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Final Report

Title: Tolerance of different fresh market pumpkin cultivars to bacterial spot

Prepared for the Fresh Vegetable Growers of Ontario (FVGO)
November 8, 2018

Research Team:
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- Elaine Roddy, Vegetable Specialist, OMAFRA

RATIONALE: *Xanthomonas cucurbitae*, causes bacterial spot of pumpkins and squash and was identified in Ontario in 2012. Growers with bacterial spot in pumpkins have experienced 80-100% yield loss, as fruit infections lead to fruit collapse and rot in the field or during storage. The disease is reported on a range of pumpkin cultivars in other regions, but the relative tolerance of cultivars has not been compared. The purpose of this project was to examine the tolerance of fresh market pumpkin cultivars to the disease.

Highlights/Summary:
- Trials were completed in 2016-2018. In 2017, there was a planting error, and in 2018 only one trial developed bacterial spot symptoms, so only results from 2016 and 2018 (Ridgetown trial) are discussed.
    - All pumpkin cultivars were susceptible to bacterial spot on foliage and fruit in 2016. In 2018, all cultivars except 'Lil Pump-ke-mon' and 'Snow Ball' developed bacterial spot symptoms. There were no differences in foliar incidence and severity by the end of the growing season in either year.
    - Differences in the level of symptoms on fruit were observed in 2016 but not 2018. The incidence of fruit with spot tended to be lower in mini/novelty pumpkin compared to the jack-o-lantern and pie types. Gladiator, Howden, and Magic Wand, which are all jack-o-lantern types, had higher incidence of soft rots at harvest in 2016. Similarly, the jack-o-lantern cultivars tended to have higher storage losses (ie. soft rot) in storage compared to mini, white, and pie types in 2016.
- Additional data on powdery mildew resistance (2018 Ridgetown) and yield in the absence of bacterial spot (2018 Cedar Springs) and is available in Appendix A and B, respectively.

Funding: Fresh Vegetable Growers of Ontario, OMAFRA-UofG Partnership

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TITLE: Tolerance of different fresh market pumpkin cultivars to bacterial spot, 2016

PEST(S): Bacterial spot (*Xanthomonas cucurbitae*)

RATIONALE: *Xanthomonas cucurbitae*, causes bacterial spot of pumpkins and squash and was identified in Ontario in 2012. Growers with bacterial spot in pumpkins have experienced 80-100% yield loss, as fruit infections lead to fruit collapse and rot in the field or during storage. Furthermore, the disease is reported on a range of pumpkin cultivars (Ravanlou and Babadoost 2015), but the relative tolerance of cultivars has not been compared. This project will provide a foundation for integrated pest management of the disease in Ontario by examining the tolerance of popular fresh market pumpkin cultivars to the disease.

METHODS: The trial was completed at Ridgetown Campus, University of Guelph. The trial was seeded with 15 different pumpkin varieties using a cone seeder on June 9 at a rate of 3 seeds per meter. Rows were spaced 4 m apart. Each treatment plot was 7 m long. Plant stand was spotty 10 days after planting, so thin spots were hand planted. The trial was setup as a randomized complete block design with 4 replications per treatment. A preventative downy mildew fungicide program was implemented with applications of Torrent (200 mL/Ha) + Sylgard 309 (150 mL/Ha) on July 25, Aug 17 and Orondis Ultra (400 mL/Ha) on Aug 4. Powdery mildew was managed using applications of Quintec (400 mL/Ha) on July 25, Aug 24 and Fontelis (1.25 mL/Ha) on Aug 9. Cucumber beetle was controlled on Aug 9 with Matador (83 mL/Ha) and with Alias (240 mL/Ha) on Jun 23, July 5, and 11.

The trial was inoculated with *X. cucurbitae* CT12PT1A on the evening of July 11 and 29. Inoculum was applied at a concentration of ~1 x 10^6 cfu/mL + 0.025% Sylgard 309 and applied in 200 L of water per Ha. Inoculum was applied to 1 m width of the row (plants at 4 leaf stage) using a hand-held CO_2 sprayer (35 psi) with ULD 120-02 nozzles and a 1 m wide boom.

