vineland
RESEARCH & INNOVATION CENTRE

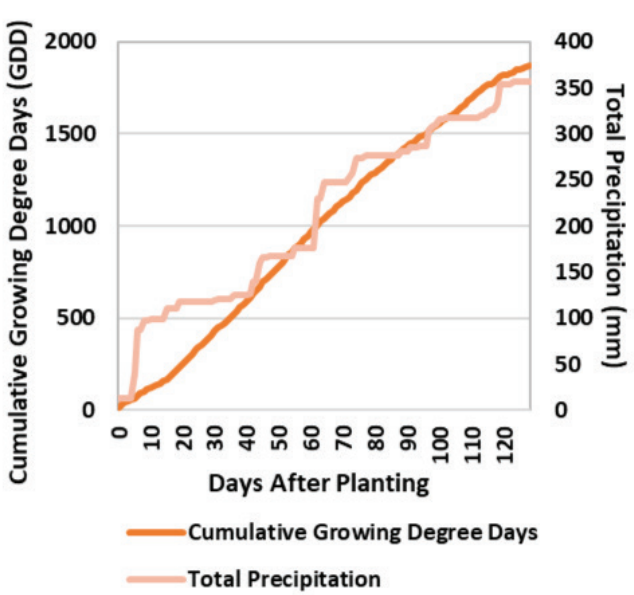
2019 Sweet Potato Research Update

This research update shares results from field trials conducted during the 2019 growing season and greenhouse slip production trials.

In 2019, trials were continued at Vineland, Ontario to determine the number of days to maturity and the optimal plant spacing for the new sweet potato variety Radiance using U.S. varieties Covington and Orleans as commercial benchmarks.

The storage trial was continued to observe the weight loss of Radiance during curing and long-term storage.

A slip treatment trial was conducted to determine the impact of Ethephon and Gro-Bark on the production of greenhouse marketable slips, slip survival rates and sweet potato yield in the field.



Graph 1: Cumulative growing degree days (GDD) and total precipitation for the 2019 growing season at Vineland.

Temperatures and precipitation

The 2019 summer in Vineland was cool and wet compared to 2018. 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 (June 5) until final harvest (October 11) there were 1,874 GDD in 2019 (see Graph 1) compared to 1,982 GDD in 2018. Total precipitation for the 2019 growing season was 356.5 mm (see Graph 1), which was higher than the 2018 growing season when it was 267.8 mm.

Days to maturity trial

Slips were harvested in a greenhouse at Vineland June 3 and planted in the field June 5 in single rows spaced 1.2 m centre-to-centre with an in-row spacing of 30 cm.

Harvests were conducted twice a week from September 10 to October 11 (see Table 1 on page 2). Five consecutive plants from the middle of the plot were harvested (see Picture 1 on page 2). Brix %, total weight and weight by grade (U.S. grade#1, U.S. grade #2, jumbo and culls) were measured immediately after each harvest. Following data collection, sweet potatoes were cured at 28˚C and 85% relative humidity (RH) with adequate ventilation for 14 days. After curing, sweet potatoes were placed in long-term storage at 13˚C to 16˚C

Table 1: Date, number of days after planting and cumulative growing degree days at each harvest in the maturity trial at Vineland in 2019.

