

Project Title: Evaluation of water use efficiency of spring wheat on fine sandy loam  
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 Objective: To evaluate water use response of spring wheat varieties on yield and quality

Methods:

Eight spring wheat cultivars were grown under six irrigation levels as a split plot, randomized complete block design with four replications, where irrigation levels represent the whole plot and the eight spring wheat varieties were the sub plot factor. The irrigation levels included full irrigation (FullIrr), deficit irrigation (2/3FullIrr), various levels of early irrigation termination events (FullIrr-1, FullIrr-2 FullIrr-3) and a rain-fed check. The daily potential evapotranspiration was monitored (Creston Weather Station) and daily crop water use was determined using a crop coefficient approach. To trigger irrigation, daily soil water balance was calculated and plant water availability was maintained above 50% in treatment FullIrr. The amount and timing of irrigation for each treatment is shown in Figure 1 and details of agronomic management in Table 1.

Figure 1. Rainfall events, irrigation application amount and timing of application

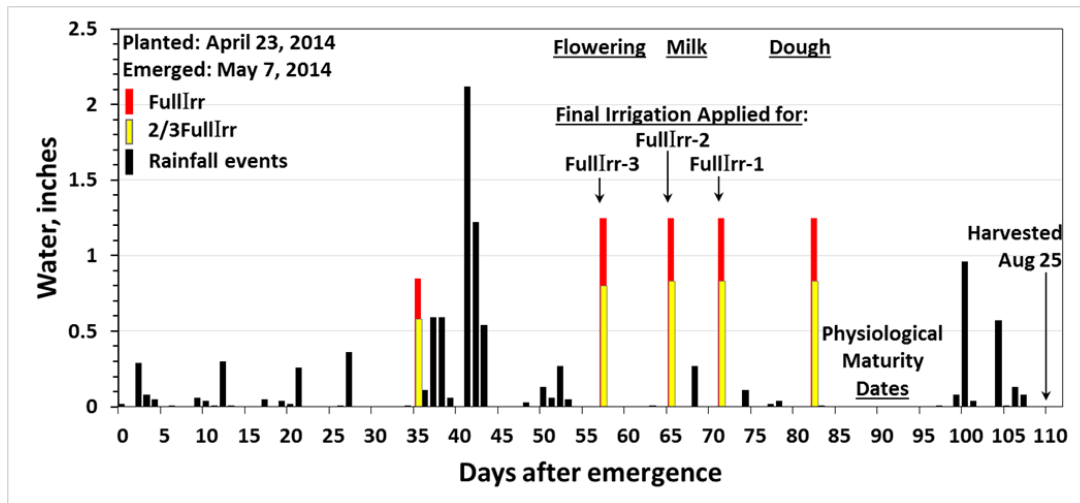


Table 1: Material and Methods - Water use efficiency in spring wheat - 2014

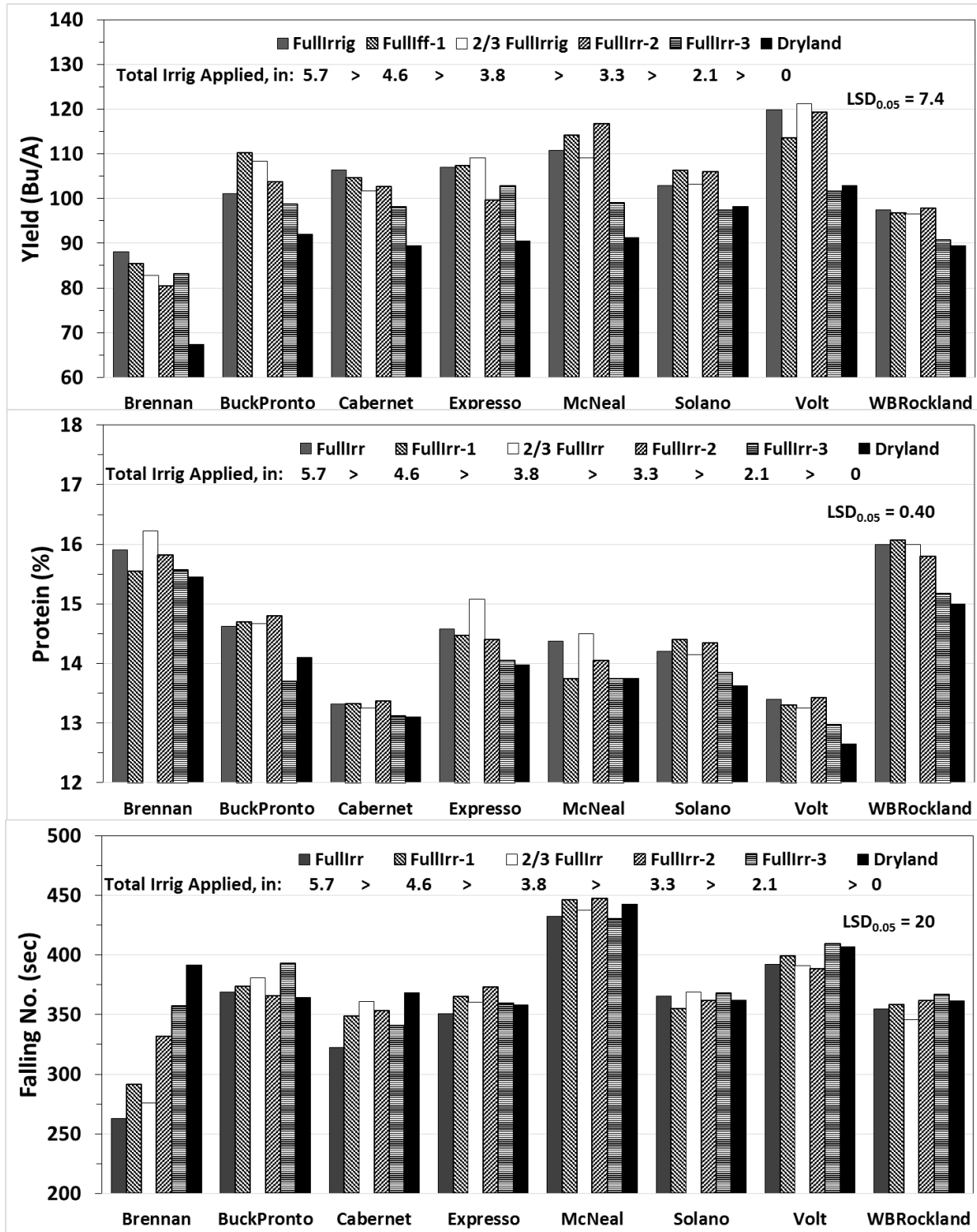
Seeding Date:	4/23/14	Herbicide:	5/30/14
Julian Date:	113		Huskie 11 floz/ac, Axial XL 16.4 floz/ac
Seeding Rate:	20 plnts/sqft	Insecticide:	7/1/14
Previous Crop:	Canola		Warrior II 1.5 floz/ac
Tillage:	Conventional	Fungicide:	7/1/2014
Irrigation:	Yes		Headline 7 floz/ac
Soil Type:	Fine sandy loam	Harvest Date:	8/26/14
Soil Test:	120-14-69	Julian Date:	238
Fertilizer:	200-30-100		

