

## APPENDIX A.8

### 2002 NEW JERSEY SMALL ROUND HEIRLOOM TOMATO OBSERVATION TRIAL RESULTS<sup>1</sup>

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#### INTRODUCTION

Heirloom tomatoes are an expanding niche in the produce industry. Growers are trying to determine which heirlooms consumers prefer, but there are several hundred possibilities. Yields, plant and fruit characteristics vary widely among the different varieties and heirlooms need special post harvest handling. The tomato program enhancement grant is evaluating heirloom tomatoes to help growers make determinations as to which varieties have acceptable horticultural characteristics for New Jersey conditions. This report is one of five from 2002.

#### MATERIALS AND METHODS

##### Culture

Seeds were sown on April 15 in 200 cell trays and transplanted into 48 cell trays. The media contained peat-vermiculite formulated for tomato transplant production at Snyder Research and Extension Farm on May 10. Plants were transferred to the Rutgers Agricultural Research and Extension Center (RAREC) and maintained in the greenhouse until one week before transplanting when they were placed in an outside protected area to harden off. Beds on 5-ft centers were formed and black plastic mulch with drip irrigation tube was laid. Plants were set in the field on May 26 by hand in single rows with 24 inches between plants. Plants were staked with 8 ft. tomato stakes using one stake between every two plants. Tomato string was used to hold the plants on the stakes. The first string was placed at 6 inches off the ground and the rest of the strings (5 – 7) were placed at 8 – 12 inches apart.

Before bed making a pre-plant fertilizer was applied at 60-lbs/A nitrogen as calcium nitrate. All additional fertilizer was applied through the drip system four times during the growing season with Peters 20-20-20 at a rate of 62 lbs/A of nitrogen (N), phosphorus (P<sub>2</sub>O<sub>5</sub>), and potassium (K<sub>2</sub>O) for three applications and 1 application at the rate of 30 lbs/A for total nutrients of 216 lbs/A of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O per mulched acre. A total of three-pounds boron was applied with the other nutrients through the drip system.

The herbicide *Napropamide* (Devrinol 50DF - 3 lbs/A) was applied broadcast prior to bedding. This was followed with *metolachlor* (Dual Magnum II - 1.9 oz/A) and *paraquat* (Gramoxone Extra - 0.25 pts/A) between the beds after the plastic was laid. Insects and diseases were controlled using commercial recommendations for tomatoes. *Imidacloprid* (Admire - 3ml/flat) was applied as a drench to the seedling flats before transplanting in enough water to saturate

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the growing media without draining off. The following materials were applied to the foliage with an air blast sprayer: *Avermectin-B* (Agri-mek 0,15EC – 8 oz/A), *azoxystrobin* (Quadris - 6 oz/A) and *lambda-cyhalothrin* (Warrior – 4 oz/A) – August 23 and *cyfluthrin* (Baythroid 2 – 2.8 oz/A) and *chlorothalonil* (Bravo Weather Stik – 3.0 pt/A) – August 27.

Over all the temperature throughout the growing season was warm and dry. With the monthly high average temperatures of 67, 76, 82, 87, 96, 80, and 64 degrees fahrenheit for months April, May, June, July, August, September and October, respectively. With the monthly low average temperatures of 45, 51, 62, 66, 66, 58 and 48 degrees fahrenheit for months April, May, June, July, August, September and October, respectively. The monthly rainfall (in inches) for April, May, June, July, August, September and October was 3.32, 3.86, 6.10, 2.08, 2.96, 2.53 and 5.78, respectively for a season total of 26.63 inches. Tensiometers were placed in each replication at the 12-inch depth to schedule supplement irrigation.

### Experimental Design, Harvesting and Evaluation

The cultivars were arranged in a randomized complete block design with four plants per plot and two replications. Tomatoes were hand harvested on July 26, August 1, 9, 15, 24, 30, September 6, 12, 19, 25 and October 7. Fruits were graded into marketable and culls; both were counted and weighed. Culls were further divided by the type of defect (blossom end rot, insect damage, green shoulder, cat facing, zipper, rot, small, misshapen; radial, concentric, and transversal cracks; sunburn, rain checking, and miscellaneous) and counted.

At the 7th harvest, five fruit were randomly selected from marketable fruit for each replication to evaluate internal and external fruit characteristics. Data was collected on vine vigor, fruit cover and plant height on October 25. Data were statistically analyzed using ANOVA and compared with Least Significant Difference (LSD) Test at the 5% level. All yield data is recorded in 25 lb boxes.

