



The Influence of Irrigation Frequency on Potato Yield, Performance, and Disease Severity at IREC in 2012

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Introduction: Soil moisture can have significant influence on potato early dying symptoms caused by the pathogen *Verticillium dahlia* (Verticillium wilt). Water-logged soils in the spring and soils too wet or too dry during tuber development have been shown to 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. Potatoes are grown successfully under both irrigation schedules on Tulelake soils (silty clay loam with high organic matter) because they 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.

Russet Norkotah and Yukon Gold were added to the trial in 2011 and 2012. Russet Norkotah was added because of its' high susceptibility to Verticillium wilt. Yukon Gold was added to evaluate tuber *Rhizoctonia solani* (black scurf) and *Colletotrichum coccodes* (black dot) on a light-skinned variety. 2011 and 2012 trials results are presented in this report.

Trial Information for 2011 and 2012

Location: IREC, Tulelake, CA

Soil Type: Tulebasin mucky silty clay loam (4.5 % organic matter)

Planting Date: May 17, 2011 and May 14, 2012

Vine Kill Date: September 15, 2011 and September 4, 2012

Days to Vine Kill: 2011 = 121 days; 2012 = 110 days

Harvest Date: September 30, 2011 and September 25, 2012

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: R. Burbank = 11.3 inches; Yukon Gold = 9.1 inches; R. Norkotah = 10.0 inches

Row Spacing: 36 inch rows

Number of Reps: 4 replications

Fertilizer: 2011 = 170-0-0-0S; 2012 = 217-73-16-37S

Herbicides: 2011 Matrix split-applied; 2012 Matrix + metribuzin

Insecticides: 2011 Movento and Coragen; 2012 Admire Pro

Fungicides and 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 prevent sprinkler overspray into adjacent 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. Percent coverage of black dot sclerotia on the lower 8 inches of potato stem was estimated by evaluating 20 stems per plot shortly before harvest.

Results

Crop ET and applied water were tracked for both irrigation schedules throughout the growing season in 2011 and 2012 (Figures 1 and 2). Total applied water for the 40% and 20% depletion irrigation schedule was similar at the end of the season.

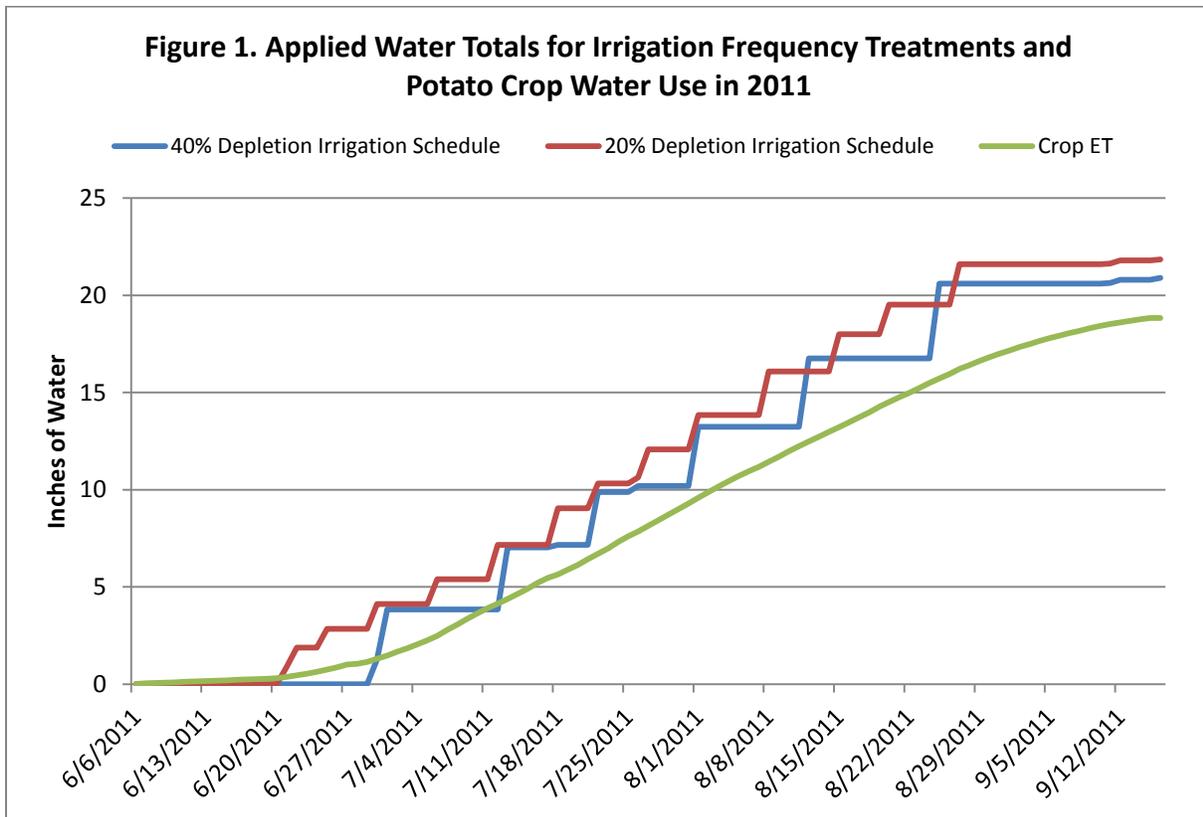
Varieties differed in yield both years (Table 1), but irrigation treatments had a similar effect on yield for all varieties in 2011 and 2012. Total and U.S. No. 1 yield were higher for the 20% depletion irrigation schedule compared to the 40% depletion schedule (Table 1). The yield increase associated with the 20% depletion schedule was related to an increase in the number of tubers per plant. The 40% depletion schedule had slightly larger tuber size, but one less tuber per plant compared to the 20% depletion schedule. The 20% depletion schedule had less knobs and growth cracks and lower cull yield compared to the 40% depletion schedule (Table 2).

