2017 and 2018 Field Sweet Potato Research Update

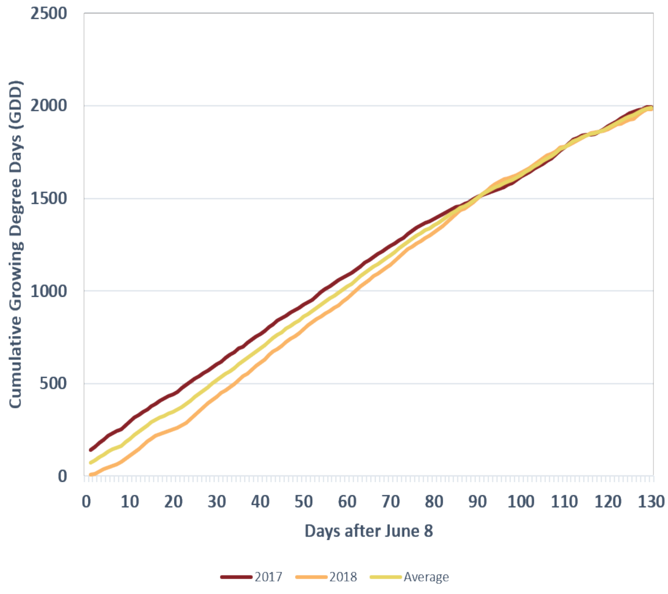
This research update shares results from the 2017 and 2018 growing seasons.

Temperatures and precipitation

The 2017 summer in Vineland, ON was cool and wet compared to 2016, while the summer of 2018 was hot with a dry spring and a wet fall.
Cumulative growing degree days (GDD, base 10˚C) are a measure of heat accumulation to predict when a crop will reach maturity. From the time of planting (May 26) until final harvest (October 13) there were 1,993 GDD in 2017 and 1,982 in 2018 (see Graph 1). Total precipitation for the 2017 growing season was 280.4 mm and 267.8 mm in 2018.

Production trials in 2017 and 2018

In 2017 and 2018, trials were conducted at Vineland to determine the number of days to maturity and optimal plant spacing for the sweet potato variety Radiance using Covington and Orleans sweet potato varieties as commercial benchmarks. In addition, a black plastic mulch plant spacing trial was performed to investigate whether black plastic mulch can be used to increase total yields.



Graph 1: 2017 and 2018 growing seasons and average cumulative growing degree days at Vineland, ON.

Picture 1: Maturity trial at Vineland.

Days to maturity trial

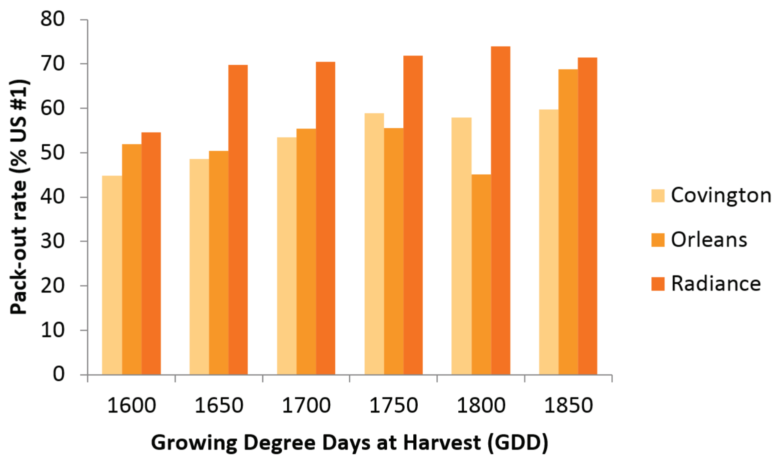
Radiance and Covington were tested during the 2017 and 2018 growing seasons while Orleans was tested only in 2018. Sweet potato slips were planted in single rows spaced 1.2 m centre-to-centre, with an in-row spacing of 30 cm on May 26, 2017 and June 4, 2018.

Five consecutive sweet potato plants were harvested from the middle of each plot, twice a week from September 7 to October 10 in both years to assess their maturity. Brix, flesh colour, total weight (kg) and weight (kg) by grade were measured immediately following each harvest.