Foliar disease assessments were completed on Aug 10, 31, and Sept 12. All the leaves inside two randomly placed hula-hoops (68.6 cm diameter) laid within the spray area were counted, and the number of leaves with symptoms was recorded. All lesion types were counted including small lesions, 1-3 mm in diameter and ranging in colour from light green to yellow, tan and beige, and dark chocolate brown. This data was used to calculate the percentage of leaves with symptoms. The area under the disease progress curve for the number of symptomatic leaves was then calculated using the following equation: where Y_i is number of infected leaves at day X_i and Y_{i-1} is number of infected leaves at day X_{i-1}: AUDPC = $\sum [((Y_i + Y_{i-1}) (X_i - X_{i-1}))/2]$. On the same dates, the percent leaf area within the hulahoops was estimated and these data were also used to calculate an AUDPC based on leaf area with symptoms. Defoliation in each plot was also assessed on a whole plot basis on Aug 25, Sept 1, 9, and used to calculate the AUDPC for defoliation.

Fruit were harvested on Sept 19 and sorted into rots (lack of structural integrity), mature (<75% green), and immature (>75% green). The number and weight of all fruit in each plot was recorded. Ten fruit in the mature category were assessed for the presence of bacterial spot and three week storability. The incidence of fruit with lesions and the mean number of lesions per fruit was calculated. Fruit showing no rotten spots were stored on skids with 2 reps each in an open-air shed and in a coverall. Fruit showing rot were removed once a week for 3 weeks.

Statistical analysis for fruit data was conducted using ARM 9 (Gylling Data Management, Brookings, SD) and SAS v9.4. Data were tested for normality using Bartlett's homogeneity of variance test or the Shapiro-Wilk test. Analysis of variance was conducted using Tukey's HSD and mean comparisons were performed when $P \leq 0.05$.

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RESULTS: Final disease incidence and severity and AUDPC at the end of the growing season (early September) did not differ among pumpkin cultivar (Table 1). Defoliation on Sept 9 was highest in Karat Gold and Pick-A-Pie, and this was significantly greater than all other cultivars except Magic Lantern, Rhea, and Howden. However, it was unclear whether defoliation was caused primarily by bacterial spot, or other factors such as cultivar maturity.

The incidence of pumpkin fruit with any bacterial spot symptoms ranged from 50 to 100% in pumpkins that were mature and possessed structural integrity (Table 2). Jack-B-Little had the lowest rate of fruit symptoms, and this was significantly less than all other cultivars except Lil Pump-Ke-Mon, Gold Speck, and Snow Ball. The mini pumpkins Hooligan, Jack-B-Little, and Snow Ball had the fewer lesions per fruit than all other cultivars except Lil-Pump-Ke-Mon, and Gold Speck. However, the number of lesions per kg of fruit harvested did not differ among cultivars. The number of fruit with soft rot (i.e. complete lack of structural integrity) at harvest was higher in Gladiator than all other cultivars except Howden. Similarly, Gladiator had higher yield of rots than all other cultivars except Howden and Magic Wand. The percentage of pumpkins lost to rot in storage was higher in Gladiator than all other cultivars, and higher in Howden than all other cultivars except Magic Lantern, Rhea, Kratos, Magic Wand, Karat Gold, and Blue Doll.

CONCLUSIONS: All pumpkin cultivars tested exhibited symptoms of bacterial spot on foliage and fruit. There were no differences in foliar incidence and severity by the end of the growing season, however, differences in the level of symptoms on fruit were observed. This suggested that foliar susceptibility may not be a strong indicator of fruit susceptibility; additional analysis will be performed in future years to explore this possibility. For fruit, the incidence of fruit with spot tended to be lower in mini/novelty pumpkin compared to the jack-o-lantern and pie types. A similar result was observed for number of lesions per fruit, although on a per kg basis, there was no difference in the number of lesions among cultivars. Gladiator, Howden, and Magic Wand, which are all jack-o-lantern types, had higher incidence of rots at harvest. Similarly, the jack-o-lantern cultivars tended to have higher storage losses (ie. soft rot) in storage compared to mini, white, and pie types. This work will be repeated in 2017 to confirm results.

ACKNOWLEDGEMENTS: Elaine Roddy (OMAFRA) worked collaboratively on this trial and completed all foliar disease assessments and assisted with fruit assessments and Dr. Laura L. Van Eerd who assisted in preparation of this report.

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Table 1. Defoliation (%), severity (% leaf area affected), and incidence (% leaves with symptoms) of bacterial spot (*X. cucurbitae*) in various fresh market pumpkin cultivars, Ridgetown, ON, 2016.

