

CANNING TOMATO VARIETY TRIALS 1964

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CANNING TOMATO VARIETY TRIALS FOR 1964

These trials were designed to evaluate the more promising new tomato varieties and numbered introductions for canning, when grown in Virginia. Tomato canners and growers need high yields of fruit with good processing characteristics, and which produce a high-quality canned product. This trial provides information to aid in selection for: introduction by tomato breeders, stocking by seedsmen, and production by plantsmen and vegetable growers.

Six numbered lines from the Southern Tomato Exchange Program (STEP) and 3 other varieties were tested against Campbell 146, the leading commercial canning variety of Virginia. The trials were conducted near Warsaw, which is in an important canning area of Virginia. The canning trial tomatoes were grown adjacent to fresh-market variety trials. The culture was identical until harvesting, which began somewhat later on the canning trial, because more advanced maturity was desired. For information on the fresh-market trials, see Virginia Agricultural Experiment Station Research Report No. 92.

Acknowledgments

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Experiment Description and Production Conditions

Location: V.P.I. Eastern Virginia Research Station, Richmond County, 2 miles north of Warsaw.
Elevation: 140 feet.
Soil: Sassafras sandy loam; pH 6.1.
Previous crop: Corn. Fallow thereafter.
Plot sizes: One row; records taken on 15 plants.
Plot design: Randomized block.
Replications: Four.
Spacing: Plants 2' apart in row; 5' between rows.
Fertilizer: 5-10-10 applied at the rate of 1,220 lb. per acre. Eighteen days before field setting, broadcast and disked into the soil at the rate of 720 lb.; 1 day before setting, placed in rows and mixed with the soil below the plant at the rate of 200 lb.; and 48 days after field setting, sidedressed at the rate of 300 lb. Also 1/2 pint per plant of starter solution (6 lb. 10-52-17 to 100 gals. water) applied at field setting.
Plants: Greenhouse plants grown in peat pots.
Field planting date: April 28.
Cultivation: Frequently enough to control weeds.
Pesticides: Maneb plus Sevin or Malathion as spray. Eighteen days before field setting, Aldrin was broadcast at the rate of 2.9 lb. per acre and worked into soil.
Growing conditions: Erratic distribution of moisture seriously reduced plant vigor and probably the yield. Irrigation was not available. See Table 8 for record of precipitation and temperature.

Harvesting and Grading Procedure

Harvest maturity: Firm, red ripe when available.
Harvest interval: Weekly.
Grading: According to U.S.D.A. Grades for Cannery Tomatoes. The fruit was graded into U. S. 1's, 2's and culls based on color, shape, cracks, and decay. The minimum size limit was 1 7/8".

Canning Procedure

When: Tomatoes were canned the day following harvest.
Preparation: Tomatoes were soaked in fresh water to remove dirt, scalded in 195°F water for 30 seconds; immersed in cold water; cored and peeled.
Filling: About 11 ounces of U. S. No. 1 tomatoes were hand filled into #303 plain can. Firming salt, 25 grain sodium chloride plus calcium chloride, was added to each can. Cans were topped off with natural juice from peeled, cored U. S. No. 2 tomatoes of the same variety; about 3/8" headspace was allowed.
Exhausting: Passed through exhaust box to a center can temperature of 130°F.
Processing: Continuous cooker, 12 minutes at boiling.
Cooling: Air stacked in cases.

Miscellaneous Comments on Data Recorded

Only STEP 373, STEP 397, ES-24, Heinz 1370, and Campbell 146 were in the

trials previously. New entries this season were STEP 430, STEP 431, STEP 434, Supermarket, and 65 S3-2.

The tomato plants were somewhat small and lacking in vigor during the entire season. This was probably the result of limited water supply during early growth.

Fruit size is related to fruit weight; weight was determined by total weight/count.

The U. S. Standard for grades of canned tomatoes, effective August 1, 1946, gives the following factors and point value:

I. Drained weight	20
II. Wholeness	20
III. Color	30
IV. Absence of defects	<u>30</u>
Total Score	100

Drained weight and defects were not scored at V.P.I. in this canning trial, but flavor was added as a factor. Since there is a rather close relationship between wholeness and drained weight*, the following factors and point values were used to determine the weighted overall score of the canned product.

I. Wholeness	50
II. Color	35
III. Flavor	<u>15</u>
Total Score	100

These factors were scored organoleptically by a panel of seven trained participants.

Canned samples of all varieties in the trial were submitted for grading to the U. S. Grading Service in Richmond.

