

## Project Title

Processing tomato cultivar trials, 2023

## Research Agency/location

University of Guelph Ridgetown Campus

## Lead and Key Investigators

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## Executive summary

Processing tomato cultivar trials were conducted at two locations. At the Ridgetown site the trial evaluating cultivar performance was combined with a Pinnacle tolerance screening trial in a split-plot design. Cultivar performance was evaluated at a second site in Chatham Township. Cultivars recommended by processing company representatives were evaluated for field yield performance, fruit size and handling measurements, processing measurements and fruit quality measurements. In 2023 we encountered flooding at the Ridgetown site. Affected trial entries are noted. The Chatham Township site was uniform and provided an excellent comparison of variety performance.

The results of the Pinnacle tolerance screening will be summarized in a separate report to follow.

## Objectives

1. To measure the field, handling, peeling and fruit quality performance of new hybrids recently listed in seed company catalogues.
2. To evaluate the trial entries for tolerance to Pinnacle herbicide.

## Materials and Methodology

### Cultivars

Ontario processing tomato company representatives were surveyed for hybrids of interest for the trial. Like 2022, there were 20 entries plus 2 check cultivars H3406 and H5108 in the cultivar trial in 2023. The old cultivars O7983 and O8245 were used only to fill and even out blocks but the results are reported. They do serve as benchmarks for comparing results from trials conducted many years ago.

Transplants were grown in 200 cell plug trays in the greenhouses at Ridgetown Campus.

### Trial sites

#### Ridgetown site

One site was established in the same field as the processing tomato breeding plots near Selton Line and Kenesserie Road. This trial was set in the field on May 23, 2023. The cultivar trial was set up as an RCBD experimental design with 4 replications. Cultivars were randomized in all 4 replications.

The Pinnacle tolerance screening trial was superimposed on 3 replications of the RCBD cultivar trial, as a split-plot design. Main plot treatment was cultivar and sub-plot treatment was unsprayed or sprayed at the high label rate (12g/ha) Pinnacle. This is different from all previous trials where a 2X rate of Pinnacle was used.

Row spacing was 5 feet apart. Main plots were 36 feet long and planted in twin rows 22 inches apart and plants 18 inches apart within a row, to achieve a plant population of 11,616 plants per acre. Weeds were controlled by ppi Dual II Magnum 1.75 L/ha and Sencor 75D 600 g/ha, followed by cultivation and hoeing. There were four additional applications of Sencor 75D at 200 g/ha tank mixed with fungicides. Foliar and fruit diseases were controlled with sprays of Echo 720 (1.7 L/ha tank mixed with Sencor or 2.8 L/ha alone) and Bravo (2.4 L/ha tank mixed with Sencor or 4 L/ha alone). This site received 17.1 inches of rainfall from June 10 to September 28 (compared to 7.8 inches in 2022).

### Chatham Township site

A second trial site was established on a farm of Rob McKerrall on Greenvalley Line in Chatham Township. The trial at this site was established on June 1, 2023, in an RCBD experimental design with 3 replications. There were no sub-plot treatments at this site. The trial was planted with the same transplanter at the same row, twin-row and plant spacings as the Ridgetown site. PPI weed control was managed by the grower as was spraying for diseases.

### Yield measurements

The plots at both sites were not sprayed with Ethrel to observe the natural sequence in maturity. At the Ridgetown site unsprayed sub-plots, and at the Chatham township site the plots, were harvested on 2 days each week, on the date closest to the time when 80% of the fruit were red ripe. Five plants, with no adjacent plants missing, were cut at soil level and the fruit were shaken by hand into a wheelbarrow. Fruit were sorted into red ripe, breakers, processing green, grass green and limited use/rots grade categories and the weight of fruit in each grade category was measured. An 11-quart basket of red ripe fruit was retained as a sample for fruit handling, peeling and quality evaluations.

### Fruit handling measurements

From the 11-quart basket sample of red ripe fruit, a 3 kg sub-sample of fruit was weighed out for further evaluations. The number of fruit in this sub-sample was counted to measure average fruit size in grams. The fruit were dropped onto a concrete floor from a height of 4 feet. Only the fruit with cracks extending into the flesh were weighed and the results are reported as % cracking. The fruit with stems attached were counted and reported as percent of the total fruit number to estimate persistence of stem attachment. The uniformity of fruit size (i.e., diameter) was estimated on a weight basis by grading the fruit into 4 size categories using spaced steel bars. Size 1 was 1" or less, size 2 was greater than 1" and less than or equal to 1 1/2", size 3 was greater than 1 1/2" and less than or equal to 1 3/4" and size 4 was fruit diameter greater than 1 3/4".

### Peeling and peeled colour measurements

After going through the handling evaluations described above, the 3 kg fruit samples were peeled. The tomatoes were submerged in caustic potash (30% solution by weight) with Turgitol surfactant (0.3% by volume), at 102 +/- 1°C for 40 seconds. The sample was rinsed twice in water. The peels were removed mechanically. The peeled tomatoes were rinsed in water and drained and weighed. This weight was expressed as percent of the initial sample weight and is reported as percent peeling recovery. After

peeling, the tomatoes were sorted for colour, peels still attached, and blemishes. The percent of fruit that had no significant colour defects, and that peeled relatively easily were reported as percent cannable.

### Fruit quality measurements

The remaining red ripe fruit from the 11-quart basket field sample were made into thin pulp and used for fruit quality measurements. Fruit were washed and dried and blended in a Waring Commercial blender, (with customized tomato blades) on medium speed, for 40 seconds, under vacuum. The juice sample was collected with a ladle through the sieve. Colour (Hunter a and Hunter b) was measured with a Konica-Minolta CR-410T chroma meter. The Hunter a/b ratio and Hunter Hue Angle were calculated. The pH of the juice was measured using a benchtop digital pH meter and natural tomato soluble solids (NTSS) was measured in degrees Brix using a Palette PR-101 digital refractometer.

### Pinnacle tolerance screening

At the Ridgetown site (described above) one sub-plot within each cultivar main plot was sprayed with a high label rate (12g/ha) of Pinnacle (thifensulfuron-methyl 50%) 2.5 weeks after transplanting (June 19).

### Visual ratings of Pinnacle injury

One week later (June 26) two raters (S.L. and S.C.) separately assessed the plants for symptoms of Pinnacle injury on a scale of 0 to 5.

### Yield measurements and maturity

Plants in both unsprayed and sprayed sub-plots were harvested as described above for Yield Measurements. Yields from the Pinnacle-sprayed subplots were not included in the cultivar trial data, but were used only for the Pinnacle screening trial. Samples of red ripe fruit were not retained for any further measurements for the Pinnacle-sprayed sub-plots.

## Results and Conclusions

### General comments about the yield results

Despite our best efforts to choose a good location in the field, in 2023 there was flooding from excessive rainfall in part of the Ridgetown cultivar trial site. The replications extended roughly in an east-west direction and the east end of each rep was flooded. The results for H1418, LS0176, N3306, Nunhems 00245, TSH44 and Pumatis should be treated with caution for the Ridgetown site.

