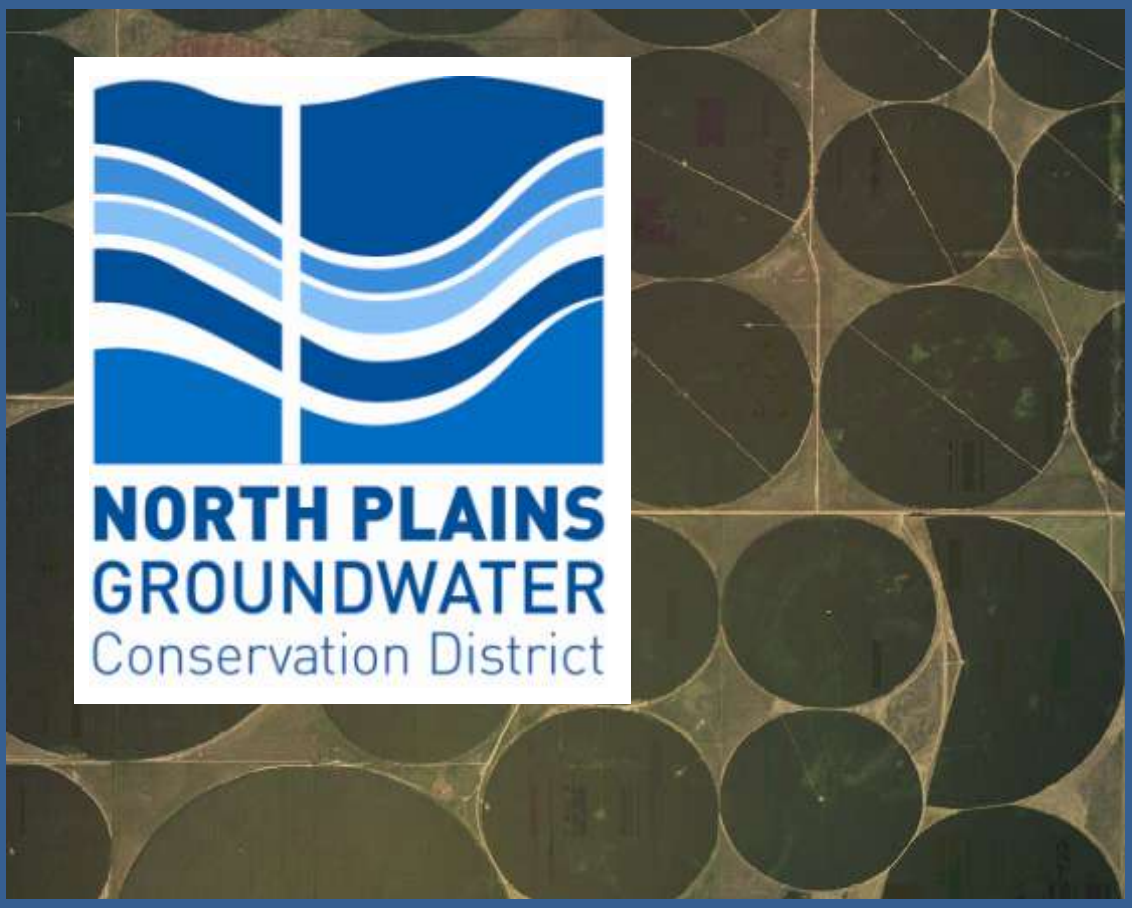
200 Bushels of Corn on 12 inches of Irrigation Water Demonstration Project – 2010



Principal Participants:

Leon New – Irrigation Engineer (District Conservationist)
Randy Coon – Natural Resources Specialist
Harold Grall – Moore County Cooperator
Danny Krienke – Ochiltree County Cooperator
Phil Haaland – Hartley County Cooperator

Table of Contents

Executive Summary 5
Introduction 6
Methods 6
Moore County Demonstration – Harold Grall 9
Ochiltree County Demonstration – Daniel Krienke 15
Hartley County Demonstration – Phil Haaland 19
Conclusion 29
Appendix A – District Field Demonstration Data 31
Appendix B – AquaSpy 47
Appendix C – Precision Irrigation Limited Irrigation Resource Planner 57

Executive Summary

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 crop acre. The 200-12 Project is a five year on-farm demonstration that shows 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 restricted and diminishing groundwater resources. The District plans to double the number of demonstrations in 2011.

In 2010, three District directors (Harold Grall, Danny Krienke and Phil Haaland) dedicated their own irrigated acres for the first year of the 200-12 Project. The cooperators implemented new and proven irrigation management technologies and practices to aid in the strategic management of each reduced irrigation water demonstration site.

Harold Grall of Moore County dedicated 120 acres for the on-farm demonstration. He saved ten inches of irrigation for the year when compared to his normal practices. Mr. Grall has an Actual Production History (APH) of 217 bushels for the field in the previous nine years. He yielded 198 bushels in the 200/12 program in 2010. His farm average yield for other fields was ten percent less than normal. Mr. Grall saved $100.34 per acre in costs on corn produced this year due to the reduction in irrigation, seed, fertilizer and harvest costs. The reduced corn yield cost $89.87 per acre. The demonstration's net gain was $10.47 per acre with ten inches less irrigation water used compared to typical production from the same field.

Danny Krienke of Ochiltree County dedicated 120 acres for the on-farm demonstration. He saved five inches of applied irrigation for the year when compared to his normal practices. Mr. Krienke has an adjusted APH of 196 bushels from this field for 2010. The field demonstration produced 192 bushels for the year. Mr. Krienke saved $61 per acre in cost on corn produced in 2010 due to the reduction in irrigation, seed, fertilizer, and harvest costs. The reduced corn yield cost $18.92 per acre. The demonstration's net gain was $42.08 per acre, with 5 inches less irrigation water used compared to typical production from the same field.

Phil Haaland of Hartley County dedicated 30 acres for the District's on-farm demonstration from a 120 acre field in which he was demonstrating hybrid varieties for a separate demonstration project. On the 30 acres, Haaland saved eleven inches of applied irrigation for the year. Haaland's field has an APH of 240 bushels and came in with 191 bushels for the year. In simulating a 250 gpm well on a 120 acre circle, Mr. Haaland saved $122.46 per acre in costs on corn produced this year due to the reduction in irrigation, seed, fertilizer and harvest costs. The reduced corn yield cost $231.77 per acre. This demonstration's net loss was $109.31 per acre with eleven inches less irrigation water used compared to a typical production from the

same field. If the production capacity of the irrigation pivot was actually 250 gpm, Haaland said he would have only irrigated half a circle (60 acres) which would have increased his yield and would have been closer to break-even.

By reducing current irrigation volumes by as little as three inches over the one million acres of irrigated cropland, it may be possible to save up to 250,000 acre-feet of groundwater per year within the District. This water savings can prolong the viability of agriculture irrigation in the area.

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 200-12 Project 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 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 soil profile. In the 200-12 Project's first year, three of the District's directors dedicated their own irrigated acres to establish the program. In 2010, the three directors that participated in the demonstrations were as follows: Phil Haaland dedicated 30 acres in Hartley County; Harold Grall dedicated 120 acres in Moore County; and Danny Krienke dedicated 120 acres in Ochiltree County. The directors are committed to continuing the demonstrations in their fields. The information in this report provides the results of these field demonstrations for 2010.

Methods

The three cooperators individually selected commercially available corn hybrids based on their experience as growers and irrigated the hybrids using center pivots. At each demonstration site, the District installed water meters to record and verify the amount of water applied on the fields, rain gauges to measure rainfall, gypsum block moisture sensors at 1, 2, 3 and 4 feet depth in the crop's root zone to monitor soil water content; and AquaSpy® continuous soil water monitoring probes to 60" depth. Each demonstration site was equipped with PivoTrac™ irrigation pivot continuous monitoring and control system to monitor irrigation application

frequency. During the growing season, District personnel collected data and maintained recording equipment in each demonstration field. Appendix A contains the District's Field Demonstration data.

The cooperators and the District's Conservationist used the real-time data from AquaSpy® and PivoTrac™ along with the data collected at least weekly from the sites to monitor crop and soil moisture conditions, as well as to schedule irrigation frequency and volumes. Appendix B contains individual field demonstration results related to AquaSpy® soil moisture sensors. Then, the District compared rainfall, irrigation applications, and soil water data collected from the fields to evapotranspiration (ET) as reported by the NPET Network for fully irrigated corn until it was discontinued on September 1st; and to an irrigation application computer model "Limited Irrigation Resource Planner" created by Precision Irrigation. Appendix C contains individual field demonstration results related to Precision Irrigation Limited Irrigation Resource Planner.

The District compared the harvest results for each grower to the Actual Production History (APH) for the field and adjusted the yield results to reflect 15.5% moisture content for corn based on the yield formula used by the National Corn Growers Association. The District analyzed production gains and losses based on $4.73 per bushel corn and the growers expenses relating to irrigation, seed, fertilizer and harvest costs. The District did not analyze land costs because land costs are highly variable between growers and across the District. The following discussion provides detailed information for each grower's field.

Moore County Demonstration – Harold Grall

Planting and Crop Information - For his demonstration, Harold Grall strip tilled and planted 120 acres of corn in a field identified by its section number, "Grall #414". Grall planted the bulk of the field with Pioneer 34 F 96. In the same field he planted twelve rows of four comparative Pioneer hybrid plots at 1.5 acres each. He irrigated the corn through a center pivot with a 475 gpm nozzle package that delivered an average 1.2 inches of irrigation water in 5 days. The planting and crop information for Grall #414 is shown in the table below.

Table – Planting and Crop Information for Grall #414

Planted:	May 13	**Fertilizer:**	203-22-3
Hybrid:	Pioneer 34F96	**Insecticide:**	Comite; Headline fung.
Seeding Rate:	23,000	**Herbicide:**	Sharpen, Rifle, Roundup, Atrazine
Soil Type:	Sherm Silty Clay Loam	**Harvested:**	September 22
Row Width:	30 Inches	**No. Acres:**	120
GPM Per Acre	4.0	**Tillage:**	Strip Till
Irr/Rain/Soil Water: 28.80"		**Irrigation:**	10.86 Inches

Comparative Pioneer Hybrids: 33B54, PO751HR, 36V75, and 35F40 (1.5 acre plots)

Beginning Soil Water Profile and Growing Season Rainfall -The soil profile was full in the demonstration field at the beginning of the growing season which represents approximately two inches of available water per foot of soil. Seasonal rainfall totaled 13.05 inches. Because rainfall that followed planting maintained a full soil water profile, Grall delayed irrigation until June 26 when he applied 1.17 inches of water with additional fertilizer. Early on, the crop did not root as deep as desired, but eventually used soil water from 48 inches in September. The crop was continuously irrigated beginning in mid July thru mid August, when crop water use was high during pollination and early grain fill. The following table shows monthly rainfall as recorded by a District rain gauge at the field.

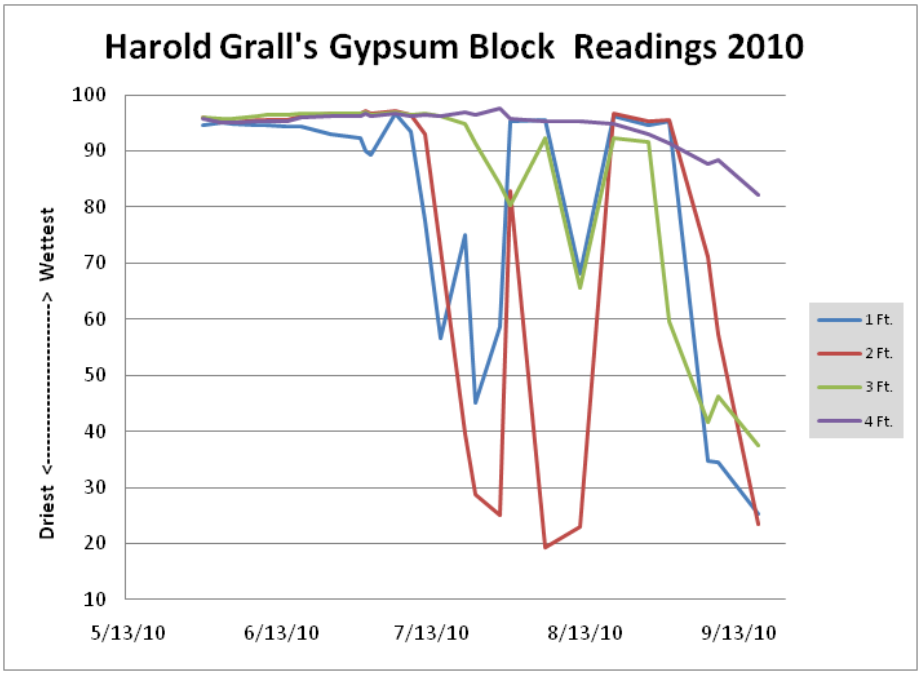
Table – Monthly Rainfall Data for Grall #414

May– 2.51" June- 4.01" July- 2.80" August- 3.73" Sept-0" Total: 13.05"

Growing Season Water Tracking – The District tracked total water throughout the growing season with rain gauges, well meters, gypsum blocks and AquaSpy® sensors. Gypsum block soil moisture sensors were installed at 1, 2, 3 and 4 feet and AquaSpy® soil moisture sensors were installed to five feet in the root zone to monitor soil water levels in only hybrid 34 F 96. The gypsum block readings are shown in a graph following this paragraph. The growing season water tracked by the District, including rainfall, irrigation, and soil moisture at various growth stages throughout the season, compared to the water demand for the crop as measured by the

NPET Network, are shown in the next graph. A table showing the order of events follows the graphs. "Total Wet" means total irrigation, rainfall plus net soil water.

Graph – Gypsum Block Readings for Grall #414



Graph – Growing Season Water Tracking for Grall #414.