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**

Cultivar	Source
Bloody Butcher	Scheepers Kitchen Garden Seeds
Borgo Cellano	Scheepers Kitchen Garden Seeds
Garden Peach	Tomato Growers Supply Co.
Juane Flamme	Tomato Growers Supply Co.
Ladino di Panocchio	Marianna's Heirlooms
Madagascar	Marianna's Heirlooms
Mr. Stripey	Tomato Growers Supply Co.
Stupice	Tomato Growers Supply Co.

## **Table 2. Fruit Characteristics Key**

### **Shape:**

- 1- Beef Steak
- 2- Flattened Globe
- 3- Round
- 4- Blocky
- 5- Long Blocky

*(Key continued from previous page)*

### **Shape (Cont) :**

- 6- Very Deep-Round Oval
- 7- Pear
- 8- Plum
- 9- Oxheart
- 10- Bell
- 11- Flat
- 12- Elongated Oxheart

### **Stem Scar:**

- 1- Small
- 2- Small / Medium
- 3- Medium
- 4- Medium / Large
- 5- Large

### **Jelly Color:**

- 1- Red
- 2- Yellow / Red
- 3- Yellow
- 4- Yellow / Green
- 5- Green

### **External Color:**

- 1- White
- 2- Green
- 3- Light Yellow
- 4- Yellow
- 5- Dark Yellow

### **External Color (Cont):**

- 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- Red Mahogany
- 17- Orange Mahogany

### **Core Size:**

- 1- Small
- 2- Small / Medium
- 3- Medium
- 4- Medium / Large
- 5- Large

### **Overall Internal:**

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

### **Firmness:**

- 1- Firm
- 2- Medium / Firm
- 3- Medium
- 4- Medium / Soft
- 5- Soft

### **Blossom Scar:**

- 1- Small
- 2- Small / Medium
- 3- Medium
- 4- Medium / Large
- 5- Large

### **Internal Flesh Color:**

- 1- Red
- 2- Yellow / Red
- 3- Yellow
- 4- Yellow / Green
- 5- Green

### **Overall External:**

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

## **Table 3. Plant Characteristics Key**

### **Plant Color:**

- 1- Dark Green
- 2- Green
- 3- Light Green

### **Stem Attachment:**

- 1- Jointed
- 2- Jointless

### **Plant Vigor:**

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

### **Leaf Type:**

- 1- Regular
- 2- Regular / Narrow
- 3- Regular / Curled
- 4- Regular / Fuzzy
- 5- Potato

### **Fruit Cover:**

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

### **Vine Size:**

- 1- Small
- 2- Small / Medium
- 3- Medium
- 4- Medium / Large
- 5- Large

## RESULTS AND DISCUSSION

The days to harvest from transplanting, total yield, percent marketable fruit and average marketable fruit size for harvest 1, 2 and 3 (early yield) are shown in Table 4.

The cultivar 'Bloody Butcher' had the highest total and marketable yield, but it was not significantly different from 'Borgo Cellano', 'Stupice' or 'Ladino di Panocchio' for total yield or 'Borgo Cellano' and 'Ladino di Panocchio' for marketable yield. 'Madagascar' had the lowest total yield, marketable yield, percent marketable fruit and smallest marketable fruit size. This cultivar should have been included in the cherry trial since it had a small fruit size. All cultivars had over 50% marketable fruit except 'Madagascar' at 28%.

The cultivar 'Bloody Cellano' highest number of cull fruit but was only statistically different from 'Garden Peach' and 'Madagascar'. When the cull fruit were separated by the type of cull (data not shown) there were no statistical differences for blossom end rot, green-shoulder, zippered fruit, misshapen fruit, rain checking, insect damage, cracks, gold flecking, under sized fruit or cat facing.

**Table 4. Small round heirloom yield and fruit size for early season harvest – RAREC Bridgeton, New Jersey - 2002**

Cultivar	Days to Harvest	Total Boxes/A	Marketable Boxes/A	Cull Boxes/A	% Marketable	Marketable Fruit Wt. Oz.
Bloody Butcher	61	600	443	157	74	2.0
Borgo Cellano	61	378	251	127	71	2.5
Garden Peach	67	251	230	21	91	2.2
Juane Flamme	61	317	220	98	69	2.2
Ladino di Panocchio	61	491	411	80	84	3.6
Madagascar	67	4	1	3	28	0.4
Mr. Stripey	61	319	284	35	90	2.3
Stupice	61	424	326	98	77	2.1
<b>LSD 0.05</b>	-----	<b>258</b>	<b>163</b>	<b>123</b>	<b>39</b>	<b>1.6</b>

