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The Influence of Irrigation Frequency on Potato Yield, Performance, and Disease Severity at IREC in 2011

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Introduction

Studies have shown soil moisture can have significant influence on potato early dying. Water-logged conditions in the spring and drought stress during tuber development were specified as conditions that increase the incidence and severity of early-dying. In Tulelake, growers differ in their opinion on how to irrigate a potato crop to minimize early-dying. Some growers prefer to irrigate frequently with short sets and some growers prefer to irrigate less frequent with long sets. Both irrigation schedules have merit as Tulelake soils (silty clay loam with high organic matter) have high water-holding capacity.

This study compared two irrigation schedules at the low and high limits of suggested soil moisture depletion between irrigation events. One schedule allows the soil to reach 40% depletion between irrigation (less frequent irrigation with more water applied per irrigation). The second schedule allows the soil to reach 20% depletion between irrigation (more frequent irrigation with less water applied per irrigation). The study was established in 2010 at IREC using Russet Burbank in a field with moderate Verticillium wilt pressure. In 2010, there was no difference in disease severity and potato yield between irrigation treatments. In 2011, we repeated the study at IREC in a field with high Verticillium wilt pressure (187 cfu of *Verticillium dahliae* per gram of soil). We also planted multiple varieties in 2011 including Russet Norkotah which is very susceptible to early dying.

General Trial Information

Location:	IREC, Tulelake, CA
Soil Type:	Tulebasin mucky silty clay loam (4.5 % organic matter)
Planting Date:	May 17, 2011
Vine Kill Date:	September 15, 2011
Days to Vine Kill:	121 days
Harvest Date:	September 30, 2011

General Trial Information Continued

Irrigation:	Solid-set sprinklers with 42 X 30 ft head spacing (2 irrigation schedules)
Plot Size:	2 rows (6 ft) wide by 30 ft
In-Row Spacing:	Russet Burbank = 11.3 inches; Yukon Gold = 9.1 inches;
	Russet Norkotah = 10.0 inches
Row Spacing:	36 inch rows
Number of Reps:	4 replications
Fertilizer:	170-0-0-0S
Herbicides:	Matrix split-applied
Insecticides:	Movento and Coragen
Fungicides:	None
Fumigation:	None

Irrigation Scheduling and Data Collection: Irrigation events for both treatments were scheduled using a combination of soil moisture monitoring (watermark sensors) and crop evapotranspiration. Thirty foot buffer zones were placed around each plot to minimize sprinkler overspray into surrounding plots. The entire plot was harvested and run across a gradeline to determine tuber yield, tuber size distribution, tuber external/ internal quality, and tuber disease symptoms. The percent coverage of black dot sclerotia on the lower 8 inches of potato stems was estimated in each plot by evaluating 20 stems per plot shortly before harvest.

Results

Total applied water for both irrigation schedules was similar at the end of the growing season (Figure). Both irrigation schedules (80% assumed application efficiency) tracked crop ET throughout the growing season (Figure).

Total potato yield, US No. 1 yield, and the number of tubers per plant were higher in the 20% depletion irrigation schedule compared to the 40% depletion irrigation schedule for all varieties (Table 1).

The 20% depletion schedule had lower incidence of *Verticillium* wilt on 8/25/2011 averaged across varieties and a lower percent coverage of black dot on Yukon Gold tubers compared to the 40% depletion schedule (Table 2). *Rhizoctonia* (black scurf) tuber coverage was less in the 20% depletion schedule compared to the 40% depletion schedule for all varieties, but the effect was not statistically significant (Table 2).

In summary, the 20% depletion schedule resulted in higher yield and less Verticillium wilt and black dot symptoms compared to the 40% depletion schedule in 2011. These results agree with yield studies that recommend maintaining 70% to 85% available soil moisture throughout the growing season for optimal yield and plant health. This study will be repeated in 2012.

