2004 NEW JERSEY HEIRLOOM TOMATO OBSERVATION TRIAL RESULTS[1]

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Introduction

This is the third year evaluating heirloom tomatoes for New Jersey growers under the five-year Program Enhancement Grant funded by the New Jersey Agricultural Experiment Station. New Jersey growers are looking for new markets to help maintain agricultural viability on their farms. There is increasing demand for heirloom tomatoes in the market place at roadside stands, tailgate markets, restaurants and in the wholesale market. It is difficult for growers to evaluate heirloom tomatoes since there are hundreds of varieties. The objective of this study is to help growers narrow down the number of varieties suitable for New Jersey growing conditions and markets.

Materials and Methods

Culture

All seeds were disinfected with chlorine bleach (1 part Clorox in 4 parts water for two minutes then rinsed in water for 10 minutes). Seeds were sown on April 8 in 72-cell trays (1 1/2" X 1 1/2") containing peat and vermiculite media at the Rutgers Agricultural Research and Extension Center (RAREC). Seedlings were thinned to 1 plant per cell on April 27. Plants were grown in a greenhouse until one week before transplanting when they were placed in an outside protected area to harden off. On May 7 *imidacloprid* (Admire) was applied as a drench to the seedling flats before transplanting at a rate of three milliliters (ml) per flat (72 plants) in sufficient water to saturate the growing media without draining off.

The trial was established in a field (Chillum silt loam, 6.45) at RAREC in Upper Deerfield. Beds on 6-ft centers were formed and black plastic mulch with drip irrigation tube was laid. On May 14 plants were set in the field using a water wheel transplanter in single rows with 24 inches between plants. After transplanting, the two lower suckers were removed from each plant and 8 ft. tomato stakes with one stake between every two plants were set. Tomato string was used to hold the plants on the stakes. The first string was placed 6 inches off the ground and the remaining strings (5 – 7) were placed at 8 – 12 inch intervals.

Before bed making and based on soil testing, 60 lbs/A of nitrogen, plus phosphorus (P_2O_5) and potassium (K_2O) were disked into the sandy loam soil. For weed control, Devrinol 50DF (3 lbs/A) was applied and incorporated during bedding. After laying plastic, Devrinol 50DF(4 lbs/A), Sandea (1 oz/A) and Sencor 75 (1/3 lb/A) was applied between the beds to control the weeds. Three applications of 37 lbs/A of N, P_2O_5 and K_2O were applied through the drip system during the growing season. A total of 1.4 pounds per acre boron was applied with the other nutrients through the drip system. Insecticides (Spintor-6 oz/A July 18, Provado-3oz/A August 29 and Actara-4oz/A September 5) were applied for insect control.

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Applying the following materials controlled diseases: Bravo WS 3 pt/A (July 18, August 29, September 5 and 12); Bravo WS 1.5 pt/A (August 6); and Curzate 5 oz/A (July 18 and August 29). Rainfall was 3.82, 3.42, 5.55, 4.23 and 2.60 inches in May, June, July, August and September, respectively. Rainfall was supplemented with drip irrigation.

Experimental Design, Harvesting and Evaluations

The trial consisted of single plots with eight plants. Tomatoes were hand harvested on July 15, 22 and 29, August 5, 11, 17 and 26, September 2, 8 and 16. Fruits were graded into marketable and culls, counted and weighed. Culls were further divided by type of defect (blossom end rot, insect damage, green shoulder, cat facing, zipper, rot, small, misshapen, cracks, sunburn and rain checking) and counted. At the seventh harvest, ten fruit were randomly selected from marketable fruit to evaluate internal and external characteristics. On September 8, data was collected on vine vigor, vine size, plant color and plant height. All yield data is recorded in pounds per plot since there was no replication.

The cultivars and seed sources are listed in Table 1 followed by the key for fruit characteristics in Table 2 and plant characteristics in Table 3.

