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EVALUATION OF PROCESSING TOMATO BREEDING LINES AND CULTIVARS FOR MECHANICAL HARVESTING AND QUALITY IN 1992

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INTRODUCTION

The 1992 growing season began with good conditions for planting. Soil moisture was good, but temperatures were below normal. The remainder of the season temperatures remained below normal with rainfall above average. Production in the state was about 340,000 tons; acreage for harvest was about 14,000 acres, and average yield about 24.5 tons/acre.

New growing methods machine harvest-bulk handling and new processing technology require a continuous supply of better suited varieties for the industry to remain competitive. Ohio continues to be the second largest processing tomato production state in the United States. This breeding work continues with emphasis on improvement of the whole-canned tomato (whole-pack) and tomato suitable for diced product; work also continues on development of improved varieties for juice, sauce and paste products.

Selection for earliness and improved fruit setting ability, especially under stress conditions, is being carried out to reduce the problem of split fruit set and allow 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 productivity in machine harvest. 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 for and intensively evaluated for in cooperation with commercial processors include: acidity, pH, high soluble solids and viscosity, good red, as well as, crimson fruit color (og^c), and especially fruit attributes conditioning efficient peeling characteristics and corelessness for wholepack and diced product. This also includes improvement of raw product suitable for juice, sauce, ketchup, and other tomato products.

For whole-canned production, Ohio 7983 and Ohio 8245 continued to constitute a major proportion of 1992 commercial acreage. Ohio 7983 acreage is substantial and 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

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suited for coreless wholepack and diced pack, as well as pureed product.

Ohio 8245 continued to perform well as a new productive main-season variety; its excellent disease resistance and quality attributes of color and solids continue to be noteworthy; it is widely used for whole and diced pack as well as for sauce and other tomato product.

The attempt to utilize improved color crimson gene ($\underline{og^c}$) continued with development of Ohio 8556 and commercial acreage of this cultivar did well; it is a jointless Verticillium-Fusarium resistant line with excellent whole pack-diced product quality. Improved color potential continues to be a major objective in the breeding program and several new lines with the crimson color trait were promising this season; these were advanced for further evaluation in 1993. In addition, some of these crimson lines have been utilized in formulating new hybrids with the crimson color trait in order to take advantage of the added vigor and disease resistance that the hybrid condition tends to impart.

Ohio 8550 was also in advanced trial; its earliness is a major attribute; productivity and quality is good. It has jointless fruit stem and is Verticillium-Fusarium resistant.

The early Ohio hybrids OX 1 and OX 4 were tested extensively and showed promise. Also, this year the following new Ohio hybrids were evaluated extensively and performed well: OX 38, OX 64 and OX 88. The use of hybrid processing tomato cultivars is increasing and exhibit potential for making possible more rapid improvements in productivity and disease resistance as compared with inbreds (open pollinated cultivars). Hybrid cultivars tend to exhibit consistent yield advantages over open pollinated varieties. Multiple disease resistance can be incorporated into hybrids more readily and they are showing potential for earliness and more dependable performance under stress conditions.

Seed is being produced of the open pollinated cultivars as well as the hybrids. In addition to station trials, pilot commercial trials with grower-canners will be continued in 1993.

MATERIALS AND METHODS

Location: Vegetable Crops Branch, Fremont, Ohio.

Soil: Silty clay loam, spring bedded (May 10).

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

Herbicide: 1.5 pt/A Treflan incorporated May 17; Sencor directed spray 0.50 lb./A July 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.

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 followed for insect and disease control.

Weather Data (OARDC, Fremont, Ohio)

	Temperature		Rainfall (inches)	
	1992	40 Yr. Avg.	1992	40 Yr. Avg.
April	46.0	48.7	2.37	3.35
May	56.7	59.5	3.09	3.67
June	63.8	69.1	4.29	3.97
July	69.2	72.9	5.78	4.01
August	65.8	70.8	2.83	3.53
September	60.8	64.1	5.97	3.15

HARVEST INFORMATION

Below normal temperatures and above average rainfall characterized the season. Harvest was later than normal; however, conditions at harvest did allow for good recovery rates.

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 (Table 1). 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). 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; the sample was cut in half, quartered, extracted in a Food Processing Equipment Co. laboratory pulper, and de-aerated (Tables 1a and 2; Figs. 1 and 2) (OSU/OARDC Lab).

