 to 98 degrees. Pivotrac™ provided a text message when the center pivot entered and departed the "200-12" field. Irrigation amounts were calculated using the time (in hours) the "200-12" and the "control" fields were individually irrigated using corresponding water meter readings. Seasonal water meter readings averaged 688 gpm and delivered an average of 1.03 inches of irrigation in a 3.5 day revolution. Planting and crop information for "Laubhan 200-12" and "Laubhan Control" are shown in the table 41 below.

Table 41: Planting and Crop Information for Tommy Laubhan

"200-12" Demonstration Field			
Planted:	*May 7*	**Harvested:**	*October 25*
Hybrid:	*P1266AM*	**Seeding Rate:**	*32,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*62*	**GPM Per Acre:**	*5.5*
Total Water:	*31.90 in.*	**Soil Type:**	*Veal Loam, Texroy Loam*
Fertilizer:	*270-70-15-60s-4zn*	**Insecticide:**	*Comite*
Herbicide:	*Roundup, Banvel D, Cinch ATZ*		
Control Demonstration Field			
Planted:	*May 7*	**Harvested:**	*October 24*
Hybrid:	*P1266AM*	**Seeding Rate:**	*32,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*62*	**GPM Per Acre:**	*5.5*
Total Water:	*36.04 in.*	**Soil Type:**	*Texroy, Quannah Soils*
Fertilizer:	*270-70-15-60s-4zn*	**Insecticide:**	*Comite*
Herbicide:	*Roundup, Banvel D, Cinch ATZ*		

Beginning Soil Water Profile and Growing Season Rainfall

"200-12" Demonstration Field: Gypsum block soil moisture sensors were installed April 30 just prior to planting. Initial readings show soil water was good at 1 foot following 2.12 inches of pre-water, 30 percent at 2 feet, 50 percent at 3 and 4 feet, and 35 percent at 5 feet in the profile following planting. The sensors indicate pre-water did not reach two feet in the soil profile. Additional readings show the profile was filled to 5 feet by 2.57 inches of irrigation following planting, followed by 1.0 inch of rainfall June 4 and 1.57 inches June 11. Plants were at the 6 leaf growth stage. Additional sensor readings show the crop had adequate soil moisture during the growing season. Beneficial rainfall was 1.71 inches June 25 at the eight leaf stage and 1.89 inches July 2 at 10 leaves. Plant roots used water from 1, 2 and 3 feet plus irrigation during July

and early August at tassel, pollination and early grain development growth stages. Plant water use was high during hotter temperatures. Rainfall of 1.85 inches August 27 plus 0.87 inches September 3 provided good soil water to finish the crop and left 3.20 inches more in the soil profile than at planting. Seasonal rainfall from planting until harvest was 13.82 inches. Gypsum blocks were in Texroy loam soil that holds 2.0 inches of available water for potential plant use at 1, 2 and 3 feet and 1.7 inches at 4 and 5 feet.

Control Demonstration Field: Soil moisture sensors show soil water was good at 1, 2, 3, 4 and 5 feet following planting. Weekly gypsum moisture sensor readings that followed show the profile was generally maintained at field capacity during the growing season. Beneficial rainfall was 1.0, 1.57 and 1.71 inches in June, 1.89, 0.59 and 1.22 inches in July, 1.84 and 1.85 inches in August and 0.87 in September. The soil profile gained 0.62 inches of water from planting until harvest. Rainfall totaled 13.82 inches from planting until harvest. Gypsum soil moisture sensors were installed in Texroy loam soil that holds 2.0 inches of water for potential plant use at 1, 2 and 3 feet and 1.7 inches at 4 and 5 feet in the soil profile. Monthly rainfall recorded at the demonstration fields are in table 42.

Table 42: Monthly Rainfall Data for Tommy Laubhan

	May	June	July	August	September	Total
"200-12"	0.35"	4.53"	3.87"	3.77"	1.30"	**13.82"**
Control	0.35"	4.53"	3.87"	3.77"	1.30"	**13.82"**

Growing Season Water Tracking: The District tracked crop total water throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. A 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 "200-12" field. Another set of the same type of sensors were installed in each "control" field. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in the field. Gypsum blocks were installed in the "200-12" field and "control" field one week prior to planting. Each AquaSpy® probe was installed following crop emergence. Installing and reading the gypsum blocks prior to planting provided advanced soil moisture conditions and information to help guide and manage irrigation. 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 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 "200-12" field are shown first, followed by the same illustrations for the "control" field.

Figure 49: Gypsum Block Readings for Tommy Laubhan's "200-12" Demonstration Field (181 bu/ac)

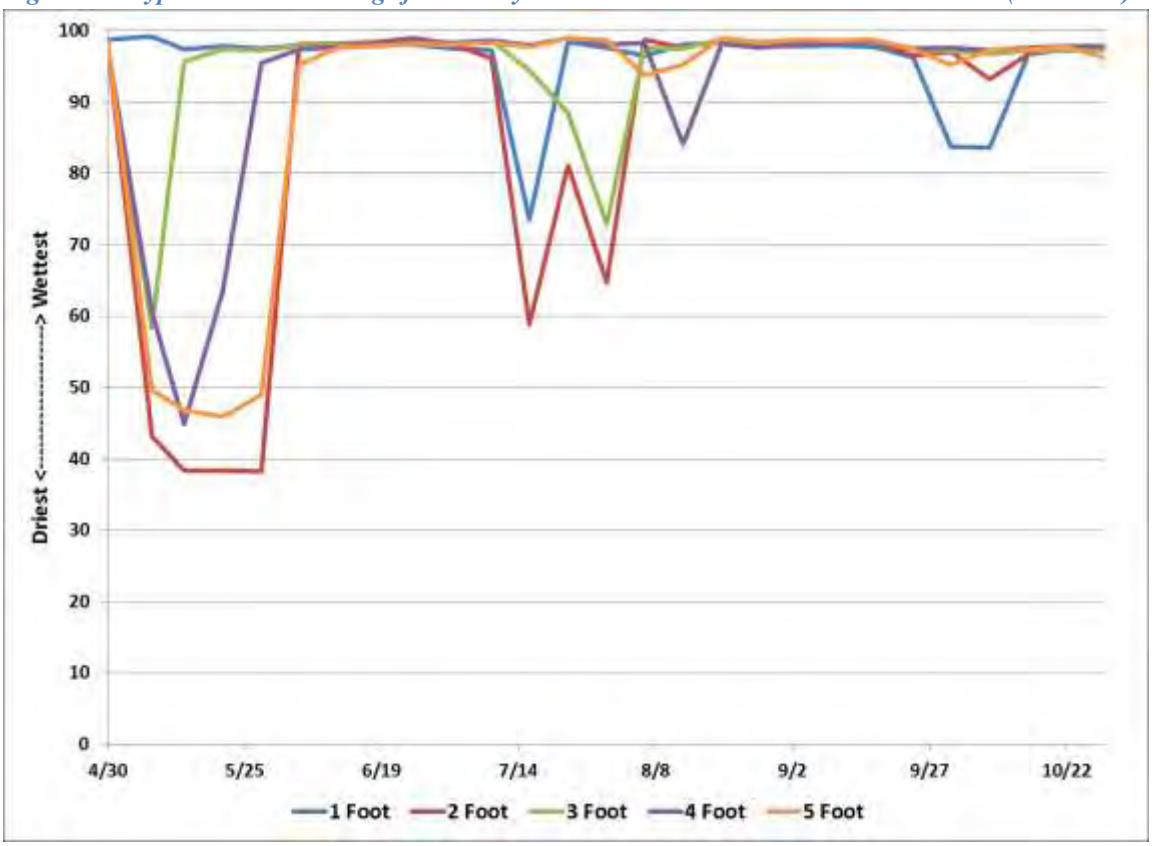


Figure 50: Growing Season Water Tracking for Tommy Laubhan's "200-12" Demonstration Field (181 bu/ac)

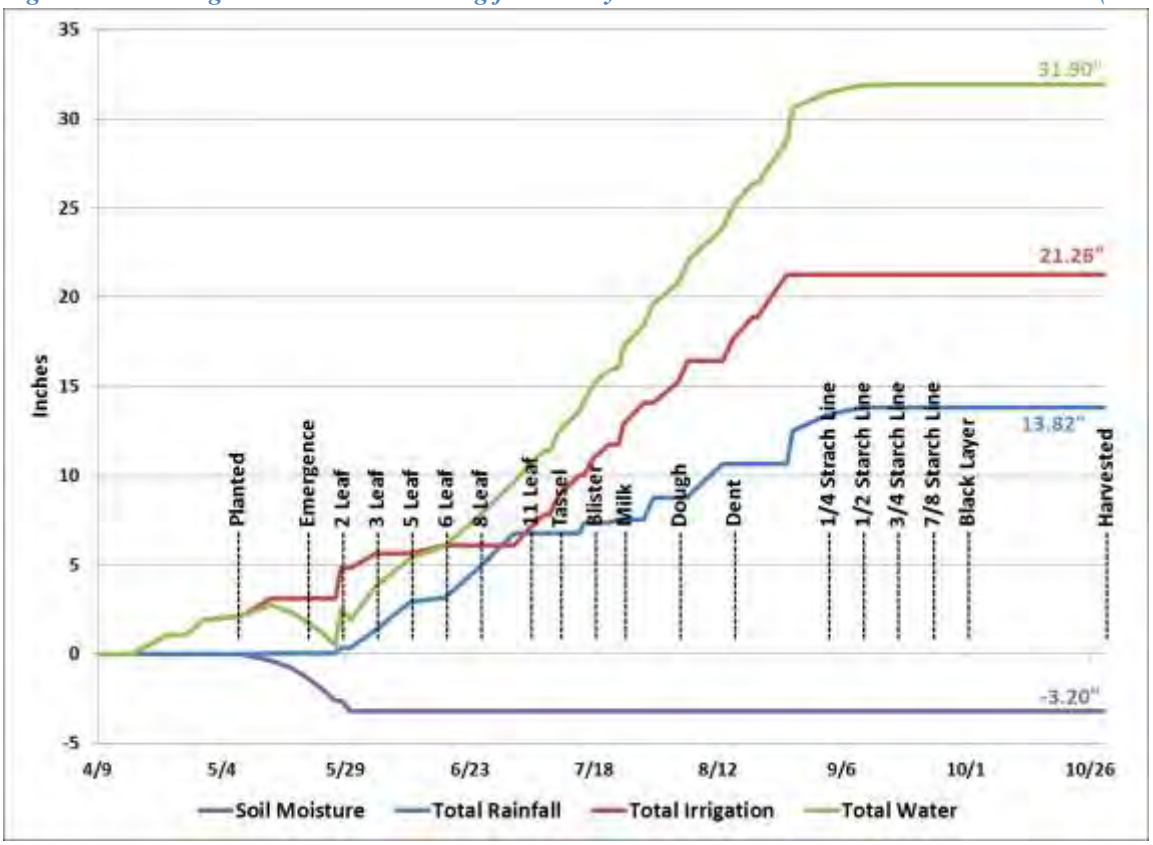


Table 43: Demonstration Field Data for Tommy Laubhan's "200-12" Demonstration Field

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			No Meter		No Gypsum Blocks								Leon
4/16			0		No Gypsum Blocks					Prewater			Tommy
4/23	0.50	1.09	11.25		No Gypsum Blocks						90 N		Kari
4/27					No Gypsum Blocks					Prewater			Tommy
4/30	0.02	0.8	19.59		98.7	97.9	97.6	97.6	98.3	Prewater	20 Y	671	Kari
5/7		0.23	22.01							Plant			Tommy
5/8			22.01		99.2	43.2	58.3	60.6	49.6		98 N		Kari
5/14	0.03	0.97	32.02		97.4	38.3	95.7	44.9	46.8		150 N		Kari
5/21			49.09	Emergence	97.8	38.3	97.4	63.5	45.9	200-12	125 Y	673	Kari
5/28	0.32	1.72	49.81	2 Leaf	97.5	38.2	97.2	95.4	49.0		115 N		Kari
6/4	1.00	0.85	58.6	3 Leaf	97.9	98.1	97.8	97.4	95.2		120 N		Kari & David
6/11	1.57		58.6	5 Leaf	98.1	98.2	98.1	97.7	97.6		120 N		Kari & David
6/18	0.25	0.43	63.05	6 Leaf	98.3	98.4	98.1	98.0	97.8		9 N		Kari & David
6/25	1.71		77.79	8 Leaf	98.1	98.9	98.5	98.6	98.2	200-12	246 Y	676	Paul
7/2	1.89		86.6	10 Leaf	97.5	98.1	98.3	98.3	98.0		252 N		Paul
7/5		0.94	Pivotrac	11 Leaf						200-12	278 Y	670	Leon
7/8		0.78	Pivotrac	12 Leaf						200-12	278 Y	670	Leon
7/9			99.28	12 Leaf	97.3	96.1	98.6	98.6	98.3	Control	59 Y	690	Paul
7/11	.	1.11	Pivotrac	Tassel						200-12	278 Y	670	Leon
7/15		1.12	Pivotrac	Silk						200-12	278 Y	670	Leon
7/16	0.59		120.29	Silk	73.6	58.9	94.4	97.9	97.7	Control	23 Y	698	Paul
7/18		0.98	Pivotrac	Blister						200-12	278 Y	670	Leon
7/21		0.73	Pivotrac	Blister						200-12	278 Y	670	Leon
7/23	0.17		141.29	Blister	98.4	81.1	88.4	99.0	99.0	200-12	146 Y	677	Paul
7/24		1.16	Pivotrac	Milk						200-12	278 Y	670	Leon
7/28		1.17	Pivotrac	Milk						200-12	278	670	Leon
7/30	1.22		162.27	Milk	97.6	64.8	72.9	98.1	98.6		81 N		Paul
8/4		1.18	Pivotrac	Dough						200-12	278 Y	670	Leon
8/6		1.17	Pivotrac	Dough						200-12	278 Y	670	Leon
8/6	0.08		174.5	Dough	96.5	98.7	97.6	98.3	93.7	Control	286 Y	709	Paul
8/13	1.84		187.3	hd Dough	98.1	97.6	97.5	84.1	95.2	200-12	100 Y	724	Paul
8/15		1.2	Pivotrac	Dent						200-12	278 Y	670	Leon
8/15				Dent									Tommy
8/19		1.24	Pivotrac	Dent						200-12	278 Y	670	Leon
8/20			209.16	Dent	98.3	98.6	98.8	98.2	99.0	Control	40 Y	720	Jerry
8/23		1.24	Pivotrac	Dent						200-12	278 Y	670	Leon
8/26		1.17	Pivotrac	Dent						200-12	278 Y	670	Leon
8/27	1.85		230.84	Dent	97.9	98.1	98.2	97.6	98.4	Control	330 Y	645	Paul
9/3	0.87		236.35	1/4 ml	97.8	98.2	98.2	98.1	98.7		113 N		Paul
9/10	0.40		236.35	1/2 ml	97.9	98.4	98.4	98.4	98.6		114 N		Paul