		Defoliation (%)		Incidence (% symptomatic leaves)		Severity (% leaf area affected)	
Variety	Type	Sept 9	AUDPC [a]	Sept 12	AUDPC	Sept 12	AUDPC
Gladiator	Jack-o-lantern	43 cd [b]	456 cd	75 a	1556 a	35 a	566 a
Magic Lantern	Jack-o-lantern	80 ab	735 abc	86 a	1759 a	51 a	741 a
Lil Pump-Ke-Mon	Mini	30 d	297 d	96 a	1814 a	34 a	545 a
Rhea	Jack-o-lantern	60 a-d	600 bcd	79 a	1669 a	51 a	892 a
Kratos	Jack-o-lantern	53 bcd	569 bcd	87 a	1829 a	58 a	857 a
Hooligan	Mini	53 bcd	538 bcd	88 a	1801 a	55 a	621 a
Jack-B-Little	Mini	55 bcd	470 cd	66 a	1341 a	29 a	442 a
Howden	Jack-o-lantern	66 abc	681 abc	92 a	1632 a	61 a	841 a
Magic Wand	Jack-o-lantern	48 cd	530 bcd	95 a	1864 a	57 a	795 a
Karat Gold	Jack-o-lantern	90 a	941 a	84 a	1698 a	60 a	952 a
Cannonball	Pie	50 bcd	560 bcd	88 a	1747 a	41 a	876 a
Pick-A-Pie	Pie	88 a	811 ab	94 a	1898 a	68 a	1040 a
Gold Speck	Mini	53 bcd	459 cd	87 a	1578 a	35 a	577 a
Blue Doll	Blue - medium	43 cd	438 cd	96 a	1902 a	28 a	463 a
Snow Ball	White - small	50 bcd	469 cd	92 a	1746 a	52 a	996 a

[a] AUDPC = area under the disease progress curve.

[b] Numbers in a column followed by the same letter are not significantly different ($P \leq 0.05$), Tukey's HSD.

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Table 2. In various fresh market pumpkin cultivars, disease incidence on fruit and percent of rots in mature and immature fruit expressed based on number or weight of fruit at harvest or after 3 weeks of storage, Ridgetown, ON, 2016[z].

		Rots – harvest (% mature)		Rots – storage (% mature)	Mature Fruit (not incl. rots)		
Variety	Type	# fruit	Weight (kg)	# fruit	Spot (% fruit)	# lesions / fruit [a]	# lesions / kg
Gladiator	Jack-o-lantern	27.2 a [b]	20.39 a	89.8 a	97 ab	49 ab	10.16 a
Magic Lantern	Jack-o-lantern	0.5 c	0.10 b	29.6 bc	98 ab	49 ab	12.64 a
Lil Pump-Ke-Mon	Mini	0.0 c	0.00 b	0.0 d	75 a-e	6 cde	13.10 a
Rhea	Jack-o-lantern	1.3 c	1.99 b	4.9 bcd	96 abc	64 ab	11.12 a
Kratos	Jack-o-lantern	0.5 c	1.35 b	23.0 bcd	93 a-d	25 abcd	5.49 a
Hooligan	Mini	0.0 c	0.00 b	0.6 cd	63 b-d	4 e	10.31 a
Jack-B-Little	Mini	0.0 c	0.00 b	0.6 cd	50 e	3 e	10.91 a
Howden	Jack-o-lantern	24.2 ab	12.95 ab	39.2 b	100 a	116 a	20.30 a
Magic Wand	Jack-o-lantern	1.7 c	6.78 ab	18.8 bcd	95 a-d	30 abc	7.41 a
Karat Gold	Jack-o-lantern	0.0 c	0.00 b	21.8 bcd	88 a-d	29 abc	9.13 a
Cannonball	Pie	0.0 c	0.00 b	0.8 cd	93 a-d	25 abcd	16.44 a
Pick-A-Pie	Pie	2.8 bc	4.03 b	1.3 cd	100 a	19 bcd	11.90 a
Gold Speck	Mini	0.0 c	0.03 b	0.0 d	60 de	5 de	13.50 a
Blue Doll	Blue - medium	0.0 c	0.00 b	2.6 bcd	93 a-d	44 ab	9.92 a
Snow Ball	White - small	0.0 c	0.00 b	0.0 d	61 cde	4 e	2.99 a

[a] Data in this column were subjected to an arsine square root transformation to meet assumptions of normality. The back-transformed means are presented.