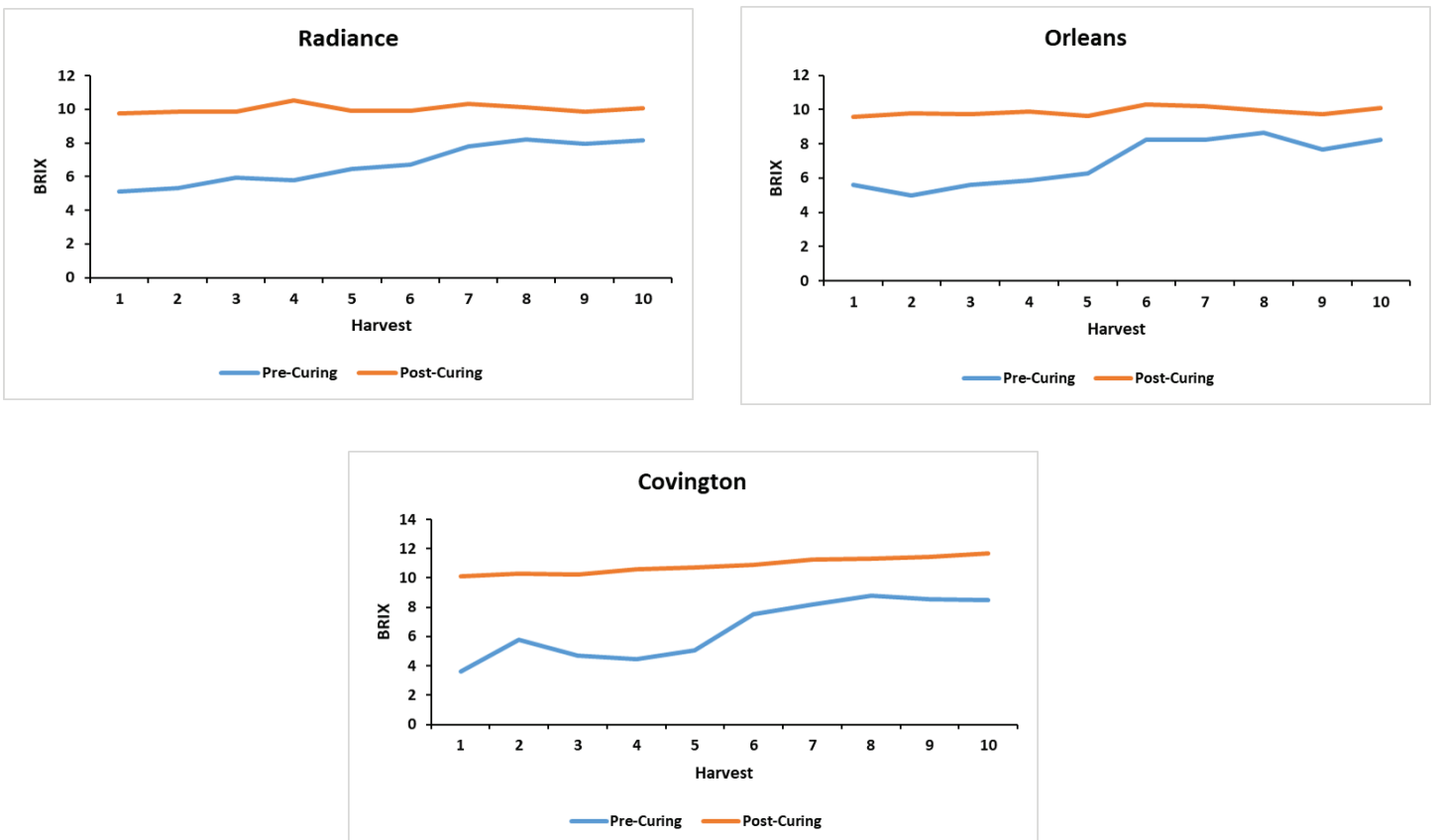
Harvest	Date	Days after planting (DAP)	Growing degree days (GDD)
Harvest 1	September 10, 2019	98	1,517
Harvest 2	September 13, 2019	101	1,559
Harvest 3	September 17, 2019	105	1,603
Harvest 4	September 20, 2019	108	1,644
Harvest 5	September 24, 2019	112	1,710
Harvest 6	September 27, 2019	115	1,753
Harvest 7	October 1, 2019	119	1,802
Harvest 8	October 4, 2019	122	1,823
Harvest 9	October 8, 2019	126	1,852
Harvest 10	October 11, 2019	129	1,874

and 85% to 90% RH. Brix % was measured again (post-curing Brix %) at the same interval as the harvests (twice a week).

Pre-curing Brix % for Radiance, Covington and Orleans increased from 5.13 to 8.18, 3.63 to 8.78 and 4.98 to 8.64 from the first to the last harvest (see Graph 2 on page 3). Post-curing Brix % for Radiance, Covington and Orleans increased from 9.73 to 10.51, 10.09 to 11.65 and 9.6 to 10.2 (see Graph 2). For pre-curing, both harvest date and variety affected the value of Brix %.

No significant differences were observed for Brix % between different harvest times after curing. Therefore, the yield of U.S. grade #1 should be used to determine maturity.

