

## **Year 2004 Tomato Cultivar Evaluation for Processing**

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### Introduction:

In cooperation with the Ohio State University/OARDC tomato breeding program, the Food Industries Center evaluates tomato varieties for processing quality. The Food Industries Center pilot plant facilities support for research and tomato variety development for the Mid-America Food Processors Association and their affiliated processors and growers. Evaluations of quality expanded in 2003 to include percentage loss following peeling, and this practice continued in 2004 providing an opportunity to assess ...

### Procedures Utilized:

All tomatoes were grown and were mechanically harvested at the OARDC Research Farm at Fremont, Ohio. The fruit were harvested into plastic totes and transported to the Food Industries Center Pilot Plant located in Howlett Hall on the OSU campus in Columbus, Ohio. The tomatoes were generally harvested the day previous afternoon and the transported to Columbus early the next morning for processing that day.

The following is a flow chart for our Pilot Plant tomato juice operation:

- 1) All tomatoes were washed in a soak tank with agitation
- 2) Tomatoes were spray washed while being conveyed on a stainless steel chain conveyor.
- 3) Tomatoes were sorted to remove off quality fruit.
- 4) Tomatoes were chopped in a Fitzpatrick Mill equipped with a ¾" screen.
- 5) Tomatoes were then pumped through a tube-in –tube heat exchanger to reach a hot break temperature of +/-190°F.
- 6) Tomatoes next were extracted in a Chisholm-Ryder Company Model CLE-360-D28 screw type extractor with a .20 screen.
- 7) Tomato juice was filled into 300x406 cans, a Morton salt and acid tablet added, closed and processed at 220°F for 30 minutes

The following is a flow chart for our Pilot Plant dice and whole tomato operation:

- 1) Steps 1 through 3 were follow as above for tomato juice
- 2) Tomatoes passed through a lye peeling soak tank for approximately 30 seconds with a concentration of 15% lye and a temperature of 185°F.
- 3) Tomatoes then passed over a reaction belt for 2 minutes
- 4) Tomatoes were then peeled using a rubber disk peeler while being sprayed with water.
- 5) Tomatoes were hand sorted and trimmed.
- 6) Tomatoes for dicing were run through an Urschel Laboratories, Inc. Model GK dicer set for ½" cubes.
- 7) Whole and dice tomatoes were filled into 300x406 cans, a Morton salt and acid tablet added, closed and processed at 220°F for 30 minutes.

### Analytical Procedures:

Analytical procedures were conducted on the tomatoes prior to processing, during processing operation after the hot break, and after the tomatoes had been processed. The test procedures included the following:

- 1) The pH was determined using an Orion 940 pH meter; total acid was determined by titrating to a pH of 8.2 with a 0.1N sodium hydroxide.
- 2) Soluble solids were measured on an American Optic Abbey Refractometer.
- 3) Raw Product color was measured in L, a, b color space using a Minolta CR300 Colorimeter. Measurements are reported for L (lightness to darkness) and Hue (degree of red) and for difference measurements (a measure of color uniformity). Percent Good Fruit (%GF) is a measure of top grade fruit (percentage number 1 or A+B grade), estimated from color measurements and standardized to factory grades.
- 4) Post-processing color was measured on an Agtron M35-D colorimeter

### Replication:

The multi-location trial is planted as a replicated trial with two plots per location in Wooster, OH; in Fremont, OH as an early planting and late planting; and on growers fields. Yield data (Table 2) represents machine harvest yield from two-early season plots per variety and two late season plots per variety; quality data is averaged across all locations (Table 3). Data on processing performance is based on a pooled sample from two plots, and is not replicated within a single year. Variety GEM94 was processed twice, from the early planting multi-location trial and the late planting multi-location trial (Table 4).

### Source of Varieties:

Varieties from six commercial seed suppliers and the OSU breeding program were included in the trial. Unilever varieties were included due to potential for high soluble solids and viscosity. The Sunseed variety “Red Sky” is a low gel variety and was included to evaluate for dice potential.