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				
9/17	0.03		236.35	3/4 ml	97.7	98.5	98.5	98.5	98.7		113 N		Paul
9/24			236.35	7/8 ml	96.2	96.5	97.4	97.5	97.4		114 N		Paul
10/1			236.35	Black Layer	83.7	97.0	97.1	97.6	95.2		113 N		Paul
10/8			236.35	Black Layer	83.6	93.2	96.7	97.2	97.3		113 N		Paul
10/15	2.03		236.35	Black Layer	96.7	96.7	97.2	97.6	97.4		114 N		Paul
10/22			236.35	Black Layer	97.4	97.6	97.1	97.8	97.7		113 N		Paul
10/29	0.07		236.35	Harvested	97.4	97.2	97.5	97.8	96.2		84 N		Paul
Total	**13.82**	**21.28**			**0.11"**	**-1.04"**	**-0.84"**	**-0.76"**	**-0.67"**				
Net Soil Moisture is -3.20"													
Irrigation, Rainfall Plus Net Soil Moisture is 31.90"													

• Numbers in red are not counted in the total

NORTH PLAINS GROUNDWATER Conservation District

2014-Corn Demonstration
Irrigated Medium Season Corn

200-12

Year: *2014* **County:** *Lipscomb* **Grower:** *Tommy Laubhan*

No. Acres: *62* **Variety/Hyb:** *P1266AM* **Soil Type:** *Veal Loam, Texroy Loam*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *270-70-15-60s-4zn* **Seeding:** *32,000*

Planted: *May 7, 2014* **Harvest:** *October 25, 2014*

Herbicide: *Roundup, Banvel D, Cinch ATZ* **Insecticide:** *Comite*

Yield: *181 bu/ac* **Prev. crop:** *Wheat* **Row width:** *30 Inch*

Irrigation method: *Center Pivot* **Prewater:** *1.89 in.* **Well GPM:** *5.5*

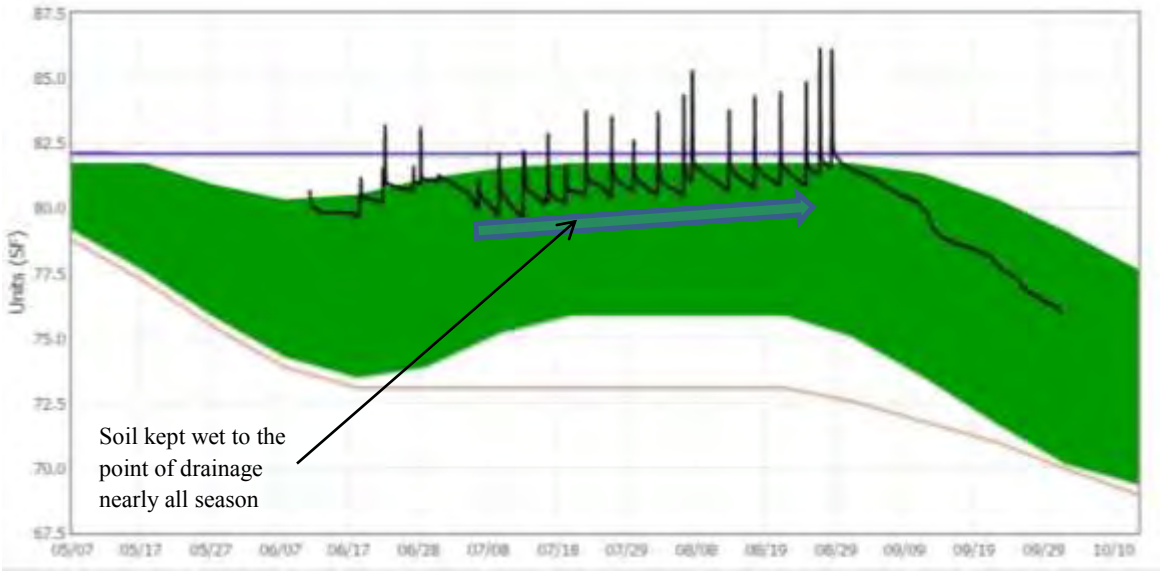
Distance between drops: *60"* **Distance from nozzle to ground:** *16"*

Application pattern: *Spray* **Crop row direction :** *Circle*

GPS Location of Pivot Pad
Latitude: *36.40097*
Longitude: *-100.10869*

GPS Location of Gypsum Blocks
Latitude: *36.400286*
Longitude: *-100.105031*

Tommy Laubhan's "200-12" Field AquaSpy® Probe Summary



This site appeared to have significant issues with drainage during every irrigation event. While it is possible that there wasn't a good installation, allowing some water to move down the side of the probe, it is most likely that the signatures were indeed caused by significant amounts of drainage. This would account for the relatively low irrigation efficiency figures and possibly the low yield. It is likely that this field would have had a significant amount of leaching and very low fertilizer use efficiency – especially from fertigation. Root activity and water uptake was largely restricted to the top 20".

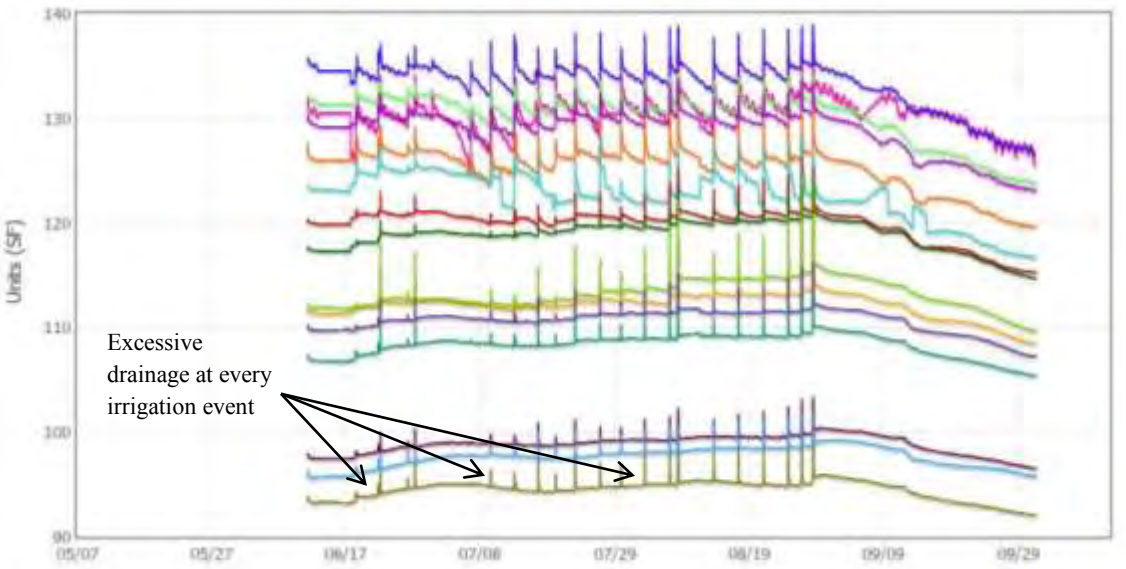


Figure 51: Gypsum Block Readings for Tommy Laubhan's Control Demonstration Field (192 bu/ac)

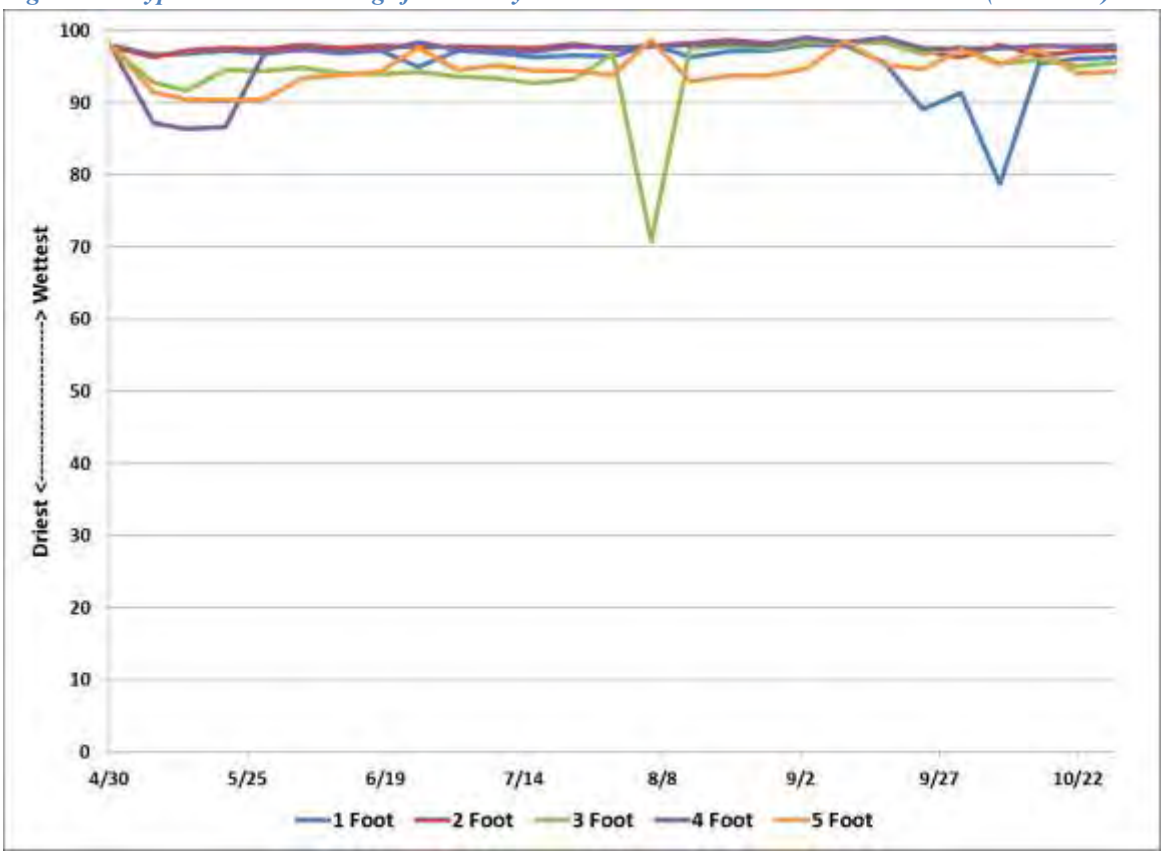


Figure 52: Growing Season Water Tracking for Tommy Laubhan's Control Demonstration Field (192 bu/ac)

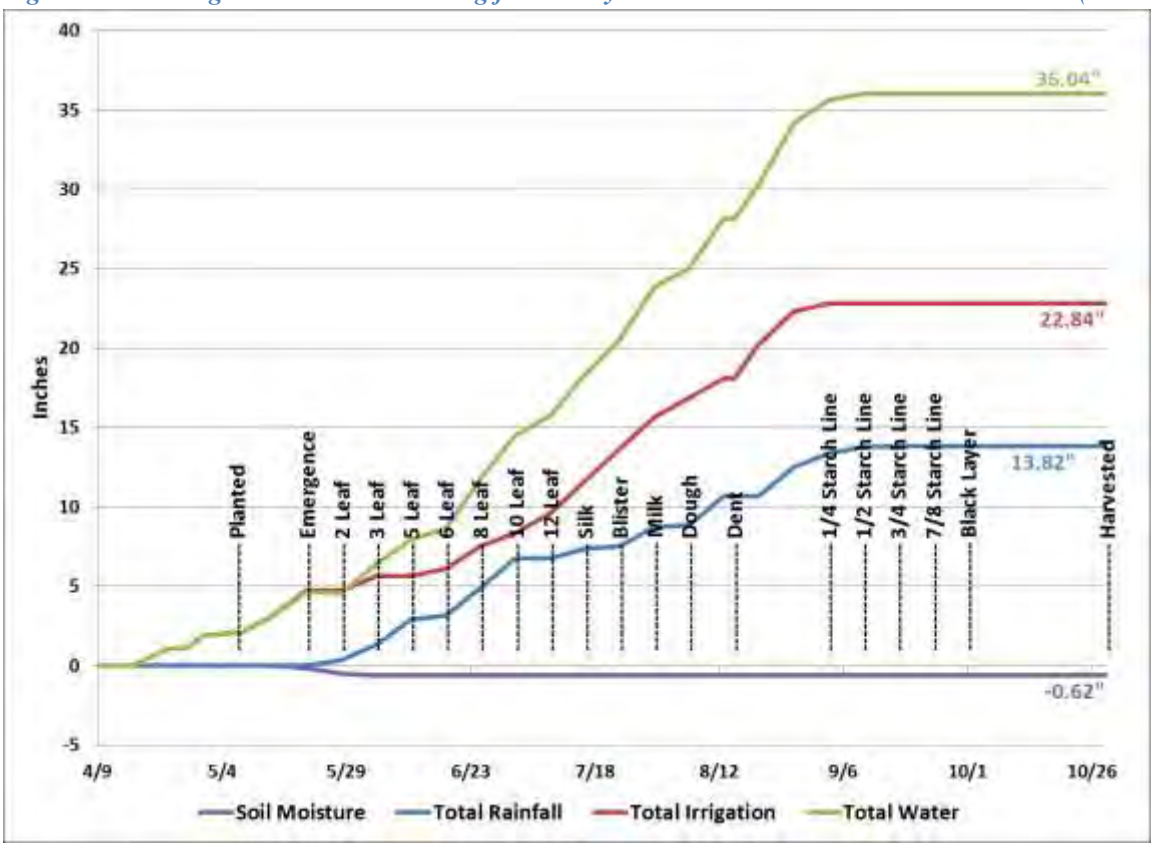


Table 44: Demonstration Field Data for Tommy Laubhan's Control Demonstration Field

