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EVALUATION OF PROCESSING TOMATO BREEDING LINES AND CULTIVARS FOR MECHANICAL HARVESTING AND QUALITY IN 1993

S.Z. BERRY, T.S. ALDRICH, K.L. SCAIFE AND W.D. BASH

Department of Horticulture
The Ohio State University
Ohio Agricultural Research & Development Center
Wooster, OH 44691

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The Processing Tomato Breeding Program

Processing tomato breeding at Ohio State University in 1993 continued to be directed toward helping provide the midwest US tomato processing industry with improved cultivars through improved germplasm and cultivar development, hybrid formulation, and an intensive evaluation program. The need for improved varieties continues in order to keep this industry competitive. This breeding work continues to be directed with emphasis on improvement of whole-canned tomato (whole-pack), diced product. Needs of the product processor are also being given attention in relation to breeding of improved varieties for juice, sauce, ketchup and paste products.

Selection for earliness and improved fruit setting ability, especially during periods of stress, is being carried out to make possible more dependable yield potential and uniform tomato harvest schedules. Other important characteristics being selected to make machine harvest more efficient include crack resistance, firmness and ability of ripe fruit to store well on the vine for extended periods. Breeding and selection was continued for resistance to Anthracnose (*Colletotricum* spp.), Fusarium (*Fusarium oxysporum* [I]) and Verticillium (*Verticillium dahliae* [Ve]) wilts, and Early blight (*Alternaria solani*). Improved quality factors being selected and evaluated in cooperation with commercial processors include: acidity, pH, soluble solids, viscosity, crimson fruit color, and especially fruit attributes conditioning efficient lye peeling characteristics, corelessness, as well as greater case yield potential for sauce products. We advanced, evaluated and selected several hundred new breeding lines with potential for utilization as OP varieties as well as in formulating new hybrids.

OP and Hybrid Cultivar Development and Evaluation

The 1993 growing season was characterized by hot, dry conditions which stressed the commercial crop, resulting in below average yields of about 22 tons/acre; production was less than 300,000 tons from about 14,000 acres. On the research trials at the OARDC Vegetable Branch, Fremont, an irrigation (1") was applied following planting due to the dry May weather and soil conditions. Light rainfall during June and July did allow for excellent crop development and yields were excellent in spite of drought conditions the remainder of the season. In our 1993 replicated machine harvest trials at Fremont, Ohio we

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[1]Professor, Research Assistant, Branch Manager and Director, Food Industries Center.

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evaluated 59 advanced OP lines and 94 hybrids. Cooperative trials were carried out with Terra, Hirzel Canning and Hunt-Wesson Cos. The new Ohio hybrids OX38, OX42 and OX88 were tested extensively and performed very well. These hybrids have exhibited potential for making possible improved productivity, disease resistance and quality. Hybrid cultivars have been giving yield advantages when compared with open pollinated varieties, and are exhibiting improved earliness and more dependable performance under stress conditions. The new disease resistant Ohio hybrid OX64, which was bred especially for high viscosity potential product use also continued to be outstanding in performance. Commercial seed increase of these Ohio hybrids is being carried out.

For whole-canned tomato production, Ohio 7983 and Ohio 8245 continued to constitute a major proportion of 1993 commercial acreage. O7983 is an early-main season type and suited for whole pack and diced pack. O8245 continues to perform well as a main season variety; its excellent productivity, disease resistance and quality attributes continue to be noteworthy. Work continued on utilization of the crimson fruit color gene ($\underline{og^c}$) for improved color with release of Ohio 8556. Commercial acreage of O 8556 did well; the variety is also jointless Verticillium-Fusarium resistant with excellent whole pack and diced product quality. Improvement of color potential continues to be a major objective in the breeding program and many new promising lines advanced and are being evaluated along with new hybrids for increased color potential such as OX135-OX137.

MATERIALS AND METHODS

Location: Vegetable Crops Branch, Fremont, Ohio.

Soil: Silty clay loam, spring bedded (May 15).

Fertilizer: 800 lb. per acre of 0-26-26 (October 27); 200 lb. per acre of 34-0-0 (May 8).

Herbicide: 1.5 pt/A Trifluralin 4EC, 1/3 lb/A Sencor DF incorporated May 17; Sencor directed spray 0.50 lb./A June 30.

Plants: Greenhouse-grown, 108 per standard flat from seed sown April 6.

Transplanted to Field: May 20, a two-row transplanter using 21-53-0 starter at 5 lb. per 100 gal. of water; 1/2 pint per plant. Following transplanting, due to extremely dry conditions, a 1.0" irrigation was applied May 21-22.

Plot Size and Spacing: Single-row plots, 20 plants per row spaced 12 inches, rows 5 feet apart.

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

Weather Data (OARDC, Fremont, Ohio)

	Temperature		Rainfall (inches)	
	1993	41 Yr. Avg.	1993	41 Yr. Avg.
April	45.2	48.6	3.15	3.31
May	59.2	59.5	0.97	3.60
June	67.3	69.0	4.39	3.99
July	73.9	73.0	1.37	3.91
August	71.1	70.8	0.75	3.47
September	52.5	64.0	2.32	3.07

HARVEST INFORMATION

Above average temperatures and below normal rainfall and drought characterized the season. The harvest period weather conditions were favorably dry allowing for excellent recovery rates.

Harvesting was with a Johnson tomato harvester and was carried out when the trial 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 and 2). 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 (Table 1 and 2). Because of the complexity of factors which determine a potentially successful variety, other factors which must be considered and can be limiting are included; eg., fruit concentration, fruit cull percentage, fruit size.

QUALITY EVALUATION

Field-run tomatoes were used for quality evaluation: OSU/OARDC Lab (raw product evaluation) (Tables 1a, 2a and Fig. 2); Hunt-Wesson Co. Lab raw product evaluation--hot break (190°F) Brix and Viscosity Potential (Tables 1b, 2b, and Figs. 3-6).

