Project Title: **UCCE Statewide Processing Tomato Variety Evaluation Trials, 2012**

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Summary:

University of California Cooperative Extension farm advisors, in cooperation with commercial growers, conducted two early-maturity and six mid-maturity variety evaluation trials in 2012. Seed companies submitted 15 early lines, and 16 replicated and 15 observational entries for the mid-maturity/full-season trial. A major change for our variety evaluation program was the move this season of both Fresno County trials from a field station to commercial fields. This season's trials saw wide variations in both yield and soluble solids between locations.

Among the early-maturity lines, top performers were HMX 1893 and N 6397 for yield and SVR 024 9 0541 and HMX 1893 for soluble solids. Among full season varieties in the replicated trials, HM 9905, N 6404 and N 6402 were highest yielding, while BQ 205, DRI 0319, AB 0311, and N 6402 were highest in soluble solids. There were no significant yield differences in the observational full season variety trials, while soluble solids were highest from H 1161 and SVR 024 9 0686. Variety performance varied significantly by trial, highlighting the importance of looking at results from the individual trials to gauge variety performance under different conditions.

Objectives:
The major objective of our project is to evaluate pre-commercial and early commercial release processing tomato varieties for fruit yield, soluble solids, color, and pH in replicated field trials conducted at multiple locations statewide. The data are combined from multiple trials to evaluate variety adaptability under a wide range of growing conditions. These tests are designed and conducted with input from seed companies, processors, and other allied industry members and are intended to generate third-party information on varieties to assist in decision-making.

Procedures:
Two early maturity and six mid-maturity/full-season variety evaluation trials were conducted in 2012. Details of the trials are presented in Table 1. Variety selections were made in October of 2011 with input from California tomato processors. Changes and/or additions were made by the seed companies based on seed availability. Table 2 lists the variety entries, their disease resistances and other characteristics as provided by the seed companies.

Test locations were transplanted from early April (Yolo and Fresno) through May 18th (San Joaquin). New varieties are generally evaluated for one of more years in non-replicated observational trials before moving forward for evaluation in the replicated trials. This year all the trials were conducted in commercial production fields with grower cooperators. This was a major change for the trials in Fresno County, as these trials had previously been conducted at UC's West Side Research and Extension Center.

Each variety was planted in a single-bed plot measuring 50 to 100 feet in length, depending on the trial location. Both double and single row plots were utilized, again depending on location (see Table 1). Experimental design of each trial was a randomized complete block with four replications. The observational trial consisted of single plots of each variety planted adjacent to the replicated trial. The farm advisor organized transplanting at the same time that the rest of the field was planted. All cultural operations, with the exception of planting and harvest, were done by the grower cooperator using the same equipment and techniques as the rest of the field. All locations used transplants and all but two used drip irrigation. A field day or arrangements for interested persons to visit the plots occurred at most locations.

Shortly before or during harvest, fruit samples were collected from each plot and submitted to a grading station run by the Processing Tomato Advisory Board (PTAB) for measurement of raw fruit quality including soluble solids (reported as °Brix, an estimate of the soluble solids percentage using a refractometer), color (LED color), and fruit pH. These samples consisted of ripe fruit picked from the vines or pulled off the harvester. Additionally, fruit samples were analyzed for cooked fruit quality by the lab of Diane Barrett at UC Davis with funding from the California League of Food Processors; results of those analyses are not reported here but are available from Dr. Barrett. For yield data, the tomatoes the plots were harvested with commercial harvest equipment, conveyed to a GT wagon equipped with weigh cells, and weighed before going to the bulk trailers for processing.

Yield and fruit quality data were subjected to analysis of variance using the SAS software package. When data were combined from multiple locations, the block effect was nested within each county. Mean separation tests were performed using Fisher's protected LSD at the 5% level. Kern County and San Joaquin County trials were missing yield data from one or more plots, therefore least-squares means are reported rather than arithmetic means. The Stanislaus replicated trial data were excluded from the analyses due to poor plant stands resulting from challenging weather conditions after transplanting. The Kern observational trial was excluded from the combined analysis due to a high number of missing plots.

Results:

Early replicated. The combined analysis of two locations of early-maturity varieties revealed that the varieties varied significantly for yield and fruit quality measurements. Because there were such major differences between these two trials, it is suggested that the results of the individual trials (Tables 3b and 3c) should be considered more informative than the combined analysis (Table 3a). The Fresno County trial experienced very good growing conditions with high yields and mean soluble solids of 5.4 °Brix, while the Yolo location suffered from a shortage of water during a critical stage, resulting in low yields and very high soluble solids (mean of 6.8 °Brix). The variety HMX 1893 was the yield leader at the Fresno location, ranked third for yield at the Yolo location, and ranked second for soluble solids at both locations. The variety N 6397 also did well at both locations (ranked fifth for yield and °Brix at Yolo, third for yield and sixth for °Brix at Fresno). Ranking of most other varieties shifted dramatically between the two locations (see Tables 3b and 3c), suggesting that the trial conditions may have played an important role in variety performance.

Mid replicated. Replicated trials of mid-maturity/full-season varieties were conducted at six locations, but results of only five trials are presented due to an issue of poor stand at one location. Results of analyses combining all locations are shown in Table 4a, and individual trials in Tables 4b – e.