Table 1. Seed Source

Variety	Seed Source
Black from Tula	Tomato Grower's Supply
Brandywine Black	Tomato Grower's Supply
Burgess Stuffing Tomato	Tomato Grower's Supply
Lemon Boy	Tomato Grower's Supply
Marizol Purple	Tomato Grower's Supply
Mule Team	Tomato Grower's Supply
Nepal	Tomato Grower's Supply
Pantano Romanesco	Tomato Grower's Supply
Paul Robeson	Tomato Grower's Supply
Southern Night	Tomato Grower's Supply
Thessaloniki	Tomato Grower's Supply
Ugly	Tomato Grower's Supply
Apple Tomato Seed	Rutgers
Better Boy	Rutgers

Table 2. Fruit Characteristics Key

Shape
1 – Beef Steak
2 – Flattened Globe
3 – Round
4 – Blocky
5 – Long Blocky
6 – Very Deep-Round
7 – Pear
8 – Plum
9 – Oxheart
10 – Bell
11 – Flat
12 - Elongated Oxheart
13 - Globe

Stem Scar
1 – Small
2 – Small/Medium

External Color
1 – White
2 – Green
3 – Light Yellow
4. – Yellow
5 – Dark Yellow
6 – Orange Yellow
7 – Orange
8 – Red Orange
9 – Red
10 – Light Pink
11 – Pink
12 – Dark Pink
13 - Purple
14 – Black
15 – Mahogany
16 – Pink Mahogany
17 – Orange Mahogany

Firmness
1 – Very Soft
2 - Soft
3 - Medium
4 – Firm
5 – Very Firm

Blossom Scar
1 - Small
2 – Small/Medium
3 - Medium
4 – Medium/Large
5 - Large

Internal Color
1 - Red
2 – Yellow/Red
3 – Yellow

Stem Scar (cont)
3 – Medium
4 – Medium/Large
5 - Large

External Color (cont)
18 – Red Gold
19 – Gold Red
20 – Red Green
21 – Yellow Red
22 – Gold

Internal Color (cont)
4 – Yellow/Green
5 - Green
6 - Red/Yellow
7 - Orange
8 - Pink
9 - Gold
10 - Light Pink
11.- Light Red
12.- Pink/Red
13. - Pink/Green

Jelly Color
1 – Green
2 – Yellow/Green
3 – Yellow
4 – Yellow/Red
5 – Red
6 - Orange

Core Size
1 – Small
2 – Small/Medium
3 - Medium
4 – Medium/Large
5 - Large

Table 2. Fruit Characteristics Key (continued)

Cracking
1 – Severe
2 - Abundant
3 - Moderate
4 - Light
5 - No

Shoulder Appearance
1 - Poor
2 - Fair
3 – Good
4 – Very Good
5 - Excellent

White Tissue
1 – Severe
2 – Moderate Heavy
3 - Moderate
4 – Slight
5 - None

Table 3. Plant Characteristics Key

Plant Color
1 – Dark Green
2 – Green
3 – Light Green
4 – Blue Green

Plant Vigor
1 – Poor
2 – Fair
3 – Good/Average
4 – Very Good
5- Excellent

Stem Attachment
1 – Jointless
2 – Jointed

Leaf Type
1 – Regular
2 – Regular/Narrow
3 – Regular/Curled
4 – Regular/Fuzzy
5 – Potato

Vine Size
1 - Small
2 – Small/Medium
3 - Medium
4 – Medium/Large
5 - Large

Results and Discussion

Rainfall was distributed evenly throughout the production season. Plants were not as vigorous in 2004 and fruit rots were not a serious problem. Early season harvests (1-4) are summarized in Table 4. Days to harvest from transplanting ranged from 62 days (Black from Tula, Marizol Purple, Paul Robeson, Southern Night, Thessaloniki and Ugly) to 76 days (Burgess Stuffing Tomato, Lemon Boy and Nepal).