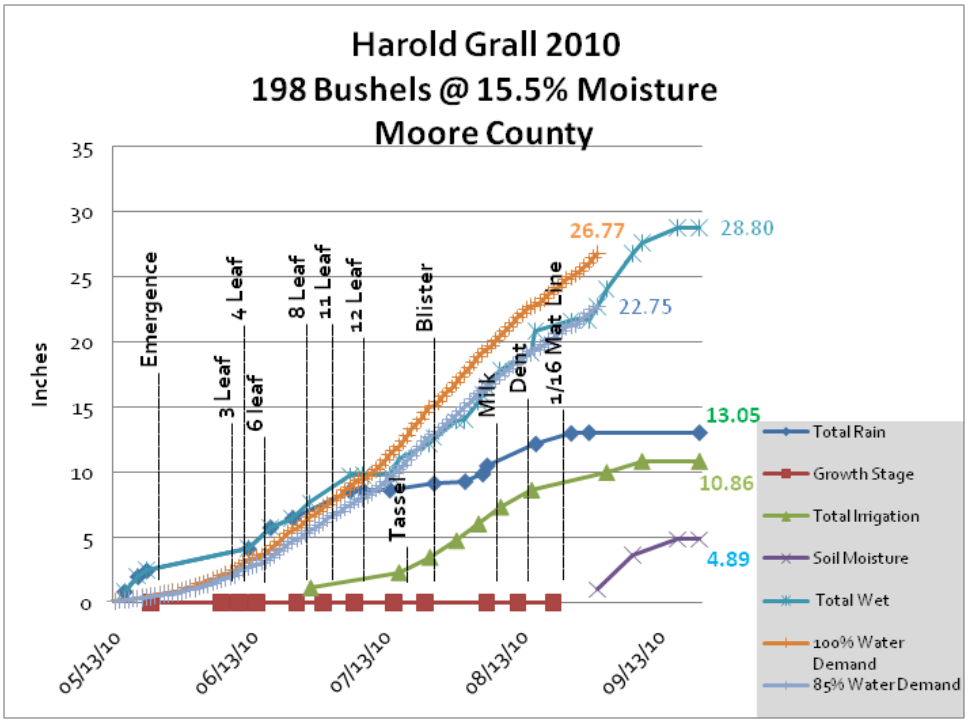


Table – Growing Season Water Tracking for Grall #414

Date	Inches		Gypsum Block Reading (Percent of soil moisture)				Growth
Mo/Day	Irrigation	Rainfall	1 foot	2 feet	3 feet	4 feet	Stage
15-May		0.9					
18		1.16					
20		0.45					
26			Install soil moisture sensors				
28			95	96	96	96	
1-Jun			95	95	96	95	
3			95	95	96	95	
8			95	95	96	95	3 leaf
10			95	95	96	95	4 leaf
12		1.68					
14			94	96	96	95	6 leaf
17		1.61	94	96	97	96	6 leaf
22		0.72					
23			93	97	97	96	8 leaf
26	1.17						
29			92	97	97	96	11 leaf
1-Jul			89	97	97	96	11 leaf
5		2.08					
6			97	97	97	97	12 leaf
8		0.03					
9			93	96	96	96	12 leaf
12			77	93	97	96	
14		0.05					
15			56	72	96	96	Tassel
16	1.17		(.96")	(1.20")	(1.92")	(1.92")	(6.0")
20			75	40	95	97	
22			45	29	91	96	pollinate
			(.64")	(.58")	(1.6")	(1.9")	(4.72")
23	1.17						blister
24		0.49					
29	1.27		95	83	80	96	blister
			(1.90")	(1.37")	(1.3")	(1.9")	
31		0.15					
3-Aug	1.29						
4-Aug		0.57					
5		0.63	96	19	92	95	dough
			(1.9")	(.40")	(1.85")	(1.9")	

- Numerals in Red are Available Soil Moisture

Table (Continued) – Growing Season Water Tracking for Grall #414

Date	Inches		Gypsum Block Reading (Percent of soil moisture)				Growth
Mo/Day	Irrigation	Rainfall	1 foot	2 feet	3 feet	4 feet	Stage
9	1.29						
12			68.1	23	67.5	95.2	dent
15	1.29		(1.12")	(.48")	(1.08")	(1.9")	
16		1.67					
19			96.2	96.7	92.2	94.8	
			(1.95")	(1.95")	(1.9")	(1.9")	
24		0.81					
26			94.6	95.3	91.6	93	
28		0.05					
30			95.4	95.6	59.6	91.3	
1-Sep	1.35						
7			34.7	71.1	41.6	87.7	
9	0.86		34.5	57.3	46.3	88.3	
17			25.2	23.4	37.5	82.2	
22		Harvest	198 bushels per acre at 15.5% moisture				
Total	10.86	13.05	1.50"	1.47"	1.27"	.65"	
Irrig/Rain/Soil		28.80"	Amount soil moisture used			4.89"	
Post Harvest							
23-Sep		0.4					
30-Sep			25.0	21.8	37.5	84.1	
7-Oct							
14			24.0	22.3	37.9	86.2	

- Numerals in Red are Available Soil Moisture

Harvest Results - The field produced 198 bushel corn yield, within one percent of the 200 bushel goal. The crop underwent some hail damage just prior to tassel which negatively affected yield. His farm average yield for other fields was ten percent less than normal. The field's actual production history (APH) is 217 bushels for the previous nine years. Grall saved ten inches of irrigation for the year when compared to his normal practices. The field produced 18.23 bushels (1021 lbs) from each inch of irrigation and 6.88 bushels (385 lbs) from irrigation, rain, and additional soil water. Crop production costs were about $100.34 per acre less than normal corn production costs from reduced seed, fertilizer, irrigation and harvest expenses. At $4.73 per bushel, the reduced corn yield cost $89.87 per acre. The demonstration's net gain was $10.47 per acre with less irrigation water used compared to typical production from the same field. A summary of the demonstration results are shown in the following table.

Table – 2010 Demonstration Results for Grall #414

Irrigation		Irrig/Rain/Soil	PRODUCTION		CROP VALUE @ $4.73/Bu		
No	Inches	Inches	Bu/Ac	Bu/Ac-In Irrigation	Per Acre	Acre-In of Irrigation	Ac-In of Irrig/Rain/Soil
9	10.86	*28.80	198	18.23	$936.54	$86.24	$32.52

***Includes 4.89 inches of water removed from four feet of soil, rainfall, and irrigation.**

Additional Harvest Results – To ensure the success of the program, the two most determining factors were hybrid and plant population. In addition to harvesting the field, Grall collected two samples of Pioneer Hybrid 34 F 96 adjacent to the four comparative Pioneer hybrid plots. The 1.5 acre hybrid plots were used to determine which commercially available hybrids performed best under reduced irrigation. Russell French, Agronomist for Pioneer Hybrid International, provided the plot harvest data. The plot test results are shown in the following table.

Table - Additional Harvest Results

HYBRID	SEEDING RATE	PRODUCTION (BUSHELS PER ACRE)
34 F 96	23,000	203
34 F 96	23,000	203
33 B 54	23,000	193
PO751HR	23,000	188
36 V 75	23,000	186
35 F 40	23,000	175

Ochiltree County Demonstration – Daniel Krienke

Planting and Crop Information - For his demonstration, Danny Krienke conventionally tilled and planted 120 acres of corn in a field identified by its section number, "Krienke #47". Krienke planted the field with Pioneer 33 B 54. He irrigated the corn through a center pivot with a 600 gpm nozzle package that delivered an average 0.98 inches of irrigation water in 3.7 days. The planting and crop information for Krienke #47 is shown in the table below.

Table – Planting and Crop Information for Krienke #47

Planted:	May 11	**Fertilizer:**	176-79-0
Hybrid:	Pioneer 33B54	**Insecticide:**	None
Seeding Rate:	26,500	**Herbicide:**	Cinch ATZ
Soil Type:	Pullman Silty Clay Loam	**Harvested**:	September 25
Row Width:	30 inches	**No. Acres:**	120
GPM/Acre:	5.1	**Tillage:**	Conventional

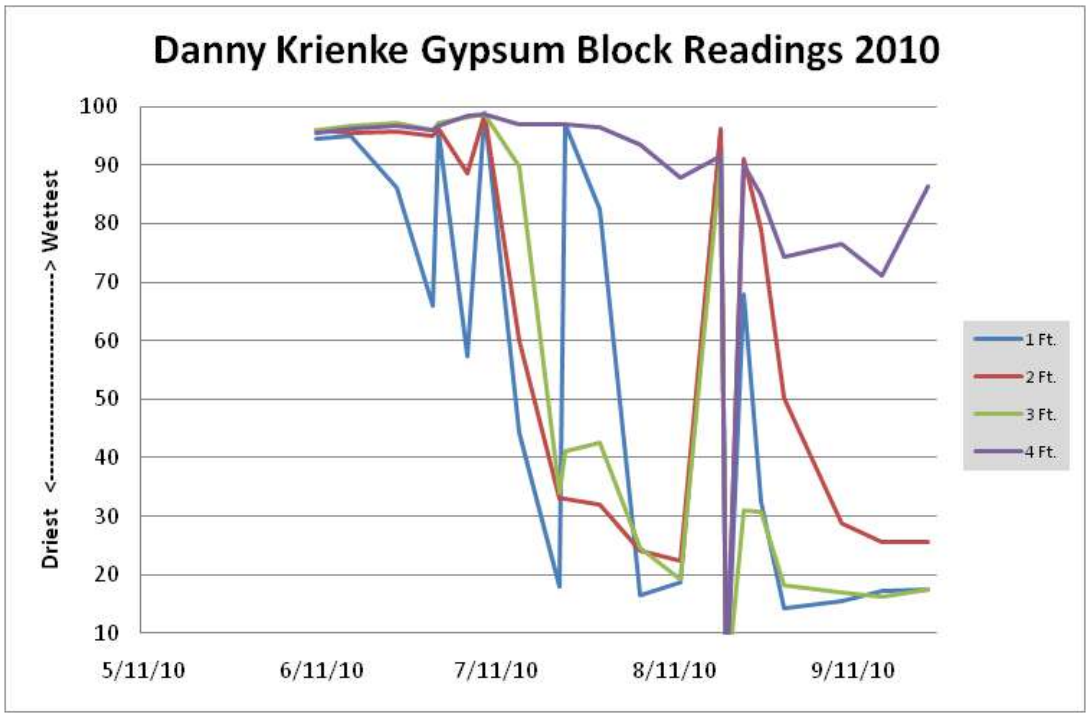
Beginning Soil Water Profile and Growing Season Rainfall - The soil profile was full in the demonstration field at the beginning of the growing season which represents approximately two inches of available water per foot of soil. Seasonal rainfall totaled 12.90 inches. Rainfall following planting was good in May and June, but became less in July when corn water use was high. Corn used soil water throughout three feet in the root zone. Only limited water was used from four feet. During the corn high water period at early grain fill, irrigation was at full capacity from 5.1 gpm per acre. The following table shows monthly rainfall as recorded by a District rain gauge at the field.

Table – Monthly Rainfall Data for Krienke #47

May- 3.10" June- 4.87" July- 1.60" August- 2.29" Sept- 1.04" Total: 12.90"

Growing Season Water Tracking for Krienke #47 – The District tracked total water throughout the growing season with rain gauges, well meters, gypsum blocks and AquaSpy® sensors. Gypsum block soil moisture sensors installed at 1, 2, 3 and 4 feet and AquaSpy® soil moisture sensors were installed to five feet in the root zone to monitor soil water levels. The gypsum block readings are shown in a graph following this paragraph. The growing season water tracked by the District, including rainfall, irrigation, and soil moisture at various growth stages throughout the season, compared to the water demand for the crop as measured by the NPET Network, are shown in the next graph. A table showing the order of events follows the graphs.

Graph – Gypsum Block Readings for Krienke #47



Graph – Growing Season Water Tracking for Krienke #47

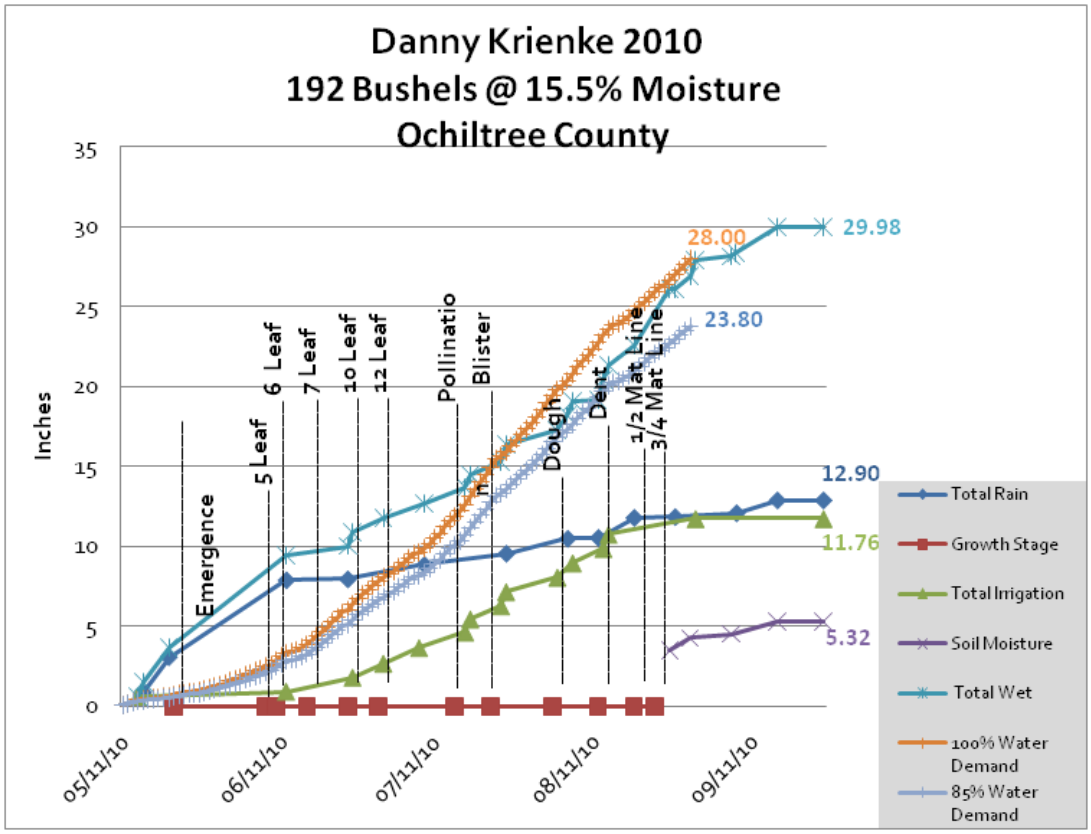


Table – Growing Season Water Tracking for Krienke #47

Date	Inches		Gypsum Block Reading (Percent of soil moisture)				Growth	
Mo/Day	Irrigation	Rainfall	1 foot	2 feet	3 feet	4 feet	Stage	
14-May	0.71							
15		0.9						
20		2.2						
8-Jun			Install soil moisture sensors				5 leaf	
10			94	96	96	96	6 leaf	
11	0.21							
12		4.81						
16			95	96	97	96	7 leaf	
24		0.06	86	96	97	97	10 leaf	
25	0.88							
30	0.88		96	96	97	97	12 leaf	
1-Jul			96	96	97	97	12 leaf	
6			57	89	98	98		
8	0.98	0.9						
9			99	99	99	99		
15			44	60	90	97	pollinate	
16	0.98		(.82")	(1")	(1.80")	(1.90")	(5.52")	
17	0.82							
22			18	33	34	97	blister	
			(.38")	(.65")	(.67")	(1.9")		
23	0.82							
24	0.9	0.7						
29			82	32	42	96	dough	
			(1.38")	(.60")	(.80")	(1.90")		
3-Aug	0.9							
5		0.93						
6	0.9		63	22	22	95	dent	
			(1.05")	(.45")	(.45")	(1.9")		
11		0.06						
12	0.9		18.7	22.5	19.1	87.9	1/16Mat ln	
13	0.9		(.38")	(.45")	(.40")	(1.48")		
17		1.25						
19			96.1	96	91	91.5		
			(1.95")	(1.95")	(1.9")	(1.9")	1/2 mat line	
26		0.05	32.4	79.1	30.7	84.8		
30			15.4	28.7	17	76.5		

- Numerals in Red are Available Soil Moisture

Table (Continued) – Growing Season Water Tracking for Krienke #47

Date	Inches		Gypsum Block Reading (Percent of soil moisture)				Growth	
Mo/Day	Irrigation	Rainfall	1 foot	2 feet	3 feet	4 feet	Stage	
31	0.98							
8-Sep		0.24						
16-Sep		0.80	17.3	25.6	16.3	71.2		
24			17.5	25.5	17.5	86.3		
25		Harvest	192 bushels per acre 15.5% moisture					
Total	11.76	12.90	1.65"	1.48"	1.65"	.54"		
Irrig/Rain/Soil		29.98"	Amount of soil moisture used			5.32'		
Post Harvest								
23-Sep		0.33						
29			15.4	23.3	16.7	87.6		
7-Oct								
14			96.2	20.2	15.8	88.4		

- Numerals in Red are Available Soil Moisture

Harvest Results - The field produced 192 bushel corn yield, within four percent of the 200 bushel goal. The field's APH is 218 bushels; however, general crop production within the area was down approximately 10% from previous years. More than the normal number of days with temperatures above 100 degrees in August, when the crop was going through its final stages of grain fill, reduced yields in the surrounding area by 10%. The 10% yield reduction adjusts Krienke's APH to 196 bushels per acre. Krienke saved 5 inches of irrigation for the year when compared to his normal practices. The field produced 16.3 bushels (914 lbs) from each inch of irrigation and 6.4 (358 lbs) from 29.98 inches of irrigation, rainfall and soil water. Corn production costs were approximately $61.00 less than normal production from reduced seed, fertilizer, irrigation and harvest costs. At $4.73 per bushel, the reduced corn yield cost $18.92 per acre. The demonstration's net gain was $42.08 per acre with less irrigation water used compared to typical production from the same field. A summary of the demonstration results are shown in the following table.

