APPENDIX A.7

2002 NEW JERSEY PASTE HEIRLOOM TOMATO OBSERVATION TRIAL RESULTS[1]

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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 media 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 with 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) where placed at 8 – 12 inch intervals.

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_2O_5), and potassium (K_2O) for three applications and 1 application at the rate of 30 lbs/A for total nutrients of 216 lbs/A of N, P_2O_5 and K_2O 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)

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was applied as a drench to the seedling flats before transplanting in enough water to saturate the growing media without draining off. The following materials were applied to the foliage with an air blast sprayer: A*vermectin-B* (Agri-mek 0,15EC – 8 oz/A), *azoxystrobin* (Quadris - 6 oz/A) and *lambdacyhalothrin* (Warrior – 4 oz/A) – August 23 and *cyfluthrin* (Baythriod 2 – 2.8 oz/A) and *chlorothalonil* (Bravo Weather Stik – 3.0 pt/A) – August 27.

Overall, 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 were; 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 supplemental 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 seventh harvest, five fruit was 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 *(Table continues on next page)*

Cultivar	Source
Black Plum	Seed of Change
Canestrino	Marianna’s Heirlooms
Dix Doights de Naples	Marianna’s Heirlooms
Ernie's Plump	Marianna’s Heirlooms
Federle	Seed Savers Exchange
Gallo Plum	Marianna’s Heirlooms
Giant Italian Paste	Burpee’s Seeds
Heart's Fire	Shepherd’s Garden Seeds
Heidi	Chuck Wyatt’s Heirloom Tomatoes
Howard German	Tomato Grower’s Seed Co.
Italian Gold	Burpee’s Seeds
Polish Linguisa	Shepherd’s Garden Seeds

Cultivar	Source
Super Marzano	Shepherd's Garden Seeds
Super Sarno	Johnny's Selected Seeds

(Table continued from previous page)

Table 2 Fruit Characteristics Key *(Table continues on next page)*

Shape:
1- Beef Steak
2- Flattened Globe
3- Round
4- Blocky
5- Long Blocky
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
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. Field Observations Key *(Table continues on next page)*

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

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

Table 3. Field Observations Key
(Table continued from previous page)

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

(Table continued from previous page)

RESULTS AND DISCUSSION

Table 4 summarizes the days to harvest, yield components and marketable fruit size. All the cultivars were ready to harvest 61 days from transplant except 'Federle' and 'Heidi' which took 67 days. There was a wide range in total and marketable yield among the cultivars. Two cultivars had no marketable yield for the early harvests, 'Federle' and 'Polish Linguisa'. 'Heart's Fire' had the highest total and marketable yield. The percent marketable fruit varied between 0 and 94 percent. The cultivars 'Heidi' had 94% marketable fruit. This cultivar is not an heirloom type, which may explain the high percentage of marketable fruit. Fruit size varied between 1.1 to 7.2 ounces per fruit.

Table 4. Plum- Paste Heirloom yield and fruit size for first, second, and third harvest (early) – RAREC Bridgeton, New Jersey - 2002

Cultivar	Days to Harvest	Total Boxes/A	Marketable Boxes/A	Cull Boxes/A	% Marketable	Marketable Fruit Wt. Oz.
Black Plum	61	347	233	125	68	1.1
Canestrino	61	262	200	63	76	2.8
Dix Doights de Naples	61	151	41	110	26	1.9
Ernie's Plump	61	401	278	123	69	6.5
Federle	67	82	0	82	0	--
Gallo Plum	61	41	13	28	21	1.5
Giant Italian Paste	61	373	194	180	55	7.2
Heart's Fire	61	622	477	146	75	2.3
Heidi	67	163	152	11	94	2.3
Howard German	61	114	14	100	8	1.3
Italian Gold	61	263	70	194	27	3.4
Polish Linguisa	61	83	0	83	0	--
Super Marzano	61	355	28	327	8	3.8
Super Sarno	61	188	112	77	56	3.9
LSD 0.05	--------	**188**	**171**	**113**	**32**	**2.0**