Combining all trials together for analysis, the varieties varied significantly for yield and all fruit quality measurements. However, there was also a significant variety by location interaction for yield, Brix and pH, meaning that varieties performed somewhat differently depending on the trial location. Therefore, the reader should use some caution when viewing the combined results (Table 4a), and may find it more informative to look at the results of individual trials (Table 4b to 4e).

Mean yield of the combined trials was 47 tons per acre, with a wide range of trial averages from 32.7 (Fresno) to 63.4 tons per acre (Yolo). Variety HM 9905 ranked first overall with a mean of 53.2 tons per acre; it was the top performer in the Kern, Fresno and San Joaquin county trials. At other locations, first-ranked varieties were UG 19406 (Yolo) and N 6402 (Merced). See Table 4b.

Overall, the soluble solids averaged 5.3 °Brix when data were combined from all trials, but trial averages varied widely from 4.6 to 6.4 °Brix (from Fresno and Merced trials respectively, see Table 4c). Top performers overall were BQ 205, DRI 0319, AB 0311, and N 6402. However, at particular locations, other varieties made it into that top group (for example, AB 2 at Yolo and Fresno, and N 6404 at San Joaquin and Kern). The leaders for Brix-yield (tons per acre x °Brix) were N 6402 and N 6404.

The Merced County trial had the best fruit color overall (average of 20.6). Best fruit color was observed in varieties H 5608, SUN 6366, AB 0311, and N 6402, with LED color measurements averaging 21.2 to 21.7. (Table 4d). Fruit pH of vareities ranged from 4.32 to 4.51 (mean = 4.40, Table 4e), with lowest means for UG 19406, UG 19006, AB 2, and PX 024 8 1245. The Merced trial had the highest average pH, while the Yolo and San Joaquin trials had the lowest pH (4.33).

Mid observational. Mid-maturity/full-season varieties which are new to our trial program were evaluated in single plots at six locations. Results of analyses combining five of these locations are shown in Table 5a, and individual trial results are in Tables 5b – 5e. While the average yields of varieties ranged from 35 to 50.1 tons per acre, these means were found to be statistically similar; therefore no conclusions can be drawn regarding yield due to the high variability between trial locations (Table 5b). Because these varieties are not replicated within a trial location, we do not know if the variation in performance by location is due to the particular conditions of that location or due to experimental error (random factors not of interest). When all trials were combined for analysis, significant differences were found among varieties for °Brix, color, and pH (Table 5a). Varieties with the highest soluble solids were BQ 268, H 1161, and SVR 024 9 0686 (5.7 to 5.8 °Brix). Those with the best color included C 316, H 1175 and BQ 272 (measurements of 21 to 21.6). Fruit pH was lowest in H 1161 and H 1170 (pH of 4.31 to 4.35).

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Many thanks to the California Tomato Research Institute and to participating seed companies for their continued support of this project. The cooperation of the Processing Tomato Advisory Board and of the California tomato processors is also greatly appreciated. A special thanks to Gail Nishimoto for her help with the statistical analyses. Thanks to Sam Matoba of the Diane Barrett lab for managing the analysis of cooked fruit quality and dealing with our compressed planting and harvest schedule this season. And lastly, we are indebted to our excellent grower cooperators for their very generous in-kind support. It is their interest in and support of research that makes this project possible.

Table 1. 2012 UCCE processing tomato variety trial details.

	Fresno County Early	Yolo County Early	Merced County	Fresno County	Kern County	Yolo County	Stanislaus County	San Joaquin County
Advisor:	M LeStrange & T. Turini	G. Miyao	S. Stoddard	M LeStrange & T. Turini	J. Nunez	G. Miyao	S. Stoddard	B. Aegerter
Transplant date:	5-Apr	6-Apr	30-Apr	2-May	4-May	9-May	14-May	18-May
Fruit quality sampling date:	6-Aug (123 days)	2-Aug (118 days)	9-Sep (132 days)	17-Sep (138 days)	6-Sep (125 days)	12-Sep (126 days)	16-Sep (125 days)	28-Sep (133 days)
Harvest date:	15-Aug (132 days)	2-Aug (118 days)	26-Sep (149 days)	18-Sep (139 days)	14-Sep (133 days)	12-Sep (126 days)	26-Sep (135 days)	29-Sep (134 days)
Cooperator and trial location:	Farming D, Five Points	D.A. Rominger & Sons, Winters	A-Bar Ranch, s. of Dos Palos	Harris Farms, Five Points	Fanucchi Farms, s. Kern Co.	JH Meek & Sons, w. of Davis	Cox & Perez, Westley	Hal Robertson Farms, s. of Tracy
Irrigation:	buried drip	furrow	buried drip	buried drip	buried drip	buried drip	furrow	buried drip
Bed width, plant density	66” single row, 17” spacing, ~5600 plants/ac	60” double row, ~8700 plants/ac	80” double row, ~7200 plants/ac	80” double row, 20” spacing, ~7840 plants/ac	60”	60” double row	66” double row	60” single row, ~7000 plant/ac
Field variety	H 8504		N 6385	H 4407				H 5508
Notes:	near perfect growing conditions	good stand, water shortage; very low yield and high Brix	some TSWV and CTV	some CTV & TSWV; split set at harvest	Missing data due to tree being in way of harvester.	good stand, good growth-Vert and some TSWV	poor stand due to high winds at planting, data not included in combined analysis	

Table 2. Varieties evaluated in 2012: information provided by seed companies.