1. Hunter Color Difference Meter (CDM).
2. Percent Soluble Solids: Abbe Refractometer
3. 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.
4. pH was determined by the glass electrode method.

Viscosity analysis results 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, (Tables 1b, 2a; Figs. 3 and 4) (Hunt/Wesson Lab).

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. J. Hirzel, Hirzel Canning Co., Toledo, OH.
5. K. Wagner and W. Springer, 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 1992.

Variety or Test Line	Ripe Usable T/A	% of Potential			Fruit Wt. (oz.)
		Ripe	Green	Cull	
Harvest Date 8/31/92					
O X 4	30.4	84	11	5	2.3
O X 1	27.8	87	9	4	2.2
O 9244	25.8	85	12	3	2.1
O 90139	25.6	86	11	3	1.9
O X 5	23.6	85	12	3	1.9
O 7983	21.5	91	7	2	1.7
O 90134	21.3	80	13	7	2.1
O 7814	20.0	80	15	5	1.9
Harvest Date 9/9/92					
O X 38	31.4	85	9	6	1.8
O X 42	30.6	91	3	6	1.7
O X 7	30.1	92	2	6	1.8
O 90128	28.7	85	7	8	2.1
PS 696	28.3	87	6	7	2.0
PS 2196	26.6	89	4	7	2.0
O X 9	25.5	79	12	9	2.1
O 90135	24.9	89	5	6	1.9
O 8444	24.6	85	7	8	2.4
O 8556	24.4	83	5	12	2.3
O 9240	24.0	82	11	7	2.0
O 8446	23.6	88	5	7	2.1
O X 6	23.2	90	4	6	2.2
O 8550	23.2	79	8	13	2.1
O 8245	22.9	90	5	5	1.7
O 9242	22.7	74	18	8	2.5
O 86120	22.5	83	7	10	2.2
O 87160	22.2	79	4	17	1.9
O 8675	22.2	83	9	9	2.1
O 87175	22.1	85	5	10	2.0
O 8986	20.1	74	10	16	2.1
O 9241	19.5	82	6	12	2.0
O 8991	17.7	83	4	13	1.6
Harvest Date 9/24/92					
O 8689	21.1	80	11	9	2.1
SO 12	22.0	83	7	10	2.0
O 88129	19.1	70	6	24	2.1
O 9243	18.1	81	9	10	1.7
O 88122	17.4	82	1	17	1.9
O 8690	17.2	80	10	10	2.0
O 88119	17.2	74	5	21	1.7
O 90116	17.2	77	6	17	2.7
O 8994	16.6	75	13	12	3.0
O 88154	15.0	80	5	15	1.9
LSD .05	8.1				0.3

Table 1a. Trial I. Laboratory evaluation of processing tomato varieties and test lines. Vegetable Crops Branch, OARDC, Fremont, OH 1992.