Table – 2010 Demonstration Results for Krienke #47

Irrigation		Irrig/Rain/Soil	PRODUCTION		CROP VALUE @ $4.73/Bu		
No	Inches	Inches	Bu/Ac	Bu/Ac-In Irrigation	Per Acre	Acre-In of Irrigation	Ac-In of Irrig/Rain/Soil
13	**11.76**	***29.98**	**192**	**16.32**	**$908.16**	**$77.22**	**$30.29**

*Includes 5.32 inches of water removed from four feet of soil, rainfall, and irrigation.

Hartley County Demonstration – Phil Haaland

Planting and Crop Information - For his demonstration, Phil Haaland strip tilled and planted 30 acres of multi-plot corn hybrid varieties within a 120 acre circle identified by its section number, "Haaland #44". The purpose of his demonstration was to collect improved drought tolerant corn production data based on plant populations and other strategies. Haaland planted the 30 acres with Pioneer Hybrid 33 B 54 with a seeding rate 27,500, and compared the plot with three other plots in the field with seeding rates of 15,000, 20,000 and 25,000. He irrigated the 30 acres in alternate 7 day passes, simulating 250 gpm irrigation capacity on a 120 acre field. The planting and crop information for Haaland #44 is shown in the table below.

Table – Planting and Crop Information for Haaland #44

Planted:	April 28	**Fertilizer:**	10 Tons Manure + 179-0-0
Hybrid:	Pioneer 33B54	**Insecticide:**	Oberon; Headline fung.
Seeding Rate:	27,500	**Herbicide:**	Balance,Flex,Atrazine,Laudis
Soil Type:	Dallam Fine Sandy Loam	**Harvested:**	September 22
Row Width:	30 Inches	**No. Acres:**	30
GPM Per Acre:	2.1 (simulated)	**Tillage:**	Strip Till
Irrigation:	11.20 inches	**Irrig/Rain/Soil Water:**	30.59 inches

Comparative seeding rates: 15,000, 20,000 and 25,000 in 0.54 acre plots within the 30 acres

Beginning Soil Water Profile and Growing Season Rainfall – The soil profile was full in the demonstration field at the beginning of the growing season which represents average 1.85 inches of available water per foot of soil. Seasonal rainfall totaled 14.30 inches. Haaland began full irrigation in early June. The crop searched for and used stored soil water from five feet, at pollination and early grain fill in July. The following table shows monthly rainfall as recorded by a District rain gauge at the field.

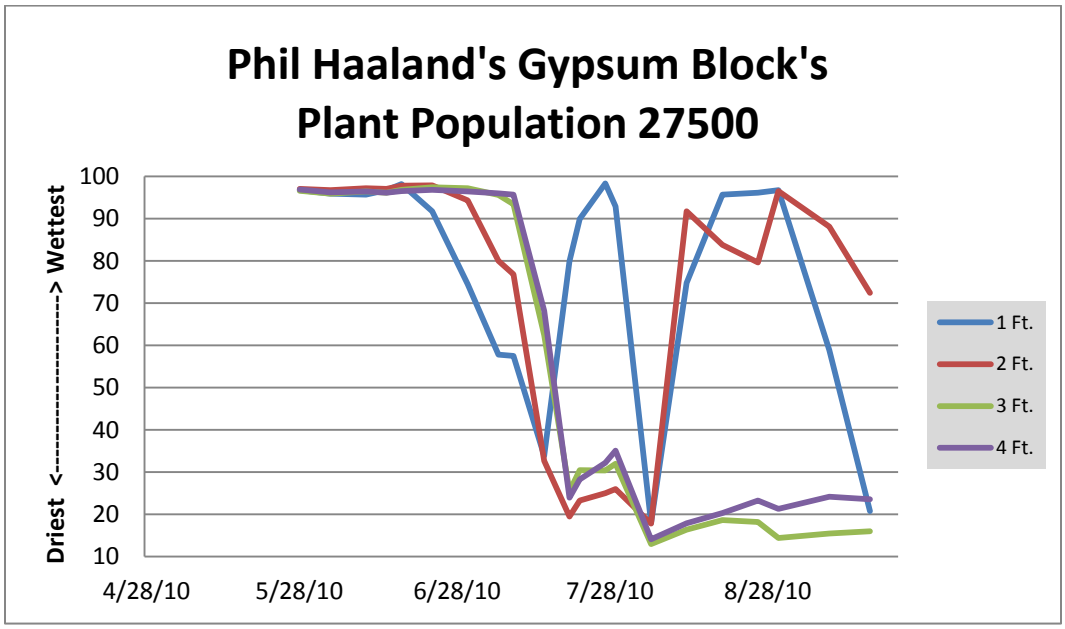
Table – Monthly Rainfall Data for Haaland #44

May - 2.12" June- 5.46" July - 1.94" August - 4.78" Sept - 0" Total: 14.30"

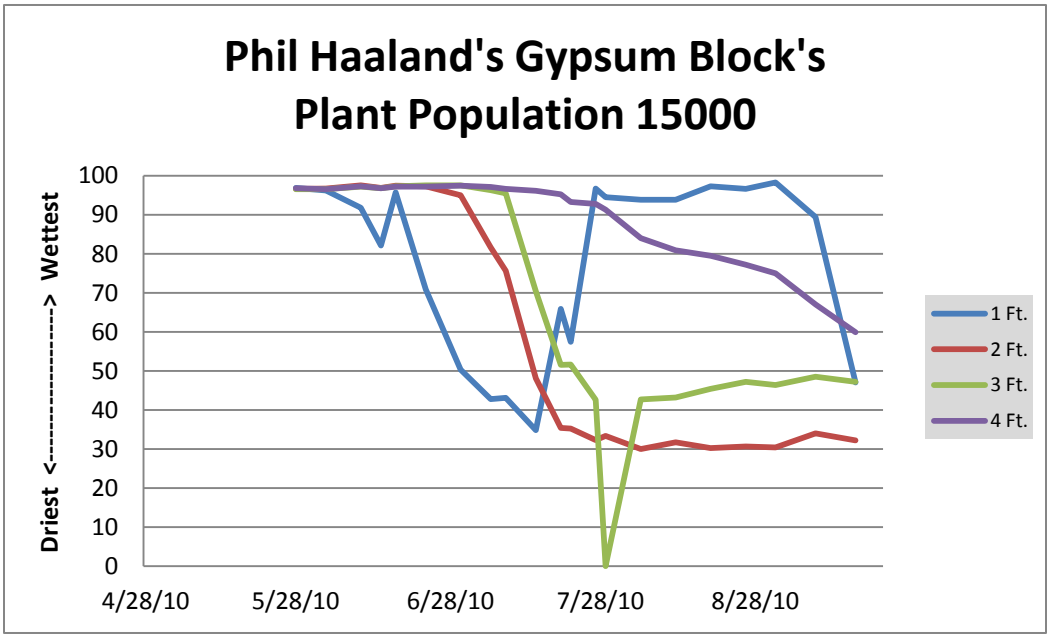
Growing Season Water Tracking for Haaland #44 – The District tracked total water throughout the growing season with rain gauges, well meters, gypsum blocks and AquaSpy® sensors. Gypsum block soil moisture sensors installed at 1, 2, 3 and 4 feet and AquaSpy® soil moisture sensors were installed to five feet in the root zone to monitor soil water levels in the 27,500 seeding population and in the 15,000 seeding population comparison plot. The District installed AquaSpy® sensors to monitor soil water levels in only the 27,500 seeding population. The gypsum block readings are shown in two graphs following this paragraph. The growing season water tracked by the District, including rainfall, irrigation, and soil moisture at various

growth stages throughout the season, compared to the water demand for the crop as measured by the NPET Network, are shown in the next two graphs. Two tables showing the order of events follow those graphs.

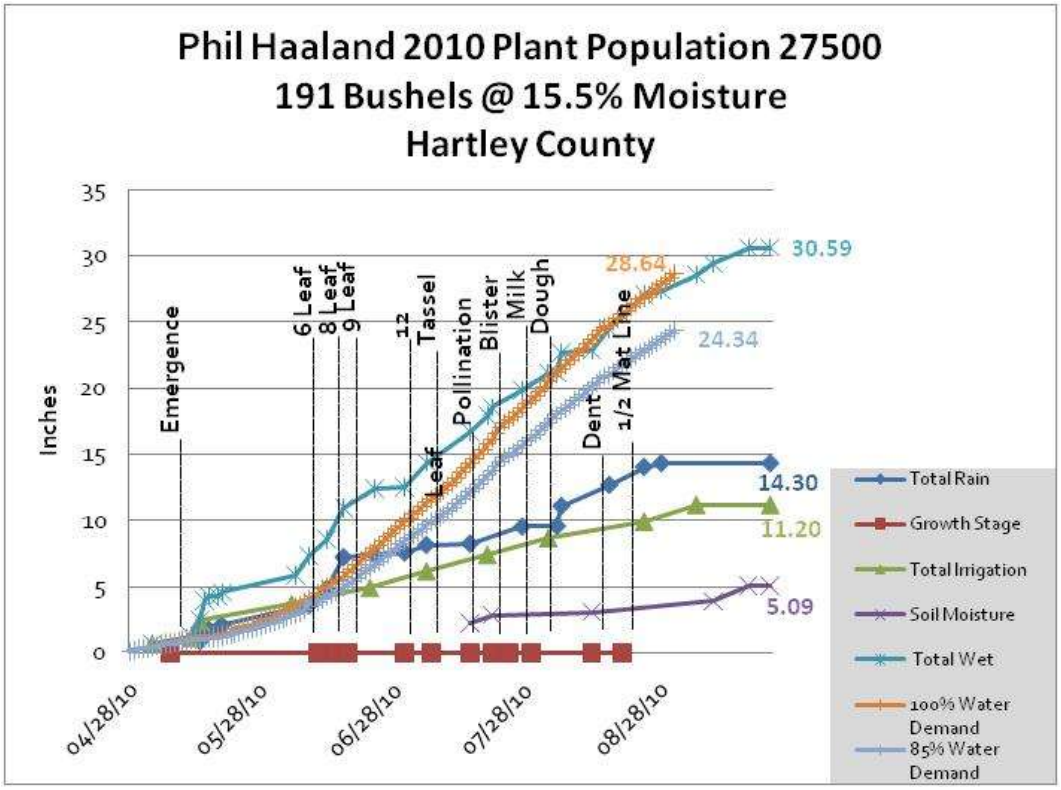
Graph – Gypsum Block Readings for Haaland #44 (27,500 population)



Graph – Gypsum Block Readings for Haaland #44 (15,000 population)



Graph – Growing Season Water Tracking for Haaland #44 (27,500 population)



Graph – Growing Season Water Tracking for Haaland #44 (15,000 population)

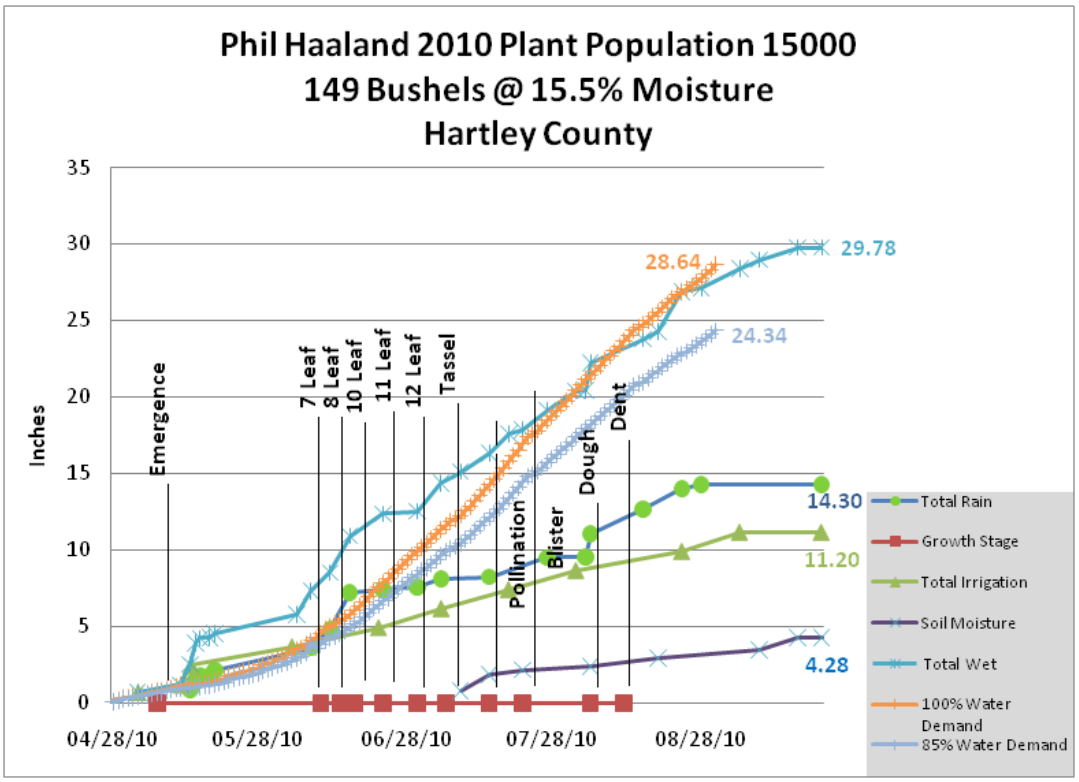


Table – Growing Season Water Tracking for Haaland #44 (27,500 population)

Date	Inches		Gypsum Block Reading (Percent of soil moisture)				Growth	
Mo/Day	Irrigation	Rainfall	1 foot	2 feet	3 feet	4 feet	Stage	
3-May	0.7							
12	0.5							
14		0.9						
15		0.6						
16		0.3						
18		0.02						
19		0.3						
26			Install soil moisture sensors					
28			97	97	97	97		
3-Jun			96	97	96	96		
8	1.25	1.48						
10			96	97	96	96	6 leaf	
12		1.23						
14			97	97	96	96	8 leaf	
16		2.4						
17			98	98	97	96	9 leaf	
23	1.25	0.2	92	98	97	97	10 leaf	
30		0.15	75	94	97	96	12 leaf	
5-Jul		0.57						
6	1.25		58	80	96	96	Tassel	
9			57	77	93	96	Tassel	
14		0.1						
15			34	33	62	68	pollinate	
19	1.25		(.56")	(.63")	(.95")	(1")	(3.14")	
20			79.9	19.5	25.5	24		
22			89.9	23.3	30.5	28.3	blister	
			(1.28")	(.46")	(.58")	(.55")		
24		1.27						
29			93	26	32	35		
			(1.44")	(.52")	(.60")	(.65")		
2-Aug	1.25							
4		0.05						
5		1.52	18	18	13	14	dent	
			(.31")	(.36")	(.26")	(.26")		
12	1.25		74.8	91.7	16.4	17.9	Mat line	
			(.99")	(1.73")	(.32")	(.35")		
16		1.58						

- Numerals in Red are Available Soil Moisture

Table (Continued) – Growing Season Water Tracking for Haaland #44 (27,500 population)

Date	Inches		Gypsum Block Reading (Percent of soil moisture)				Growth	
Mo/Day	Irrigation	Rainfall	1 foot	2 feet	3 feet	4 feet	Stage	
19			95.7	83.8	18.7	20.3	1/2mat line	
			(1.6")	(1.35")	(.39")	(.41")		
23	1.25							
24		1.35						
26			96.1	79.6	18.2	23.3		
28		0.28						
30			96.7	96.5	14.4	21.3		
5-Sep	1.25							
9			58.9	88.1	15.5	24.2		
17			20.8	72.4	16.0	23.6		
22		Harvest	191 bushels per acre at 15.5% moisture					
Total	11.20	14.30	1.23"	.79"	1.61	1.46"		
Irrig/Rain/Soil		30.59"	Amount of soil moisture used			5.09"		
Post Harvest								
23-Sep		0.27						
30-Sep			22.9	66.5	17.2	25.3		
7-Oct								
14-Oct			22.3	61.5	16.7	24.9		