Yield components and marketable fruit size are summarized in table 5. Total yield ranged from 463 to 2940 boxes/A. The cultivars 'Ernie's Plump', 'Super Marzano' and 'Super Sarno' had the highest total yields and were statistically different from all other cultivars. 'Giant Italian Paste' had the lowest yield, but was not different from 'Federle'. The cultivar 'Federle' had the lowest marketable yield, but was not statistically different from 'Gallo Plum', 'Howard German' or 'Polish Linguisa'. 'Super Sarno', 'Super Marzano' and 'Heidi' had the highest yields among the

fourteen cultivars. However, except for 'Super Sarno', they were not statistically different from four or five other cultivars. The cultivar 'Heidi' had the fewest cull fruit, but statistically was equal to 'Canestrino' and 'Giant Italian Paste. 'Ernie's Plump' and 'Black Plum' had the greatest number of cull fruit per acre. When culls were separated by type of defect (data not shown), Ernie's Plump' and 'Dix Doights de Naples' had significantly more blossom end rot fruit than all other cultivars. This was followed by 'Super Marzano' that was statistically higher than the remaining cultivars. 'Super Sarno' had more insect damage than all cultivars. Green shoulder can be a determent to commercial tomato cultivars since the area under the shoulder is usually hard, therefore, reducing the eatable portion. 'Heart's Fire' had more green shoulder and radial. As with the early harvest 'Heidi' had the highest percentage marketable fruit, but it was not statistically better than 'Canestrino', 'Ernie's Plump', or 'Italian Gold'. 'Federle' and 'Howard German' had the lowest percent marketable fruit. The fruit size varies widely among the different cultivars from 0.8 to 6.2 ounces/fruit. 'Black Plum', 'Canestrino', 'Heart's Fire', 'Heidi', 'Italian Gold' and 'Super Sarno' had the lowest fruit size. While 'Polish Linguisa', 'Howard German', 'Giant Italian Paste' and 'Ernie's Plump' were the largest.

Table 5. Plum Paste heirloom tomato 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.
Black Plum	1511	990	521	65	0.8
Canestrino	1662	1364	299	82	1.9
Dix Doights de Naples	1552	903	649	58	1.7
Ernie's Plump	2402	1774	628	74	5.6
Federle	463	50	414	11	3.5
Gallo Plum	976	523	453	49	4.2
Giant Italian Paste	115	802	353	70	4.5
Heart's Fire	1389	701	688	50	1.6
Heidi	1984	1800	185	91	1.9
Howard German	1101	259	842	22	5.5
Italian Gold	1509	1084	426	72	2.3
Polish Linguisa	1168	309	859	28	6.2
Super Marzano	2440	1467	974	61	3.3
Super Sarno	2940	2059	880	70	2.7
LSD 0.05	**586**	**610**	**220**	**20**	**1.9**

Table 6 summarizes the data for total, marketable cull yields, percent marketable fruit and marketable fruit size for the late season harvest. 'Heidi' had significantly higher total and marketable yields than all other cultivars during this period. The cultivar 'Super Sarno' had the lowest total yield, but it was not statistically different from 'Super Marzano', 'Polish Linguisa', 'Howard German', 'Gallo Plum' 'Federle', 'Dix Doights de Naples' or 'Black Plum'. The same cultivars had the lowest marketable yield except 'Black Plum'.

'Federle' had the most cull fruit, but was not statistically different from 'Polish Linguisa', 'Super Marzano', 'Howard German' or 'Ernie's Plump'. While, 'Black Plum' had the fewest cull fruit, but was not statistically less than seven other cultivars. When the cull fruit were separated and counted by type, the cultivar 'Dix Doights de Napes' had significantly more blossom end rot

(BER) than the other cultivars. Two had no BER: 'Giant Italian Paste' and Heart's Fire'. Cracked fruit is a problem with some heirloom tomatoes, which reduces shelf life or makes them unmarketable. 'Heart's Fire' had significantly more concentric cracked fruit in the late harvest period than any other cultivar. 'Canestrino' and 'Ernie's Plump' had statistically more cracked fruit than all other cultivars except 'Heart's Fire'.

Four cultivars 'Heidi', 'Giant Italian Paste', 'Canestrino' and 'Black Plum' had a statistically higher percentage marketable fruit while 'Federle' and 'Polish Linguisa' had the lowest. Marketable fruit size varied from 0.6 ounces for 'Black Plum' to 4.8 ounces for 'Howard German'. This shows the wide range of fruit size of Paste tomatoes.