TRIAL	VAR	COMPANY	UC code	days to maturity	Disease Resistance	processed use	Brix	std compared	vine size	fruit shape	UC trial years
Early	**APT 410 (STD)**	Monsanto	732	114	VFFNP	Multiuse	med	chk	med	78 g	97 - 08, 11, 12
Replicated	BOS602	Orsetti	1005	114	VFFN	Multiuse	5.3	APT410	med-lg	blocky	11, 12
	BQ204	Woodbridge See	1008	105	VFFNP	dice/paste	med	H2206	compact	63 g	11, 12
	BQ287	Woodbridge See	1029	106	VFFNP	Multiuse, EFH	high	H2206	med	75 g	12
	H1015	Heinz	1009	114	VFFNP	Multiuse, EFH	5.2	APT410	med	blocky	11, 12
	H2206 (STD)	Heinz	951	99	VF	Multiuse, EFH	5.11		compact	round	07, 08, 11, 12
	H3044	Heinz	472	110	VFFN	Multiuse	4.82		med	blocky	9, 90, 92-98, 11, 1
	HMX 1893	Harris Moran	1030	116	VFFN TSW	multiuse	high		med	elong. sq	12
	K2769	Keithly Williams	1010		VFFNP						11, 12
	K2770	Keithly Williams	1011		VFFN TYLCV						11, 12
	N6397	Nunhems	1012	116	VFFN	Multiuse	high	APT410	Large	round	11, 12
	SVR 024 9 0541	Monsanto	1031	114	VFFP			APT410			12
	SVR 024 9 0599	Monsanto	1032	110	VFF						12
	UG 15308	United Genetics	1015	114	VFFNP	peel	5.3	APT410	med	sq round	11, 12
	UG 15908	United Genetics	1016	114	VFFNP TSW	peel	5.3	APT410	med	sq round	11, 12
Mid	AB 0311	Monsanto	1017	118	VFFNP SW	intermediate bo	5.6	AB2/6366	med-lg		11,12
Replicated	**AB 2 (STD)**	Monsanto	868	122	VFFP	Multiuse	5.3	check	med	sq	tandard since '0
	BQ 163	Woodbridge See	982	118	VFFNP	Paste/peel	5.7-5.9	AB2	med	blocky	10, 11, 12
	BQ 205	Woodbridge See	984	120	VFFNP	paste/peel	5.7-6.2	6366	lg	blocky	10, 11, 12
	DRI 0319	Monsanto	1023	125	VFFNP SW	ermediate bostw	5.7	AB2/6366	lg		12
	H 5508	Heinz Seed	986	128	VFFN SW	paste	4.8	H9780	lg	blocky	09,10, 11, 12
	H 5608	Heinz Seed	987	128	VFFNP SW	MultiUse	5	H9780	V. lg	blocky	10, 11, 12
	H 9780 (STD)	Heinz Seed	866	139	VFFNP	Multiuse	5.4	H9780	V. lg	blocky	02, 03, 05-12
	HM9905	Harris Moran	999	125	VFFN	Multiuse, EFH	med	N6368	lg	elong. sq	10,11, 12
	N 6402	Nunhems	1027	122	VFFN SW	solids/multiuse	5.6-5.7	AB2/6366	lg	blocky	12
	N 6404	Nunhems	1026	125	VFFN SW	multiuse	5.3-5.4	H 8504	med-lg	blocky	12
	PX 024 8 1245	Monsanto	1013	125	VFFNP	Multiuse, EFH	5.2	AB2/S6366	med-lg	large	11(early), 12
	SUN 6366 (STD)	Nunhems	919	118	VFFNP	Multiuse	high	AB2/As410	med	sq/blocky	04 to 12
	UG 19006	United Genetics	1003	125	VFFNP	Multiuse, EFH	med	H8504/H9780	lg	sq round	10,11, 12
	UG 19306	United Genetics	1004	130	VFFNP	Multiuse, EFH	med	H9557/H9780	lg	sq round	10,11, 12
	UG19406	United Genetics	991	128	VFFNP	Multiuse, EFH	high	H9780	lg	sq round	09 to 12
Mid	BQ 268	Woodbridge See	1034	118	VFFNP	med-hi visc, EFH	5.3-5.5		lg		12
OBSERVED	BQ 270	Woodbridge See	1035	118	VFFNP	med vis, peeler	5.7-5.9		lg		12
	BQ 272	Woodbridge See	1036	125	VFFNP SW'	multi/visc	5.5-5.7		lg		12
	BQ 273	Woodbridge See	1033	125	VFFNP SW	high visc	5.4		med-lg		12
	C 316	Harris Moran	1037	124	VFFFNP	multiuse	high	Hypeel 849	med	oval	12
	H 1161	Heinz Seed	1038	125	VFFNP	thin/multiuse	5.8	AB2	lg	oval	12
	H 1170	Heinz Seed	1039	128	VFFN	hick/multiuse, EF	5.3	H 9780	lg	blocky	12
	H 1175	Heinz Seed	1040	130	VFFN	paste, EFH	4.9	H 9780	V lg	blocky	12
	HMX1885	Harris Moran	1025	120	VFFNP TSW	multiuse	med/hi	H5608	lg	blocky/sq	11, 12
	HMX1892	Harris Moran	1041	122	VFFNP	Multiuse, EFH	high	H3402	lg	elong. sq	12
	HMX1894	Harris Moran	1042	125	VFFNP TSW	pear peel, EFH	med	H2601	lg	pear	12
	N 6405	Nunhems USA	1046	125	VFFN	solids/multiuse	5.6-5.7	AB2/6366/8504	med	blocky	12
	N 6407	Nunhems USA	1043	130	VFFN SW	solids, EFH	5.5-5.6	6368/ 9780	med-lg	blocky	12
	SVR 024 9 0686	Monsanto	1044	125	not provided			AB2/6366			12
	UG 18806	United Genetics	1045	125	VFFNP	thick, EFH			med	sq round	12