Picture 1: Comparison of Radiance (left), Covington (middle) and Orleans (right) from a single plant harvested during the maturity trial.



Graph 2: Comparison of pre-curing and post-curing Brix % values for Radiance, Orleans and Covington.

The U.S. grade #1 yield of Radiance increased gradually from first harvest on September 5 (24.1 t/ha) and optimal yield was observed on October 8 (38.2 t/ha) when the cumulative GDD reached 1,852 (126 DAP) (see Graph 3 on page 4). Covington reached the highest yield of U.S. grade #1 (38.8 t/ha) on the same harvest date as Radiance when GDD was 1,852 (126 DAP) (see Graph 3). The highest U.S. grade #1 yield of Orleans (32.5 t/ha) was observed 115 DAP when GDD reached 1,750 (see Graph 3).

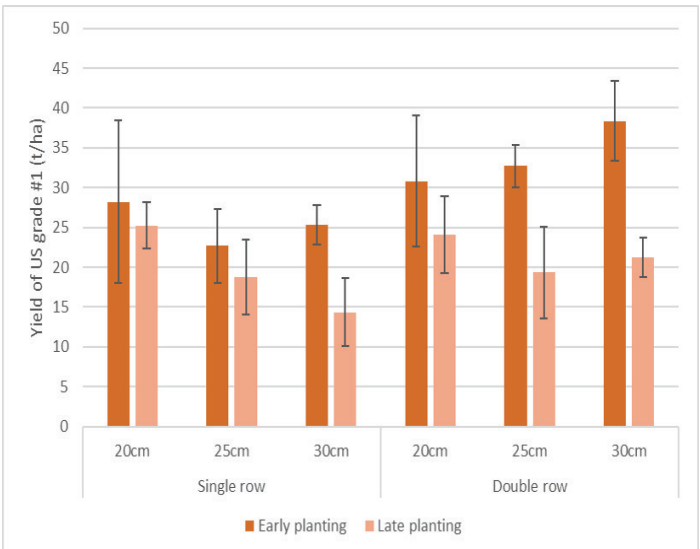
The 2019 data was different from the two previous years. In 2017 and 2018, Radiance reached the highest U.S. grade #1 yield 11 to 20 days earlier than Covington and Orleans. By contrast, the optimal U.S. grade #1 yield of Radiance and Covington was determined to be on the same harvest date in 2019. The observed differences could be attributed to a number of factors including lower cumulative GDD, significant higher precipitation in 2019 as well as the generation of slips used that year.

