

EVALUATION OF TWO AUTOMATED IRRIGATION SCHEDULING METHODS FOR SPRINKLER IRRIGATED POTATO

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Introduction

Irrigation scheduling for potato can use soil water tension, soil water content, or crop evapotranspiration estimates. Measurement of evapotranspiration and the use of an allowable soil water depletion value can be used to automatically schedule irrigations. Netafim (Fresno, CA) has developed an irrigation scheduling method for potato using evapotranspiration estimates. The Malheur Experiment Station has developed soil water tension criteria for automatically or manually initiating potato irrigations. A range of soil water tensions were evaluated for their effect on potato yield, grade and processing quality under furrow, sprinkler, and drip irrigation on silt loam soil. For furrow or sprinkler irrigated potato the ideal irrigation criterion is 50 to 60 cb (Eldredge et al., 1992; Shock et al., 1993, 2003). Soil water tension has been measured using granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200SS, Irrrometer Co., Riverside, CA). Granular matrix sensors were calibrated to soil water tension (Shock, 2003). Granular matrix sensors are inexpensive, require little maintenance, and can be used to schedule irrigations automatically using controllers and electric valves. This trial tested two automatic sprinkler irrigation scheduling methods with two new processing potato varieties (Payette Russet and Clearwater Russet).

Methods

The trial was conducted on an Owyhee silt loam previously planted to wheat at the Malheur Experiment Station, Ontario, Oregon. A soil analysis taken in the fall of 2017 showed that the top foot of soil had a pH of 7.8, 2.6% organic matter, 8 ppm nitrate-N, 3 ppm ammonium-N, 37 ppm phosphorus (P), 469 ppm potassium (K), 16 ppm sulfur (S), 3243 ppm calcium, 563 ppm magnesium (Mg), 278 ppm sodium, 7 ppm zinc (Zn), 4 ppm manganese (Mn), 2.4 ppm copper (Cu), 11 ppm iron, and 0.3 ppm boron (B). In the fall of 2017, the wheat stubble was shredded and the field was irrigated. The field was then disked, moldboard plowed, and groundhogged. Based on the soil analysis, 25 lb of N/acre as urea 44 lb of P/acre as monoammonium phosphate, 104 lb of K/acre as potassium chloride, 200 lb of S/acre as elemental sulfur, 7 lb of Mn/acre as manganese sulfate, 1 lb of Cu/acre as copper sulfate, 1 lb per acre Zn as zinc sulfate, and 4 lb of B/acre as Granubor II were broadcast before plowing. Following plowing, the field was fumigated with 20 gal/acre of Telone[®] II and bedded on 36-inch row spacing.

On March 29, 2018, 100 lb N as urea and Admire (Imidacloprid) at 7 oz/acre (0.25 lb ai/acre) was shanked into both sides of the beds at 6-inch depth. On April 3, seed of Payette Russet and Clearwater Russet was cut by hand into 2.5-oz seed pieces, treated with Maxim[®] MZ dust, and stored to suberize. Payette Russet seed pieces were treated with giberellic acid to accelerate inherent slow sprouting. Payette Russet seed pieces were dipped for five minutes in a solution of 2 mg of giberellic acid/liter prior to application of Maxim MZ dust.

The experimental design was a randomized complete block design with two treatments, two variety split plots, and six replicates. The treatments were two automated irrigation scheduling methods: 1) irrigation scheduling based on soil water tension (OSU), 2) irrigation scheduling based on potato evapotranspiration (Netbeat). Main plots were six potato rows wide by 120 ft long. Each main plot was divided into two variety split plots (Payette Russet and Clearwater Russet).

Potato seed pieces were planted on April 4-5 using a 2-row assist-feed planter with 9-inch seed spacing in 36-inch rows. Red potatoes were planted between variety split plots as markers to separate the split plots at harvest

After all bed preparation operations were finished, a sprinkler irrigation system was installed and herbicide was broadcast on the whole field using a ground sprayer. Herbicide was a mixture of 1.33 pt/acre (1.3 lb ai) of Dual II Magnum[®] (metolachlor), 2 pt/acre (0.83 lb ai) of Prowl[®] (pendimethalin), and 32 oz/acre of Roundup[®] (glyphosate). The herbicides were incorporated by applying 0.75 inch of water to the whole field with the sprinkler irrigation system.

After the herbicide was incorporated, the sprinkler system was rearranged according to the experimental design. Each plot had two sprinkler lines spaced 20 ft apart installed on a blank bed on each side of the plot. Sprinkler risers (Netafim Meganet yellow nozzles) were installed 20 ft apart on the sprinkler line. Wooden guards were installed behind each sprinkler to separate irrigations between adjacent plots.

Soil water tension in all main plots of all treatments was measured using four granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200SS, Irrrometer Co., Riverside, CA) in Clearwater Russet split plots. The sensors were installed at 8-inch depth below each of the middle two potato rows in each Clearwater Russet split plot. The datalogger (CR1000, Campbell Scientific, Logan, UT) read and recorded the SWT every hour.

The plots of each treatment were divided into two irrigation zones due to water flow limitations. The OSU treatment was irrigated automatically using the datalogger based on soil water tension (SWT) feedback. The datalogger automatically irrigated all plots in each OSU treatment zone when the average SWT of all OSU treatment plots in each zone reached or exceeded 50 cb. Irrigation durations were 5 hours, 49 minutes to apply 1.1 inches of water. The datalogger made irrigation decisions for each zone every 24 hours with zone 1 having decisions at 12 AM and zone 2 at 12 PM. The datalogger controlled the irrigations for each OSU zone using a controller (SDM CD16AC controller, Campbell Scientific) and solenoid valves (Dorot, Tulsa, OK). Automatic irrigations were started on June 6 and terminated on September 2.

The Netbeat treatment in each trial was irrigated automatically based on potato evapotranspiration using a controller (NMC-Junior Pro Irrigation, Netafim) and solenoid valves (Dorot). The controller made irrigation decisions for each zone every 24 hours with zone 1 having decisions at 6 AM and zone 2 at 6 PM.