The Chatham Township site was very uniform across all replications through the season and should be relied upon for drawing conclusions.

### Ridgetown site yields (Table 1)

Table 1 shows the maturity and yield results from the Ridgetown site alone. The trial entries are arranged by maturity since comparisons of cultivar performance are most meaningful within similar maturity categories.

**As noted above, in Table 1 the results for H1418, LS0176, N3306, Nunhems 00245, TSH44 and Pumatis should be approached cautiously due to lack of uniformity across the Ridgetown site.**

### Ridgetown site fruit size and handling and peeling measurements (Table 2)

Table 2 shows the results of fruit size measurements, stem retention, cracking or firmness and a distribution of different fruit size categories for the Ridgetown site alone. These four size categories help to show how uniform fruit size is since the average fruit size does not show this. Fruit size uniformity is important for whole peeled tomatoes.

The fruit were sorted after peeling based on colour and attached peel tags assuming they would be used for wholepack end use. The fruit with good enough quality to can were weighed and this was divided by the weight of the fruit that came out of the peeling process and expressed as a percent (cannable, percent). This represents how much sorting might be necessary after peeling.

Finally, the weight of fruit good enough to can was divided by the weight of fruit put into the peeling process and expressed as a percent (recovery, percent). This represents the percent of fruit, by weight, coming into the factory that would end up in a can if they were packed for wholepack end use.

**As noted above, in Table 2 the results for H1418, LS0176, N3306, Nunhems 00245, TSH44 and Pumatis should be approached cautiously due to lack of uniformity across the Ridgetown site.**

### Ridgetown site fruit quality measurements (Table 3)

Table 3 shows the results of fruit quality measurements from the Ridgetown site alone. As above, the cultivars are sequenced by maturity date.

**As noted above, in Table 3 the results for H1418, LS0176, N3306, Nunhems 00245, TSH44 and Pumatis should be approached cautiously due to lack of uniformity across the Ridgetown site.**

### Chatham Township site yield data (Table 4)

The entries are arranged in sequence of maturity first by number of days from transplant to harvest and then in no particular order within an equivalent numbers of days. The maturity sequence is slightly different from the Ridgetown site.

### Chatham Township fruit size, handling and peeling measurements (Table 5)

Fruit samples from the Chatham Township site were peeled in 2023. The procedures followed are the same as those described under Table 2 above.

### Chatham Township fruit quality measurements (Table 6)

The NTSS measured at the Chatham Township site was higher, on average, than solids at the Ridgetown site. Overall the fruit pH was lower than what was measured at the Ridgetown site and this is similar to the trend observed in 2022 and 2021.

### Pinnacle tolerance screening

The results for the Pinnacle tolerance screening (Objective 2) will be summarized and interpreted in a second, separate part to this report.

### Acknowledgements

The support of the Ontario Tomato Research Institute, the seed companies and the processor representatives is gratefully acknowledged. Rob McKerrall and his team are deserving of special thanks for freely offering his farm shop and experienced staff to make repairs to our transplanter.

Table 1. Processing tomato cultivar trial yield measurements, Ridgely site, 2023.

Name	Maturity	Red ripe	Breakers	Proc Grn	Grass Grn	Lim Use	Red + Breakers	Red + Breakers + Proc Grn	Red + Breakers + Proc Grn + Grass Grn	Potential Yld
	days	tons/acre	tons/acre	tons/acre	tons/acre	tons/acre	tons/acre	tons/acre	tons/acre	tons/acre
H5108	93 d	26.2 abcd	4.5 ab	1.3	1.4 b	3.17	30.7 abc	32 abcd	32 abcd	36.6 ab
TSH44	93 d	28.4 abcd	6.2 ab	2.7	1.2 b	3.3	34.6 abc	37.3 abcd	37.3 abcd	41.8 ab
Nunhems 00254	93 d	31 abcd	3 b	0.7	0.6 b	3.47	33.9 abc	34.6 abcd	34.6 abcd	38.7 ab
TSH43	96 cd	39.5 a	7.3 ab	1.9	0.8 b	1.98	46.8 a	48.8 a	48.8 a	51.6 a
H1014	97 cd	19.3 bcd	3.4 b	1.2	1.4 b	3.54	22.7 bc	23.8 bcd	23.8 bcd	28.8 ab
H1301	98 bcd	30.6 abcd	8.1 ab	1.9	1.4 b	1.02	38.7 abc	40.7 abcd	40.7 abcd	43.1 ab
N3306	98 bcd	27.6 abcd	4.5 ab	0.7	2.6 b	2.49	32.1 abc	32.9 abcd	32.9 abcd	38 ab
H2239	100 bcd	27.4 abcd	11.4 a	3.6	4.5 ab	2.56	38.8 abc	42.4 abcd	42.4 abcd	49.4 ab
LS0188	102 bcd	36.8 ab	7.3 ab	3.3	2.9 b	2.39	44.1 ab	47.4 ab	47.4 ab	52.7 a
LS0176	102 bcd	17.6 cd	2.8 b	1	1.5 b	1.98	20.4 c	21.4 cd	21.4 cd	24.8 b
Pumatis	104 bcd	15 d	3.3 b	1.1	2.5 b	2.12	18.3 c	19.4 d	19.4 d	24 b
HM 58871	104 bcd	21.6 abcd	5.2 ab	2	3.6 b	2.31	26.8 abc	28.8 abcd	28.8 abcd	34.7 ab
LS0645	104 bcd	18.3 bcd	3 b	1.4	1.7 b	2.45	21.3 bc	22.7 cd	22.7 cd	26.9 ab
HM 588841	104 bcd	26.2 abcd	9.8 ab	1.5	1.5 b	3.02	36 abc	37.5 abcd	37.5 abcd	42 ab
H3406	106 abcd	35.2 abc	6.4 ab	0.8	0.4 b	0.98	41.5 abc	42.3 abcd	42.3 abcd	43.8 ab
H2123	106 abcd	29.4 abcd	6 ab	2.1	2.1 b	1.98	35.4 abc	37.4 abcd	37.4 abcd	41.5 ab
Ohio 8245	106 abcd	25.7 abcd	6.1 ab	1.4	3 b	1.41	31.8 abc	33.2 abcd	33.2 abcd	37.6 ab
CC337	106 abcd	38.5 a	5.6 ab	1.5	0.7 b	1.24	44.1 ab	45.6 abc	45.6 abc	47.5 ab
Ohio 7983	110 abc	28.6 abcd	7.5 ab	2	1.7 b	3.23	36.1 abc	38.1 abcd	38.1 abcd	43 ab
H1648	110 abc	28.6 abcd	5.3 ab	2.8	2.9 b	3.11	33.9 abc	36.7 abcd	36.7 abcd	42.7 ab
LS0266	111 ab	36.7 ab	4.8 ab	1.2	1 b	5.1	41.5 abc	42.7 abcd	42.7 abcd	48.8 ab
H1418	119 a	21.4 abcd	3.3 b	3.4	9.8 a	1.06	24.7 abc	28.1 abcd	28.1 abcd	38.9 ab
p value	***	***	0.003 **	ns	***	ns	***	***	***	***
Mean	102.2	27.3	5.5	1.8	2.1	2.5	32.9	34.6	36.8	39.2
CV	5.2	26.0	52.5	76.5	96.5	65.5	26.6	26.4	25.1	24.7

Means are based on fruit samples from 5 plants harvested in each of 4 replications. Entries are arranged by days from transplant to harvest and then alphabetically. Means within columns followed by the same letter are not different (Tukey's HSD,  $\alpha = 0.05$ ). These results for H1418, LS0176, N3306, Nunhems 00245, TSH44 and Pumatis should be approached cautiously due to flooding at the Ridgely site.