Spacing trial

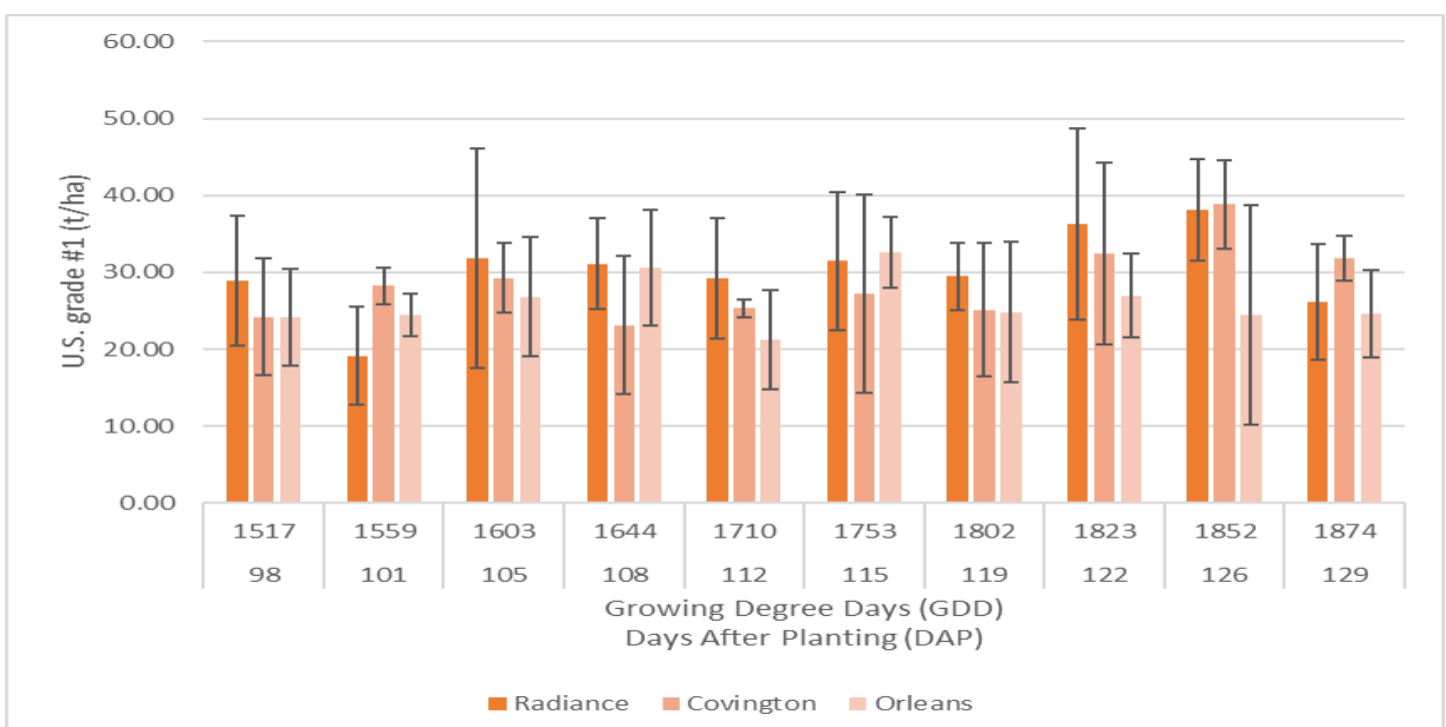
Slips of Radiance, Covington and Orleans were planted twice (early planting June 5 and late planting June 27) using single and double rows with in-row spacing of 20, 25 and 30 cm. Harvest was conducted September 25 for both early planting and late planting trials. The harvested sweet potatoes were graded and weighed into U.S. grade #1, U.S. grade #2, jumbo and culls.

Radiance yielded higher U.S. grade #1 using double row planting compared to single row planting at all spacing when planted early (June 5). The highest U.S. grade #1 yield of Radiance (38.36 t/ha) was observed when planted in double rows with an in-row spacing of 30 cm, which is a 51.65% yield increase compared to single row planting using the same in-row spacing (see Graph 4 and Table 2 on page 6).

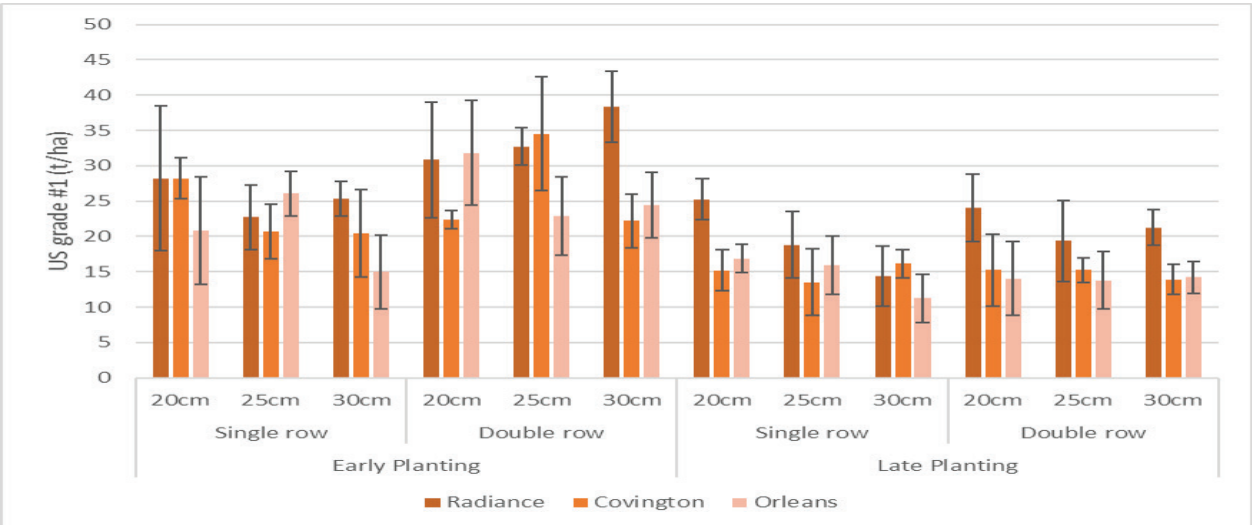
Late planting of Radiance is feasible in southern Ontario according to this research. Radiance slips are normally harvested twice from a Canadian greenhouse starting mid-May until early June. Since late planting in a single row can achieve relatively the same yield of U.S. grade #1 as early planting (see Graph 4 and Table 2 on page 6), a third harvest of Radiance slips can be used at the end of June for planting by most Ontario growers. A third cut of Radiance will minimize the shortage of slips as well as optimize the profit of Canadian greenhouse slip producers. Single row planting is recommended for late planting of Radiance since there was no significant yield benefit compared to double row planting.