The water for the sprinkler system was supplied by a well that maintained a continuous and constant water pressure of 30 psi. Water applied to each treatment was measured by totalizing flow meters (model M, Netafim) read five times per week. The total water applied to each treatment was measured from emergence to the last irrigation on September 2. Approximately 3 inches of water were applied uniformly to each treatment from emergence to the start of automated irrigations on June 6. Potato evapotranspiration (ET_c) was calculated with a modified Penman equation (Wright, 1982) using data collected at the Malheur Experiment Station by an AgriMet weather station. Potato ET_c was estimated and recorded from crop emergence on May 6 until September 9.

Catch can tests were run to determine the water application rate that the sprinkler system actually applied to the harvest rows. The proportion of the water applied to the middle two potato rows relative to the whole plot area was used to adjust the calculations of water applied based on the water meter readings.

Plant nutrition was monitored by weekly petiole and soil solution analyses starting June 8 and ending August 10 (Tables 2, 3, and 4). Petiole samples were collected from the middle two beds in each split plot. To avoid damage to the harvest rows, soil samples were collected from the border rows in each split plot. Composite petiole and soil samples were made that combined the samples from all the replicates of each variety in each treatment. The petiole and soil samples were analyzed by Western Laboratories, Inc., Parma Idaho. Plant nutrients were applied through the sprinkler system to the respective treatments only if both the root tissue and soil solution analyses concurrently indicated a deficiency (Table 5).

The potatoes were sprayed aerially on June 12 and 27 with the fungicide Bravo[®] (chlorothalonil) at 1 pt/acre (0.75 lb ai/acre). The field was sprayed aerially on July 28 and August 20 with the insecticides Agri-Mek[®] (abamectin) at 3.5 oz/acre (0.02 lb ai/acre) and Movento[®] (Spirotetramat) at 5 oz/acre (0.08 lb ai/acre).

On August 21, plants in each split plot were evaluated subjectively for maturity.

The potato vines were flailed on October 1. Fifty feet of the middle two rows of each variety split plot in each main plot were harvested on October 8. All tubers from each split plot were placed into burlap sacks and placed in a barn where they were kept under tarps. All sacks from each split plot were weighed. Four sacks from a representative area in each split plot were selected for grading. Tubers were graded by market class (U.S. No. 1 and U.S. No. 2) and weight (<4 oz, 4-6 oz, 6-10 oz, 10-20 oz, and >20 oz). Tubers were graded as U.S. No. 2 if any of the following conditions occurred: growth cracks, bottleneck shape, abnormally curved shape, or two or more knobs. Marketable tubers are U.S. No. 1 and U.S. No. 2 larger than 4 oz. A 20-tuber sample from each split plot was placed into storage. The storage temperature was gradually reduced to 45°F.

After 6 weeks in storage, a 10-tuber sample from each split plot was evaluated for specific gravity, fry color, and internal defects. Ten tubers per plot were cut lengthwise and the center slices from each tuber were fried for 2.5 min in 375°F soybean oil. Percent light reflectance was measured on the stem and bud ends of each slice. Percent light reflectance was measured using a Photovolt Reflectance Meter model 577-A (Photovolt Instruments, Minneapolis, MN), with a green tristimulus filter, calibrated to read 0% light reflectance on the black standard cup and 71.7% light reflectance on the white porcelain standard plate. Specific gravity of all varieties

was measured from a 10-tuber sample from each plot using the weight-in-air, weight-in-water method.

On January 24, 2019, ten tubers from each split plot of the OSU and Netbeat treatments were analyzed for nutrient content and moisture. Tuber nutrient content and moisture were used to calculate tuber nutrient uptake in the harvested yield.

Data were analyzed with the General Linear Models analysis of variance procedure using NCSS (Number Cruncher Statistical Systems, Kaysville, UT) using Fisher's protected LSD (least significant difference) for means separation at the 95% confidence level.

Results and Discussion

The petiole NO_3 concentration for Payette Russet and Clearwater Russet remained above the critical level during the season for both irrigation scheduling systems (Figs. 1 and 2). The soil solution nitrogen concentration remained above the critical level all season for both varieties with both irrigation scheduling systems (Fig. 3). A total of 25 lb N/acre was applied through the drip tape during the season to both irrigation scheduling systems (Table 1). Despite the limited amount of N applied during the season, the soil contained substantial amounts of total available N (Table 2). Previous research has shown that with carefully scheduled irrigations, N fertilizer requirements for potato are low (Feibert et al., 1998). Soil solution and petiole analyses for the other nutrients are found in tables 3 and 4 and the amounts of nutrients applied based on the analyses are in table 2. The amounts of nutrients applied were the same for both irrigation scheduling systems, except that the Netbeat irrigation scheduling received an additional 5 lb Mg/acre.

Treatment differences

The OSU irrigation scheduling system maintained the soil water tension below 50 to 60 cb, close to the target of 50 cb (Fig. 4). The Netbeat irrigation scheduling maintained the soil water tension below 20 to 30 cb during the season. The average soil water tension was 35 cb and 24 cb for the OSU and Netbeat irrigation scheduling, respectively (Table 5).

Both zones of the OSU irrigation scheduling system applied 12 irrigations and on average each irrigation applied 1.6 inches of water. The OSU system should have been calculated and managed to apply only 1.2 inches of water per irrigation. The Netbeat irrigation scheduling applied 18 irrigations in zone 1 and 16 irrigations in zone 2 and on average each irrigation applied 2 inches of water.

Potato ET_c totaled 31.5 inches and precipitation totaled 1.05 inches from crop emergence on May 6 until the last irrigation. The total amount of water applied plus precipitation for the two zones with OSU irrigation scheduling was 25.7 inches and 26.8 inches (Table 5). The total amount of water applied plus precipitation for the two zones with Netbeat irrigation scheduling was 38.7 inches and 34.1 inches. The total amount of water applied plus precipitation for the OSU irrigation scheduling system was 84% of ET_c and for the Netbeat irrigation scheduling system was 116% of ET_c (Table 5).