V = Verticillium Wilt race 1
FFF = Fusarium Wilt races 1 &
N = Root knot nematode
Bsp, P = Bacterial speck race 0
TSWV, SW = Spotted Wilt
TYLCV = Tomato Yellow Leaf Curl Virus

All descriptions were provided by participating seed companies
Check with seed company to confirm disease resistance.

Table 3a. Early maturity processing tomato varieties, combined analysis, two replicated trial locations, 2012.

Variety	Yield (tons/ac)		Soluble solids (°Brix)	Color	pH
HMX 1893	46.7 (1)	a	6.5 (2)	21.4 (11)	4.35 (1)
N 6397	45.6 (2)	a b	6.3 (5)	20.6 (6)	4.52 (14)
H 1015	44.9 (3)	a b	6.1 (9)	20.3 (1)	4.49 (10)
UG 15908	44.3 (4)	a b	6.0 (11)	21.0 (7)	4.46 (6)
K 2770	43.5 (5)	a b c	5.7 (14)	21.4 (11)	4.39 (2)
SVR 024 9 0599	43.4 (6)	a b c	6.3 (3)	21.4 (11)	4.44 (3)
BOS 602	42.9 (7)	b c	6.0 (10)	20.3 (1)	4.45 (5)
UG 15308	42.7 (8)	b c d	6.3 (4)	20.4 (4)	4.52 (14)
BQ 287	42.5 (9)	b c d	6.1 (8)	20.3 (1)	4.49 (10)
SVR 024 9 0541	42.2 (10)	b c d	6.7 (1)	21.0 (7)	4.49 (10)
APT 410 (STD)	40.4 (11)	c d e	5.9 (12)	21.0 (7)	4.47 (9)
H 3044	40.1 (12)	c d e	5.4 (15)	20.4 (4)	4.44 (3)
BQ 204	39.3 (13)	d e	5.8 (13)	21.5 (14)	4.51 (13)
K 2769	37.4 (14)	e	6.2 (6)	21.3 (10)	4.46 (6)
H 2206 (STD)	37.1 (15)	e	6.1 (7)	21.6 (15)	4.46 (6)
Mean	42.2		6.1	20.9	4.46
CV=	8.2		5.6	3.5	1.6
LSD @ 0.05=	3.43		0.34	0.73	0.071
# Locations	2		2	2	2

Numbers in parentheses (x) represent relative ranking within a column.
LSD = Least significant difference at the 95% confidence level. Means followed by the same letter are not significantly different.
CV = coefficient of variation (%), a measure of the variability in the experiment.

Table 3b. Early maturity processing tomato varieties, Fresno County trial, 2012

Variety	Yield (tons/ac)	Soluble solids (° Brix)	LED color	pH
HMX 1893	71.3 a	5.7 (2)	21.5 (11)	4.30 (1)
UG 15908	70.1 a	5.1 (13)	21.8 (14)	4.43 (9)
N 6397	69.4 a b	5.5 (6)	21.0 (5)	4.48 (14)
H 1015	69.3 a b	5.5 (6)	20.3 (3)	4.44 (11)
UG 15308	68.2 a b c	5.4 (8)	21.0 (5)	4.48 (14)
K 2770	67.3 a b c d	5.2 (11)	21.3 (10)	4.30 (1)
BQ 287	64.5 b c d e	5.7 (2)	20.0 (1)	4.43 (9)
SVR 024 9 0541	64.0 b c d e	5.7 (2)	22.0 (15)	4.47 (13)
APT 410 (STD)	63.1 c d e	5.1 (13)	21.5 (11)	4.41 (8)
SVR 024 9 0599	62.0 d e	5.6 (5)	21.0 (5)	4.40 (5)
BOS 602	61.5 e	5.4 (8)	20.0 (1)	4.40 (5)
H 3044	60.9 e	4.8 (15)	20.8 (4)	4.38 (3)
BQ 204	59.2 e	5.2 (11)	21.0 (5)	4.45 (12)
H 2206 (STD)	52.9 f	5.4 (8)	21.5 (11)	4.40 (5)
K 2769	52.8 f	5.9 (1)	21.0 (5)	4.38 (3)
Mean	63.8	5.4	21.0	4.41
CV	5.9	6.6	3.5	1.6
LSD @ 0.05=	5.36	0.51	1.04	0.101