Variety or Test Line	pH	% Total Acid as Citric	% Soluble Solids	Vitamin C mg/100 g	Agtron E-5	Hunter CDM L	Hunter CDM a/b
O X 4	4.4	0.28	4.0	18	39	51.4	1.1
O X 1	4.4	0.28	3.8	13	40	46.7	1.2
O 9244	3.9	0.31	3.9	14	42	45.5	1.2
O 90139	4.0	0.31	4.0	14	49	47.9	1.3
O X 5	4.4	0.27	3.8	15	39	47.4	1.1
O 7983	3.9	0.29	4.0	14	49	47.2	1.2
O 90134	4.4	0.27	3.8	15	39	43.0	1.2
O 7814	3.9	0.32	4.0	13	42	43.0	1.3
O X 38	4.4	0.28	3.8	12	47	55.1	1.0
O X 42	3.9	0.31	4.7	18	47	43.1	1.1
O X 7	3.9	0.32	3.9	15	44	45.1	1.1
O 90128	4.4	0.27	3.5	10	47	46.7	1.2
PS 696	3.9	0.28	4.0	15	43	45.7	1.2
PS 2196	4.3	0.27	3.8	13	46	45.0	1.2
O X 9	4.0	0.32	4.1	13	40	43.9	1.1
O 90135	4.4	0.26	3.8	11	48	35.2	1.3
O 8444	3.9	0.31	4.3	15	46	47.1	1.2
O 8556	3.9	0.31	3.6	11	51	48.1	1.4
O 9240	4.0	0.31	4.0	13	45	43.1	1.2
O 8446	4.5	0.22	3.5	12	46	52.7	1.0
O X 6	4.0	0.29	4.1	14	46	46.1	1.3
O 88550	3.9	0.31	4.0	13	45	47.6	1.3
O 8245	3.8	0.35	4.8	13	51	45.9	1.2
O 9242	3.9	0.32	4.5	13	44	44.2	1.3
O 86120	4.0	0.29	3.9	10	51	46.4	1.3
O 87160	4.4	0.26	3.5	14	42	44.6	1.1
O 8675	3.8	0.30	3.8	13	42	44.1	1.2
O 87175	4.1	0.26	4.1	10	43	45.7	1.3
O 8986	4.4	0.21	3.5	12	53	43.6	1.1
O 9241	4.5	0.27	3.8	13	41	44.9	1.3
O 8991	4.3	0.24	3.5	11	50	45.1	1.1
O 8689	4.0	0.28	3.7	13	40	44.3	1.2
SO 12	4.4	0.26	3.5	11	39	45.8	1.3
O 88129	4.5	0.26	3.5	11	47	46.4	1.1
O 9243	4.4	0.27	3.8	15	43	48.7	1.4
O 88122	4.4	0.29	3.8	10	52	49.2	1.3
O 8690	4.5	0.26	3.8	11	49	40.8	1.3
O 88119	4.4	0.23	3.5	12	40	34.8	1.3
O 90116	4.4	0.28	3.8	8	43	41.5	1.3
O 8994	4.4	0.24	3.8	10	46	40.2	1.3
O 88154	4.5	0.25	3.2	12	39	44.5	1.2

Table 1b. OSU Machine Harvest Trial I. Quality Evaluation (Beatrice/Hunt-Wesson Lab) Fremont, OH 1992.

Cultivar	pH	Raw Brix	Viscosity Potential Index cases/ton (72/8 oz. sauce)
O 7814	4.2	5.0	31.4
O 7983	4.2	4.5	29.8
O 8245	4.2	4.9	35.1
PS 696	4.4	4.7	31.3
PS 2196	4.3	4.5	30.2
SO 12	4.3	4.1	28.7
O X 1	4.2	4.2	29.0
O X 2	4.3	4.9	30.8
O X 4	4.2	4.8	31.7
O X 5	4.3	4.2	29.1
O X 6	4.3	4.6	31.8
O X 7	4.2	4.4	30.6
O X 9	4.3	4.7	33.5
O X 38	4.3	3.4	25.4
O X 42	4.2	5.2	39.6
O 8444	4.3	5.0	33.8
O 8446	4.4	4.4	29.5
O 8550	4.4	4.5	25.7
O 8675	4.3	4.7	31.5
O 8689	4.3	4.2	24.2
O 8690	4.3	4.3	25.2
O 8556	4.5	4.1	27.5
O 86120	4.3	3.8	22.2
O 88110	4.3	4.1	37.4
O 88119	4.4	4.8	29.4
O 88122	4.4	4.1	31.3
O 88129	4.4	4.3	26.8
O 88154	4.4	4.0	25.1
O 8986	4.3	3.5	33.6
O 8991	4.4	4.0	33.3
O 8994	4.3	3.7	32.7
O 90116	4.3	3.8	28.0
O 90128	4.3	4.3	28.6
O 90135	4.4	4.7	31.5
O 90139	4.3	4.5	28.2
O 9240	4.5	4.1	22.3
O 9241	4.3	4.8	27.7
O 9242	4.3	4.9	28.3
O 9243	4.3	4.4	26.7
O 9244	4.4	4.1	26.5

Table 2. Trial II. Laboratory evaluation of processing tomato varieties and test lines. Vegetable Crops Branch, OARDC, Fremont, OH 1992.