Graph 4: Comparison of U.S. grade #1 yield of Radiance planted early and late at Vineland using single and double row plantings with three in-row spacings (20, 25 and 30 cm).



Graph 3: Comparison of U.S. grade #1 yields for Radiance, Covington and Orleans harvested at different GDDs and DAPs at Vineland in 2019.

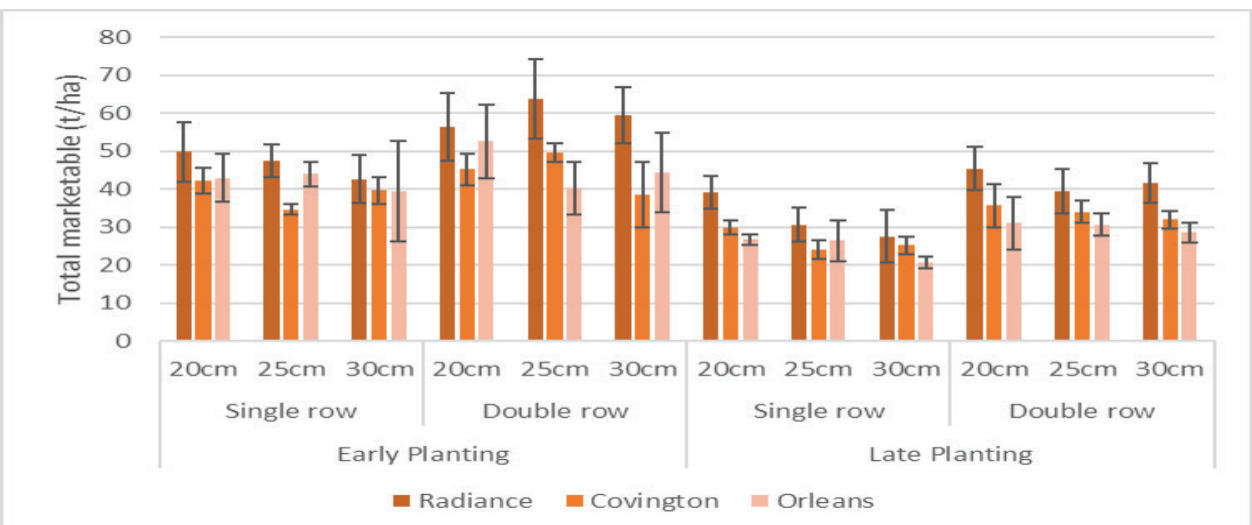


Graph 5: Comparison of U.S. grade #1 yields of Radiance, Covington and Orleans planted at Vineland in 2019 using single and double row plantings with three in-row spacings (20, 25 and 30 cm) and two planting dates (early and late).

An optimal yield of U.S. grade #1 (25.2 t/ha) was observed for Radiance when planted in a single row with an in-row spacing at 20 cm for late planting (see Graph 5 and Table 2 on page 6).

Covington and Orleans were included in the spacing trial as a comparison to Radiance. The total marketable yield of Radiance was higher than Covington and Orleans for both early and late planting with single and double rows at all spacings (see Graph 6).