**Table 1. Source of Varieties**

Genotype	Source	Genotype	Source
GEM94	GEM Seeds	FG00-115	OSU
GEM818	GEM Seeds	FG00-117	OSU
GEM31	GEM Seeds	FG00-118	OSU
GEM611	GEM Seeds	FG00-125	OSU
GEM94	GEM Seeds	FG01-140	OSU
GEM32	GEM Seeds	FG01-158	OSU
GEM46	GEM Seeds	FG01-160	OSU
GEM111	GEM Seeds	FG99-19	OSU
Red Sky	Sunseeds	FG99-24	OSU
TSH8	Tomato Sol.	Ohio 3614	OSU
TSH20	Tomato Sol.	Ohio 7983	OSU
TSH12	Tomato Sol.	OX23	OSU (Hirzel)
C205	Unilever	OX323	OSU (GEM)
U2008	Unilever	OX325	OSU (GEM)
C258	Unilever	H3702	Heinz
PS696	Seminis	H9704	Heinz

## Results

Table 2. Field Performance of Canning Trail Varieties

GENOTYPE	Yield Potential		Ripe Yield		% Green	% Cull	FRT Sz		Vine	Disease		
	Mean	Rank	Mean	Rank			(gm)	Rank	Width In.	Severity	Rank	
C205	31.84	22	22.54	27	10.20	21.81	31	75.75	1	27.50	0.875	2
C258	53.05	1	37.46	1	10.71	17.60	29	76.66	3	34.25	0.750	1
FG00-115	39.02	9	28.44	11	10.68	16.22	28	69.63	4	30.75	1.000	11
FG00-117	48.68	2	36.53	3	13.89	12.31	25	66.00	7	31.75	1.000	11
FG00-118	44.41	4	33.13	5	16.25	8.54	11	58.06	21	31.50	0.875	2
FG00-125	30.06	26	24.90	20	8.97	8.75	12	63.73	20	23.50	1.000	11
FG01-140	29.65	27	23.56	24	9.79	9.34	15	68.49	17	25.25	1.250	28
FG01-158	44.02	5	31.72	6	19.95	6.70	5	73.03	27	32.75	1.000	11
FG01-160	39.84	7	31.60	7	10.97	7.66	8	67.13	24	30.25	1.375	29
FG99-19	39.77	8	29.45	10	17.07	9.55	16	65.55	16	31.75	0.875	2
FG99-24	29.10	28	19.45	31	17.51	13.68	27	59.20	5	26.00	0.875	2
GEM111	31.60	23	23.95	23	13.43	9.10	13	61.01	19	25.00	0.875	2
GEM31	28.44	30	23.28	26	8.21	9.90	18	54.89	14	27.00	1.125	23
GEM32	36.60	11	29.88	9	9.50	8.51	10	60.56	22	28.50	0.875	2
GEM46	32.85	19	26.33	15	9.71	9.63	17	57.15	15	25.00	1.000	11
GEM611	34.45	16	27.23	14	8.20	11.94	23	62.37	9	25.50	1.125	23
GEM818	32.11	21	25.23	18	15.51	5.53	2	61.24	30	25.50	1.125	23
GEM94	25.12	31	19.84	30	13.74	10.88	20	62.37	12	24.25	1.000	11
H3702	32.93	18	25.12	19	15.39	9.20	14	67.59	18	29.50	0.875	2
H9704	30.78	25	23.36	25	15.85	7.50	6	63.50	26	27.25	1.375	29
O7983	32.73	20	24.57	22	12.77	11.90	22	62.37	10	25.25	1.000	11
OH3614	28.95	29	21.56	29	11.72	12.47	26	68.04	6	26.00	1.000	11
OX23	35.90	13	28.09	12	12.28	8.31	9	62.37	23	29.25	0.875	2
OX323	43.09	6	33.75	4	16.28	5.61	3	59.42	29	30.25	1.000	11
OX325	46.29	3	36.88	2	13.51	6.58	4	61.92	28	33.00	1.000	11
PS696	38.16	10	31.02	8	12.67	7.64	7	61.92	25	27.25	1.125	23
RedSKy	36.17	12	22.11	28	13.26	21.22	30	72.58	2	29.00	1.125	23
TSH12	34.88	15	27.70	13	16.94	4.14	1	55.79	31	29.00	0.875	2
TSH20	34.22	17	25.90	17	11.11	11.23	21	55.34	11	32.00	1.375	29
TSH8	31.17	24	24.88	21	8.79	10.54	19	55.57	13	29.00	1.000	11
U2008	35.08	14	25.90	16	12.85	12.05	24	67.59	8	27.25	1.000	11
Mean	35.84		27.27		12.83	10.52		63.77		28.39	1.02	
LSD 0.05	11.75		10.29		8.62	8.60		6.71		5.45	0.354	

