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EVALUATION OF PROCESSING TOMATO BREEDING LINES AND CULTIVARS FOR MECHANICAL HARVESTING AND QUALITY IN 1988

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INTRODUCTION

Tomatoes continue to be the most important processed crop in Ohio with a harvested acreage in 1988 of about 16,000 acres. Record drought conditions occurred through the planting period into July, accompanied by record high temperatures, which severely stressed the crop and reduced production to about 308,000 tons contract production; from about 368,000 tons contract production in 1987, which in itself was a reduced tomato crop. The excessively high temperatures, frequently exceeding 90°F during July and early August stressed blooming and fruit set. Yield for 1988 was projected at 18.0 tons per acre, which would be down 22% from the 23.0 tons per acre in 1987.

Although processing tomato production is located mainly in the northwest area of the state, areas are being developed in south-central Ohio and harvest started in that area the latter part of July. Harvest in the northwest area of the state began in early August. Rains in August slowed harvest activity and caused some mold, disease, and fruit cracking losses, further reducing crop prospects. September was characterized by below average temperatures and the commercial harvest was not completed until the end of the month.

New planting practices, growing methods machine harvest-bulk handling and new processing technology require a continuous supply of better suited varieties in order that the industry remain competitive. Ohio continues to be the second largest processing tomato production state in the United States. This breeding work continues to be directed with emphasis on improvement of the whole-canned tomato (whole-pack) and tomato suitable for diced product. Other needs of the canner are also being given attention in relation to development of improved varieties for the processor of various juice, sauce and paste products.

Selection for earliness and improved fruit setting ability, especially during periods of heat stress, is being carried out to reduce the problem of split fruit set and make possible more uniform tomato harvest schedules. Other important characteristics being selected to make machine harvest and bulk handling more efficient include crack resistance, firmness and ability of ripe fruit to store well on the vine for extended periods to allow maximum fruit recovery in machine harvest. Thus, in addition to increased productivity, a major objective is more effective utilization of yield already being attained, especially in

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regard to factors minimizing loss due to green, overripe and decayed fruit. Jointless pedicel (j2) is being utilized to facilitate machine harvest and allow harvest of fruit free of stems.

Improved quality factors being selected for and intensively evaluated for in cooperation with commercial processors include: acidity, pH, soluble solids, viscosity, color (crimson fruit color [og^c], vitamin C, and especially fruit attributes conditioning efficient lye or steam peeling characteristics and corelessness.

Ohio 7870 continues to be used as an early-main season Verticillium-Fusarium resistant, machine harvest cultivar. It continued to exhibit excellent productivity and especially good fruit disease resistance and holding ability.

Ohio 7814 acreage increased in 1988 and it is proving to be a valuable asset as an early-main season Fusarium resistant, jointless pedicel, machine harvest type with excellent firmness, holding ability and resistance to fruit rots. It is especially suited for coreless wholepack and diced pack, as well as pureed product manufactured.

Ohio 832 is a main-season, early, Verticillium-Fusarium resistant type. Fruit have the crimson color characteristic, are uniform ripening, crack resistant and represent an improvement in color and raw product recovery quality characteristics over that of Ohio 7870. It is primarily for product manufacture and has exhibited improved processing color, solids and viscosity.

The Ohio 7983 has been extensively evaluated and is very promising as an early, high quality machine harvest, jointless pedicel, whole-pack type. Commercial acreage of Ohio 7983 is increasing.

Ohio 8243 is an early main-season, jointless pedicel, machine harvest cultivar with Fusarium wilt resistance. It is suitable for coreless wholepack, as well as diced and processed product. Ohio 8243 has shown good performance. It has been superior in most quality aspects for wholepack as well as processed product and is being extensively grown.

Ohio 8245 is a productive main season, jointless pedicel, machine harvest variety with Fusarium and Verticillium wilt resistance. It has excellent quality aspects for coreless wholepack, diced product, as well as processed product. It is being extensively grown and its use will greatly increase in 1989.

Ohio 8442 and Ohio 8444 are Verticillium-Fusarium, Bacterial Speck resistant lines, which have exhibited good potential for product use with advantageous earliness and quality attributes in addition to disease resistance and are being extensively evaluated in commercial trial.

The use of hybrid processing tomatoes by the industry has increased. Hybrids have been exhibiting potential for enabling achievement of improved productivity and quality levels and acreage planted to hybrids is increasing. Research to develop parental material with improved earliness, productivity, disease resistance and quality is continuing and such material is being utilized in newly formulated hybrids. Hybrid varieties are receiving increased attention, however, the economic advantage in continuing to use open pollinated varieties remains an important management consideration.

MATERIALS AND METHODS

Location: Vegetable Crops Branch, Fremont, Ohio.

Soil: Silty clay loam, fall bedded.

