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MISSED THE UCCE TOMATO TRAVELING ROAD SHOW?

This issue of vegetable crop facts summarizes many of the presentations that were made at the tomato meetings in Woodland, Modesto, and Five Points last month.

FRESH MARKET TOMATO CROP ESTIMATES FROM USDA

According to the latest USDA NASS estimates, California fresh market tomato producers had a really good year last year. Even better than 2003. This may strike many of you as odd. After all, some fields were not even harvested in the middle of the summer because the price was so low, yet NASS estimated a crop worth $421 million, 15% more than 2003. Compared to 2003, yields were slightly down (1160 vs 1200 boxes per acre) and acreage slightly up (3000 more acres in 2004). The real difference was price, which was estimated to average $9.80/box last season, while “only” $9.00 in 2003. Could this be right? Perhaps. It is difficult to say if the average price was adjusted for volume. While everybody remembers the price spike last fall because of the hurricanes that hit Florida and early October rains here, the total number of boxes sold at those lofty levels was small in comparison to summer shipments. The other factor is vine ripes, which have higher box value than greens.

Tomatoes for fresh market: value by state and United States, 2004.

state	area harvested *acres*	yield *boxes/A*	Production *1,000 boxes*	Value *$/box*	Total *1,000 dollars*
AL	1,200	1140	1,368	$8.70	11,902
AR	1,300	420	546	$8.00	4,368
CA	**37,000**	**1160**	**42,920**	**$9.80**	**420,616**
FL	42,000	1440	60,480	$8.28	500,472
GA	5,800	680	3,944	$11.25	44,370
IN	1,700	640	1,088	$19.43	21,134
MD	1,200	520	624	$12.25	7,644
MI	2,100	1040	2,184	$12.00	26,208
NJ	3,000	920	2,760	$9.25	25,530
NY	2,400	600	1,440	$15.88	22,860
NC	2,000	1240	2,480	$7.25	17,980
OH	6,700	660	4,422	$11.20	49,526
PA	3,700	600	2,220	$7.38	16,373
SC	3,500	1200	4,200	$6.63	27,825
TN	6,200	800	4,960	$8.50	42,160
TX	1,100	420	462	$16.25	7,508
VA	5,500	1520	8,360	$11.48	95,931
US	126,400	1144	144,602	$9.30	1,344,795

Source: Vegetables 2004 Summary, NASS USDA January 2005

Statewide Processing Tomato Variety Trials
Combined Yield Results - 2004

Michelle Le Strange, Tulare and Kings Counties, Joe Nunez, Kern County, Gene Miyao, Yolo County, Mike Murray, Colusa County, Jan Mickler, Stanislas County, , Merced

Four early and 6 mid-season variety tests were conducted throughout the major processing tomato production regions of California during the 2004 season. The major objective is to conduct processing tomato variety field tests that evaluate fruit yield, °Brix (a measure of soluble solids %), color, and pH in various statewide locations. The data from all test locations are used to analyze variety adaptability under a wide range of growing conditions. As in the past, both replicated and observational lines were evaluated.

Procedures

Early maturity tests were planted in February or early March and mid-season lines were planted from March to May. Tests were primarily conducted in commercial production fields with grower cooperators, however the Fresno trials were located at the UC West Side Research and Extension Center [WSREC] near Five Points.

Each variety was usually planted in one-bed wide by 100 foot long plots (Fresno used 75 foot long plots). Seeding or transplanting was organized by the Farm Advisor at approximately 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 test locations were primarily furrow irrigated.

Results

A complete research report can be found at the VRIC website www.vric.ucdavis.edu. Click on Vegetable Information, Choose Tomato as the crop, scroll down to other and click on 2004 Statewide Processing Tomato Variety Evaluation trials. OR call a Farm advisor and ask them to mail you a copy.

Combined and individual location means for yield of fruit from replicated, midseason processing tomato varieties, 2004.

Variety	Yield (Tons/A) 6 Locations Combined		Yolo	Colusa	Stanislaus	Fresno	Kern	Merced
U 941	45.1	A	54.1	42.4	44.4	52.9	27.4	49.5
H 8892	43.2	A B	53.8	42.0	46.1	46.3	22.9	48.1
H 5503	43.0	A B	52.8	41.2	45.3	48.4	26.5	44.0
H 2401	42.9	A B C	49.7	41.2	40.3	50.1	21.8	54.5
H 9665	42.4	A B C D	50.1	41.5	39.6	39.6	27.4	56.4
H 5803	40.9	B C D E	54.0	40.6	36.4	41.4	23.0	50.0
Sun 6360	40.3	B C D E	48.2	35.8	42.1	47.6	22.5	45.9
PS 296	40.1	C D E	50.8	35.1	53.2	37.1	22.1	42.4
H 2501	39.9	D E	47.5	33.5	40.0	43.0	25.7	50.0
H 2601	39.6	D E	42.6	39.9	40.9	37.8	24.3	52.1
Red Sky	39.2	E	49.0	34.6	41.6	41.2	25.5	43.4
UG 151	38.9	E	50.7	32.6	43.1	41.0	20.3	45.8
Halley 3155	38.7	E	53.7	34.4	42.0	36.7	24.0	41.4
CPL 4863-N	38.7	E	49.3	39.5	40.1	37.5	18.3	47.4
U 005	38.3	E	45.7	35.4	41.3	35.9	25.2	46.5
Sun 6119	38.1	E F	50.5	34.5	39.3	36.5	19.4	48.2
La Rossa	35.4	F G	53.9	28.0	35.9	34.2	26.3	33.8
PX 607	34.0	G	45.3	29.7	35.8	35.4	19.2	38.3
MEAN	39.9		50.1	36.8	41.5	41.2	23.4	46.5
LSD @ 0.05=	2.9		2.8	4.5	7.7	6.1	N.S.	8.2
C.V.=	12.7		4.0	8.7	13.0	10.5	32.9	12.4
VARIETY X LOCATION LSD @ 0.05=	7.1							