U. S. grade #1 optimal yield (34.5 t/ha) and total marketable yield (49.5 t/ha) were observed for Covington using double row planting at 25 cm spacing when planted in early June (see Table 2 on page 6 and Table 3 on page 7). U.S. grade #1 optimal yield (31.8 t/ha) and total marketable yield (52.5 t/ha) were observed for Orleans using double row planting at 20 cm spacing when planted in early June (see Tables 2 and 3). Data suggests double row planting is beneficial for early planting.



Graph 6: Comparison of total marketable yields of Radiance, Covington and Orleans planted at Vineland in 2019 using single and double row plantings with three in-row spacings (20, 25 and 30 cm) and two planting dates (early and late).

Table 2: Percentage change 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 June 5 and late refers to June 27).

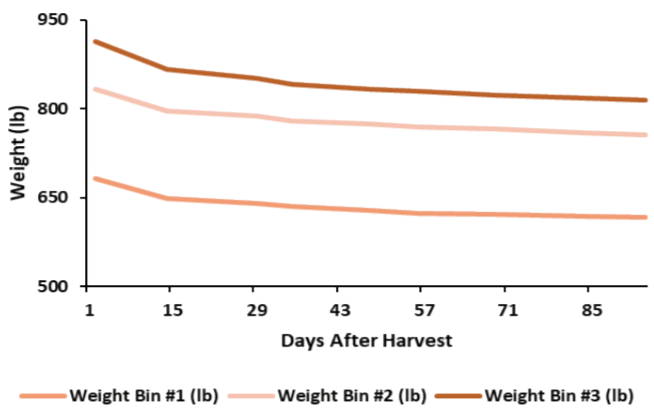
Variety	Planting	Row density	In-row spacing		
			20 cm	25 cm	30 cm
Covington	Early	Single	28.22	20.72	20.47
		Double	22.38	34.52	22.21
		Change	**-20.67%**	**66.57%**	**8.49%**
	Late	Single	15.21	13.52	16.15
		Double	15.22	15.25	13.89
		Change	**0.09%**	**12.81%**	**-13.96%**
Orleans	Early	Single	20.80	26.06	14.97
		Double	31.84	22.87	24.43
		Change	**53.09%**	**-12.23%**	**63.21%**
	Late	Single	16.86	15.96	11.23
		Double	14.03	13.78	14.24
		Change	**-16.80%**	**-13.66%**	**26.85%**
Radiance	Early	Single	28.21	22.70	25.29
		Double	34.46	32.73	38.36
		Change	**22.14%**	**44.19%**	**51.65%**
	Late	Single	25.24	18.82	14.36
		Double	24.09	19.37	21.24
		Change	**-4.56%**	**2.92%**	**47.89%**

Table 3: Percentage change 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 June 5 and late refers to June 27).

Variety	Planting	Row density	In-row spacing		
			20 cm	25 cm	30 cm
Covington	Early	Single	42.29	34.62	39.64
		Double	45.22	49.53	38.38
		Change	**6.93%**	**43.07%**	**-3.18%**
	Late	Single	29.72	23.98	25.18
		Double	35.57	33.94	31.87
		Change	**19.68%**	**41.53%**	**26.57%**
Orleans	Early	Single	42.93	43.96	39.47
		Double	52.51	40.19	44.40
		Change	**22.32%**	**-8.58%**	**12.49%**
	Late	Single	26.67	26.34	20.55
		Double	31.01	30.60	28.58
		Change	**16.27%**	**16.17%**	**39.08%**
Radiance	Early	Single	49.78	47.37	42.52
		Double	59.85	63.70	59.48
		Change	**20.23%**	**34.47%**	**39.89%**
	Late	Single	39.13	30.60	27.5
		Double	45.36	39.45	41.50
		Change	**15.92%**	**28.92%**	**50.91%**

Storage trial

Radiance was harvested from the field into three macro bins October 16. The harvested sweet potatoes were weighed and cured immediately at 28˚C and 85% RH for 14 days with adequate ventilation. After curing, sweet potatoes were weighed and stored at 13˚C to 16˚C and 85% to 90% RH with adequate ventilation. The weight of each bin was recorded every two weeks and rotting sweet potatoes were discarded.



Graph 7: Weight of three bins of Radiance recorded every two weeks after harvest.