Table 2. Processing tomato cultivar trial, fruit size, handling and peeling measurements, Ridgely site, 2023.

Name	Days	Avg fr sz grams	Stems percent	Cracking		Size 1		Size 2		Size 3		Size 4		Peeling Recovered		Peeling Cannable		Peeling Retained	
				percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent
H5108	93 d	55.7 bcdefg	2 ab	16 cde	0 b	32 efg	46 ab	22 bcde	80 ab	64.1	51.3								
TSH44	93 d	57 bcdef	2 ab	16 cde	0 b	37 defg	52 a	12 cde	74.3 b	56	41.7								
Nunhems 00254	93 d	52.7 cdefgh	2 ab	6 de	0 b	27 efg	47 ab	26 abcde	75.2 ab	57.5	43.2								
TSH43	96 cd	72.7 a	5 ab	41 a	0 b	18 fg	31 abc	51 a	78.4 ab	64.7	51.1								
H1014	97 cd	44.9 fgh	3 ab	14 cde	0 b	72 abc	25 abc	3 e	80.7 ab	57.8	48								
H1301	98 bcd	47.3 efgh	1 ab	11 cde	0 b	71 abc	25 abc	4 e	82.4 ab	62.4	51.7								
N3306	98 bcd	45.5 fgh	7 a	12 cde	0 b	69 abcd	30 abc	1 e	87.4 ab	66.1	58.5								
H2239	100 bcd	54.6 bcdefg	0 b	1 e	0 b	36 efg	55 a	9 cde	83.5 ab	71.4	59.9								
LS0188	102 bcd	68.6 abc	1 ab	13 cde	0 b	14 g	38 abc	47 a	84.1 ab	75.1	63.1								
LS0176	102 bcd	53.6 cdefgh	3 ab	18 bcde	1 b	54 bcde	26 abc	20 bcde	86 ab	78.4	67.4								
Pumatis	104 bcd	48.8 efgh	5 ab	15 cde	0 b	38 cdefg	45 ab	17 bcde	88.2 ab	85.1	74.8								
HM 58871	104 bcd	59.9 abcdef	0 b	36 ab	0 b	32 efg	42 ab	26 abcde	90.1 a	74.5	67								
LS0645	104 bcd	50.4 efgh	2 ab	5 de	1 b	55 bcde	35 abc	9 cde	89.4 ab	64.5	57.7								
HM 588841	104 bcd	66.7 abcd	0 b	17 bcde	0 b	24 efg	37 abc	39 ab	89.3 ab	66.5	59.4								
H3406	106 abcd	58.3 abcdef	2 ab	18 bcde	0 b	31 efg	51 a	19 bcde	89.9 ab	75.6	68								
H2123	106 abcd	58.7 abcdef	3 ab	15 cde	0 b	44 cdefg	36 abc	19 bcde	88.7 ab	71.5	63.5								
Ohio 8245	106 abcd	51.1 efgh	3 ab	30 abc	0 b	34 efg	34 abc	32 abc	85.3 ab	73	62.8								
CC337	106 abcd	46.5 efgh	4 ab	13 cde	1 b	92 a	7 c	0 e	79 ab	76.6	60.5								
Ohio 7983	110 abc	54 cdefgh	1 ab	4 de	0 b	48 cdef	46 ab	6 de	84.1 ab	73.9	62.1								
H1648	110 abc	60.7 abcde	5 ab	14 cde	0 b	37 defg	32 abc	31 abcd	88.6 ab	70.5	62.5								
LS0266	111 ab	69.4 ab	1 b	20 bcde	0 b	19 fg	42 ab	39 ab	90.7 a	77.6	70.4								
H1418	119 a	52.4 defgh	5 ab	5 de	0 b	31 efg	40 abc	29 abcde	90 ab	89.8	80.8								
p value	***	***	**	***	***	***	***	***	***	ns	ns								
Mean	102.2	54.6	2.5	16.1	0.3	45.9	34.8	19.0	84.2	70.5	59.7								
CV	5.2	10.4	94.3	44.6	222.0	26.2	32.7	49.5	6.5	18.6	20.7								

Means are based on fruit samples from 5 plants harvested in each of 4 replications. Entries are arranged by days from transplant to harvest and then alphabetically. Means within columns followed by the same letter are not different (Tukey's HSD,  $\alpha = 0.05$ ). These results for H1418, LS0176, N3306, Nunhems 00245, TSH44 and Pumatis should be approached with caution due to flooding at this site in 2023.

Table 3. Processing tomato cultivar trial, fruit quality measurements, Ridgetown site, 2023.