The Netbeat irrigation scheduling system had higher total yield, marketable yield, total U.S. No.1 yield, and yield of tubers 10 to 20 oz than the OSU irrigation scheduling system (Table 6). There was no statistically significant difference in the percentage of U.S. No. 1 tubers between irrigation scheduling systems. The OSU irrigation scheduling system had higher water use efficiency than the Netbeat irrigation scheduling system. There was no statistically significant difference in tuber fry color and specific gravity between irrigation scheduling systems. The only internal tuber defect encountered was internal brown spot, with no statistically significant difference between treatments.

The Netbeat irrigation scheduling had tubers with higher phosphorus and iron concentrations than the OSU irrigation scheduling (Table 7). Based on total yield, the Netbeat irrigation scheduling had higher phosphorus, calcium, and iron uptake by the tubers than the OSU irrigation scheduling (Table 8).

Variety differences

Averaged over treatments, Clearwater Russet had higher marketable yield, yield of tubers > 20 oz, and yield of tubers 10 to 20 oz than Payette Russet. Averaged over treatments, Payette Russet had higher specific gravity than Clearwater Russet. There was no statistically significant difference in the percentage of tubers with internal brown spot between varieties.

Averaged over treatments, the harvested tubers of Clearwater Russet removed 234 lb/acre of nitrogen and 327 lb/acre of potassium, considerably more than the amounts of fertilizer applied. Clearwater Russet had higher tuber concentrations of magnesium than Payette Russet (Table 7). Based on total yield, Clearwater Russet had higher tuber uptake of magnesium than Payette Russet (Table 8).

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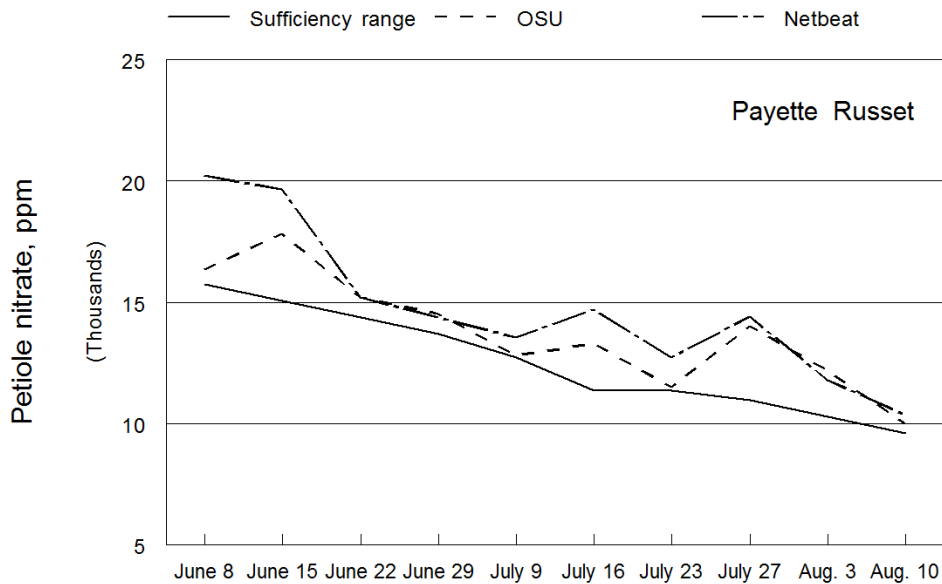


Figure 1. Payette Russet petiole nitrate over time with two irrigation scheduling treatments. Malheur Experiment Station, Oregon State University, Ontario, OR.

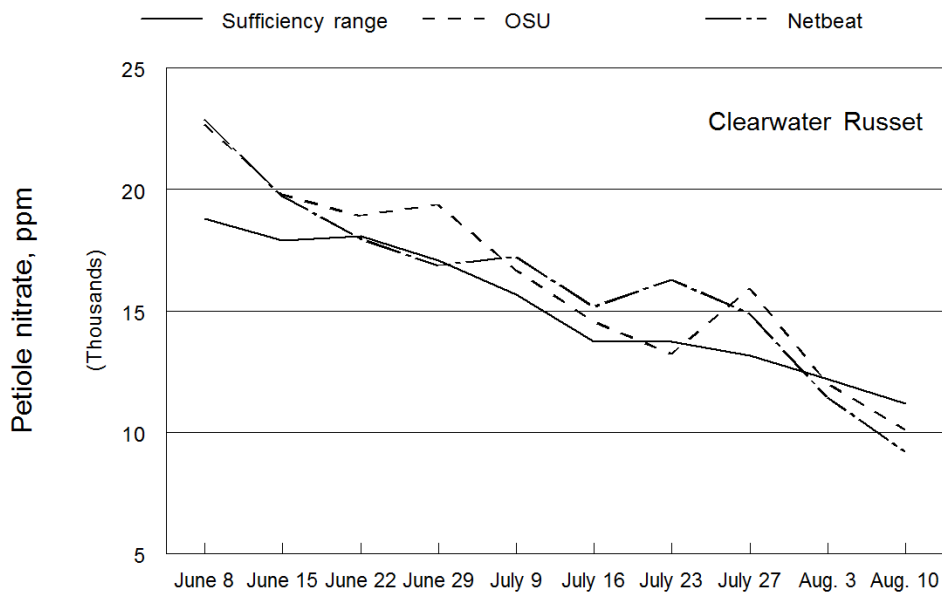


Figure 2. Clearwater Russet petiole nitrate over time with two irrigation scheduling treatments. Malheur Experiment Station, Oregon State University, Ontario, OR.