- Numerals in Red are Available Soil Moisture

Table – Growing Season Water Tracking for Haaland #44 (15,000 population)

Date	Inches		Gypsum Block Reading (Percent of soil moisture)				Growth	
Mo/Day	Irrigation	Rainfall	1 foot	2 feet	3 feet	4 feet	Stage	
3-May	0.7							
12	0.5							
14		0.9						
15		0.6						
16		0.3						
18		0.02						
19		0.3						
26			Install soil moisture sensors					
28			96.9	96.6	96.5	96.8		
3-Jun			96.2	96.7	96.5	96.5		
8	1.25	1.48						
10			91.8	97.5	97.2	97.3	6 leaf	
12		1.23						
14			82.1	96.9	96.8	96.8	8 leaf	
16		2.4						
17			95.7	97.4	97.3	97.2	9 leaf	
23	1.25	0.2	70.9	97.3	97.5	97.2	10 leaf	
30		0.15	50.3	95.0	97.5	97.4	12 leaf	
5-Jul		0.57						
6	1.25		42.8	81.6	96.3	97.1	Tassel	
9			43.1	75.6	95.5	96.6	Tassel	
14		0.1						
15			34.8	48.1	70.4	96.1	pollinate	
19	1.25							
20			65.9	35.4	51.5	95.2		
22			57.4	35.2	51.6	93.3	Blister	
24		1.27						
27			96.7	32.3	42.6	92.8		
29			94.5	33.3	42.6	91.3	Blister	
2-Aug	1.25							
4		0.05						
5		1.52	93.8	30.0	42.7	84.0	Dent	
12	1.25		93.8	31.7	43.2	80.9	Mat line	
16		1.58						

Table (Continued) – Growing Season Water Tracking for Haaland #44 (15,000 population)

Date	Inches		Gypsum Block Reading (Percent of soil moisture)				Growth	
Mo/Day	Irrigation	Rainfall	1 foot	2 feet	3 feet	4 feet	Stage	
19			97.3	30.2	45.4	79.5	1/2mat line	
23	1.25							
24		1.35						
26			96.6	30.6	47.2	77.2		
28		0.28						
30			98.3	30.4	46.4	75.0		
5-Sep	1.25							
9			89.4	34.0	48.5	67.0		
17			47.0	32.2	47.2	59.9		
22		Harvest	147 bushels per acre at 15.5% moisture					
Total	11.20	14.30	.92"	1.32"	1.10"	.94"		
Irrig/Rain/Soil		29.78	Amount of soil moisture used			4.28"		
Post Harvest								
23-Sep		0.27						
30-Sep			48.8	32.0	50.3	69.9		
7-Oct								
14-Oct			45.5	30.2	53.0	74.4		

Numerals in Red are Available Soil Moisture

Harvest Results - The field demonstration of the Pioneer Hybrid 33 B 54 with a 27,500 plant population produced 191 bushel corn yield, within 4.5 percent of the 200 bushel goal. The field's APH is 240 bushels. Timely rainfall significantly contributed to the 191 bushel per acre yield. As a result of simulating a 250 gallon per minute system on 120 acres, Haaland saved eleven inches of applied irrigation for the year when compared to his normal practices. Production was 17 bushels (914 lbs) from each inch of irrigation and 6.2 (350 lbs) from 30.59 inches of irrigation, rainfall and net soil water. Mr. Haaland saved $122.46 per acre in costs on corn produced this year due to the reduction in irrigation, seed, fertilizer and harvest costs. At $4.73 per bushel, the reduced corn yield cost $231.77 per acre. This demonstration's net loss was $109.31 per acre with less irrigation water used compared to a typical production from the same field. If the production capacity of the irrigation pivot was actually 250 gpm, Haaland said he would have only irrigated half a circle (60 acres) which would have increased his yield and would have been closer to break-even. Haaland compared the yield of Pioneer Hybrid 33 B 54 with a seeding rate of 27,500 to the three test plots with seeding rates of 15,000, 20,000, and 25,000 populations using the same hybrid. A summary of the demonstration results and a comparison to the three test plots are shown in the following tables.

Table –Demonstration Results for Haaland #44

2010 Demonstration Results							
Irrigation		Irrig/Rain/Soil	Production		Crop Value @ $4.73/Bu		
No	Inches	Inches	Bu/Ac	Bu/Ac-In Irrigation	Per Acre	Acre-In of Irrigation	Ac-In of Irrig/Rain/Soil
10	11.20	*30.59	191	$17.05	$903.43	$80.66	$29.53

***Includes 5.09 inches of water removed from four feet of soil, rainfall, and irrigation.**

Table – Harvest results for Pioneer Hybrid 33 B 54 with a 27,500 plant population compared to three test plots of the same hybrid.

Seeding Rate	Bushels per Acre	Pounds per Plant	Bushels per irrigation inch
15,000	149	0.549	13.3
20,000	172	0.488	15.3
25,000	178	0.399	15.9
27,500 (Demonstration)	191	0.391	17.0

Conclusion

The 200-12 Project 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 restricted and diminishing groundwater resources. By using real-time technologies to monitor soil-water conditions in the root zone, all three demonstrations showed that growers can better manage their irrigation water needs and reduce their irrigation. In two of the demonstrations (Grall and Krienke), the 200 bushel production goal amounted to a 10 percent reduction in their APH. Their reductions in corn yields were mitigated by decreased input costs that resulted in a net financial gain per acre for these two growers. In the third demonstration (Haaland), the grower simulated a 250 gpm irrigation capacity on a 120 acre field. This demonstration showed a condition that an increasing number of growers are facing throughout the District, where there is simply not enough groundwater available to continue to irrigate as usual. Haaland remarks that If the production capacity of the irrigation pivot was actually 250 gpm, he would have only irrigated half a circle (60 acres) which would have increased his yield and would have been closer to break-even. The three demonstrations saved an average of approximately 8 inches per acre. If the technologies and methods utilized by the demonstrations can be translated to three inches of reduced irrigation over the one million acres of corn and other crops in the District, the water 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 – District Field Demonstration Data

2010-Corn Demonstration
Irrigated Medium Season Corn

Year: 2010 **County:** Moore **Grower:** Harold Grall
No. Acres: 120 **Variety/Hyb:** 34F96 **Soil Type:** 100% Sherman Silty Loam

Meter Type: McCrometer **Meter SN:** GP10-1695

Meter Mult. Gallons X 100 **Tillage:** Strip Till
Fertilizer: 203-22-3 **Seeding Rate:** Population 23000
Planting Date: 5/13/2010 **Harvest Date:** 9/22/2010

Herbicide: Sharpen,Rifle,Roundup-Pre;Balance Atrazine-Post **Insecticide:** Cornite;fung;headline

Yield: 198 Bushels @ 15.5% **Previous crop:** Corn **Row width :** 30"

Irrigation method: Center Pivot **Prewater:** None **Well GPM:** 475
Pivot info distance between drops : 60" Distance from application nozzle to ground : 18"
Application pattern: Leap Quad Crop row direction: straight
GPS Location: Latitude: 35.96842
Elevation: 3793 Ft Longitude: -102.13525

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
5/13/10									0.11	0.09
5/14/10									0.22	0.19
5/15/10	0.90								0.24	0.20
5/16/10									0.29	0.25
5/17/10									0.33	0.28
5/18/10	1.16								0.37	0.31
5/19/10									0.42	0.36
5/20/10	0.45								0.47	0.40
5/21/10				Emergence					0.53	0.45
5/22/10									0.62	0.52
5/23/10									0.68	0.58
5/24/10									0.77	0.65
5/25/10									0.80	0.68
5/26/10									0.84	0.71
5/27/10									0.91	0.77
5/28/10					94.70	95.90	96.00	95.70	1.01	0.86
5/29/10									1.13	0.96
5/30/10									1.23	1.05
5/31/10									1.31	1.11
6/1/10					95.10	95.00	95.70	95.00	1.45	1.23
6/2/10									1.55	1.32
6/3/10					94.80	95.00	95.80	95.00	1.64	1.39
6/4/10									1.80	1.53

County: Moore Crop: Corn Grower: HG P.Date 5/13

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
6/5/10									1.96	1.67
6/6/10									2.08	1.77
6/7/10									2.24	1.90
6/8/10				3 leaf	94.70	95.50	96.30	95.30	2.37	2.01
6/9/10									2.50	2.13
6/10/10				4 leaf	94.60	95.50	96.40	95.40	2.80	2.38
6/11/10									3.09	2.63
6/12/10	1.68								3.23	2.75
6/13/10									3.37	2.86
6/14/10				6 leaf	94.30	95.60	96.40	95.40	3.48	2.96
6/15/10									3.63	3.09
6/16/10									3.83	3.26
6/17/10	1.61			6 leaf	94.40	96.20	96.80	95.90	4.07	3.46
6/18/10									4.37	3.71
6/19/10									4.70	4.00
6/20/10									5.00	4.25
6/21/10									5.31	4.51
6/22/10	0.72								5.58	4.74
6/23/10				8 leaf	93.00	96.60	96.80	96.20	5.80	4.93
6/24/10									5.96	5.07
6/25/10									6.26	5.32
6/26/10		1.17	38278						6.59	5.60
6/27/10									6.79	5.77
6/28/10									7.03	5.98
6/29/10				11 leaf	92.30	96.80	96.60	96.30	7.29	6.20
6/30/10					90.00	97.20	96.90	96.60	7.58	6.44
7/1/10					89.30	96.80	96.50	96.30	7.87	6.69
7/2/10									8.08	6.87
7/3/10									8.30	7.06
7/4/10									8.63	7.34
7/5/10	2.08								8.89	7.56
7/6/10				12 leaf	96.60	97.20	97.00	96.80	9.16	7.79
7/7/10									9.38	7.97
7/8/10	0.03								9.46	8.04
7/9/10				12 leaf	93.40	96.40	96.40	96.20	9.68	8.23
7/10/10									9.99	8.49
7/11/10									10.26	8.72
7/12/10					77.50	93.00	96.70	96.50	10.58	8.99
7/13/10									11.00	9.35
7/14/10	0.05								11.39	9.68
7/15/10				Tassel	56.50	72.60	96.20	96.20	11.66	9.91
7/16/10		1.17							12.00	10.20
7/17/10									12.40	10.54
7/18/10									12.86	10.93
7/19/10									13.31	11.31

County: Moore Crop: Corn Grower: HG P.Date 5/13

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
7/20/10					75.00	39.60	94.90	97.00	13.73	11.67
7/21/10									14.12	12.00
7/22/10				Blister	45.20	28.80	91.30	96.50	14.56	12.38
7/23/10		1.17							14.99	12.74
7/24/10	0.49								15.18	12.90
7/25/10									15.46	13.14
07/26/10									15.81	13.44
07/27/10				Blister	58.70	25.00	84.10	97.60	16.20	13.77
07/28/10									16.53	14.05
07/29/10		1.27	155779	Blister	95.30	82.80	80.30	95.80	16.90	14.37
07/30/10									17.28	14.69
07/31/10	0.15								17.65	15.00
08/01/10									18.04	15.33
08/02/10									18.47	15.70
08/03/10		1.29							18.86	16.03
08/04/10	0.57								19.18	16.30
08/05/10	0.63			Milk	95.60	19.40	92.40	95.30	19.47	16.55
08/06/10									19.75	16.79
08/07/10									20.10	17.09
08/08/10		1.29							20.49	17.42
08/09/10									20.83	17.71
08/10/10									21.15	17.98
08/11/10									21.48	18.26
08/12/10				Dent	68.10	23.00	65.70	95.20	21.85	18.57
08/13/10									22.18	18.85
08/14/10									22.49	19.12
08/15/10		1.29	281552						22.73	19.32
08/16/10	1.67								22.81	19.39
08/17/10									23.04	19.58
08/18/10									23.31	19.81
08/19/10					96.20	96.70	92.20	94.80	23.66	20.11
08/20/10				1/16 Mat line	(1.95 Aval	(1.95 A	(1.9 A	(1.9 A	23.95	20.36
08/21/10									24.24	20.61
08/22/10									24.53	20.85
08/23/10									24.86	21.13
08/24/10	0.81								24.98	21.23
08/25/10									25.19	21.41
08/26/10			290601		94.60	95.30	91.60	93.00	25.45	21.63
08/27/10									25.78	21.91
08/28/10	0.05								26.10	22.19
08/29/10									26.45	22.48
08/30/10					95.40	95.60	59.60	91.30	26.77	22.75
08/31/10										
09/01/10		1.35	325729							
09/02/10										

County: Moore Crop: Corn Grower: HG P.Date 5/13

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
09/03/10										
09/04/10										
09/05/10										
09/06/10										
09/07/10					34.70	71.10	41.60	87.70		
09/08/10										
09/09/10		0.86	333165		34.50	57.30	46.30	88.30		
09/10/10										
09/11/10										
09/12/10										
09/13/10										
09/14/10										
09/15/10										
09/16/10										
09/17/10			353858		25.20	23.40	37.50	82.20		
9/18/2010										
9/19/2010										
9/20/2010										
9/21/2010										
9/22/2010		Harvest								
Total	13.05	10.86			1.50	1.47	1.27	0.65	4.89	
Irrig/Rain/Soil	28.80									
Post Harvest										
9/23/2010	0.40									
9/24/2010										
9/25/2010										
9/26/2010										
9/27/2010										
9/28/2010										
9/29/2010										
9/30/2010					25.00	21.80	37.50	84.10		
7-Oct										
10/14/2010					24.00	22.30	37.90	86.20		

2010-Corn Demonstration
Irrigated Medium Season Corn

Year: 2010 **County:** Ochiltree **Grower** Danny Krienke
No. Acres: 120 **Variety/Hyb** Pioneer 33B54 **Soil Type:** Sherman Clay Loam
Meter Type: McCrometer **Meter SN:** 99-8-2020N
Meter Mult. Gallons X 1000 **Tillage:** Conventional
Fertilizer 176-79-0 **Seeding Rate:** Population 26500
Planting Date: 5/11/2010 **Harvest Date:** 9/25/2010
Herbicide Cinch ATZ **Insecticide** None
Yield: 192 Bushels @ 15.5% **Previous crop:** Wheat **Row width:** 30"
Irrigation method: Center Pivot **Prewater** None **Well GPM:** 619
Pivot info Distance between drops : 60" Distance from application nozzle to ground: 12"
Application pattern: Spray Crop row direction (straight or planted in a circle): straight
GPS Location: Latitude: 36.40101
Elevation 2940 Ft Longitude: -100.85433

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
5/11/10			986443						0.10	0.09
5/12/10									0.20	0.17
5/13/10									0.30	0.26
5/14/10		0.60	988758						0.40	0.34
5/15/10	0.90								0.43	0.37
5/16/10									0.48	0.41
5/17/10									0.53	0.45
5/18/10									0.57	0.48
5/19/10									0.61	0.52
5/20/10	2.20								0.65	0.55
5/21/10				Emergence					0.70	0.60
5/22/10									0.78	0.66
5/23/10									0.85	0.72
5/24/10									0.91	0.77
5/25/10									0.95	0.81
5/26/10									0.98	0.83
5/27/10									1.06	0.9
5/28/10									1.17	0.99
5/29/10									1.29	1.1
5/30/10									1.37	1.16
5/31/10									1.44	1.22
6/1/10									1.59	1.35
6/2/10									1.68	1.43
6/3/10									1.78	1.51