General Notes on Entries

Fresh tomatoes for canning

Higher-than-average total marketable yields were produced by 65 S3-2, STEP 373, STEP 397, and Campbell 146. Lower-than-average total marketable yields were produced by STEP 430, STEP 431, and STEP 434. The highest yield of U.S. No. 1's was produced by 65 S3-2. STEP 434 and STEP 430 produced the lowest yield of U. S. No. 1's. Fruit cracking was not a serious problem with any variety tested.

*Kramer, Amihud, B. A. Twigg, Jane Cooler, F. W. Cooler. (1962). Relation of Factors of Quality to Grades of Canned Tomatoes. Food Technology 16(1): 30-32.

Canned tomatoes

Color ratings given by the organoleptic panel were highest for STEP 373 and 65 S3-2. Flavor ratings were highest for STEP 373, STEP 431, Supermarket, and STEP 397. STEP 397 had the highest wholeness rating. STEP 373 had the highest weighted over-all score for quality of canned product. Percent recovery of raw stock was highest for Heinz 1370, with a yield of 28 #303 cans from a 33 lb. basket.

Comments on Individual Entries

(For a comparison of entries, see tables 1 through 6)

Campbell 146 - This variety is used as the standard or check for comparison. It has been the most widely grown variety for canning. It was the second-highest yielding variety, definitely with the top group. It produced 40% U. S. No. 1's which was significantly lower than 65 S3-2. The fruit were rather large, having an average seasonal weight of 5.28 oz. Percent raw stock recovery during peeling, coring, and trimming was below average. The over-all score of the canned product was above average because of better-than-average wholeness and color. The canned product was within the desirable pH range at 4.22, and acidity was above average.

ES-24 - Total marketable yield was average, as was percent No. 1's. This variety rates better-than-average in the over-all trial because the State-Federal Grading Service in Richmond gave this variety the highest average score for drained weight, wholeness, and color. Fruit size was about average at 4.8 oz. The pH was among the lowest and ascorbic acid content was highest.

Heinz 1370 - This variety was in the higher-than-average yielding group and had the highest percent recovery in preparation with a calculated yield of 28 #303 cans per 33 lb. basket. It had a small core and was very firm, so that little seed cavity material was lost in coring and peeling. Comments have been heard that Heinz 1370 is difficult to peel since it was bred for tomato products, but no unusual difficulty was experienced in peeling in this trial. It is smaller than average, being almost 1 ounce lighter than Campbell 146. It is not an intensely red variety, but produced an above-average yield of U. S. No. 1's. Percent dry weight, soluble solids, and pH were below average.

STEP 434 - Total marketable yield was below average. Yield and percent of U. S. No. 1's were below average. Fruit was large. Percent recovery during preparation was among the lowest. Color, wholeness, and flavor of the canned product were all below average. Solids and pH were about average. This variety does not hold much promise for canning.

STEP 431 - This variety had below-average total marketable yield. Yield of U. S. No. 1's was below average. Fruit was larger than average. Percent raw stock recovery was below average. It was above average in wholeness and among the best in flavor when canned. Percent dry weight and pH were higher than average. This variety is no better than Campbell 146.

STEP 430 - Total marketable yield was below average, and the yield and percent of U. S. No. 1's were among the lowest. Fruit was largest in the trial; average seasonal fruit weight was about 5.8 ounces. Percent recovery of raw stock during preparation was above average. When canned, only flavor was scored above average. The canned product had the highest average percent dry weight.

STEP 397 - Though yielding with the top group, the percent and yield of U. S. No. 1's of this variety were below average. It was above average in fruit size. Percent raw stock recovery was below average. Color of the canned product was not as good as last year and below average in the trial this year, but wholeness and flavor were above average. The pH averaged 4.34 for the season, which is within the safe range, but was still highest in the trial. Percent soluble solids and percent dry weight of the canned product were above average.

STEP 373 - This variety produced a total marketable yield of 292 cwt per acre, which placed it in the high-yielding group. The yield and percent of U. S. No. 1's were above average. The percent recovery of raw stock was better than average, and the fruit were relatively easy to core. The fruit was among the smallest in the trial, averaging only 4 ounces for the season. The canned product scored best in color and among the best in flavor, to give it the highest weighted over-all score. It was above average in pH, percent soluble solids, and dry weight.

Supermarket - Thought yielding with the best, green shoulders on the fruit would eliminate this as a canning variety. Even when soft ripe, areas around the stem end required removal during preparation, so that percent raw stock recovery was well below average. Fruit size was slightly below average. Flavor was among the best, but wholeness was among the worst because of excessive trimming and resultant breakdown.