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			No Meter		No Gypsum Blocks								Leon
4/16			0		No Gypsum Blocks					Prewater			Tommy
4/23	0.5	1.09	11.25		No Gypsum Blocks						90 N		Kari
4/27					No Gypsum Blocks					Prewater			Tommy
4/30	0.02	0.8	19.59		98.0	97.9	98.1	98.4	98.3	Prewater	20 Y	671	Kari
5/7		0.23	22.01							Plant			Tommy
5/8			22.01		96.7	96.4	92.9	87.2	91.5		98 N		Kari
5/14	0.03	0.97	32.02		96.8	97.2	91.7	86.4	90.5		150 N		Kari
5/21		1.65	49.09	Emergence	97.2	97.6	94.5	86.6	90.4	200-12	125 Y	673	Kari
5/28	0.32		49.81	2 Leaf	96.9	97.5	94.4	96.8	90.5		115 N		Kari
6/4	1.00	0.92	58.6	3 Leaf	97.4	98.1	94.9	97.5	93.4		120 N		Kari & David
6/11	1.57		58.6	5 Leaf	96.9	97.6	94.1	97.1	93.9		120 N		Kari & David
6/18	0.25	0.43	63.05	6 Leaf	97.3	97.9	94.0	97.2	94.3		9 N		Kari & David
6/25	1.71	1.42	77.79	8 Leaf	95.0	97.7	94.3	98.4	97.7	200-12	246 Y	676	Paul
7/2	1.89	0.85	86.6	10 Leaf	97.2	97.8	93.6	97.4	94.5		252 N		Paul
7/9		1.23	99.28	12 Leaf	96.9	97.7	93.4	97.5	95.2			690	Paul
7/16	0.59	2.03	120.29	Silk	96.3	97.6	92.7	97.1	94.4	Control	23 Y	698	Paul
7/23	0.17	2.03	141.29	Blister	96.6	98.2	93.3	97.8	94.4	200-12	146 Y	677	Paul
7/30	1.22	2.03	162.27	Milk	96.5	97.5	96.8	97.7	93.9		81 N		Paul
8/6	0.08	1.18	174.5	Dough	98.2	97.9	70.9	97.8	98.7	Control	86 Y	709	Paul
8/13	1.84	1.24	187.3	hd Dough	96.3	98.3	97.6	98.0	93.0	200-12	100 Y	724	Paul
8/15				Dent									Tommy
8/20		2.11	209.16	Dent	97.1	98.7	97.9	98.3	93.7	Control	40 Y	720	Jerry
8/27	1.85	2.1	230.84	Dent	97.3	98.3	97.6	98.1	93.8	Control	330 Y	645	Paul
9/3	0.87	0.53	236.35	1/4 ml	98.1	99.0	98.4	99.1	94.8		113 N		Paul
9/10	0.40		236.35	1/2 ml	97.9	98.4	98.4	98.4	98.6		114 N		Paul
9/17	0.03		236.35	3/4 ml	95.7	98.6	98.4	99.1	95.3		113 N		Paul
9/24			236.35	7/8 ml	89.1	97.1	96.8	97.6	94.7		114 N		Paul
10/1			236.35	Black Layer	91.4	96.3	97.8	97.5	97.4		113 N		Paul
10/8			236.35	Black Layer	78.7	98.0	95.5	97.6	95.3		113 N		Paul
10/15	2.03		236.35	Black Layer	95.5	96.6	96.0	97.9	97.5		114 N		Paul
10/22			236.35	Black Layer	96.1	97.1	95.1	97.8	94.1		113 N		Paul
10/29	0.07		236.35	Harvested	96.3	97.4	95.6	97.9	94.3		84 N		Paul
Total	**13.82**	**22.84**			**0.00"**	**-0.06"**	**-0.10"**	**-0.37"**	**-0.09"**				
Net Soil Moisture is -0.62"													
Irrigation, Rainfall Plus Net Soil Moisture is 36.04"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

Control

Year: *2014* **County:** *Lipscomb* **Grower:** *Tommy Laubhan*

No. Acres: *62* **Variety/Hyb:** *P1266AM* **Soil Type:** *Texroy, Quannah Soils*

Meter Type: *Seametrics*

Meter Mult: *Ac Ft x 1* **Tillage:** *Strip Till*

Fertilizer: *270-70-15-60s-4zn* **Seeding:** *32,000*

Planted: *May 7, 2014* **Harvest:** *October 24, 2014*

Herbicide: *Roundup, Banvel D, Cinch ATZ* **Insecticide:** *Comite*

Yield: *192 Bu/Acre* **Prev. crop:** *Wheat* **Row width:** *30 Inch*

Irrigation method: *Center Pivot* **Prewater:** *1.89 in.* **Well GPM:** *5.5*

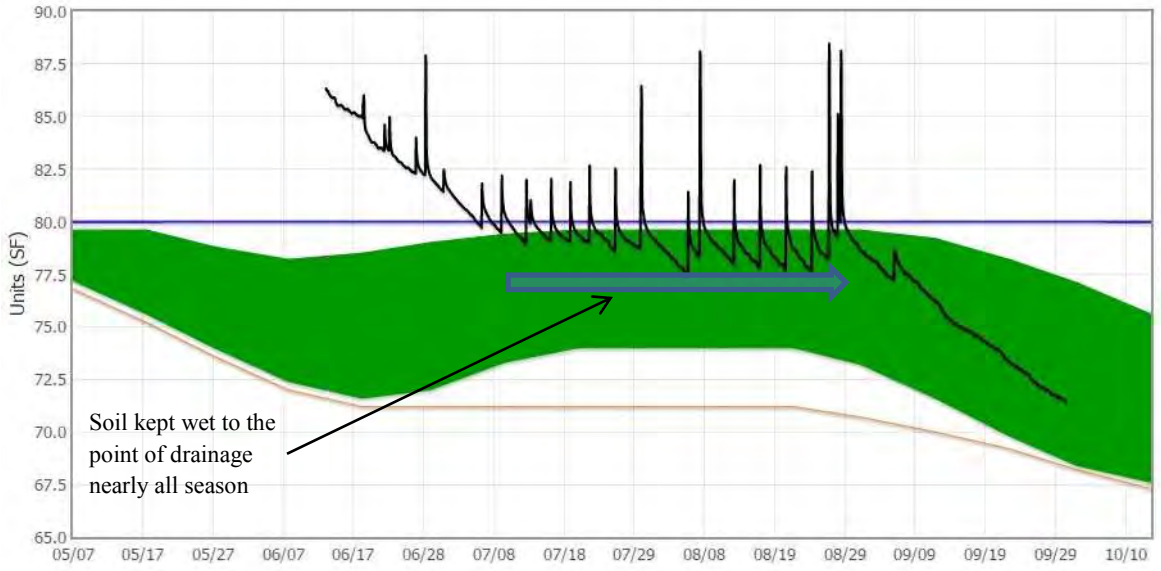
Distance between drops: *60"* **Distance from nozzle to ground:** *16"*

Application pattern: *Spray* **Crop row direction :** *Circle*

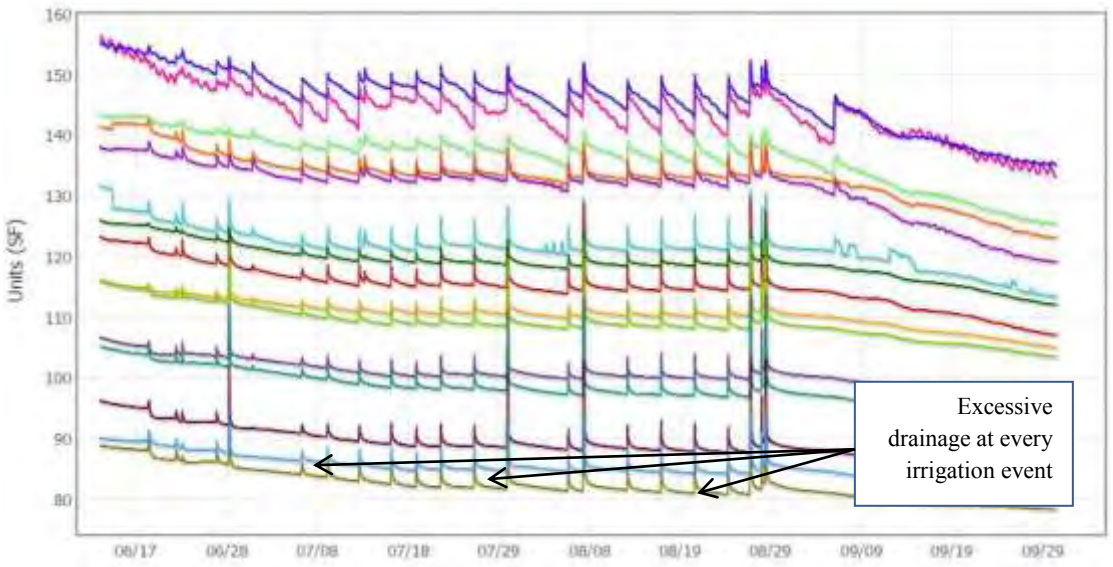
GPS Location of Pivot Pad
Latitude: *36.40097*
Longitude: *-100.10869*

GPS Location of Gypsum Blocks
Latitude: *36.401029*
Longitude: *-100.105039*

Tommy Laubhan's Control Field AquaSpy® Probe Summary



This field was almost identical to the "200-12" treatment with significant amounts of drainage from every irrigation. This would account for the very similar yield and water use efficiency figures between the two sites. It is likely that this field would have had a significant amount of leaching and very low fertilizer use efficiency – especially from fertigation. Root activity and water uptake was largely restricted to the top 28". There seemed to be some bedding in of the probe during the early irrigation cycles that caused a reduction in the values reported over the first 2 weeks of operation.



Harvest Results: The "200-12" field produced a 181 bushel per acre corn yield. Irrigation totaled 21.28 inches, of which 2.12 was pre-water. Production in the "control" field was 192 bushels per acre. Seasonal irrigation totaled 20.72 inches, pre-water 2.12 making total irrigation 22.84 inches. The "control" field produced 11 more bushels per acre than the "200-12" and irrigation was 1.56 inches more. Corn production was 8.50 bushels (476 lbs) per inch of irrigation in the "200-12" field compared to 8.40 (471 lbs) in the "control". Production from each inch of irrigation, rainfall and net soil water that totaled 31.90 inches was 5.67 bushels (318 lbs) per acre in the "200-12" field. Irrigation, rainfall and net soil water totaled 36.04 inches in the "control" field where production was 5.32 bushels (298 lbs) per inch. Crop production costs were $21.76 per acre less for the "200-12" field than for the "control" from reduced irrigation and harvest expenses. At $4.00 per bushel, the eleven bushel per acre increased corn yield in the "control" field amounts to $44.00 more per acre. The "control" field‟s net gain was $22.24 per acre with 1.56 inches additional irrigation used compared to production from the "200-12" field. Net return from the "200-12" field was $265.90 per acre compared to $288.14 from the "control" field. Net return for each inch of irrigation is $12.49 for the "200-12" field compared to $12.61 from the "control". Net return from the additional 1.56 inches of irrigation in the "control" field is $14.25. Laubhan said, "There was more plant chlorosis in the circle than anticipated, especially in the „200-12‟ field. Isolated areas in the fields did not yield anything. I was disappointed that P1266AM did not handle iron chlorosis as needed. There are other hybrids that will. I will use one of them in the future." Laubhan added, "I think soil in the „control‟ field has more crop production potential than in the „200-12‟ south half of the circle." A summary of the demonstration results are shown in table 45.

Table 45: Tommy Laubhan's 2014 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $4.00/bu		
			bu/ac	lb/ac-in Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"200-12"	21.28	*31.90	181	476	$724.00	$34.00	$22.68
Control	22.84	†36.04	192	470	$768.00	$33.63	$21.30

*Includes -3.20 inches of water added to five feet of soil, plus rainfall, and irrigation.
†Includes -0.62 inches of water added to from five feet of soil, plus rainfall, and irrigation.

Richard Schad's 2014 Hansford County Demonstration

Planting and Crop Information: For his demonstration, Richard Schad strip tilled and planted 41 acres of corn in the west half circle of the northwest quarter of section 157 for his "200-12" field, "Schad 200-12". He planted the field with Channel 214-00DGVT2 at a seeding rate of 27,400 seeds per acre. Schad planted 124 acres, also strip tilled, in the southwest quarter of section 157 to Channel 214-14VT3 Prib at 32,200 seeds per acre for his "control" field, "Schad Control". The "200-12" field was irrigated using a center pivot where seasonal water meter readings average 700 gpm. At that capacity, 1.50 inches of irrigation was delivered to the crop in a 4.6 day revolution. Water meter readings averaged 798 gpm for the center pivot that irrigated the "control" field. The system applied 1.30 inches of irrigation in a 3.8 day revolution. The two wells that typically pump 1700 gpm irrigate 416 acres of cotton and corn. Available water is stretched, especially when no rainfall helps. Both the "200-12" and "control" fields were damaged by a wind storm June 30 at the 7 to 8 leaf growth stage. Shad estimates 10 to 20 percent green snap damage. A bad hailstorm hit both fields July 16 at 10 leaves shredding leaves and damaging stalks. Shad said he had held water back on the "200-12" field prior to the storms, therefore the plants were not quite as far along. He said, "Ch214-00DGVT2 is a tough hybrid with great ear flex that recovered to produce a good yield following the storm damages." He added, "The „control" field was damaged more than he expected and yielded far less." Planting and crop information for "Schad 200-12" and "Schad Control" are shown in table 46.

Table 46: Planting and Crop Information for Richard Schad

"200-12" Demonstration Field			
Planted:	*May 20*	**Harvested:**	*October 24*
Hybrid:	*CH214-00DGVT2Prib*	**Seeding Rate:**	*27,400*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*41*	**GPM Per Acre:**	*4.1*
Total Water:	*39.45 in.*	**Soil Type:**	*Oslo Silty Clay Loam*
Fertilizer:	*175-44-3-5.5s-0.47zn*	**Insecticide:**	*None*
Herbicide:	*Prequel, Aatrex, Powermax, Detonate, Laudis, High N*		
Control Demonstration Field			
Planted:	*May 21*	**Harvested:**	*October 14*
Hybrid:	*CH214-14VT3P*	**Seeding Rate:**	*32,000*
Row Width:	*30 in.*	**Tillage:**	*Strip Till*
No. Acres:	*124*	**GPM Per Acre:**	*4.1*
Total Water:	*25.18 in.*	**Soil Type:**	*Oslo Silt Clay Loam, Sunray Clay Loam*
Fertilizer:	*155-44-3-5.5s-0.47zn*	**Insecticide:**	*None*
Herbicide:	*Prequel, Aatrex, Powermax, Detonate, Laudis, High N*		

Beginning Soil Water Profile and Growing Season Rainfall

"200-12" Demonstration Field: The soil profile was dry following wheat. 8.65 inches of pre-water did not penetrate to 4 feet. The gypsum block sensors were installed April 17 following 4.11 inches of pre-water. The sensors indicate an additional 4.54 inches of pre-water refilled the

soil profile at 1, 2 and 3 feet. Readings that followed show good soil water at 1, 2 and 3 feet, 30 percent at 4 feet and about 95 percent at 5 feet. Weekly readings show good soil moisture levels were maintained at 1, 2, 3 and 5 feet the remainder of the growing season. No irrigation was applied for about 30 days following 1.79 inches of rainfall May 28, 0.77 inches June 4 and 0.88 June 10 with the wind storm that caused 10 to 20 percent green snap. The crop received an additional beneficial 1.26 inches of rain June 26 and 0.94 July 2. The crop was damaged by hail July 16, however, plants recovered to produce a 199 bushel per acre yield. Weekly irrigation maintained production potential in August when three rainfall events totaled only 0.65 inches. Rainfall September 10 and 17 totaled 1.43 inches to help finish the crop. Sensors show the crop used most water from 1 and 2 feet in September, about 50 percent from 3 feet and dipped into water stored at 4 feet finishing the crop. Rainfall was good following planting May 20, except in August. Total rainfall from planting until harvest was 10.87 inches. Gypsum block sensors were installed in Oslo silty clay loam soil which holds approximately 1.80 inches of available water per foot for potential crop use. The moisture sensors were installed in mid-April prior to planting but following some pre-water.