County Ochiltree Crop: Corn Grower: DK P.Date 5/11

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
6/4/10									1.95	1.66
6/5/10									2.10	1.79
6/6/10									2.22	1.89
6/7/10									2.34	1.99
6/8/10				5 leaf					2.49	2.12
6/9/10									2.62	2.23
6/10/10				6 leaf	94.40	95.90	96.00	95.50	2.90	2.47
6/11/10									3.18	2.70
6/12/10	4.81	0.32	989440						3.34	2.84
6/13/10									3.44	2.92
6/14/10									3.51	2.98
6/15/10									3.66	3.11
6/16/10				7 leaf	95.10	95.60	96.60	96.30	3.85	3.27
6/17/10									4.14	3.52
6/18/10									4.38	3.72
6/19/10									4.70	4.00
6/20/10									4.99	4.24
6/21/10									5.29	4.50
6/22/10									5.62	4.78
6/23/10									5.90	5.02
6/24/10	0.06			10 leaf	86.20	95.70	97.10	96.70	6.05	5.14
6/25/10		0.88	992304						6.40	5.44
6/26/10									6.78	5.76
6/27/10									7.00	5.95
6/28/10									7.26	6.17
6/29/10									7.55	6.42
6/30/10		0.88	995167	12 leaf	66.00	95.00	96.00	96.00	7.82	6.65
7/1/10				12 leaf	95.80	96.30	97.10	96.80	8.08	6.87
7/2/10									8.27	7.03
7/3/10									8.47	7.20
7/4/10									8.77	7.45
7/5/10									9.02	7.67
7/6/10					57.40	88.70	98.10	98.40	9.31	7.91
7/7/10									9.58	8.14
7/8/10	0.90	0.98							9.66	8.21
7/9/10					98.90	98.80	98.80	98.60	9.89	8.41
7/10/10									10.19	8.66
7/11/10									10.51	8.93
7/12/10									10.80	9.18
7/13/10									11.23	9.55
7/14/10									11.61	9.87
7/15/10				Pollination	44.20	60.00	89.70	97.00	11.86	10.08

County Ochiltree Crop: Corn Grower: DK P.Date 5/11

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
7/16/10		0.98	001548						12.20	10.37
7/17/10		0.82							12.64	10.74
7/18/10									13.12	11.15
7/19/10									13.60	11.56
7/20/10									14.05	11.94
7/21/10									14.47	12.30
7/22/10				Blister	18.00	33.00	34.00	97.00	14.99	12.74
7/23/10		0.82	006910		97.00	33.00	41.00	97.00	15.51	13.18
7/24/10	0.70	0.90							15.70	13.35
7/25/10									15.96	13.57
07/26/10									16.33	13.88
07/27/10									16.69	14.19
07/28/10									17.02	14.47
07/29/10			008975	Blister	82.50	32.00	42.50	96.40	17.38	14.77
07/30/10									17.76	15.10
07/31/10									18.10	15.39
08/01/10									18.51	15.73
08/02/10									18.99	16.14
08/03/10		0.90	012786	Dough					19.45	16.53
08/04/10									19.81	16.84
08/05/10	0.93				16.60	24.20	24.60	93.40	20.10	17.09
08/06/10		0.90	015691						20.39	17.33
08/07/10									20.77	17.65
08/08/10									21.23	18.05
08/09/10									21.62	18.38
08/10/10									21.98	18.68
08/11/10	0.06								22.35	19.00
08/12/10		0.90	018265	Dent	18.70	22.50	19.10	87.90	22.76	19.35
08/13/10		0.90							23.20	19.72
08/14/10									23.61	20.07
08/15/10									23.85	20.27
08/16/10									23.93	20.34
08/17/10	1.25								24.11	20.49
08/18/10	0.03								24.37	20.71
08/19/10					96.10	96.00	91.00	91.50	24.73	21.02
08/20/10				1/2 Mat line	(1.95 Aval)	(1.95 Av	(1.9 A	(1.9 A	25.04	21.28
08/21/10									25.32	21.52
08/22/10									25.59	21.75
08/23/10				3/4 Mat line	68.00	91.00	31.00	90.00	25.96	22.07
08/24/10									26.17	22.25
08/25/10									26.40	22.44

County Ochiltree Crop: Corn Grower: DK P.Date 5/11

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
08/26/10	0.05		021523		32.40	79.10	30.70	84.80	26.66	22.66
08/27/10									26.97	22.92
08/28/10									27.30	23.21
08/29/10									27.66	23.51
08/30/10			024073		14.20	50.10	18.10	74.40	28.00	23.80
08/31/10		0.98								
09/01/10										
09/02/10			024705							
09/03/10										
09/04/10										
09/05/10										
09/06/10										
09/07/10										
09/08/10	0.24									
09/09/10			024705		15.40	28.70	17.00	76.50		
09/10/10										
09/11/10										
09/12/10										
9/13/2010										
9/14/2010										
9/15/2010										
9/16/2010	0.80		024705		17.30	25.60	16.30	71.20		
9/17/2010										
9/18/2010										
9/19/2010										
9/20/2010										
9/21/2010										
9/22/2010										
9/23/2010										
9/24/2010					17.50	25.50	17.50	86.30		
9/25/2010		harvest								
Total	12.90	11.76			1.65	1.48	1.65	0.54	5.32	
irrig/rain/soil	29.98									
Post Harvest										
9/23/2010	0.33									
9/26/2010										
9/27/2010										
9/28/2010										
9/29/2010					15.40	23.30	16.70	87.60		

2010-Corn Demonstration
Irrigated Medium Season Corn

Year: 2010 **County:** Hartley **Grower:** Phil Haaland

No. Acres: 32 **Variety/Hyb:** 33B54 **Soil Type:** Dallam fine sandy loam

Meter Type: McCrometer **Meter SN:** GP10-1694

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

Fertilizer: 10 Tons Manure 179-00 **Seeding :** *27500*

Planting Date: 4/28/2010 **Harvest :** 9/22/2010

Herbicide: Balance,flex,Atrazine-Pre,Laudis,Banvel-Post **Insecticide:** Oberon;Headline;fung

Yield: 191 Bushels @ 15.5% **Previous crop:** Wheat **Row width:** 30"

Irrigation method: Center Pivot **Prewater:** None **Well GPM:** 450

Pivot info: Distance between drops: 60" Distance from application nozzle to ground: 12"

Application pattern: Spray Lon Crop row direction : Straight

Elevation: 3962 Ft **GPS Location:** Latitude: 36.03736

Longitude: -102.43579

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
4/28/10									0.11	0.09
4/29/10									0.22	0.19
4/30/10									0.33	0.28
5/1/10									0.37	0.31
5/2/10		0.70							0.42	0.36
5/3/10									0.48	0.41
5/4/10									0.57	0.48
5/5/10									0.64	0.54
5/6/10									0.74	0.63
5/7/10				Emergence					0.79	0.67
5/8/10									0.84	0.71
5/9/10									0.91	0.77
5/10/10									1.00	0.85
5/11/10		0.50							1.08	0.92
5/12/10									1.15	0.98
5/13/10									1.20	1.02
5/14/10	0.90	1.25							1.20	1.02
5/15/10	0.60								1.23	1.05
5/16/10	0.30								1.28	1.09
5/17/10									1.32	1.12
5/18/10	0.02								1.35	1.15
5/19/10	0.30								1.43	1.22
5/20/10									1.50	1.28
5/21/10									1.61	1.37
5/22/10									1.75	1.49
5/23/10									1.85	1.57
5/24/10									1.97	1.67
5/25/10									2.04	1.73
5/26/10									2.11	1.79
5/27/10									2.18	1.85
5/28/10					96.70	97.00	96.60	96.9	2.32	1.97

County Hartley Crop: Corn/27500 Grower: PH P.Date: 4/28

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
5/29/10									2.48	2.11
5/30/10									2.59	2.20
5/31/10									2.70	2.30
6/1/10									2.87	2.44
6/2/10									2.98	2.53
6/3/10					95.90	96.70	95.90	96.20	3.11	2.64
6/4/10		1.25							3.29	2.80
6/5/10									3.45	2.93
6/6/10									3.60	3.06
6/7/10									3.86	3.28
6/8/10	1.48								4.06	3.91
6/9/10									4.24	3.60
6/10/10				6 leaf	95.70	97.20	96.40	96.40	4.53	3.85
6/11/10									4.80	4.08
6/12/10	1.23								4.99	4.24
6/13/10									5.17	4.39
6/14/10				8 leaf	96.70	97.00	96.10	96.10	5.35	4.55
6/15/10									5.54	4.71
6/16/10	2.40								5.76	4.90
6/17/10				9 leaf	98.20	97.80	96.80	96.50	6.05	5.14
6/18/10									6.31	5.36
6/19/10									6.62	5.63
6/20/10									6.96	5.92
6/21/10									7.29	6.20
6/22/10		1.25							7.59	6.45
6/23/10	0.20				91.70	97.90	97.40	96.80	7.87	6.69
6/24/10									8.10	6.89
6/25/10									8.44	7.17
6/26/10									8.77	7.45
6/27/10									9.04	7.71
6/28/10									9.33	7.93
6/29/10									9.62	8.18
6/30/10	0.15			12 leaf	74.50	94.30	97.20	96.40	9.90	8.42
7/1/10									10.15	8.63
7/2/10									10.42	8.86
7/3/10									10.72	9.11
7/4/10									11.04	9.38
7/5/10	0.57	1.25							11.34	9.64
7/6/10				Tassel	57.80	80.00	95.60	96.00	11.62	9.88
7/7/10									11.86	10.08
7/8/10									12.03	10.23
7/9/10				Tassel	57.50	76.80	93.40	95.70	12.27	10.43
7/10/10									12.60	10.71
7/11/10									12.88	10.95
7/12/10									13.21	11.23

County Hartley Crop: Corn/27500 Grower: PH P.Date: 4/28

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
7/13/10									13.61	11.57
7/14/10	0.10								13.96	11.87
7/15/10				Pollination	33.90	32.70	62.40	68.20	14.26	12.12
7/16/10									14.60	12.41
7/17/10									14.96	12.72
7/18/10									15.34	13.04
7/19/10		1.25							15.77	13.40
7/20/10			303513	Blister	79.90	19.50	25.50	24.00	16.16	13.74
7/21/10									16.55	14.07
7/22/10					89.90	23.30	30.50	28.30	17.00	14.45
7/23/10									17.41	14.80
7/24/10	1.27			Milk					17.57	14.93
7/25/10									17.81	15.14
07/26/10									18.12	15.40
07/27/10			347534		98.30	25.00	30.40	32.20	18.48	15.71
07/28/10									18.78	15.96
07/29/10			358247	Dough	92.90	26.00	32.00	35.10	19.10	16.24
07/30/10									19.42	16.51
07/31/10									19.74	16.78
08/01/10									20.09	17.08
08/02/10		1.25							20.48	17.41
08/03/10									20.84	17.71
08/04/10	0.05								21.16	17.99
08/05/10	1.52		397703	Dough	18.00	17.80	13.00	14.10	21.44	18.22
08/06/10									21.71	18.45
08/07/10									22.05	18.74
08/08/10									22.39	19.03
08/09/10									22.69	19.29
08/10/10									23.00	19.55
08/11/10									23.34	19.84
08/12/10			439385	Dent	74.80	91.70	16.40	17.90	23.68	20.13
08/13/10									24.03	20.43
08/14/10									24.34	20.69
08/15/10									24.58	20.89
08/16/10	1.58								24.71	21.00
08/17/10									24.98	21.23
08/18/10									25.27	21.48
08/19/10			483673	1/2 Matline	95.70	83.80	18.70	20.30	25.57	21.73
08/20/10					(1.6 Avail)	(1.35 Avl	(.39 Av	(.41 A	25.84	21.96
08/21/10									26.13	22.21
08/22/10									26.41	22.45
08/23/10									26.71	22.71
08/24/10	1.35	1.25							26.85	22.83
08/25/10									27.05	22.99
08/26/10			526644		96.10	79.60	18.20	23.30	27.29	23.20

County: Hartley Crop: Corn/2750 0 Grower: PH *P.Date:* 4/28

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
08/27/10									27.53	23.40
08/28/10	0.28								27.80	23.63
08/29/10									28.06	23.85
08/30/10					96.70	96.50	14.40	21.30	28.35	24.10
08/31/10									28.64	24.34
09/01/10										
09/02/10										
09/03/10										
09/04/10										
09/05/10		1.25								
09/06/10										
09/07/10										
09/08/10										
09/09/10			579569		58.90	88.10	15.50	24.20		
09/10/10										
09/11/10										
09/12/10										
09/13/10										
09/14/10										
09/15/10										
09/16/10										
09/17/10					20.80	72.40	16.00	23.60		
9/18/2010										
9/19/2010										
9/20/2010										
9/21/2010										
9/22/2010										
Total	14.30	11.20			1.23	0.79	1.61	1.46	5.09	
Irrig/Rain/Soil	30.59									
Post Harvest										
9/23/2010	0.27									
9/24/2010										
9/25/2010										
9/26/2010										
9/27/2010										
9/28/2010										
9/29/2010										
9/30/2010					22.90	66.50	17.20	25.30		
10/7/2010										
10/14/2010					22.30	61.50	16.70	24.90		

2010-Corn Demonstration
Irrigated Medium Season Corn

Year: 2010 **County:** Hartley **Grower:** Phil Haaland
No. Acres: 32 **Variety/Hyb:** 33B54 **Soil Type:** Dallam fine sandy loam
Meter Type: McCrometer **Meter SN:** GP10-1694
Meter Mult. Gallons X 100 **Tillage:** Strip Till
Fertilizer: 10 Tons Manure 179-00 **Seeding Rate:** *15000*
Planting Date: 4/28/2010 **Harvest Date:** 9/22/2010
Herbicide: Balance,flex,Atrazine-Pre,Laudis,Banvel-Post **Insecticide:** Oberon;Headline;fung
Yield: 147 Bushels @ 15.5% **Previous crop:** Wheat **Row width:** 30"
Irrigation method: Center Pivot **Prewater:** None **Well GPM:** 450
Pivot info: Distance between drops: 60" Distance from application nozzle to ground: 12"
Application pattern: SprayLon Crop row direction : Straight
Elevation: 3960 Ft **GPS Location:** Latitude: 36.03923
Longitude: -102.43403

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
4/28/10									0.11	0.09
4/29/10									0.22	0.19
4/30/10									0.33	0.28
5/1/10									0.37	0.31
5/2/10		0.70							0.42	0.36
5/3/10									0.48	0.41
5/4/10									0.57	0.48
5/5/10									0.64	0.54
5/6/10									0.74	0.63
5/7/10				Emergence					0.79	0.67
5/8/10									0.84	0.71
5/9/10									0.91	0.77
5/10/10									1.00	0.85
5/11/10		0.50							1.08	0.92
5/12/10									1.15	0.98
5/13/10									1.20	1.02
5/14/10	0.90	1.25							1.20	1.02
5/15/10	0.60								1.23	1.05
5/16/10	0.30								1.28	1.09
5/17/10									1.32	1.12
5/18/10	0.02								1.35	1.15
5/19/10	0.30								1.43	1.22

County Hartley Crop: Corn/15000 Grower: PH P.Date: 4/28

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
5/20/10									1.50	1.28
5/21/10									1.61	1.37
5/22/10									1.75	1.49
5/23/10									1.85	1.57
5/24/10									1.97	1.67
5/25/10									2.04	1.73
5/26/10									2.11	1.79
5/27/10									2.18	1.85
5/28/10					96.90	96.60	96.50	96.80	2.32	1.97
5/29/10									2.48	2.11
5/30/10									2.59	2.20
5/31/10									2.70	2.30
6/1/10									2.87	2.44
6/2/10									2.98	2.53
6/3/10					96.20	96.70	96.50	96.50	3.11	2.64
6/4/10		1.25							3.29	2.80
6/5/10									3.45	2.93
6/6/10									3.60	3.06
6/7/10									3.86	3.28
6/8/10	1.48								4.06	3.91
6/9/10									4.24	3.60
6/10/10				7 leaf	91.80	97.50	97.20	97.30	4.53	3.85
6/11/10									4.80	4.08
6/12/10	1.23								4.99	4.24
6/13/10									5.17	4.39
6/14/10				8 leaf	82.10	96.90	96.80	96.80	5.35	4.55
6/15/10									5.54	4.71
6/16/10	2.40								5.76	4.90
6/17/10				10 leaf	95.70	97.40	97.30	97.20	6.05	5.14
6/18/10									6.31	5.36
6/19/10									6.62	5.63
6/20/10									6.96	5.92
6/21/10									7.29	6.20
6/22/10		1.25							7.59	6.45
6/23/10	0.20			11 leaf	70.90	97.30	97.50	97.20	7.87	6.69
6/24/10									8.10	6.89
6/25/10									8.44	7.17
6/26/10									8.77	7.45
6/27/10									9.04	7.71
6/28/10									9.33	7.93
6/29/10									9.62	8.18
6/30/10	0.15			12 leaf	50.30	95.00	97.50	97.40	9.90	8.42
7/1/10									10.15	8.63