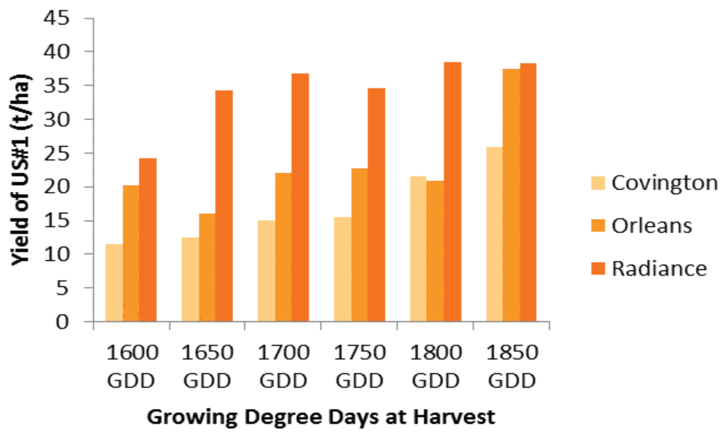
Following two years of data collection, a significant increase of Radiance U.S. grade #1 was observed at approximately 111 days after planting (DAP) and when the cumulative GDD reached 1,650. Radiance continued to produce steady amounts of U.S. grade #1 until the cumulative GDD reached 1,850 (131 DAP). A maximum yield was also observed at 1,800 cumulative GDD (120 DAP).

The Covington and Orleans varieties showed small but steady increases in the production of U.S. grade #1 when comparing cumulative GDDs. A significant increase was observed when the cumulative GDD reached 1,850 (131 DAP). The yields of Covington and Orleans U.S. grade #1 continued to increase until a killing frost mid-October.

A comparison of the three varieties showed Radiance could be harvested 11 to 20 days earlier than Covington and Orleans, making it a more suitable variety to grow in Canada, which has a cooler climate and a shorter production season compared to the southern U.S. Among the three varieties evaluated, Radiance yielded the highest pack-out rate (see Graph 2) and U.S. grade #1 (see Graph 3) across all GDDs



Graph 2: Pack-out percentage rates of U.S. grade #1 harvested at different GDDs for Covington, Orleans and Radiance planted at Vineland in 2017 and 2018. Note that Orleans was not trialled in 2018.



Graph 3: U.S. grade #1 sweet potato harvested at different GDDs for Covington, Orleans and Radiance planted at Vineland in 2017 and 2018. Note that Orleans was only trialled in 2018.

compared to Covington and Orleans (38.5 t/ha, 28.6 t/ha and 37.5 t/ha, respectively).

Two years of data suggest Radiance could be a more profitable variety for growers compared to Covington and Orleans.

Spacing trial

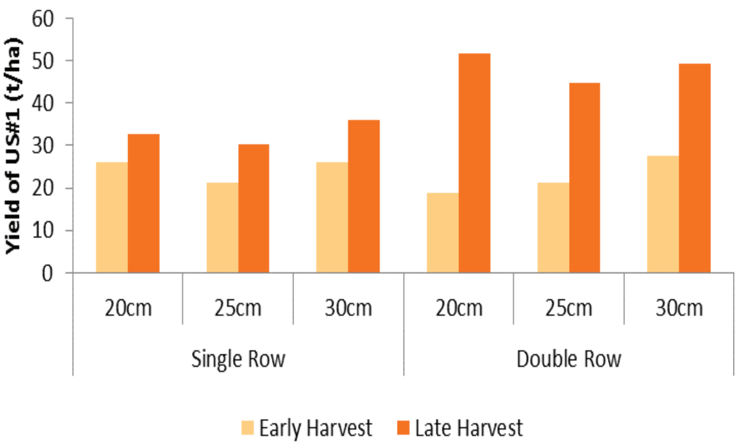
Radiance cuttings were planted in the spring of 2017 and 2018 using single and double rows with an in-row spacing of 20, 25 and 30 cm. In 2017, material was harvested on October 6. In 2018, two harvest dates were used: an early (September 17) and a late (October 10) harvest. The harvested sweet potatoes were sorted and weighed (kg) across four grades – U.S. grade #1, U.S. grade #2, jumbo and culls.