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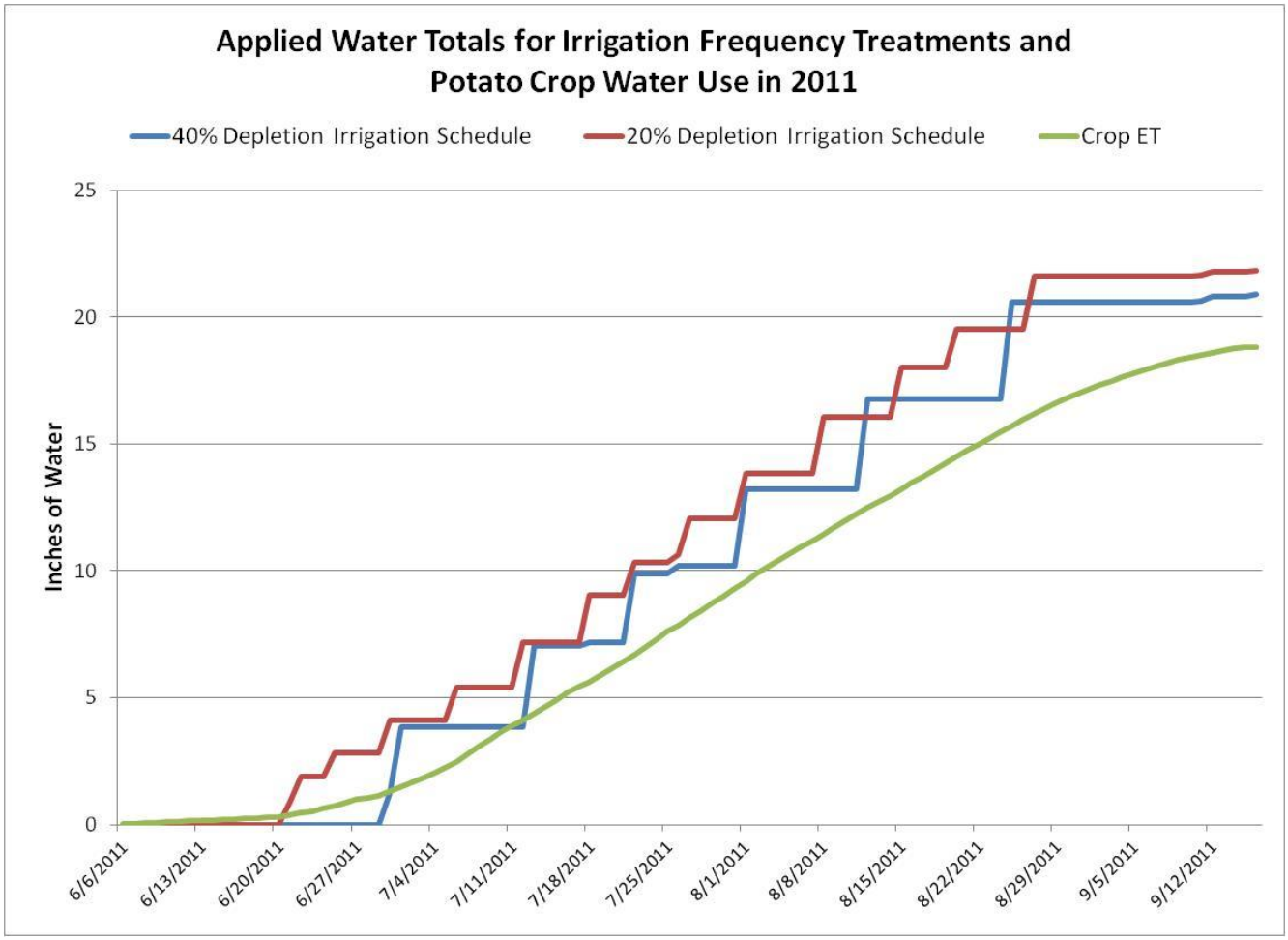
Applied Water Totals for Irrigation Frequency Treatments and Potato Crop Water Use in 2011
40% Depletion Irrigation Schedule
20% Depletion Irrigation Schedule
Crop ET
Inches of Water
25
20
15
10
5
0
6/6/2011
6/13/2011
6/20/2011
6/27/2011
7/4/2011
7/11/2011
7/18/2011
7/25/2011
8/1/2011
8/8/2011
8/15/2011
8/22/2011
8/29/2011
9/5/2011
9/12/2011

Table 1. The influence of Irrigation Frequency on Russet Burbank, Yukon Gold, and Russet Norkotah Tuber Yield, Size, and Grade at IREC in 2011.

		Tuber Yield (cwt/A)										
		U.S. No. 1's (cwt)										
Variety	Irrigation Treatment	Total 1's	10-14oz	6-10oz	4-6oz	<4oz	>14oz	Culls + 2's	Total	Plants/ Plot[1]	Tubers/ Plant	Avg Tuber Size (oz)
Russet Burbank	*[2]	279	65	140	74	44	13	52	387	63	6.5	6.3
Yukon Gold	*	344	98	168	78	45	28	23	441	65	6.8	6.7
Russet Norkotah	*	207	66	94	46	36	34	57	333	66	5.1	6.6
95% confidence interval		27	11	12	10	3	10	16	21	NS	0.6	0.3
[3]	**40% depletion**	261	75	125	61	34	25	48	369	65	5.6	6.7
**	**20% depletion**	293	78	143	71	49	24	40	405	64	6.6	6.4
95% confidence interval		23	NS	11	10	3	NS	15	20	NS	0.6	NS
Russet Burbank	**40% depletion**	264	55	136	74	40	14	56	374	63	6.3	6.3
Russet Burbank	**20% depletion**	295	76	144	75	47	11	48	401	63	6.7	6.4
Yukon Gold	**40% depletion**	333	110	154	68	34	32	30	428	66	6.1	7.1
Yukon Gold	**20% depletion**	355	86	182	87	57	25	17	454	65	7.4	6.3
Russet Norkotah	**40% depletion**	186	60	85	41	30	30	58	305	68	4.4	6.7
Russet Norkotah	**20% depletion**	228	72	104	52	42	37	55	361	64	5.7	6.6
95% confidence interval		29	15	14	11	6	NS	16	24	NS	0.6	0.4

1 The seed spacing for Russet Burbank was 11.3 inches, 100% emergence = 64 plants per plot. The seed spacing for Yukon Gold was 9.1 inches, 100% emergence = 79 plants per plot. The seed spacing for Russet Norkotah was 10.0 inches, 100% emergence = 72 plants per plot. Row spacing was 36 inches.