County Hartley Crop: Corn/15000 Grower: PH P.Date: 4/28

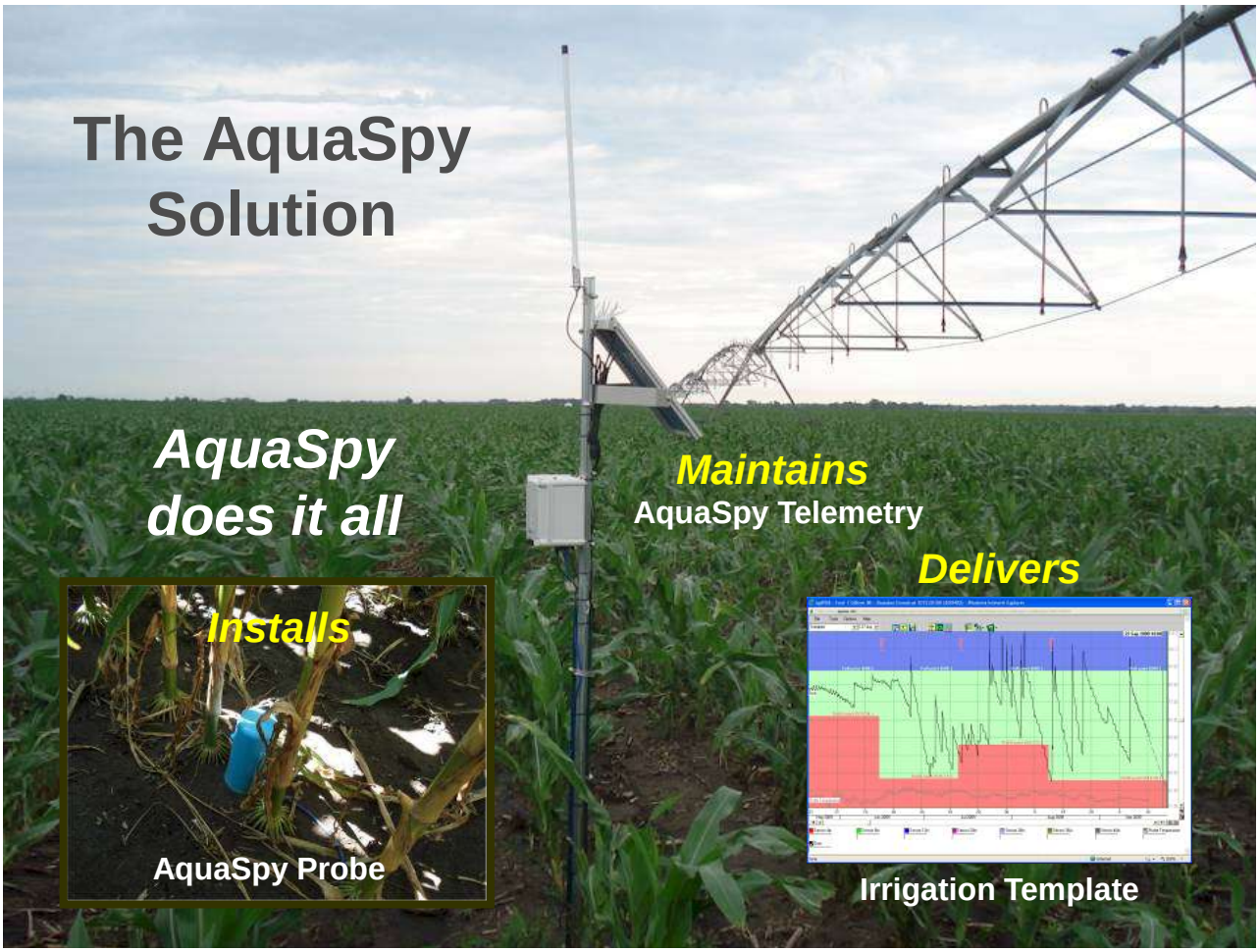
Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
7/2/10									10.42	8.86
7/3/10									10.72	9.11
7/4/10									11.04	9.38
7/5/10	0.57	1.25							11.34	9.64
7/6/10				Tassel	42.80	81.60	96.30	97.10	11.62	9.88
7/7/10									11.86	10.08
7/8/10									12.03	10.23
7/9/10				Tassel	43.10	75.60	95.50	96.60	12.27	10.43
7/10/10									12.60	10.71
7/11/10									12.88	10.95
7/12/10									13.21	11.23
7/13/10									13.61	11.57
7/14/10	0.10								13.96	11.87
7/15/10				Pollination	34.80	48.10	70.40	96.10	14.26	12.12
7/16/10									14.60	12.41
7/17/10									14.96	12.72
7/18/10									15.34	13.04
7/19/10		1.25							15.77	13.40
7/20/10			303513		65.90	35.40	51.50	95.20	16.16	13.74
7/21/10									16.55	14.07
7/22/10				Blister	57.40	35.20	51.60	93.30	17.00	14.45
7/23/10									17.41	14.80
7/24/10	1.27								17.57	14.93
7/25/10									17.81	15.14
07/26/10									18.12	15.40
07/27/10			347534		96.70	32.30	42.60	92.80	18.48	15.71
07/28/10									18.78	15.96
07/29/10			358247	Blister	94.50	33.30	0.00	91.30	19.10	16.24
07/30/10									19.42	16.51
07/31/10									19.74	16.78
08/01/10									20.09	17.08
08/02/10		1.25							20.48	17.41
08/03/10									20.84	17.71
08/04/10	0.05								21.16	17.99
08/05/10	1.52		397703	Dough	93.80	30.00	42.70	84.00	21.44	18.22
08/06/10									21.71	18.45
08/07/10									22.05	18.74
08/08/10									22.39	19.03
08/09/10									22.69	19.29
08/10/10									23.00	19.55
08/11/10									23.34	19.84
08/12/10			439385	Dent	93.80	31.70	43.20	80.90	23.68	20.13
08/13/10									24.03	20.43

County Hartley Crop: Corn/15000 Grower: PH P.Date: 4/28

Date	Inches		Water	Growth	Moisture Reading				100%	85%
mm/dd/yy	Rain	Irrigation	Meter	Stage	1 Ft.	2 Ft.	3 Ft.	4 Ft.	100 ET	85 ET
08/14/10									24.34	20.69
08/15/10									24.58	20.89
08/16/10	1.58								24.71	21.00
08/17/10									24.98	21.23
08/18/10									25.27	21.48
08/19/10			483673		97.30	30.20	45.40	79.50	25.57	21.73
08/20/10									25.84	21.96
08/21/10									26.13	22.21
08/22/10									26.41	22.45
08/23/10									26.71	22.71
08/24/10	1.35	1.25							26.85	22.83
08/25/10									27.05	22.99
08/26/10			526644		96.60	30.60	47.20	77.20	27.29	23.20
08/27/10									27.53	23.40
08/28/10	0.28								27.80	23.63
08/29/10									28.06	23.85
08/30/10									28.35	24.10
09/02/10										
09/03/10										
09/04/10										
09/05/10		1.25								
09/06/10										
09/07/10										
09/08/10										
09/09/10			579569		89.40	34.00	48.50	67.00		
09/10/10										
09/11/10										
09/12/10										
09/13/10										
09/14/10										
09/15/10										
09/16/10										
09/17/10					47.00	32.20	47.20	59.90		
9/18/2010										
9/19/2010										
9/20/2010										
9/21/2010										
9/22/2010		Harvest								
Total	14.30	11.20			0.92	1.32	1.10	0.94	4.28	
Irrig/Rain/Soil		29.78								

Appendix B – AquaSpy

The District used AquaSpy® strategic irrigation management to measure soil moisture up to 60 vertical inches in the soil profile. The AquaSpy® soil moisture probe uses capacitance sensors every four inches along its vertical column to communicate moisture and salinity levels at various depths. The real-time data retrieval ability from these type sensors greatly enhances the grower's ability to use the information for strategic management of irrigation. The District will continue to use this type of soil moisture sensors in its demonstrations. The following report has been provided by AquaSpy® without edit from the District.


The AquaSpy Solution
AquaSpy does it all
Installs
AquaSpy Probe
Maintains
AquaSpy Telemetry
Delivers
Irrigation Template

Harold Grall

- Good early root growth (36” by tassel)
- No evidence of any drainage
- Able to maintain moisture in top 24” during critical period but never able to refill profile
- 3rd foot (28”-36”) continued to dry during critical period indicating plant requirements not fully met by irrigation
- 4th foot dried down during grain filling
- All soil moisture extracted by end of season. Finished with a dry profile.
- Possibly only room for improvement would be to try and get greater volume of water on during critical pollination period but probably limited by irrigation infrastructure.

Intelligence in every drop

AquaSpy™

Danny Kreinke

- Roots to 28” by onset of tassel and continued to grow to 40” during pollination period
- Active root zone in top 36” and irrigation was able to penetrate to 36”
- Continued root growth during pollination is an indication that not all plant water requirements met during this time
- “Windshield wiping” irrigation method allowed good deep penetration of moisture and ability to refill profile each time
- Soil dried down by harvest time and not a lot of late root activity is an indication that plant requirements largely met with water that was available in top 40”
- Opportunities for further improvement are not immediately obvious and will require further discussion. I would want to check yield at probe site vs rest of field.

Intelligence in every drop

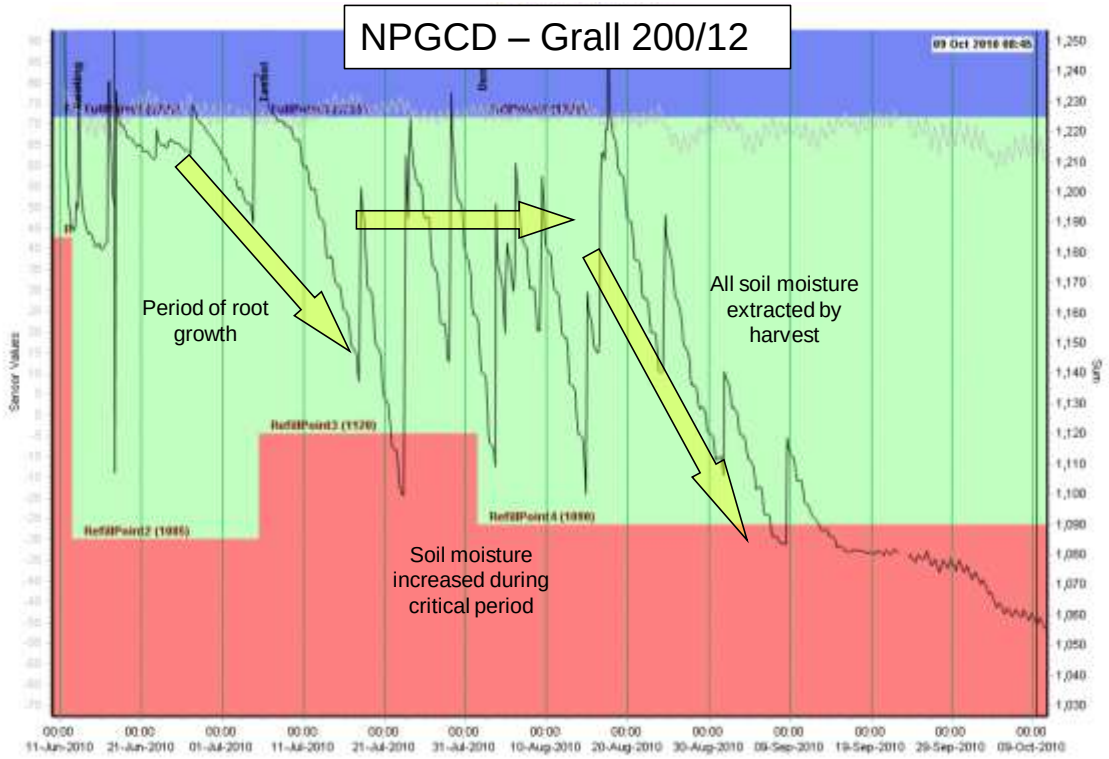
AquaSpy™

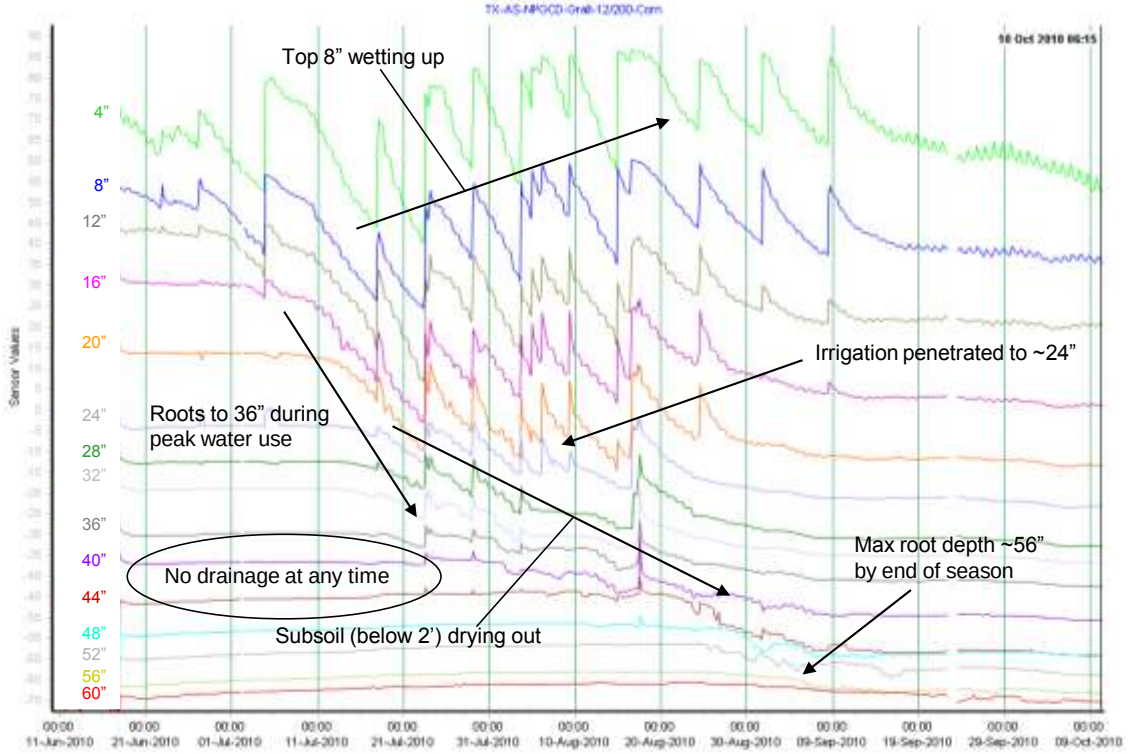
Phil Haaland

- Rapid early root growth to 36” indicated plant was already looking for moisture heading into critical pollination period
- Soil completely dry to 24” by onset of tassel
- Soil completely dry to 44” during pollination
- Significant moisture stress leading up to and including pollentation would have greatly reduced yield
- Late irrigation only able to penetrate to ~16” but yield potential already reduced. Even at this late stage irrigation did not exceed plant requirements.
- No evidence of drainage at any time
- Soil dried out quickly and was never wet back up.
- Max root depth was >60” and soil was very dry by harvest
- Possibly could have had a better result for same irrigation volume by altering irrigation timing

