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EVALUATION OF PROCESSING TOMATO BREEDING LINES AND CULTIVARS FOR MECHANICAL HARVESTING AND QUALITY IN 1989

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INTRODUCTION

Rainfall was above normal the early part of the 1989 season in contrast to record drought in 1988. Some early-planted fields were flooded and waterlogged fields had to be planted late. Late-plantings were made during intermittent periods of dry weather. Hot, dry weather occurred in July with resultant stress on some of the water damaged shallow rooted plantings. Production intentions at the beginning of the season of over 17,000 contract acres and 430,000 ton production at expected 25 tons/acre yield had to be revised down to about 22 tons/acre. Poor ripening conditions resulted in problems with color development along with losses from blossom-end rot and mold.

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 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], and especially fruit attributes conditioning efficient lye or steam peeling characteristics and corelessness.

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

Ohio 7814 acreage continues to be substantial and 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 is especially suited for coreless wholepack and diced pack, as well as pureed product manufactured.

The Ohio 7983 has been extensively evaluated and is very promising as an early, high quality machine harvest, jointless pedicel, whole-pack type similar to Ohio 7814. 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 been superior in most quality aspects for wholepack as well as processed product.

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 has greatly increased.

Ohio 8550 is a most recently developed early-main season line with Verticillium-fusarium resistance. It has excellent quality for whole pack, diced product, as well as processed product. Seed is being increased in winter nursery and pilot commercial trials with grower-canners will be made in 1990.

The use of hybrid processing tomatoes by the industry in Ohio has increased. Hybrids have exhibited potential for making possible improved productivity, disease resistance and quality; acreage planted with hybrids is increasing. In general hybrid cultivars do not produce large yield advantages when compared with open pollinated varieties, however, they can provide improved earliness and more dependable performance under stress conditions. In that hybrid seed production is a labor intensive manual operation such seed is more costly than that of open pollinated variety seed.

The Ohio hybrid OX4 has shown potential for earliness, productivity, and Verticillium and Fusarium resistance along with excellent color and quality; seed is being increased for pilot commercial grower canner trial.

MATERIALS AND METHODS

Location: Vegetable Crops Branch, Fremont, Ohio.

Soil: Silty clay loam, spring 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 28; Sencor directed spray 0.5 lb./A June 24.

Plants: Greenhouse-grown, 108 per standard flat from seed sown April 5.

Transplanted to Field: May 22, 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, 20 plants per row spaced 12 inches, rows 5 feet apart.

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

Weather Data (Fremont, Ohio)

	Temperature		Rainfall (inches)	
	1989	37 Yr. Avg.	1989	37 Yr. Avg.
April	45.0	48.6	3.61	3.39
May	56.0	59.5	5.69	3.69
June	68.2	69.1	4.43	3.95
July	73.6	73.1	1.38	3.98
August	69.7	70.9	2.30	3.65
September	61.4	64.2	2.80	3.01

HARVEST INFORMATION

Above average rainfall early in the season resulted in some waterlogged soil conditions that limited root growth. This resulted in crop stress as moisture became limiting in July. 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 & 3). 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 & 3). 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 & 4).

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.

Seed Sources and Cooperators

1. S.Z. Berry, Dept. of Horticulture, OSU-OARDC, Wooster, OH.
2. L.R. Nelms, 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. Mechanical harvest evaluation of processing tomato varieties and test lines of harvestable fruit were approaching optimum recovery. Vegetable Crops Branch, OARDC, Fremont, Ohio 1989.