Control Demonstration Field: Soil moisture sensing gypsum blocks were installed in mid-April following 4.26 inches of pre-water but prior to planting. Beginning gypsum block readings show the soil profile was full to 5 feet. Weekly gypsum block sensor readings show good moisture levels were maintained for the crop. A 1.79 inch rainfall in late May helped get the crop going. Rainfall of 2.91 inches was measured in June and 3.05 inches July. July 16 at the 10 leaf stage, the crop received significant leaf and stalk hail damage that limited yield. There was significant stalk damage to the plants. Nitrogen fertilizer and irrigation were reduced following plant damage from the hail storm. Rainfall continued to be good, except in August when three events totaled only 0.65 inches. Rainfall after planting totaled 10.87 inches. Gypsum block moisture sensors were installed in Oslo silty clay loam soil that holds approximately 1.80 inches of available water per foot for potential crop use. Monthly rainfall recorded by a gauge located at the two fields is listed in table 47.

Table 47: Monthly Rainfall Data for Richard Schad

	May	June	July	August	September	October	Total
"200-12"	1.79"	2.91"	3.99"	0.65"	1.49"	0.04"	**10.87"**
Control	1.79"	2.91"	3.99"	0.65"	1.49"	0.04"	**10.87"**

Growing Season Water Tracking: The District tracked crop total water throughout the growing season using rain gauges, water meters and both gypsum blocks and AquaSpy® soil moisture sensors. A 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 "200-12" field. Another set of the same type of sensors were installed in each "control" field. Both the gypsum block sensors and the soil probe were installed in close proximity to each other in the field. Gypsum block sensors were installed in the "200-12" and "control" fields prior to planting. Each AquaSpy® probe was installed following crop emergence. Installing and reading the gypsum block sensors prior to planting provided advanced soil moisture conditions and information to help guide and manage early

season irrigation. 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 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 “200-12” field are shown first, followed by the same illustrations for the “control” field.

Figure 53: Gypsum Block Readings for Richard Schad's "200-12" Demonstration Field (199 bu/ac)

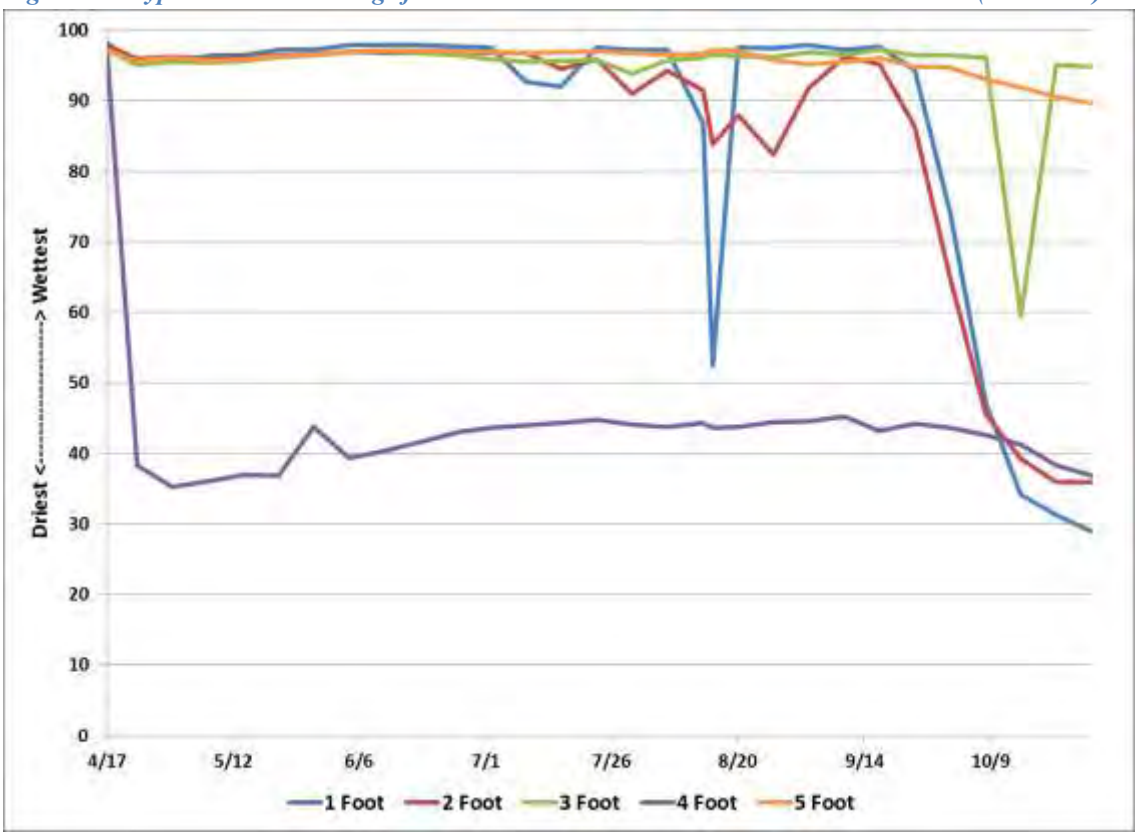


Figure 54: Growing Season Water Tracking for Richard Schad's "200-12" Demonstration Field (199 bu/ac)

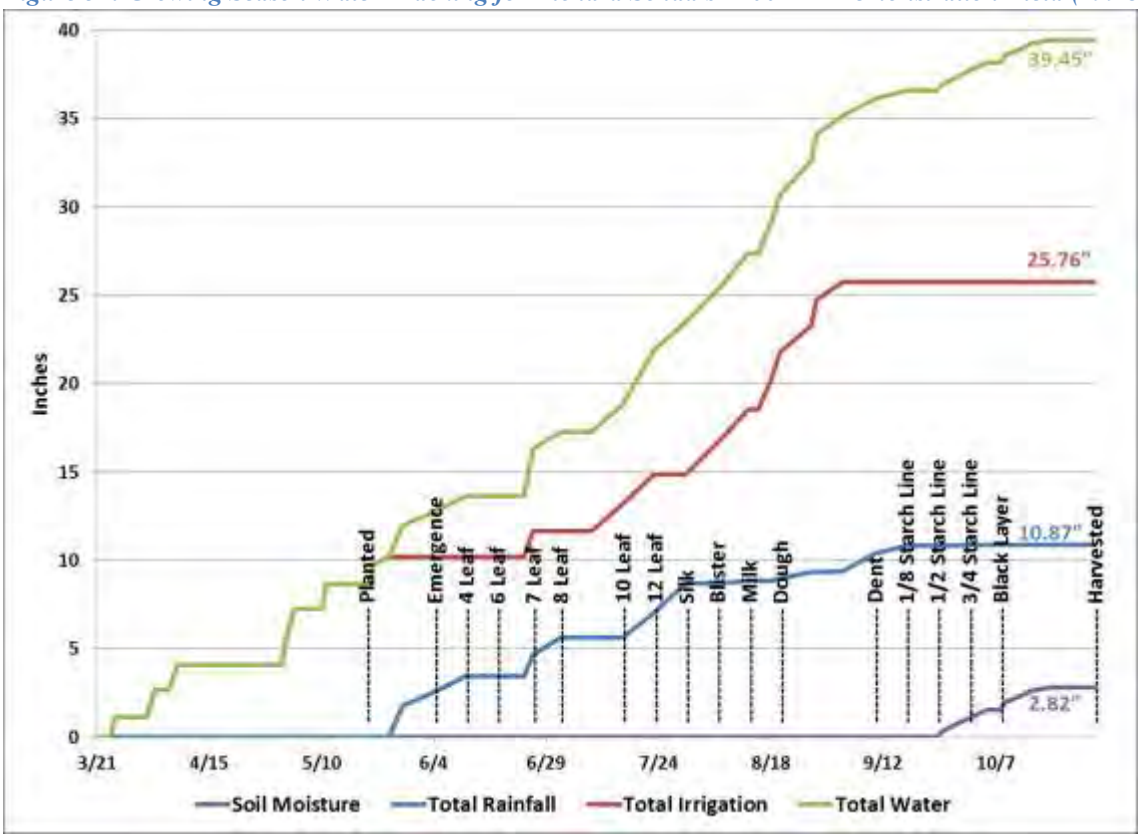


Table 48: Demonstration Field Data for Richard Schad's "200-12" Demonstration Field

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				
3/21										Prewater	180 Y		Pivotrac
3/21			13.2 hrs							Prewater	238 N		Pivotrac
3/24										Move Dry	251 N		
3/24										Prewater	251 Y		Pivotrac
3/25		1.15	17.1 hrs							Prewater	310 N	700	Pivotrac
4/1										Prewater	310 Y		Pivotrac
4/3		1.53	40.4 hrs							Prewater	180 Y	700	Pivotrac
4/6										Prewater	180 Y		Pivotrac
4/8		1.43	37.7 hrs							Prewater	305 N	700	Pivotrac
4/9			313.73		No Gypsum Blocks						305 N		Kari
4/17	0.01		313.73		98.1	97.8	97.3	97.4	97.1		307 N		K&P
4/23			317.32		95.4	96.0	95.1	38.3	95.7	Wheat	98 Y	803	Kari
4/30			326.75		95.6	96.2	95.5	35.3	96.1	Wheat	168 N		Kari
5/1										Split	180 Y		Pivotrac
5/2		1.28	33.8 hrs							Reverse	308 Y	700	Pivotrac
5/4		1.89	50.0 hrs							Split	180 Y	700	Pivotrac
5/7										Split	180 Y		Pivotrac
5/7			3.0 hrs							Stop	188 N		Pivotrac
5/8			351.32		96.5	96.0	95.4	36.2	95.7		190 N		Kari
5/10										Start	191 Y		Pivotrac
5/11		1.37	33.1 hrs							Stop	309 N	700	Pivotrac
5/14			355.53		96.5	96.1	95.7	37.0	95.9		48 N		Kari
5/20										Plant			Richard
5/21			364.74		97.2	96.5	96.2	36.8	96.3	200-12	269 Y	668	Kari
5/21		1.05	27.8 hrs							Reverse	309 Y	700	Pivotrac
5/21		0.50	13.3 hrs							Split	180 Y	700	Pivotrac
5/28	1.79		369.01		97.3	96.6	96.5	43.8	96.6		89 N		Kari
6/4	0.77		370.93	Emergence	97.9	97.0	96.9	39.3	97.0	Wheat	48 Y	715	Kari & David
6/11	0.88		376.67	4 Leaf	97.9	96.8	97.0	40.4	97.1	Wheat	178 N		Kari & David
6/18			376.67	6 Leaf	97.9	96.8	96.8	41.6	97.1		165 N		Kari & David
6/23										Start	180 Y		Pivotrac
6/24			37.3 hrs							Stop	303 N	700	Pivotrac
6/26	1.26	1.44	381.59	7 Leaf	97.7	96.8	96.5	43.1	97.0	200-12	304 N		Paul
7/2	0.94		381.59	8 Leaf	97.6	96.8	95.9	43.6	96.9		304 N		Paul
7/9			381.59	8 Leaf	92.7	96.8	95.6	44.0	96.8		304 N		Paul
7/16		1.55	386.9	10 Leaf	92.0	94.5	95.7	44.3	96.9		181 N		Paul
7/23	1.40	1.67	392.62	12 Leaf	97.6	95.9	95.8	44.8	97.0	200-12	292 N		Paul
7/30	1.65		395.76	Silk	97.3	91.0	93.8	44.1	96.8		221 N		Paul
8/6		1.77	398.69	Blister	97.3	94.3	95.8	43.8	96.6		205 N		Paul

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				
8/13	0.15	1.92	405.25	Milk	86.8	91.5	96.1	44.3	96.7		299 N		Paul
8/15				Milk	52.5	83.9	96.6	43.6	97.2		300 N		Leon
8/18		1.65	410.88	Milk							180 Y		Leon
8/20	0.13	1.59	416.31	Dough	97.6	87.9	96.3	43.8	97.1		260 N		Jerry
8/27	0.37	1.51	421.49	Dough	97.5	82.4	96.2	44.4	95.8		239 Y	629	Paul
8/28		1.46	426.48	Dough							304 Y		Leon
9/3	0.06	1.00	429.9	Dough	97.9	91.8	96.9	44.6	95.2		189 N		Paul
9/10	0.97		429.9	Dent	97.3	96.2	96.6	45.2	95.5		190 N		Paul
9/17	0.46		429.9	1/8 ml	97.7	95.2	97.2	43.2	96.1		190 N		Paul
9/24			429.9	1/2 ml	94.4	86.4	96.4	44.2	94.9		180 N		Paul
10/1	0.04		429.9	3/4 ml	74.3	65.1	96.4	43.7	94.8		180 N		Paul
10/8			429.9	Black Layer	47.2	45.6	96.1	42.6	93.1		180 N		Paul
10/15	0.64		429.9	Black Layer	34.1	39.2	59.4	41.3	91.9		158 N		Paul
10/22			429.9	Black Layer	31.3	36.0	95.1	38.3	90.6		157 N		Paul
10/29			429.9	Harvested	28.9	35.9	94.9	36.9	89.6		157 N		Paul
Total	**10.87**	**25.76**			**1.19"**	**1.10"**	**0.20"**	**0.00"**	**0.33"**				
Net Soil Moisture is 2.82"													
Irrigation, Rainfall Plus Net Soil Moisture is 39.45"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