Table 6. Plum Paste heirloom tomato yield and fruit size for late season harvests – RAREC, Bridgeton, New Jersey – 2002

Cultivar	Total Boxes/A	Marketable Boxes/A	Cull Boxes/A	% Marketable	Marketable Fruit Wt. Oz.
Black Plum	1061	866	196	81	0.6
Canestrino	1549	1263	285	81	1.6
Dix Doights de Naples	1016	586	431	58	1.0
Ernie's Plump	1779	1097	682	61	4.4
Federle	1171	209	962	18	3.5
Gallo Plum	975	498	477	52	4.2
Giant Italian Paste	1922	1569	352	82	3.9
Heart's Fire	1719	1159	560	68	1.1
Heidi	2297	2058	239	90	1.5
Howard German	1113	331	782	30	4.8
Italian Gold	1487	1009	477	68	1.8
Polish Linguisa	1058	153	905	15	4.6
Super Marzano	1075	453	622	42	2.0
Super Sarno	741	314	426	43	2.9
LSD 0.05	**471**	**439**	**281**	**11**	**1.1**

All cultivars were harvested for 74 days except 'Federle' and 'Heidi' which harvested for 68 days. These two cultivars were six days later at the beginning of the season than all others. The cultivars 'Heidi' and 'Ernie's Plump' had the highest total and marketable yield for the season long harvest. They were statistically different from all other cultivars for total yield, but 'Ernie's Plump' did not differ from several cultivars for marketable yield. 'Heidi' had the highest percentage marketable fruit and lowest cull numbers than all other cultivars except 'Canestrino'. Cultivars such as 'Federle' and 'Polish Linguisa' had a low percentage of marketable fruit. As with the other harvests, fruit size varied from 0.7 to 5.6 ounces per fruit. This relates to the variability in the germplasm.

Table 7. Plum Paste heirloom tomato yield and fruit size for total harvests – RAREC, Bridgeton, New Jersey – 2002

Cultivar	Total Harvest Days	Total Boxes/A	Marketable Boxes/A	Cull Boxes/A	% Marketable	Marketable Fruit Wt. Oz.
Black Plum	74	2918	2078	840	71	0.7
Canestrino	74	3472	2827	646	81	1.8
Dix Doights de Naples	74	2719	1530	1190	56	1.4
Ernie's Plump	74	4581	3150	1432	69	5.2
Federle	68	1716	259	1457	15	3.5
Gallo Plum	74	1992	1034	989	52	4.4
Giant Italian Paste	74	3449	2564	885	75	4.1
Heart's Fire	74	3728	2336	1393	63	1.4
Heidi	68	4444	4010	434	90	1.7
Howard German	74	2328	604	1724	26	4.9
Italian Gold	74	3259	2163	1098	67	2.0
Polish Linguisa	74	2307	462	1846	20	5.6
Super Marzano	74	3871	1948	1923	51	2.8
Super Sarno	74	3868	2485	1383	64	2.8
LSD 0.05	--------	**842**	**950**	**278**	**12**	**1.1**

Fruit characteristics for the fourteen cultivars are summarized in table 8. All cultivars had elongated fruit except 'Giant Italian Paste' and 'Heart's Fire', which were round. One cultivar 'Italian Gold' was dark yellow in color. The remainder ranged from orange to red with the exception of 'Black Plum' that was red mahogany. The fruit for all cultivars was medium to firm except for 'Federle' that was medium soft. This would make this cultivar unacceptable for the wholesale market. All cultivars had average or better blossom and stem scars. 'Super Marzano', 'Polish Linguisa', 'Howard German' and 'Federle' had a fair overall exterior rating. The results were similar for the interior rating. Jelly color was red to yellow for all cultivars except 'Canestrino' which was green. The green color may detract from consumer acceptance. The fruit flesh color varied from the jelly color with some cultivars. A large core size can detract from an acceptable fruit. All these cultivars had medium to large cores except 'Italian Gold' which was small.

Table 8. Plum Paste heirloom tomato fruit characteristics for the seventh harvest – RAREC, Bridgeton, New Jersey – 2002 *(Table continued next page)*

Cultivar	Length (in)[1]	Width (in)[1]	L/W[1]	Shape[2]	Ext. Color[2]	Firm-ness[3]	Stem Scar[4]	Blossom Scar[4]	Overall Ext.[5]	Overall Int.[5]	Jelly Color[6]	Intern. Flesh[6]	Core Size[4]
Black Plum	1.7	1.1	1.5	6	16	2	1	1	1	2	2	1	4
Canestrino	2.0	1.9	1.1	10	9	2	1	1	1	3	5	3	5
Dix Doights de Naples	2.3	1.2	2.0	5	9	1	1	1	2	1	1	1	3
Ernie's Plump	2.8	2.6	1.1	10	9	2	2	1	2	2	1	2	4
Federle	4.1	1.5	2.7	5	8	4	2	1	4	3	1	3	5
Gallo Plum	4.4	1.9	2.3	12	9	2	3	1	3	2	1	1	3
Giant Italian Paste	2.2	2.7	0.8	3	5	1	2	1	1	4	2	4	4