Table 5 summarizes the combined yield and fruit size data for the mid season harvests (4, 5, 6 and 7). Total yield ranged from 547 to 1668 boxes/A for the mid season harvests. There were no statistical differences among the cultivars for total yield except for 'Madagascar', which had the lowest yield. 'Borgo Cellano' had the highest marketable yield at 1404 boxes/A, but was not statistically different from 'Garden Peach', 'Juane Flamme', 'Mr. Stripey' or 'Stupice'. These same cultivars had the lowest cull fruit number along with 'Madagascar'. Percent marketable fruit is more important than the number of culls. Most cultivars were not statistically different from one another for percent marketable fruit. 'Borgo Cellano' had the highest percent pack out, but it was not statistically different from 'Garden Peach', 'Juane Flamme', or 'Mr. Stripey' while 'Madagascar' had the lowest that was not different from the other cultivars except 'Borgo Cellano' or 'Garden Peach'.

When cull numbers were analyzed (data not shown), 'Madagascar' had the most blossom end rot followed by the cultivar 'Borgo Cellano'. These two were statistically different from each other and the other cultivars. There were no statistical differences among the cultivars for the other cull parameters.

**Table 5. Small round heirloom yield and fruit size for mid season harvests – RAREC, Bridgeton, New Jersey – 2002**

Cultivar	Total Boxes/A	Marketable Boxes/A	Cull Boxes/A	% Marketable	Marketable Fruit Wt. Oz.
Bloody Butcher	1639	888	751	55	1.4
Borgo Cellano	1545	1404	142	91	0.9
Garden Peach	1366	1113	254	82	1.5
Juane Flamme	1544	1140	404	75	1.7
Ladino di Panocchio	1634	856	778	53	2.5
Madagascar	547	328	220	59	1.1
Mr. Stripey	1668	1258	411	75	1.8
Stupice	1667	1100	567	66	1.6
<b>LSD 0.05</b>	<b>312</b>	<b>430</b>	<b>367</b>	<b>22</b>	<b>0.6</b>

Table 6 summarizes the combined yield and fruit size data for the late season harvests (8, 9, 10 and 11). Total yield ranged from 566 to 1521 boxes/A for the late season harvests.

'Madagascar' statistically had the lowest yield compared to all other cultivars. 'Borgo Cellano' and 'Bloody Butcher' were statistically equal while all other cultivars did not differ from each other. 'Garden Peach' and 'Juane Flamme' had the highest marketable yields, but did not differ statistically from 'Mr. Stripey' and 'Stupice'. 'Madagascar' had statistically the lowest marketable yield for the late season harvests.

The percentage of marketable fruit varied between 72 and 90%. The cultivars 'Bloody Butcher' and 'Madagascar' had the lowest percent marketable fruit, but only differed from 'Borgo Cellano', 'Garden Peach', and 'Juane Flamme' which had the highest percent marketable fruit.

There were no statistical differences among the cultivars for cull fruit. When cull numbers were analyzed (data not shown), 'Madagascar' had significantly more BER than the other cultivars and all other culls were not statistically different from one another. 'Stupice' had significantly more fruit with insect damage than 'Madagascar', which had the least. The other cultivars were not statistically different from one another.

The cultivar 'Ladino di Panocchio' had significantly more cat facing than the other cultivars. All other cultivars were not statistically different from each other. 'Mr. Stripey' had statistically more rot than the other cultivars. All the cultivars were not different from one another. 'Bloody Butcher' had the most concentric cracking. Two cultivars 'Borgo Cellano' and 'Madagascar' had none.

**Table 6. Small round heirloom yield and fruit size for late season harvests – RAREC, Bridgeton, New Jersey – 2002**

<b>Cultivar</b>	<b>Total Boxes/A</b>	<b>Marketable Boxes/A</b>	<b>Cull Boxes/A</b>	<b>% Marketable</b>	<b>Marketable Fruit Wt. Oz.</b>
Bloody Butcher	1360	973	387	72	1.2
Borgo Cellano	1096	984	113	90	0.7
Garden Peach	1449	1293	156	89	1.0
Juane Flamme	1450	1296	153	90	1.1
Ladino di Panocchio	1440	1056	382	73	1.5
Madagascar	566	405	162	72	0.6
Mr. Stripey	1515	1127	388	75	1.0
Stupice	1521	1202	320	80	1.3
<b>LSD 0.05</b>	<b>301</b>	<b>217</b>	<b>279</b>	<b>16</b>	<b>0.3</b>