Verticillium wilt susceptibility and *Rhizoctonia* severity on tubers differed between potato varieties in 2011 and 2012 (Table 3). Averaged across varieties, the 20% depletion irrigation schedule lowered Verticillium wilt susceptibility compared to the 40% depletion schedule in 2011. The 20% depletion schedule also lowered black dot severity on Yukon Gold tubers in 2011. Verticillium wilt susceptibility and tuber black dot severity were numerically lower for

the 20% depletion schedule compared to the 40% depletion schedule averaged across years and varieties, but the effect of irrigation scheduling was NOT statistically significant across years (Table 3). *Rhizoctonia* severity on tubers for all varieties was the same for both irrigation schedules.

In summary, potato yield for all three varieties was higher in plots irrigated with a 20% depletion schedule compared to a 40% depletion schedule. The 20% depletion schedule had similar disease symptoms compared to the 40% depletion schedule averaged across years. These results support previous yield studies that recommend maintaining 70% to 85% available soil moisture throughout the growing season for optimal potato health.

Special Thanks to the California Potato Research Advisory Board for funding support!



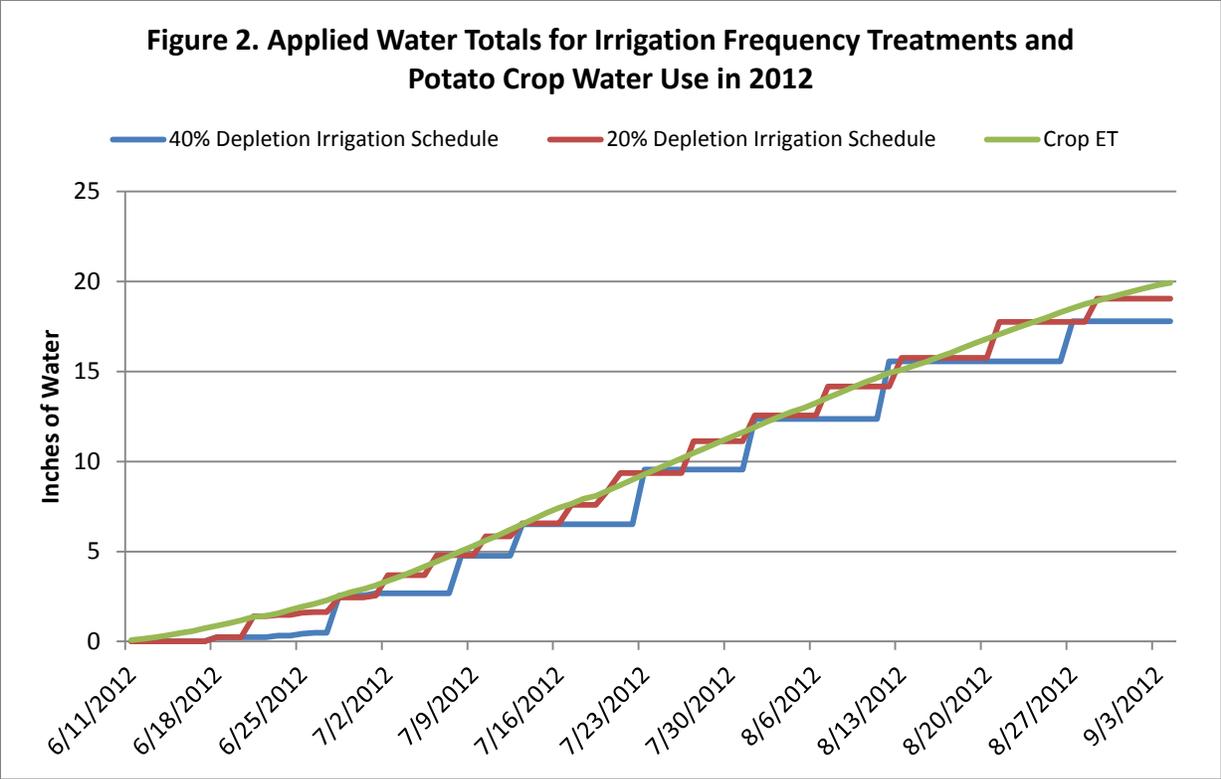


Table 1. The influence of Irrigation Frequency on Russet Burbank, Yukon Gold and Russet Norkotah's Yield, Size and Grade at IREC in 2011 and 2012.