Name	Days	L* colour	a* colour	b* colour	Hunter a/b	Hue Angle	NTSS °Brix	pH	sauce score
H5108	93 d	38.4 ab	27.9 c	18.9 abc	2 g	26.1 a	3.9 de	4.4 a	11.3 gh
TSH44	93 d	38.5 ab	29.3 abc	19.9 a	2.1 fg	25.8 ab	3.6 e	4.4 a	9.2 h
Nunhems 00254	93 d	38.2 abcd	29.9 abc	19.1 abc	2.2 defg	24.5 abcd	3.8 de	4.4 a	13.7 efgh
TSH43	96 cd	37.3 abcd	30.7 abc	17.6 bcde	2.4 abcd	22.4 defg	3.9 de	4.5 a	21.1 abcde
H1014	97 cd	37.5 abcd	28.8 bc	17.7 bcde	2.3 bcdefg	24 abcdef	4.3 cde	4.3 a	18.2 abcdefg
H1301	98 bcd	38.3 abc	29.6 abc	19.3 ab	2.2 efg	25 abc	4.4 bcde	4.5 a	12.5 fgh
N3306	98 bcd	37.6 abcd	29.8 abc	18.1 abcd	2.3 abcdefg	23.6 bcdefg	4.1 de	4.5 a	17.7 abcdefg
H2239	100 bcd	36.6 cd	29.4 abc	16.7 de	2.4 abcd	22.4 defg	4 de	4.5 a	22.3 abc
LS0188	102 bcd	36.3 d	30.4 abc	17 cde	2.5 abc	21.9 efg	3.9 de	4.4 a	23.1 ab
LS0176	102 bcd	37.2 abcd	30.6 abc	18.1 abcd	2.4 abcde	22.9 cdefg	4.4 abcd	4.3 a	19.3 abcdef
Pumatis	104 bcd	36.8 bcd	31.7 a	17.7 bcde	2.5 ab	21.8 fg	5.1 ab	4.3 a	22.1 abcd
HM 58871	104 bcd	38.8 a	29 abc	17.9 abcde	2.2 defg	24.3 abcde	4.9 abc	4.3 a	16.6 bcdefgh
LS0645	104 bcd	36.7 bcd	29 abc	17.1 cde	2.3 abcde	23.2 cdefg	4.5 abcd	4.4 a	20.6 abcde
HM 588841	104 bcd	37.5 abcd	29.1 abc	17.8 bcde	2.3 bcdefg	23.9 abcdefg	4.2 cde	4.3 a	17.8 abcdefg
H3406	106 abcd	37.4 abcd	30 abc	18.1 abcd	2.3 abcdef	23.4 bcdefg	4.3 bcde	4.4 a	18.3 abcdefg
H2123	106 abcd	37.9 abcd	29.9 abc	18.9 abc	2.2 defg	24.3 abcd	4.3 cde	4.4 a	14.7 defgh
Ohio 8245	106 abcd	38.4 ab	30.3 abc	18.8 abc	2.2 cdefg	24 abcdef	4.1 cde	4.4 a	15 cdefgh
CC337	106 abcd	38 abcd	30.9 ab	18.6 abcd	2.3 abcde	23.2 cdefg	4 de	4.4 a	17.3 abcdefg
Ohio 7983	110 abc	37.5 abcd	30.3 abc	17.7 bcde	2.4 abcde	22.9 cdefg	3.9 de	4.4 a	19.8 abcdef
H1648	110 abc	36.3 d	29.5 abc	15.9 e	2.5 a	21.6 g	4.5 abcd	4.3 a	24.9 a
LS0266	111 ab	37 abcd	29.9 abc	17.2 bcde	2.4 abcde	22.6 cdefg	3.9 de	4.4 a	21.3 abcde
H1418	119 a	37.6 abcd	30.1 abc	17.2 bcde	2.4 abcd	22.6 cdefg	5.2 a	4.3 a	21.2 abcde
p value	***	***	**	***	***	***	***	0.0143 *	***
Mean	114.9	37.5	29.8	17.9	2.3	23.5	4.2	4.4	18.2
CV	3.1	1.8	3.6	4.3	4.8	3.8	6.8	2.5	15.5

Means are based on fruit samples from 5 plants harvested in each of 4 replications. Entries are arranged by days from transplant to harvest and then alphabetically. Means within columns followed by the same letter are not different (Tukey's HSD,  $\alpha = 0.05$ ). These results for H1418, LS0176, N3306, Nunhems 00245, TSH44 and Pumatis should be approached with caution due to flooding at this site in 2023.

Table 4. Processing tomato cultivar trial yield measurements, Chatham Township site, 2023.

Name	Maturity	Red ripe	Breakers	Proc Grn	Grass Grn	Lim Use	Red + Breakers	Red + Breakers + Proc Grn	Red + Breakers + Proc Grn + Grass Grn	Potential Yld
	days	tons/acre	tons/acre	tons/acre	tons/acre	tons/acre	tons/acre	tons/acre	tons/acre	tons/acre
TSH43	102 c	42.9 ab	3.2 b	1.9 c	8.1 ab	2.9	46.2 ab	48.1 ab	56.2 ab	59 ab
TSH44	102 c	44.8 ab	7.3 ab	3.4 abc	9.2 ab	1.5	52.2 ab	55.6 ab	64.8 ab	66.3 ab
H5108	102 c	37.3 ab	5.9 ab	3.8 abc	5.8 b	1.8	43.2 ab	47 ab	52.8 ab	54.6 ab
Nunhems 00254	104.7 bc	36.2 ab	4.9 ab	3 bc	7.1 ab	2.1	41.1 ab	44.1 ab	51.2 ab	53.3 ab
Pumatis	104.7 bc	39.1 ab	7.5 ab	3.6 abc	7.8 ab	2.7	46.7 ab	50.3 ab	58.1 ab	60.8 ab
H1014	104.7 bc	30.7 b	8 ab	4 abc	9.3 ab	2.1	38.7 b	42.7 ab	52 ab	54.1 ab
N3306	107.3 abc	36.7 ab	7.7 ab	5.1 abc	5.6 b	1	44.4 ab	49.5 ab	55.1 ab	56.1 ab
H2123	110 abc	43.3 ab	7.6 ab	4.3 abc	12.1 ab	3	50.9 ab	55.2 ab	67.2 ab	70.3 ab
CC337	112.7 abc	33.1 b	3.3 b	2.8 bc	12.8 ab	2.8	36.4 b	39.2 b	52 ab	54.8 ab
HM 58871	112.7 abc	28.4 b	9.1 ab	3.9 abc	13.8 ab	2.7	37.5 b	41.3 b	55.1 ab	57.8 ab
HM 588841	112.7 abc	41.6 ab	5.8 ab	3.9 abc	8.7 ab	3.2	47.4 ab	51.3 ab	60 ab	63.2 ab
LS0176	112.7 abc	43.1 ab	5.9 ab	4.8 abc	8.4 ab	4.2	49.1 ab	53.9 ab	62.3 ab	66.5 ab
LS0188	112.7 abc	31.5 b	5 ab	3.4 abc	6.7 ab	6	36.4 b	39.8 b	46.5 b	52.6 ab
LS0266	112.7 abc	44.8 ab	7 ab	5.8 ab	17.5 a	2.8	51.8 ab	57.6 ab	75 a	78 a
H1648	112.7 abc	57 a	6 ab	3.7 abc	4.8 b	2.1	63 a	67 a	71.7 ab	73.7 ab
H2239	112.7 abc	37.6 ab	6.3 ab	4.8 abc	11.1 ab	1.9	43.9 ab	48.8 ab	59.9 ab	61.8 ab
H3406	112.7 abc	28 b	8.4 ab	4.2 abc	15.7 ab	1.2	36.3 b	40.5 b	56.3 ab	57.5 ab
LS0645	115.3 ab	39.2 ab	6.5 ab	4 abc	10.1 ab	2.9	45.7 ab	49.6 ab	59.8 ab	62.7 ab
H1301	115.3 ab	43.4 ab	10 a	5.5 abc	9.2 ab	1.1	53.7 ab	59.3 ab	68.4 ab	69.5 ab
Ohio 7983	118 a	30.8 b	5 ab	4.6 abc	7.1 ab	2.6	35.8 b	40.4 b	47.5 b	50.1 b
H1418	118 a	37.8 ab	7.6 ab	7 a	18 a	1.2	45.5 ab	52.5 ab	70.2 ab	71.4 ab
p value	***	**	*	**	***	ns	**	**	**	**
Mean	10.4	38.5	6.6	4.2	9.9	2.5	45.1	49.2	59.1	61.6
CV	3.1	18.9	31.1	28.8	35.5	65.4	16.9	16.1	14.7	13.9

Means are based on fruit samples from 5 plants harvested in each of 3 replications. Entries are arranged by days from transplant to harvest and then alphabetically. Means within columns followed by the same letter are not different (Tukey's HSD,  $\alpha = 0.05$ ).