Cultivar	Length (in)[1]	Width (in)[1]	L/W[1]	Shape[2]	Ext. Color[2]	Firm-ness[3]	Stem Scar[4]	Blossom Scar[4]	Overall Ext.[5]	Overall Int.[5]	Jelly Color[6]	Intern. Flesh[6]	Core Size[4]
Heart's Fire	1.4	1.6	0.9	3	9	2	1	1	1	2	3	2	5
Heidi	2.3	1.5	1.5	8	8	2	1	1	1	2	2	2	4
Howard German	4.0	1.7	2.4	12	7	1	2	1	4	4	1	4	4
Italian Gold	2.8	1.5	1.8	5	5	3	2	1	2	1	3	1	1
Polish Linguisa	3.6	1.6	2.2	12	9	1	2	1	4	3	1	1	5
Super Marzano	2.3	1.6	2.2	5	8	1	2	1	4	5	2	3	4
Super Sarno	3.2	91.9	1.7	5	8	2	2	1	3	2	1	2	3
LSD 0.05	**1.0**	**0.4**	**1.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

[1] – Mean of 5 fruit; [2] – see table 2; [3] – 1=firm, 5=soft; [4] – 1=small, 5=large; [5] – 1=excellent, 5=poor; [6] – 1=red, 5 =green

(Table continued from previous page)

Plant characteristics are summarized in table 9. All cultivars were green to dark green in color. Two cultivars had fair plant vigor, 'Italian Gold' and 'Super Sarno'. The plant height ranged from 4.1 to 7.3 feet. The shorter cultivars could be raised on standard tomato stakes while the taller cultivars need 6 to 7 foot stakes. Fruit cover was fair to good for most cultivars except 'Heart's Fire' where it was poor. Since fruit cover ratings were taken at the end of the season, the rating maybe higher at the beginning of harvest. All cultivars had either regular or narrow leaf type. Five cultivars had jointless stem attachment, 'Ernie's Plump', 'Federle', 'Polish Linguisa', 'Super Marzano' and 'Super Sarno'. If harvesting for processing, a jointless attachment is preferred since it does not need to be removed for processing. However, if the fruit is being sold as fresh fruit this could be a detriment.

Table 9. Plum Paste heirloom tomato plant characteristics – RAREC, Bridgeton, New Jersey – 2002

Cultivar	Plant Color[1]	Plant Vigor[2]	Avg. Plant Height (ft)[3]	Fruit Cover[2]	Leaf Type[4]	Vine Size[5]	Stem Attachment[6]
Black Plum	1	3	7.0	4	1	4	1
Canestrino	2	3	5.8	4	2	5	1
Dix Doights de Naples	2	2	7.4	3	2	4	1
Ernie's Plump	2	2	6.2	3	2	4	2
Federle	2	3	6.4	3	1	5	2
Gallo Plum	2	2	7.7	3	1	4	1
Giant Italian Paste	1	2	6.5	4	1	4	1
Heart's Fire	2	3	6.1	5	1	3	1
Heidi	2	2	5.9	4	1	3	1
Howard German	2	2	7.1	4	1	5	1
Italian Gold	1	4	4.2	4	1	4	1
Polish Linguisa	2	2	7.3	4	1	4	2
Super Marzano	1	3	5.9	4	2	4	2
Super Sarno	2	4	4.1	4	1	3	2
LSD 0.05	**-**	**-**	**1.3**	**-**	**-**	**-**	**-**

[1] – 1=dark green, 3=light green; [2] – 1=excellent, 5=poor; [3] – mean two plants; [4] – 1=regular, 5=potato; [5] – 1=small, 5=large; [6] – 1=jointed, 2=jointless

SUMMARY

Selecting a group of cultivars for further evaluation is difficult. The cultivar ‘Heidi’ is the best overall for yield and other characteristics. Which cultivars are selected for commercial planting depends on the market. The following cultivars should be evaluated in a replicated trial to collect more data: ‘Black Plum’, ‘Canestrino’, ‘Ernie’s Plump’, ‘Giant Italian Paste’, Heart’s Fire’ and Italian Gold’. These cultivars have a range of colors and size with acceptable marketable yields for most wholesale or retail markets.

NOTES