Table 3c. Early maturity processing tomato varieties, Yolo County trial, 2012

Variety	Yield (tons/ac)	Soluble solids (°Brix)	LED color	pH
SVR 024 9 0599	24.8 (1) a	7.1 (4)	21.8 (13)	4.48 (2)
BOS 602	24.4 (2) a	6.6 (10)	20.5 (7)	4.50 (5)
HMX 1893	22.1 (3) a b	7.3 (2)	21.3 (10)	4.40 (1)
K 2769	22.0 (4) a b c	6.6 (10)	21.5 (11)	4.53 (9)
N 6397	21.9 (5) a b c	7.0 (5)	20.3 (4)	4.55 (13)
H 2206 (STD)	21.3 (6) a b c d	6.9 (6)	21.8 (13)	4.53 (9)
BQ 287	20.6 (7) a b c d	6.5 (12)	20.5 (7)	4.54 (11)
H 1015	20.4 (8) a b c d	6.8 (7)	20.3 (4)	4.54 (11)
SVR 024 9 0541	20.4 (8) a b c d	7.6 (1)	20.0 (2)	4.52 (7)
K 2770	19.7 (10) b c d	6.2 (14)	21.5 (11)	4.49 (3)
BQ 204	19.4 (11) b c d	6.5 (12)	22.0 (15)	4.56 (15)
H 3044	19.4 (11) b c d	6.0 (15)	20.0 (2)	4.51 (6)
UG 15908	18.4 (13) b c d	6.8 (7)	20.3 (4)	4.49 (3)
APT 410 (STD)	17.6 (14) c d	6.7 (9)	20.5 (7)	4.52 (7)
UG 15308	17.1 (15) d	7.2 (3)	19.8 (1)	4.55 (13)
Mean	20.6	6.8	20.8	4.51
CV	15.1	4.8	3.5	1.6
LSD	4.44	0.46	1.05	NS

Tables 4a - 4e. Processing tomato varieties, combined analysis of five replicated trials, 2012.

Variety	plots (#)	Yield* (tons/acre)		Soluble solids (°Brix)	Color	pH
HM 9905	20	53.2 (1)	a	5.1 (12)	22.7 (14)	4.50 (15)
N 6404	19	49.7 (2)	b	5.5 (5)	22.4 (10)	4.43 (11)
N 6402	19	49.6 (3)	b c	5.6 (3)	21.7 (4)	4.47 (14)
H 5508	20	49.5 (4)	b c d	4.6 (16)	22.2 (7)	4.37 (6)
UG 19406	20	48.6 (5)	b c d e	5.5 (5)	22.3 (9)	4.32 (1)
SUN 6366 (STD)	20	48.2 (6)	b c d e f	5.4 (8)	21.6 (2)	4.51 (16)
UG 19306	20	47.9 (7)	b c d e f g	5.3 (10)	22.2 (7)	4.37 (6)
H 5608	20	46.2 (8)	c d e f g h	4.8 (15)	21.2 (1)	4.44 (13)
PX 024 8 1245	19	46.1 (9)	d e f g h	5.0 (14)	23.7 (16)	4.35 (4)
DRI 0319	18	45.7 (10)	e f g h i	5.7 (1)	22.4 (10)	4.38 (8)
AB 0311	20	45.1 (11)	f g h i	5.6 (3)	21.6 (2)	4.36 (5)
AB 2 (STD)	20	45.0 (12)	f g h i	5.4 (8)	22.7 (14)	4.34 (3)
BQ 205	19	44.6 (13)	g h i	5.7 (1)	22.5 (12)	4.41 (10)
H 9780 (STD)	20	44.4 (14)	h i	5.1 (12)	22.6 (13)	4.40 (9)
BQ 163	19	44.1 (15)	h i	5.5 (5)	21.9 (5)	4.43 (11)
UG 19006	20	42.5 (16)	i	5.3 (10)	21.9 (5)	4.33 (2)
Mean		47.0		5.3	22.2	4.40
CV=		11.7		5.9	4.3	1.4
LSD @ 0.05=		3.43		0.19	0.59	0.037
# Locations		5		5	5	5
LSD @ 0.05 to compare yields of varieties with 20 plots with each other		3.43				
LSD @ 0.05 to compare yields of varieties with 19 plots with each other		3.52				
LSD @ 0.05 to compare yields of varieties with 20 plots vs. varieties with 19 plots		3.48				
LSD @ 0.05 to compare yields of varieties with 20 plots vs. varieties with 18 plots		3.53				
LSD @ 0.05 to compare yields of varieties with 19 plots vs. varieties with 18 plots		3.57				

* For yield, some varieties have one or more missing plots. Least squares means for these varieties are reported rather than arithmetic means.
Numbers in parentheses (x) represent relative ranking within a column.
LSD = Least significant difference at the 95% confidence level. Means followed by the same letter are not significantly different.
NS = not significant.
CV = coefficient of variation (%), a measure of the variability in the experiment.

Table 4b. Yield (tons/acre)