Radiance yielded the highest U.S. grade #1 when double rows were harvested in October compared to single row planting at all spacing (see Graph 4). Radiance had the highest marketable yield of U.S. grade #1 with an average of 51.6 t/ha when planted in double rows with an in-row spacing of 20 cm (see Graph 4). This was a 57.8 per cent increase

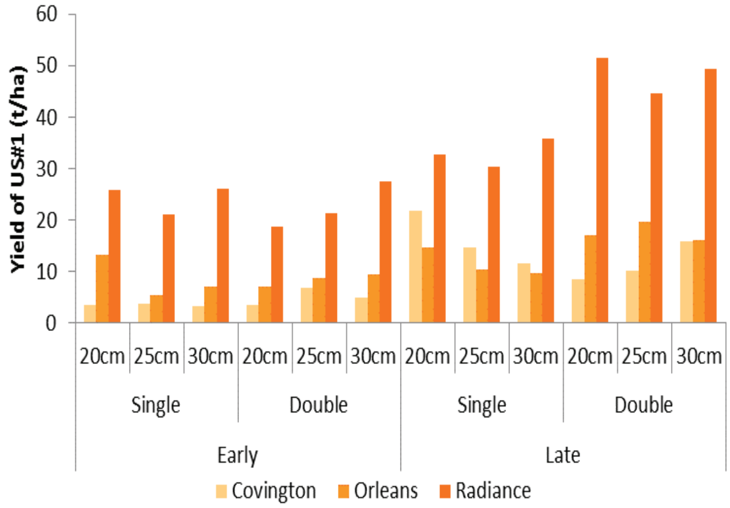
Picture 2: Total yield of six metre plot sweet potatoes in double rows.

over single row planting when harvested in October (see Table 1A). Similar results were observed for total marketable yields (see Table 1B). If an early harvest is required for the Canadian Thanksgiving market or other reasons, single row planting at 30 cm spacing is recommended for optimal yields. Double row planting with an early harvest is not recommended for Radiance since no significant yield benefit was observed.

Covington and Orleans were also included in the spacing trial as a comparison to Radiance and to provide recommendations to growers who currently produce these two commercial varieties.



Graph 4: Marketable U.S. grade #1 yields of Radiance planted at Vineland in 2017 and 2018 using single and double row plantings with three in-row spacings (20, 25 and 30 cm) and two harvest dates (early and late).



Graph 5: Marketable U.S. grade #1 yields of Covington, Orleans and Radiance planted at Vineland in 2017 and 2018 using single and double row plantings with three in-row spacings (20, 25 and 30 cm) and two harvest dates (early and late).

Radiance produced significantly higher U.S. grade #1 and total marketable yields than both Covington and Orleans for early and late harvest as well as single and double row planting at all spacing (see Graph 5). Since Covington and Orleans are later maturing varieties than Radiance, an October (late) harvest is required for optimal yields (see Table 1A and 1B).

Optimal yield of 26.02 t/ha was observed for Covington when single row planting with 20 cm in-row spacing was used and harvested in October. Optimal yield of 19.76 t/ha was

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Table 1A: Percentage increases (in bold) of U.S. grade #1 (t/ha) for Covington, Orleans and Radiance with increasing density from single to double rows and in-row spacing of 20, 25 and 30 cm (early refers to September 17 and late refers to October 10).

Variety	Harvest	Row density	In-row spacing		
			20 cm	25 cm	30 cm
Covington	Early	Single	4.82	3.68	3.30
		Double	3.66	6.80	5.05
		Increase	**-24.0%**	**84.8%**	**52.9%**
	Late	Single	26.02	14.74	11.69
		Double	8.44	10.18	13.27
		Increase	**-67.6%**	**-30.9%**	**13.5%**
Orleans	Early	Single	13.25	5.55	7.15
		Double	7.22	8.80	9.39
		Increase	**-45.5%**	**58.7%**	**31.2%**
	Late	Single	14.72	10.47	9.74
		Double	17.16	19.76	16.13
		Increase	**16.6%**	**88.7%**	**65.7%**
Radiance	Early	Single	26.0	21.1	26.1
		Double	18.8	21.4	27.6
		Increase	**-27.7%**	**1.4%**	**5.7%**
	Late	Single	32.7	30.4	35.9
		Double	51.6	44.7	49.3
		Increase	**57.8%**	**47.0%**	**37.3%**

Table 1B: Percentage increases (in bold) of total marketable yields (t/ha) for Covington, Orleans and Radiance with increasing density from single to double rows and in-row spacing of 20, 25 and 30 cm (early refers to September 17 and late refers to October 10).