Variety or Test Line	pH	% Total Acid as Citric	% Soluble Solids	Vitamin C mg/100 g	Agtron E-5	Hunter CDM L	Hunter CDM a/b
O 7983	3.5	0.36	3.8	13	44	46.9	1.1
O 8245	3.6	0.30	4.2	12	61	42.0	1.2
O 8442	3.7	0.25	4.4	23	46	46.0	1.0
O 8444	3.6	0.31	5.0	15	61	41.4	1.0
O 8556	3.6	0.28	3.8	12	38	48.7	1.1
O 90381	3.7	0.26	3.8	16	46	42.3	1.1
O 90383	3.6	0.27	3.8	15	61	45.6	1.2
O 90384	3.6	0.29	3.8	16	60	43.0	1.2
O 90385	3.5	0.34	3.2	16	36	44.1	1.2
O 90388	3.7	0.29	4.9	16	35	46.8	1.2
O 90389	3.7	0.23	3.8	18	57	43.9	1.1
O 90390	3.6	0.25	3.8	19	51	47.9	1.0
O 90391	3.9	0.22	3.5	21	48	36.9	1.0
O 90392	3.8	0.27	3.8	19	47	44.0	1.0
O 90393	3.7	0.30	3.1	16	43	42.2	1.2
O 90394	3.6	0.32	3.8	15	48	42.1	1.0
O 90395	3.6	0.27	3.4	16	37	47.2	1.2
O 90396	3.7	0.28	3.7	16	43	39.1	1.0
O 90397	3.9	0.27	3.8	15	35	47.2	1.3
O X 1	3.6	0.32	3.7	20	50	41.6	1.1
O X 3	3.7	0.28	3.9	18	38	40.3	1.0
O X 4	3.5	0.31	4.2	16	48	41.5	1.1
O X 5	3.7	0.27	4.6	15	41	47.6	1.2
O X 8	3.5	0.32	4.3	17	42	39.3	1.0
O X 9	3.6	0.32	3.7	19	46	47.3	1.0
O X 15	3.4	0.33	4.5	18	39	46.8	1.2
O X 17	3.6	0.32	4.9	16	35	46.9	1.2
O X 24	3.7	0.30	4.0	17	37	44.2	1.2
O X 32	3.7	0.25	3.8	22	42	35.4	1.1
O X 34	3.6	0.27	3.2	19	44	41.1	1.1
O X 38	3.6	0.29	4.5	18	47	42.2	1.1
O X 42	3.6	0.30	3.8	26	40	43.4	1.0
O X 46	3.6	0.29	4.3	18	35	45.0	1.2
O X 49	3.6	0.24	3.8	17	43	48.5	1.3
O X 52	3.7	0.29	3.8	18	37	44.7	1.0
O X 53	3.7	0.24	3.8	15	41	46.8	1.2
O X 54	3.6	0.28	3.7	17	37	46.4	1.2
O X 58	3.6	0.31	4.1	16	43	48.1	1.2
O X 60	3.5	0.33	4.8	18	44	44.2	1.0
O X 61	3.7	0.26	4.0	18	40	47.2	1.1
O X 62	3.7	0.26	4.1	22	42	46.3	1.1
O X 64	3.7	0.23	3.8	20	45	41.4	1.1
O X 70	3.7	0.23	3.8	17	54	40.7	1.1
O X 88	3.5	0.25	3.8	17	36	44.0	1.2
O X 93	3.6	0.30	3.4	17	46	44.9	1.1
O X 95	3.6	0.28	3.7	19	59	43.9	1.1
O 92226	3.6	0.34	4.1	15	35	45.5	1.3
O 92227	3.7	0.30	4.8	16	32	45.1	1.3
O 92228	3.6	0.29	4.4	23	42	43.7	1.0
H 1810	3.7	0.26	4.9	28	43	45.0	1.1
H 6285	3.8	0.23	3.2	19	36	47.5	1.2
H 7151	3.5	0.28	3.8	16	38	46.3	1.1
PS 696	3.6	0.28	4.2	18	45	41.3	1.1

Table 2a. OSU Machine Harvest Trial II. Quality Evaluation (Beatrice/Hunt-Wesson Lab) Fremont, OH 1992.