1. Color: Agtron ME-5M
2. Percent Soluble Solids: American optic Abbe Refractometer
3. pH was determined by Beckman Zeromatic pH meter.
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. Viscosity analysis results are expressed as a Viscosity Potential Index. Procedure: hot break-finish-capillary flow tube--60 sec flow basis; results expressed as cases/ton, 72/8 oz sauce (Hunt-Wesson).

Seed Sources and Cooperators

1. S.Z. Berry, Dept. of Horticulture, OSU-OARDC, Wooster, OH.
2. D. Wengert, Hunt-Wesson Foods, Inc., Perrysburg, OH.
3. S. Gahn, H.J. Heinz Co., 13737 Middleton Pike, Bowling Green, OH
4. W.A. Gould, Mid America Food Processors, Worthington, OH
5. J. Hirzel, Hirzel Canning Co., Toledo, OH.
6. K. Wagner, Terra-Vegetable Div., Carmel, IN.

Table 1. Trial I. Mechanical harvest evaluation of processing tomato varieties and test lines when ripe fruit was approaching optimum recovery. Replicated. Vegetable Crops Branch, OARDC, Fremont, Ohio 1993.

Variety or Test Line	Ripe Usable T/A	% of Potential Ripe	Green	Cull	Fruit Wt. (oz.)
Harvest Date 8/26/93					
H 8704	41.2	86	13	1	2.08
OX 64	38.5	88	10	2	2.01
O 90139	37.0	91	6	3	2.20
OX 9	36.4	90	7	3	2.43
OX 88	33.9	92	6	2	1.85
O 90135	33.7	92	5	3	2.04
OX 1	33.5	90	4	6	2.34
OX 4	33.2	88	7	5	2.46
H 9201	32.8	92	6	2	2.05
O 8550	31.7	86	12	2	2.40
SO 12	31.2	81	15	4	2.19
O 88110	30.0	90	6	4	1.95
PS 696	29.2	89	6	5	2.04
O 88122	29.0	92	5	3	2.08
O 8446	27.9	91	7	2	2.03
O 7814	27.6	92	3	5	1.66
O 7983	26.9	91	4	5	2.07
O 9246	26.7	89	6	5	2.06
H 8927	26.3	83	13	4	1.86
Harvest Date 8/31/93					
OX 42	42.7	91	5	4	1.90
OX 38	35.9	90	5	5	1.94
O 87160	34.9	87	9	4	1.94
H 1100	34.4	87	10	3	2.07
O 8383	31.7	83	8	9	2.59
O 9244	30.7	90	4	6	2.18
O 8556	30.7	91	5	4	2.25
O 88119	30.6	87	8	5	1.83
O 87175	30.5	91	4	5	2.17
O 86120	30.1	87	7	6	2.21
O 8986	30.0	85	4	11	2.21
PS 2196	28.5	90	3	7	2.06
O 8675	28.3	83	13	4	2.29
O 8444	28.0	80	17	3	2.66
O 9241	25.9	84	6	10	2.04
O 8991	25.9	91	4	5	1.83
O 88154	25.2	88	7	5	2.12
O 88129	24.9	86	6	8	2.09
O 8690	24.2	85	7	8	2.35
O 8994	22.3	72	9	19	2.85
Harvest Date 9/4/93					
OX 6	33.0	87	5	8	2.10
O 8689	30.2	84	10	6	2.50
O 90128	27.3	86	7	7	2.24
O 8245	25.9	85	7	8	2.05
LSD .05	9.0				0.28

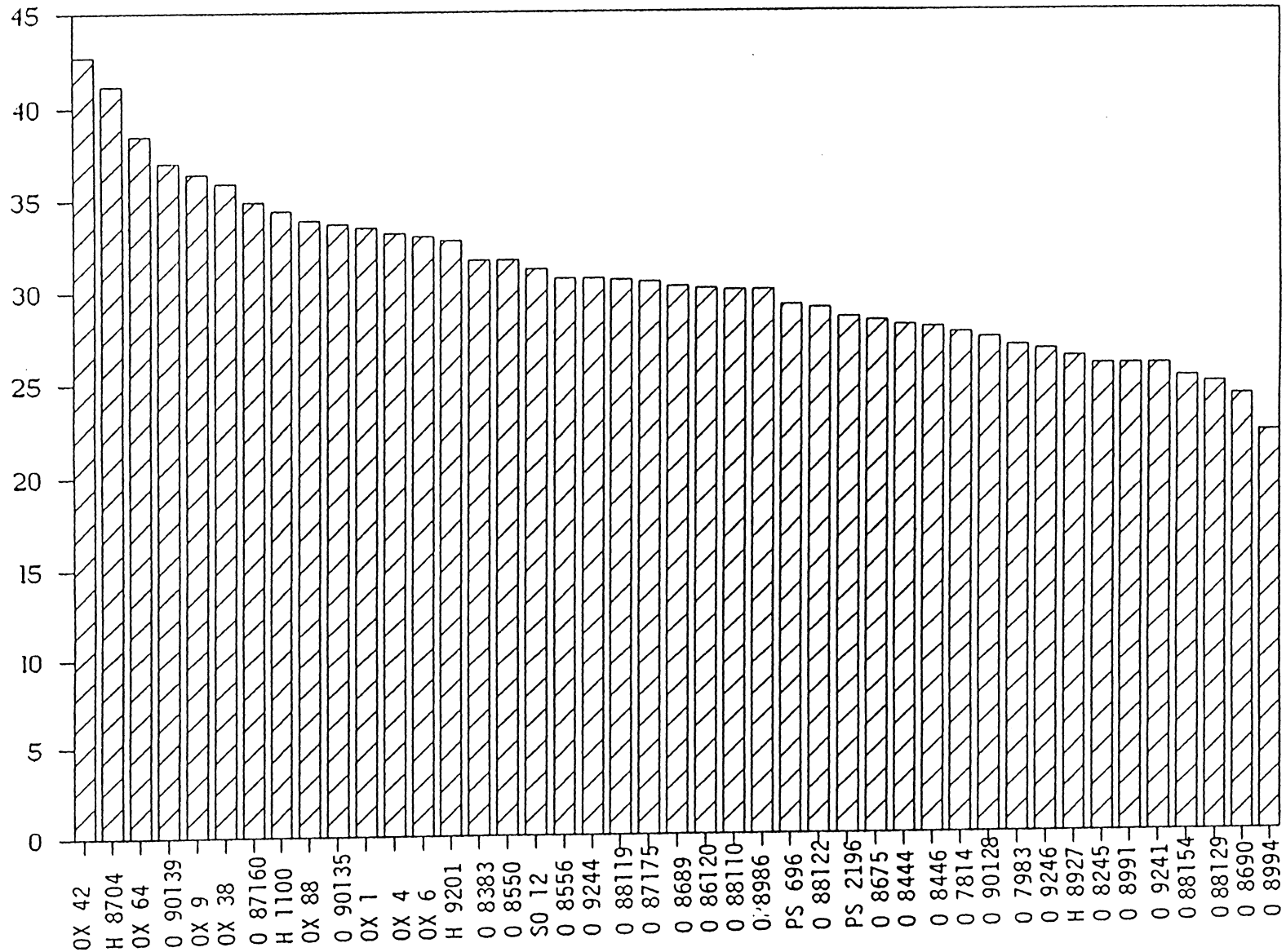
Table 1a. Trial I. Laboratory evaluation of processing tomato varieties and test lines. Vegetable Crops Branch, OARDC, Fremont, OH 1993.