Direct Seed vs. Transplant Evaluation in Processing Tomatoes

Gene Miyao, Farm Advisor, Yolo, Solano & Sacramento Counties

More Field Trials: Testing continued in 2004 on comparing transplants with direct seed in a field trial northwest of Woodland with Joe Muller and Sons. We direct seeded into single lines on March 23 when the grower seeded. Three weeks later we returned to mechanically transplant when our field seedlings were at the two-true leaf stage. Sprinkler irrigation established the crop, though residual soil moisture was good. Conditions were very good for crop establishment for both the direct seed and transplants.

Halley was our primary variety. We thinned the direct seed into clumps of 3 plants centered on 12, 16, 20 or 24 inches and transplanted with plugs with single plants at 12, 16, 20 and 24 inches. Varieties AB 2 and HM 830 were also planted but only on 12-inch spaced clumps for direct seed and 16-inch spacing for the transplants. We presumed those configurations would represent the norm for direct seed as well as for transplants. Full stands were maintained at the early stages by replanting with transplants during the first few weeks. Few replacements were needed. Furrow irrigation was used for the bulk of the remaining season.

There was minor damage from Phytophthora root rot in this Rincon silty clay loam, class 2 soil. Verticillium wilt was prevalent and caused moderate loss of canopy during the later growth stage. Harvest was timely with both establishment methods nearing optimal maturity together.

Results: Yield between direct seed and transplants were similar, although this time transplants had the advantage, 39 vs 41 tons, respectively (Table). Direct seeded Halley compensated well across our spatial differences. As a transplant, Halley was less forgiving. Yields were slightly reduced linearly as spacing between plants increased. Transplant yields ranged from 38 to 41 T/A. However, the transplant Halley spacing of 16 inches apart was similar to the 12-inch spacing, 40.0 vs 41.0 tons, respectively.

Both AB 2 and HM 830 yields responded similarly to Halley between transplanting and direct seeding. AB 2 was the highest yielding variety with 45 plus T/A. Transplants had fewer sunburn damaged fruit, fewer blossom end rot and more pink fruit. Brix levels were high, averaging 6.0, for both direct seed and transplants in this test.

Bottom line: *Yield and performance of transplants were very similar to direct seed.*

Discussion: At this point I am unsure of the value of continued comparisons. It seems that further evaluations would likely produce results where some locations and conditions would slightly favor one planting method, but without a consistently superior method identified. The upshot appears to be that establishment method is comparable between the two.

	VARIETY	Method	Spacing (inches)	Marketable Yield tons/acre	% pink	% green	% sun burn	% BER	lbs per 50 Fruit
1	**Halley**	seed	12	**37.7**	1	2	13	2	7.58
2	**Halley**	seed	16	**38.3**	1	1	13	1	7.67
3	**Halley**	seed	20	**38.8**	1	2	14	3	8.06
4	**Halley**	seed	24	**37.1**	2	1	16	1	7.75
5	**Halley**	transplant	12	**41.0**	3	2	7	2	7.83
6	**Halley**	transplant	16	**40.9**	5	2	11	2	8.05
7	**Halley**	transplant	20	**39.1**	5	4	7	2	7.53
8	**Halley**	transplant	24	**38.1**	7	2	8	1	8.56
9	**AB 2**	seed	12	**45.6**	1	2	7	2	8.77
10	**AB 2**	transplant	16	**47.8**	2	2	6	1	8.41
11	**HM 830**	seed	12	**36.9**	1	2	15	4	8.15
12	**HM 830**	transplant	16	**38.0**	2	1	11	1	8.29
			LSD 5%	3.0	3	NS	6.4	NS	NS
			C.V.	5	83	75	42	69	8
		seeded	Linear	NS	NS	NS	NS	NS	NS
			Quadratic	NS	NS	NS	NS	NS	NS
		transplanted	Linear	*	*	0.1	NS	NS	NS
			Quadratic	NS	NS	NS	NS	NS	NS
			direct seed	**39.1**	**1.3**	**1.4**	**13.0**	**2.1**	**8.0**
			transplant	**40.8**	**3.8**	**2.0**	**8.4**	**1.4**	**8.1**
				**	***	0.11	***	*	NS

NS – Not Significant at probability 0.05, *significant at probability of 0.05, ** significant at probability of 0.01

Transplant Density in the Control of Curly Top Virus

Michelle Le Strange, Farm Advisor, Tulare & Kings Counties

Overview: When curly top virus occurs on the west side of the San Joaquin Valley the amount of damage to tomatoes appears to be more extensive in transplant fields compared to direct seeded fields. Growers have been switching to transplants for a number of reasons and in the process the total number of plants per acre has been reduced. Fewer plants per area may create conditions favorable for the beet leafhopper, *Circulifer tenellus*, the vector of the virus, since it is believed that dense stands of tomatoes discourages visitation by leafhoppers.

A field trial was initiated to investigate in-row spacing (15 vs. 30 inches), number of plants per transplant plug (1, 2, or 3), on a medium vine size variety (Halley 3155) and a large vine size variety (AB2) in efforts to minimize effect of curly top virus in processing tomatoes. Disease incidence in this trial was too low to affect the results. Yield results indicate that these two varieties responded similarly to increasing plant density. In general a 15-inch spacing with 2 or 3 plants per plug yielded significantly more than 1 plant per plug regardless of variety. A 30-inch plant spacing with only 1 plant per plug yielded the least.