Variety	Harvest	Row density	In-row spacing		
			20 cm	25 cm	30 cm
Covington	Early	Single	11.7	11.2	6.8
		Double	17.5	17.7	14.4
		Increase	**50.1%**	**58.5%**	**110.8%**
	Late	Single	28.0	25.2	15.3
		Double	16.9	18.8	30.9
		Increase	**-39.8%**	**-25.4%**	**101.8%**
Orleans	Early	Single	24.6	17.9	22.5
		Double	20.7	24.1	20.9
		Increase	**-16.0%**	**34.8%**	**-6.9%**
	Late	Single	30.2	10.5	20.8
		Double	38.2	23.6	34.3
		Increase	**26.5%**	**125.7%**	**65.0%**
Radiance	Early	Single	40.6	33.9	41.3
		Double	40.7	44.6	44.4
		Increase	**0.4%**	**31.4%**	**7.3%**
	Late	Single	47.8	53.3	52.0
		Double	60.2	55.1	64.8
		Increase	**25.9%**	**3.3%**	**24.8%**

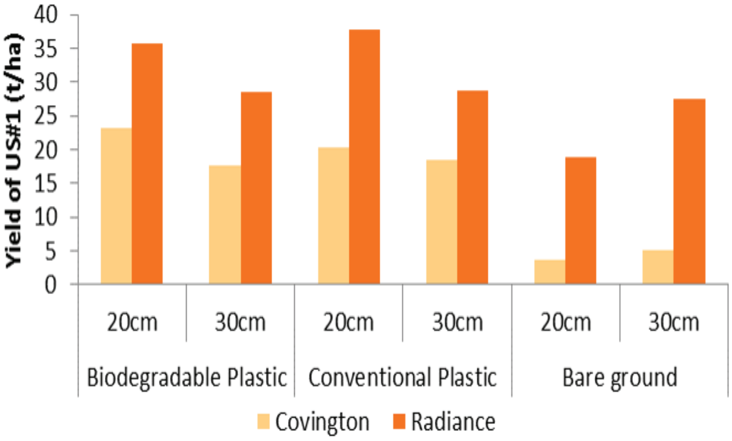
observed for Orleans when double row planting with 25 cm in-row spacing was used and harvested in October. Data suggest that double row planting is beneficial for specific varieties at a later harvest.

Black plastic mulch trial - 2018

Radiance and Covington were transplanted into raised beds prepared with biodegradable black plastic mulch, conventional plastic mulch or bare ground beds on June 12, 2018. Rows within each bed were spaced 30 cm apart, with two in-row spacing treatments of 20 cm and 30 cm.

Plots were harvested on September 17, 2018. Radiance had the highest yield at 37.8 t/ha using conventional plastic with 20 cm in-row spacing. The biodegradable plastic had a similar yield of 35.7 t/ha at 20 cm in-row spacing (see Graph 6).

Picture 3: Conventional black plastic mulch (left) and biodegradable black plastic mulch (right) (October 10, 2018).



Graph 6: U.S. grade #1 (t/ha) for Covington and Radiance planted at Vineland in 2018 on biodegradable plastic, conventional plastic and bare ground using 20 cm and 30 cm in-row spacing.