Fertilizer: 800 lb. per acre of 0-26-26, November; 200 lb. per acre of 34-0-0, April.

Herbicide: 3 lb/A Devrinol incorporated May 21; Sencor directed spray 0.5 lb./A June 27.

Plants: Greenhouse-grown, 108 per standard flat from seed sown April 9.

Transplanted to Field: May 23, a two-row transplanter using 21-53-0 starter at 5 lb. per 100 gal. of water; 1/2 pint per plant.

Plot Size and Spacing: One-row plots, 9 plants per row spaced 12 inches, rows 5 feet apart; Trial I, 3 replications; Trial II, non-replicated.

Insect and Disease Control: Standard recommended program followed for insect and disease control.

Weather Data (Fremont, Ohio)

	<u>Temperature</u>		<u>Rainfall (inches)</u>	
	<u>1988</u>	<u>36 Yr. Avg.</u>	<u>1988</u>	<u>36 Yr. Avg.</u>
April	47.6	48.7	1.57	3.36
May	62.0	59.6	0.91	3.65
June	69.6	69.2	0.63	3.91
July	76.4	73.1	2.84	4.01
August	73.5	71.0	5.68	3.66
September	62.4	64.3	1.57	3.36

HARVEST INFORMATION

Extreme record drought and heat characterized the planting period and persisted through the growing season, which severely stressed the crop. Some rain in August resulted in mold, disease and fruit cracking losses. Harvesting was with a Johnson tomato harvester and was carried out when the entries were estimated to be at a stage of fruit ripeness in which yields of marketable fruit were approaching optimum recovery with a minimum of green and cull fruit (Tables 1 & 4). Percentages reported of fruit recovery are on a weight basis.

The data for the new experimental lines is organized according to maturity groups and within maturity by once-over machine-harvest fruit yield (Tables 1 & 4). Because of the complexity of factors which determine a potentially successful variety, other factors which must be considered and that can be limiting are included; eg., fruit concentration, fruit cull percentage, fruit size, stemming character, and jointlessness. To adequately evaluate promising lines at least one or two more years of testing will be necessary.

QUALITY EVALUATION

Field-run tomatoes were used for quality evaluation; the sample was cut in half, quartered, extracted in a Food Processing Equipment Co. laboratory pulper, and de-aerated (Tables 2 & 3).

1. Agtron E-5. Instrument calibrated at 48.
2. Hunter Color Difference Meter (CDM).
3. Percent Soluble Solids: Abbe Refractometer
4. Percent Total Acid as citric: The raw sample used for pH determination was directly titrated using 0.1 normal sodium hydroxide solution to a pH of 8.1.
5. pH was determined by the glass electrode method.
6. Vitamin C (ascorbic acid) standard procedure:

$$\text{Dye Factor} \times \text{ml of dye} \times 100 = \frac{\text{mqs Vitamin C}}{100 \text{ gms}}$$

Seed Sources and Cooperators

1. S.Z. Berry, Dept. of Horticulture, OSU-OARDC, Wooster, OH.
2. Campbell Soup Co., CIRT, Napoleon, OH.
3. F. Cortelyou, Hunt-Wesson Foods, Inc., Perrysburg, OH.
4. D. Ematty, H.J. Heinz Co., 13737 Middleton Pike, Bowling Green, OH
5. W. Springer, ADI Distributors, Inc., Carmel, IN.

TABLE 1. Trial I. Field evaluation of processing tomato varieties and test lines for mechanical harvest when yields of marketable fruit were approaching optimum recovery. Vegetable Crops Branch, OARDC, Fremont, Ohio 1988.