Procedures: A transplant density experiment was established on May 21, 2004 in a commercial field of processing tomatoes grown in the Five Points - Huron area in the San Joaquin Valley. Though early incidence of curly top virus appeared low throughout the Westside of the SJV, the trial was initiated to determine yield differences of plantings of various densities. Two varieties Halley 3155 (medium vine size) and AB2 (large vine size) were seeded at 1, 2, and 3 seeds per transplant plug and grown in a commercial greenhouse until they were hand transplanted in the field at a 15" and 30" spacing. Individual plot size was one 60-inch bed wide x 100' row length. The field was grown under sprinkler and furrow irrigation and was machine harvested on October 7, 2004. Fruit samples from the mechanical harvester were hand-sorted for defects. The incidence of curly top virus was too low in the field to have an effect on yield. Results are a reflection of plant density and variety differences.

Results: In general yields were low for Fresno County, perhaps reflecting the late planting and fruit set problems associated with heat. Yields ranged from 30.7 to 17.4 tons per acre. Variety, in-row spacing, and the number of plants per transplant plug each had an effect on yield (Table 1 and Figure 1).

Variety: Over all density treatments Halley 3155 (a medium size vine) averaged 2.3 more tons per acre than AB2 (a large size vine). This proved statistically significant, although the tonnage difference between varieties at the density treatments was small.

At a 15" plant spacing across all plug densities Halley averaged 28.3 and AB2 averaged 26.6 tons per acre. At a 30" plant spacing across all plug densities Halley averaged 24.7 and AB2 averaged 21.7 tons/acre. Halley also yielded higher than AB2 at the different plug densities and across the in-row plant spacing as shown in the tables and charts.

	Tons/Acre		
	Halley	**AB2**	**Average**
15" spacing	28.3	26.6	27.4 a
30" spacing	24.7	21.7	23.2 b
Average LSD .05	26.5	24.2	25.3 1.8

	Tons/Acre		
	Halley	**AB2**	**Average**
1 plant/plug	22.5	20.9	21.7 b
2 plants/plug	28.6	25.2	26.9 a
3 plants/plug	28.3	26.4	27.4 a
Avg. (LSD = 1.8) LSD .05	26.5 a	24.2 b	25.3 2.2

In-row spacing: The closer in-row spacing of 15 inches brought higher yields than a 30-inch in row spacing across plug density and within and between varieties.

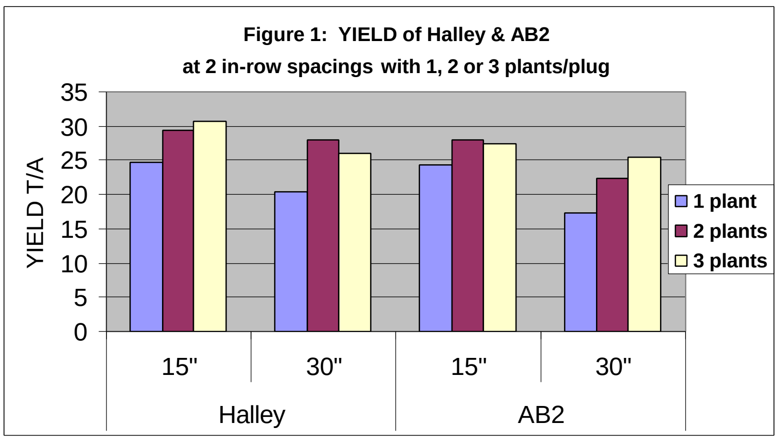
Number of plants per transplant plug: When both in-row spacings were averaged, 2 and 3 plants per plug brought higher yields than one plant per plug, however there was no yield advantage with three plants over two plants per plug. This held true in Halley and AB2.

plants per plug yielded the most fruit. A 30-inch plant spacing with 3 plants per plug yielded about the same as a 15 inch spacing with 2 plants per plug. A 30-inch spacing with only 1 plant per plug yielded the least regardless of variety. Although the variety with medium vine size, Halley 3155, yielded more than AB2, the variety with larger vine size, yield differences were small and the varieties performed consistently across density treatments.

Table 1. Effect of variety, in-row spacing, and plant number in transplant plug on yield of processing tomatoes, Fresno 2004.

Variety	In-row Spacing	Plants in Plug	Yield T/A	Percent red	Percent green	Percent sunburn	Percent rot	lbs per 50 fruit
Halley	15"	3	30.7 a	75 ab	5 ab	4 d	17 abc	7.6 a
Halley	15"	2	29.4 ab	75 ab	5 ab	6 bcd	13 abcd	8.5 a
AB2	15"	2	28.0 abc	82 ab	4 ab	6 bcd	8 d	8.5 a
Halley	30"	2	27.9 abc	73 ab	3 b	8 abc	15 abcd	8.0 a
AB2	15"	3	27.4 abc	76 ab	7 ab	5 cd	13 bcd	8.5 a
Halley	30"	3	26.0 bcd	69 b	4 ab	8 abc	19 ab	7.8 a
AB2	30"	3	25.4 bcd	76 ab	5 ab	9 ab	11 bcd	7.2 a
Halley	15"	1	24.8 cd	70 b	2 b	6 bcd	22 a	7.6 a
AB2	15"	1	24.4 cde	79 ab	3 b	8 abc	10 cd	7.1 a
AB2	30"	2	22.3 de	71 b	3 b	9 ab	17 abc	7.3 a
Halley	30"	1	20.3 ef	73 ab	4 ab	7 abcd	15 abcd	7.7 a
AB2	30"	1	17.4 f	71 b	4 ab	10 a	14 abcd	7.5 a
	LSD 0.05		4.3	11	3	4	9	ns
	CV %		11.9	10	51	37	42	14.7
Halley	average		26.5 a	73	4	6	17	7.9
AB2	average		24.2 b	76	4	8	12	7.7
	LSD 0.05		1.8					

ns no significant difference   Results followed by same letter are not significantly different from each other.