Cultivar	pH	Raw Brix	Viscosity Potential Index cases/ton (72/8 oz. sauce)
O 7983	4.2	4.6	29.8
O 8245	4.3	4.9	29.8
O X 1	4.2	4.7	28.8
O X 4	4.2	4.3	29.0
PS 696	4.2	4.8	34.9
O 8556	4.4	4.5	27.2
O 90381	4.4	3.6	38.1
O 90383	4.3	4.3	25.6
O 90384	4.2	4.6	28.7
O 90385	4.3	4.0	30.8
O 90388	4.3	4.5	34.2
O 90389	4.4	4.2	29.5
O 90390	4.4	4.2	35.2
O 90393	4.2	4.0	36.6
O 90395	4.3	4.5	34.0
O 90396	4.4	4.0	31.5
O 90397	4.4	4.0	32.4
O 8442	4.2	4.0	35.5
O 8444	4.3	4.9	34.7
H 1810	4.2	5.2	37.2
H 6285	4.4	4.8	32.5
H 7151	4.2	5.0	36.3
O 92226	4.3	4.3	31.2
O 92227	4.3	4.7	32.3
O 92228	4.3	4.1	31.2
O X 38	4.4	4.2	31.9
O X 3	4.4	3.8	28.3
O X 8	4.3	4.6	29.9
O X 9	4.4	4.3	30.4
O X 15	4.3	4.7	30.7
O X 17	4.3	4.6	23.3
O X 24	4.3	4.2	27.4
O X 26	4.2	4.3	29.4
O X 32	4.3	4.1	32.3
O X 34	4.4	4.5	28.7
O X 42	4.2	4.4	34.7
O X 46	4.2	4.4	32.6
O X 49	4.4	4.8	29.1
O X 52	4.1	4.8	34.8
O X 53	4.3	4.9	33.0
O X 58	4.4	5.4	39.4
O X 60	4.3	5.8	37.1
O X 61	4.3	5.5	41.7
O X 62	4.3	5.6	36.9
O X 64	4.3	4.8	41.3
O X 70	4.4	5.2	36.8
O X 88	4.3	4.3	25.5
O X 93	4.3	4.9	32.5
O X 95	4.2	5.6	36.6