Variety or Test Line	pH	% Total Acid as Citric	% Soluble Solids	Agtron ME-5M
H 8704	3.8	0.31	3.4	49
OX 64	4.0	0.27	3.4	48
O 90139	4.3	0.32	3.9	55
OX 9	4.1	0.38	4.0	53
OX 88	4.1	0.34	3.9	52
O 90135	4.1	0.36	3.8	44
OX 1	3.9	0.45	4.2	53
OX 4	4.0	0.42	4.2	51
H 9201	4.0	0.35	3.7	59
O 8550	4.0	0.31	3.7	58
SO 12	3.8	0.45	4.7	53
O 88110	4.0	0.32	3.1	48
PS 696	4.0	0.37	3.9	57
O 88122	4.2	0.30	3.8	48
O 8446	3.8	0.40	3.7	59
O 7814	4.0	0.32	3.8	50
O 7983	3.9	0.36	3.8	57
O 9246	4.1	0.36	4.3	48
H 8927	3.9	0.31	3.4	55
OX 42	4.0	0.36	3.5	49
OX 38	4.2	0.31	3.6	53
O 87160	4.0	0.32	2.9	52
H 1100	3.9	0.37	3.9	59
O 8383	4.0	0.41	4.8	49
O 9244	4.0	0.36	4.3	40
O 8556	3.9	0.37	4.0	49
O 88119	4.0	0.31	3.2	48
O 87175	4.0	0.33	3.6	51
O 86120	4.0	0.36	3.4	48
O 8986	4.0	0.27	3.1	58
PS 2196	4.0	0.41	4.1	52
O 8675	4.1	0.34	4.5	60
O 8444	3.9	0.46	4.5	60
O 9241	4.2	0.34	4.5	54
O 8991	3.9	0.36	3.9	53
O 88154	4.1	0.26	3.0	58
O 88129	4.1	0.35	4.3	53
O 8690	4.2	0.29	4.2	42
O 8994	4.0	0.36	4.0	41
OX 6	4.0	0.38	4.6	52
O 8689	4.2	0.33	4.3	43
O 90128	4.1	0.33	3.6	55
O 8245	3.9	0.37	3.3	63

Table 1b. OSU Machine Harvest Trial I. Quality Evaluation (Beatrice/Hunt-Wesson Lab) Fremont, OH 1993.

Cultivar	pH	Brix	Viscosity Potential Index cases/ton (72/8 oz. sauce)
O 8245	4.5	5.0	30.2
H 1100	4.2	4.6	33.0
H 8704	4.5	4.8	41.9
H 8927	4.3	4.8	40.9
PS 696	4.4	5.3	31.0
PS 2196	4.2	5.8	30.4
SO 12	4.7	6.0	35.1
OX 1	4.4	5.5	26.5
OX 4	4.4	5.5	30.8
OX 6	4.2	6.3	33.1
OX 9	4.5	5.4	28.7
OX 38	4.5	5.9	34.5
OX 42	5.1	4.6	28.3
OX 64	3.6	4.9	42.0
OX 88	4.3	5.3	28.3
O 8444	4.1	6.4	27.1
O 8550	4.5	5.4	29.5
O 8675	5.1	5.4	24.1
O 8689	4.6	5.6	30.2
O 8690	4.4	6.0	29.8
O 86120	4.5	5.0	24.0
O 87160	4.3	4.8	28.5
O 87175	4.5	4.9	26.4
O 88110	4.3	5.0	28.1
O 88119	5.2	4.7	34.5
O 88122	4.4	5.9	31.9
O 88129	4.5	5.8	30.5
O 88154	4.4	4.6	32.6
O 8986	4.7	4.3	29.6
O 8991	4.5	5.9	33.2
O 8994	4.8	5.5	35.6
O 90128	4.7	4.8	28.1
O 90135	3.9	5.7	28.6
O 90139	4.6	5.8	26.5
O 9246	5.0	6.1	29.1