Trends in Marketing – Interesting Facts

Roberta Cook, Agricultural Economist, UC Davis

US Fresh-Cut Vegetable Facts

- Fresh-cut veggies represented 31% of all pre-packaged produce retail sales in 2003.
- Carrots were about half the $1.3 billion fresh-cut veggie category, followed by spinach ($108 million), potatoes ($87 million), celery ($85 million) and mixed vegetables ($69 million)
- 77% of consumers purchase fresh-cut veggies, but on average, only once every 9 weeks

US Sales of Salads by Type for 2002/03 in million $

Fresh-cut Salads	$ volume	Segment share %
Total	$2,357,987	100%
Blends	1,039,863	44%
Garden (IBB)	702,950	30%
Kits	283,653	12%
Organic	144,927	6%
Romaine hearts	107,278	5%
Slaw	79,316	3

Managing Tomato Soluble Solids with Drip Irrigation

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With the explosion of drip irrigation use in processing tomato production the issue of managing fruit soluble solids has become a hot topic. We conducted a series of trials in previous years, examining the response of tomato fruit to soil moisture stress. *Our most important finding was that only green fruit are affected by water stress; once a tomato ripens, its soluble solids concentration (SSC) cannot be increased by water stress.* This suggests that the only way for a grower to substantially increase SSC is to begin to dry down the field while most fruit are still green.

2004 Field Trials: We conducted trials in 7 drip-irrigated fields in Fresno and Kings Counties to evaluate the effects of late-season deficit irrigation on fruit yield and SSC. These fields represented different growers, a range of soil conditions, and a harvest period from July 19 to September 21; details are given in Table 1. The cooperating growers determined the timing and volume of irrigation delivered to their fields. Water meters were installed in the drip lines of 7 individual beds, 300-400 ft from the tail end of the field; on 5 of these lines a gate valve was also installed. About 4-7 weeks before harvest (corresponding to 5-25% of fruit having begun external color change) the gate valves were partially closed, reducing irrigation flow in those lines by 25-50%. Fruit yield and SSC from the rows receiving reduced irrigation were compared with that of matching rows receiving the growers' irrigation treatment. (In field 4 the trial was not set up until approximately 25% of the fruit were red, so the 'reduced' irrigation treatment consisted of complete irrigation cutoff).

On the day the reduced irrigation treatment began, approximately 20 fruit per row at the 'turning' or 'pink' stages of ripeness (as defined by USDA fresh market standards) were collected, blended, and evaluated for SSC by refractometer. A second set of later-maturing fruit were collected and analyzed 2-4 weeks later. At harvest, fruit were graded into marketable (sound red fruit), green, and cull (sunburn, limited use, and rot) categories, and marketable yield calculated. SSC, pH, and color were determined on blended samples of red fruit from each subplot.

Results: Based on prior research, crop water requirement for full irrigation over the last 4-6 weeks of the season would require approximately 80-90% of CIMIS ETo. By this criterion, all growers followed a deficit irrigation regime, varying in the degree of severity (Table 2). No prolonged irrigation cutoff period was employed in any field; all growers continued to make light irrigations to within 14 days of harvest. SSC of early-maturing fruit varied from 4.2 to 5.9 ^{o}brix among fields (Fig. 1). This range was partly attributable to cultivar differences, and partly to field-specific factors. For example, in field 2 the wetting pattern quickly came to the soil surface, and the grower had been deficit irrigating for several weeks before the trial began in an attempt to keep the top of the beds dry; this was reflected in the very high brix of early-maturing fruit. The pattern of subsequent SSC development was quite consistent across fields. Later-maturing fruit (those exposed to deficit irrigation while still green) showed substantially increased SSC. Overall fruit SSC at harvest was intermediate between that of early- and late-maturing fruit. These results were consistent with our prior observations that, after ripening, fruit SSC does not increase regardless of subsequent soil moisture stress.

High yields were observed at all sites, with extraordinarily high yields in fields 1 and 3 (Table 2). High SSC was also achieved, across all fields averaging 5.5 ^{o}brix in the grower plots. Although the trends were not statistically significant for all individual fields, across fields the reduced irrigation treatment reduced marketable fruit yield slightly. However, the yield loss was offset by a corresponding increase in SSC; overall, brix yield was equivalent in both irrigation treatments. Across fields, differences between irrigation treatments in cull rates and blended fruit color were not significant. None of the trial fields showed severe vine decline at harvest; only in field 6 could the reduced and grower irrigation treatments be distinguished visually.

These results indicated that processing tomatoes can tolerate a significant degree of water stress before brix yield is compromised. Irrigation regimes as low as 20-40% of ETo over the fruit ripening period did not significantly reduce brix yield when compared to wetter treatments. This means that growers have substantial flexibility in late-season drip irrigation scheduling, enabling them to tailor irrigation based on field-specific factors such as the SSC of early-ripening fruit. The consistent pattern of increasing fruit SSC in response to deficit irrigation suggested that SSC monitoring of ripening fruit could be a useful tool in irrigation scheduling; the large differences among fields in SSC of early-ripening fruit emphasized that some fields may require more severe irrigation deficits to achieve acceptable fruit SSC than others.