65 S3-2 - This variety had the highest average total marketable yield in the trial, and was highest in yield and percent of U. S. No. 1's. Fruit was among the smallest in the trial. The fruit were relatively easy to peel and core and above average in percent raw stock recovery. Color of the canned product was among the best, but flavor was among the poorest. Wholeness was average. This variety appears promising for canning, but should be tested further to determine its dependability.

General Comments

When comparing yields from the fresh market trial (see Research Report 92, December 1964) with those from the canning trial, the same variety yielded about the same for canning or the fresh market. Only 1 of the 6 varieties tested in both trials yielded a significantly lower amount in the canning trial -- this was STEP 430. It yielded 256 cwt. in the fresh market trial and 179 cwt. in the canning trial.

Standards for grading were different because the 2 trials were harvested for different markets. It is generally claimed that canning yields are lower, because of the longer period the fruit is exposed on the vine.

Table 7 contains combined data showing the seasonal change in chemical composition of tomatoes in the Warsaw trials.

Table 1 - Ten Tomato Varieties or Breeding Lines Tested for Canning at Warsaw, Virginia in 1964.

Entry	Weighted over-all score ⁽¹⁾	Total market-able yield cwt/A (2A)	U.S. No. 1 grade yield cwt/A (2A)	Percent total yield U.S. No. 1 (2D)	Average market-able fruit weight ounces (2A)	Seed source ⁽³⁾
65 S3-2	3.82	297.6 a	152.5 a	51	4.00 d	2
STEP 373	4.04	292.2 a	111.9 b	38	4.00 d	8
STEP 397	3.81	284.0 a	83.6 bc	29	5.44 a	8
Campbell 146	3.89	283.0 a	114.5 b	40	5.28 ab	7
Heinz 1370	3.83	269.7 ab	104.0 b	39	4.32 cd	7
Supermarket (4)	3.81	254.6 ab	103.5 b	41	4.48 cd	1
ES-24	3.82	226.9 b	86.6 bc	38	4.80 bc	3
STEP 434	3.52	199.3 c	47.4 d	24	5.60 a	4
STEP 431	3.88	180.5 c	64.3 cd	36	5.60 a	5
STEP 430	3.70	179.1 c	48.8 d	27	5.76 a	6
Average	3.81	246.7	91.7	36	4.92	

(1) See Table 4 for an explanation of factors included in canned-product quality rating.

(2) The letters a, b, c, d, e indicate the statistical significance of each characteristic. For example, data followed by an "a" are significantly different, at a given level of assurance, from those not having an "a"; those followed by a "b" are significantly different from those not having a "b", etc.

(2A) Statistical significance at the 5% level

(2B) Statistical significance at the 1% level

(2C) No statistical significance

(2D) Averages only, no statistics applied

(3) Seed sources:

1. Asgrow Seed Company
2. Delaware - Brasher
3. Eastern States Farmers' Exchange
4. Florida - Strobel and Walter
5. Florida - Walter
6. Florida - Walter and Hayslip
7. Joseph Harris Company
8. S. E. V. B. L. - S. C. - Andrus

(4) Supermarket, recently released, was in these trials as STEP 429.

Table 2 - Percent Marketable Yield of Total Marketable Yield
from Tomatoes Harvested in Canning Trials, 1964.

Entry	Approximate percent of total marketable yield at each harvest				
	7/20 83*	7/27 90*	8/3 97*	8/10 104*	8/17 111*
Campbell 146	9	12	40	27	12
ES-24	8	8	36	29	19
Heinz 1370	8	11	32	32	17
STEP 434	18	12	35	22	13
STEP 431	8	6	45	30	11
STEP 430	10	10	32	28	20
STEP 397	13	8	48	20	11
STEP 373	9	6	51	27	7
Supermarket	27	19	11	35	8
65 S3-2	17	15	50	16	2
Average	12.7	10.7	38.0	26.1	12.0

*Days from field setting on April 28, 1964.

Table 3 - Percent Raw Stock Recovery of U. S. No. 1's and 2's
from Entries in Canning Tomato Variety Trails, 1964⁽¹⁾.