Table 3. Raw Product Evaluation

Genotype	L		Hue		Chroma		Ldiff		Hdiff		%GF		Brx		pH	%Crack	
		Rank		Rank		Rank		Rank		Rank		Rank		Rank			Rank
<b>C205</b>	42.83	30	46.06	28	38.12	8	7.59	30	12.26	31	51.56	30	4.70	20	4.40	60.0	21
<b>C258</b>	40.86	21	44.16	18	36.59	21	4.96	21	7.13	22	62.50	24	4.90	8	4.35	55.0	15
<b>FG00-115</b>	39.30	12	44.88	23	33.97	30	5.19	22	7.28	23	65.63	23	4.53	25	4.34	62.5	23
<b>FG00-117</b>	38.97	11	45.78	25	35.48	25	5.63	26	9.63	26	67.19	21	4.45	27	4.36	57.5	18
<b>FG00-118</b>	38.84	7	43.01	12	33.80	31	3.92	12	5.27	14	73.44	15	4.55	24	4.29	57.5	18
<b>FG00-125</b>	39.47	13	41.98	9	36.56	22	3.23	5	4.88	12	76.56	10	4.45	28	4.44	62.5	23
<b>FG01-140</b>	40.11	15	42.75	11	36.84	18	4.43	15	5.36	15	75.00	13	4.85	11	4.36	45.0	11
<b>FG01-158</b>	42.63	29	44.99	24	36.99	16	6.76	29	10.18	27	59.38	28	5.00	6	4.31	25.0	3
<b>FG01-160</b>	41.56	24	44.38	21	38.24	6	6.32	28	11.11	29	60.94	25	4.58	23	4.31	37.5	6
<b>FG99-19</b>	40.73	19	44.65	22	38.23	7	5.53	25	9.13	25	68.75	20	4.75	17	4.40	20.0	1
<b>FG99-24</b>	37.78	3	43.17	13	34.29	28	3.66	8	3.97	7	78.13	9	4.70	21	4.37	40.0	8
<b>GEM111</b>	40.81	20	44.31	20	37.40	13	5.26	24	8.51	24	73.44	15	4.78	14	4.24	55.0	15
<b>GEM31</b>	38.95	10	40.82	4	36.33	23	2.92	3	3.27	2	87.50	4	4.78	16	4.39	62.5	23
<b>GEM32</b>	38.94	9	42.13	10	37.40	14	3.40	6	3.76	6	76.56	10	4.80	13	4.28	45.0	11
<b>GEM46</b>	38.24	5	40.68	3	37.00	15	2.81	2	3.46	5	89.06	3	4.75	18	4.28	67.5	28
<b>GEM611</b>	41.56	25	43.31	14	39.24	3	3.97	13	5.22	13	73.44	15	4.40	30	4.36	72.5	31
<b>GEM818</b>	40.25	17	41.80	7	37.44	11	2.93	4	4.43	10	84.38	5	4.88	10	4.35	47.5	13
<b>GEM94</b>	39.74	14	41.13	5	39.30	2	3.83	9	3.40	4	84.38	5	5.25	2	4.40	60.0	21
<b>H3702</b>	42.99	31	45.95	26	39.08	5	5.25	23	7.11	21	70.31	19	5.18	3	4.19	72.5	30
<b>H9704</b>	40.48	18	41.89	8	39.63	1	2.77	1	4.16	8	82.81	7	4.45	29	4.28	37.5	6
<b>O7983</b>	38.93	8	43.45	15	35.35	26	4.37	14	6.13	18	76.56	10	4.73	19	4.38	62.5	23
<b>OH3614</b>	36.65	1	41.41	6	34.07	29	3.84	10	4.70	11	82.81	7	4.68	22	4.40	70.0	29
<b>OX23</b>	38.81	6	44.18	19	34.85	27	4.52	17	6.06	17	71.88	18	4.50	26	4.34	55.0	15
<b>OX323</b>	41.88	27	46.92	30	37.76	9	8.26	31	12.16	30	53.13	29	4.83	12	4.32	27.5	4
<b>OX325</b>	40.90	22	43.64	17	36.72	19	4.47	16	6.02	16	75.00	13	4.88	9	4.36	47.5	13
<b>PS696</b>	41.66	26	47.61	31	37.41	12	4.83	20	6.80	19	51.56	30	4.38	31	4.36	57.5	18
<b>RedSky</b>	40.17	16	46.06	27	36.24	24	4.61	19	7.09	20	60.94	25	4.78	15	4.26	32.5	5
<b>TSH12</b>	37.94	4	39.13	1	36.95	17	3.55	7	3.34	3	96.88	1	5.43	1	4.32	42.5	9
<b>TSH20</b>	37.42	2	40.15	2	36.64	20	3.85	11	2.84	1	93.75	2	5.03	5	4.40	20.0	1
<b>TSH8</b>	41.28	23	43.51	16	39.08	4	4.60	18	4.41	9	67.19	21	4.93	7	4.32	42.5	9
<b>U2008</b>	41.96	28	46.36	29	37.53	10	5.88	27	10.24	28	60.94	25	5.18	4	4.22	65.0	27
<b>Mean</b>	40.09		43.56		36.92		4.62		6.43		72.63		4.77		4.33	50.5	
<b>LSD (0.05)</b>	3.055		3.801		2.097		2.255		4.297		21.36		0.45		0.11	24.5	