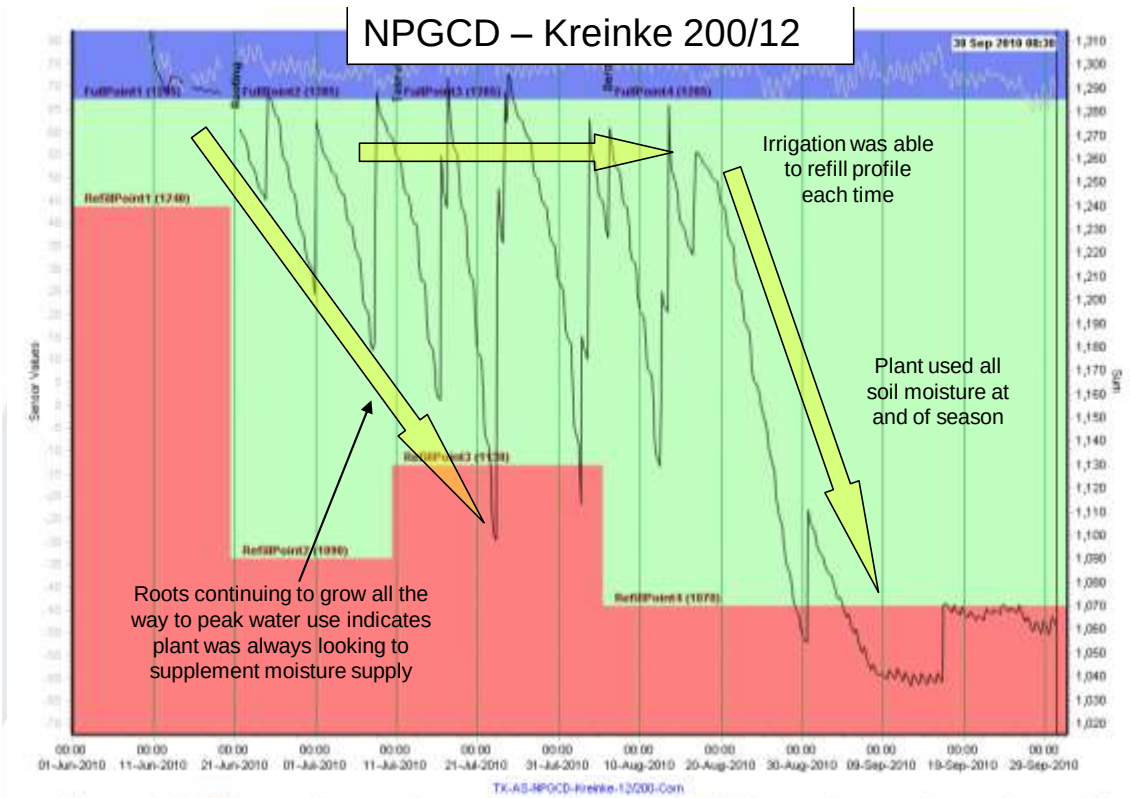
Intelligence in every drop

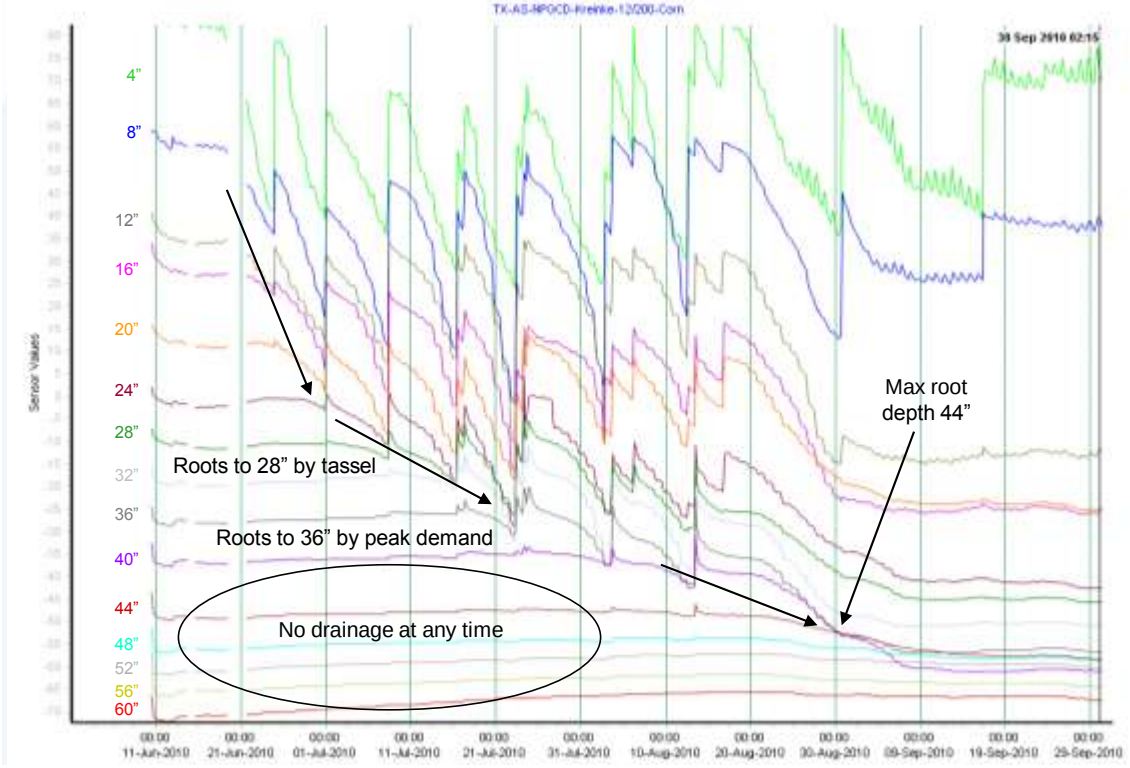
AquaSpy™


NPGCD – Grall 200/12
Period of root growth
All soil moisture extracted by harvest
Soil moisture increased during critical period

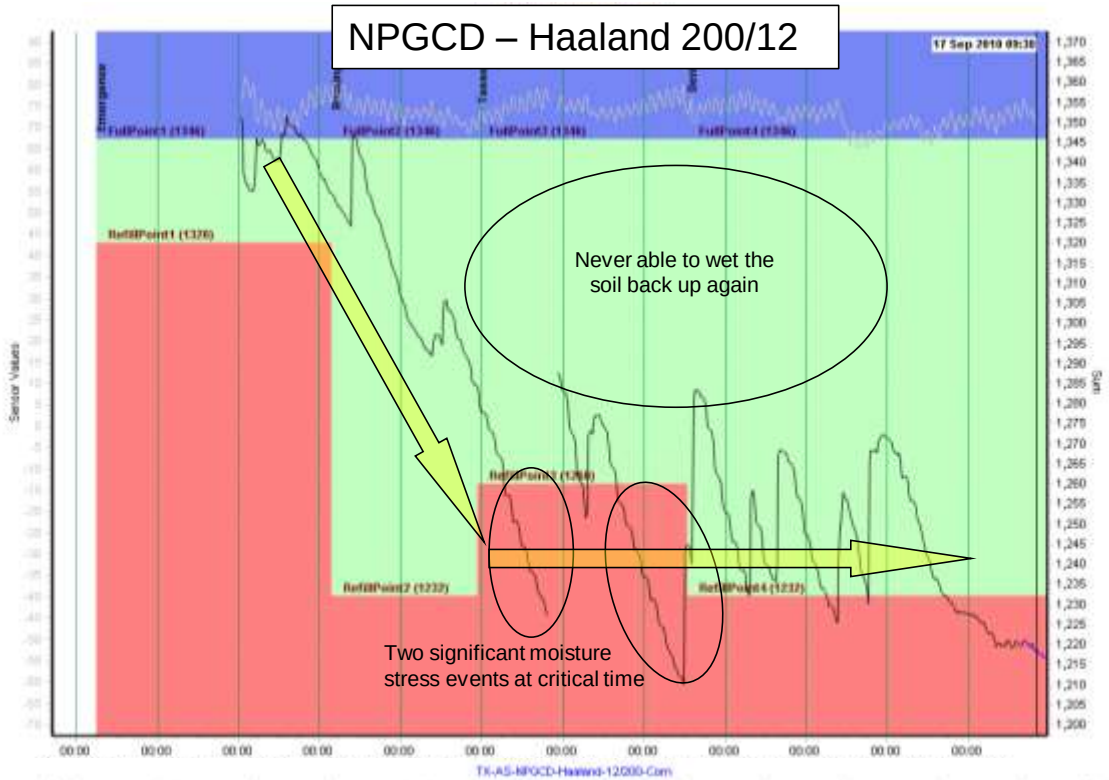

Top 8" wetting up
Irrigation penetrated to ~24"
Roots to 36" during peak water use
No drainage at any time
Max root depth ~56" by end of season
Subsoil (below 2') drying out
4"
8"
12"
16"
20"
24"
28"
32"
36"
40"
44"
48"
52"
56"
60"

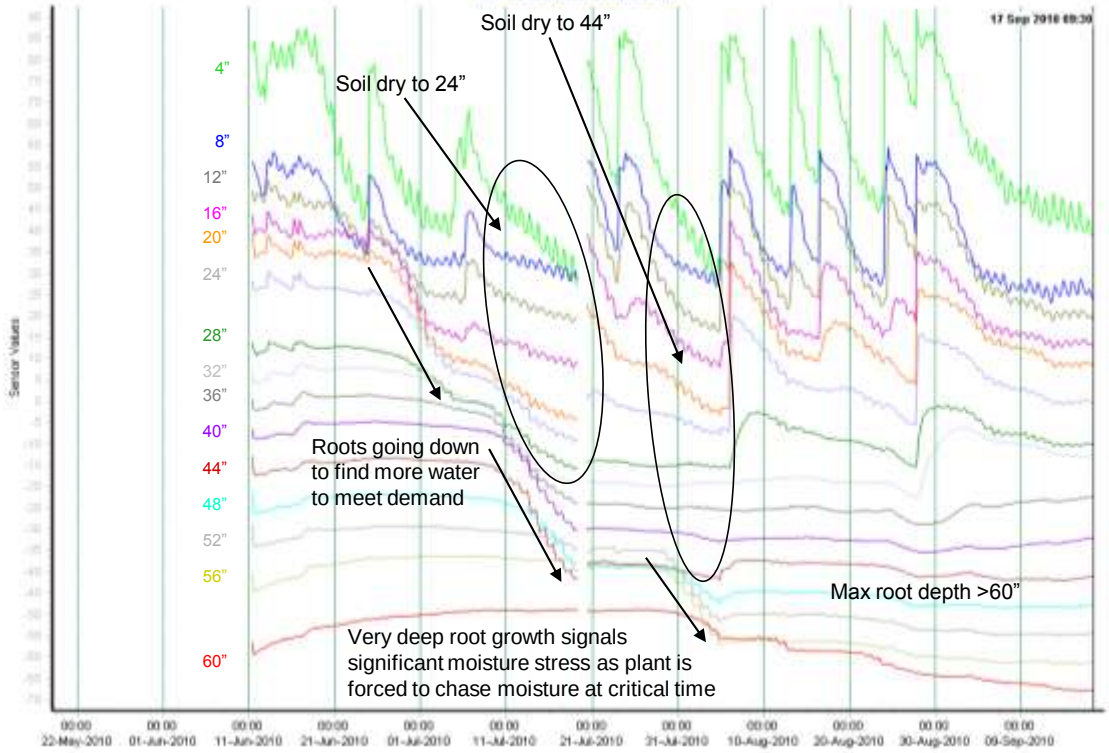
NPGCD – Kreinke 200/12





NPGCD – Haaland 200/12





Appendix C – Precision Irrigation Limited Irrigation Resource Planner

The Limited Irrigation Resource Planner (LIRP) is an irrigation management planning model developed by Precision Irrigation. The model relies on timely data inputs to predict future plant water demand. Since some of the data inputs could not be automatically downloaded in the system during the demonstrations, the model predictions were not timely enough for cooperators or the District to make irrigation management decisions based on the model. The District used the model as a comparative tool. With further automation such as directly downloading real-time information from the various inputs, models such as the LIRP show promise and may become a viable tool in irrigation management. The following report has been provided by Precision Irrigation without edit from the District.

Precision Irrigation and the NPGCD 200/12 Project

Objective: The North Plains Groundwater Conservation District initiated a program to demonstrate growing corn with limited water resources, specifically to limit applied irrigation water to 12 inches per acre. Precision Irrigation was asked to participate and to provide input as to when irrigation water should be applied to the demonstration fields.

Method: Precision Irrigation has developed water balance models for the purpose of irrigation management. These models estimate soil moisture levels given the soil moisture content at planting, applied irrigation, received precipitation, and accumulative evapotranspiration (ET).

When the soil moisture content falls below the management allowable depletion, plants are not able to extract sufficient moisture to meet the water demands of the aerial parts of the plant, a deficit ET condition exists and the plant experiences yield reducing moisture stress. The loss of yield is a function of the stage of growth when the water deficit occurs and is proportional to the ET deficit.

A Limited Irrigation Resource Planner (LIRP) was developed to answer the question, "When should a limited amount of irrigation water be applied to minimize yield loss due to moisture stress?" The growing season for each field was simulated with no irrigation water applied. The day with the greatest yield loss was determined and an irrigation application scheduled that day. The season was simulated again, with the first irrigation application, and a new day with the greatest yield loss was determined. An irrigation application scheduled for that day. This process was repeated until the budgeted total applied water (12 inches) was used. Thus an irrigation plan or schedule was developed for each field that would result in the maximum yield for the amount of water applied, FIG 1. After the crop was planted the LIRP was updated with actual precipitation, applied irrigation and ET data daily and the irrigation plan revised accordingly, FIG 2.

Results: We started the season with a "full" profile and during the 2010 corn growing season, we received about 3.00 to 4.00 inches more precipitation than average. Most of the rainfall came early in the growing season. During the grain filling growth stages, the crop experienced above normal ET rates. For these reasons, managing irrigation to maximize yield with a limited amount of irrigation water was a particular challenge and required a paradigm shift regarding irrigation management.

Validation: A complete analysis of the data will be conducted but a preliminary comparison of the estimated plant available water (PAW) from LIRP and PAW as measured by soil moisture blocks has been made, Figure 3. Results indicate the LIRP estimates of soil moisture were inline with measured amounts.

Site Discussion

Hartley County: Irrigation water was applied on May 3 and May 10. The application on the 10th was a bit untimely as it was followed by a rainfall event that resulted in some moisture being lost to percolation. A similar situation happened on June 7 when irrigation was applied immediately prior to a significant rainfall event and additional moisture was lost to percolation. The field soil moisture was allowed to decline to stress levels during grain filling. The fact that this field has less soil moisture holding capacity than the other sites enhances the irrigation management challenge. Incorporating precipitation forecasts and the LIRP schedule into management decisions may have helped the yield on this field.

Moore County: Planting of this ridge till field was timed according to weather forecast and immediately prior to a significant rainfall event which filled the profile. Irrigation water was withheld until June 24th when water was applied to incorporate fertilizer. The LIPR did not schedule an irrigation at this time; however, this "premature" application of water did not result in increased ET deficit or contribute to significant yield loss. Continuous irrigation was started about July 15th. Because of the high ET rates, the crop still experienced yield reducing stress during the grain filling stages. During this period the capacity of the irrigation system was less than water consumption rate of the crop. Very little moisture was lost to percolation or runoff from this field. The irrigation of this field aligned very close to the schedule suggested by the LIRP.

Ochiltree County: This field experienced significant rainfall, unfortunately much of it was excessive resulting in significant runoff and/or percolation. It appears that the sprinkler was shut down for a few days at the end of July. Had the sprinkler continued to run during this time, according to the LIPR plan, the deep dip in soil moisture might not have occurred during the milk stage. Incorporating precipitation forecasts and the LIRP schedule into management decisions may have improved the yield on this field.