200-12

Year: *2014* **County:** *Hansford* **Grower:** *Richard Schad*

No. Acres: *41* **Variety/Hyb:** *Ch214-00DGVT2* **Soil Type:** *Oslo Silty Clay Loam*

Meter Type: *Seametrics* **Meter Mult:** *Ac Ft x 1*

Tillage: *Strip Till*

Fertilizer: *175-44-3-5.5s-0.47zn* **Seeding:** *27,400*

Planted: *May 20, 2014* **Harvest:** *October 24, 2014*

Herbicide: *Prequel, Aatrex, Powermax, Detonate, Laudis, High N* **Insecticide:** *None*

Yield: *199 bu/ac* **Prev. crop:** *Wheat* **Row width:** *30 Inch*

Irrigation method: *Center Pivot* **Prewater:** *8.65 in.* **Well GPM:** *4.1*

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

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

GPS Location of Pivot Pad

Latitude: *36.310531*

Longitude: *-101.54604*

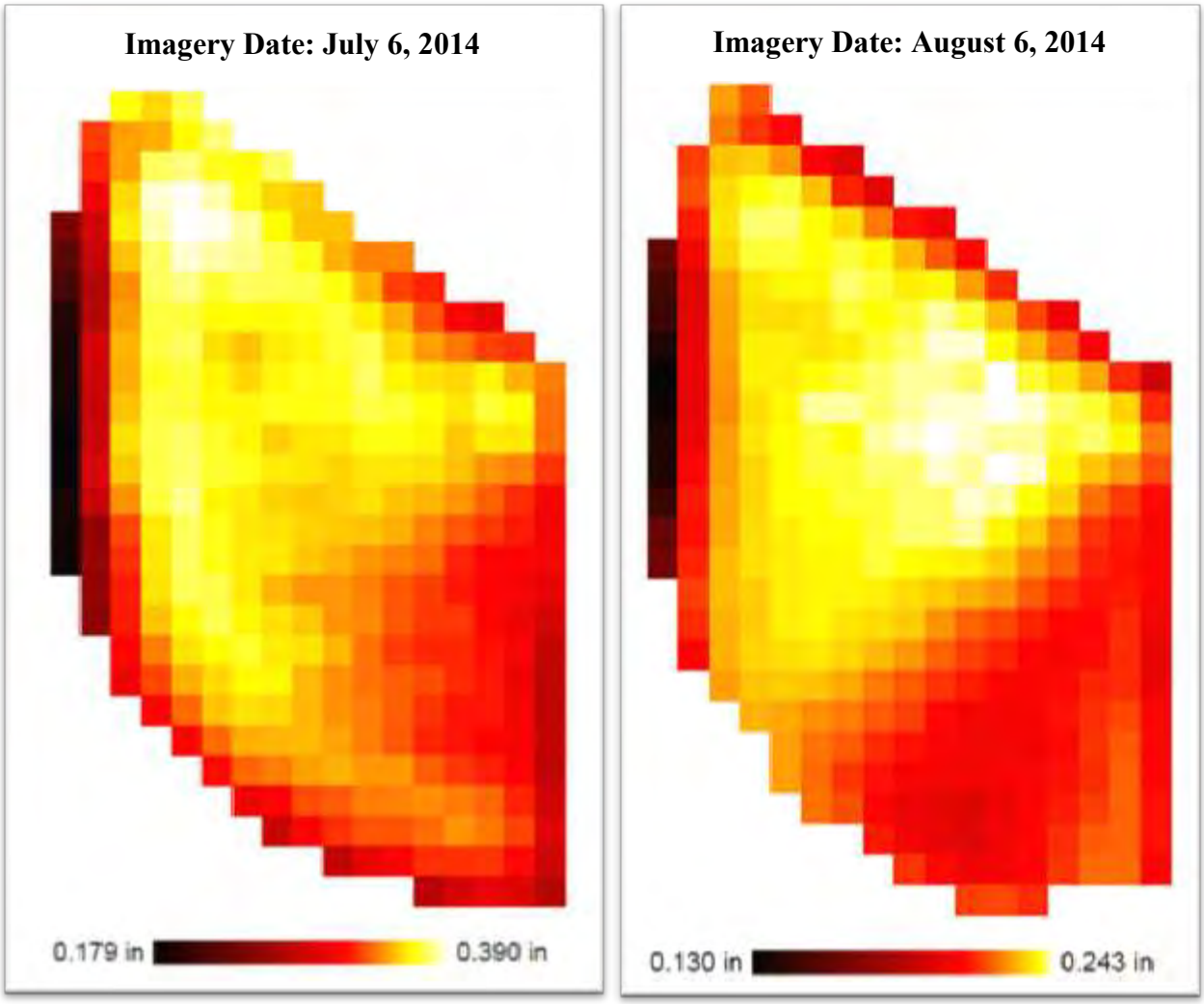
GPS Location of Gypsum Blocks

Latitude: *36.30778*

Longitude: *-101.54649*

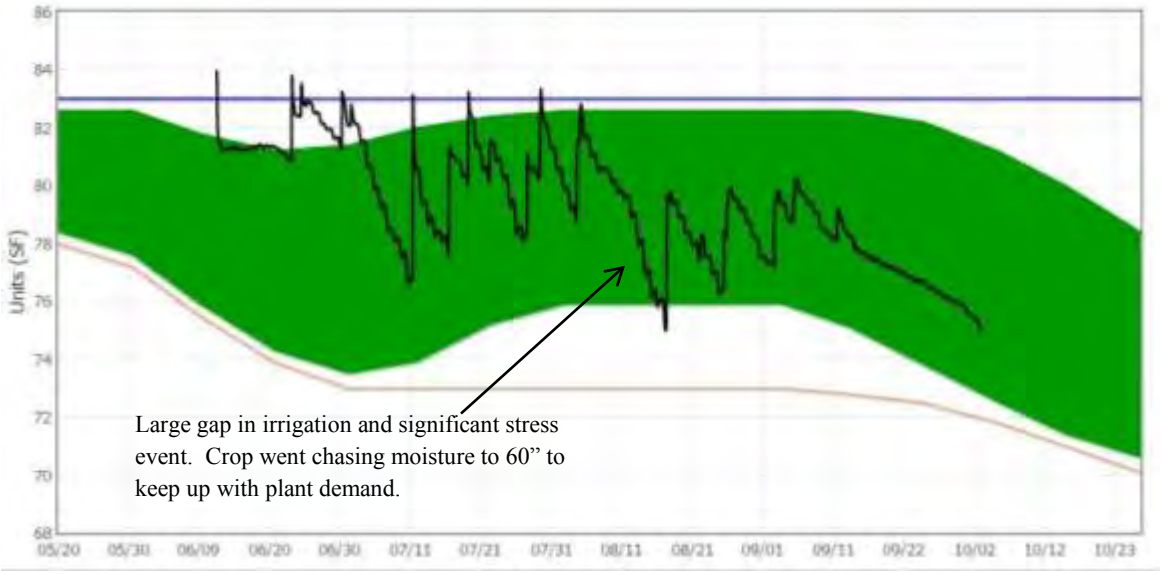
Satellite Imagery: Satellite imagery was initiated and used in 2013 to learn and evaluate its potential for an irrigation and water management tool for growers in connection with HydroBio. The use of satellite imagery was continued for the 2014 growing season. Richard Schad"s "200-12" field was one of eighteen "200-12" project fields included in 2014. His field was from 180 to 304 degrees in the circle. The field received hail damage July 16, but plants recovered to make a good yield. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Richard Schad"s "200-12" field are shown in figure 55 to illustrate examples of what is displayed on the website. The first image was on July 6 at the 8 leaf stage. The second image is on August 6 at the blister stage. The satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 199 bushels per acre with 25.76 inches of irrigation following wheat in 2013.

Figure 55: Daily Water Use for Richard Schad's "200-12" Demonstration Field



Note: Each Square Represents 1/8 of an Acre

Richard Schad's "200-12" Field AquaSpy® Probe Summary



The soil moisture probe data suggests a somewhat higher yield, especially in light of the water applied. However, there was a period of significant moisture stress in mid-August that may have caused tipping back of the ear and a reduction in yield. There was a very large gap between irrigations at this time, which suggests some external issue that may have caused problems with the sprinkler. If more timely irrigation could have been applied at that point, it is likely that a significantly higher yield would have been obtained. The profile began completely full as indicated by the drainage events early in the season. It is possible that some of the 8.65" of pre-irrigation wasn't required but it is impossible to tell since the probe data does not cover this period.

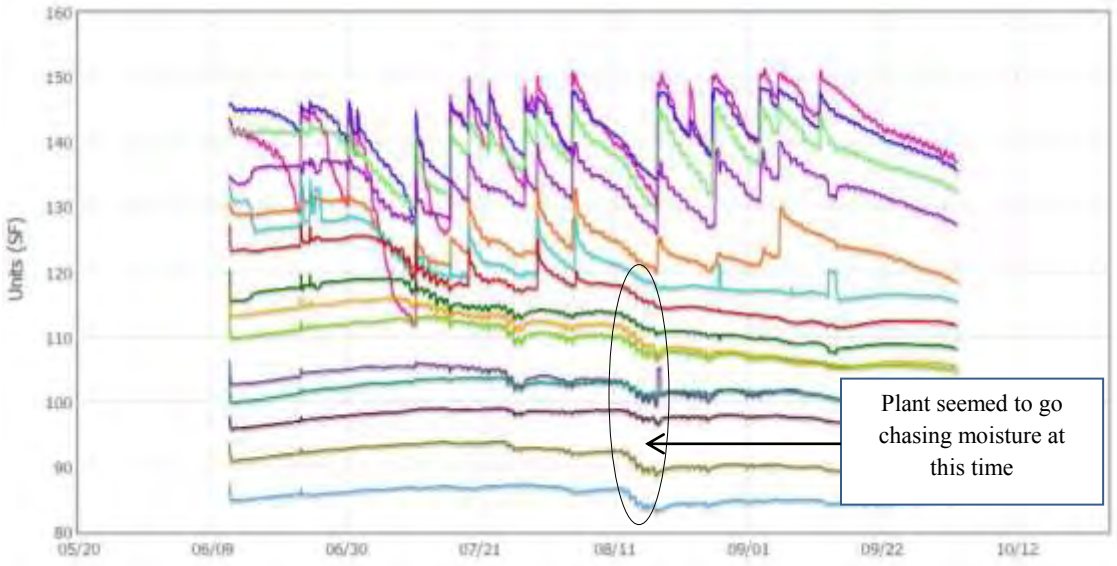


Figure 56: Gypsum Block Readings for Richard Schad's Control Demonstration Field (126 bu/ac)

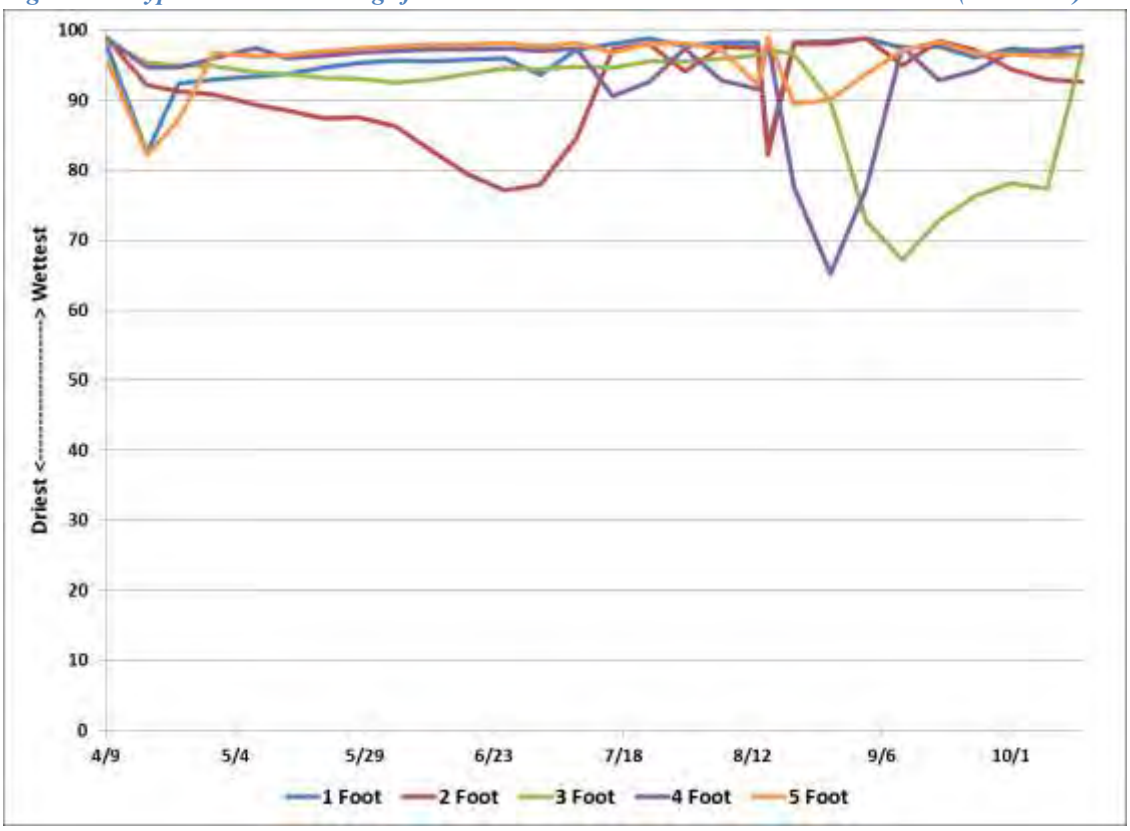


Figure 57: Growing Season Water Tracking for Richard Schad's Control Demonstration Field (126 bu/ac)