**Table 4. Processed product**

Genotype	Date	gm/frt	% Loss	pH	% Acidity	Brix	Agtron	Red	Blue	Green	Yellow
<b>GEM94</b>	8/31/2004	77.21	14.37	4.22	0.4544	5.2		26.1	1.3	0.0	-1.3
<b>Ohio 7983</b>	8/31/2004	67.20	21.77	4.17	0.4672	4.4		24.9	1.2	0.0	-1.1
<b>GEM818</b>	8/31/2004	61.51	15.85	4.14	0.4448	4.2		30.2	1.6	0.0	-1.2
<b>FG00-125</b>	8/31/2004	63.66	22.66	4.27	0.3840	4		27.5	1.5	-0.1	-1.3
<b>FG99-24</b>	8/31/2004	60.48	20.85	4.22	0.4512	4.5		27.7	1.7	0.1	-1.1
<b>PS696</b>	9/8/2004	69.78	14.81	4.13	0.4096	4.6		35.4	2.2	0.3	-0.9
<b>C205</b>	9/8/2004	82.47	16.88	4.23	0.4096	5.4		30.9	1.5	0.0	-1.2
<b>OX23</b>	9/8/2004	74.06	16.21	4.18	0.4160	5.4		34.8	2.1	0.3	-0.8
<b>GEM31</b>	9/8/2004	51.11	16.06	4.22	0.4288	5.2		29.9	1.6	0.1	-0.9
<b>GEM611</b>	9/8/2004	61.51	17.83	4.23	0.3776	4.4		29.3	1.5	0.0	-1.1
<b>GEM94</b>	9/8/2004	80.64	11.18	4.21	0.3648	5.0		32.1	1.7	0.1	-1.0
<b>H3702</b>	9/9/2004	68.47	11.54	4.05	0.4512	4.5		37.2	2.3	0.3	-1.0
<b>GEM32</b>	9/9/2004	71.15	12.08	4.10	0.3808	4.8		35.2	2.2	0.3	-0.9
<b>H9704</b>	9/9/2004	71.15	13.60	4.09	0.3968	3.8		33.7	2.0	0.1	-1.1
<b>GEM46</b>	9/9/2004	71.15	13.60	4.14	0.3552	4.1		30.2	1.6	0.1	-1.0
<b>TSH8</b>	9/14/2004	55.83	18.87	4.26	0.3520	4.1		35.5	2.0	0.3	-0.8
<b>TSH20</b>	9/14/2004	59.49	11.48	4.28	0.3392	3.5		32.3	1.8	0.0	-1.2
<b>GEM111</b>	9/14/2004	65.98	17.47	4.21	0.3616	4.4		31.7	1.9	0.2	-0.9
<b>U2008</b>	9/14/2004	86.40	21.15	4.17	0.3808	4.8		31.0	1.9	0.3	-0.8
<b>Red Sky</b>	9/14/2004	72.58	17.97	4.15	0.3776	4.2		32.1	1.8	0.1	-1.0
<b>OX323</b>	9/14/2004	63.66	16.89	4.20	0.3712	4.4		32.5	1.7	0.1	-1.0
<b>FG01-140</b>	9/16/2004	71.15	15.69	4.23	0.3744	4.4		34.0	1.8	0.0	-1.1
<b>FG01-158</b>	9/16/2004	80.64	15.30	4.23	0.3456	3.9		32.9	1.7	0.0	-1.1
<b>FG99-19</b>	9/16/2004	61.51	14.89	4.21	0.3328	4.4		30.5	1.5	0.0	-1.2
<b>FG01-160</b>	9/16/2004	78.89	17.75	4.25	0.3712	3.8		31.8	1.8	0.1	-1.0
<b>C258</b>	9/16/2004	80.64	19.46	4.25	0.3104	4.0		27.5	1.5	-0.1	-1.3
<b>OX325</b>	9/16/2004	62.57	12.43	4.22	0.3392	4.2		32.5	1.8	0.0	-0.9
<b>TSH12</b>	9/23/2004	44.80	25.55	4.29	0.3424	4.4		31.5	1.5	0.0	-1.2
<b>FG00-118</b>	9/23/2004	56.70	27.21	4.14	0.3616	4.1		29.7	1.6	0.0	-1.0
<b>FG00-115</b>	9/23/2004	58.53	25.00	4.14	0.3104	4.3		29.3	1.5	-0.1	-1.1
<b>FG00-117</b>	9/23/2004	57.60	20.65	4.20	0.2944	4.0		27.6	1.3	0.0	-1.1
<b>Ohio 3614</b>	9/23/2004	71.15	23.52	4.21	0.3712	4.6		26.8	1.2	-0.1	-1.2
<b>Mean</b>		67.49	17.52	4.20	0.38	4.41		31.07	1.70	0.08	-1.06