Fig. 1. OSU TRIAL I, MACHINE HARVEST, OARDC, FREMONT, OHIO. 1992

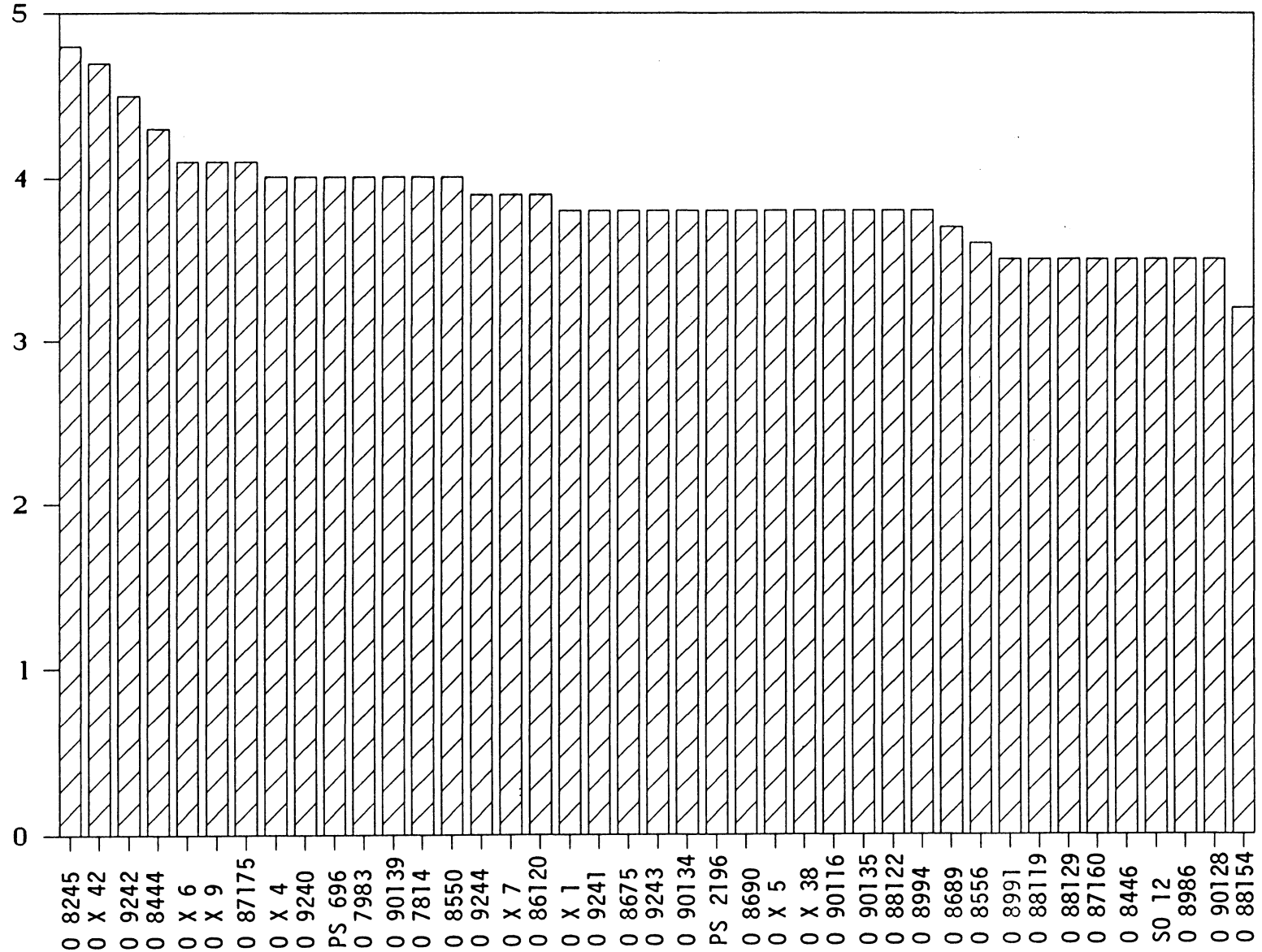


Fig. 2. OSU TRIAL II, MACHINE HARVEST, OARDC, FREMONT, OHIO.1992