FIG. 1. OSU TRIAL I. MACHINE HARVEST, OARDC, FREMONT, OH 1993



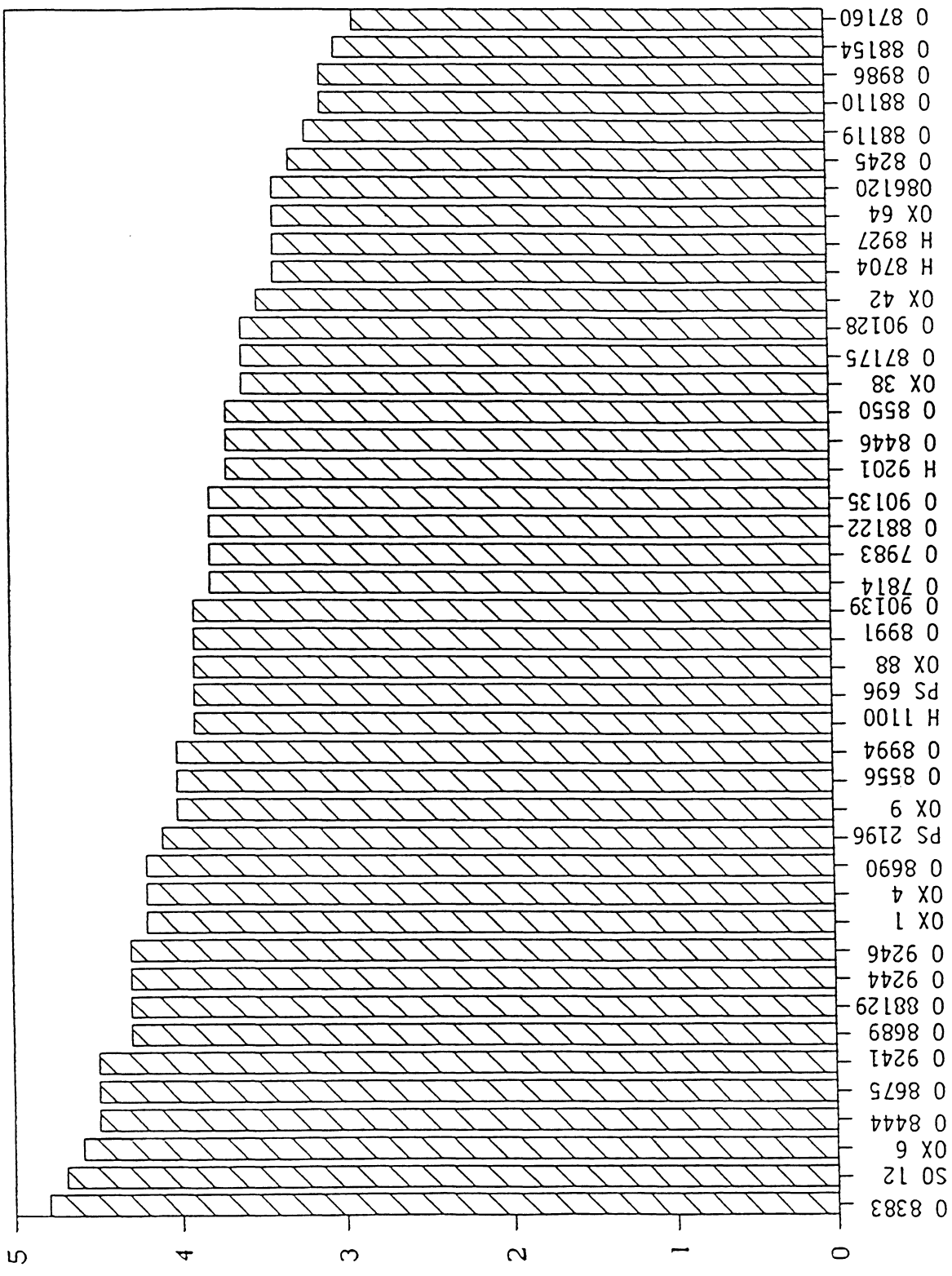


FIG. 2. OSU TRIAL I. MACHINE HARVEST, OARDC, FREMONT, OH 1993
Soluble Solids
0
1
2
3
4
5
O 8383
SO 12
OX 6
O 8444
O 8675
O 9241
O 8689
O 88129
O 9244
O 9246
OX 1
OX 4
O 8690
PS 2196
OX 9
O 8556
O 8994
H 1100
PS 696
OX 88
O 8991
O 90139
O 7814
O 7983
O 88122
O 90135
H 9201
O 8446
O 8550
OX 38
O 87175
O 90128
OX 42
H 8704
H 8927
OX 64
O 86120
O 8245
O 88119
O 88110
O 8986
O 88154
O 87160