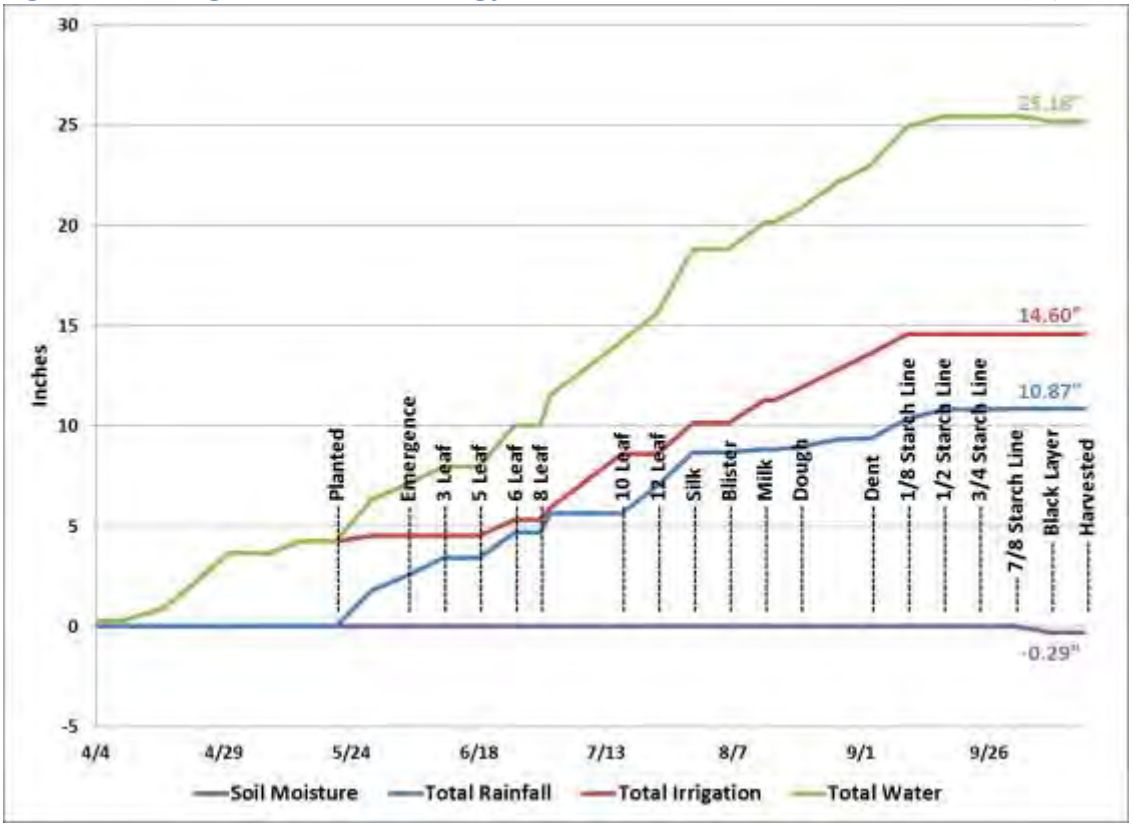


Table 49: Demonstration Field Data for Richard Schad's Control Demonstration Field

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				
4/4		0.29	18.9 hrs									850	Pivotrac
4/9			287		98.3	98.9	98.5	99.0	96.0		97 N		K,P,L
4/17	0.01	0.58	293		82.4	92.2	95.3	94.7	82.2	Prewater	293 Y	865	K&P
4/23		1.26	306		92.4	91.3	95.0	94.6	87.2	Prewater	265 Y	819	Kari
4/30		1.55	322		92.9	90.8	94.9	96.0	96.8	Prewater	184 Y	885	Kari
5/8			322		93.4	89.3	94.0	97.5	96.2		166 N		Kari
5/14		0.58	328		93.7	88.6	93.8	96.0	96.5		199 N		Kari
5/21			328		94.6	87.4	93.2	96.4	97.0		198 N		Kari
5/21										Plant			Richard
5/28	1.79	0.29	331		95.3	87.5	93.1	96.8	97.4	Control	30 N		Kari
6/4	0.77		331	Emergence	95.7	86.3	92.5	97.0	97.7		29 N		Kari & David
6/11	0.88		331	3 Leaf	95.6	82.8	92.9	97.2	97.9		29 N		Kari & David
6/18			331	5 Leaf	95.8	79.4	93.7	97.2	97.9		6 N		Kari & David
6/25	1.26	0.77	339	6 Leaf	96.0	77.1	94.5	97.4	98.1		356 N		Paul
6/30	Wind			8 Leaf	Green Snap								Richard
7/2	0.94	0.58	345	8 Leaf	93.6	77.9	94.4	97.0	97.7	Control	70 Y		Paul
7/9		1.35	359	8 Leaf	97.2	84.6	94.8	97.4	98.1	Control	142 Y	790	Paul
7/16	Hail	1.35	373	10 Leaf	98.0	97.2	94.6	90.6	96.8	Control	310 Y	769	Paul
7/23	1.40		379	12 Leaf	98.8	98.0	95.6	92.6	98.0	Control	48 Y	738	Paul
7/30	1.65	1.55	389	Silk	97.7	94.1	95.6	97.4	98.1		258 N		Paul
8/6			392	Blister	98.3	97.6	95.9	92.8	97.3	Control	162 Y	775	Paul
8/13	0.15	1.16	401	Milk	98.3	97.5	96.5	91.6	92.2	Control	112 Y	768	Paul
8/15				Milk	83.3	82.2	97.3	98.5	98.9	Control	Y		Leon
8/20	0.13	0.58	407	Dough	98.3	98.0	96.6	77.6	89.4	Control	196 Y	725	Jerry
8/27	0.37	0.87	416	Dough	98.4	98.0	89.9	65.2	90.1		166 N		Paul
9/3	0.06	0.87	425	Dent	98.8	98.8	72.8	77.3	93.7		173 N		Paul
9/10	0.97	0.97	435	1/8 ml	97.5	95.0	67.2	97.7	97.1		29 N		Paul
9/17	0.46		435	1/2 ml	97.7	98.5	72.8	92.8	98.4		29 N		Paul
9/24			435	3/4 ml	96.1	97.1	76.3	94.2	96.7		28 N		Paul
10/1	0.04		435	7/8 ml	97.4	94.4	78.1	96.8	96.6		28 N		Paul
10/8			435	Black Layer	97.0	92.9	77.3	97.1	96.2		28 N		Paul
10/15	0.64		435	Harvested	96.4	92.6	97.6	97.7	96.3		8 N		Paul
Total	**10.87**	**14.60**	**14.32**		**-0.05"**	**-0.13"**	**-0.09"**	**-0.05"**	**0.03"**				
Net Soil Moisture is -0.29"													
Irrigation, Rainfall Plus Net Soil Moisture is 24.89"													

• Numbers in red are not counted in the total

2014-Corn Demonstration
Irrigated Medium Season Corn

Control

Year: *2014* **County:** *Hansford* **Grower:** *Richard Schad*

No. Acres: *124* **Variety/Hyb:** *Ch214-14VT3P* **Soil Type:** *Oslo Silty Clay Loam, Sunray Clay Loam*

Meter Type: *Senninger* **Meter Mult:** *Ac Ft x 1*

Tillage: *Strip Till*

Fertilizer: *155-44-3-5.5s-0.47zn* **Seeding:** *32,200*

Stopped N following Hail

Planted: *May 21, 2014* **Harvest:** *October 14, 2014*

Herbicide: *Prequel, Aatrex, Powermax, Detonate, Laudis, High N* **Insecticide:** *None*

Yield: *126 bu/ac* **Prev. crop:** *Corn* **Row width:** *30 Inch*

Irrigation method: *Center Pivot* **Prewater:** *4.26 in.* **Well GPM:** *4.1*

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

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

GPS Location of Pivot Pad

Latitude: *36.302737*

Longitude: *-101.545804*

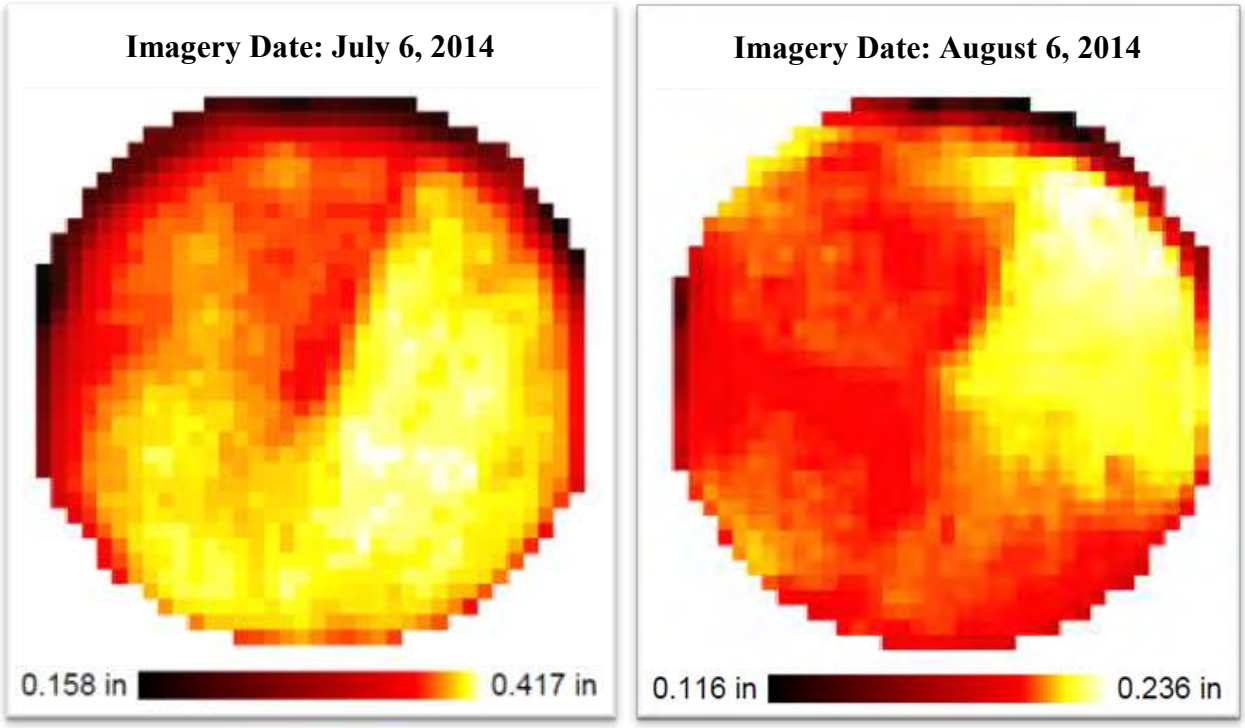
GPS Location of Gypsum Blocks

Latitude: *36.303022*

Longitude: *-101.549636*

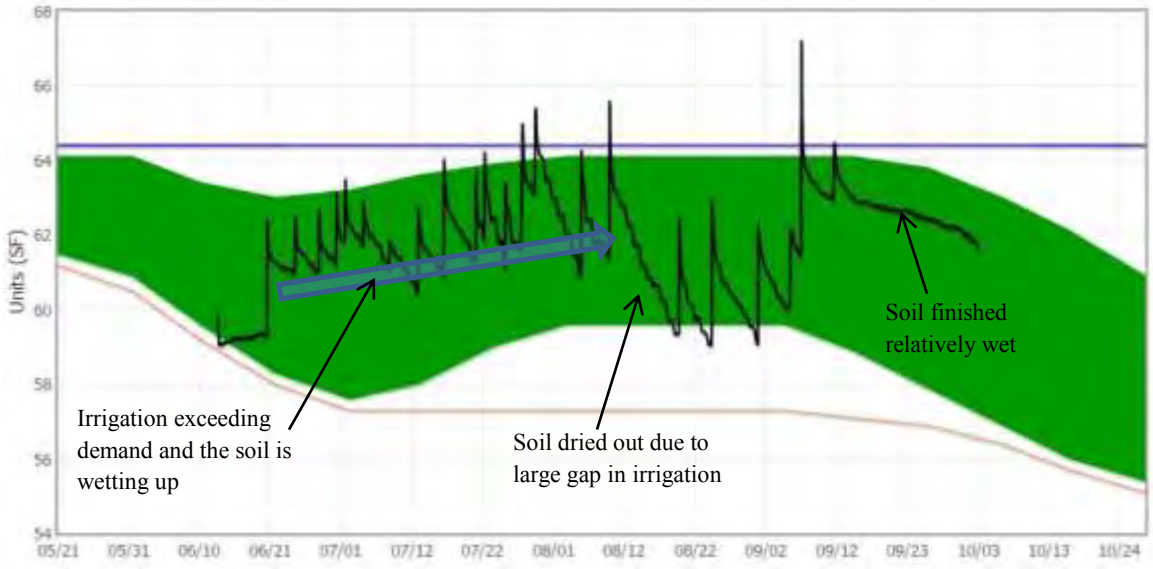
Satellite Imagery: Richard Schad‟s “control” field was one of eighteen “200-12” project fields included in satellite imagery in 2014. Plants were damaged by a bad hail storm July 16 at the 10 leaf stage. A website was established and made available to project cooperators and District staff. We learned that satellite imagery has potential, but requires additional development, especially in establishing beginning soil moisture and tracking rainfall. Monitoring the soil profile and root zone during the growing season was improved in 2014. Two satellite images of Richard Schad‟s “control” field in figure 58 illustrate examples of what is displayed on the website. The first image is on July 6 at the 8 leaf stage. The second image is on August 6 at the blister stage. Satellite imagery data changes when the next satellite passes, usually in three day increments. Corn yield was 126 bushels per acre with 14.60 inches of irrigation. The plants never recovered from hail.

Figure 58: Daily Water Use for Richard Schad's “control” Demonstration Field

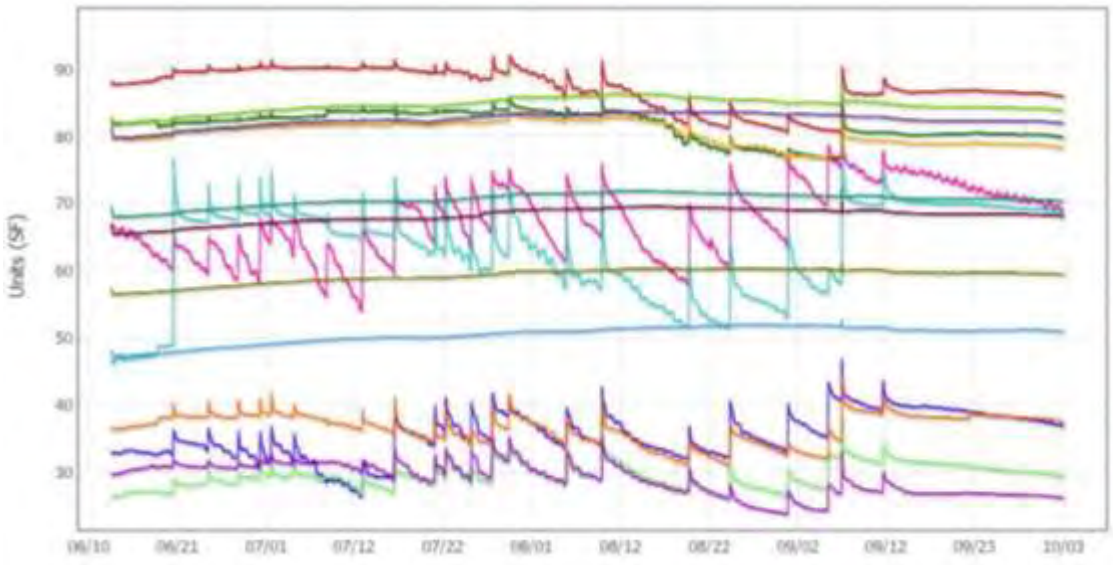


Note: Each Square Represents 1/8 of an Acre

Richard Schad's Control Field AquaSpy® Probe Summary



The "control" site suffered hail and a large yield reduction as a result. It is evident that irrigation was able to exceed demand in the early part of the season – presumably due to reduced growth from the hail event. The "control" treatment also suffered a large gap in irrigation during mid-August, which forced the plants to chase moisture to the 36" level. There was evidence of repeated drainage events early in the season due to wet soil and supply exceeding demand. The soil finished relatively wet at the end of the season.