Variety or Test Line	No. of plots harvested	Ripe Usable T/A	% of Potential			Fruit Wt. (oz.)	% with stems	Stems (j2=jointless) (+ =jointed)
			Ripe	Green	Cull			
Harvest Date 8/22/89								
HZ7155	3	20.8	69	27	4	3.2	13	j2
OX3	3	20.0	81	16	4	1.7	2	j2
Easy Winner	1	20.0	66	32	2	3.4	10	j2
Malinta	1	20.0	78	16	6	2.9	6	j2
087160	3	16.6	81	15	4	1.7	0	j2
08383	3	15.9	64	31	6	2.7	1	j2
088169	1	15.0	69	29	3	1.8	0	j2
08689	1	14.2	56	40	4	2.1	0	j2
07814	3	13.5	74	22	4	1.9	1	j2
08655	4	13.3	70	26	4	2.4	32	+
07870	2	13.2	74	20	6	2.6	53	+
08446	3	11.0	58	38	4	2.1	1	j2
Harvest Date 8/28/89								
08690	1	12.8	71	27	2	2.0	0	j2
08550	3	11.4	68	29	4	2.1	0	j2
08696	2	9.5	67	29	4	1.8	0	j2
Harvest Date 9/5/89								
08245	3	25.0	87	10	3	2.2	3	j2
08243	2	24.1	89	9	2	1.7	0	j2
OX8	2	22.7	85	10	5	1.9	0	j2
07983	3	21.2	83	12	5	2.1	0	j2
08556	4	21.2	84	11	6	2.2	1	j2
08675	3	20.9	84	11	6	1.9	1	j2
OX7	4	20.8	84	11	5	2.1	1	j2
HZ6285	4	18.9	75	17	8	2.7	16	j2
OX4	2	18.4	82	12	6	2.0	1	j2
088119	3	17.7	81	10	10	1.7	1	j2
OX6	3	17.6	76	18	5	2.1	1	j2
PSXP696	2	17.6	82	15	4	1.9	0	j2
OX5	4	17.5	74	21	5	2.1	1	j2
OX2	2	17.3	72	22	6	2.0	2	j2
086120	2	17.2	89	4	7	2.2	3	j2
08687	3	16.9	86	8	6	1.9	1	j2
086121	3	16.7	83	12	5	2.0	1	j2
087175	2	16.6	84	11	6	2.0	1	j2
HZ722	4	16.3	84	7	10	1.8	0	j2
OX1	2	16.0	75	20	5	2.1	5	j2
OX9	2	15.9	82	9	9	2.2	4	j2
HZ7190	3	15.7	73	16	11	2.3	9	j2
088110	3	14.5	81	15	4	2.0	2	j2
086137	3	14.3	77	13	11	2.8	15	j2

TABLE 2. Trial I. Laboratory evaluation of processing tomato varieties and test lines. Vegetable Crops Branch, OARDC, Fremont, Ohio, 1989.

Variety or Test Line	pH	% Citric acid	% Soluble solids	Hunter CDM a/b	Agtron
HZ7155	4.5	0.24	4.5	2.8	43
OX3	4.4	0.18	4.5	2.7	42
Easy Winner	4.5	0.26	6.0	2.7	36
Malinta	4.4	0.21	4.6	2.4	34
087160	4.6	0.20	4.2	2.7	35
08383	4.5	0.25	6.4	2.6	38
088169	4.4	0.27	5.5	2.5	47
08689	4.5	0.25	5.0	2.8	41
07814	4.3	0.17	4.9	3.0	40
08655	4.8	0.16	5.6	2.5	35
07870	4.4	0.30	5.1	2.8	39
08446	4.5	0.17	5.2	2.3	42
08690	4.5	0.22	6.1	3.1	40
08550	4.7	0.17	5.2	2.5	36
08696	4.4	0.26	5.4	2.8	39
08245	4.3	0.32	5.7	2.8	40
08243	4.4	0.25	5.0	2.5	47
OX8	4.4	0.27	5.1	2.8	37
07983	4.5	0.19	4.9	2.3	42
08556	4.4	0.22	5.8	3.3	40
08675	4.5	0.20	6.0	2.4	42
OX7	4.4	0.21	4.9	2.4	37
HZ6285	4.7	0.18	5.8	2.4	36
OX4	4.3	0.26	6.8	2.4	43
088119	4.7	0.17	5.7	2.3	39
OX6	4.4	0.22	5.1	2.7	38
PSXP696	4.3	0.29	5.0	2.6	43
OX5	4.7	0.19	5.3	2.3	36
OX2	4.4	0.30	4.8	2.6	41
086120	4.4	0.27	5.7	3.0	42
08687	4.7	0.16	6.1	2.4	38
086121	4.5	0.25	4.7	2.7	48
087175	4.4	0.27	5.7	3.0	39
HZ722	4.5	0.19	4.9	2.4	41
OX1	4.3	0.23	5.0	2.9	42
OX9	4.3	0.27	5.0	2.7	40
HZ7190	4.4	0.32	4.7	2.8	44
088110	4.8	0.18	5.9	2.3	38
086137	4.5	0.29	6.3	2.7	37

TABLE 3. Trial II. Mechanical harvest evaluation of processing tomato varieties and test lines of harvestable fruit were approaching optimum recovery. Vegetable Crops Branch, OARDC, Fremont, Ohio 1989.