[b] Numbers in a column followed by the same letter are not significantly different ($P \leq 0.05$), Tukey's HSD.

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TITLE: Tolerance of different fresh market pumpkin cultivars to bacterial spot, 2017

PEST(S): Bacterial spot (*Xanthomonas cucurbitae*)

RATIONALE: *Xanthomonas cucurbitae*, causes bacterial spot of pumpkins and squash and was identified in Ontario in 2012. Growers with bacterial spot in pumpkins have experienced 80-100% yield loss, as fruit infections lead to fruit collapse and rot in the field or during storage. Furthermore, the disease is reported on a range of pumpkin cultivars (Ravanlou and Babadoost 2015), but the relative tolerance of cultivars has not been compared. This project will provide a foundation for integrated pest management of the disease in Ontario by examining the tolerance of popular fresh market pumpkin cultivars to the disease.

METHODS: The trial was completed at Ridgetown Campus, University of Guelph. The trial was seeded with 15 different pumpkin varieties using a cone seeder in early June and inoculated with *X. cucurbitae* CT12PT1A in early July. Plant stand was spotty 10 days after planting, so thin spots were hand planted. Preventative fungicide applications for powdery mildew and downy mildew were applied at regular intervals. Foliar disease assessments were completed on August 14, August 26 and September 11. All the leaves inside two randomly placed hula-hoops (68.6 cm diameter) laid within the spray area were counted, and the number of leaves with symptoms was recorded. All lesion types were counted including small lesions, 1-3 mm in diameter and ranging in colour from light green to yellow, tan and beige, and dark chocolate brown. Defoliation in each plot was also assessed on a whole plot basis. A planting error was observed in early September and due to the number of plots contaminated with the wrong cultivar is was decided to end the trial.

RESULTS & CONCLUSIONS: Unfortunately, there was an error in planting and some plots were contaminated with other cultivars. This made is impossible to draw conclusions from foliar disease ratings and to complete fruit ratings. The planting error was not apparent until early September when fruit began to turn, and the canopy began to collapse, so replanting was not an option. We think the error occurred either because of a calibration issue with a new cone seeder, or because of errors during replanting (by hand) in thin spots in the stand. More attention will be made next year to avoid these problems. This work will be repeated twice in 2018 to confirm results from 2016. One trial will be completed at Ridgetown Campus and a second trial will be completed at the Cedar Springs Research Station. This space has already been secured. FVGO will not be invoiced for the 2017 trial until the completion of the extra trial in 2018.

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TITLE: Tolerance of different fresh market pumpkin cultivars to bacterial spot, 2018

PEST(S): Bacterial spot (*Xanthomonas cucurbitae*)

METHODS: One trial was completed at Ridgetown Campus (RC), University of Guelph and a second trial at the Cedar Springs (CS) Research Station, Dealtown, ON. Trial were seeded with a cone seeder on June 6 at RC and June 8 at CS and inoculated with *X. cucurbitae* CT12PT1A on July 9 and 31. Preventative fungicide applications for powdery mildew and downy mildew were applied on July 27 (Orondis Ultra @ 600 mL/Ha and Quintec @ 400 mL/Ha) and Aug 14 (Fontelis @ 1.25 L/Ha and Zampro @ 1 L/Ha).

Foliar disease assessments were completed on August 9, 13 and 31 at RT and CS. All the leaves inside two randomly placed hula-hoops (68.6 cm diameter) laid within the spray area were counted, and the number of leaves with symptoms was recorded. All lesion types were counted including small lesions, 1-3 mm in diameter and ranging in colour from light green to yellow, tan and beige, and dark chocolate brown.

Pumpkins were harvested on Oct 3 at RT and Oct 11 at CS and sorted into immature, mature, and rots (not structural integrity). Ten fruit per plot were assessed for bacterial spot and the number of lesions recorded. Some plots did not have 10 mature fruit and in these cases all mature fruit per plot were assessed. Ten fruit per plot were then placed on pallets for outdoor storage and assessed for rot once a week for three weeks. Storage was not completed at CS due a lack of bacterial spot symptoms on foliage and fruit.