Variety	Irrigation Treatment	Tuber Yield (cwt/acre)							Total	Tubers/Plant	Avg Tuber Size (oz)	% Stand ¹	
		U.S No. 1's (cwt)											
		Total 1's	>14oz	10-14 oz	6-10 oz	4-6 oz	<4oz	Culls					
Russet Burbank	* ²	360	29	83	165	84	51	42	453	7.7	6.4	97	
Yukon Gold	*	378	62	99	153	64	39	24	441	6.8	7.2	79	
Russet Norkotah	*	312	35	68	137	72	49	40	402	6.5	6.3	91	
P-value<0.05; S= Significant NS= Not Significant		S	S	S	NS	NS	NS	S	NS	NS	S	S	
	* ³	40% depletion	335	45	83	141	66	39	40	414	6.5	6.8	90
	**	20% depletion	365	39	84	162	81	53	31	450	7.5	6.5	88
P-value<0.05; S= Significant NS= Not Significant		S	NS	NS	S	S	S	S	S	S	S	NS	

¹ The seed spacing for Russet Burbank was 11.3", Yukon Gold 9.1" & Russet Norkotah 10". Row spacing was 36". 100% emergence = 64 plants Burbank, 79 plants Yukon & 72 plants Norkotah

² Averaged across all irrigation treatments

³ Averaged across all three varieties; all three varieties responded similarly to treatments

Table 2. The Influence of Irrigation Frequency on Russet Burbank, Yukon Gold, & Russet Norkotah External Defects, & Internal Characteristics at IREC in 2011 and 2012.

Variety	Irrigation Treatment	% Hollow		% Vascular		% Growth		
		Heart ¹	% Stem End ¹	Discoloration ¹	% Knobs ²	Cracks ²	% Green ²	% Cull ²
Russet Burbank	* ³	11.9	3.1	14.4	3.4	1.2	1.0	7.1
Yukon Gold	*	4.4	7.5	10.6	1.6	0.2	1.6	4.8
Russet Norkotah	*	4.4	1.9	6.9	3.1	1.0	3.6	10.2
P-value<0.05; S= Significant NS= Not Significant		NS	NS	NS	S	S	NS	S
** ⁴	40% depletion	5.8	2.9	12.9	3.5	1.0	2.4	9.0
**	20% depletion	7.9	5.4	8.3	2.0	0.6	1.7	5.7
P-value<0.05; S= Significant NS= Not Significant		NS	NS	NS	S	S	NS	S

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

² % of total tuber count

³ Averaged across all irrigation treatments

⁴ Averaged across all three varieties; all three varieties responded similarly to treatments

Table 3. The Influence of Irrigation Frequency on Russet Burbank, Yukon Gold, & Russet Norkotah Disease Ratings at IREC in 2011 and 2012.

Variety	Irrigation Treatment	Vert Rating 1 ¹	Vert Rating 2 ¹	% Rhizoc Incidence ²	Rhizoc Tuber		Black Dot			
					Severity Rating ³	% Rhizoc Coverage ⁴	Black Dot Incidence ²	Severity Rating ³	% Black Dot Coverage ⁴ on Tubers ⁴	% Black Dot Stem Coverage ⁵
Russet Burbank	* ⁶	1.9	5.5	16.3	4.8	1.1	n/a	n/a	n/a	26.5
Yukon Gold	*	3.4	6.7	17.5	4.7	0.7	99 ⁸	3.4 ⁸	13.6 ⁸	32.4
Russet Norkotah	*	5.6	8.3	62.5	3.8	6.0	n/a	n/a	n/a	25.5
P-value<0.05; S= Significant NS= Not Significant		S	S	S	S	S	n/a	n/a	n/a	S
** ⁷	40% depletion	3.7	6.9	30.8	4.4	2.9	99 ⁸	3.2 ⁸	15.7 ⁸	27.7
**	20% depletion	3.6	6.8	33.3	4.5	2.3	99 ⁸	3.6 ⁸	11.4 ⁸	28.6
P-value<0.05; S= Significant NS= Not Significant		NS	NS	NS	NS	NS	NS	NS	NS	NS

¹ Verticillium Wilt rating 0-9 scale, 0= No symptoms, 1=Trace, 2= 1-5% of plants show symptoms, 3= 5-10%, 4= 10-20%, 5= 20-40%,

6= 40-60%, 7= 60-75%, 8= 75-90%, 9=90-100%; Rating 1= early August, Rating 2= 1 week following rating 1

² % of 10 tubers with signs of disease

³ Disease severity rating (10 tubers/plot) 1-5 scale; 5= no infection

⁴ Percent of tuber surface covered in disease

⁵ Percent of Stem Covered in Black Dot

⁶ Averaged across all irrigation treatments

⁷ Averaged across all three varieties; all three varieties responded similarly to treatments

⁸ Black dot disease evaluations was only evaluated on Yukon Gold tubers