Table 7 summarizes the combined yield and fruit size data for the total seasonal harvests. Total yield ranged from 1117 to 3611 boxes/A for the full season. Cultivars ‘Bloody Butcher’, ‘Juane Flamme’, ‘Ladino di Panocchio’, ‘Mr. Stripey’ and ‘Stupice’ had the highest yields among all cultivars. ‘Madagascar’ had the lowest yield and was statistically different from all other cultivars. There were no differences among the cultivars for marketable yield except for ‘Madagascar’, which had the lowest yield. ‘Bloody Butcher’ and ‘Ladino di Panocchio’ had significantly more cull fruit than all other cultivars while ‘Madagascar’ had the lowest. Madagascar had fewer cull fruit than ‘Stupice’, ‘Bloody Butcher’ and ‘Ladino di Panocchio’. ‘Borgo Cellano’, ‘Garden Peach’ and ‘Juane Flamme’ had more than 80% marketable fruit, but were not statistically different from ‘Mr. Stripey’ and ‘Stupice’. ‘Bloody Butcher’ had the lowest percent market fruit at 65%, but only statistically differed from ‘Borgo Cellano’ and ‘Garden Peach’.

When cull numbers were analyzed (data not shown), ‘Madagascar’ had significantly more BER than the other cultivars followed by ‘Borgo Cellano’. All other cultivars were not statistically different from one another. ‘Stupice’ had significantly more fruit with insect damage than ‘Madagascar’, which had the least. Zippers on fruit can be a cosmetic defect that may or may not cause rejection of the product. Any zippering on the fruit caused it to be considered a cull in this trial. ‘Bloody Butcher’ statistically had the most zippers, but the other cultivars had only a few for the total season. The cultivar ‘Ladino di Panocchio’ was the only one with a significant number for cat facing for the season. With dry weather for most of the production season there were few fruit rots. ‘Mr. Stripey’ did have more rotten fruit than the other cultivars, but it was still a low number for the season (23 fruit). ‘Bloody Butcher’ had more concentric cracks than any other cultivar. Two cultivars ‘Borgo Cellano’ and ‘Madagascar’ had no concentric cracks for the season. There were no statistical differences among the cultivars for the following parameters: green shoulder, small fruit, radial cracking, transversal cracking, sunburn fruit or rain checking.

**Table 7. Small round heirloom yield and fruit size for total seasonal harvests – RAREC, Bridgeton, New Jersey – 2002**

Cultivar	Total Harvest Days	Total Boxes/A	Marketable Boxes/A	Cull Boxes/A	% Marketable	Marketable Fruit Wt. Oz.
Bloody Butcher	74	3599	2305	1294	65	1.3
Borgo Cellano	74	3019	2639	380	87	0.8
Garden Peach	68	3065	2635	430	86	1.2
Juane Flamme	74	3310	2656	655	81	1.4
Ladino di Panocchio	74	3565	2325	1240	66	2.0
Madagascar	68	1117	733	384	66	0.8
Mr. Stripey	74	3502	2668	833	76	1.3
Stupice	74	3611	2627	985	73	1.5
<b>LSD 0.05</b>	-----	<b>443</b>	<b>566</b>	<b>563</b>	<b>16</b>	<b>0.3</b>

Table 8 summarizes the fruit characteristics for the seventh harvest from a sample of 5 marketable fruit per replication. Most cultivars were round to blocky except ‘Ladino di Panocchio’, which was flat. The external color for the cultivars were orange to red except ‘Garden Peach’ that has a distinct pale yellow color and ‘Madagascar’ that is dark pink. Fruit firmness is a concern to growers if they plan to ship fruit to the wholesale market. These cultivars would be acceptable for shipping except ‘Mr. Stripey’ which was medium soft in firmness. A small stem and blossom scar are desirable traits for tomatoes. All eight cultivars have either small or medium small scars. The overall external and internal ratings were very good to excellent for all cultivars except ‘Mr. Stripey’, which had an internal rating of good. Jelly and internal flesh color can affect the acceptance of a cultivar. Most standard cultivars have red to yellow red colors. This group of heirloom’s jelly varied between red to yellow green. Most were yellow-to-yellow green, which may make them unacceptable for the market. Internal flesh color was a more consistent red color. The exceptions were ‘Bloody Butcher’ and ‘Ladino di Panocchio’ that had a yellow flesh. Most cultivars had a medium to large core, which can reduce the acceptance.