Variety or Test Line	No. of plots harvested	Ripe Usable T/A	% of Potential			Fruit Wt. (oz.)	% with stems	Stems (j2=jointless) (+ =jointed)
			Ripe	Green	Cull			
Harvest Date 8/21/89								
08984	1	20	72	27	2	2.1	0	j2
088123	1	20	80	15	5	1.8	0	j2
OX11	2	16	70	26	4	2.2	1	j2
088176	1	15	74	22	4	2.2	0	j2
088157	1	15	77	15	8	2.5	54	+
08987	2	15	67	28	5	2.0	2	j2
088194	1	15	60	26	14	2.0	2	j2
088152	1	14	77	19	4	1.9	2	j2
088197	1	13	66	24	10	2.0	4	j2
08990	1	12	71	27	2	1.7	0	j2
08992	2	12	66	28	6	1.6	0	j2
088117	1	11	64	22	14	1.7	2	j2
088112	1	11	59	27	15	3.3	2	j2
08993	1	10	59	33	8	3.1	18	j2
088129	2	10	55	35	10	2.0	0	j2
088154	1	10	59	35	6	2.2	0	j2
08985	1	10	69	24	7	2.1	0	j2
088130	2	9	49	43	8	1.7	0	j2
08991	2	9	69	26	4	1.8	0	j2
Harvest Date 8/24/89								
088144	2	19	66	29	4	2.4	1	j2
088206	1	17	68	28	4	1.6	0	j2
088174	1	16	68	30	2	2.1	0	j2
088199	1	14	75	21	5	1.9	4	j2
08994	1	14	73	22	5	3.3	64	+
OX10	2	11	55	43	2	2.1	4	j2
08243	2	10	57	42	2	1.6	1	j2
07870	2	9	50	44	6	2.8	64	+
Harvest Date 8/28/89								
088156	1	19	77	20	3	1.9	0	j2
088149	2	11	66	29	5	2.0	1	j2
08245	2	11	56	42	2	2.0	2	j2
CXN121	2	10	71	19	10	2.4	0	j2
07814	2	9	73	24	3	1.8	0	j2

TABLE 4. Trial II. Laboratory evaluation of processing tomato varieties and test lines. Vegetable Crops Branch, OARDC, Fremont, Ohio, 1989.

Variety or Test Line	pH	% Citric acid	% Soluble solids
08984	4.5	0.25	4.3
088123	4.2	0.31	4.5
OX11	4.8	0.16	5.9
088176	4.2	0.29	4.6
088157	4.3	0.23	3.8
08987	4.6	0.16	5.1
088194	4.4	0.26	4.1
088152	4.2	0.25	3.4
088197	4.2	0.26	3.6
08990	4.2	0.27	4.1
08992	4.1	0.25	4.1
088117	4.7	0.26	4.3
088112	4.2	0.28	4.4
08993	4.2	0.24	4.2
088129	4.5	0.19	6.0
088154	4.2	0.26	3.9
08985	4.2	0.29	4.2
088130	4.4	0.18	4.9
08991	4.1	0.29	3.6
088144	4.7	0.17	5.0
088206	4.2	0.26	4.0
088174	4.5	0.28	4.9
088199	4.2	0.29	4.1
08994	4.2	0.26	4.6
OX10	4.6	0.21	5.7
08243	4.5	0.18	5.5
07870	4.4	0.19	5.3
088156	4.7	0.23	5.2
088149	4.6	0.17	5.3
08245	4.3	0.22	5.8
CXN121	4.5	0.20	5.4
07814	4.5	0.19	5.9