Table 5. Processing tomato cultivar trial, fruit size, handling and peeling measurements, Chatham Township site, 2023.

Name	Days	Avg fr sz grams	Stems		Cracking		Size 1		Size 2		Size 3		Size 4		peeledwt		cannable		recovery	
			percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent
TSH43	102 c	89 a	4.8 ab	23.8 ab	0	4.7 h	15.2 ab	80 a	94 a	79.9 ab	75 a									
TSH44	102 c	64.3 bcdef	2.1 ab	20.5 abc	0	17.3 fgh	45.4 ab	37.1 bcdefg	90.4 ab	79.7 ab	72.1 ab									
H5108	102 c	60.1 cdefg	4 ab	13.3 abc	0.3	19.8 defgh	49 a	31.3 cdefgh	89.5 ab	79.4 ab	71.1 ab									
Numhems 00254	104.7 bc	63.9 bcdef	0.8 b	15.5 abc	0	19.8 defgh	32.8 ab	47.3 bcd	86.8 ab	76.6 ab	67.1 ab									
Pumatis	104.7 bc	63.8 bcdef	4.2 ab	8.5 bc	0	18.5 defgh	35.4 ab	46.2 bcd	87.5 ab	80.6 ab	70.7 ab									
H1014	104.7 bc	55.3 efg	3.7 ab	8.8 bc	0	45.4 bcdef	41.5 ab	12.9 efgh	83.9 ab	84 a	71 ab									
N3306	107.3 abc	64.7 bcdef	2.8 ab	15.2 abc	0	54.9 bc	37.9 ab	7.2 gh	83 ab	81.9 ab	68.2 ab									
H2123	110 abc	65.1 bcdef	5 ab	4.9 bc	0.4	30.2 bcdefgh	36.6 ab	32.8 bcdefg	80.6 ab	75.7 ab	61 ab									
CC337	112.7 abc	47.8 g	1 b	2 c	1	85 a	12.5 b	0 h	81 ab	81.4 ab	65.8 ab									
HM 58871	112.7 abc	59.5 defg	0.6 b	34 a	0.2	39.3 bcdefg	33.1 ab	27.4 cdefgh	76.4 b	56.3 b	43.2 b									
HM 588841	112.7 abc	71.3 bcd	0.7 b	15.2 abc	0	15 gh	20.7 ab	64.2 ab	80.7 ab	59.9 ab	48.2 ab									
LS0176	112.7 abc	68.5 bcde	2.2 ab	21.4 abc	0	25.4 cdefgh	28.6 ab	46 bcd	78.5 ab	68.2 ab	53.5 ab									
LS0188	112.7 abc	62.7 cdef	0 b	18.3 abc	0	27 cdefgh	29.3 ab	43.9 bcde	84.2 ab	77.8 ab	65.4 ab									
LS0266	112.7 abc	72.8 bc	0.7 b	15.2 abc	0	17.5 efgh	42.7 ab	39.8 bcdef	78.6 ab	76.2 ab	60.1 ab									
H1648	112.7 abc	76.6 ab	8 a	22.9 abc	0	14 gh	30.4 ab	55.5 abc	83.1 ab	81.8 ab	68.1 ab									
H2239	112.7 abc	60.3 cdefg	1.9 ab	6.3 bc	0.3	36.9 bcdefg	35.6 ab	27.2 cdefgh	79.7 ab	81.9 ab	65.2 ab									
H3406	112.7 abc	61.1 cdef	2 ab	13.5 abc	0	24.2 defgh	46.9 a	28.9 cdefgh	81.8 ab	67.2 ab	55 ab									
LS0645	115.3 ab	56.6 efg	2.5 ab	6.7 bc	0	47.4 bcde	37.8 ab	14.3 efgh	82.3 ab	70.5 ab	58 ab									
H1301	115.3 ab	52.7 fg	4.8 ab	21.4 abc	0	58.6 ab	30.3 ab	10.1 fgh	82.2 ab	79.6 ab	65.5 ab									
Ohio 7983	118 a	53.2 fg	0 b	4.9 bc	0.2	48.4 bcd	32.6 ab	18.6 defgh	85.5 ab	78.3 ab	66.9 ab									
H1418	118 a	56.7 efg	5.7 ab	5.1 bc	0	40.8 bcdefg	43.2 ab	16.2 defgh	83.9 ab	78.5 ab	65.9 ab									
p value	***	***	**	***	ns	***	**	***	*	*	*									
Mean	114.9	63.2	2.8	14.2	0.1	29.3	34.2	32.7	83.5	76.0	63.7									
CV	3.1	6.7	84.4	49.0	377.3	30.1	31.3	30.8	6.1	11.2	14.7									

Means are based on fruit samples from 5 plants harvested in each of 3 replications. Entries are arranged by days from transplant to harvest and then alphabetically. Means within columns followed by the same letter are not different (Tukey's HSD,  $\alpha = 0.05$ ).

Table 6. Processing tomato cultivar trial, fruit quality measurements, Chatham Township site, 2023.