U. S. No. 1's								
Entry	Entry No.	Date of Harvest					Variety average	Rank
		7/21	7/28	8/4	8/11	8/18		
STEP 373	4	81.8	84.6	85.7	85.1	84.7	84.4	4
STEP 397	5	83.1	82.9	85.1	81.2	81.8	82.8	6.5
STEP 429 (Supermarket)	7	80.0	72.8	82.7	83.3	79.6	79.7	10
STEP 430	8	86.0	83.5	84.9	83.3	87.5	85.0	3
STEP 431	9	81.4	84.5	83.1	81.0	84.4	82.8	6.5
STEP 434	10	83.4	80.0	79.2	80.1	82.0	80.9	9
65 S3-2	11	86.1	85.6	85.3	83.0	85.3	85.1	2
Campbell 146	80	84.0	83.1	81.6	76.2	80.4	81.1	8
Heinz 1370	81	85.0	85.9	86.7	87.8	86.3	86.3	1
ES-24	82	87.0	82.9	81.8	84.9	82.0	83.7	5
Average		83.8	82.6	83.6	82.6	83.4	83.2	

U. S. No. 2's								
STEP 373	4	84.5	87.9	81.4	80.5	80.5	83.0	2
STEP 397	5	88.0	79.8	76.7	64.5	71.0	78.0	6
STEP 429 (Supermarket)	7	73.6	82.2	75.5	74.8	73.3	75.9	7
STEP 430	8	81.6	78.9	79.5	74.1	79.6	78.7	5
STEP 431	9	80.7	77.9	71.3	73.5	74.5	75.6	8
STEP 434	10	77.2	74.0	72.1	71.3	71.9	73.3	10
65 S3-2	11	86.0	81.7	80.6	78.9	80.1	81.4	3
Campbell 146	80	78.0	74.9	72.9	72.8	71.5	74.0	9
Heinz 1370	81	87.0	85.4	82.8	83.7	80.8	83.9	1
ES-24	82	82.1	78.1	76.7	81.3	78.8	79.4	4
Average		81.9	80.1	76.9	75.5	76.2	78.3	

(1) Percent recovery is an indication of the weight of peeled, cored, and trimmed tomatoes that may be obtained from 100 lbs. of raw stock.

Table 4 - Ten Tomato Varieties Tested for Quality Characteristics of Canned Product, 1964.

Variety	Variety No.	Organoleptic Evaluations ⁽³⁾					(1D) Rank
		(1A), ² Color	(1A), ² Wholeness	(1A), ² Flavor	(1D), ² Weighted over-all score*		
Campbell 146	80	3.91 bc	4.03 ab	3.51 ab	3.89	2	
ES-24	82	3.74 cde	4.03 ab	3.57 ab	3.82	5.5	
Heinz 1370	81	3.88 bc	3.88 abcd	3.57 ab	3.83	4	
STEP 434	10	3.57 e	3.63 de	3.08 bc	3.52	10	
STEP 431	9	3.83 bcd	4.00 abc	3.74 a	3.88	3	
STEP 430	8	3.68 de	3.77 cde	3.57 ab	3.70	9	
STEP 397	5	3.68 de	4.06 a	3.63 a	3.81	7.5	
STEP 373	4	4.28 a	3.80 bcde	3.83 a	4.04	1	
Supermarket	7	3.97 b	3.57 e	3.86 a	3.81	7.5	
65 S3-2	11	4.17 a	3.74 de	2.86 c	3.82	5.5	
Average		3.87	3.85	3.52	3.81		

(1) The letters a, b, c, d, e indicate the statistical significance of each characteristic. For example, data followed by an "a" are significantly different, at a given level of assurance, from those not having an "a"; those followed by a "b" are significantly different from those not having a "b", etc.

(1A) Statistical significance at the 5% level

(1B) Statistical significance at the 1% level

(1C) No statistical significance

(1D) Averages only, no statistics applied.

(2) Rating: 1 = poor, 5 = excellent.

(3) Rated by 8 trained judges, for each of 4 harvest dates and 2 replications.

* Weighted values - Color 50, Wholeness 35, Flavor 15.

Table 5 - Chemical Attributes of Canned Tomatoes for 1964 at Warsaw, Virginia.

Entry	Variety No.	pH (1A)	Percent acid as citric (1A)	Brix-acid ratio* (1D)	Percent soluble solids (1A)	Percent dry weight (oven method)	Ascorbic acid
STEP 397	5	4.34 a	.28 ab	23.3	6.52 a	7.06 a	19.2 cd
STEP 373	4	4.32 a	.29 abc	22.2	6.45 a	7.33 a	20.4 c
STEP 434	10	4.28 ab	.26 a	23.8	6.18 ab	6.86 ab	15.9 ef
STEP 431	9	4.27 ab	.31 bcd	19.9	6.18 ab	7.23 a	14.8 f
STEP 430	8	4.27 ab	.29 abc	21.3	6.19 ab	7.36 a	16.1 ef
Supermarket	7	4.27 ab	.29 abc	21.4	6.20 ab	6.87 ab	17.2 e
Campbell 146	80	4.22 bc	.34 de	18.0	6.12 ab	6.93 ab	17.7 de
Heinz 1370	81	4.21 bc	.33 cde	17.4	5.74 c	6.25 b	22.7 b
65 S3-2	11	4.18 c	.36 e	16.4	5.90 bc	6.64 ab	17.4 de
ES-24	82	4.16 c	.35 de	17.9	6.26 a	6.66 ab	26.8 a
Average		4.25	.31	20.2	6.17	6.92	18.8

(1) The letters a, b, c, d, e indicate the statistical significance of each characteristic. For example, data followed by an "a" are significantly different, at a given level of assurance, from those not having an "a"; those followed by a "b" are significantly different from those not having a "b", etc.