Harvest Results: The "200-12" field produced a 199 bushel per acre corn yield. Irrigation totaled 25.76 inches of which 8.65 inches were pre-water. Production in the "control" field was 126 bushels per acre, where total irrigation was 14.60 inches. Pre-season irrigation was 4.26 inches for the "control" field. In comparison, the "200-12" field produced 73 more bushels per acre than the "control" with 11.16 more inches of irrigation. Corn production was 7.72 bushels (432 lbs) per inch of irrigation in the "200-12" field compared to 8.63 bushels (483 lbs) in the "control". Production from each inch of irrigation, rainfall and net soil water that totaled 39.45 inches was 5.04 bushels (282 lbs) per acre in the "200-12" field. Irrigation, rainfall and net soil water totaled 25.18 inches in the "control" field where production was 5.0 bushels (280 lbs) per inch. Crop production costs were $123.23 per acre more for the "200-12" field than for the "control" from increased fertilizer, irrigation and harvest expenses. At $4.00 per bushel, the additional 73 bushel per acre corn yield amounts to $292.00 more per acre. The "200-12" field"s net gain was $168.77 per acre with 11.16 inches more irrigation used compared to production from the "control" field. Net return from the "200-12" field was $333.38 compared to $164.61 from the "control" with 11.16 inches more irrigation. Net return from each inch of irrigation is $12.94 for the "200-12" field compared to $8.63 in the "control". Both the "200-12" and "control" fields were damaged by a wind storm June 30 at the 7 to 8 leaf growth stage. Shad estimates 10 to 20 percent green snap damage. A bad hailstorm hit both fields July 16 at 10 leaves shredding leaves and damaging stalks. Plants in the "200-12" field were not quite as advanced as in the "control" and recovered better to produce a more normal yield. Shad stopped nitrogen for the "control" field following the hail damage. A summary of Schad"s demonstration results are shown in table 50.

Table 50: Richard Schad's 2014 Demonstration Results

	Irrigation (in.)	Total Water (in.)	Production		Crop Value @ $ 4.00/bu		
			bu/ac	lb/ac-in Irrigation	Per Acre	Acre-in of Irrigation	Acre-in of Total Water
"200-12"	25.76	*39.45	199	432	$796.00	$30.90	$20.17
Control	14.60	†25.18	126	483	$504.00	$34.52	$20.01

*Includes 2.82 inches of water removed from five feet of soil, plus rainfall, and irrigation.
†Includes -0.29 inches of water added to five feet of soil, plus rainfall, and irrigation.

Conclusion

The North Plains Groundwater Conservation District‟s "200-12" Project demonstrates how potential water conservation technologies and irrigation management practice adjustments 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 limited and diminishing groundwater resources. By using real-time technologies to monitor soil-water conditions in the root zone, all 20 demonstrations showed that growers can manage their irrigation water needs better and reduce crop irrigation. In the ten "200-12" demonstration fields where grain was harvested, **Harold Grall** produced 21 more bushels per acre in the "control" field than the "200-12" with 7.78 more inches of irrigation. Crop production costs were $66.14 per acre less for the "200-12" field than for the "control". Net return from the "200-12" field was $409.25 per acre compared to $427.11 from the "control". The "control" field‟s net gain was $17.86 per acre. **Danny Krienke** produced 2 more bushels per acre in the "control" field than the "200-12" with 1.64 more inches of irrigation. Crop production costs were $19.20 per acre less for the "200-12" field than for the "control" from reduced seed, irrigation and harvest expenses. Net return from the "200-12" field was $455.90 compared to $444.70 from the "control" field. The "200-12" field‟s net gain was $11.20 per acre with 1.64 less inches of irrigation used compared to production from the "control" field. **David Ford** produced 7 bushels per acre more in the "200-12" field compared to the "control" with 1.01 more inches of irrigation. Crop production costs were $13.10 per acre more for the "200-12" field than for the "control" from increased irrigation and harvest expenses. Net return from the "200-12" field was $405.43 compared to $390.53 for the "control". The "200-12" field‟s net gain was $14.90 per acre with 1.01 inches more irrigation used compared to the "control" field. **Brian Bezner** produced 107 bushels per acre more in his "control" field compared to the "200-12" field with 9.63 more inches of irrigation. Crop production costs were $200.29 more for the "control" field than the "200-12" from additional seed, irrigation and harvest expenses. Net return from the "control" field was $527.43 compared to $299.72 from the "200-12" field. The "control" field‟s net gain is $227.71 per acre with 9.63 inches more irrigation used compared to production from the "200-12". Plants in the "200-12" field did not recover from significant hail damage suffered on June 25. **Joe Reinart** produced 78 more bushels per acre in the "control" field than the "200-12" field with 9.65 more inches of irrigation. Crop production costs were $136.91 more per acre for the "control" field than the "200-12" field. Net return from the "control" field was $487.52 per acre compared to $312.43 from the "200-12". Net gain from the "control" field was $175.09 per acre. It was difficult to establish profile moisture in the "200-12" field following cotton in 2013. There was no soil moisture at planting, except at 5 feet. **Brent Clark** produced 4 more bushels per acre in the "control" field compared to the "200-12" with 0.58 inches less irrigation. Crop production costs were $0.96 per acre less for the "200-12" field than for the "control" from reduced harvest expenses. Net return from the "control" field was $455.49 compared to $440.45 from the "200-12" field. The "control" field‟s net gain was $15.04 per acre. **Hartley Feeders & Dennis Buss** produced 21 bushels per acre more in the "200-12" field than the "control" with

2.06 inches more irrigation. Crop production costs were $33.82 per acre more for the “200-12” field than for the “control” from increased irrigation and harvest expenses. Net return from the “200-12” field was $353.89 compared to $303.71 from the “control”. The “200-12” field‟s net gain was $50.18 per acre with 2.06 inches more irrigation used compared to net return from the “control” field. **Phil Haaland** produced 47 bushels per acre more in his “control” field than the “200-12” with 9.83 inches more irrigation. Crop production costs were $110.85 per acre more for the “control” field than for the “200-12” from increased seed, irrigation and harvest expenses. Net return from the “control” field was $481.12 per acre compared to $403.97 from the “200-12” field. The “control” field‟s net gain was $77.15 per acre with 9.83 inches more irrigation used compared to production from the “200-12” field. Value of the additional 9.83 inches of irrigation for the “control” field is $7.85 per inch. **Tommy Laubhan** produced 11 bushels per acre more in the “control” field than the “200-12” with 1.56 inches more irrigation. Crop production costs were $21.76 per acre less for the “200-12” field than for the “control” from reduced irrigation and harvest expenses. Net return from the “200-12” field was $265.90 per acre compared to $288.14 from the “control”. The “control” field‟s net gain was $22.24 per acre with 1.56 inches more irrigation used compared to the “200-12” field. **Richard Schad** produced 73 more bushels per acre in the “200-12” field than the “control” with 11.16 inches more irrigation. Crop production costs were $123.23 per acre more for the “200-12” field than for the “control” from increased fertilizer, irrigation and harvest expenses. Net return was $333.38 from the “200-12” field compared to $164.61 from the “control”. The “200-12” field‟s net gain was $168.77 per acre with 11.16 inches more irrigation. Both the “200-12” and “control” fields were damaged by hail July 16. Plants in the “200-12” recovered to produce a good yield, where those in the “control” field did not. **Summary:** Corn production averaged 198 bushels per acre in the “200-12” fields compared to 215 bushels per acre in the “control” fields. Irrigation averaged 17.59 inches in the “200-12” fields compared to 20.12 inches in the “control”. Corn production averaged 11.83 bushels (662 lbs) per inch of irrigation in the “200-12” fields compared to 10.97 bushels (563 lbs) per inch in the “control”. Net return averaged $368.03 per acre from the “200-12” fields compared to $397.03 from the “control”. Average net gain from the “control” fields is $29.00 per acre. Average value of the additional 2.53 inches of irrigation applied to “control” fields is $11.46 per inch. Irrigation, rainfall plus net soil water averaged 28.46 inches in the “200-12” fields compared to 30.40 inches in the “control”. Irrigation plus rainfall averaged 27.68 inches but soil water only 0.78 inches in the “200-12” fields. Average rainfall of 10.09 inches exceeds the “200-12” project goal of 8.0 inches, but 0.78 inches of soil water is much less than the goal of 6 inches, so irrigation had to be more. **Appendix A** is a summary of water and harvest demonstration results. **Appendix B** lists corn hybrids, planting date and seeding rate information selected by each cooperating grower. **Appendix C** describes net return per acre for each “200-12” and “control” field. **Appendix D** is a polynomial that indicates that the water management and corn production practices used in eight of the ten “200-12” fields in 2014 can potentially produce more Net Return Dollars per acre than those used in the “control” fields. **Appendix E** shows net return per inch of irrigation applied to each ““200-12”” and “control” field. Three “200-12” fields and one “control” field received hail damage. Read more about hail damage in Grall, Bezner and Schad‟s individual grower demonstration reports.

We learned that more high efficiency LEPA center pivot irrigation systems are needed to help stretch available water and that crop residue remains essential. Irrigation systems must get more of the available water to the crop. Growers tended to reduce center pivot speed to 6 to 8 day revolutions. We learned it is easy to over water corn with 4 and especially 5.0 gpm per acre when rainfall is more normal and that soil moisture sensors can help. Also, we learned that drought tolerant hybrids were commonly planted, mostly in May and early June, and performed well. Overall, 2014 was an improved corn production year with more rainfall and cooler temperatures, but beginning soil moisture was typically low following 2013 crops. Rainfall was typically less than one inch in August following timely, beneficial amounts in previous months. The reduced August rainfall, combined with higher temperatures, may explain why some yields were less than in 2013. When the technologies and methods utilized by the "200-12" demonstrations can be translated to 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 the 2014 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 ($/ac)	Net Return Per Ac-In of Irrigation ($)
Harold Grall	"200-12"	Jun 12	1.02	11.94	12.96	9.19	22.15	-0.68	21.47	201	15.51	9.36	$ 409.25	$ 31.58
	Control	Jun 04	3.64	17.10	20.74	10.71	31.45	1.29	32.74	222	10.70	6.78	$ 427.11	$ 20.59
Danny Krienke	"200-12"	Jun 16	0.00	14.42	14.42	7.76	22.18	3.34	25.52	217	15.05	8.50	$ 455.90	$ 31.62
	Control	Jun 16	1.10	14.96	16.06	7.76	23.82	1.75	25.57	219	13.64	8.56	$ 444.70	$ 27.69
David Ford	"200-12"	May 29	2.04	12.82	14.86	10.96	25.82	2.24	28.06	206	13.86	7.34	$ 405.43	$ 27.28
	Control	May 29	2.54	11.31	13.85	10.96	24.81	3.12	27.93	199	14.37	7.12	$ 390.53	$ 28.20
Brian Bezner	"200-12"	May 21	1.28	10.97	12.25	10.71	22.96	1.36	24.32	168	13.71	6.91	$ 299.72	$ 24.47
	Control	May 21	1.17	20.71	21.88	10.71	32.59	2.17	34.76	275	12.57	7.91	$ 527.43	$ 24.11
Joe Reinart	"200-12"	Jun 04	0.00	14.83	14.83	8.95	23.78	-4.27	19.51	177	11.94	9.07	$ 312.43	$ 21.07
	Control	Apr 25	2.85	21.63	24.48	9.93	34.41	-4.68	29.73	255	10.42	8.58	$ 487.52	$ 19.91
Brent Clark	"200-12"	Apr 29	0.00	19.59	19.59	10.45	30.04	-0.19	29.85	223	11.38	7.47	$ 440.45	$ 22.48
	Control	Apr 29	0.00	19.01	19.01	10.45	29.46	-1.38	28.08	227	11.94	8.08	$ 455.49	$ 23.96
Hartley Feeders	"200-12"	Jun 05	1.82	16.25	18.07	6.49	24.56	4.05	28.61	192	10.63	6.71	$ 353.89	$ 19.58
	Control	Jun 06	3.08	12.93	16.01	6.49	22.50	3.19	25.69	171	10.68	6.66	$ 303.71	$ 18.97
Phil Haaland	"200-12"	May 19	3.00	18.89	21.89	11.68	33.57	2.30	35.87	219	10.00	6.11	$ 403.97	$ 18.45
	Control	May 19	3.00	28.72	31.72	11.68	43.40	-5.16	38.24	266	8.39	6.96	$ 481.12	$ 15.17
Tommy Laubhan	"200-12"	May 07	2.12	19.16	21.28	13.82	35.10	-3.20	31.90	181	8.51	5.67	$ 265.90	$ 12.50
	Control	May 07	2.12	20.72	22.84	13.82	36.66	-0.62	36.04	192	8.41	5.33	$ 288.14	$ 12.62
Richard Schad	"200-12"	May 20	8.65	17.11	25.76	10.87	36.63	2.82	39.45	199	7.73	5.04	$ 333.38	$ 12.94
	Control	May 21	4.26	10.34	14.60	10.87	25.47	-0.29	25.18	126	8.63	5.00	$ 164.61	$ 11.27
Average	**"200-12"**	**May 25**	**1.99**	**15.60**	**17.59**	**10.09**	**27.68**	**0.78**	**28.46**	**198**	**11.83**	**7.22**	**$368.03**	**$ 22.20**
	Control	**May 21**	**2.38**	**17.74**	**20.12**	**10.34**	**30.46**	**-0.06**	**30.40**	**215**	**10.97**	**7.10**	**$397.04**	**$ 20.25**