The starting weight of sweet potatoes in the three bins was 682 lbs, 834 lbs and 914 lbs (see Graph 7). After 14 days of curing, the weight loss of each bin was 4.99%, 4.56% and 5.25%. The weight loss slowed down to about 1% for every two weeks when moved to long-term storage. After 69 days of storage virtually no rotting was observed in the three bins. The majority of rotting was observed in the first 14 days, during curing, due to severely damaged tubers.

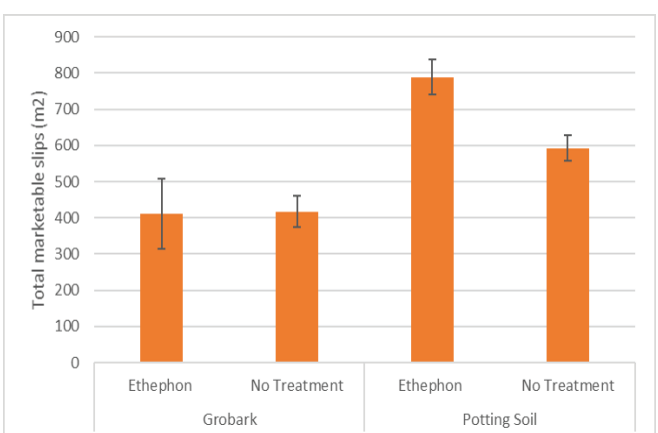
Greenhouse slip treatment trial

In 2019, a slip treatment trial was continued in a greenhouse at Vineland by evaluating the effects of Ethephon, a plant growth regulator, and Gro-Bark, an alternative growing medium, on the production of slip quantity and quality. A field trial was also conducted to determine if the use of Ethephon or Gro-Bark had a negative impact on slip survival and sweet potato yield.

Radiance slips were produced mid-March from sweet potato seeds bedded in a greenhouse using the growing medium Gro-Bark mix (U.S. Perennial WF) and potting soil (Agromix G6) and treated with an Ethephon (FLOREL Plant Growth Regulator, 500 ppm) spray or non-Ethephon spray (see Picture 2 on page 9). Slips were harvested June 3 and June 24 and the number of marketable slips was recorded for all treatments.

Slips harvested first from all treatments were transplanted into the field in single rows spaced 1.2 m centre-to-centre, with an in-row spacing of 30 cm, June 5. The number of surviving plants were recorded mid-July and sweet potatoes were harvested September 18. Harvested sweet potatoes were weighed and sorted into U.S. grade #1, U.S. grade #2, jumbo and culls.

The highest number of marketable slips harvested (790 m^2) was found in potting soil treated with an Ethephon spray and the lowest number harvested was 410 m^2 from Gro-Bark treated with an Ethephon spray (see Graph 8).

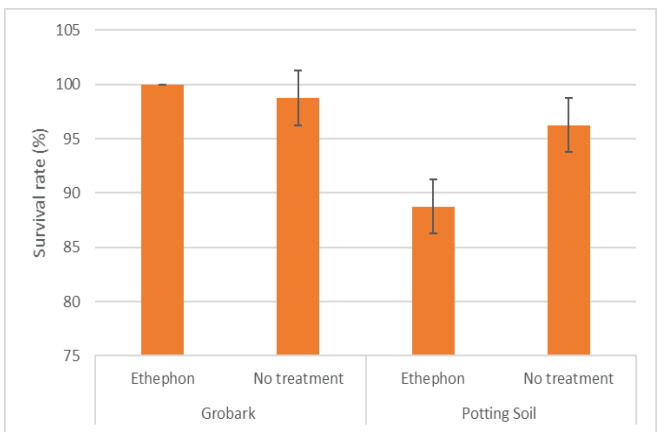


Graph 8: Total marketable slips harvested per m^2 from all treatments (Ethephon spray vs. non-Ethephon spray and Gro-Bark vs. potting soil) over two harvests on June 3 and June 24 in a greenhouse at Vineland.

Picture 2: Radiance slips growing in a greenhouse under different treatments (left - soil with no treatment vs. Gro-Bark with Ethephon spray; right - soil with Ethephon spray vs. Gro-Bark with no treatment).

In general, sweet potato seeds growing in potting soil produced more marketable slips than in Gro-Bark. This could be attributed to the higher amount of rotting seeds observed in Gro-Bark than in potting soil. It was also found slips grew faster in potting soil than in Gro-Bark. Gro-Bark could be retaining more moisture than potting soil causing more seed potato to rot.