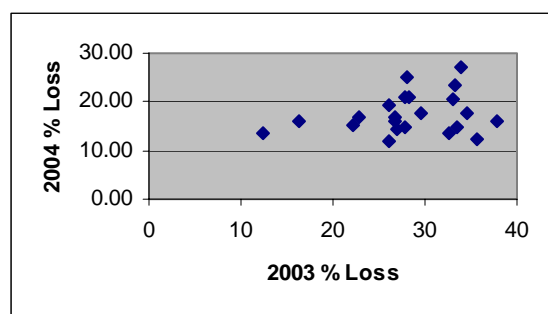
### Conclusions:

The data collected from the cultivar tests are presented in Tables 2-4, above. Table 2 lists field performance data for the varieties included in the "Canning Trial". Table 3 lists quality evaluation data for raw product, with data collected in Wooster, OH. Processed product quality data are from the Food Industries Center Pilot Plant, Columbus, OH.

Each year we state that the environmental conditions for the past processing season deviated from those of the norm. This year, Ohio experienced cold and wet growing conditions, with precipitation unevenly distributed throughout the growing season. Despite heavy spring rains, precipitation for the growing season was only a few inches above normal for the season. Temperatures were below normal for the entire season.

During processing and evaluation perceptions are made about the years crop. This year's tomatoes appeared larger, an observation that is supported by comparisons across years (Table 5, below). Percentage factory loss was lower in 2004, and comparisons across two years suggests a strong environmental component (Figure 1). Several varieties have had low factory loss two years in a row (Table 6), these varieties are likely to produce higher factory yields per ton of raw product.

**Figure 1. Comparison of Percentage Loss for varieties tested in 2003 & 2004**



**Table 5. Comparison across years.**

Year	Fruit Size	% Loss	pH	Solids (Brix)
2004	67.49	17.4	4.2	4.41
2003	63.66	27.3	4.3	4.64
2002	61.51	nd	4.4	3.73
2001	50.40	nd	4.1	3.53
2000	65.98	nd	4.2	3.64
1999	48.38	nd	4.3	3.89

**Table 6. Percentage loss, sorted by two-year performance.**

Genotype	2003	2004	Average
H9704	12.31	13.60	12.96
GEM31	16.27	16.06	16.17
FG01-158	22.14	15.30	18.72
GEM32	26.07	12.08	19.08
OX323	22.8	16.89	19.85
GEM94	27.04	14.37	20.71
PS696	27.79	14.81	21.30
OX23	26.75	16.21	21.48
C205	26.81	16.88	21.85
C258	26.09	19.46	22.78
GEM46	32.68	13.60	23.14
GEM611	29.62	17.83	23.73
OX325	35.56	12.43	24.00
FG99-19	33.57	14.89	24.23
FG99-24	27.93	20.85	24.39
U2008	28.29	21.15	24.72
GEM111	34.65	17.47	26.06
FG00-115	28.01	25.00	26.51
FG00-117	33.03	20.65	26.84
GEM818	37.93	15.85	26.89
Ohio3614	33.19	23.52	28.36
FG00-118	33.98	27.21	30.60