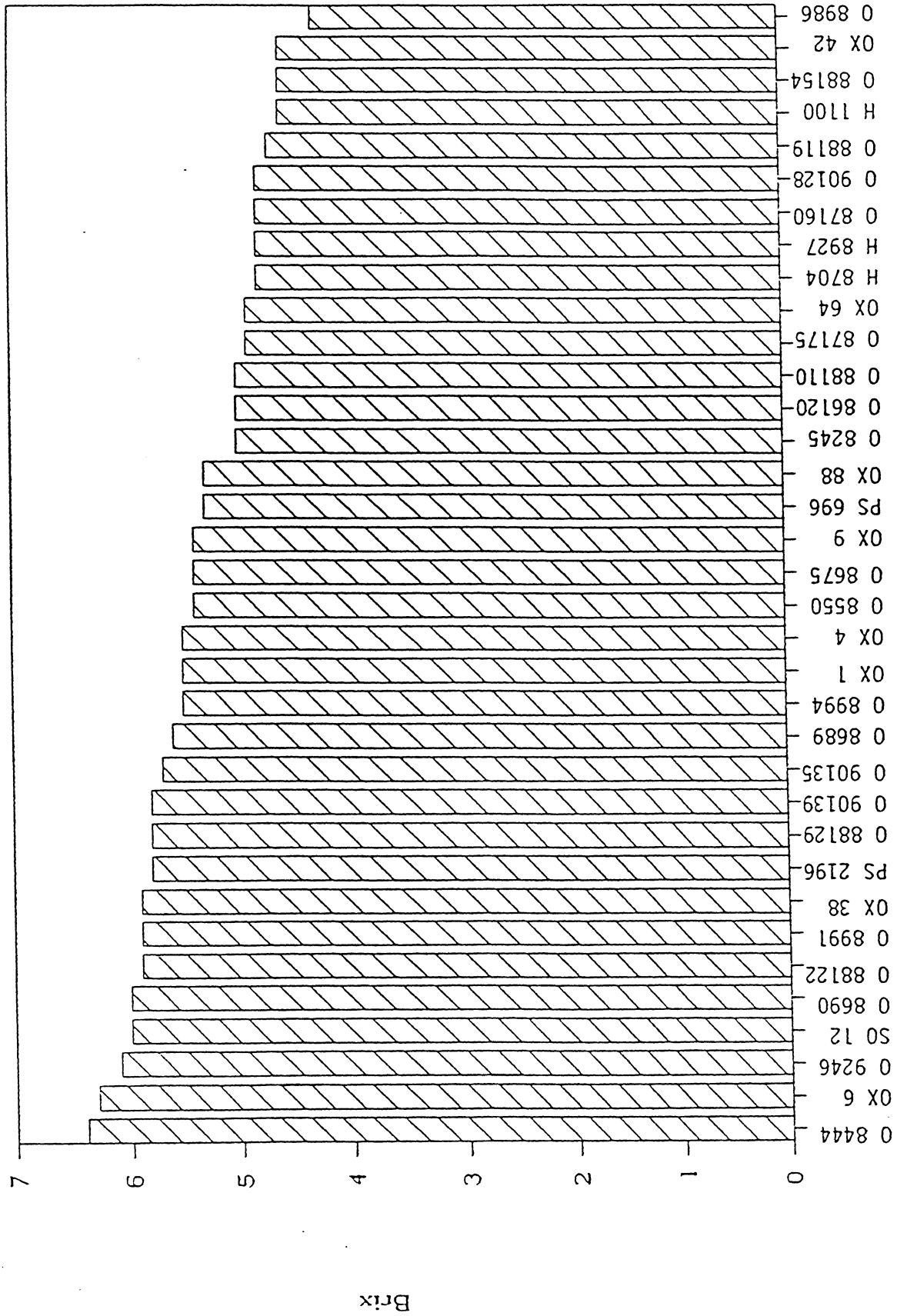


FIG. 3. OSU TRIAL I. MACHINE HARVEST, OARDC-HUNT/WESSON, FREMONT, OH. 1993

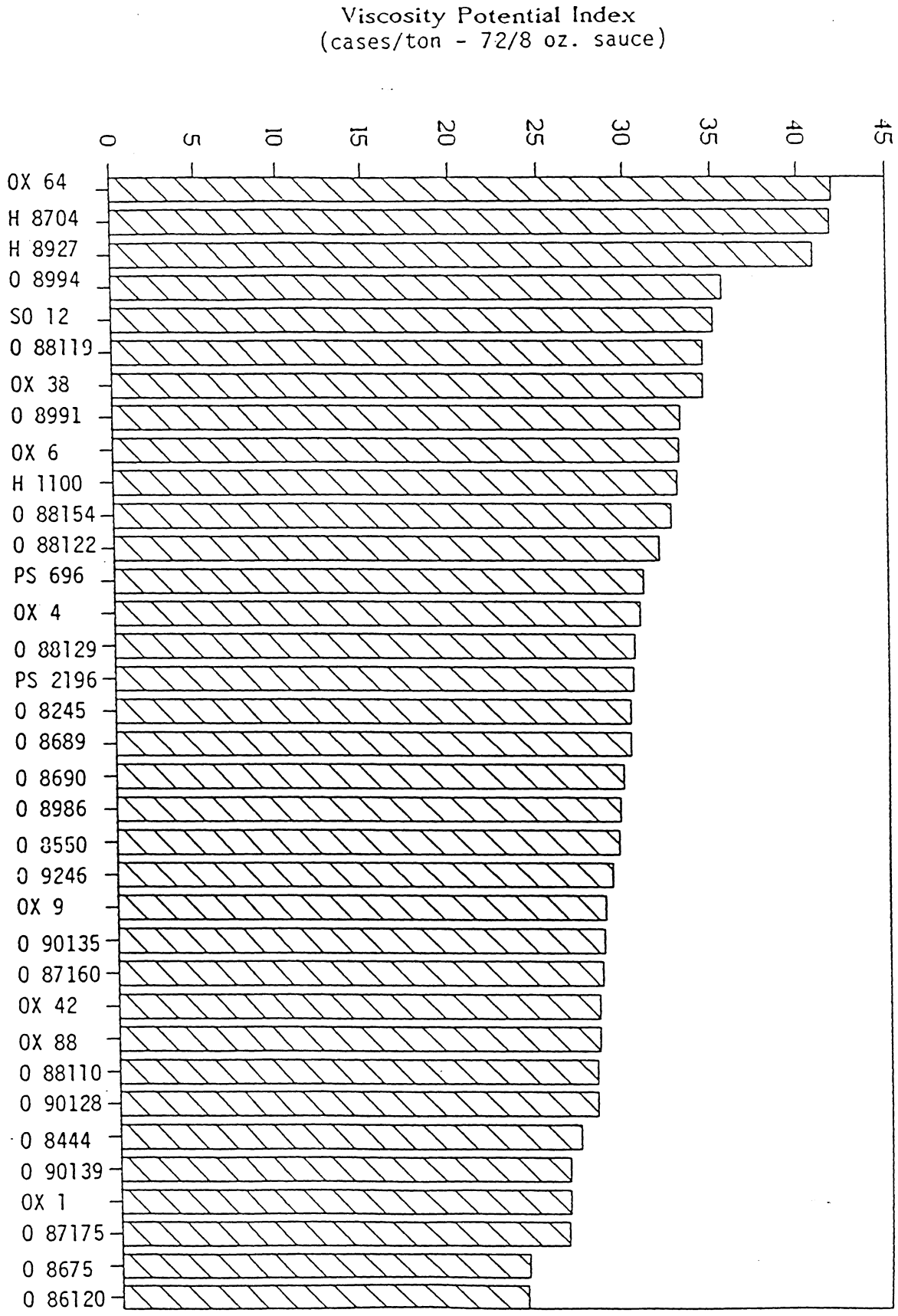


FIG. 4. OSU TRIAL I. MACHINE HARVEST, OARDC - HUNT/WESSON, FREMONT, OH. 1993

Table 2. Trial II. Mechanical harvest evaluation of processing tomato varieties and test lines when ripe fruit was approaching optimum recovery. Replicated. Vegetable Crops Branch, OARDC, Fremont, Ohio 1993.