The cultivars ‘Black from Tula’, ‘Marizol Purple’, ‘Paul Robeson’, ‘Southern Night’ and ‘Ugly’ yielded more total and marketable yield than the average for the trial. ‘Mule Team’ and Marizol Purple had the largest fruit (10.77 and 13.43 oz/fruit, respectively). The remaining cultivars had medium size fruit except the cultivar ‘Apple Tomato’ which was small.

Table 4. Heirloom tomato yield and fruit size for first, second, third and fourth harvest (early) – Rutgers Agricultural Research and Extension Center, Bridgeton, New Jersey – 2004.

Variety	DTH[1]	Total Lbs/Plot	Marketable Lbs/Plot	Cull Lbs/Plot	% Marketable	Fruit Wt. Oz.
Black from Tula	62	72.0	53.8	18.2	75	7.65
Brandywine Black	69	48.5	28.0	20.5	58	7.66
Burgess Stuffing Tomato	76	25.7	10.3	15.5	40	5.75
Lemon Boy	76	30.3	21.7	8.6	72	7.73
Marizol Purple	62	109.9	104.0	5.9	95	10.77
Mule Team	69	23.3	17.6	5.7	76	13.43
Nepal	76	25.2	16.4	8.9	65	6.66
Pantano Romanesco	69	26.2	14.0	12.2	53	7.86
Paul Robeson	62	69.3	46.3	23.0	67	8.62
Southern Night	62	84.4	51.5	32.9	61	7.04
Thessaloniki	62	51.0	34.8	16.2	68	6.79
Ugly	62	104.8	84.3	20.5	80	8.65
Apple Tomato Seed	69	17.2	17.2	0.0	100	3.61
Better Boy	69	45.4	30.0	15.4	66	6.16
Mean	**----**	**52.4**	**37.9**	**14.5**	**----**	**----**

[1]Days to harvest for marketable fruit from transplanting

Table 5 summarizes the combined yield and fruit size for the mid season harvests (5, 6, and 7). The total yield varied between 74.2 and 155.8 lbs/plot. 'Brandywine Black', 'Burgess Stuffing Tomato', 'Lemon Boy', Southern Night' and Better Boy' yielded more fruit than the average for all cultivars. However, only 'Burgess Stuffing Tomato', 'Lemon Boy', 'Ugly' and 'Better Boy' had more marketable fruit than the average among the cultivars. The percent marketable fruit increased for most cultivars compared to the early harvest. Fruit size did decrease for all cultivars except 'Burgess Stuffing Tomato', 'Nepal' and 'Better Boy'.

Table 5. Heirloom tomato yield and fruit size for the fifth, sixth and seventh harvest (mid season) – Rutgers Agricultural Research and Extension Center, Bridgeton, New Jersey – 2004.

Variety	Total Lbs/Plot	Marketable Lbs/Plot	Cull Lbs/Plot	% Marketable	Fruit Wt. Oz.
Black from Tula	95.6	62.0	33.7	65	6.96
Brandywine Black	108.6	72.5	36.2	67	5.72
Burgess Stuffing Tomato	155.8	125.4	30.4	81	6.08
Lemon Boy	138.3	118.6	19.7	86	8.01
Marizol Purple	97.6	76.2	21.4	78	9.35
Mule Team	91.8	77.4	14.3	84	9.49
Nepal	78.6	59.8	18.8	76	7.27
Pantano Romanesco	74.2	49.5	24.7	67	6.77
Paul Robeson	85.8	61.5	24.4	72	8.06
Southern Night	106.7	64.6	42.1	61	6.19
Thessaloniki	83.7	71.2	12.5	85	6.70
Ugly	100.0	85.8	14.2	86	6.66
Apple Tomato Seed	99.1	75.2	24.0	76	4.52
Better Boy	110.4	87.3	23.1	79	6.53
Mean	**101.9**	**77.6**	**24.3**	**----**	**----**

Table 6 summarizes the total, marketable, cull yield, percent marketable fruit and fruit size for the late harvest period. Six cultivars ('Burgess Stuffing Tomato', 'Lemon Boy', 'Marizol Purple', 'Nepal', 'Thessaloniki' and 'Better Boy') had higher total yield than the average for all cultivars. These same cultivars with the addition of 'Mule Team' had above the mean for marketable yield. Fruit size continued to decrease as the season progressed. Only 'Mule Team' and 'Thessaloniki' had larger fruit than at the mid season harvest, but they were still smaller than during the early harvest period. Percent marketable fruit ranged between 48 and 90%. 'Lemon Boy' had the highest percentage marketable fruit and 'Brandywine Black' the lowest.