Summary: To summarize our drip irrigation scheduling work over the last 3 years, initiating deficit irrigation early in the fruit ripening period, and applying 40-60% of ETo from then until harvest, is likely to achieve acceptable fruit SSC with minimal yield reduction under most field conditions. In fields in which early-ripening fruit are significantly below the desired SSC level, more severe deficit may be warranted. To date we have not conducted irrigation trials in a field with severe vine decline problems; the ability to substantially increase fruit SSC by deficit irrigation may be compromised in fields in which factors other than water stress (foliar or root pathogens, nutrient deficiency, etc.) seriously reduce late-season vine vigor. Also, initiating deficit irrigation as early as 6 weeks preharvest may increase the potential for root intrusion into the drip tape; although this has not been a wide-spread problem in these trial fields, growers should be vigilant.

Table 1. Soil texture, cultivar, and harvest date for 2004 drip irrigation trial fields.

Field	Location	Soil texture	Cultivar	Harvest date
1	Five Points	sandy clay loam	AB 2	19 July
2	Cantua Creek	sandy clay loam	HM 830	22 July
3	Five Points	sandy clay loam	AB 2	23 July
4	Huron	clay	Halley	5 Aug
5	Firebaugh	clay	Peto 849	17 Aug
6	Firebaugh	clay	Heinz 9665	14 Sept
7	Huron	clay	Heinz 9663	21 Sept

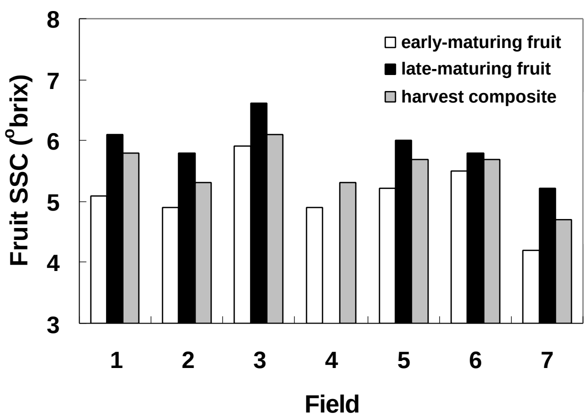

Fig. 1. Fruit soluble solids concentration (SSC) development in the grower irrigation treatment over the fruit ripening period.

Table 2. Effect of late-season irrigation management on tomato yield and fruit soluble solids concentration (SSC).

Field	Irrigation treatment	Cutback initiation (days preharvest)	% of ETo applied in cutback period	Mkt. yield (tons/acre)	Soluble solids (° brix)	Brix yield (tons/acre)
1	grower		66	71	5.8	4.1
	reduced	38	46	69	6.0	4.2
				ns	*	ns
2	grower		27	52	6.1	3.2
	reduced	21	17	49	6.1	3.0
				**	ns	*
3	grower		57	87	5.3	4.6
	reduced	26	33	83	5.4	4.5
				ns	ns	ns
4	grower		46	59	5.3	3.1
	reduced	29	0	56	5.4	3.0
				ns	ns	ns
5	grower		32	45	5.7	2.6
	reduced	39	20	45	5.7	2.6
				ns	ns	ns
6	grower		67	46	5.7	2.6
	reduced	42	33	42	5.9	2.5
				*	*	ns
7	grower		43	55	4.7	2.6
	reduced	46	27	53	4.8	2.5
				ns	ns	ns
Ave	**grower**			**59**	**5.5**	**3.3**
	reduced			**57**	**5.6**	**3.2**
				*****	******	**ns**

ns, *, **irrigation treatments not significantly different, or significantly different at $p < 0.05$ or 0.01, respectively

Evaluation of EFS Varieties over Time of Harvest

Michelle Le Strange, Farm Advisor, Tulare and Kings Counties

Overview: Certain processing tomato varieties have been bred for Extended Field Storage (EFS). Some of these are included in the UC statewide variety trials, however under that protocol the EFS lines are only harvested one time and this procedure does not adequately address or evaluate a variety's potential for extended field storage. It is well documented that yields of processing tomatoes decrease during periods when high-sustained air temperatures occur and disrupt fruit set. Previous work by others has investigated planting EFS varieties early and letting ripe fruit store in the field for long periods before harvesting. This was not the aim of this project.

The results from this one study showed that under some field conditions fruit yield (T/A) decreased fairly fast (within 7 days) for all tested varieties and quality of yield was not maintained. Some varieties performed better than others, but more field tests are needed.

Procedures: A field study was established in Five Points at the UC WSREC in Fresno County on May 26, 2004. Five EFS varieties were selected to compare with a standard tomato variety, Halley 3155. Seedlings were hand transplanted on 12-inch spacing and grown with typical commercial practices under furrow irrigation. Irrigation cutoff was on August 20, 2004. Plot size was 45' of row on a 66' tomato bed. The trial was arranged in a split plot design for three separate harvest dates without disrupting the growth of tomatoes on neighboring beds. Each variety was replicated five times within each harvest date. At harvest time tomato roots were undercut by machine and a portion of the plot was hand harvested for fruit yield and quality. The three harvest dates were Sept 15 (111 days after transplanting (DAT), Sept 22 (118 DAT), and Oct 5 (131 DAT). PTAB data was collected at each harvest and samples were sent to Diane Barrett's food science lab on the UC Davis campus to gather cooked tomato data. There was virtually no insect or disease pressure in the field, however weeds were an issue. In spite of fumigation with vapam prior to planting and two herbicide applications, several hand weedings were needed to remove nightshade and patches of dodder from the field. The last weeding was timed with irrigation cutoff, which seemed to intensify vine breakdown and sunburn.