Statistical analysis was conducted using ARM 9 (Gylling Data Management, Brookings, SD). Data were tested for normality using Bartlett's homogeneity of variance test. Analysis of variance was conducted using Tukey's HSD and mean comparisons were performed when $P \leq 0.05$.

RESULTS & CONCLUSIONS: There were no differences among treatments for foliar disease incidence or severity (Table 1). There were also no differences among treatments for the incidence of lesions on fruit, or fruit rot incidence as a percentage of total yield by number of fruit or fruit weight (Table 2). Very little rot developed post-harvest and there were no differences among treatments (*data not shown*). Symptoms were highly variable among plots of the same cultivar. Bacterial spot symptoms were observed on all cultivars except 'Lil Pump-ke-mon' and 'Snow Ball'. No bacterial spot symptoms were observed at the CS location.

ADDITIONAL RESULTS:
Powdery mildew was observed at RT. Defoliation and leaf area with symptoms was evaluated on Sept 5 (Appendix A). Yield data for the CS is presented in Appendix B. Black rot (fruit rot phase of gummy stem blight) was observed on pumpkin fruit at CS and is the primary cause of rot in the trial. Some caution should be used to interpret yield results as pumpkins were harvested on the same date, and not by maturity. Yield data for the Ridgetown trial is not presented since bacterial spot symptoms were observed in the trial on foliage and fruit. Thus, it is better to review yield in terms of percent rot (Table 2).

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Table 1. Bacterial spot incidence (% of leaves) and leaf area (% affected) on pumpkin cultivars inoculated with *X. cucurbitae*, Ridgetown, ON, 2018.

Cultivar	Type	Incidence (% leaves)	Severity (% leaf area)
Gladiator	Jack-o-lantern	6 a	1 a
Magic Lantern	Jack-o-lantern	30 a	5 a
Lil Pump-ke-mon	Mini	0 a	0 a
Rhea	Jack-o-lantern	4 a	0 a
Kratos	Jack-o-lantern	8 a	1 a
Hooligan	Mini	5 a	1 a
Jack-B-Little	Mini	5 a	1 a
Howden	Jack-o-lantern	15 a	3 a
Magic Wand	Jack-o-lantern	0 a	0 a
20 Karat Gold	Jack-o-lantern	17 a	2 a
Cannonball	Pie	15 a	0 a
Pick-a-pie	Pie	13 a	6 a
Gold Speck	Mini	12 a	5 a
Blue Doll	Blue - medium	3 a	0 a
Snow Ball	White - small	0 a	0 a

Numbers in a column followed by the same letter are not significantly different at $P \leq 0.05$, Tukey's HSD.

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Table 2. Bacterial spot incidence (lesions/fruit) and fruit rot incidence (% of total by number and weight) on pumpkin cultivars inoculated with *X. cucurbitae*, Ridgetown, ON, 2018.

			Rot Incidence	
Cultivar	Type	Incidence (lesions/fruit)	% total by number of fruit	% total by fruit weight
Gladiator	Jack-o-lantern	0.2 a	35 a	22 a
Magic Lantern	Jack-o-lantern	2.3 a	43 a	36 a
Lil Pump-ke-mon	Mini	0.0 a	2 a	1 a
Rhea	Jack-o-lantern	0.6 a	7 a	17 a
Kratos	Jack-o-lantern	0.1 a	9 a	3 a
Hooligan	Mini	0.9 a	0 a	0 a
Jack-B-Little	Mini	0.2 a	0 a	0 a
Howden	Jack-o-lantern	14.9 a	32 a	21 a
Magic Wand	Jack-o-lantern	0.0 a	7 a	2 a
20 Karat Gold	Jack-o-lantern	19.5 a	41 a	24 a
Cannonball	Pie	3.5 a	10 a	7 a
Pick-a-pie	Pie	2.2 a	4 a	2 a
Gold Speck	Mini	0.1 a	6 a	6 a
Blue Doll	Blue - medium	3.0 a	4 a	3 a
Snow Ball	White - small	0.0 a	1 a	0 a

Numbers in a column followed by the same letter are not significantly different at $P \leq 0.05$, Tukey's HSD.

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Appendix A. Leaf area (%) with powdery mildew and defoliation (%) in pumpkin cultivars inoculated with *X. cucurbitae*, Ridgetown, ON, Sept 5, 2018.