Table 6. Heirloom tomato yield and fruit size for the eighth, ninth and tenth harvest (late season) – Rutgers Agricultural Research and Extension Center, Bridgeton, New Jersey – 2004.

Variety	Total Lbs/Plot	Marketable Lbs/Plot	Cull Lbs/Plot	% Marketable	Fruit Wt. Oz.
Black from Tula	17.8	11.4	6.5	64	5.78
Brandywine Black	28.3	13.6	14.8	48	5.79
Burgess Stuffing Tomato	116.1	83.5	32.6	72	4.28
Lemon Boy	80.3	71.9	8.3	90	5.81
Marizol Purple	94.9	81.2	13.7	86	7.73
Mule Team	54.6	47.8	6.5	88	10.85
Nepal	56.8	46.7	10.1	82	5.14
Pantano Romanesco	54.5	36.6	17.9	67	5.58
Paul Robeson	31.6	18.4	13.2	58	5.54
Southern Night	36.2	24.6	11.6	68	7.03
Thessaloniki	65.1	41.9	23.3	64	4.78
Ugly	46.9	38.0	8.9	81	7.79
Apple Tomato Seed	41.8	26.3	15.5	63	3.37
Better Boy	56.3	41.7	14.7	74	5.33
Mean	**55.8**	**41.7**	**14.1**	**----**	**----**

Table 7 summaries the number of day's fruit was harvested, total, marketable and cull yields, percentage and size of marketable fruit. Fruit harvest ranged from 49 to 63 days. All cultivars still had marketable fruit to ripen when the trials was terminated. Six cultivars ('Burgess Stuffing Tomato', 'Lemon Boy', 'Marizol Purple', 'Southern Night', 'Ugly' and 'Better Boy') had higher total yield than the average for the trial. This was also true for marketable yield except 'Southern Night' which was less than the average. The percentage marketable fruit ranged from 61 to 86% for the full season. All cultivars had medium fruit size except 'Marizol Purple' and 'Mule Team' (large) and 'Apple' (small).

Table 7. Heirloom tomato yield and fruit size for all harvests. – Rutgers Agricultural Research and Extension Center, Bridgeton, New Jersey – 2004.

Variety	Total Harvest Days	Total Lbs/Plot	Marketable Lbs/Plot	Cull Lbs/Plot	% Marketable	Fruit Wt. Oz.
Black from Tula	63	185.5	127.1	58.3	69	7.10
Brandywine Black	56	185.5	114.0	71.4	61	6.11
Burgess Stuffing Tomato	49	297.6	219.1	78.5	74	5.23
Lemon Boy	49	248.9	212.3	36.5	85	7.08
Marizol Purple	63	302.4	261.5	41.0	86	9.23
Mule Team	56	169.4	142.9	26.5	84	10.30

Variety	Total Harvest Days	Total Lbs/Plot	Marketable Lbs/Plot	Cull Lbs/Plot	% Marketable	Fruit Wt. Oz.
Nepal	49	160.6	122.9	37.8	76	6.21
Pantano Romanesco	56	154.9	100.1	54.8	65	6.39
Paul Robeson	63	186.6	126.1	60.5	68	7.73
Southern Night	63	227.2	140.7	86.6	62	6.62
Thessaloniki	63	199.8	147.8	51.9	74	6.03
Ugly	63	251.6	208.0	43.6	83	7.56
Apple Tomato Seed	56	158.1	118.7	39.4	75	4.07
Better Boy	56	212.2	159.0	53.2	75	6.10
Mean	**----**	**210.0**	**157.2**	**52.9**	**----**	**----**

Table 8 summaries the yield for green fruit remaining at the end of the season. Since most heirloom tomatoes are indeterminate they will continue to produce as long as the plant is healthy. Six of the cultivars ('Black from Tula', 'Brandywine Black', 'Burgess Stuffing Tomato', 'Southern Night', 'Apple' and 'Better Boy' had less than the average total yield. This was also true for marketable yield with the addition of 'Pantano Romanesco'.