Ethephon spray increased the number of marketable slips by 33% when produced from seed potato bedded in potting soil but no significant difference was observed with Gro-Bark. Radiance slips produced in Gro-Bark with Ethephon spray had a 100% survival rate when transplanted in the field, the highest slip survival rate among all treatments. The lowest survival rate observed was 89% for potting soil with Ethephon spray, which was significantly lower than other treatments. In general, slips produced using Gro-Bark had better survival rates than potting soil when transplanted in the field (see Graph 9).



Graph 9: Field survival rate of Radiance slips harvested from the greenhouse grown under different treatments (Ethephon spray vs. non-Ethephon spray and Gro-Bark vs. potting soil).

Radiance slips produced in Gro-Bark without Ethephon spray yielded the highest U.S. grade #1 (31.14 t/ha) (see Graph 10 on page 10). The lowest yield of U.S. grade #1 was observed for potting soil with Ethephon spray (18.96 t/ha). Radiance slips produced in Gro-Bark yielded higher U.S. grade #1 than in potting soil (see Graph 10).

Although slips sprayed with Ethephon produced slightly lower U.S. grade #1 and total marketable yield, the yield differences were not statistically significant. This suggests that Ethephon does not have a significant impact on sweet potato yield.

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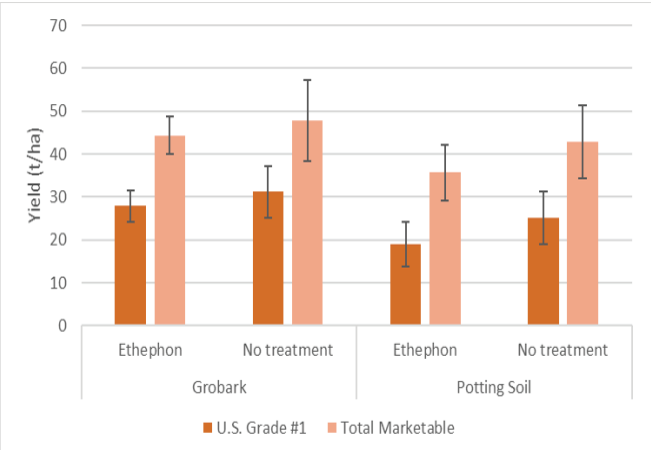

Graph 10: U.S. grade #1 yield and total marketable yield produced by greenhouse-grown Radiance slips under different treatments (Ethephon spray vs. non-Ethephon spray and Gro-Bark vs. potting soil).

For greenhouse slip production, potting soil should be considered a better growing medium, potentially producing 50% to 100% more marketable slips than Gro-Bark.

Ethephon could be applied to increase the number of marketable slips by 33%, however, the survival rate when transplanted in the field could be decreased by 10%. Although lower U.S. grade #1 and total marketable yields were observed for slips produced with Ethephon spray, the yield differences were not statistically significant. Further research trials are required to confirm these results.

Summary

- Brix % should not be considered when determining the maturity of sweet potatoes since there is no significant difference between harvest time after curing.
- Late planting of Radiance is feasible in southern Ontario. Single row is recommended for late planting since there is no benefit to a double row system.
- Minimal weight loss of Radiance was observed during long-term storage.
- Radiance slips produced in a greenhouse can be harvested a third time in mid/end of June to optimize the profit of greenhouse slip production.
- Radiance slips treated with Ethephon spray in a greenhouse, produced lower U.S. grade #1 sweet potatoes in the field than non-treated slips, but the difference was not significant.
- Radiance slips produced in a greenhouse using Gro-Bark had better survival rates in the field than those produced using potting soil.
- Sweet potato seeds bedded in potting soil produced more marketable slips than those bedded in Gro-Bark.
- Ethephon spray increased the number of marketable slips produced in potting soil but had no significant impact on those produced in Gro-Bark.
- Radiance slips grown in Gro-Bark survived better in the field than those produced in potting soil.
- Radiance slips treated with Ethephon spray produced lower U.S. grade #1 sweet potatoes in the field than non-treated slips, but the difference was not significant.

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