Variety or Test Line	Ripe Usable		% of Potential Cull	Fruit Size (oz)	Stems %	Stems (j2-jointless) (+-jointed)
	Tons/	% of Potential				
<u>Harvest Date 8/25/88</u>						
Ohio 87160	20.3	73	7	2.1	0	j2
Ohio 86121	19.9	84	2	2.1	0	j2
Ohio 7983	15.9	76	3	1.8	0	j2
Ohio 7870	13.8	67	3	2.1	36	+
Ohio 8383	13.0	66	9	2.1	0	j2
Ohio 7814	12.0	79	3	1.6	0	j2
<u>Harvest Date 8/30/88</u>						
Easy Winner	18.0	64	1	2.3	3	j2
Ohio 86120	17.5	78	4	2.1	1	j2
Ohio 8556	17.2	67	2	2.1	0	j2
Ohio 8655	15.3	72	5	2.6	11	+
Ohio 86113	13.2	82	4	1.9	0	j2
<u>Harvest Date 9/7/88</u>						
Ohio 8675	26.5	75	5	2.2	2	j2
Malinta	25.0	67	3	2.5	0	j2
Ohio 8689	23.0	66	8	2.2	0	j2
Ohio 8690	22.6	74	6	2.1	1	j2
Ohio 8696	22.4	61	12	1.9	0	j2
Ohio 8673	21.8	80	3	2.2	1	j2
Medalist	21.3	60	18	2.6	0	j2
Ohio 8687	20.0	76	7	2.0	0	j2
Ohio 8245	19.7	74	5	2.0	1	j2
Allegro	18.7	66	18	2.8	18	+
Ohio 8446	18.5	73	6	2.3	3	j2
Ohio 8567	17.8	63	10	2.6	0	j2
Ohio 832	17.1	66	6	3.2	24	+
Heinz 7145	16.0	63	3	2.1	0	j2
Ohio 86137	15.0	62	16	2.7	6	+
Ohio 8442	14.8	81	9	1.8	1	j2
Heinz 2653	14.0	71	12	1.7	3	J2
Heinz 722	13.2	65	4	1.6	0	j2
<u>Harvest Date 9/15/88</u>						
Ohio 87175	27.0	83	7	2.0	0	j2
Ohio 8841	24.1	67	5	1.9	1	J2
Ohio 8243	22.3	72	7	2.0	3	J2
Ohio 8444	19.2	68	10	2.5	11	J2
LSD 5%	8.6	14	6	0.4		

TABLE 2. Trial I. Laboratory evaluation of processing tomato varieties and test lines. Vegetable Crops Branch, OARDC, Fremont, Ohio, 1987.

Variety or Test Line	pH	% Citric acid	% Soluble solids	Color		
				Hunter CDM a/b	Agtron E5	Vit. C mg/100 gm
Ohio 7814	4.4	0.30	3.9	2.1	52	11.1
Ohio 7870	4.5	0.30	3.1	2.3	--	14.3
Ohio 832	4.3	0.33	4.5	2.7	41	8.4
Ohio 8243	4.5	0.29	4.0	2.5	36	16.6
Ohio 8245	4.5	0.31	3.9	2.4	46	18.7
Ohio 8442	4.4	0.28	3.9	2.5	50	17.1
Ohio 8444	4.4	0.41	4.2	2.4	51	14.0
Ohio 8446	4.4	0.30	3.4	2.4	56	7.8
Allegro	4.4	0.27	3.8	2.4	37	17.1
Heinz 2653	4.5	0.34	4.2	2.7	43	16.6
Heinz 722	4.5	0.30	4.0	2.4	37	16.6
Heinz 7145	4.6	0.28	3.3	2.3	63	16.6
Malinta	4.5	0.28	4.0	2.3	57	14.5
Medalist	4.4	0.30	4.3	2.5	50	16.1
Easy Winner	4.6	0.28	4.1	2.4	54	26.4
Ohio 8243-3-4	4.4	0.32	4.5	4.8	54	13.2
Ohio 8556	4.6	0.28	3.7	2.5	44	18.1
Ohio 86120	4.5	0.26	3.8	2.6	34	18.7
Ohio 86121	4.5	0.26	3.8	2.5	59	15.0
Ohio 8687	4.4	0.34	3.8	2.5	36	24.4
Ohio 8689	4.4	0.28	4.0	2.6	40	7.2
Ohio 8690	4.7	0.28	3.1	2.5	40	18.1
Ohio 8567	4.5	0.28	3.5	2.2	48	9.6
Ohio 8696	4.8	0.25	3.6	2.4	37	17.6
Ohio 8655	4.7	0.28	3.3	2.5	33	14.5
Ohio 8673	4.4	0.28	3.1	2.2	29	15.0
Ohio 8675	4.4	0.29	3.9	2.6	41	8.4
Ohio 86113	4.4	0.30	4.1	2.6	32	18.1
Ohio 86137	4.4	0.30	4.1	2.6	32	18.1
ON 2444	4.0	0.47	3.4	2.2	34	20.8
Ohio 87175	4.6	0.28	3.2	2.5	41	21.2

TABLE 3. Direct-seeded observation trial of advanced lines at Columbus, Ohio. Laboratory evaluation of processing tomato varieties and test lines. OSU Horticulture Department Farm, Columbus, Ohio. 1988.