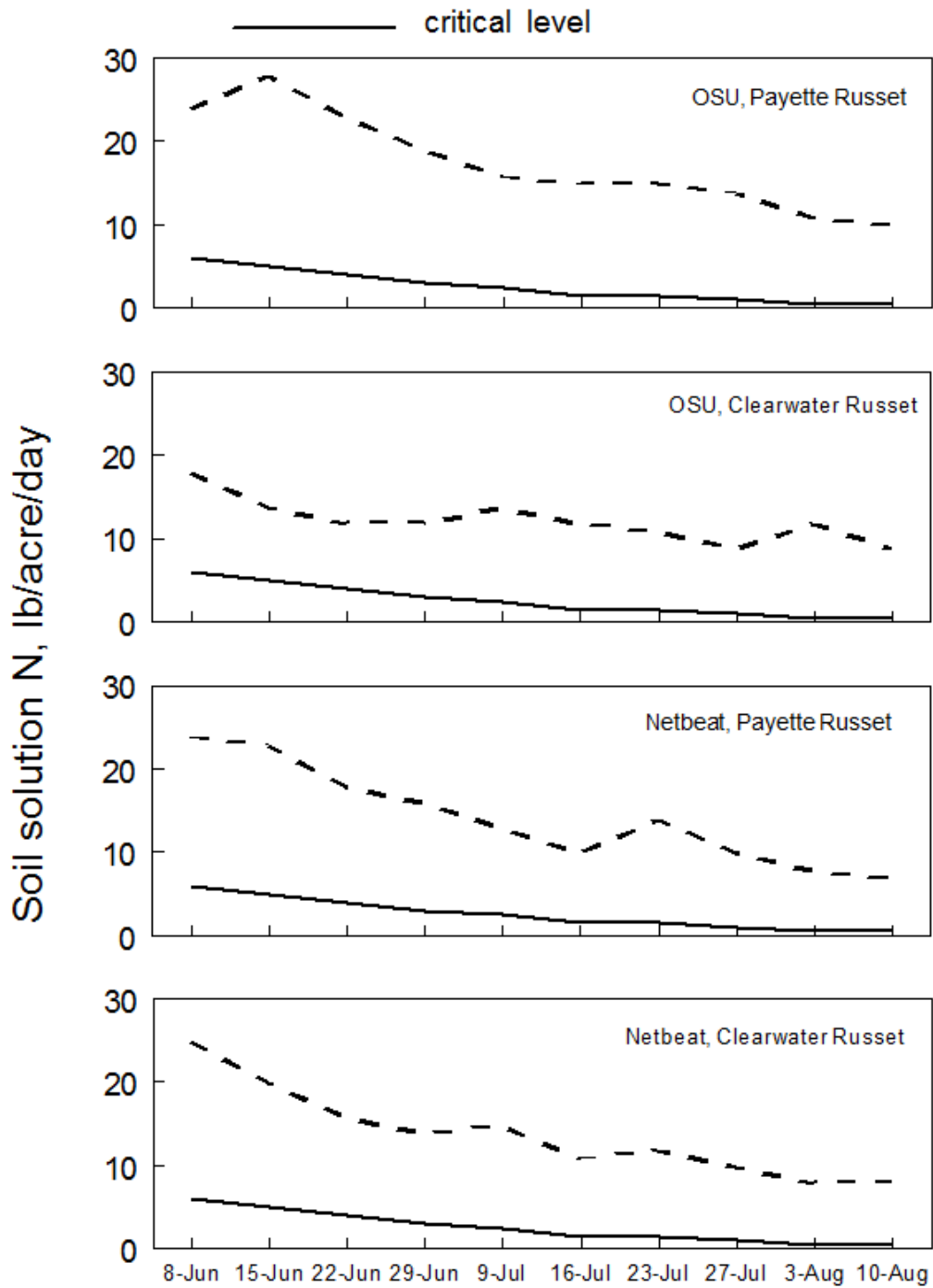


Figure 3. Soil solution nitrogen over time with two irrigation scheduling treatments and two varieties. Malheur Experiment Station, Oregon State University, Ontario, OR.

Table 1. Nutrients applied to two potato varieties and two irrigation scheduling systems. The Netbeat irrigation scheduling had an additional 5 lb Mg/acre applied (total of 21 lbMg/acre). Malheur Experiment Station, Oregon State University, Ontario, OR.

Date	N	K	Mg	Mn	S
13-Jun			5	0.25	
20-Jun		5	5		
29-Jun	10	10	3		
5-Jul	15	10	3		5
20-Jul		18			
25-Jul		15			
30-Jul		10			
7-Aug		10			
14-Aug		20			
Total	25	98	16	0.25	5

Nitrogen was applied as Uran (32% N), potassium as potassium chloride, manganese was applied as manganese carbonate (5%), magnesium was applied as magnesium carbonate (3%), and sulfur as elemental sulfur (52%).

Table 2. Total available soil N for two potato varieties with two irrigation scheduling systems. Malheur Experiment Station, Oregon State University, Ontario, OR.

Date	OSU		Netbeat	
	Payette Russet	Clearwater Russet	Payette Russet	Clearwater Russet
	----- lb/acre -----			
8-Jun	168	123	171	174
15-Jun	198	99	162	138
22-Jun	159	81	126	111
29-Jun	135	81	114	96
9-Jul	114	99	93	102
16-Jul	108	84	72	75
23-Jul	108	78	96	84
27-Jul	96	66	72	72
3-Aug	75	84	54	57
10-Aug	69	66	48	54

Table 3. Potato petiole analyses for two varieties with two irrigation scheduling systems. Malheur Experiment Station, Oregon State University, Ontario, OR. Continued on next page.