Variety or Test Line	Ripe Usable T/A	% of Potential			Fruit Wt. (oz.)
		Ripe	Green	Cull	
Harvest Date 8/26/93					
OX 49	38.3	86	13	1	2.37
OX 70	38.4	88	10	2	2.10
OX 101	38.4	95	3	2	2.08
OX 4	38.2	89	8	3	2.46
OX 88	37.5	86	9	5	2.06
O 7983	36.7	90	6	4	1.92
OX 1	34.7	94	4	2	2.42
OX 46	34.7	89	9	2	2.08
OX 3	34.4	86	12	2	1.81
H 6285	34.2	88	10	2	2.70
OX 99	32.1	87	9	4	2.38
OX 55	31.5	86	10	4	2.03
H 7151	31.4	90	9	1	2.32
O 8687	30.8	93	6	1	2.19
OX 137	30.3	92	6	2	2.13
OX 72	30.0	87	9	4	1.55
OX 71	29.9	87	10	3	2.06
O 90389	29.3	87	11	2	2.43
OX 119	28.4	92	5	3	2.00
O 88144	27.9	88	8	4	2.05
H 9201	27.4	91	7	2	1.89
OX 134	25.2	92	5	3	2.24
O 93218	25.2	83	9	8	2.14
O 90393	24.7	89	6	5	2.02
OX 69	23.5	92	6	2	1.97
O 93216	22.9	78	11	11	2.27
Harvest Date 9/1/93					
OX 52	45.6	90	7	3	1.89
OX 53	43.3	90	5	5	2.00
OX 50	40.6	85	6	9	2.03
OX 17	39.1	91	5	4	1.94
OX 127	38.5	90	6	4	2.30
OX 110	38.4	89	5	6	1.86
OX 54	37.7	90	5	5	2.08
OX 95	37.3	93	4	3	2.19
OX 51	37.1	94	2	4	2.22
OX 34	37.0	91	5	4	2.19
OX 113	37.0	89	6	5	2.40
OX 5	36.5	92	5	3	2.08
OX 116	36.5	90	7	3	2.61
O 90384	35.3	89	6	5	2.42
OX 97	34.9	87	7	6	2.29
OX 24	34.7	90	4	6	2.18
O 93213	34.7	92	5	3	2.11
OX 58	34.3	89	4	7	2.22
OX 121	34.1	92	4	4	2.46
OX 135	34.1	89	7	4	1.81
OX 129	33.2	91	6	3	2.27
OX 73	33.1	89	4	7	2.43

Table 2. (cont.) Trial II. Mechanical harvest evaluation of processing tomato varieties and test lines when ripe fruit was approaching optimum recovery. Replicated. Vegetable Crops Branch, OARDC, Fremont, Ohio 1993.

Variety or Test Line	Ripe Usable T/A	% of Potential			Fruit Wt. (oz.)
		Ripe	Green	Cull	
Harvest Date 9/1/93 (cont.)					
OX 120	33.1	90	8	2	2.46
OX 126	32.1	91	4	5	2.37
OX 89	31.9	91	4	5	1.80
OX 68	31.6	90	6	4	2.03
OX 64	31.2	87	7	6	2.10
OX 74	30.7	87	5	8	2.26
OX 138	30.3	87	7	5	2.05
O 8383	30.0	85	5	10	2.80
OX 125	29.8	86	6	8	2.34
O 88169	29.3	88	3	9	1.98
OX 111	29.2	90	6	4	2.21
OX 106	28.9	89	7	4	1.78
O 93217	28.9	88	4	8	1.89
OX 122	28.4	88	7	5	2.18
OX 124	28.2	84	9	7	2.08
O 90383	28.0	86	10	4	1.81
O 8990	27.1	88	8	4	2.08
O 93214	25.7	86	7	7	2.03
Harvest Date 9/4/93					
OX 80	41.2	90	4	6	2.24
OX 9	40.8	86	8	6	2.35
O 8245	40.0	88	9	3	2.32
PS 696	39.0	91	4	5	1.97
OX 8	37.9	90	5	5	2.19
OX 38	37.6	90	5	5	1.84
OX 132	35.2	85	9	6	2.46
O 90385	35.0	91	6	3	1.95
OX 130	34.9	90	6	4	2.51
O 90390	34.7	93	3	4	1.90
OX 114	34.2	83	11	6	2.56
OX 118	33.9	88	5	7	2.34
OX 115	32.5	85	8	7	2.24
O 93219	31.7	85	11	4	1.92
OX 128	31.5	86	8	6	2.34
OX 60	30.7	90	4	6	2.22
O 8556	30.0	86	8	6	2.21
OX 117	29.8	89	3	8	2.26
O 93207	29.5	82	4	14	2.27
O 93215	29.3	91	5	4	1.74
O 90381	28.3	88	9	3	1.92
O 90388	28.1	82	4	4	2.30
OX 136	27.6	87	7	5	2.03
OX 131	27.0	88	7	5	2.05
O 90397	26.9	88	6	6	2.18
O 93220	25.7	86	3	11	2.35
O 90395	21.5	82	6	12	2.03
LSD .05	9.2				0.36

Table 2a. Trial II. Laboratory evaluation of processing tomato varieties and test lines. Vegetable Crops Branch, OARDC, Fremont, OH 1993.