- (1A) Statistical significance at the 5% level
- (1B) Statistical significance at the 1% level
- (1C) No statistical significance
- (1D) Averages only, no statistics applied.

* Serum refractometer reading, uncorrected for salts and acids present, divided by percent acid as citric.

Table 6 - Official U.S.D.A., Agricultural Marketing Service Grade Score for Ten Varieties of Tomatoes Canned in 1964 and Graded in 1965.

Variety	Code	Drained weight ⁽¹⁾	Wholeness ⁽²⁾	Color ⁽³⁾	Total ⁽⁴⁾	Rank
STEP 373	4	17.6	17.8	27.7	63.1	7
STEP 397	5	18.6	17.6	27.0	63.2	6
STEP 429	7	16.9	16.8	27.7	61.4	8
STEP 430	8	18.3	18.0	27.1	63.4	4.5
STEP 431	9	18.3	18.1	27.1	63.5	3
STEP 434	10	18.2	17.0	27.3	57.1	9
65 S3-2	11	17.9	18.0	27.8	63.7	2
Campbell 146	80	18.0	18.0	27.4	63.4	4.5
Heinz 1370	81	17.5	18.2	27.6	63.3	5
ES-24	82	19.5	18.3	27.8	65.6	1
Average		18.1	17.8	26.9	62.8	

(1) Drained weight score points: (A) = 18-20, (B) = 15-17*, (C) = 12-14*, (SStd) = 0-11*.

(2) Wholeness score points: (A) = 18-20, (B) = 15-17, (C) = 12-14*.

(3) Color score points: (A) = 27-30, (B) = 23-26*, (C) = 19-22*, (SStd) = 0-18*.

(4) Absence of defects was not scored or included in total. Coring, peeling, and trimming operations, not variety, govern the absence of defects factor.

* Limiting rule.

Table 7 - Harvest Date Effect on Chemical Characteristics of Ten Tomato Varieties Canned in 1964 at Warsaw.

Harvest Date	Harvest number	pH	Citric acid	% Soluble solids	Dry weight	Ascorbic acid*
		(1A)				(1A)
7/20/64	1	4.32 a	.33 a	6.46 a	7.37 a	19.34 a
7/27/64	2	4.26 b	.30 ab	6.37 a	7.17 ab	19.53 a
8/3/64	3	4.23 bc	.32 a	6.18 ab	6.67 c	18.82 a
8/10/64	4	4.19 c	.32 a	5.82 c	6.72 bc	17.45 b
8/17/64	5	4.26 b	.28 b	6.04 bc	6.66 c	18.95 a
Average		4.25	.31	6.17	6.92	18.82

(1) The letters a, b, c, d, e indicate the statistical significance of each characteristic. For example, data followed by an "a" are significantly different, at a given level of assurance, from those not having an "a"; those followed by a "b" are significantly different from those not having a "b", etc.

- (1A) Statistical significance at the 5% level
- (1B) Statistical significance at the 1% level
- (1C) No statistical significance
- (1D) Averages only, no statistics applied.

* Ascorbic acid, mg/100 ml.

Table 8 - Climatological Data in 1964 for the Canning Tomato Variety Trials at the Eastern Virginia Research Station, 2 Miles North of Warsaw.

For week ending	Temperature			Precipitation* (inches)
	Max.	Min.	Avg.	
May 2	77	33	55	1.15
May 9	89	39	61	0.02
May 16	84	42	66	0.18
May 23	91	45	68	0.29
May 30	89	43	67	0.19
June 6	84	46	64	0.39
June 13	100	52	77	0.28
June 20	97	48	77	0.27
June 27	95	57	77	2.98

For week ending	Temperature			Precipitation* (inches)
	Max.	Min.	Avg.	
July 4	95	60	80	0.01
July 11	92	56	74	0.82
July 18	92	66	78	1.77
July 25	88	68	77	0.69
Aug 1	93	57	76	0.35
Aug 8	90	56	73	1.68
Aug 15	89	51	71	0.84
Aug 22	93	55	73	0.65

* Field was not irrigated.