Cultivar	Type	Defoliation (%)	Leaf area (%)
Gladiator	Jack-o-lantern	48 bcd	38 ab
Magic Lantern	Jack-o-lantern	80 ab	53 ab
Lil Pump-ke-mon	Mini	**25 d**	58 ab
Rhea	Jack-o-lantern	60 abcd	35 ab
Kratos	Jack-o-lantern	71 abc	73 ab
Hooligan	Mini	48 bcd	55 ab
Jack-B-Little	Mini	**25 d**	24 ab
Howden	Jack-o-lantern	78 ab	85 a
Magic Wand	Jack-o-lantern	45 bcd	33 ab
20 Karat Gold	Jack-o-lantern	91 a	63 ab
Cannonball	Pie	68 abc	73 ab
Pick-a-pie	Pie	78 ab	48 ab
Gold Speck	Mini	**30 cd**	30 ab
Blue Doll	Blue - medium	**35 cd**	16 b
Snow Ball	White - small	**21 d**	45 ab

Numbers in a column followed by the same letter are not significantly different at $P \leq 0.05$, Tukey's HSD.

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Appendix B. Pumpkin yield (#/plot and tons/acre) in different pumpkin cultivars, Cedar Springs, ON, Oct 11, 2018.

		Yield (thousands/acre)				Yield (tons/acre)				Rot (% by
Cultivar	Type	Mature	Green	Rot	Total	Mature	Green	Rot	Total	weight)
Gladiator	Jack-o-lantern	4.5 e	0.2 c	0.1 b	4.8 cd	67.1 ab	1.2 a	1.1 abc	69.3 abc	1.6 b
Magic Lantern	Jack-o-lantern	7.8 cde	0.7 bc	0.2 b	8.7 cd	88.9 a	3.0 a	2.4 abc	94.4 a	2.1 b
Lil Pump-ke-mon	Mini	39.1 ab	1.0 c	0.3 b	39.5 ab	45.2 b-e	0.1 a	0.1 bc	45.4 b-e	0.3 b
Rhea	Jack-o-lantern	3.7 e	1.0 c	0.0 b	3.8 d	64.2 abc	0.8 a	0.0 c	65.0 a-d	0.3 b
Kratos	Jack-o-lantern	4.2 e	0.0 c	0.2 b	4.4 d	68.8 ab	0.0 a	2.9 abc	71.7 abc	3.9 ab
Hooligan	Mini	22.9 bcd	1.0 c	0.8 ab	23.7 bc	24.5 de	0.0 a	0.6 abc	25.2 e	2.5 b
Jack-B-Little	Mini	32.4 ab	3.0 a	0.7 ab	36.0 ab	20.1 e	0.6 a	0.4 bc	21.1 e	1.7 b
Howden	Jack-o-lantern	2.7 e	0.2 c	0.6 ab	3.4 d	33.6 cde	1.6 a	4.9 abc	40.1 cde	13.2 ab
Magic Wand	Jack-o-lantern	5.8 cde	0.3 c	0.2 b	6.3 cd	73.0 ab	2.6 a	2.6 abc	78.2 ab	2.7 b
20 Karat Gold	Jack-o-lantern	5.5 de	0.4 c	1.0 ab	6.9 cd	57.7 a-d	3.0 a	7.3 a	68.0 a-d	10.4 ab
Cannonball	Pie	7.0 cde	0.3 c	1.8 a	9.0 cd	26.4 de	0.6 a	6.9 ab	33.8 de	18.1 a
Pick-a-pie	Pie	10.4 cde	0.6 bc	0.7 ab	11.6 cd	41.5 b-e	1.3 a	2.2 abc	45.0 b-e	4.7 ab
Gold Speck	Mini	40.6 a	2.3 ab	1.6 a	44.6 a	23.6 e	0.4 a	0.7 abc	24.7 e	3.0 b
Blue Doll	Blue - medium	4.1 e	0.5 c	0.0 b	4.6 d	70.2 ab	1.8 a	0.0 c	72.0 abc	0.0 b
Snow Ball	White - small	23.2 abc	0.4 c	0.0 b	23.6 bc	61.7 abc	0.3 a	0.0 c	62.0 a-d	0.0 b

Numbers in a column followed by the same letter are not significantly different at $P \leq 0.05$, Tukey's HSD.
The primary cause of fruit rot was black rot (gummy stem blight).
Interpret yield data with caution as maturity dates varied among cultivars.