University of California Cooperative Extension

Vegetable Crop Facts

Merced and Madera Counties

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EDITION #5: Tomatoes – Processing & Fresh Market

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UPCOMING Meetings

Please contact the listed website or person for meeting agenda and additional information.

March 25	UC Salinity /Drainage Annual Meeting, Sacramento, CA Sponsored by UC Water Resources Center www.waterresources.ucr.edu Contact John Letey, UC Riverside (909) 787-4327
March 31	Cool-Season Crop Production Meeting, Modesto, CA Sponsored by UCCE Stanislaus County Contact Jan Mickler (209) 525-6800
April 14	Harvesting the Assets of Your Farm or Ranch, Reedley, CA Sponsored by UCCE, Agri- & Nature-Tourism Workgroup Contact Jim Sullins, Tulare County Director (559) 685-3303
April 26 27 28	Tailoring Risk Management to Fit Your Farm Sponsored by UCCE Tulare, Fresno & San Joaquin Counties Contact the local UCCE office
May 7	Riparian, Aquatic & Rangeland Weed Management, Exeter Sponsored by UCCE Tulare County Contact Michelle Le Strange, (559) 685-3309, ext 220
May 18	Blueberry Production Field Day, UC KAC, Parlier, CA Sponsored by UCCE Tulare County Contact Manuel Jimenez, (559) 685-3303

Introducing Christi Hansard

Christi Hansard joined Cooperative Extension in Fresno County in December 2003. She was hired as a Staff Research Associate to assist with the vegetable crops program under the direction of Farm Advisors Shannon Mueller and Michelle Le Strange. Christi has nine years of experience in agricultural research; she has both her Pest Control Advisor's license (PCA) and Qualified Applicators License (QAL). In addition, she has participated in training on research issues, laws and regulations, GLPs, and pesticide safety. Christi can be reached by phone in Fresno at 559-456-7553, FAX: 559-456-7575, or email: bchansard@ucdavis.edu.

Shannon will coordinate activities for melons (specifically cantaloupe and watermelons), onions, and garlic. Michelle will coordinate activities for processing tomatoes, fresh market tomatoes, peppers and other vegetables. This year we plan to focus on variety evaluations and a limited number of pest management studies, but will expand the program as opportunities present themselves. Industry support of the vegetable crops program has always been strong. We appreciate your continued support of ongoing research and would like to discuss research needs and industry priorities when possible.

Transplant Population Studies with Processing Tomato

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

With estimates of processing tomato transplant use exceeding 50% statewide, a substantial effort was devoted to transplant studies in 2003. Summaries of the trial results are:

1) Single row vs. double row comparisons in this year's test showed no yield difference between the two configurations with 7 vs. 8.6 thousand plants/acre, respectively.

2) Twin-row variations in spacing within the row of 13.5, 27 and 40 inches resulted in no substantial yield difference among the wide variation in plant populations.

3) On a single seed line per bed, 12-inch spacing between plants yielded the highest when comparing 12, 16, 20, 24 and 28-inch distance between transplants. As distance between plants increased, yields declined linearly.

4) Direct seeded yields were higher than transplants, 25.2 vs. 19.5 tons/acre, respectively, at a UCD campus site. Many production problems were encountered, resulting in high variation in yield. Our transplants were planted behind schedule as well as were afflicted with an unidentified disorder during early fruit set. Additionally, stinkbug damage and an associated yeast rot were severe.

DISCUSSION: Ideal transplant populations were not clearly identified in our recent field tests. Local tests over the past several years presented opposing results. Even so, a target population of 7,000 plants per acre on single or double lines appears reasonable. Higher plant populations may be beneficial if substantial skips or plant loss during establishment is expected or if later season diseases further reduce stands.

For yield potential, single lines may well be on par with double seed lines. Varieties, soil types and environmental factors probably influence the optimal plant population & row configuration to maximize yield.