Results: Harvest date affected tonnage, quality of yield, PTAB parameters, and cooked analysis of tomato fruit (data not shown). For yield and quality of yield at harvest all varieties responded similarly to delayed harvest. With each successive harvest date:

? Tonnage decreased
? Lbs/ 50 fruit decreased
? % green fruit decreased
? % rotten fruit increased
? % sunburned fruit increased

PTAB results were less consistent and did not follow as clear a trend over harvest date.

- ? Color decreased slightly for each EFS variety, but not for Halley.
- ? °Brix increased slightly for each EFS variety, but not for Halley.
- ? pH did not follow a trend.

This data is from one field study and will be modified and repeated. No conclusions are being drawn at this time.

Table 1. YIELD Results - EFS Varieties x Harvest Date 2004

	YIELD T/A				Lbs/50 Fruit			
Variety	**AVG.**	**H1**	**H2**	**H3**	**AVG.**	**H1**	**H2**	**H3**
U 886	**26.1** a	36.6 a	24.9	16.8 ab	**9.8** a	10.6 a	9.9 ab	9.0 a
PS 849	**25.1** a	34.0 a	21.4	19.8 a	**9.8** a	11.0 a	9.4 ab	9.0 a
U 027	**24.9** ab	37.7 a	21.7	15.3 abc	**9.5** a	10.4 a	9.5 ab	8.5 ab
H 9665	**23.5** ab	31.3 a	23.3	16.0 abc	**8.8** b	9.1 b	9.2 b	8.1 b
Halley*	**21.4** bc	31.7 a	21.8	10.6 c	**9.7** a	10.4 a	10.2 a	8.6 ab
H 9780	**18.8** c	24.4 b	19.2	14.0 bc	**9.8** a	10.5 a	9.8 ab	9.1 a
average	**23.3**	**32.6**	**22.1**	**15.4**	**9.6**	**10.3**	**9.7**	**8.7**
LSD Var	3.6	6.8	ns	5.8	0.5	1.1	0.9	0.8
LSD H	5.2				0.7			
LSD H x Var	ns				ns			
CV %	21.2				7.3			

* check variety   H1 = Sept 15   H2 = Sept 22   H3 = Oct 5   LSD@ 0.05   ns = not significant

Table 2. QUALITY of Yield Results - EFS Varieties x Harvest Date 2004

	% Green			% Rot			% Sunburn			% Rot + Sunburn		
Variety	H1	H2	H3	H1	H2	H3	H1	H2	H3	H1	H2	H3
U 886	8.0	1.5	2.5	6.2	12.6	18.6	3.1	4.8	6.4	9.3	17.4	25.0
PS 849	4.0	3.1	2.3	4.6	9.8	15.8	4.7	3.6	7.6	9.3	13.4	23.4
U 027	2.8	2.0	0.2	3.7	13.3	15.6	4.5	6.7	21.9	8.2	19.9	37.4
H 9665	6.5	2.0	0.9	5.2	6.7	10.0	7.2	10.5	14.4	12.4	17.2	24.5
Halley*	5.1	3.3	1.2	5.7	10.1	20.5	1.5	4.0	12.8	7.2	14.0	33.3
H 9780	6.3	7.6	3.5	5.3	7.8	15.1	3.5	9.4	13.7	8.7	17.1	28.9
average	**5.5**	**3.3**	**1.8**	**5.1**	**10.1**	**15.9**	**4.1**	**6.5**	**12.8**	**9.2**	**16.5**	**28.8**
LSD H		0.6			3.5			3.7			4.7	
LSD Var		1.9			2.9			2.6			4.3	
LSD H x Var		ns			ns			ns			ns	
CV %		72.8			37.8			45.7			32.4	

* check variety   H1 = Sept 15   H2 = Sept 22   H3 = Oct 5   LSD@ 0.05   ns = not significant

Dodder Management in Tomatoes

Tom Lanini, Extension Weed Ecologist, University of California, Davis

As Chuck Rivara of CTRI once said, *"Dodder is like a car accident. It's a curiosity when you see it in someone else's field, but it's a real problem when it's in yours."*

Dodder: A stem parasitic weed, is often considered a disease rather than a flowering plant. Germinating dodder seeds emerge as rootless, long yellow-orange thread-like leafless stems. The thread-like seedling coils around the host stem, adheres to it by adhesive discs, penetrates its tissue and vascular system via haustoria, and exploits the host by withdrawing nutrients and water. The part of the seedling in contact with the soil dies soon after haustoria formation. New shoots are continuously produced, forming new attachments to the same plant and allowing attack of neighboring plants. Thus, the vigor of the host plant is lowered and crop production is dramatically reduced.

Damage: Dodder that is not controlled can reduce tomato yields by over 75% and produce thousands of seeds that can remain viable for up to 20 years. Dodder is estimated to be present in about 30,000 acres of tomatoes in California, in addition to parasitizing many rotational crops including alfalfa, asparagus, carrot, onion, safflower, sugarbeet and melon. Dodder also infests many broadleaf weeds.

Dodder control can be achieved by avoidance, hand removal, resistant tomato varieties, and herbicides. None of these methods work 100% of the time, but all offer some hope for managing this native, parasitic weed. Another complicating factor is that several dodder species are involved, with field dodder (*Cuscuta pentagona*) being the most common.

