EARLY AND LATE HARVEST POTATO VARIETY RESPONSE TO DRIP IRRIGATION

Clinton C. Shock, Eric P. Eldredge, and Lamont D. Saunders
Malheur Experiment Station
Oregon State University
Ontario, Oregon, 1999

Introduction

The objective of this trial was to compare the yield and grade of seven potato cultivars, at two harvest dates, grown using drip irrigation. Soil water potential was kept constant by high frequency, automated drip irrigations. Irrigations were based on -30 kPa soil water potential that would start the irrigation. Water was supplied by one drip tape per two-row bed, with injection of a dilute solution of calcium nitrate plus polyacrylamide in each irrigation.

The early harvest trial was harvested 80 days after emergence and the late harvest trial was harvested 120 days after emergence. The experimental line, AO92023-3, was among the most productive in total yield at both harvest dates. AO92023-3 had the highest yield of US Number One tubers at both harvest dates. Shepody, AO92023-3, and Ranger Russet were among the most productive of larger than 12 oz US Number One tubers at the late harvest.

Materials and Methods

The 1999 study was conducted on Owyhee silt loam in a field that was in winter wheat the previous year. The stubble was flailed then disked twice and 100 lb P_2O_5/acre and 20 lb N/acre were broadcast. The field was deep ripped, moldboard plowed, fumigated with Telone II at 25 gallon/acre in October, and bedded into 72-inch beds in November, 1998.

Soil samples were taken in March from the top and second foot, and complete analysis was performed. The top foot of soil had pH 7.5, 0.5 percent free lime, 1.5 percent organic matter, 7 ppm nitrate-N, 5 ppm ammonium-N, 35 ppm P, 375 ppm K, 3160 ppm Ca, 284 ppm Mg, 151 ppm Na, 1.7 ppm Zn, 5.4 ppm Fe, 7.9 ppm Mn, 0.5 ppm Cu, 10 ppm sulfate-S, and 0.5 ppm B.

On April 7, the field was sprayed with Roundup to control volunteer wheat and winter annual weeds. Potato seed of seven varieties was cut by hand into 2-oz seed pieces and treated with Tops MZ. Potatoes were planted on April 22 with seed pieces planted 10-in deep, spaced 9 in apart in 36-in rows. Plots were 1 row (3 ft) wide by 22.5 ft long, with 2 red skinned potato plants between plots.

A two-row-per-bed configuration was maintained at planting by leaving off the center furrowing shovel of the Parma two-row cup-type planter. On April 29, the beds were formed with a spike-tooth bed harrow and winged shovels, dragging a 12-ft vee of 5/8-in

chain to pull soil into the bed center. A tank mix of Prowl at 1 lb ai/acre plus Dual at 2 lb ai/acre in 30 gal/acre water was applied for weed control on May 17.

On May 18, tape was shanked in to a depth 3 to 4 in in the center of the bed, 18 in from each row of plants. The drip tape was 8 mil Nelson Pathfinder (Nelson Irrigation, Walla Walla, WA) with emitters ever 12 in and 0.22 gal/min/100 ft output at 10 psi. Potatoes had not emerged by that date, due to cool, dry, windy weather.

Soil water was kept nearly constant in each treatment by high-frequency, automated drip irrigations based on soil water potential measurements. Irrigation was automated by granular matrix sensors (GMS, Watermark soil moisture sensors, model 200 SS, by Irrometer Corp., Riverside, CA). The GMS were installed 9 in from the plant row June 11, with ten sensors 6 in deep and five sensors 24 in deep. A control program read the sensors every 6 hours. The GMS were connected through multiplexers to a data logger that controlled the irrigation solenoid valves. The relationship between sensor electrical resistance and soil moisture had already been determined (Shock, Barnum, and Seddigh, 1998). The volume of water applied to each treatment was recorded by a water meter.

When the average sensor reading of the shallow sensors in a treatment reached -30 kPa , the program sent a signal to the solenoid valve to irrigate that treatment. The same signal also opened a solenoid on a pressurized fertilizer injector, to provide a metered flow of polyacrylamide plus calcium nitrate solution into the irrigation water. Irrigation duration was 3 hrs and each irrigation added 0.106 acre-in/acre.

The early harvest trial was harvested on August 12 and the late harvest trial was harvested on September 29. Potato yield and grade were compared, and total water applied was compared to an estimate of potato evapotranspiration.

On August 12, the vines were flailed on the early harvest plots. The tubers were lifted with a two-row digger and picked by hand. At grading, a 20-tuber sample of US Number One tubers from each plot was placed into storage. Early harvest tubers were tested for specific gravity and fry color on September 10. On September 20, the vines were flailed on the late harvest plots. On September 28-29, the tubers were lifted with a two-row digger. The tubers were picked up by hand. At grading, a 20-tuber sample of US Number One tubers from each plot was placed into storage. Storage temperature was slowly lowered to 45 °F. On January 19-20, 2000, the specific gravity and fry color of 10 tubers from each sample were measured.

Results and Discussion

The approximate date of 50 percent emergence for these potatoes was May 24, giving 80 days to the early harvest and 120 days to the late harvest. Both trials suffered water stress in June and early July, a factor which may have reduced the productivity of these trails.

The yields of the early and late harvested drip- irrigated potato differed on average by only 52.8 cwt/acre (Table 1). At the early harvest average total yield over all varieties was 373.4 cwt/acre and at the late harvest was 426.2 cwt/acre. The line AO92023-3 was among the most productive in total yield at both harvest dates. The line AO92023-3 had the highest yield of US Number One tubers at both harvest dates. Shepody, AO92023-3, and Ranger Russet were among the most productive of US Number One tubers >12 oz at the late harvest.