Table 8. Heirloom tomato yield and fruit size for green fruit at the end of the season. – Rutgers Agricultural Research and Extension Center, Bridgeton, New Jersey – 2004.

Variety	Total Lbs/Plot	Marketable Lbs/Plot	Cull Lbs/Plot	% Marketable	Fruit Wt. Oz.
Black from Tula	25.3	14.3	11.0	56	4.61
Brandywine Black	17.0	7.8	9.2	46	4.88
Burgess Stuffing Tomato	14.2	6.0	8.2	42	3.54
Lemon Boy	38.2	23.2	15.1	61	4.94
Marizol Purple	27.5	21.9	5.6	80	5.69
Mule Team	28.0	25.0	2.9	90	6.85
Nepal	40.3	16.6	23.7	41	5.98
Pantano Romanesco	37.4	12.3	25.1	33	5.24
Paul Robeson	32.0	25.4	6.6	79	5.21
Southern Night	12.2	10.0	2.1	82	4.86
Thessaloniki	50.5	28.6	21.9	57	3.32
Ugly	34.7	28.0	6.7	81	5.81
Apple Tomato Seed	2.6	1.7	0.9	66	2.46
Better Boy	17.4	12.1	5.4	69	3.57
Mean	**27.0**	**16.6**	**10.3**	**----**	**----**

Table 9 summaries the external fruit characteristics for all cultivars. All the cultivars were globe to flat globe in shape. The shoulder appearance was good to excellent for all cultivars except 'Ugly' which was very rough. Heirloom tomatoes have a tendency to be soft when ripe. This set of cultivars followed that pattern except 'Apple' and 'Burgess Stuffing' which were firm to very firm. Large stem and blossom scars are not as serious of a concern as with standard round tomatoes. All cultivars had medium to large scars except 'Apple' and Burgess Stuffing' which were medium to small. There is a wide variation in external fruit color for heirloom tomatoes. That is one thing that can make the fruit attractive to consumers. These cultivars ranged in color from yellow to pink mahogany.

Table 9. Heirloom tomato external fruit characteristics - Rutgers Agricultural Research and Extension Center, Bridgeton, New Jersey – 2004.

Variety	Diameter (cm)	Depth (cm)	Dia/Dep	Shoulder Appearance	Shape	Firm-ness	Stem Scar	Blossom Scar	External Color
Black from Tula	8.01	5.95	0.74	4	2	2	4	5	16
Brandywine Black	7.10	5.32	0.75	*	*	*	*	4	16
Burgess Stuffing Tomato	7.90	6.30	0.80	5	13/3	4	2	1	8
Lemon Boy	7.02	6.25	0.89	4	2	3	3	2	4
Marizol Purple	8.27	6.14	0.74	3	13/3	3	4	4	11
Mule Team	9.90	7.15	0.72	3	2/3	3	5	4	9
Nepal	7.75	5.68	0.73	3	13	2	5	3	9
Pantano Romanesco	7.65	6.05	0.79	3	2	3	4	3	9
Paul Robeson	8.71	5.95	0.68	4	2	1	4	5	16
Southern Night	7.80	6.35	0.81	3	2/13	1	5	3	16
Thessaloniki	7.00	6.10	0.87	4	3	1	4	2	9
Ugly	9.90	6.42	0.65	2	2	2	5	3	9
Apple Tomato Seed	5.95	4.85	0.82	3	13	5	1	1	11
Better Boy	7.80	6.45	0.83	3	3/13	3	4	2	9

* Mixed variety

The internal fruit characteristics are summarized in table 10. Internal color ranged from yellow to a pink/green with most being red to light pink. The cultivars with the pink mahogany external fruit color had green jelly color while the remaining cultivars had a yellow color. A large core size reduces the amount of eatable flesh. Three cultivars ('Paul Robeson', 'Ugly' and 'Better Boy') had medium large to large cores. Cracked fruit can reduce shelf life and make the fruit unmarketable in a short period of time. Among these cultivars 'Black from Tula', 'Mule Team', 'Southern Night' and 'Ugly' had the most cracked fruit. Internal white tissue also reduces the among to consumable tomato flesh. Three cultivars ('Lemon Boy', 'Southern Night' and 'Apple') had no white tissue. The worst cultivar for internal white tissue was 'Black from Tula'.

Table 10. Heirloom tomato internal fruit characteristics – Rutgers Agricultural Research and Extension Center, Bridgeton, New Jersey – 2004.

Variety	Internal Color	Jelly Color	Core Size	Cracking	White Tissue
Black from Tula	13	1	3	1	2
Brandywine Black	*	1	2	*	*
Burgess Stuffing Tomato	11	3	2	5	3
Lemon Boy	3	3	2	4	5
Marizol Purple	1	3	2	4	4
Mule Team	1	3	3	2	3

Variety	Internal Color	Jelly Color	Core Size	Cracking	White Tissue
Nepal	1	3	3	3	4
Pantano Romanesco	1	3	2	4	3
Paul Robeson	13	1	4	4	4
Southern Night	8	1	3	1	5
Thessaloniki	11	3	3	4	4
Ugly	11	3	5	2	3
Apple Tomato Seed	12	2	1	5	5
Better Boy	11	3	4	4	4

* Mixed Variety

Plant characteristics are summarized in table 11. All these cultivars could be produced on a standard four/five foot tomato stake. They all have good to excellent plant vigor and the vine size is medium to large. Two of the cultivars ('Black from Tula' and 'Southern Night') were potato leaf types while the remainder were regular tomato leaf. All cultivars had jointed stem attachments.

Table 11. Heirloom tomato plant characteristics – Rutgers Agricultural Research and Extension Center, Bridgeton, New Jersey – 2004.

Variety	Avg. Plant Height (ft)	Plant Color	Plant Vigor	Vine Size	Leaf Type	Stem Attachment
Black from Tula	4.0	1	3	4	5	2
Brandywine Black	4.8	1	3	4	1	2
Burgess Stuffing Tomato	5.8	1	5	3	1	2
Lemon Boy	5.1	2	3	3	1	2
Marizol Purple	5.6	4	4	4	1	2
Mule Team	4.9	2	3	4	1	2
Nepal	5.1	1	4	4	1	
Pantano Romanesco	5.0	1	3	5	1	2
Paul Robeson	6.1	1	3	4	1	2
Southern Night	4.8	1	3	4	5	2
Thessaloniki	5.7	1	4	4	1	2
Ugly	4.4	1	3	3	1	2
Apple Tomato Seed	6.2	1	5	5	1	2
Better Boy	4.5	1	3	3	1	2

Conclusion

Based on yield data and fruit characteristics the best full season cultivars were 'Lemon Boy', 'Marizol Purple', and 'Ugly'. These cultivars should be evaluated for another year before moving them into a full replicated trial. Two specialty cultivars: 'Burgess Stuffing' and 'Apple' should also be considered for continued evaluation.

2004 OBSERVATION TOMATO CULTIVARS


Burgess Stuffing
Tomato


Burgess Stuffing
Tomato


Hawaiian Pineapple


Hawaiian Pineapple


Lemon Boy


Lemon Boy


Marizol Purple


Marizol Purple


Mule Team


Mule Team


Nepal


Nepal


Pantano Romanesco


Pantano Romanesco


Paul Robeson


Paul Robeson


Southern Night


Southern Night


Thessaloniki


Thessaloniki


Ugly


Ugly