Variety or Test Line	pH	% Total Acid as Citric	% Soluble Solids	Agtron ME-5M
O 7983	4.1	0.33	4.1	52
O 8245	4.0	0.36	4.2	54
PS 696	4.1	0.35	4.1	51
O 8556	4.2	0.33	4.4	49
O 93207	4.2	0.26	3.8	53
H 6285	4.0	0.35	4.3	61
H 7151	4.2	0.31	4.9	47
O 93213	4.2	0.36	4.8	50
O 93214	4.2	0.35	4.4	50
O 93215	4.3	0.34	4.4	52
O 93216	4.0	0.34	4.0	43
O 93217	4.3	0.35	3.9	54
O 93218	4.2	0.38	5.9	46
O 8687	4.2	0.26	4.6	42
O 88144	4.2	0.32	4.5	67
OX 3	4.1	0.26	3.4	54
OX 5	4.1	0.30	3.6	66
OX 9	4.0	0.34	4.0	47
OX 17	4.1	0.31	3.4	58
OX 24	4.2	0.28	3.8	52
OX 34	4.1	0.30	3.7	60
OX 38	4.1	0.29	3.4	60
OX 49	4.1	0.28	3.5	68
OX 52	4.1	0.30	3.3	49
OX 53	4.2	0.27	3.4	44
OX 54	4.1	0.27	3.6	56
OX 88	4.2	0.27	3.6	53
OX 95	4.0	0.26	3.8	62
OX 97	4.1	0.32	4.0	55
OX 99	4.1	0.33	4.4	57
OX 106	4.2	0.29	3.8	53
OX 116	4.1	0.30	4.0	49
OX 117	4.3	0.27	3.4	49
OX 118	4.1	0.29	3.6	46
OX 119	4.3	0.27	5.0	49
OX 120	4.2	0.31	5.1	40
OX 121	4.0	0.29	4.0	42
OX 124	4.1	0.36	4.9	43
OX 125	4.3	0.29	3.9	41
OX 126	4.1	0.27	4.1	44
OX 127	4.1	0.33	3.5	47
OX 128	4.2	0.30	4.4	41
OX 129	4.2	0.28	4.4	43
OX 130	4.2	0.28	4.3	44
OX 131	4.2	0.33	4.4	50
OX 132	4.0	0.38	5.1	42
OX 134	4.2	0.32	3.9	41
OX 136	4.1	0.37	4.8	43
OX 137	4.3	0.32	3.9	39

Table 2b. OSU Machine Harvest Trial II. Quality Evaluation (Beatrice/Hunt-Wesson Lab) Fremont, OH 1993.

Cultivar	Raw Brix	Viscosity Potential Index cases/ton (72/8 oz. sauce)
O 7983	5.6	29.3
O 8245	6.2	37.5
O 8383	6.8	28.4
O 8444	6.8	41.1
O 8556	4.6	19.7
O 8990	5.3	27.8
H 1100	6.5	46.6
H 6285	6.0	31.9
H 7151	6.0	31.2
H 8704	5.5	31.8
H 8927	4.7	30.9
H 9201	5.7	50.2
PS 696	6.6	39.3
O 93213	5.7	30.9
O 93214	6.4	31.7
O 93215	6.8	38.0
O 93216	5.6	32.5
O 93207	5.2	29.9
O 93217	5.5	31.0
O 93220	5.1	37.0
O 90381	5.1	33.6
O 90383	5.1	40.8
O 90384	5.0	27.2
O 90385	5.2	----
O 90388	6.9	68.5
O 90389	5.1	29.1
O 90390	5.3	37.7
O 90393	5.2	38.3
O 90395	5.2	31.0
O 90397	6.1	29.2
OX 38	5.0	32.7
OX 42	5.4	32.9
OX 58	5.7	37.8
OX 60	5.7	42.1
OX 64	4.5	39.4
OX 68	5.7	37.0
OX 69	5.2	39.2
OX 70	4.9	26.5
OX 71	4.7	30.6
OX 72	4.7	34.3
OX 73	5.8	31.6
OX 74	6.8	44.4
OX 78	5.8	36.5
OX 79	5.2	34.7
OX 80	5.7	36.2
OX 110	5.2	42.7
OX 113	5.4	41.9
OX 114	5.7	42.7
OX 137	5.7	30.8