Name	Days	L* colour	a* colour	b* colour	Hunter a/b	Hue Angle	NTSS	pH	sauce score
TSH43	102 c	35.9 b	32.3 ab	16.5 ab	3 a	18.3 d	4.3 abc	4.2 ab	32 a
TSH44	102 c	37.6 ab	31.7 ab	16.9 ab	2.6 bc	21.1 abc	3.9 c	4.1 b	24.3 bcde
H5108	102 c	37.2 ab	30.5 b	17.4 ab	2.4 bc	22.4 a	4.2 abc	4.2 ab	21.6 de
Nunhems 00254	104.7 bc	37.8 ab	31.3 ab	18 a	2.4 c	23 a	4.3 abc	4.2 ab	19.7 e
Pumatis	104.7 bc	36.7 ab	31.9 ab	16.9 ab	2.7 bc	20.6 abcd	4.6 abc	4.2 ab	26 abcde
H1014	104.7 bc	36.7 ab	31.8 ab	16.9 ab	2.6 bc	20.9 abc	4.3 abc	4.3 ab	25 bcde
N3306	107.3 abc	36 b	31.9 ab	15.9 b	2.8 abc	19.9 bcd	4 bc	4.3 ab	28.1 abc
H2123	110 abc	37.2 ab	31.5 ab	17.5 ab	2.5 bc	21.8 ab	4.4 abc	4.3 ab	22.3 cde
CC337	112.7 abc	36.8 ab	31.8 ab	16.1 ab	2.7 abc	20.3 abcd	4.1 bc	4.0 a	27 abcd
HM 58871	112.7 abc	39 a	31.7 ab	17.3 ab	2.5 bc	21.6 abc	5 a	4.2 ab	22.2 cde
HM 588841	112.7 abc	36.6 b	32.2 ab	16.8 ab	2.6 bc	20.9 abc	4.7 ab	4.3 ab	24.8 bcde
LS0176	112.7 abc	36.9 ab	31.9 ab	17.3 ab	2.6 bc	21.2 abc	4.2 abc	4.3 ab	24 bcde
LS0188	112.7 abc	36.5 b	33.4 ab	17.5 ab	2.7 abc	20.4 abcd	4.3 abc	4.4 ab	25.6 bcde
LS0266	112.7 abc	36.9 ab	33 ab	17.3 ab	2.7 abc	20.5 abcd	4.6 ab	4.3 ab	25.3 bcde
H1648	112.7 abc	35.9 b	33.7 a	16.4 ab	2.8 ab	19.4 cd	4.6 abc	4.3 ab	28.9 ab
H2239	112.7 abc	36.8 ab	31.5 ab	15.9 b	2.7 abc	20.2 abcd	4.4 abc	4.3 ab	27.2 abcd
H3406	112.7 abc	37.7 ab	32.2 ab	17.4 ab	2.6 bc	21.2 abc	4.5 abc	4.3 ab	23.1 bcde
LS0645	115.3 ab	37.1 ab	31.6 ab	16.6 ab	2.6 bc	20.9 abc	4.4 abc	4.2 ab	25.4 bcde
H1301	115.3 ab	36.9 ab	31.6 ab	17.5 ab	2.5 bc	21.7 abc	4.6 ab	4.3 ab	22.8 bcde
Ohio 7983	118 a	36.7 ab	34 a	18.1 a	2.7 abc	20.6 abcd	4.2 abc	4.2 ab	24.1 bcde
H1418	118 a	36.6 b	33.3 ab	17.3 ab	2.7 abc	20.3 abcd	4.3 abc	4.2 ab	25.9 abcde
p value	***	**	**	***	***	***	***	*	***
Mean	114.9	36.9	32.1	17.0	2.6	20.8	4.4	4.3	25.0
CV	3.1	1.8	3.0	3.8	5.0	3.6	5.6	1.8	8.3

Means are based on fruit samples from 5 plants harvested in each of 3 replications. Entries are arranged by days from transplant to harvest and then alphabetically. Means within columns followed by the same letter are not different (Tukey's HSD,  $\alpha = 0.05$ ).

## Project Title

Processing tomato cultivar trials Part 2: screening for Pinnacle tolerance, 2023

## Research Agency/location

University of Guelph Ridgetown Campus

## Lead and Key Investigators

Steve Loewen

Satinder Chopra

## Executive summary

A split-plot RCBD experimental design with unsprayed and sprayed with a 12g/ha (high label rate) of Pinnacle was used to investigate differences in processing tomato cultivar tolerance to Pinnacle herbicide. Based on several different methods the following conclusions were drawn: Susceptible: H1418, H2239, H5108, HM 58871, LS0176, LS0266 and N1069 (susceptible check). Possibly susceptible: H1014, H2123, HM 588841, Pumatis. Unclear or possibly resistant: LS0645, Nunhems 00254. Resistant: CC337, H1648, H3406, LS0188, N1480e (resistant check), N3306, TSH34, TSH44. The Pinnacle rate was changed this year to assist growers in anticipating the potential trade-offs if Pinnacle must be relied upon for weed control. This year's results showed that even in susceptible cultivars, it is difficult to detect yield differences by the time harvest arrives.

## Objective

The first objective of this project was to measure the field, handling, peeling and fruit quality performance of new hybrids recently listed in seed company catalogues. The results of that work were presented in a separate report. The second objective was to evaluate the trial entries for tolerance to Pinnacle herbicide. These results are reported here.

## Materials and Methodology

### Cultivars

Ontario processing tomato company representatives were surveyed for hybrids of interest for the trial. Like 2022, there were 20 entries plus 2 check cultivars H3406 and H5108 in the cultivar trial in 2023. N1069 and N1480e were added for the Pinnacle tolerance trial as check cultivars based on their known reaction to Pinnacle exposure. Our own previous work has confirmed N1069 as showing significant visual injury from Pinnacle exposure and N1480e as being resistant to Pinnacle.

Transplants were grown in 200 cell plug trays in the greenhouses at Ridgetown Campus.

### Trial site

The trial site and experimental setup is reproduced here from the cultivar trial report for convenience.

One site was established in the same field as the processing tomato breeding plots near Selton Line and Kenesserie Road. This trial was planted on May 23, 2023.

The Pinnacle tolerance screening trial was superimposed on 3 replications of the RCBD cultivar trial, as a split-plot design. Cultivars were randomized in all 3 replications. Main plot treatment was cultivar and sub-plot treatment was unsprayed or sprayed at the high label rate (12g/ha) Pinnacle. This is different from all previous trials where a 2X rate of Pinnacle was used.

Row spacing was 5 feet apart. Main plots were 36 feet long and planted in twin rows 22 inches apart and plants 18 inches apart within a row, to achieve a plant population of 11,616 plants per acre. Weeds were controlled by ppi Dual II Magnum 1.75 L/ha and Sencor 75D 600 g/ha, followed by cultivation and hoeing. There were four additional applications of Sencor 75D at 200 g/ha tank mixed with fungicides. Foliar and fruit diseases were controlled with sprays of Echo 720 (1.7 L/ha tank mixed with Sencor or 2.8 L/ha alone) and Bravo (2.4 L/ha tank mixed with Sencor or 4 L/ha alone). This site received 17.1 inches of rainfall from June 10 to September 28 (compared to 7.8 inches in 2022).

### Pinnacle tolerance screening

One sub-plot within each cultivar main plot was sprayed with a high label rate (12g/ha) of Pinnacle (thifensulfuron-methyl 50%) 2.5 weeks after transplanting (June 19).

### Visual ratings of Pinnacle injury

One week later (June 26) two raters (S.L. and S.C.) separately assessed the plants for symptoms of Pinnacle injury on a scale of 0 to 5. Thus there was a total of 6 ratings per entry.

### Yield measurements and maturity

Plants in both unsprayed and sprayed sub-plots were harvested as described previously for Yield Measurements. No other evaluations were conducted on the fruit from Pinnacle-sprayed sub-plots.

## Results/Conclusions

### Yield results (Table 1)

In this experiment where the goal is to determine if a tomato cultivar is tolerant to Pinnacle or not, the most interesting response to observe is the interaction between cultivar (= entry in Table 1) and Pinnacle treatment (unsprayed or sprayed). If the interaction is determined to be truly different and not merely numerically different (which is usually an artifact of random variation in experimental conditions), then we would conclude that a cultivar behaves differently if it is exposed to Pinnacle than if it is not exposed.

In 2023 the interactions were significant between cultivar and the maturity. On average, over all cultivars, Pinnacle treated sub-plots were slightly later in maturity than unsprayed plots, but individual comparisons, within cultivar showed enough random variation that it is not possible to say with certainty that the difference was due to Pinnacle exposure. This is further supported by the fact that some plots matured earlier with Pinnacle application. Recall that in 2023 we sprayed with the high label rate (lower than the 2X rate used in previous years) and at this lower rate, we might expect responses to be less exaggerated.