Variety	plots (#)	Mean of five locations	Yolo	San Joaquin	Fresno	Kern	Merced
HM 9905	20	53.2 a	66.6	44.4	41.2	66.0	47.7
N 6404	19	49.7 b	67.7	35.6	34.8	61.4	49.1
N 6402	19	49.6 b c	67.9	35.6	30.1	57.7	56.6
H 5508	20	49.5 b c d	64.1	42.4	34.7	52.7	53.4
UG 19406	20	48.6 b c d e	69.6	44.3	34.9	50.6	43.7
SUN 6366 (STD)	20	48.2 b c d e f	63.2	40.7	30.8	55.5	50.7
UG 19306	20	47.9 b c d e f g	66.9	37.6	31.8	61.3	42.0
H 5608	20	46.2 c d e f g h	60.9	41.7	33.8	49.5	45.1
PX 024 8 1245	19	46.1 d e f g h	54.0	45.3	35.0	44.3	51.9
DRI 0319	18	45.7 e f g h i	63.8	38.0	32.5	52.2	42.0
AB 0311	20	45.1 f g h i	62.6	36.9	29.8	47.1	48.9
AB 2 (STD)	20	45.0 f g h i	67.2	38.0	28.4	45.2	46.0
BQ 205	19	44.6 g h i	65.5	36.1	31.0	43.4	46.9
H 9780 (STD)	20	44.4 h i	53.7	38.0	26.5	57.6	46.0
BQ 163	19	44.1 h i	59.1	34.8	33.9	47.2	45.6
UG 19006	20	42.5 i	61.5	36.4	34.0	35.3	45.3
Mean		47.0	63.4	39.2	32.7	51.7	47.6
CV		11.7	5.9	8.4	10.2	18.5	10.8
LSD		3.43	5.35	4.71	4.74	13.67	7.31
VarXLoc LSD		7.68 to compare variety yields at different locations					
# Locations		5					

LSD @ 0.05 to compare yields of varieties with 20 plots with each other	3.43
LSD @ 0.05 to compare yields of varieties with 19 plots with each other	3.52
LSD @ 0.05 to compare yields of varieties with 20 plots vs. varieties with 19 plots	3.48
LSD @ 0.05 to compare yields of varieties with 20 plots vs. varieties with 18 plots	3.53
LSD @ 0.05 to compare yields of varieties with 19 plots vs. varieties with 18 plots	3.57

* For yield, some varieties have one or more missing plots. Least squares means for these varieties are reported rather than arithmetic means.
LSD = Least significant difference at the 95% confidence level. Means followed by the same letter are not significantly different.
CV = coefficient of variation (%), a measure of the variability in the experiment.

Table 4c. Soluble solids (°Brix)

Variety	Mean of five locations								Yolo	San Joaquin	Fresno	Kern	Merced
BQ 205	5.7	a							5.1	5.2	5.0	6.1	7.3
DRI 0319	5.7	a							5.6	5.2	4.7	6.0	7.0
AB 0311	5.6	a	b						5.4	5.2	4.8	5.6	7.2
N 6402	5.6	a	b	c					4.8	5.3	4.7	6.1	7.0
BQ 163	5.5		b	c	d				5.0	5.1	4.8	5.9	6.7
N 6404	5.5		b	c	d	e			5.0	5.3	4.3	6.2	6.6
UG 19406	5.5		b	c	d	e			4.9	4.9	4.9	5.7	6.9
AB 2 (STD)	5.4		b	c	d	e			5.2	5.2	5.0	5.6	6.2
SUN 6366 (STD)	5.4			c	d	e			4.6	5.0	4.9	5.9	6.5
UG 19006	5.3				d	e			5.0	4.8	4.6	5.9	6.3
UG 19306	5.3					e	f		5.0	5.1	4.6	5.6	6.2
H 9780 (STD)	5.1						f	g	5.1	5.0	4.5	5.4	5.6
HM 9905	5.1							g	4.6	4.7	4.7	5.3	6.1
PX 024 8 1245	5.0							g	4.7	4.7	4.6	5.3	5.9
H 5608	4.8							h	4.4	4.2	4.3	5.6	5.6
H 5508	4.6							h	4.3	4.2	3.8	5.4	5.4
MEAN	5.3								4.9	4.9	4.6	5.7	6.4
CV	5.9								4.9	4.8	5.2	7.3	5.9
LSD	0.19								0.34	0.34	0.34	0.59	0.54
VarXLoc LSD	0.44 to compare varieties at different locations												

LSD = Least significant difference at the 95% confidence level. Means followed by the same letter are not significantly different.
CV = coefficient of variation (%), a measure of the variability in the experiment.

Table 4d. PTAB (LED) color

Variety	Mean of five locations							Yolo	San Joaquin	Fresno	Kern	Merced
H 5608	21.2	a						21.5	21.0	21.8	21.5	20.3
SUN 6366 (STD)	21.6	a	b					23.3	21.3	21.8	21.5	20.0
AB 0311	21.6	a	b	c				22.0	21.5	23.0	21.5	20.0
N 6402	21.7	a	b	c				22.5	21.3	23.8	21.3	19.5
BQ 163	21.9		b	c	d			23.5	21.0	22.5	22.3	20.0
UG 19006	21.9		b	c	d	e		23.5	20.5	22.5	22.5	20.5
H 5508	22.2			c	d	e	f	23.3	21.5	23.5	21.8	20.8
UG 19306	22.2			c	d	e	f	23.0	21.8	23.3	22.3	20.5
UG 19406	22.3				d	e	f	23.3	21.8	23.0	22.3	21.0
N 6404	22.4				d	e	f	23.0	21.3	24.5	22.5	20.5
DRI 0319	22.4				d	e	f	23.3	21.8	24.0	22.8	20.3
BQ 205	22.5					e	f	24.5	21.3	22.8	23.0	20.8
H 9780 (STD)	22.6						f	22.8	21.5	23.8	23.5	21.3
HM 9905	22.7						f	24.3	21.8	23.5	22.8	21.0
AB 2 (STD)	22.7						f	23.8	21.5	23.8	23.3	21.0
PX 024 8 1245	23.7						g	24.3	22.3	25.3	24.8	22.0
Mean	22.2							23.2	21.4	23.3	22.5	20.6
CV	4.3							3.8	3.0	5.6	3.6	4.7
LSD	0.59							1.26	NS	1.86	1.15	NS
VarXLoc LSD	NS											

LSD = Least significant difference at the 95% confidence level. Means followed by the same letter are not significantly different.
NS = not significant.
CV = coefficient of variation (%), a measure of the variability in the experiment.