Date	OSU		Netbeat	
	Payette Russet	Clearwater Russet	Payette Russet	Clearwater Russet
----- P, 0.2 - 0.55 % -----				
8-Jun	0.69	0.66	0.64	0.60
15-Jun	0.62	0.56	0.68	0.39
22-Jun	0.64	0.49	0.37	0.26
29-Jun	0.53	0.25	0.32	0.24
9-Jul	0.40	0.23	0.36	0.20
16-Jul	0.40	0.31	0.36	0.24
23-Jul	0.33	0.28	0.31	0.30
27-Jul	0.35	0.24	0.33	0.32
3-Aug	0.27	0.29	0.35	0.30
10-Aug	0.28	0.25	0.30	0.26
----- K, 7.5 - 15% -----				
8-Jun	9.90	9.30	10.30	8.80
15-Jun	8.10	8.40	8.30	9.60
22-Jun	8.70	8.30	9.60	10.20
29-Jun	10.40	5.40	5.80	5.60
9-Jul	8.50	6.60	7.70	6.60
16-Jul	8.30	8.10	8.40	7.80
23-Jul	7.40	6.50	7.00	7.00
27-Jul	7.30	7.10	7.60	7.20
3-Aug	7.20	8.00	8.90	8.30
10-Aug	6.50	7.20	7.60	7.80
----- S, 0.2 - 0.5% -----				
8-Jun	0.35	0.30	0.28	0.29
15-Jun	0.26	0.33	0.38	0.20
22-Jun	0.39	0.36	0.20	0.20
29-Jun	0.36	0.20	0.21	0.20
9-Jul	0.39	0.30	0.28	0.27
16-Jul	0.48	0.44	0.33	0.31
23-Jul	0.38	0.34	0.36	0.31
27-Jul	0.42	0.36	0.39	0.38
3-Aug	0.38	0.32	0.37	0.35
10-Aug	0.34	0.28	0.31	0.32
----- Ca, 0.45 - 2% -----				
8-Jun	1.43	1.11	1.65	1.07
15-Jun	1.62	0.98	1.57	1.02
22-Jun	1.40	1.22	1.37	0.96
29-Jun	1.65	1.09	1.22	0.79
9-Jul	1.67	0.80	1.57	0.84
16-Jul	2.10	1.03	2.01	1.03
23-Jul	2.34	1.17	1.85	1.24
27-Jul	2.10	1.47	2.10	1.31
3-Aug	2.30	1.56	2.31	1.65
10-Aug	1.80	1.50	1.95	1.50
----- Mg, 0.4 - 1.7% -----				
8-Jun	0.50	0.53	0.65	0.53
15-Jun	0.50	0.53	0.48	0.61
22-Jun	0.58	0.61	0.49	0.57
29-Jun	0.55	0.58	0.46	0.48
9-Jul	0.55	0.51	0.50	0.34
16-Jul	0.60	0.55	0.51	0.42
23-Jul	0.51	0.51	0.55	0.49
27-Jul	0.59	0.65	0.66	0.53
3-Aug	0.75	0.70	0.65	0.65
10-Aug	0.75	0.75	0.64	0.52

Table 3. (Continued.) Potato petiole analyses for two varieties with two irrigation scheduling systems. Malheur Experiment Station, Oregon State University, Ontario, OR.

Date	OSU		Netbeat	
	Payette Russet	Clearwater Russet	Payette Russet	Clearwater Russet
----- Zn, 23 - 55ppm -----				
8-Jun	42	75	65	42
15-Jun	47	68	71	45
22-Jun	37	63	69	40
29-Jun	34	52	61	49
9-Jul	41	52	62	51
16-Jul	52	51	51	45
23-Jul	46	45	43	36
27-Jul	35	41	52	32
3-Aug	33	34	41	40
10-Aug	37	42	45	41
----- Mn, 33 - 70 ppm -----				
8-Jun	80	74	92	85
15-Jun	97	64	89	78
22-Jun	83	74	85	62
29-Jun	74	62	93	70
9-Jul	65	69	89	64
16-Jul	76	79	82	83
23-Jul	95	90	78	65
27-Jul	76	84	71	51
3-Aug	80	82	87	64
10-Aug	86	69	71	58
----- Cu, 5 - 30 ppm -----				
8-Jun	21	18	26	20
15-Jun	15	13	19	15
22-Jun	13	10	14	13
29-Jun	12	7	10	10
9-Jul	9	9	13	13
16-Jul	11	11	12	11
23-Jul	9	9	10	9
27-Jul	9	8	8	9
3-Aug	11	9	10	10
10-Aug	12	8	8	8
----- B, 21 - 55 ppm -----				
8-Jun	64	52	46	56
15-Jun	73	39	33	43
22-Jun	60	37	35	41
29-Jun	55	42	41	52
9-Jul	50	42	32	41
16-Jul	42	46	40	52
23-Jul	36	39	33	50
27-Jul	29	39	37	43
3-Aug	37	40	37	38
10-Aug	29	36	42	34

Table 4. Soil solution analyses for two potato varieties with two irrigation scheduling systems. Malheur Experiment Station, Oregon State University, Ontario, OR. Continued on next page.