The cultivar (entry) by Pinnacle treatment interaction was not significant for yield in 2023, even though there were numerical differences in yield between sprayed and unsprayed sub-plots within cultivar. The yields were numerically different, but either random variation (or the effects of partial flooding) may explain this. On average, over all plots, yield between sprayed and unsprayed plots was not different.

Again, numerical differences are due to random variation. Thus at this rate of Pinnacle, for the cultivars tested, on average, yield is not negatively affected by exposure to Pinnacle. This tends to support findings from previous years, that it is difficult to detect differences in yield between sprayed and unsprayed plots for any particular cultivar by the time harvest arrives.

### Incidence of visual injury ratings for all symptoms (Table 2)

Four days after spraying subplots with a 12g/ha rate of Pinnacle, the plants in each sprayed subplot were rated for visual symptoms of Pinnacle injury on a scale of 0 to 5, where 0 = completely resistant, no evidence of any symptoms; 1 = probably resistant, uncertain or very slight amount of yellowing of meristems; 2 = possibly resistant, very slight cupping of leaflets, very slight yellowing of meristems; 3 = intermediate, slight yellowing, slight cupping of leaflets; 4 = probably susceptible, clear yellowing of leaflets, cupping of leaflets; 5 = clearly susceptible, epinasty of leaves, usually yellowing of meristems and leaflets, often necrosis on recently emerged leaflets.

Since these were category ratings rather than evenly spaced, continuous quantities, for each cultivar, the number of each rating category was counted (Table 2). Since there were 3 replications in the trial, and there were 2 individuals rating separately, the maximum number of ratings for each cultivar is 6.

These entries showed good evidence of resistance to severe visual foliage injury: CC337, H1648, H3406, LS0188, N1480e (resistant check), N3306, TSH43 and TSH44.

H1014 was clearly susceptible in 2022 and 2021 at higher rates of Pinnacle but was strongly rated as resistant in 2023 under the lower Pinnacle rate. We interpret this cautiously as H1014 might be susceptible at a higher rate but appears to show resistance at a lower rate.

The results of this assessment for 2023 showed that H1418, H2123, H2239, H5108, HM 58871, HM 588841, LS0176, LS0266, Pumatis and N1069 (susceptible check) were susceptible to visual foliar injury 4 days after spraying.

Entry H1301 was Unclear in 2023 but called as resistant based on 2022 results. LS0645 and Nunhems 00254 were also Unclear in their response.

### Summary (Table 3)

A range of rating methods and maturity and yield measurements results in the following conclusions on cultivar response to being sprayed with a high label rate of Pinnacle 2 weeks after transplanting in 2023:

Susceptible: H1418, H2239, H5108, HM 58871, LS0176, LS0266 and N1069 (susceptible check).

Possibly susceptible: H1014, H2123, HM 588841, Pumatis

Unclear or possibly resistant: LS0645, Nunhems 00254

Resistant: CC337, H1648, H3406, LS0188, N1480e (resistant check), N3306, TSH34, TSH44.

### Acknowledgements

The support of the Ontario Tomato Research Institute, the seed companies and the processor representatives is gratefully acknowledged.

**Table 1. Days from transplant to harvest and yields for unsprayed and Pinnacle-sprayed plots for each cultivar, 2023.**