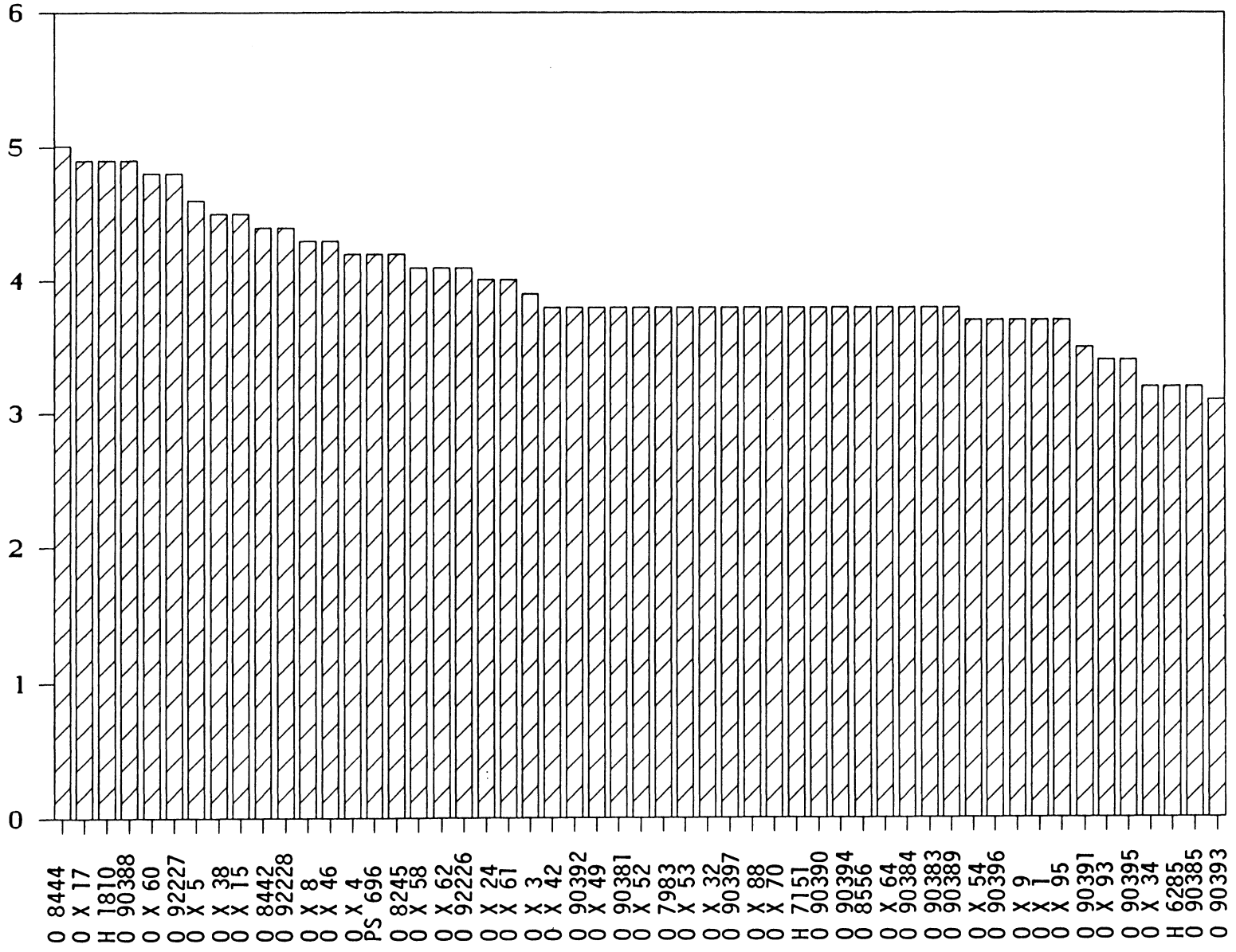


Fig. 3. OSU TRIAL I, MACHINE HARVEST, OARDC-HUNT/WESSON, FREMONT, OH,1992

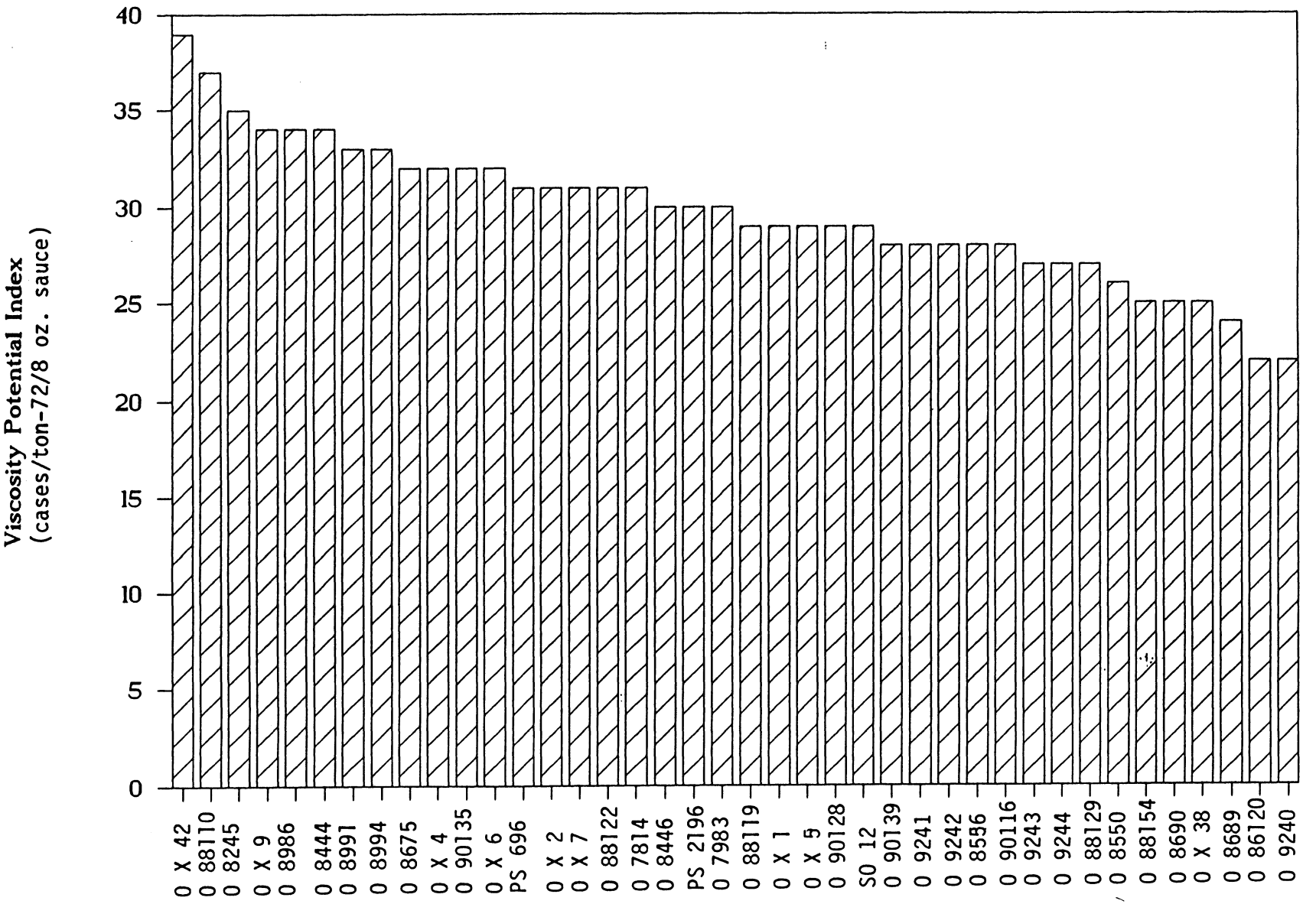