Variety or Test Line	pH	% Citric acid	% Soluble solids	Color		Vit. C mg/ 100/gm
				Hunter CDM a/b	Agtron E5	
Ohio 7814	4.4	0.39	4.7	2.8	48	16.6
Ohio 7870	4.6	0.30	4.3	2.6	47	13.5
Ohio 832	4.5	0.29	4.5	1.4	47	17.6
Ohio 7983	4.6	0.35	3.9	2.4	42	27.5
Ohio 8383	4.7	0.36	3.8	2.6	31	16.6
Ohio 8243	4.5	0.36	4.4	2.6	36	19.2
Ohio 8245	4.3	0.48	4.3	2.4	33	20.7
Ohio 8442	4.6	0.31	4.1	2.4	32	23.8
Ohio 8444	4.4	0.46	5.1	2.6	44	14.4
Ohio 8446	4.6	0.41	4.7	2.7	33	17.6
Allegro	4.5	0.40	4.3	2.6	36	19.2
Heinz 2653	4.5	0.37	4.6	2.7	40	10.8
Heinz 722	4.4	0.42	4.8	2.8	43	13.2
Heinz 7145	4.7	0.28	3.9	2.6	31	21.8
Malinta	4.5	0.34	4.6	2.4	34	13.0
Medalist	4.5	0.37	3.6	2.6	35	17.6
Easy Winner	4.7	0.30	4.0	2.5	35	18.7
Ohio 8243-3-4	4.5	0.38	4.8	2.7	40	6.6
Ohio 8556	4.6	0.36	5.0	2.7	43	7.2
Ohio 86120	4.6	0.32	4.5	2.8	33	16.1
Ohio 86121	4.6	0.30	4.1	2.5	38	15.5
Ohio 8687	4.6	0.29	4.8	2.7	49	20.7
Ohio 8689	4.7	0.25	4.5	2.6	39	13.0
Ohio 8690	4.7	0.28	4.6	2.8	30	14.5
Ohio 8567	4.7	0.28	3.9	2.3	53	21.8
Ohio 8655	4.6	0.30	4.6	2.7	34	19.7
Ohio 8673	4.7	0.31	3.7	2.5	48	15.5
Ohio 8675	4.4	0.42	3.9	2.5	36	18.1
Ohio 86113	4.5	0.30	4.0	2.2	43	12.4
Ohio 86137	4.6	0.33	3.7	2.7	31	21.8
ON 2444	4.5	0.39	4.1	2.3	49	16.6
Ohio 87160	4.6	0.28	4.2	2.5	52	20.7
Ohio 87175	4.7	0.31	4.1	2.6	44	20.2

TABLE 4. Trial II. Evaluation of processing tomato varieties and test lines for mechanical harvest when yields of marketable fruit were approaching optimum recovery. Vegetable Crops Branch, OARDC, Fremont, Ohio 1988.

Variety or Test Line	Ripe Usable		% of Potential Cull	Fruit Size (oz)	Stems %	Stems (j2-jointless) (+-jointed)
	Tons/ A	% of Potential				
<u>Harvest Date 8/25/88</u>						
Ohio 88109	17.2	72	3	2.1	0	j2
Ohio 88194	16.7	65	2	1.9	0	j2
Ohio 88197	15.2	80	4	2.1	0	j2
Ohio 88127	13.2	59	6	1.8	0	j2
<u>Harvest Date 8/31/88</u>						
Ohio 88110	21.4	76	0	2.1	0	j2
Ohio 88139	20.4	74	0	1.9	0	j2
Ohio 88144	19.5	81	3	1.9	2	j2
Ohio 88122	18.5	71	0	1.8	0	j2
Ohio 88122	18.1	79	1	1.9	0	j2
Ohio 88199	17.9	70	2	1.9	2	j2
Ohio 88183	17.2	76	2	2.4	0	j2
Ohio 88206	16.5	60	6	2.0	2	j2
Ohio 88112	16.4	58	4	2.9	0	j2
Ohio 88117	15.2	70	1	1.9	0	j2
Ohio 88198	15.2	70	2	1.9	0	j2
FM 6203	11.4	67	10	2.8	4	+
Ohio 88156	7.9	69	3	2.0	0	j2
<u>Harvest Date 9/08/88</u>						
Heinz 7145	21.7	72	9	2.3	0	j2
Ohio 88119	18.9	68	17	2.1	2	j2
Ohio 88189	17.9	85	7	1.8	0	j2
Ohio 88129	17.0	68	7	2.1	0	j2
Ohio 88128	16.8	71	7	2.0	0	j2
Ohio 8245	16.5	72	4	2.1	2	j2
Ohio 88191	16.5	69	11	2.1	0	j2
Ohio 88108	16.3	70	10	1.9	0	j2
Ohio 88176	16.1	68	7	2.1	0	j2
Ohio 88157	15.6	64	11	2.1	28	+
Ohio 88149	15.2	77	10	2.1	4	j2
Ohio 88124	11.0	50	12	1.8	0	j2
<u>Harvest Date 9/15/88</u>						
Ohio 88169	27.6	77	21	2.1	0	j2
Ohio 88130	23.1	74	15	1.8	0	j2
Ohio 88164	21.3	73	10	2.0	2	j2
Heinz 2653	18.3	77	17	1.7	4	j2
Ohio 88165	15.0	73	9	2.0	0	j2
Ohio 88126	12.5	52	21	2.9	0	j2

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