Conclusion: Although this year the LIRP may not have been used to make decisions as when to apply irrigation water. The LIRP shows to have potential to be an excellent management tool for the purpose of determining when to apply a limited amount of irrigation water in order to maximize yield. Had the irrigation of these fields been managed according to the LIRP, the yields of the Hartley and Ochiltree county fields might have been higher or less water applied.

Improvements:
This year the entry of applied irrigation and measured rainfall data into the LIRP was delayed as much as 7 to 10 days. This delay would be unacceptable in an actual production situation. The use of remotely monitored sprinkler status, sprinkler position, and rainfall will allow for preliminary data to be collected closer to real time and will resolve this situation. LIRP has the capability to access this remotely collected data daily and updated irrigation plans are available to the irrigation manager in a very timely manor.

During the growing season there was a discrepancy between the plant growth model and the actual growth rates observed in the field. A method to adjust the LIPR growth model has been added. Further investigation into this situation will be conducted. Accurately predicting growth stages is vital to planning future water requirements.

Further comparison of measured soil moisture data and LIRP estimated soil moisture may result in adjusting the crop coefficients used to calculate crop ET from reference ET.

LIPR can be used prior to planting to simulate yield results of various management decisions such at planting dates, varieties, nozzle packages, tillage practices, etc.

Figures:

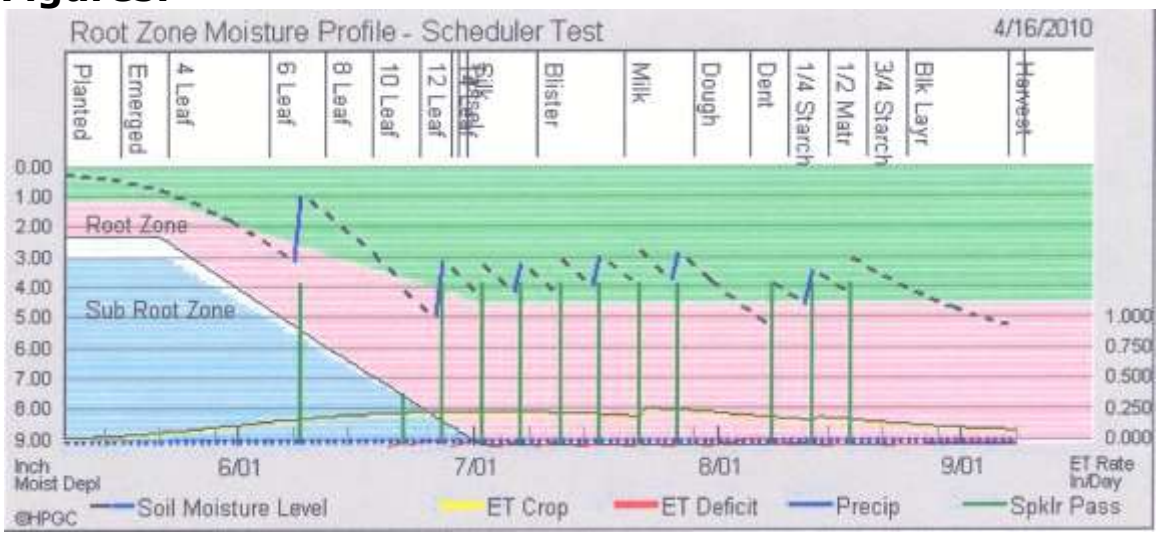


Figure 1. This is a typical LIRP irrigation schedule developed prior to planting.

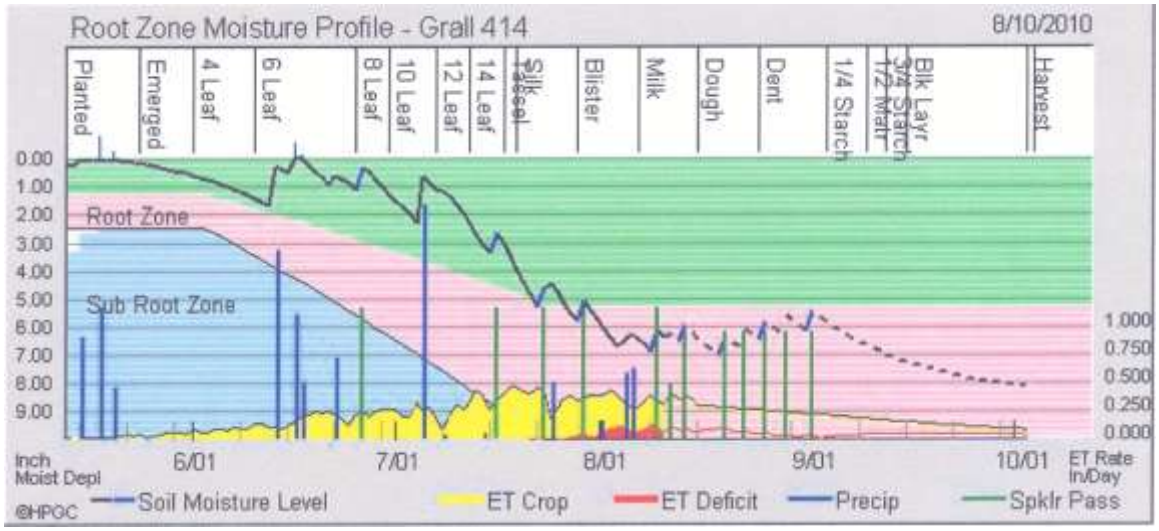


Figure 2: LIRP irrigation schedule in mid season.

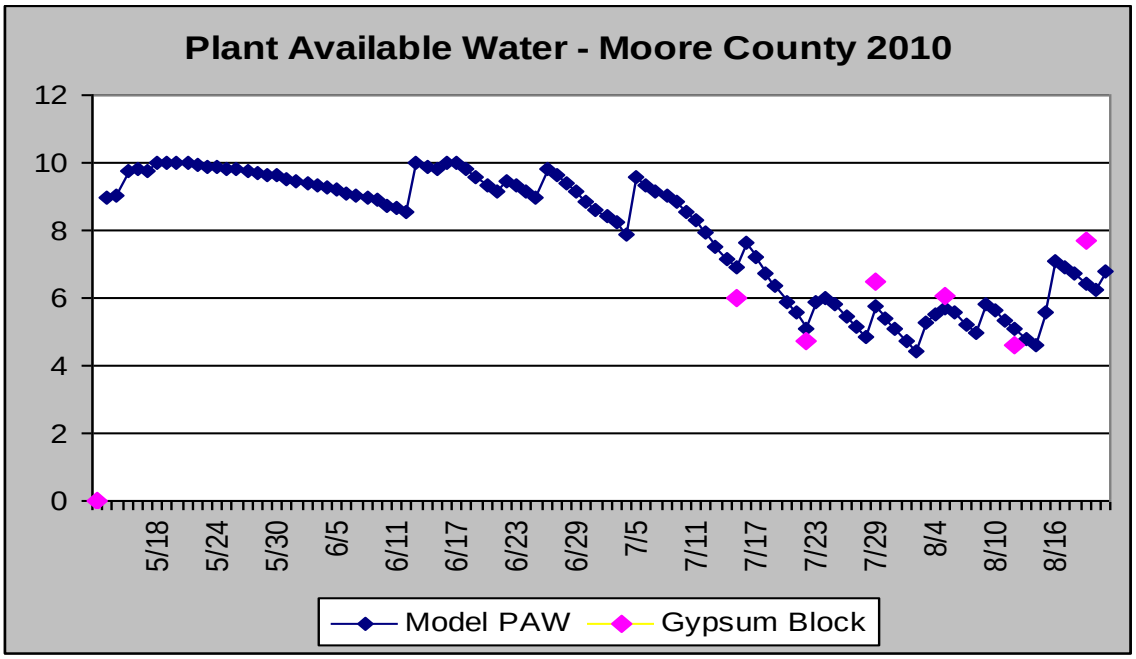


Figure 3, LIRP modeled PAW and PAW measured by gypsum blocks.

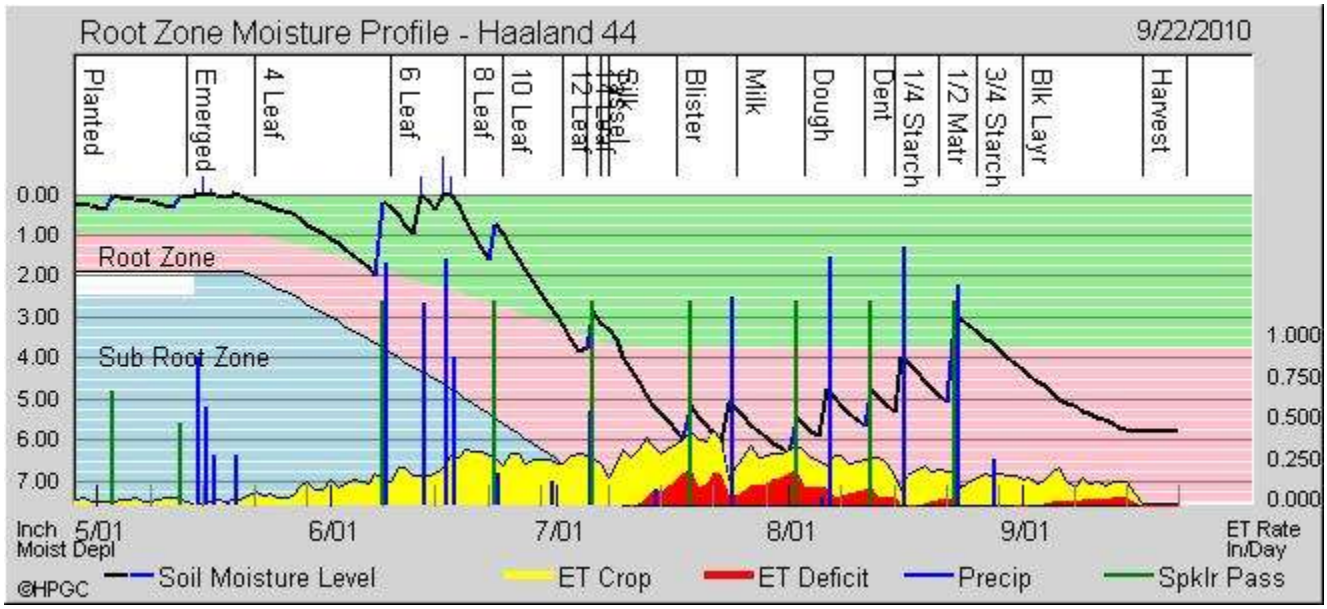


Figure 4, End of season soil moisture model for the Hartley county field.

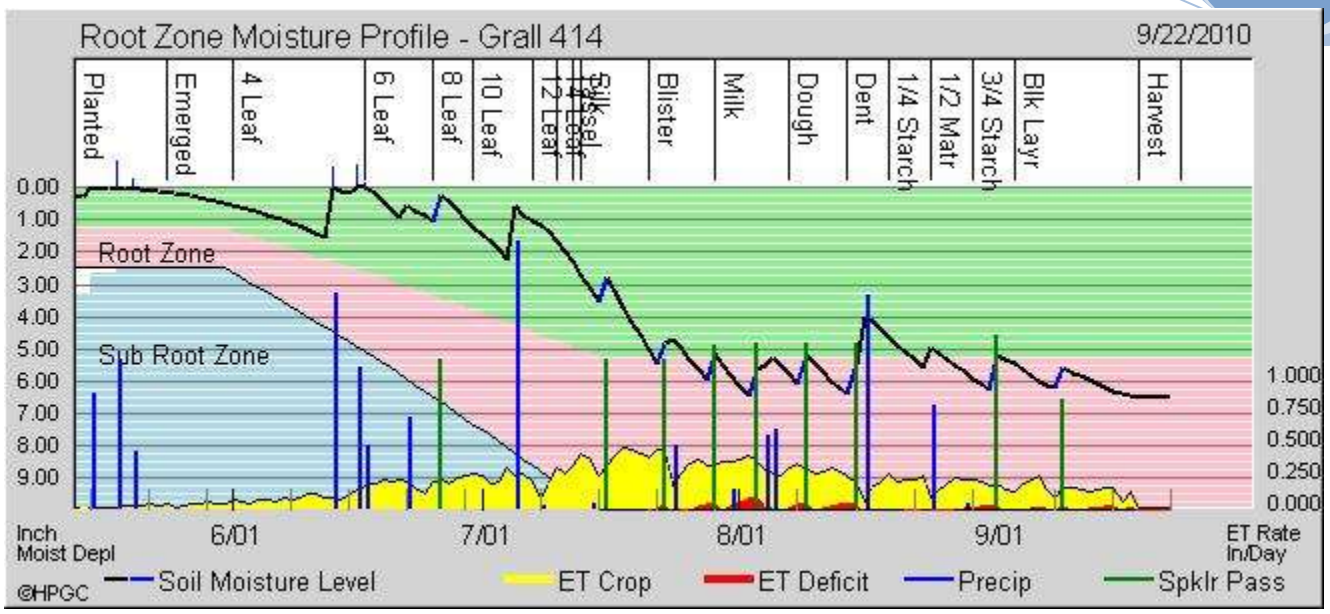


Figure 5 End of season soil moisture model for the Moore County field

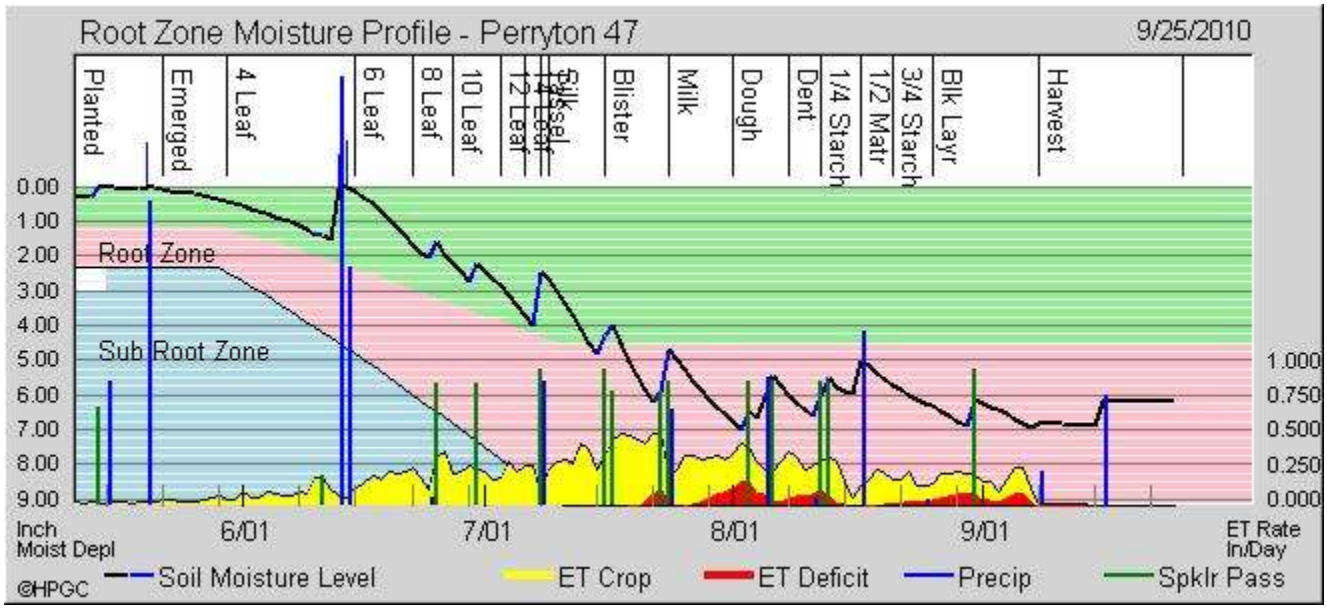


Figure 6 End of season soil moisture model for the Ochiltree county field.