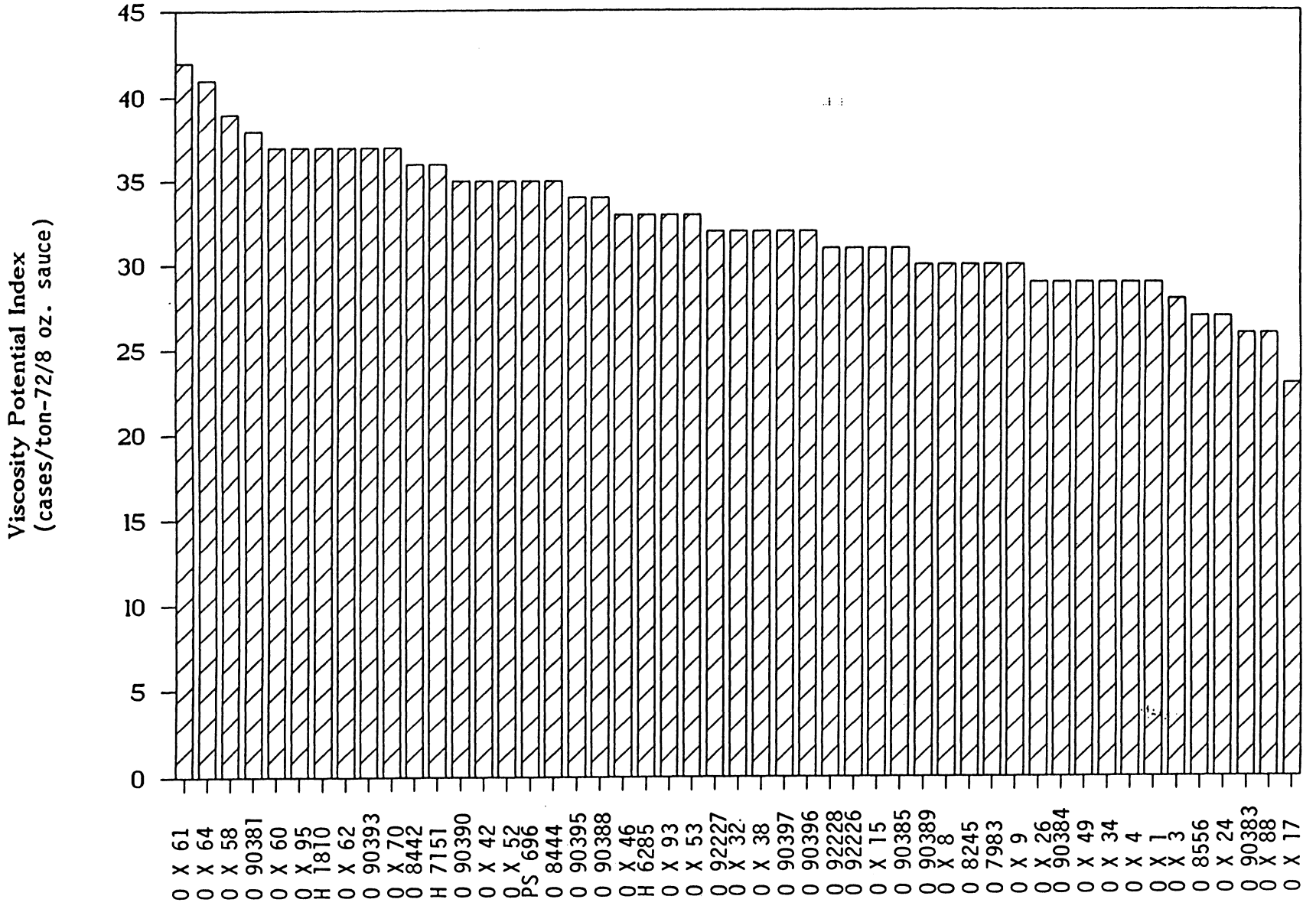


Fig. 4. OSU TRIAL II, MACHINE HARVEST, OARDC-HUNT/WESSON, FREMONT, OHIO.1992



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