Table 4e. Fruit pH

Variety	Mean of five locations	Yolo	San Joaquin	Fresno	Kern	Merced
UG 19406	4.32 a	4.21	4.21	4.37	4.34	4.48
UG 19006	4.33 a b	4.25	4.29	4.36	4.32	4.44
AB 2 (STD)	4.34 a b c	4.29	4.26	4.30	4.37	4.46
PX 024 8 1245	4.35 a b c	4.26	4.28	4.40	4.30	4.49
AB 0311	4.36 b c d	4.33	4.30	4.27	4.41	4.51
UG 19306	4.37 c d	4.29	4.27	4.41	4.34	4.54
H 5508	4.37 c d	4.27	4.37	4.34	4.40	4.48
DRI 0319	4.38 d e	4.34	4.29	4.33	4.40	4.58
H 9780 (STD)	4.40 d e f	4.34	4.28	4.41	4.42	4.54
BQ 205	4.41 e f g	4.28	4.30	4.43	4.49	4.57
BQ 163	4.43 f g	4.33	4.39	4.41	4.45	4.56
N 6404	4.43 f g	4.42	4.35	4.35	4.47	4.56
H 5608	4.44 g h	4.43	4.44	4.38	4.39	4.58
N 6402	4.47 h i	4.47	4.43	4.34	4.50	4.63
HM 9905	4.50 i	4.42	4.44	4.46	4.54	4.63
SUN 6366 (STD)	4.51 i	4.44	4.39	4.57	4.52	4.61
MEAN	4.40	4.33	4.33	4.38	4.42	4.54
CV	1.4	1.4	1.2	1.3	1.1	1.7
LSD	0.037	0.086	0.073	0.082	0.071	0.108
VarXLoc LSD	0.083 to compare varieties at different locations					

LSD = Least significant difference at the 95% confidence level. Means followed by the same letter are not significantly different.
CV = coefficient of variation (%), a measure of the variability in the experiment.

Tables 5a - 5e. Processing tomato varieties in 2012 observational trials. Observational varieties are planted in only a single plot at each location, data presented are the means of five locations.

Variety	Yield tons/acre	Soluble solids (°Brix)	Color	pH
HMX 1892	50.1 (1)	4.9 (12)	23.4 (10)	4.36 (3)
H 1161	48.2 (2)	5.7 (2)	23.4 (10)	4.31 (1)
H 1175	46.2 (3)	5.0 (10)	21.4 (2)	4.47 (13)
N 6407	45.7 (4)	5.5 (4)	22.6 (7)	4.40 (8)
H 1170	44.9 (5)	5.4 (5)	22.6 (7)	4.35 (2)
BQ 272	43.4 (6)	4.9 (12)	21.6 (3)	4.48 (15)
HMX 1894	43.0 (7)	4.7 (14)	25.8 (15)	4.46 (12)
BQ 273	42.0 (8)	4.6 (15)	22.6 (7)	4.39 (7)
BQ 270	41.9 (9)	5.1 (7)	22.0 (4)	4.47 (13)
N 6405	41.5 (10)	5.1 (7)	23.8 (12)	4.42 (10)
BQ 268	40.6 (11)	5.8 (1)	24.0 (14)	4.36 (3)
HMX1885	39.3 (12)	5.1 (7)	22.0 (4)	4.38 (5)
UG 18806	37.6 (13)	5.4 (5)	23.8 (12)	4.38 (5)
C 316	35.6 (14)	5.0 (10)	21.0 (1)	4.42 (10)
SVR 024 9 0686	35.0 (15)	5.7 (2)	22.2 (6)	4.41 (9)
Mean	42.6	5.2	22.8	4.40
CV	19.9	9.4	7.0	1.3
LSD @ 0.05	NS	0.62	2.04	0.074

LSD = Least significant difference at the 95% confidence level. Means followed by the same letter are not significantly different.
NS = not significant.
CV = coefficient of variation (%), a measure of the variability in the experiment.
Numbers in parentheses are the relative ranking of each variety within a column.

Table 5a to 5d. Individual variables measured in observational varieties, 2012. Note that observational varieties were not replicated within each location, so the statistical analyses were performed only on data combined from different locations.

Table 5b. Yield (tons/acre)

Variety	Mean of five locations	Yolo	San Joaquin	Stanislaus	Fresno	Merced
HMX 1892	50.1	81.9	33.7	37.5	25.8	71.5
H 1161	48.2	70.1	35.8	48.3	33.6	53.2
H 1175	46.2	66.4	35.2	22.4	25.6	81.2
N 6407	45.7	71.5	28.7	36.8	39.7	51.7
H 1170	44.9	61.4	35.2	27.3	30.7	69.8
BQ 272	43.4	66.5	25.6	41.1	28.7	55.2
HMX 1894	43.0	59.0	21.2	32.2	30.4	72.3
BQ 273	42.0	57.0	38.6	42.3	25.6	46.6
BQ 270	41.9	58.9	35.5	35.3	28.1	51.9
N 6405	41.5	66.7	34.6	21.0	33.6	51.7
BQ 268	40.6	64.9	31.9	35.1	21.9	49.2
HMX1885	39.3	64.5	26.0	25.2	14.1	66.7
UG 18806	37.6	66.3	34.8	20.5	23.8	42.6
C 316	35.6	50.8	---	40.3	23.9	38.0
SVR 024 9 0686	35.0	47.6	32.2	32.4	23.2	39.5
Mean	42.6	63.6	32.1	33.2	27.3	56.1
CV	19.9					
LSD @ 0.05	NS					

NS = not significant.