Date	OSU		Netbeat	
	Payette Russet	Clearwater Russet	Payette Russet	Clearwater Russet
----- P, 0.6 lbs -----				
8-Jun	0.8	1.2	1.3	2.0
15-Jun	1.1	1.2	1.7	1.2
22-Jun	1.4	1.2	1.6	1.7
29-Jun	1.9	1.0	1.4	1.2
9-Jul	1.0	1.4	1.2	1.5
16-Jul	1.2	1.3	1.3	1.5
23-Jul	1.2	1.4	1.3	1.5
27-Jul	1.8	1.8	1.6	2.1
3-Aug	1.8	2.0	2.1	1.5
10-Aug	1.2	1.6	1.5	1.8
----- K, 7 lbs -----				
8-Jun	12.2	9.9	8.5	7.4
15-Jun	9.6	8.8	6.9	8.5
22-Jun	8.7	7.5	7.5	7.3
29-Jun	7.8	7.3	8.0	6.8
9-Jul	6.3	6.7	7.4	5.9
16-Jul	5.0	5.5	7.2	5.6
23-Jul	6.2	5.9	8.4	6.2
27-Jul	7.3	6.6	7.8	7.7
3-Aug	5.9	5.7	6.3	6.2
10-Aug	7.1	6.7	6.7	7.1
----- S, 2 lbs -----				
8-Jun	5.7	4.9	6.4	4.2
15-Jun	6.2	5.2	5.2	4.3
22-Jun	4.3	4.3	4.2	3.8
29-Jun	3.8	3.7	5.9	4.4
9-Jul	4.6	3.4	5.3	3.3
16-Jul	4.5	2.7	3.0	2.8
23-Jul	3.6	1.5	1.7	1.5
27-Jul	2.9	2.1	2.3	2.0
3-Aug	2.7	2.6	3.0	1.7
10-Aug	2.1	2.4	2.5	2.0
----- Ca, 3 lbs -----				
8-Jun	4.0	5.0	6.1	6.5
15-Jun	5.2	5.8	6.5	4.8
22-Jun	5.1	5.5	5.0	5.1
29-Jun	4.3	4.5	5.1	5.5
9-Jul	4.7	3.6	4.2	4.8
16-Jul	5.4	4.3	4.0	5.7
23-Jul	4.6	4.6	3.0	4.6
27-Jul	5.1	5.2	3.3	5.8
3-Aug	5.1	4.7	3.8	4.7
10-Aug	4.8	4.4	4.5	4.6
----- Mg, 1 lb -----				
8-Jun	0.5	0.4	0.3	0.3
15-Jun	0.5	0.3	0.2	0.3
22-Jun	0.6	0.4	0.5	0.4
29-Jun	0.7	0.4	0.6	0.5
9-Jul	0.9	0.5	0.7	0.6
16-Jul	1.0	0.6	0.8	0.7
23-Jul	1.3	0.8	0.9	0.8
27-Jul	1.0	1.0	1.0	1.0
3-Aug	0.8	0.8	0.7	0.7
10-Aug	0.9	0.8	0.8	0.8

Table 4. (Continued.) Soil solution analyses for two potato varieties with two irrigation scheduling systems. Malheur Experiment Station, Oregon State University, Ontario, OR.

Date	OSU		Netbeat	
	Payette Russet	Clearwater Russet	Payette Russet	Clearwater Russet
----- Zn, 56 g -----				
8-Jun	141	183	180	153
15-Jun	126	210	186	162
22-Jun	135	189	159	132
29-Jun	105	171	153	120
9-Jul	117	141	123	102
16-Jul	87	123	120	84
23-Jul	78	111	114	78
27-Jul	87	87	99	87
3-Aug	72	63	81	75
10-Aug	75	75	69	63
----- Mn, 40 g -----				
8-Jun	30	36	42	84
15-Jun	39	42	54	69
22-Jun	30	30	45	54
29-Jun	39	24	39	48
9-Jul	45	33	48	60
16-Jul	48	30	54	51
23-Jul	51	39	69	48
27-Jul	57	30	57	42
3-Aug	42	24	48	36
10-Aug	48	27	42	27
----- Cu, 28 g -----				
8-Jun	162	114	120	96
15-Jun	129	105	114	120
22-Jun	99	87	96	99
29-Jun	102	75	90	96
9-Jul	81	57	63	84
16-Jul	72	48	54	72
23-Jul	72	60	66	51
27-Jul	54	51	60	45
3-Aug	45	57	57	51
10-Aug	45	48	45	42
----- B, 28 g -----				
8-Jun	20	17	17	20
15-Jun	15	15	20	23
22-Jun	18	14	24	23
29-Jun	23	15	26	27
9-Jul	20	20	30	33
16-Jul	21	18	27	30
23-Jul	20	20	21	23
27-Jul	24	23	24	26
3-Aug	21	18	30	24
10-Aug	23	20	26	20