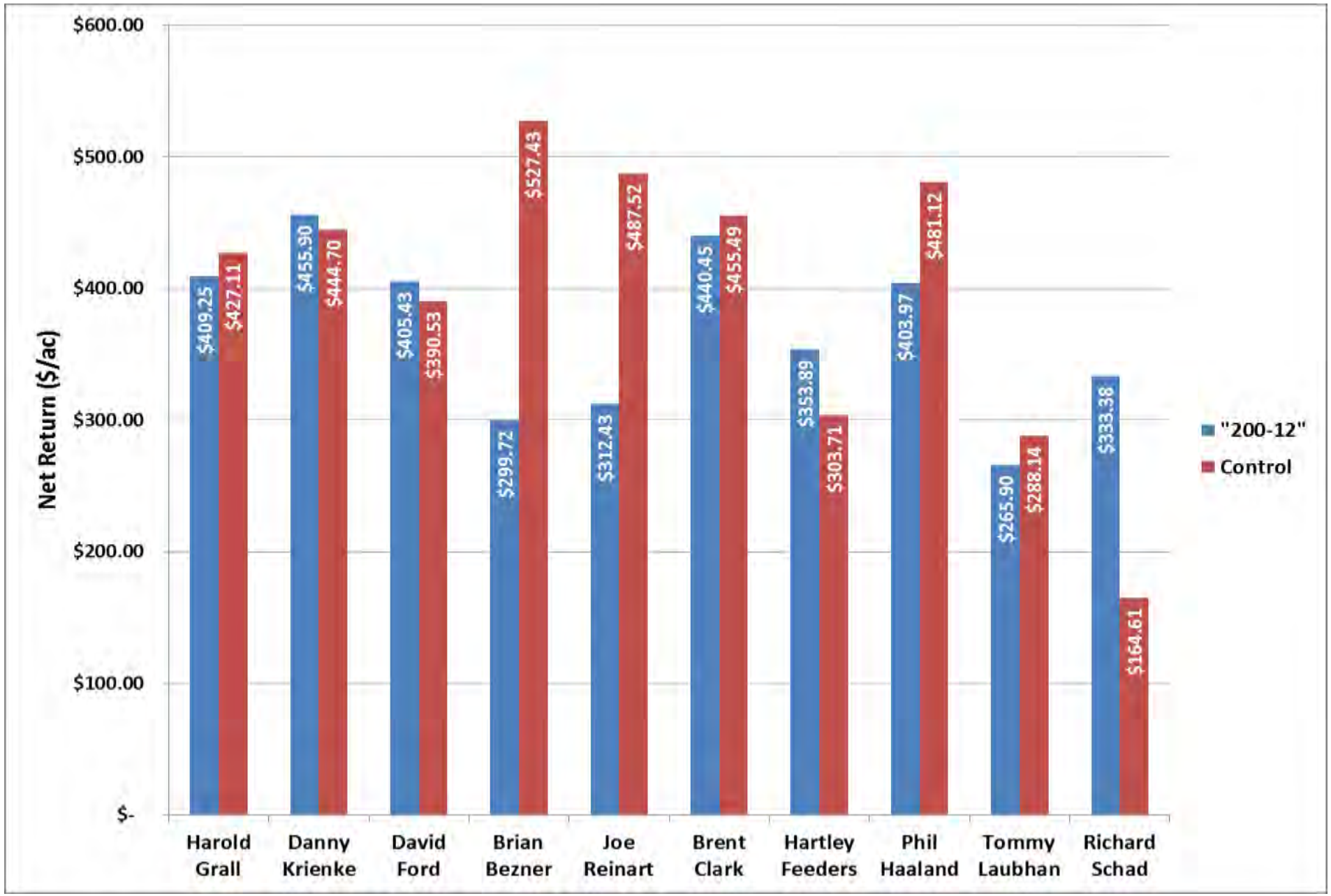
Note: Producers order is ranked highest to lowest by bushels per acre-inch of irrigation for the grower's "200-12" field.

Appendix B: Corn Hybrid and Planting Information for the 2014 "200-12" Project

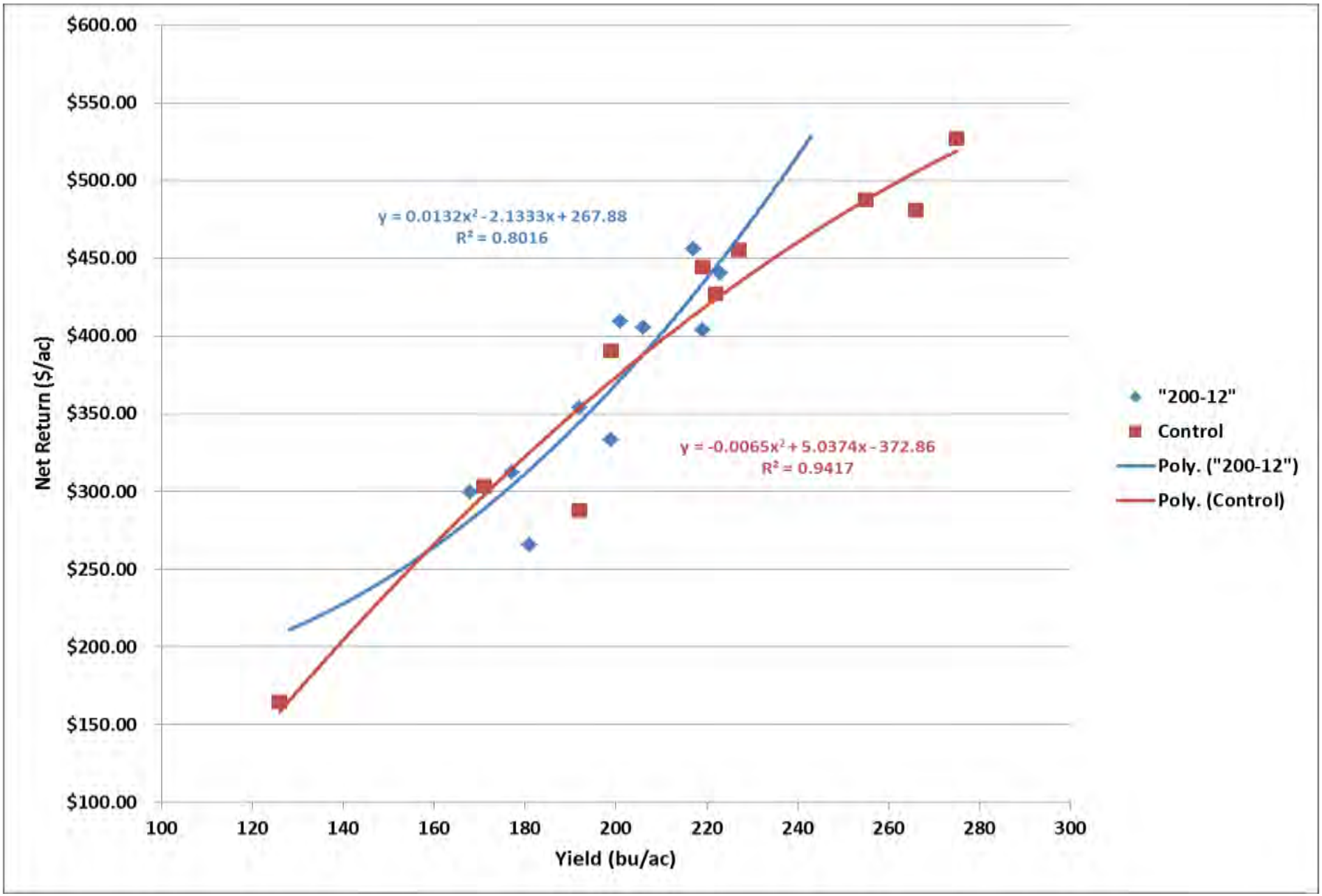
Producer	County	Field	Planted	Corn Hybrid	Seeding Rate	Yield (bu/ac)	Total Irrigation (in.)	bu/ac-in of Irrigation	Previous Crop	Acres
Harold Grall	Moore	"200-12"	Jun 12	P151AM	25,000	201	12.96	15.51	Corn	120
		Control	Jun 04	P33B54	32,000	222	20.74	10.70	Corn	120
Danny Krienke	Ochiltree	"200-12"	Jun 16	Gold Ac 24V61	26,000	217	14.42	15.04	Corn	60
		Control	Jun 16	Gold Ac 24V61	28,000	219	16.06	13.64	Corn	60
David Ford	Hartley	"200-12"	May 29	P1151AM	30,000	206	14.86	13.86	Corn	60
		Control	May 29	P1151AM	30,000	199	13.85	14.36	Corn	60
Brian Bezner	Dallam	"200-12"	May 21	Syng N72D-3111	27,000	168	12.25	13.71	Wheat	110
		Control	May 21	Syng N72D-3111	32,000	275	21.88	12.57	Wheat	128
Joe Reinart	Sherman	"200-12"	Jun 04	Ch198-00	32,000	177	14.83	11.93	Cotton	27
		Control	Apr 25	Ch217-00	32,000	255	24.48	10.41	Wheat	75
Brent Clark	Hartley	"200-12"	Apr 29	Ch214-14	27,000	223	19.59	11.38	Corn	61
		Control	Apr 29	Ch214-14	27,000	227	19.01	11.95	Corn	61
Hartley Feeders	Hartley	"200-12"	Jun 05	P1498HR	28,000	192	18.07	10.62	Corn	60
		Control	Jun 06	P1498HR	28,000	171	16.01	10.68	Corn	60
Phil Haaland	Hartley	"200-12"	May 19	P1151AM	30,000	219	21.89	10.00	Wheat	3
		Control	May 19	P1151AM	37,000	266	31.72	8.38	Wheat	117
Tommy Laubhan	Lipscomb	"200-12"	May 07	P1266AM	32,000	181	21.28	8.50	Wheat	62
		Control	May 07	P1266AM	32,000	192	22.84	8.40	Wheat	62
Richard Schad	Hansford	"200-12"	May 20	Ch214-00VT2	27,400	199	25.76	7.72	Wheat	41
		Control	May 21	Ch214-14VT3	32,200	126	14.60	8.63	Corn	124
Average		**"200-12"**	**May 25**	**-**	**28,440**	**198**	**17.59**	**11.83**	**"200-12" Total**	**604**
		Control	**May 21**	**-**	**31,020**	**215**	**20.12**	**10.97**	**Control Total**	**867**
									Project Total	**1471**

Note: Producers order is ranked highest to lowest by bushels per acre-inch of irrigation for the grower's "200-12" field.

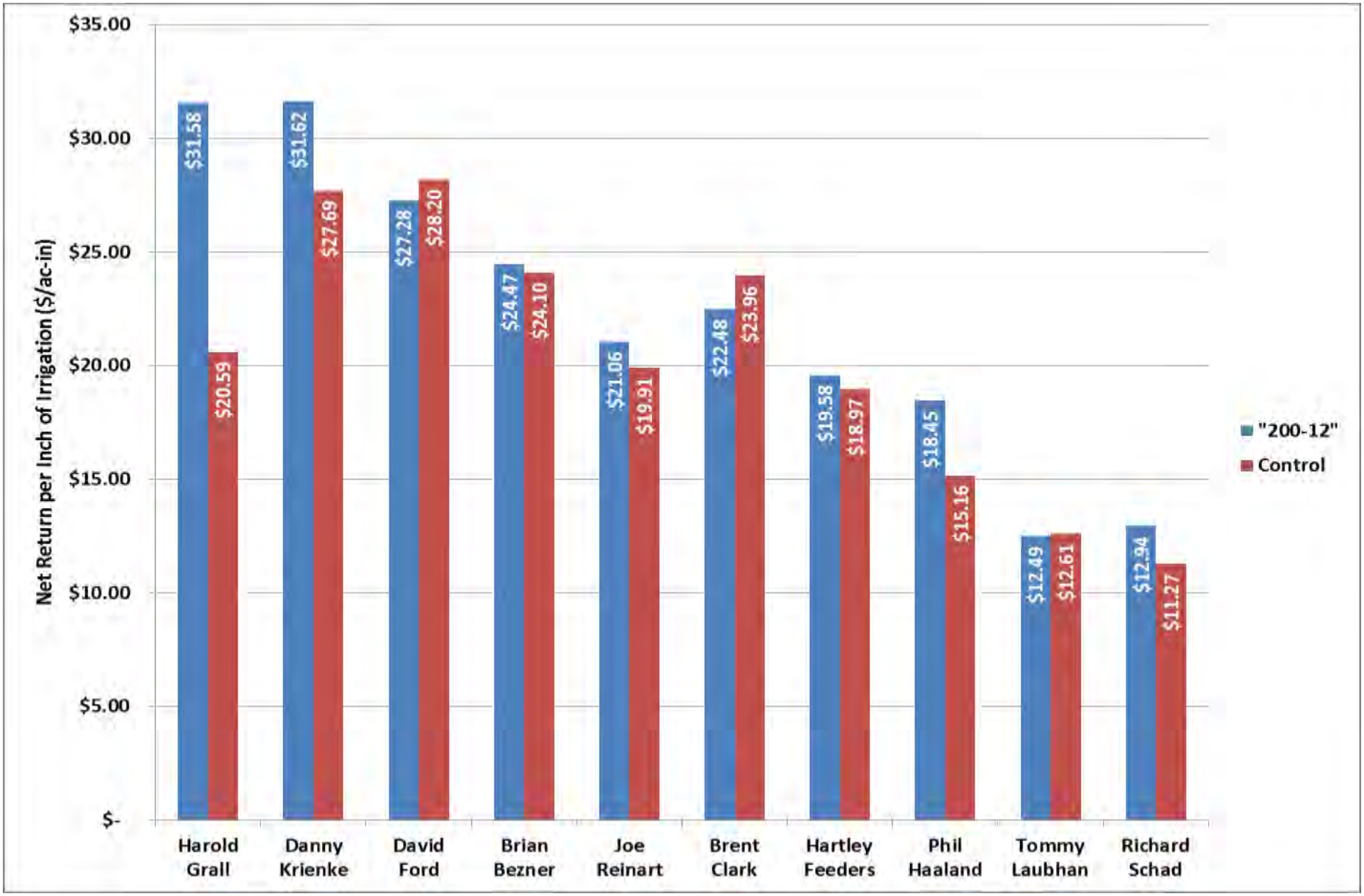
Appendix C: Net Return per Acre for Each “200-12” and “control” Demonstration Field



Appendix D: Corn Yield vs. Net Return per Acre



Appendix E: Net Return per Inch of Irrigation for Each “200-12” and “control” Field



NORTH PLAINS
GROUNDWATER
Conservation District

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