[2] Averaged across irrigation treatments

[3] Averaged across all three varieties

Table 2. The Influence of Irrigation Frequency on Russet Burbank, Yukon Gold, & Russet Norkotah Disease Ratings, External Defects, & Internal Characteristics at IREC in 2011.

Variety	Irrigation Treatment	Vigor Rating 6/24/11[1]	Vert Wilt Rating 8/8/11[2]	Vert Wilt Rating 8/25/11[2]	Avg Rhizoc. Coverage on Tubers %	Rhizoc. Tuber Severity Rating[3]	Avg Black Dot Coverage on Tubers %	Avg Black Dot Coverage on Lower Stem %	Black Dot Tuber Severity Rating[4]	Growth Knobs %[5]	Growth Cracks %[5]	Shape %[5]	Green %[5]	Hollow Heart %[6]	Tuber Stem End Necrosis %[6]	Tuber Vascular Discolor-ation %[6]
Russet Burbank	*[7]	3.2	2.3	6.1	1.9	4.8	n/a[9]	27.1	n/a	15.5	1.4	2.1	1.7	23.0	4.0	3.0
Yukon Gold	*	3.9	4.4	7.9	0.7	4.8	17.0	40.2	3.50	5.0	0.0	2.1	1.5	1.0	8.0	3.0
Russet Norkotah	*	3.0	6.0	8.8	11.0	3.5	n/a	30.0	n/a	11.1	1.3	4.1	6.8	6.0	0.0	3.0
95% confidence interval		0.4	0.6	0.3	1.3	0.1	n/a	4.4	n/a	6.0	0.5	1.1	3.0	10.0	NS	NS
**[8]	40% depletion	3.0	4.3	7.8	5.1	4.3	n/a	31.9	n/a	11.6	1.3	3.3	3.9	6.0	2.0	4.0
**	20% depletion	3.7	4.1	7.4	4.0	4.4	n/a	32.9	n/a	9.5	0.5	2.3	2.7	14.0	6.0	3.0
95% confidence interval		0.2	NS	0.2	NS	NS	n/a	NS	n/a	NS	0.4	NS	NS	8.0	NS	NS
Russet Burbank	40% depletion	2.9	2.3	6.3	2.0	4.8	n/a	29.1	n/a	17.3	1.9	2.7	2.0	10.0	3.0	2.0
Russet Burbank	20% depletion	3.5	2.3	6.0	1.7	4.8	n/a	25.1	n/a	13.8	0.9	1.6	1.5	35.0	5.0	5.0
Yukon Gold	40% depletion	3.5	4.3	8.0	0.9	4.8	19.9	39.3	3.25	4.8	0.0	3.2	2.2	0.0	3.0	5.0
Yukon Gold	20% depletion	4.3	4.5	7.8	0.6	4.8	14.2	41.1	3.81	5.3	0.1	1.1	0.7	3.0	13.0	2.0
Russet Norkotah	40% depletion	2.8	6.5	9.0	12.4	3.3	n/a	27.4	n/a	12.8	1.8	4.1	7.6	8.0	0.0	5.0
Russet Norkotah	20% depletion	3.3	5.5	8.5	9.7	3.7	n/a	32.5	n/a	9.5	0.7	4.1	6.0	5.0	0.0	2.0
95% confidence interval		NS	NS	0.4	NS	NS	3.1	NS	0.24	NS	0.6	NS	NS	11.0	NS	NS

[1] Early Season Vigor Rating 0-5 scale, 5= highest vigor

[2] Verticillium Wilt Rating 0-9 scale, 0= 0 Symptoms, 1= Trace, 2= 1-5% of plants show symptoms of disease, 3= 5-10%, 4= 10-20%, 5= 20-40%, 6= 40-60%, 7= 60-75%, 8= 75-90%, 9= 90-100%

[3] Rhizoctonia (black scurf) Severity Tuber Rating (10 tubers/ plot) 1-5 scale, 5= no infection

[4] Black Dot Severity Tuber Rating (10 tubers/ plot) 1-5 scale, 5= no infection.

[5] % of total tuber count

[6] 10 tubers evaluated from each plot (6-14oz tubers)

[7] Averaged across irrigation treatments

[8] Averaged across all three varieties

[9] n/a = not available; Black dot was present on Russet tubers but it was not evident without magnification, thus visual evaluations were only made on yukon gold.