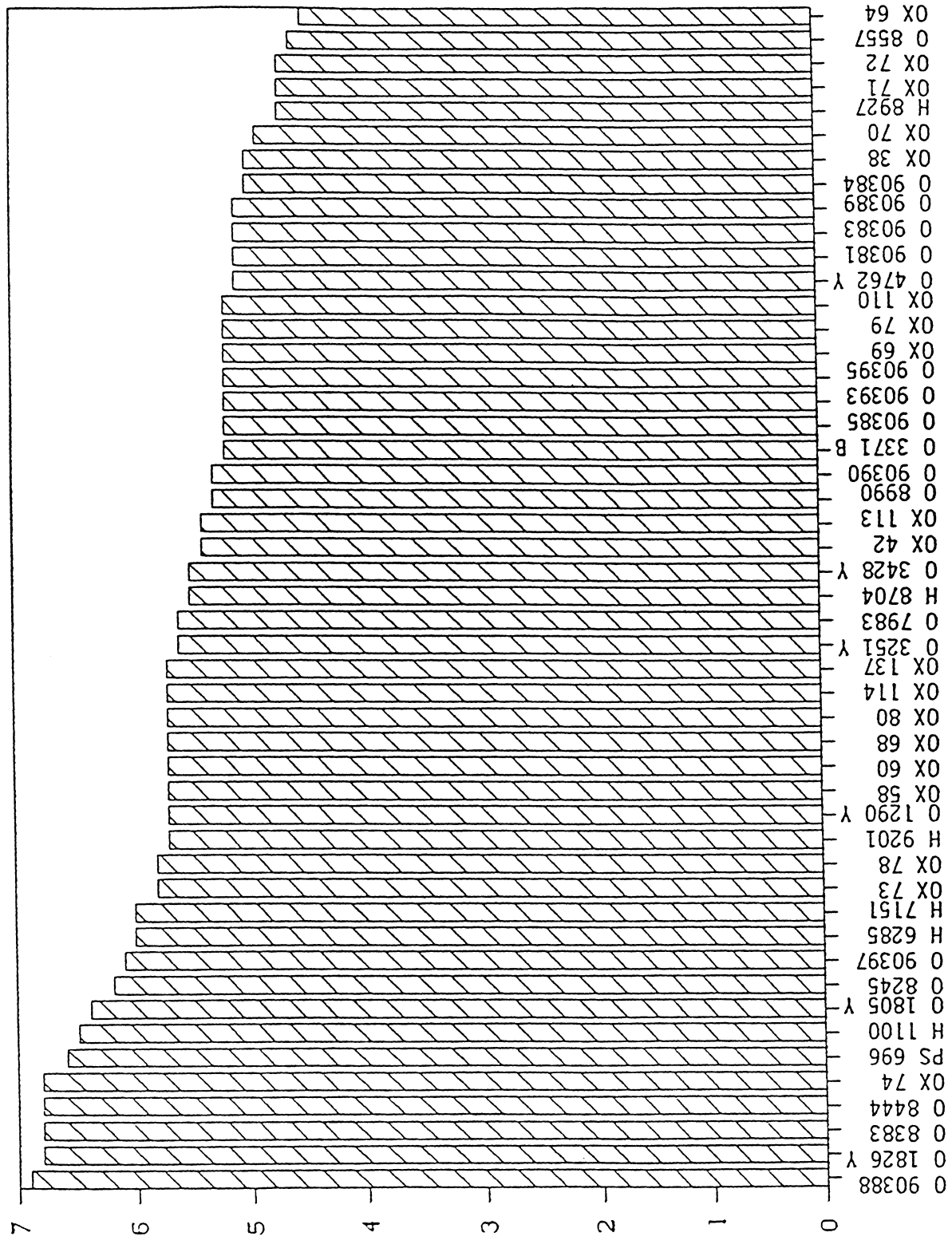
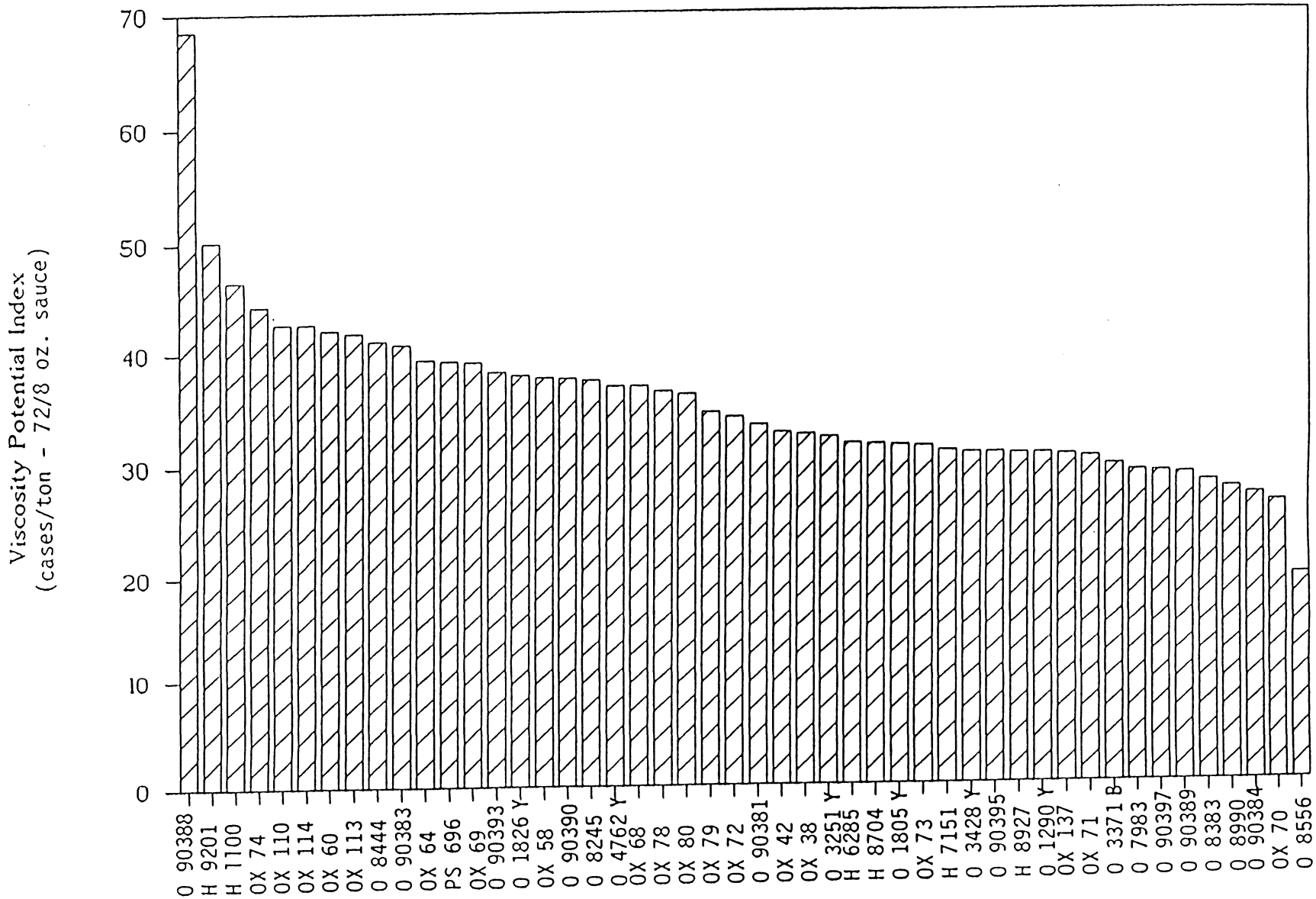


FIG. 5. OSU TRIAL II. MACHINE HARVEST, OARDC-HUNT/WESSON, FREMONT, OH. 1993

FIG. 6. OSU TRIAL II. MACHINE HARVEST, OARDC-HUNT/WESSON, FREMONT, OH. 1993



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Disclaimer Clause

This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for the products mentioned, nor is criticism meant for products not mentioned. The authors and the Ohio Agricultural Research and Development Center assume no liability resulting from the use of these recommendations.