Avoidance: Fluctuations in soil moisture and temperature near the soil surface may initiate germination of buried dodder seed. Temperatures during the spring and early summer months are ideal for dodder emergence. However, dodder emergence in field trials was observed to cease or dramatically decline in early to mid May, despite temperatures in the optimum range for germination and emergence. We have confirmed these observations in several tomato fields. Thus, a way to avoid major dodder infestations is to plant after mid-May. Late planting can reduce dodder infestation, but that is not always practical due to cannery delivery dates. Some growers have utilized transplants in order to plant late, but still deliver tomatoes within the delivery time frame. Dodder also has a more difficult time attaching to larger plants.

Shallow cultivation: Due to the absence of roots, dodder seedlings (before attachment to the crop) are easy to control by shallow cultivation. In addition, tillage may hasten drying the soil surface, thus preventing further dodder germination and emergence. Complete dodder removal can only be achieved with the destruction of the infested crop plants.

Hand removal: Removal by hand crews, of the tomatoes with dodder attached, remains a viable but expensive option, when infestations are small. When infestations are extensive, hand removal would be prohibitively expensive, not to mention the loss in the tomato stand. Hand removal is often done when dodder is first detected to prevent spread and seed production. In a trial area, farm workers were observed to remove dodder about 90% of the time. The remaining 10% was generally missed, because it was too small to be easily detected. If a hand crew can be sent back through a field about 15 to 21 days after the first hand weeding, the remaining dodder plants can be removed prior to any dodder seed production.

Plants with attached dodder do not need to be removed from the field unless they have viable seed. Dodder can reattach to a new host if left in close proximity to living tomato plants, but if the plants are moved 6 or more inches from the remaining tomato plants, the dodder will not be able to reach a new host.

Resistant varieties: Dodder resistant tomato varieties continue to be a viable option for preventing dodder infestation. Thus far, four Heinz varieties have been shown to be dodder resistant in field trials: H9492, H9553, H9992, and H 9888. Additionally, CDX 233, H1100, H9997, and SVR 024 2 0665, have shown excellent dodder resistance in greenhouse studies. Some dodder is able to attach and survive on these varieties, but generally, tomato yields are not reduced and dodder seed production is very low or non-existent. Varieties to avoid if dodder is potentially a problem include AB2, ENP 113, APT 410, CDX 222, H2501, H2601, H8892, and H9665, which are all highly sensitive to dodder.

Herbicides: The preemergence herbicides used in tomatoes are not effective in preventing dodder germination or attachment to tomato plants. Metam sodium controls many weeds prior to vegetable planting, but hard seeded species, such as dodder are not affected. Trifluralin controls dodder well in alfalfa, but the incorporation of the herbicide in tomatoes, allows dodder seed near the soil surface to escape control. Layby herbicides, such as Tillam or Treflan, are applied too late to control attached dodder.

The nature of attachment and association between host and parasite requires a highly selective herbicide to destroy the attached dodder without crop damage. Matrix (rimsulfuron) has been shown in studies conducted by Bob Mullen in San Joaquin County, to suppress dodder, particularly when split applications are used. However, the control achieved by the best Matrix treatments was only about 50%. Even when Matrix rates were increased to 2X the current label rate, dodder still survived. By the end of the season, dodder growth in the best Matrix plots was still extensive, indicating that Matrix alone is not providing adequate control.

Spread by equipment: The primary means of dodder spread from field to field is on equipment. As more custom operations are performed, the chances for dodder spread increase. To prevent the spread of dodder (and other diseases), wash equipment after leaving an infested tomato field, before entering another.

If new dodder patches are detected, eradication of these patches should be done before they have a chance to produce seeds. Patches can be removed by hand removal, spraying both host and parasite, with a contact herbicide or by searing with a flame-throwing torch or hand burner.

Evaluation of variety tolerance to herbicide control of yellow nutsedge and nightshade in a processing tomato/cotton production system in salty soil.

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Summary. Certain processing tomato varieties were found to be sensitive to the new nutsedge herbicide Sandea (halosulfuron-methyl), and phytotoxicity was exasperated when Matrix (rimsulfuron, for nightshade control) was added to the tank-mix. SUN 6119 and H 9780 had more than 50% phytotoxicity one week after spraying, however, there was no significant effect on yield. No significant phytotoxicity was seen with the other herbicide treatments. Results from 2003 show that the Sandea + Matrix combination gives excellent weed control in fields with nutsedge and nightshade weed problems. It is important for growers to know that while Sandea may cause some yellowing of the plants, this effect is temporary and should not impact yield.

Methods: This trial was established in a field near Los Banos to evaluate current nightshade and nutsedge herbicides on weed efficacy and crop performance in different varieties. Five processing tomato varieties and six herbicide treatments were used.

The herbicide treatments consisted of:

1. Dual Magnum (metolachlor) PPI – grower applied at label rate (UTC)
2. Dual + Sandea (halosulfuron-methyl) 1 oz/A + NIS
3. Dual + Matrix (rimsulfuron) 2 oz/A + NIS
4. Dual + Sencor (metribuzin) 2/3 lb broadcast
5. Dual + Sandea 1 oz/A + Matrix 2 oz/A + NIS
6. Dual + Matrix 2 oz/A + NIS + Sencor 2/3 lb broadcast

The varieties used were:

1. Halley 3155
2. H9665
3. PS 296
4. SUN 6119 (not commercial release)
5. H9780

Herbicide applications were broadcast applied June 16, 2004 over-the-top when plants were at full bloom. Post application phytotoxicity ratings were based on yellowing, stunting, and leaf necrosis using a scale of 0 to 10.

Results: Phytotoxicity ratings are shown in Table 2. Averaged across varieties, Sandea + Matrix tank mix caused significantly greater phytoxicity, almost 35% seven days after application, as compared to the other treatments. Matrix + Sencor tank mix ranked second at 8% damage.