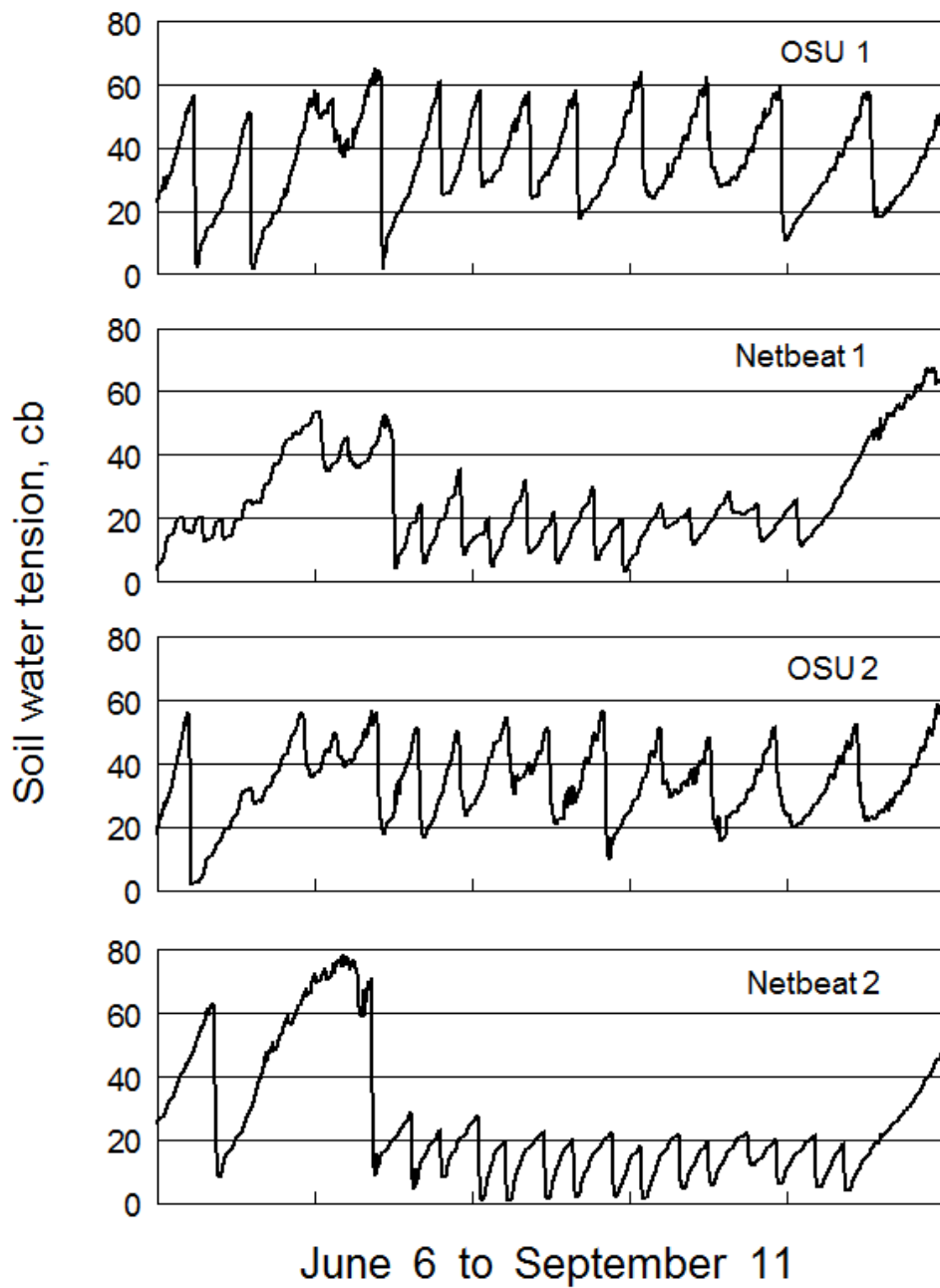


Figure 4. Soil water tension at 8-inch depth for two irrigation scheduling treatments. Malheur Experiment Station, Oregon State University, Ontario, OR.

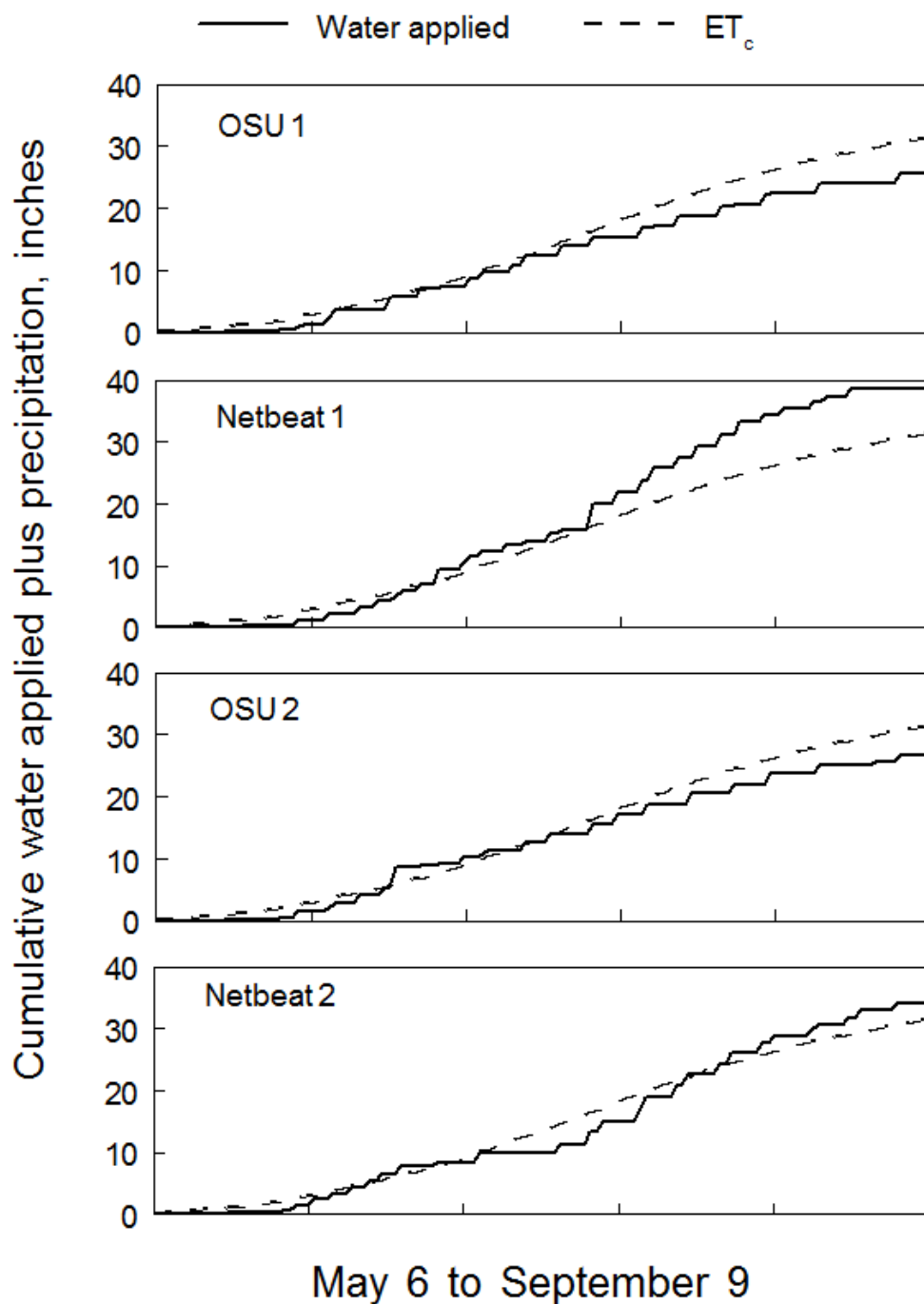


Figure 5. Cumulative water applied plus precipitation for two irrigation scheduling treatments. Malheur Experiment Station, Oregon State University, Ontario, OR.

Table 5. Number of irrigations, total water applied, and average soil tension for two irrigation scheduling systems. Malheur Experiment Station, Oregon State University, Ontario, OR.