Table 5c. Soluble solids (°Brix)

Variety	Mean of five locations	Yolo	San Joaquin	Stanislaus	Fresno	Merced
BQ 268	5.8 a	5.5	5.4	5.7	4.9	7.4
H 1161	5.7 a b	5.1	5.3	5.4	5.4	7.2
SVR 024 9 0686	5.7 a b c	4.9	5.0	6.4	5.5	6.5
N 6407	5.5 a b c d	5.1	5.3	5.8	4.7	6.7
UG 18806	5.4 a b c d e	4.9	5.9	5.2	5.1	6.1
H 1170	5.4 a b c d e	4.6	5.0	5.8	4.9	6.5
BQ 270	5.1 b c d e f	4.9	5.0	5.0	5.0	5.8
N 6405	5.1 b c d e f	4.7	5.3	5.3	5.0	5.3
HMX 1885	5.1 c d e f	4.8	5.3	5.5	4.4	5.3
C 316	5.0 d e f	5.5	4.9	5.1	4.7	4.7
H 1175	5.0 d e f	4.2	4.8	5.0	4.1	6.8
HMX 1892	4.9 d e f	4.8	5.0	4.9	4.8	5.2
BQ 272	4.9 e f	4.2	5.7	4.8	4.5	5.3
HMX 1894	4.7 f	4.4	5.8	4.3	4.1	4.7
BQ 273	4.6 f	4.6	4.8	4.6	4.4	4.5
Mean	5.2	4.8	5.2	5.3	4.8	5.9
CV	9.4					
LSD @ 0.05	0.62					

LSD = Least significant difference at the 95% confidence level. Means followed by the same letter are not significantly different.
CV = coefficient of variation (%), a measure of the variability in the experiment.

Table 5d. Color

Variety	Mean of five locations		Yolo	San Joaquin	Stanislaus	Fresno	Merced
C 316	21.0	a	21.0	20.0	23.0	20.0	21.0
H 1175	21.4	a b	22.0	20.0	21.0	23.0	21.0
BQ 272	21.6	a b	22.0	20.0	23.0	23.0	20.0
BQ 270	22.0	a b c	23.0	21.0	22.0	23.0	21.0
HMX1885	22.0	a b c	22.0	20.0	21.0	24.0	23.0
SVR 024 9 0686	22.2	a b c	25.0	22.0	23.0	22.0	19.0
N 6407	22.6	a b c	23.0	21.0	25.0	23.0	21.0
H 1170	22.6	a b c	23.0	21.0	23.0	23.0	23.0
BQ 273	22.6	a b c	24.0	20.0	23.0	24.0	22.0
HMX 1892	23.4	b c	23.0	22.0	26.0	22.0	24.0
H 1161	23.4	b c	23.0	22.0	28.0	24.0	20.0
N 6405	23.8	c d	24.0	22.0	27.0	23.0	23.0
UG 18806	23.8	c d	26.0	22.0	27.0	22.0	22.0
BQ 268	24.0	c d	26.0	21.0	27.0	24.0	22.0
HMX 1894	25.8	d	25.0	21.0	32.0	23.0	28.0
Mean	22.8						
CV	7.0						
LSD @ 0.05	2.04						

Table 5e. pH of raw fruit

Variety	Mean of five locations		Yolo	San Joaquin	Stanislaus	Fresno	Merced
H 1161	4.31	a	4.30	4.21	4.23	4.37	4.42
H 1170	4.35	a b	4.25	4.28	4.22	4.45	4.53
HMX 1892	4.36	a b c	4.35	4.31	4.22	4.37	4.55
BQ 268	4.36	a b c	4.29	4.31	4.23	4.43	4.55
UG 18806	4.38	a b c	4.28	4.28	4.34	4.44	4.54
HMX1885	4.38	a b c	4.40	4.30	4.41	4.27	4.51
BQ 273	4.39	b c d	4.48	4.32	4.20	4.41	4.55
N 6407	4.40	b c d e	4.24	4.40	4.28	4.48	4.60
SVR 024 9 0686	4.41	b c d e f	4.36	4.32	4.25	4.47	4.64
C 316	4.42	b c d e f	4.40	4.43	4.33	4.41	4.52
N 6405	4.42	c d e f	4.42	4.38	4.31	4.47	4.54
HMX 1894	4.46	d e f	4.39	4.42	4.42	4.43	4.63
BQ 270	4.47	d e f	4.44	4.39	4.35	4.59	4.56
H 1175	4.47	e f	4.47	4.37	4.31	4.56	4.63
BQ 272	4.48	f	4.53	4.34	4.41	4.51	4.61
Mean	4.40						
CV	1.3						
LSD @ 0.05	0.074						

LSD = Least significant difference at the 95% confidence level. Means followed by the same letter are not significantly different.
CV = coefficient of variation (%), a measure of the variability in the experiment.