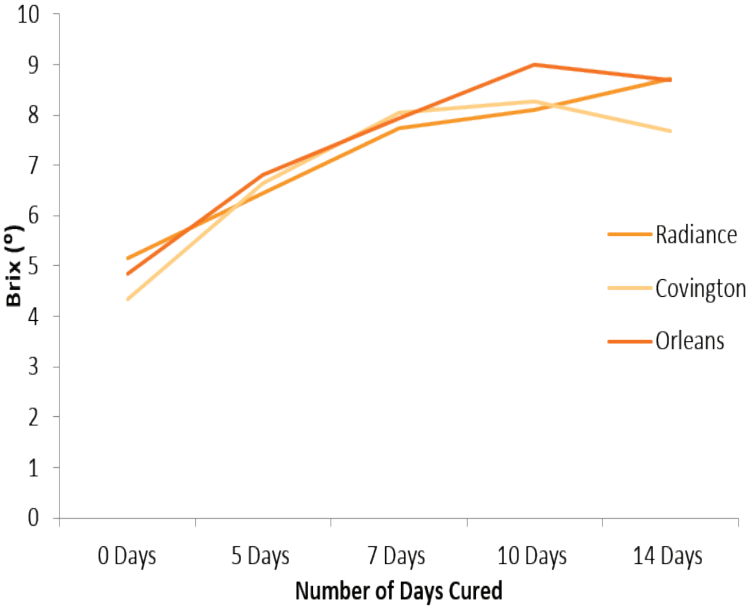
The use of black plastic mulch in double rows significantly increased Covington's yield compared to a double row planting system on bare ground.

Conventional plastic must be removed prior to harvest adding additional labour, while the biodegradable plastic was degraded enough that removal was not necessary (see Picture 3). Results suggest if using this planting system, biodegradable plastic is not only more environmentally-friendly but also requires less labour than conventional black plastic mulch.

Curing

It has been suggested that the current recommendation of curing for five days is not sufficient to adequately cure sweet potatoes produced in Canada.

A curing duration trial was conducted in 2018 to determine the ideal curing time required (in days) to maximize total sugars (Brix) for the sweet potato varieties Radiance, Covington and Orleans.



Graph 7: Average Brix values at 0, 5, 7, 10 and 14 days of curing for Radiance, Covington and Orleans in 2018.

Brix values were measured at harvest and at five, seven, 10 and 14 days under curing conditions and at three harvest intervals for Radiance, Orleans and Covington. Results indicated that sweet potatoes should be cured immediately after harvest for a minimum of seven to 10 days to ensure proper curing (see Graph 7).

Harvest

Harvest using a machine digger generally starts mid-September to October depending on GDD. Vines are mowed and side-cut three to five days prior to harvest to toughen the skin and avoid excessive damage.

To avoid chilling injury, harvest should take place before soil temperature drops below 10˚C.

Picture 4: Flesh colour comparison between Radiance (top image) and Covington (bottom image).

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Postharvest
Sweet potatoes should be cured immediately following harvest. They should be cured at 28˚C and 85% relative humidity for seven to 14 days or once sprouts begin to form. During curing, adequate ventilation is critical. After curing, sweet potatoes should be stored at 13˚C to 16˚C and 85 to 90% relative humidity for a maximum of 12 months.

Pest management
White grubs, wireworms and postharvest storage rots are the most significant pests in Ontario (see Picture 5). Wireworm damage was found on Vineland's sweet potato trials planted on non-fumigated land after harvesting. Land fumigation prior to planting is considered to be an effective strategy against soil-borne pests such as white grubs and wireworms.

To minimize yield reduction caused by viruses, virus-free slips should be used. Roots used to produce slips should not be saved for more than two generations.

Picture 5: Early season wireworm feeding damage on sweet potato roots.

Minimizing harvesting damage with adequate ventilation during curing and storage periods are also effective ways to avoid rot.

Summary
- Radiance matured 11 to 20 days earlier than Covington and Orleans
- Radiance produced the highest U.S. grade #1 across all GDDs compared to Covington and Orleans
- Radiance produced significantly higher U.S. grade #1 and total marketable yields than both Covington and Orleans for early and late harvest as well as single and double row planting at all spacing
- Double row planting can decrease total acreage while still providing high yields when a later harvest (mid-October) is desired. There is no benefit to a double row planting system if an early harvest (early September) is desired.
- Biodegradable black plastic mulch can increase yields in a double row planting system if an early harvest is desired
- Under Canadian conditions, curing for a minimum of seven days is required to adequately cure sweet potatoes
- Adequate ventilation is critical for curing and postharvest storage to avoid economic loss caused by rot

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