Table 2. Spring wheat water use effects on agronomic performance — 2014

Cultivar	HT in	PM* days	SS seeds/lb	MC %	YLD bu/A	PRO %	TWT lb/bu	TKW g	FN sec
Full Irrigation (FullIrrig)									
Brennan	29.1	94	11,411	13.0	88.2	15.9	60.4	39.8	263
Buck Pronto	29.5	96	9,410	13.9	101.1	14.6	60.2	48.2	369
Cabernet	25.4	94	11,070	12.5	106.4	13.3	59.9	41.0	323
Espresso	27.4	98	10,929	13.4	107.0	14.6	60.9	41.6	351
McNeal	32.4	96	10,061	14.2	110.8	14.4	60.9	45.1	433
Solano	24.8	96	10,498	13.2	102.9	14.2	60.8	43.2	365
Volt	28.7	97	11,834	13.9	119.9	13.4	62.5	38.4	392
WB Rockland	25.1	97	10,552	12.8	97.5	16.0	60.3	43.1	355
Deficit Irrigation (2/3FullIrrig )									
Brennan	27.1	93	11,439	12.8	82.8	16.2	60.3	39.7	276
Buck Pronto	28.2	94	9,615	13.8	108.4	14.7	60.2	47.2	381
Cabernet	25.2	92	11,341	12.5	101.7	13.3	59.5	40.0	361
Espresso	27.9	97	11,777	13.4	109.1	15.1	61.0	39.2	360
McNeal	31.5	94	10,262	14.2	109.1	14.5	60.8	44.2	438
Solano	25.1	96	10,735	13.1	103.3	14.2	60.9	42.3	369
Volt	30.3	96	11,779	13.8	121.2	13.3	62.5	38.5	391
WB Rockland	23.9	97	10,458	12.9	96.6	16.0	60.2	43.4	346
One Irrigation Event terminated Early (FullIrrig-1)									
Brennan	26.5	92	11,679	12.7	85.5	15.6	60.7	38.9	292
Buck Pronto	30.1	94	9,514	13.9	110.2	14.7	60.3	47.7	374
Cabernet	25.3	92	11,246	12.5	104.7	13.3	59.5	40.4	349
Espresso	26.0	94	11,216	13.1	107.3	14.5	60.7	40.5	365
McNeal	31.5	94	10,195	14.1	114.2	13.8	60.9	44.6	446
Solano	24.4	94	10,847	13.3	106.3	14.4	60.4	42.0	355
Volt	29.5	95	12,360	13.8	113.6	13.3	62.3	36.8	399
WB Rockla	24.5	97	10,497	12.7	96.8	16.1	60.2	43.3	358
Two Irrigation Events Terminated Early (FullIrrig-2)									
Brennan	25.8	89	11,475	12.7	80.5	15.8	60.6	39.6	332
Buck Pronto	29.6	92	9,958	13.8	103.7	14.8	60.0	45.7	366
Cabernet	24.3	91	11,442	12.5	102.6	13.4	59.3	39.7	353
Espresso	25.3	93	11,549	13.0	99.7	14.4	60.3	39.3	373
McNeal	31.3	93	10,309	14.0	116.7	14.1	61.0	44.0	447
Solano	25.6	95	11,035	13.0	106.0	14.4	60.4	41.2	362
Volt	31.6	94	12,378	13.8	119.2	13.4	62.2	36.7	388
WB Rockland	25.2	95	10,778	12.6	97.8	15.8	60.2	42.2	362
Three Irrigation Events Terminated Early (FullIrrig-3)									
Brennan	25.93	86	12,039	13.0	83.2	15.6	60.5	37.8	357
Buck Pronto	30.30	88	10,700	13.6	98.8	13.7	60.0	42.9	393
Cabernet	26.18	88	11,829	12.7	98.1	13.1	58.9	38.4	341
Espresso	25.95	94	11,752	13.1	102.8	14.1	60.4	38.6	359
McNeal	33.85	89	10,976	14.1	99.1	13.8	60.1	41.4	430
Solano	25.25	91	11,302	13.1	97.3	13.9	59.8	40.2	368
Volt	30.80	92	12,214	13.6	101.7	13.0	60.8	37.5	410
WB Rockland	24.05	93	11,194	12.8	90.8	15.2	59.8	40.6	367
Dryland									
Brennan	24.2	83	12,571	12.7	67.4	15.5	60.2	36.2	392
Buck Pronto	30.2	88	10,289	13.7	92.1	14.1	59.6	44.2	364
Cabernet	24.8	85	12,395	12.3	89.5	13.1	58.8	36.7	369
Espresso	26.2	90	11,950	12.8	90.6	14.0	59.8	38.1	358
McNeal	31.6	87	11,494	14.2	91.3	13.8	59.6	39.6	443
Solano	26.7	90	11,536	13.0	98.2	13.6	59.8	39.4	362
Volt	30.5	90	13,231	13.4	103.0	12.7	61.5	34.4	407
WB Rockland	25.2	91	11,297	12.6	89.5	15.0	59.8	40.3	362
C.V	12.0	5.0	8.7	4.8	15.2	7.3	1.6	8.6	12.4
LSD	1.6	3.2	417.0	0.7	7.4	0.4	0.5	1.4	20.0
Pr>F <sub>(0.05) - Irr</sub>	0.758	<0.0001	<0.0001	0.417	<0.0001	<0.0001	<0.0001	<0.0001	0.009
Pr>F <sub>(0.05) - Var</sub>	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Pr>F <sub>(0.05) - Irr x Var</sub>	0.3918	0.9882	0.8800	0.0330	0.7321	0.4700	0.0020	0.8342	0.0003

HT: height, PM: physiological maturity \*(duration from emergence), SS: seed size, MC: moisture content, YLD: yield, PRO: protein, TWT: test weight, TKW: thousand kernel weight, FN: falling number,

Figure 2. Yield, protein and falling number responses to water treatments



## Summary:

The main effect of irrigation was significant for yield, protein, physiological maturity, and seed size. Volt responded the most in terms of yield whereas Brennan responded the least. The expected relationship between yield and protein was observed. Brennan had the highest protein whereas Volt had the least. Except Cabernet, an increase in protein was observed when irrigation was triggered during milk to soft dough stage indicating increased soil N uptake for enhanced protein. Irrigation did not impact plant height and no visible plant lodging was observed.

There was a significant interaction between irrigation and variety on falling number and test weight. Test weight for Cabernet was sensitive to drought (dryland) with only 58.7 lbs/bu and increased with supplemental irrigation. Test weight for Volt was the highest under dryland conditions, and increased further as supplemental irrigation was increased. Except for Brennan, most of the varieties showed resistance to preharvest sprout (PHS) with falling numbers greater than 300 FN. However, FN values tended to decrease with increased irrigation. Brennan was the most susceptible to PHS, with FN values dramatically decreasing with increased irrigation. Chances of PHS in Brennan is high (FN lower than 300) when irrigation was applied at milk or dough stage.