**Table 8. Small round heirloom fruit characteristics for the seventh harvest – RAREC, Bridgeton, New Jersey – 2002** (Table continues on next page)

Cultivar	Length (in) <sup>1</sup>	Width (in) <sup>1</sup>	L/W <sup>1</sup>	Shape <sup>2</sup>	Ext. Color <sup>2</sup>	Firm-ness <sup>3</sup>	Stem Scar <sup>4</sup>	Blossom Scar <sup>4</sup>	Overall Ext. <sup>5</sup>	Overall Int. <sup>5</sup>	Jelly Color <sup>6</sup>	Intern. Flesh <sup>6</sup>	Core Size <sup>4</sup>
Bloody Butcher	1.5	1.8	0.9	3	8	2	1	1	2	2	3	3	3
Borgo Cellano	1.7	1.3	1.3	6	9	1	1	1	1	1	3	1	2
Garden Peach	1.4	1.7	0.7	3	3	2	1	1	1	1	3	1	5
Juane Flamme	1.8	1.6	1.1	8	7	3	1	2	1	1	4	1	3
Ladino di Panocchio	1.3	2.0	0.7	11	9	2	2	2	2	2	4	3	4
Madagascar	1.5	1.2	1.3	4	12	1	1	1	1	1	1	1	2
Mr. Stripey	1.5	1.5	1.0	4	9	4	1	1	1	3	4	2	4

Cultivar	Length (in) <sup>1</sup>	Width (in) <sup>1</sup>	L/W <sup>1</sup>	Shape <sup>2</sup>	Ext. Color <sup>2</sup>	Firmness <sup>3</sup>	Stem Scar <sup>4</sup>	Blossom Scar <sup>4</sup>	Overall Ext. <sup>5</sup>	Overall Int. <sup>5</sup>	Jelly Color <sup>6</sup>	Intern. Flesh <sup>6</sup>	Core Size <sup>4</sup>
Stupice	1.4	1.7	0.9	3	9	3	1	1	1	2	1	1	3
<b>LSD 0.05</b>	<b>0.2</b>	<b>0.2</b>	<b>0.1</b>	-	-	-	-	-	-	-	-	-	-

<sup>1</sup>-Mean of 5 fruit; <sup>2</sup> - see table 2; <sup>3</sup> - 1=firm, 5=soft; <sup>4</sup> - 1=small, 5=large; <sup>5</sup> - 1=excellent, 5=poor; <sup>6</sup> - 1=red, 5 =green

(Table continued from previous page)

Table 9 summarizes plant characteristics that were evaluated at the last harvest. Plant color and vigor was acceptable for these cultivars. Plant height can be a problem for growers of heirloom tomatoes. Most cultivars are indeterminate which makes them very tall. This group of cultivars ranged from 5.6 to 8.9 feet, which makes staking a problem. Normal tomato stakes are approximately five feet, but for cultivars at least six foot stakes are needed and eight foot ones are better. Fruit cover was average to poor for all cultivars. This could lead to sunburn fruit, but there was little problem with sunburn fruit in this trial. Leaf types vary among the heirloom tomatoes from the standard leaf to a potato appearance. 'Bloody Butcher' is the only cultivar in this group that had a potato leaf appearance. All cultivars had a medium to large vine size, which coincides with the average plant height. All cultivars had jointed stem attachment that means the calyx remains attached to the fruit. For the fresh market calyx attached to the fruit provides a better appearance and consumer acceptance.

**Table 9. Small round heirloom tomato plant characteristics – RAREC, Bridgeton, New Jersey – 2002**

Cultivar	Plant Color <sup>1</sup>	Plant Vigor <sup>2</sup>	Avg. Plant Height (ft) <sup>3</sup>	Fruit Cover <sup>2</sup>	Leaf Type <sup>4</sup>	Vine Size <sup>5</sup>	Stem Attachment <sup>6</sup>
Bloody Butcher	2	3	5.8	4	5	3	1
Borgo Cellano	1	1	6.0	4	2	4	1
Garden Peach	2	2	6.9	4	2	3	1
Juane Flamme	1	3	5.6	5	2	4	1
Ladino di Panocchio	2	2	6.5	4	2	4	1
Madagascar	1	2	8.9	3	1	5	1
Mr. Stripey	2	3	6.1	3	2	4	1
Stupice	2	3	5.9	3	3	4	1
<b>LSD 0.05</b>	<b>2</b>	<b>2</b>	<b>2.4</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1</b>

<sup>1</sup> - 1=dark green, 3=light green; <sup>2</sup> - 1=excellent, 5=poor; <sup>3</sup> - mean two plants; <sup>4</sup> - 1=regular, 5=potato; 5 - 1=small, 5=large; <sup>6</sup> - 1=jointed, 2=Jointless

## SUMMARY

All the cultivars in this observation trial should be evaluated in multi replicated cultivar trials. The cultivar 'Madagascar' had the lowest yield which may be a reason for removing it from the evaluation list.