Irrigation scheduling	No. of irrigations	Total water applied plus precipitation		Average soil water tension
		inches	% of ET _c	cb
OSU zone 1	12	25.8	82.2	36.0
OSU zone 2	12	26.9	85.7	34.0
OSU average	12	26.4	83.9	35.0
Netbeat zone 1	18	38.7	123.2	22.1
Netbeat zone 2	16	34.2	108.9	25.5
Netbeat average	17	36.5	116.1	23.8

Table 6. Yield, grade, and processing quality of two potato varieties grown with two irrigation scheduling systems. Malheur Experiment Station, Oregon State University, Ontario, OR.

Irrigation scheduling	Variety	Total yield	Marketable	U.S. No. 1	U.S. No. 1				U.S. No. 2	< 4 oz	Cull	Water use efficiency*	Fry color	Sugar ends	Internal brown spot	Specific gravity	
					Total	>20 oz	10 - 20 oz	6 - 10 oz									4 - 6 oz
		---- cwt/acre ----	%	----- cwt/acre -----				----- % -----									
OSU	Payette Russet	694.2	538.4	98.1	681.1	3.2	162.2	221.1	151.9	1.9	142.7	11.2	26.4	44.4	0.0	12	1.102
	Clearwater Russet	743.1	659.0	96.4	716.7	17.0	300.8	233.9	107.3	19.2	57.7	7.2	28.2	44.9	0.0	0	1.090
	Average	718.6	598.7	97.3	698.9	10.1	231.5	227.5	129.6	10.5	100.2	9.2	27.3	44.7	0.0	6	1.096
Netbeat	Payette Russet	772.7	629.6	97.9	756.4	6.0	234.4	251.8	137.4	9.8	126.8	6.4	21.3	43.9	0.0	5	1.100
	Clearwater Russet	802.4	694.9	93.6	749.7	29.2	345.2	233.3	87.2	35.9	54.8	16.8	22.2	42.4	3.3	5	1.088
	Average	787.5	662.2	95.8	753.1	17.6	289.8	242.6	112.3	22.9	90.8	11.6	21.7	43.1	1.7	5	1.094
Average	Payette Russet	733.4	584.0	98.0	718.8	4.6	198.3	236.5	144.6	5.9	134.8	8.8	23.8	44.1	0.0	8	1.101
	Clearwater Russet	772.7	676.9	95.0	733.2	23.1	323.0	233.6	97.2	27.5	56.3	12.0	25.2	43.6	1.7	3	1.089
LSD (0.05)	Treatment	67.4	54.2	NS	52.3	NS	39.5	NS	NS	NS	NS	NS	3.8	NS	NS	NS	NS
	Variety	NS	41.7	2.7	NS	18.8	51.1	NS	23.6	17.9	22.2	NS	NS	NS	NS	NS	0.006
	Trt X Var	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

*cwt total yield/inch of water applied

Table 7. Tuber nutrient concentration (dry weight basis) of two potato varieties grown with two irrigation scheduling systems. Malheur Experiment Station, Oregon State University, Ontario, OR.

Irrigation scheduling	Variety	N	P	K	S	Ca	Mg	Zn	Mn	Cu	Fe	B	
		----- % -----						----- ppm -----					
OSU	Payette Russet	1.26	0.19	1.70	0.10	0.06	0.07	8.8	35.5	3.8	76.0	26.3	
	Clearwater Russet	1.26	0.19	1.73	0.09	0.05	0.08	8.2	36.5	3.8	78.7	26.7	
	Average	1.26	0.19	1.71	0.09	0.06	0.07	8.5	36.0	3.8	77.3	26.5	
Netbeat	Payette Russet	1.19	0.22	1.76	0.10	0.06	0.07	15.3	32.5	3.7	152.0	24.0	
	Clearwater Russet	1.20	0.21	1.70	0.10	0.06	0.09	10.5	34.7	3.2	157.5	23.2	
	Average	1.20	0.22	1.73	0.10	0.06	0.08	12.9	33.6	3.4	154.8	23.6	
Average	Payette Russet	1.23	0.21	1.73	0.10	0.06	0.07	12.1	34.0	3.8	114.0	25.2	
	Clearwater Russet	1.23	0.20	1.72	0.09	0.06	0.08	9.3	35.6	3.5	118.1	24.9	
LSD (0.05)	Treatment	NS	0.02	NS	NS	NS	NS	NS	NS	NS	39.6	NS	
	Variety	NS	NS	NS	NS	NS	0.01	NS	NS	NS	NS	NS	
	Trt X Var	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	

Table 8. Tuber nutrient uptake in the harvested tubers of two potato varieties grown with two irrigation scheduling systems. Malheur Experiment Station, Oregon State University, Ontario, OR.

Irrigation scheduling	Variety	N	P	K	S	Ca	Mg	Zn	Mn	Cu	Fe	B
		----- lb/acre -----										
OSU	Payette Russet	233.7	35.5	314.9	17.9	10.4	12.3	0.2	0.7	0.1	1.4	0.5
	Clearwater Russet	234.7	35.5	323.1	16.7	10.0	15.0	0.1	0.7	0.1	1.5	0.5
	Average	234.2	35.5	319.0	17.3	10.2	13.6	0.2	0.7	0.1	1.4	0.5
Netbeat	Payette Russet	254.7	46.9	371.9	21.9	12.9	15.6	0.3	0.7	0.1	3.3	0.5
	Clearwater Russet	232.6	40.9	330.9	18.8	12.2	17.1	0.2	0.7	0.1	3.0	0.5
	Average	243.6	43.9	351.4	20.4	12.5	16.3	0.3	0.7	0.1	3.1	0.5
Average	Payette Russet	244.2	41.2	343.4	19.9	11.6	13.9	0.2	0.7	0.1	2.3	0.5
	Clearwater Russet	233.6	38.2	327.0	17.8	11.1	16.0	0.2	0.7	0.1	2.3	0.5
LSD (0.05)	Treatment	NS	7.9	NS	NS	2.3	NS	NS	NS	NS	0.8	NS
	Variety	NS	NS	NS	NS	NS	2.0	NS	NS	NS	NS	NS
	Trt X Var	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS