Ohio Vegetable & Small Fruit Research & Development Program - 2017

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Project Final Report

Project Title:	Soil Moisture Effects on Tuber Yield and Quality in Eight Varieties of Specialty Potato
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Project Summary

The purpose of this experiment was to document the effects of soil moisture levels throughout the season on tuber yield and quality in eight “specialty-type” varieties of potato. Specialty-type potatoes have the highest market value of all types of potato and, due to other factors, can serve as an important source of revenue for diversified vegetable farms, especially ones focused on local-regional and/or organic labels and direct-marketing and/or retail approaches. However, their special tuber shapes, sizes, and skin colors also make specialty-type potato varieties particularly prone to market rejection due various defects altering tuber appearance (but not edibility). Decades of research and grower experience have made it clear that tuber growth and development are strongly affected by soil moisture levels but in variety-specific ways. To our knowledge, these effects have not been formally tested in Ohio in specialty-type varieties. Therefore, we completed a field experiment in 2017 in which eight varieties were subjected to three soil moisture regimens: 1) rainfall only (none), 2) rainfall plus partial soil moisture deficit replacement (partial), or 3) rainfall plus full soil moisture deficit replacement (full). Estimated soil moisture deficits on an experiment-wide basis were partially or fully replaced using drip irrigation applied to individual rows in this randomized, replicated experiment involving twenty-four treatments (8 varieties x 3 soil moisture regimens). Key results included: 1) increases in total and B-size yields with irrigation, with lowest yield values for rain-fed only plots; b) irrigation not increasing the percentage of B-size tubers for individual varieties; c) similar external and internal quality values across all soil moisture regimens within individual varieties. In this experiment, overall tuber quality was also observed to differ among varieties.

Materials and Methods

Variety Selection. Eight varieties were selected based on their skin and flesh color combination, shape, and early to mid-season maturity. Seed of the eight varieties was obtained from producers or breeding programs (see Table 1).

A summary of dates for keys steps in the project is available in Table 2.

Seed and Soil Preparation. Seed potatoes were stored in a controlled room at 49-50ºF until being cut on May 11 (except for 'Peter Wilcox', which was cut on May 18). Seed pieces were cut to contain at least two eyes and to be able to pass through the planter. For each plot, 36 seed pieces were placed in a mesh bag and cured in a separate location until planting.

The experimental area located in Field 14 at Horticulture Unit 1 at the OSU-OARDC contains a Wooster silt-loam soil. Area preparation began with spraying the clover cover with Round-Up on April 25. On May 19, the field was moldboard-plowed and dairy manure-based compost was added at a rate of 15 lbs N/A (the compost is approx. 2% nitrogen by dry weight). Fertilizer (400 lbs/A of 10-20-20) was broadcast-applied on May 23 and incorporated by disking on May 23 and 24.

Planting, Plot Establishment and Maintenance, Soil Moisture Monitoring, and Irrigation Management. Plots were seeded on May 24 using a 1-row McConnell potato planter. Plots were 30' long with 30" between and 10" within hills. At the time of planting, 10-20-20 (640 lbs/A) and Admire 2 insecticide was applied in row. Dual II Magnum and Sencor 75 DF pre-emergent herbicides were also applied the day of planting.

Colorado potato beetles were controlled with a calendar-based spray program with multiple active ingredients. Plots were re-hilled on June 20 prior to canopy closure. Drip irrigation treatments were started on July 5 when plots were flowering, at the onset of tuber initiation.

The checkbook method and crop water usage tables were employed to estimate soil moisture deficits, as outlined by the University of Minnesota Extension Service Publication FO-01322 Irrigation Scheduling Checkbook Method. Each day, the maximum air temperature was obtained from the OARDC weather station for Wooster, OH. Using this number and the appropriate stage of plant development, the average daily water use for potatoes was estimated using Table 5 from the publication. This number was added to the previous day's soil water deficit and any rainfall or irrigation events subtracted. The deficit threshold was set at 0.5 inches. Irrigation was initiated in the partial and full plots when the calculated threshold was reached in the full plots. Irrigation was terminated in the full plots when the calculated water applied was equal to or greater than the deficit. Irrigation periods in the partial plots lasted half as long as the full plots. Rainfall and irrigation totals are available in Table 3.

Stand counts. On three days between June 12 and June 26, the number of emerged plants was counted in each plot and the percent emergence was calculated out of 36 possible plants.

Average emergence was at least 70% by the final stand count in 7 of 8 varieties. 'Adirondack Blue' averaged only 50% at the second stand count. However, after re-hilling, 'Adirondack Blue' never recovered and its average emergence was 19% at the final stand count.

Volumetric water content (VWC). Just prior to running irrigation, the VWC was measured in the top 8" of soil using a TDR soil moisture meter. Measurements were taken at the top and bottom of the potato hills

throughout the field. VWC data recorded the day of each irrigation event can be seen in Figure 1. In a silt loam soil, the range of VWC that plants can extract water from the soil is considered to be between 16-35%.

Vine Kill and Harvest. On August 23, the plots were vine killed with Forfeit 280. Vine kill was initiated at this time as test digs indicated that tubers were nearing or past the US B size stage. On September 14, all plots were harvested using a one-row digger that removed the tubers from the ground and shook the soil off of them before dropping on the ground. All tubers were collected from the ground by hand and placed into labeled wooden crates until grading.

Storage Conditions. Immediately after harvest, crates were stored in the upper level of a bank barn under ambient conditions. During this time, day and night temperatures ranged from 74-81 deg F and 70-73 deg F, respectively, for the first two weeks. After September 28, the temperatures ranged from 61-66 deg F during the day and 49-61 deg F at night. Tubers were then moved to a cooler on October 2. The cooler was set at 50 deg F and the potatoes remained there until grading.

Tuber Data Collection. After 8 weeks of storage, all tubers were evaluated for total and marketable yields. Total weights were recorded and all tubers inspected for marketability (disease, rot, misshapen, pest damage, etc). Marketable tubers were then passed through a sizer to separate them based on their diameter; we used less than 2" for a US B-size and greater than 2" for US A-size. Weights of both size groups were recorded. Data available in Table 4.

As the yield evaluations were completed, five B-size tubers were collected from each plot. The external quality of the tubers was evaluated for skin color, tuber shape, skin texture, eye depth and overall appearance based on a 9-point hedonic scale, per protocols established by a regional consortium of potato breeders, pathologists, and agronomists (http://u.osu.edu/vegprolab/technical-reports/2016-ohio-potato-germplasm-evaluation-report/). The tubers were cut into four wedges to determine the percentage of tubers displaying internal defects including hollow heart, brown center, necrosis and vascular discoloration. Pictures were also taken to document the external and internal appearances (Figure 3).

Project Information and Data

Please see Tables 1-4, Figures 1 and 2, and pages 9-16.

Table 1. Characteristics of specialty potato varieties grown in Wooster, OH in 2017.

Variety name	Skin color	Flesh color	Tuber shape	Seed supplier
Adirondack Blue	purple	purple	oblong	Bruce Pryputniewicz
Adirondack Red	red	pink	oblong	Bruce Pryputniewicz
Austrian Crescent	brown	yellow	fingerling	Childstock Farms, Inc.
HZC07-6049	red	yellow	round-oblong	Childstock Farms, Inc.
Michigan Purple	purple	white	round	Michigan State University Potato Breeding Program
Peter Wilcox	purple	yellow	round-oblong	Tucker Farms, Inc.
Purple Pelisse	purple	dark purple	oblong-fingerling	Childstock Farms, Inc.
Raspberry	red	red/dark pink	oval	Michigan State University Potato Breeding Program

Table 2. Completion dates of key steps of the experiment conducted in Wooster, OH 2017.

General steps	What was done	Date completed (2017)
Seed preparation	Cut seed potatoes and started curing	May 11 May 18
Field establishment & activities	Field plowed, disked and compost applied	May 19 thru 24
	Pre-plant fertilizer application	May 23
	Planting	May 24
	Pre-emergence herbicide application	May 24
	Hilling	June 20
	Irrigation treatments	July 5, 18, 21 & 31 August 3, 7, 9, 14 & 17
	Vine kill	August 23
	Harvested tubers	September 14
Data collection	Stand counts	June 12, 19 & 26
	TDR measurements	July 21 & 31 August 3, 7, 9, 14 & 17
	Yield evaluations	November 13 thru 17
	Tuber quality & pictures	November 29 & 30

Table 3. Precipitation and irrigation data for specialty potatoes grown in Wooster, OH in 2017.

	May	**June**	**July 1-4**	**July 5-31**	**August**	**Total**
Normal precipitation (in.)	1.10	3.90	0.60	3.50	2.80	11.90
Precipitation received (in.)	1.40	3.75	0.21	4.19	1.01	10.56
						-1.34
Irrigation received (inches)						
Partial treatment				0.91	1.05	
Full treatment				1.82	2.10	
Total inches received						
No irrigation	1.40	3.75	0.21	4.19	1.01	10.56
Partial	1.40	3.75	0.21	5.10	2.06	12.52
Full	1.40	3.75	0.21	6.01	3.11	14.48

Table 4. Yield data for specialty potatoes grown in Wooster, OH in 2017 under varying levels of irrigation.

Variety	Irrigation treatment*	Total yield (cwt/A)	US A's (cwt/A)	US B's (cwt/A)	A-sized %	B-sized %	Cull %
Adirondack Blue	None	97	51	24	50.8	25.5	23.7
	Partial	159	70	45	43.4	27.1	29.6
	Full	83	32	28	35.0	34.3	30.8
Adirondack Red	None	393	158	134	40.2	34.2	25.6
	Partial	395	146	158	36.8	40.6	22.6
	Full	436	147	161	33.6	36.9	29.4
Austrian Crescent	None	159	1	**114**	0.6	72.4	27.0
	Partial	202	2	**150**	1.0	74.4	24.7
	Full	232	0	**168**	0.0	72.5	27.5
HZC07-6049	None	299	134	116	43.3	39.9	16.8
	Partial	306	144	125	46.7	40.8	12.4
	Full	370	182	135	48.0	36.9	15.1
Michigan Purple	None	434	257	67	59.3	15.9	24.8
	Partial	417	269	58	64.3	13.9	21.8
	Full	461	260	68	56.0	15.1	28.9
Peter Wilcox	None	280	106	129	36.8	46.6	16.6
	Partial	308	133	118	44.6	38.6	16.8
	Full	265	87	126	32.3	47.9	19.8
Purple Pelisse	None	166	4	141	2.4	**84.9**	**12.7**
	Partial	265	14	195	4.8	**73.3**	**21.9**
	Full	213	8	180	3.5	**85.7**	**10.9**
Raspberry	None	253	50	142	19.3	56.7	24.0
	Partial	283	52	146	18.6	51.9	29.5
	Full	297	75	150	25.1	51.0	23.9

* Irrigation treatments: None=Rainfall only; Partial = Rainfall + partial soil moisture deficit replacement; Full = Rainfall + full soil moisture deficit replacement

** Bolded text indicates that averages are significantly different at P<0.05.

Figure 1. Volumetric water content that was measured prior to irrigating potatoes in Wooster, OH in 2017.