A strong variety by herbicide interaction indicated that the amount of phytotoxicity caused by the herbicide treatments was different between the varieties. SUN 6119 (not a commercial release) and H 9780 were much more sensitive to Sandea and Sandea + Matrix than the other varieties. Sandea + Matrix tank-mix resulted in much more phytotoxicity than either chemical alone. SUN 6119 showed more than 60% phytotoxicity 7 days after application. Two weeks after herbicide application, almost no phytotoxicity symptoms could be seen.

Table 2. Crop phytotoxicity and weed control ratings as affected by herbicide treatment, Merced 2004.

Treatment	Variety	1 week post		2 weeks post		19-Aug	yield				
		Phyto, %	Weeds	Phyto, %	Weeds	Weeds	lbs/5 ft	tons/A	Color	SS, %	pH
1. UTC		0	0	0	7.3	40.9					
2. Sandea		6.27		0	0.1	14.7					
3. Matrix		3.40		0.4	0	5.3	67.00	58.37	25.8	5.07	4.39
4. Sencor		0.38		0	0	3.7					
5. Sandea + Matrix		34.76		3.4	0	8.8					
6. Matrix + Sencor		8.00		0	0	5.9					
	3155	7.5	0	0.1	---	---	63.76	55.55	25.8	5.28	4.39
	H9665	5.7		0.1	---	---	78.83	68.68	24.8	4.57	4.34
	PS 296	7.6		0.1	---	---	59.18	51.56	25.3	5.60	4.35
	SUN 6119	18.2		2.0	---	---	71.93	62.67	26.8	5.07	4.46
	H9780	13.8		1.4	---	---	66.32	57.78	26.3	4.82	4.42
Herb treatment LSD		5.94	---	1.5	1.5	5.8	NS		NS	NS	NS
Variety LSD		3.5	---	1.3	---	---	5.40	4.70	1.12	0.21	0.06
Treatment x Variety		***	---	**	---	---	NS		---	----	---
CV, %		52.6	---	269.0	194.0	70.0	14.0		3.6	3.5	1.05

SOURCES OF INFORMATION – TOMATOES

PUBLICATIONS FROM UC

Many items are available at no cost from local UCCE offices or the World Wide Web.

UC Vegetable Research & Information Center
(UC VRIC) www.vric.ucdavis.edu

UC IPM (homepage)
www.ipm.ucdavis.edu

UC IPM (tomato section): www.ipm.ucdavis.edu/PMG/selectnewpest.tomatoes.html

UC Postharvest Technology:
http://rics.ucdavis.edu/postharvest2
(be sure to browse the Produce Facts)

UC Ag Economics: Cost of Production Guidelines
http://coststudies.ucdavis.edu or (530) 752-1515

UC Ag & Natural Resources Catalogue
http://anrcatalog.ucdavis.edu

Pesticide Labels
CDMS – Ag Chemical Information Services
http://www.cdms.net/pfa/LUpdate.Msg.asp
Greenbook – http://www.greenbook.net/

INDUSTRY ORGANIZATIONS

CA Tomato Commission
www.tomato.org - *Fresh Market Tomato Industry*

CA Tomato Research Institute www.tomatonet.org/ctri.htm
A voluntary assessment by growers to support research for processing tomato crop improvement.

CA Tomato Growers Association
www.ctga.org
Represents growers in the bargaining, economic, public policy and business leadership arenas.

CA League of Food Processors
www.clfp.com
Represents and promotes processors in CA.

Processed Tomato Foundation www.tomatonet.org/ptf
Partnership of CA tomato growers & processors to address food safety and environmental issues.

Processing Tomato Advisory Board
www.ptab.org
Established CA fruit quality standards and conducts grading program to assure high fruit quality.

WEATHER & IRRIGATION

CIMIS - CA Irrigation Management & Info System
CA Dept Water Resources - www.cimis.water.ca.gov
UC IPM - Weather, day degree modeling and CIMIS
www.ipm.ucdavis.edu/WEATHER/weather1.html

GOVERNMENT

CDFA - www.cdfa.ca.gov
CDPR - www.cdpr.ca.gov
CA AG Statistics Services - http://www.nass.usda.gov/ca
Curly Top Virus Control Program - (559) 445-5472

CALIFORNIA TOMATO PROCESSORS

Authentic Specialty Foods, Inc., Rosemead
Campbell Soup Company, Sacramento
Con-Agra Grocery Products Co. (Hunt's), Oakdale and Helm
Del Monte Corporation, Hanford
Escalon Premier Brands, Inc., Escalon
Ingomar Packing Co., Los Banos
Los Gatos Tomato Products, Huron
Morning Star Packing Co., Los Banos, Riverbank, Volta, and Williams
Pacific Coast Producers, Woodland
Patterson Frozen Foods, Patterson
Pictsweet Frozen Foods, Inc., Santa Maria
Rio Bravo Tomato Co. LLC, Buttonwillow
San Benito Foods, Hollister
SK Foods, Inc., Lemoore and Colusa
Stanislaus Food Products Co., Modesto
Toma Tek, Firebaugh
Unilever Bestfoods, Stockton & Merced

Driers/Dehydrators

Borello Farms, Inc., Morgan Hill
Culinary Farms, West Sacramento
Gilroy Foods, Hanford
John Potter Specialty Foods, Inc., Patterson
Lester Farms, Winters
Mariani Nut Company, Winters
Timber Crest Farms, Healdsburg
Traina Dried Fruit, Patterson
Valley Sundried Products, Inc., Newman

Vegetable Crop Facts

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