Entry	Pinnacle trt	days	Red ripe	Breakers	Proc Grn	Grass Grn	Limited Use / rots	Potential yield
			tons/acre	t/a	t/a	t/a	t/a	tons/acre
CC337	1_unsprayed	103.3 abcde	37.7 abcd	5.8 a	1.8 bc	0.9 c	1.1 cd	47.2 abcde
CC337	1_Pinnacle	105.7 abcde	36.4 abcdef	9.6 a	2.5 bc	1.3 c	0.6 cd	50.5 abcd
H1014	2_unsprayed	108.3 abcde	16.2 efg	3.2 a	1.3 bc	1.7 bc	3.5 abcd	25.9 cdef
H1014	2_Pinnacle	98.3 cde	21.6 abcdefg	7.8 a	2.5 bc	3.7 bc	2.4 abcd	38 abcdef
H1301	3_unsprayed	98 cde	29.1 abcdefg	9 a	2.3 bc	1.5 bc	0.9 cd	42.9 abcde
H1301	3_Pinnacle	98 cde	37.1 abcde	7.9 a	1.3 bc	1.9 bc	0.7 cd	49 abcde
H1418	4_unsprayed	121 a	16.3 efg	2.7 a	4.4 abc	13 a	0.2 d	36.6 abcdef
H1418	4_Pinnacle	121 a	15.4 fg	6.6 a	8.1 a	10.3 ab	0.4 cd	40.8 abcdef
H1648	5_unsprayed	115.7 abc	27.2 abcdefg	5 a	2.9 abc	3.6 bc	3.4 abcd	42 abcde
H1648	5_Pinnacle	111 abcde	26.7 abcdefg	4 a	1.8 bc	2.5 bc	1.5 bcd	36.5 abcdef
H2123	6_unsprayed	115.7 abc	28.4 abcdefg	5.3 a	1.9 bc	2.7 bc	1.8 bcd	40.1 abcdef
H2123	6_Pinnacle	105.7 abcde	25 abcdefg	9.2 a	5.6 abc	4.2 bc	0.9 cd	44.8 abcde
H2239	7_unsprayed	115.7 abc	25.2 abcdefg	10.8 a	2.9 abc	3.8 bc	3 abcd	45.6 abcde
H2239	7_Pinnacle	100.7 bcde	35.7 abcdef	8.1 a	1.5 bc	0.6 c	6.5 a	52.5 ab
H3406	8_unsprayed	103.3 abcde	34.9 abcdef	6.7 a	1 bc	0.5 c	1.1 cd	44.3 abcde
H3406	8_Pinnacle	105.7 abcde	36.1 abcdef	11 a	1 bc	0.7 c	0.8 cd	49.7 abcde
H5108	9_unsprayed	103.3 abcde	27.4 abcdefg	4.8 a	1.5 bc	1.7 bc	3.6 abcd	39 abcdef
H5108	9_Pinnacle	93.3 e	17.6 cdefg	8.8 a	3.4 abc	3 bc	1.9 bcd	34.7 abcdef
HM 58871	10_unsprayed	118.3 ab	19.6 abcdefg	5.4 a	2.3 bc	4.5 abc	1.7 bcd	33.5 abcdef
HM 58871	10_Pinnacle	105.7 abcde	23 abcdefg	6.6 a	3.5 abc	5.4 abc	0.5 cd	39 abcdef
HM 588841	11_unsprayed	113 abcd	26.1 abcdefg	9.4 a	1.3 bc	1.4 c	2.3 abcd	40.5 abcdef
HM 588841	11_Pinnacle	106 abcde	34.8 abcdef	6.6 a	1.2 bc	1.6 bc	1.9 bcd	46.1 abcde
LS0176	12_unsprayed	116 abc	17.8 bcdefg	3.4 a	1.3 bc	1.9 bc	1.1 cd	25.5 def
LS0176	12_Pinnacle	103.3 abcde	19.9 abcdefg	7.8 a	6 ab	3.3 bc	0.6 cd	37.6 abcdef
LS0188	13_unsprayed	103.3 abcde	37 abcde	7.1 a	3.7 abc	3 bc	1.5 bcd	52.4 ab
LS0188	13_Pinnacle	103.3 abcde	38.9 ab	8.6 a	4.3 abc	3.4 bc	1.7 bcd	56.8 a
LS0266	14_unsprayed	113 abcd	35.5 abcdef	4.4 a	1.1 bc	1 c	5.7 ab	47.8 abcde
LS0266	14_Pinnacle	121 a	30.7 abcdefg	2.7 a	3.2 abc	6.8 abc	3.2 abcd	46.6 abcde
LS0645	15_unsprayed	118.3 ab	16 efg	3 a	1 bc	1.9 bc	2.3 abcd	24.2 ef
LS0645	15_Pinnacle	103.3 abcde	19 abcdefg	5 a	4.2 abc	7.3 abc	3.9 abcd	39.4 abcdef
N1069	22_unsprayed	105.7 abcde	30.2 abcdefg	3.6 a	1.3 bc	0.4 c	4.7 abc	40.3 abcdef
N1069 (susc)	22_Pinnacle	98 cde	23.7 abcdefg	7.1 a	3 abc	5 abc	1.9 bcd	40.8 abcdef
N1480e	23_unsprayed	95.7 de	19.6 abcdefg	4.7 a	1.8 bc	1.9 bc	1.4 cd	29.3 bcdef
N1480e (res)	23_Pinnacle	95.7 de	16.8 defg	5.8 a	1.4 bc	1.6 bc	2.2 bcd	27.7 bcdef
N3306	16_unsprayed	98 cde	26.9 abcdefg	5.4 a	1 bc	3.5 bc	1.8 bcd	38.4 abcdef
N3306	16_Pinnacle	98 cde	31.6 abcdefg	2.8 a	0.5 c	1.2 c	1.4 bcd	37.6 abcdef
Nunhems00254	17_unsprayed	94.5 de	32 abcdefg	3.4 a	0.7 bc	0.6 c	3.2 abcd	39.9 abcdef
Nunhems00254	17_Pinnacle	94.5 de	30.3 abcdefg	3.2 a	0.6 bc	1.1 c	3.7 abcd	38.8 abcdef
Pumatis	18_unsprayed	121 a	9.7 g	1.7 a	0.9 bc	2.9 bc	0.9 cd	16.1 f
Pumatis	18_Pinnacle	105.7 abcde	23.4 abcdefg	7.9 a	3.5 abc	3.2 bc	0.3 d	38.3 abcdef
TSF-43	19_unsprayed	95.7 de	38 abc	7.3 a	2.5 bc	1 c	1.7 bcd	50.6 abcd
TSF-43	19_Pinnacle	95.7 de	39.3 a	6.6 a	2.1 bc	1.1 c	1.9 bcd	51 abc
TSF-44	20_unsprayed	93.3 e	28.7 abcdefg	6.5 a	2.8 abc	1.2 c	3.7 abcd	42.9 abcde
TSF-44	20_Pinnacle	93.3 e	27.2 abcdefg	6.5 a	2.1 bc	0.5 c	2.7 abcd	38.9 abcdef
Pinnacle		108.5 a	27.7 a	6.8 a	2.9 a	3.3 a	1.9 a	42.5 a
unsprayed		103.1 b	26.3 a	5.5 b	1.9 a	2.6 a	2.3 a	38.5 b
CV		5.31	22.4	54.1	74.1	97.7	93.5	18.7
Mean		105.8	26.9	6.2	2.4	2.9	2.1	36.32
interaction (entry x pinnacle trt)		**	ns	ns	**	ns	**	ns
subplot (unsprayed or sprayed)		***	ns	*	***	0.07 *	*	**
main plot (entry)		***	**	ns	**	***	**	ns

Means are based on 3 reps. Entries arranged alphabetically. Means within cols followed by same letter are not different Tukey's HST, ( $\alpha=0.05$ ).

Table 2. Incidence of visual ratings for Pinnacle-sprayed subplots, 4 days after spraying, pooled over 3 replications and 2 raters, 2023.

Entry	Ratings of severity of response to 12g/ha Pinnacle application.					
	0 completely resistant	1 probably resistant	2 possibly resistant	3 intermediate	4 probably susceptible	5 clearly susceptible
CC337	2	4				
H1014		6				
H1301		2	1	2	1	
H1418			3		3	
H1648		3	3			
H2123			1	1	4	
H2239			1		5	
H3406	3	2	1			
H5108				2	4	
HM 58871			2		4	
HM 588841			1	2	3	
LS0176			1		5	
LS0188		6				
LS0266		1			5	
LS0645			3	1	2	
N1069 (susc)					6	
N1480e (res)		5	1			
N3306		6				
Nunhems 00254		2	1	1	2	
Pumatis		2		1	3	
TSH43	3	3				
TSH44	3	3				

Visual injury rating scale:

0 = completely resistant, no evidence of any symptoms;

1 = probably resistant, uncertain or very slight amount of yellowing of meristems;

2 = possibly resistant, very slight cupping of leaflets, very slight yellowing of meristems;

3 = intermediate, slight yellowing, slight cupping of leaflets;

4 = probably susceptible, clear yellowing of leaflets, cupping of leaflets;

5 = clearly susceptible, epinasty of leaves, usually yellowing of meristems and leaflets, often necrosis on recently emerged leaflets.

Table 3. Summary of results of different evaluations assessing tolerance of processing tomato cultivars to Pinnacle application, 2023.

Entry	Injury 4 days after spraying, 2023 (high label rate)	Conclusion from 2021 season (2X rate)	Conclusion from 2022 season (2X rate)	Final conclusion, 2023
CC337	Res		Res	Resistant
H1014	Res	Susc	Susc	Susceptible at high rates
H1301	Unclear	Unclear	Res	Resistant
H1418	Susc?	Susc	Susc	Susceptible
H1648	Res		Res	Resistant
H2123	Susc?			Susceptible?
H2239	Susc			Susceptible
H3406	Res		Res	Resistant
H5108	Susc	Susc?	Susc	Susceptible
HM 58871	Susc			Susceptible
HM 588841	Susc?			Susceptible?
LS0176	Susc			Susceptible
LS0188	Res			Resistant
LS0266	Susc			Susceptible
LS0645	Unclear			Unclear
N1069 (susc)	Susc	Susc	Susc	Susceptible
N1480e (res)	Res	Res	Res	Resistant
N3306	Res		Res	Resistant
Nunhems 00254	Unclear			Unclear
Pumatis	Susc?		Susc?	Susceptible?
TSH43	Res		Res	Resistant
TSH44	Res		Res	Resistant

Not all entries evaluated in 2023 were evaluated in 2022 and 2021. "Susceptible?" is interpreted as possibly susceptible and "Unclear" is interpreted as unclear or possibly resistant.