The differences in tuber grade categories between the early and late harvest dates show that some varieties remain more productive as the growing season continued (Table 2). The line A82360-7 showed large gains in total , marketable, and US Number One yield. The late productivity of line A82360-7 could be the result of some disease resistance that allows improved plant vigor promoting continued tuber development. The bulking rate between the early and late harvests averaged 1.3 cwt/acre/day for the 40 days between August 12 and September 20 (Table 3). The line A82360-7 continued to bulk US Number One tubers, while Ranger Russet increased the size of the over 12 oz US Number One tubers at 1.8 cwt/acre/day.

Table 1. Yield, grade, and processing quality of drip irrigated potatoes harvested early compared to a harvest date 40 days later; Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1999.

Early Harvest

Variety	Total yield	Total marketable	Percent No. One	US Number One					US Number Two	Rot	Spec. gravity	Fry color, light reflection	
				Total	> 12 oz	6 to 12 oz	4 to 6 oz	< 4 oz				Stem end	Bud end
	--------cwt/acre--------		%	----------cwt/acre----------								---------cwt/acre--------	
Russet Burbank	381	315	59	223	5	154	64	66	92	0	1.076	29.3	41.8
Shepody	348	296	77	266	37	184	45	52	30	0	1.083	38.5	48.4
Ranger Russet	375	323	81	304	18	238	48	51	20	0	1.088	38.9	43.9
Umatilla Russet	373	291	68	255	16	167	72	79	36	4	1.085	37.3	42.5
A82360-7	345	201	48	167	3	71	94	144	34	0	1.080	50.1	50.4
AO87277-6	373	306	76	285	21	172	92	67	21	0	1.089	40.7	41.5
AO92023-3	421	372	86	363	28	269	65	50	9	0	1.079	35.3	35.0
Mean	374	300	71	266	18	179	69	73	35	0	1.083	38.6	43.4
LSD (0.05)	NS	64	10	55	NS	53	28	29	29	NS	0.000	3.8	3.6

Late Harvest

Variety	Total yield	Total marketable	Percent No. One	US Number One					US Number Two	Rot	Spec. gravity	Fry color, light reflection	
				Total	> 12 oz	6 to 12 oz	4 to 6 oz	< 4 oz				Stem end	Bud end
	--------cwt/acre--------		%	----------cwt/acre----------								---------cwt/acre--------	
Russet Burbank	444	336	63	278	27	176	74	65	59	8	1.069	25.0	39.4
Shepody	379	327	73	278	103	126	48	35	50	0	1.078	38.3	47.0
Ranger Russet	401	361	82	329	92	184	53	34	32	0	1.094	40.4	45.1
Umatilla Russet	398	332	74	294	21	182	91	63	38	0	1.082	39.4	44.0
A82360-7	449	330	69	311	13	183	115	103	19		1.092	53.4	54.4
AO87277-6	423	380	83	352	83	199	70	38	28	0	1.091	41.3	41.3
AO92023-3	489	447	86	421	93	244	83	39	26		1.074	33.3	33.9
Mean	426	359	76	323	62	185	76	54	36	1	1.083	38.7	43.6
LSD (0.05)	NS	71	4	64	19	40	31	18	25	4	0.006	2.4	3.0

Table 2. Difference between early and late harvest drip irrigated potato varieties by tuber grade categories; Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1999.

Variety	Total yield	Total marketable	Percent No. One	US Number One					US Number Two
				Total	> 12 oz	6 to 12 oz	4 to 6 oz	< 4 oz	
	----------cwt/acre----------		%	----------cwt/acre----------					
Russet Burbank	63.7	21.5	3.6	54.9	21.7	22.2	10.9	-0.2	-33.4
Shepody	31.3	31.6	-3.7	11.5	66.0	-58.0	3.4	-17.7	20.1
Ranger Russet	25.7	37.1	1.0	25.0	73.7	-53.8	5.1	-17.5	12.0
Umatilla Russet	25.3	40.9	5.4	39.1	5.0	14.5	19.5	-16.0	1.8
A82360-7	103.7	129.2	21.1	144.9	10.9	112.8	21.1	-41.4	-15.7
AO87277-6	50.0	73.8	7.0	67.3	62.1	27.7	-22.5	-29.2	6.4
AO92023-3	67.5	75.5	0.0	57.8	64.9	-24.9	17.8	-11.0	17.5
Mean	52.5	58.5	4.9	57.2	43.5	5.8	7.9	-19.0	1.3

Table 3. Differences in drip irrigated potato variety tuber bulking rate per acre per day over 40 days between early to late harvest; Malheur Experiment Station, Oregon State University, Ontario, Oregon, 1999.

Variety	Total yield	Total marketable	Percent No. One	US Number One					US Number Two
				Total	> 12 oz	6 to 12 oz	4 to 6 oz	< 4 oz	
	-------cwt/acre/day--------		%	----------cwt/acre/day----------					
Russet Burbank	1.6	0.5	0.1	1.4	0.5	0.6	0.3	0.0	-0.8
Shepody	0.8	0.8	-0.1	0.3	1.7	-1.4	0.1	-0.4	0.5
Ranger Russet	0.6	0.9	0.0	0.6	1.8	-1.3	0.1	-0.4	0.3
Umatilla Russet	0.6	1.0	0.1	1.0	0.1	0.4	0.5	-0.4	0.0
A82360-7	2.6	3.2	0.5	3.6	0.3	2.8	0.5	-1.0	-0.4
AO87277-6	1.3	1.8	0.2	1.7	1.6	0.7	-0.6	-0.7	0.2
AO92023-3	1.7	1.9	0.0	1.4	1.6	-0.6	0.4	-0.3	0.4
Mean	1.3	1.5	0.1	1.4	1.1	0.1	0.2	-0.5	0.0