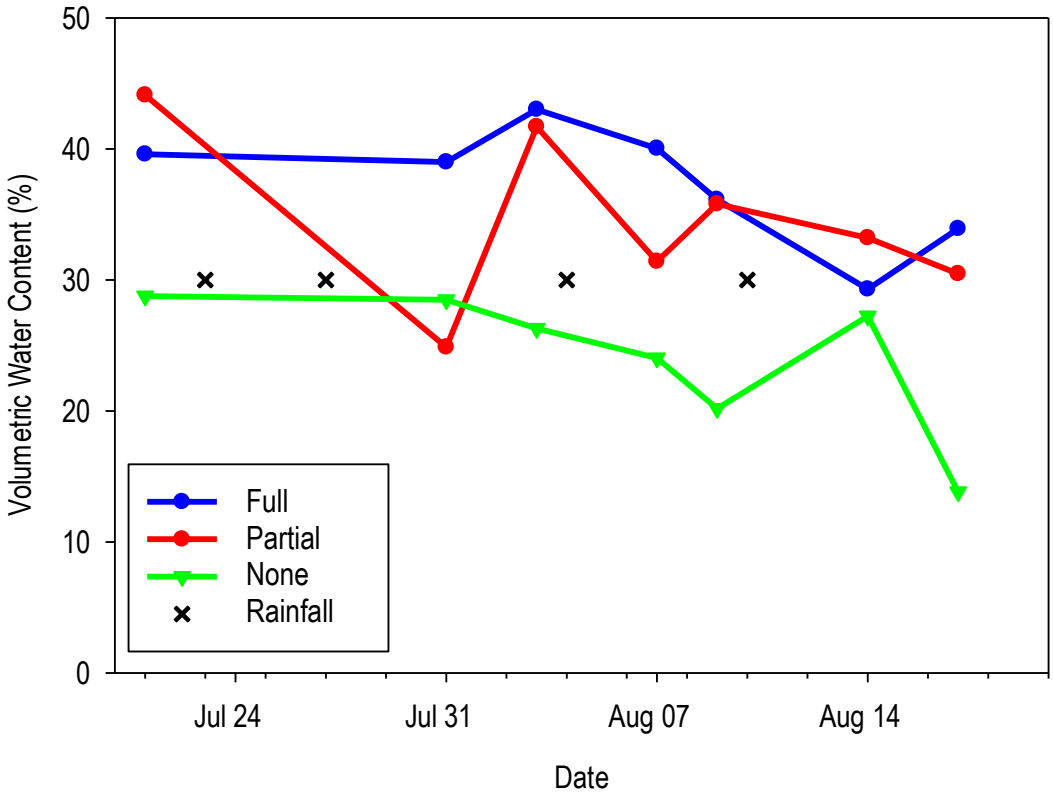
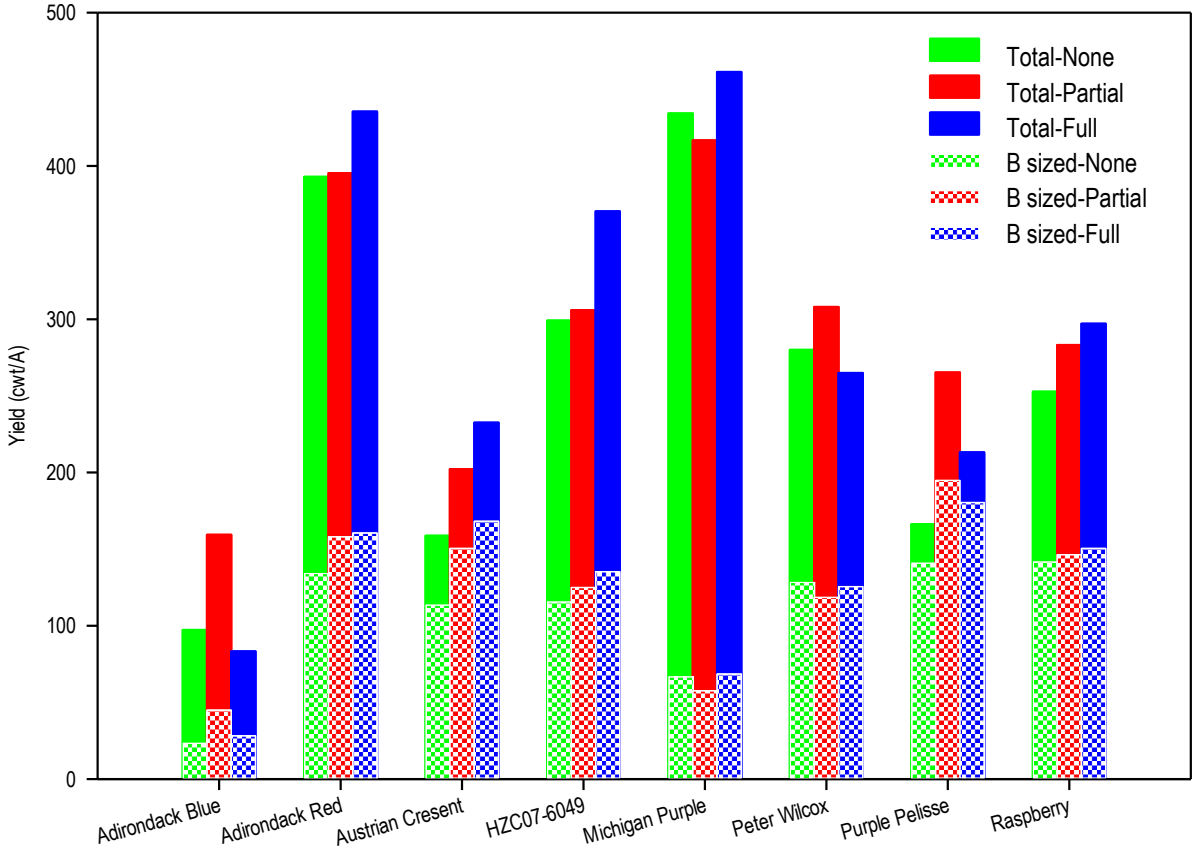
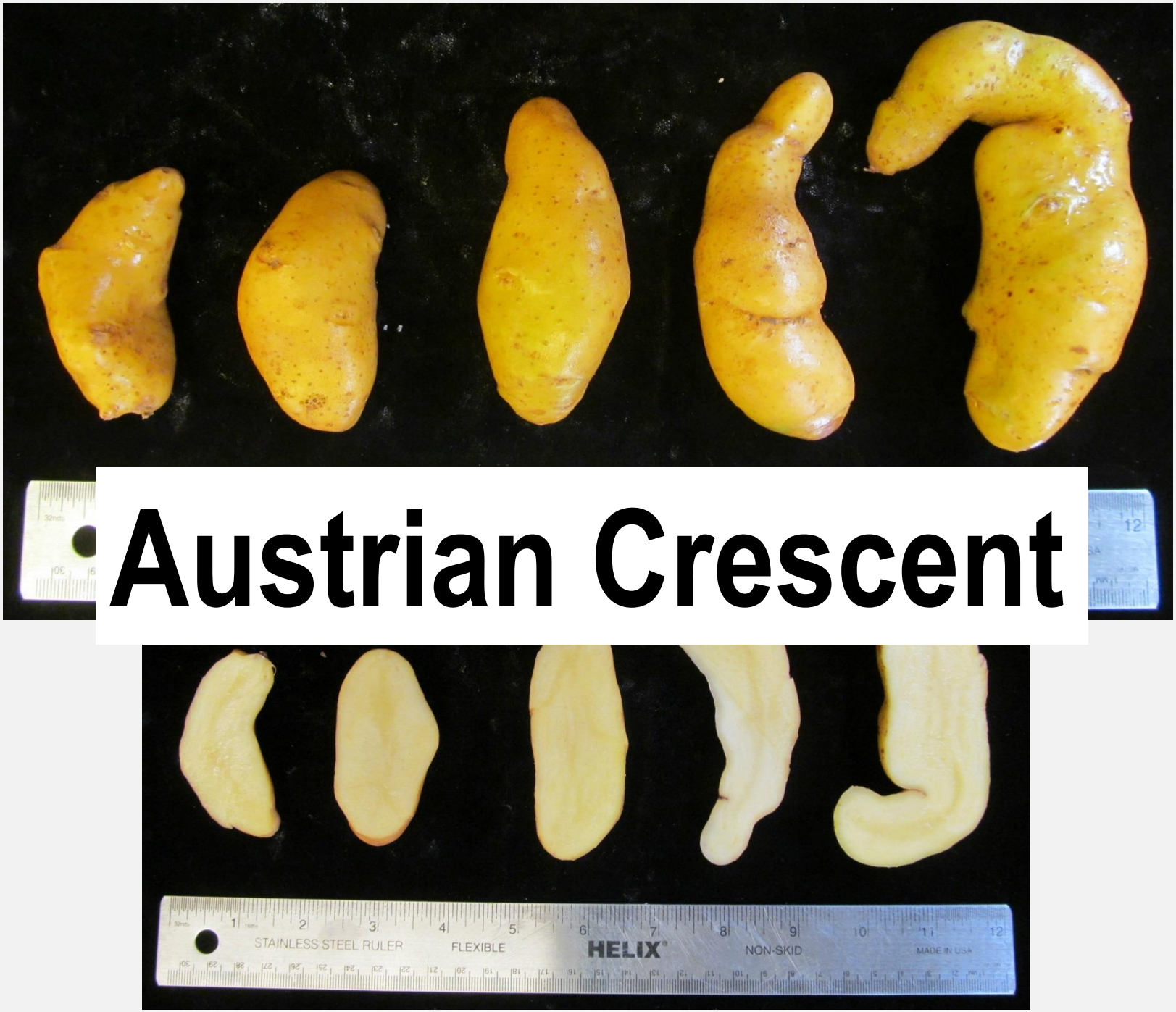


Figure 2. Total and B-sized tuber yields for eight specialty potato varieties grown under various irrigation conditions in Wooster, OH in 2017.




Adirondack Blue
HELIX
NON-SKID
MADE IN USA
FLEXIBLE


Adirondack Red
STAINLESS STEEL RULER
FLEXIBLE
HELIX
NON-SKID
MADE IN USA


Austrian Crescent
STAINLESS STEEL RULER
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