Managing Soluble Solids of Processing Tomatoes with Drip Irrigation

Tim Hartz, Vegetable Crops Department, UC Davis, Mike Cahn, Michelle Le Strange,
and Joe Nuñez, UCCE Farm Advisors, Monterey, Tulare/Kings, and Kern Counties, respectively

The dramatic increase in the use of drip irrigation for processing tomato production in recent years has refocused attention on the issue of maintaining acceptable soluble solids. When growers adopt drip, most achieve yield improvements, but often this comes with a substantial decline in soluble solids concentration. Many field trials have been conducted to develop a dependable end-of-season irrigation strategy for drip. The majority of these trials evaluated irrigation cutoff dates, since cutoff is the established management practice for furrow-irrigated fields. *Recently we have focused on deficit irrigation strategies, evaluating the effects of cutting back irrigation as early as 4-7 weeks before harvest. This early cutback strategy has proven successful in boosting soluble solids concentration (SSC) with minimum yield loss across a variety of field conditions.*

In developing an irrigation strategy for solids improvement **it is important to consider how tomato fruit respond to soil moisture stress.** The water content of green fruit is strongly influenced by soil moisture availability. However, as a fruit begins to ripen, the hydraulic connections with the plant through which both water and plant assimilates are conducted are broken. *Once a fruit reaches the breaker stage of maturity (the beginning of external orange/red color change), its SSC is set, and will not increase even if severe moisture stress is subsequently applied; in fact, SSC will decline slowly as ripening continues because tissue respiration metabolizes carbon compounds in the fruit.*

This behavior is shown in Fig.1. In three field trials conducted in 2003 we imposed deficit irrigation treatments during the final 4-5 weeks before harvest. We collected early ripening fruit at the breaker stage of maturity before the crops were stressed; at that time additional breaker-stage fruit were tagged so they could be identified later. Just before harvest those tagged fruit (now fully red) were collected along with a matching sample of late-maturing fruit at the breaker stage. *In all fields there was significantly higher SSC in late-maturing fruit than in early-maturing fruit, the result of soil moisture stress imposed in the final weeks of the season. In contrast, the SSC of the tagged, early-maturing fruit had declined an average of 0.2^{o} brix by harvest.*

This has important implications for drip irrigation management. Relying solely on an irrigation cutoff 2-3 weeks before harvest means that a substantial portion of the crop is already at or beyond the breaker stage, and the SSC of those fruit will not be influenced by the moisture stress; for a cutoff strategy to work the SSC of the remaining green fruit must be increased enough to lift the overall average. *By contrast, beginning deficit irrigation while most fruit are still green allows more control of SSC.*

As a general rule, **the irrigation requirement of a vigorous tomato field at full bloom is slightly greater than reference evapotranspiration (ETo).** As fruit ripening begins, so does vine senescence; **by harvest the crop water use is usually no more than 70-80% of ETo**. The degree of irrigation deficit necessary to achieve a desired SSC level will depend on the amount of available soil water present as fruit ripening begins, and the SSC of early ripening fruits. A sandy soil may have as little as 1-2 inches of available water in the top 2-3 feet, while a clay soil may have 4-5 inches. We have found that SSC of early-ripening fruit varies widely among fields, from near 4.0 to above 5.0° brix. Knowing these starting points, a grower can make an informed judgment about irrigation management. *As a starting point, cutting back irrigation to approximately 50% of ETo beginning at least 4-6 weeks before anticipated harvest should be sufficient to develop a significant level of soil moisture stress.* Soil moisture monitoring, and SSC monitoring, can then be used to refine management on a field-by-field basis.

Table 1 shows the results of nine field trials in which an early cutback strategy was evaluated. The timing and severity of the irrigation cutback varied in these trials; deficit irrigation began 5-7 weeks preharvest, and irrigation volume ranged between 30-70% of ETo during that period.

Averaged across all fields, each 0.1° brix SSC increase came at the expense of approximately 1 ton/acre of yield; brix yield (tons of solids / acre) was not significantly reduced by early cutback in any field, emphasizing that the deficit irrigation simply limited the amount of water in the fruit, and did not reduce the weight of solids.

Regarding monitoring of fruit SSC and soil moisture status, a few words of caution are needed. *Accurate determination of SSC of breaker-stage fruit will require a composite sample of at least 20 fruit representing all areas of the field.* If there are significant soil texture differences within the field, or any factor causing uneven water distribution (variable slope, excessively long row lengths, etc.), sampling different sections of the field separately may be appropriate. *Soil moisture should be monitored to a depth of 2-3 ft.* Until soil moisture content in that entire zone is reduced below field capacity the plant will experience no appreciable stress; in heavy soils it may take a week or more of deficit irrigation to observe a SSC response. *If deficit irrigation is started early enough it should not be necessary to increase soil moisture tension beyond 50 centibars to increase SSC to acceptable levels.* Some level of irrigation can continue until harvest, provided that a degree of stress is maintained, and that the soil is dry enough to minimize compaction from the harvest equipment.

Lastly, in theory this early cutback strategy could induce root intrusion into the drip tape. While we have not observed this in any of our trials, growers are advised to watch for signs of intrusion, and to be ready to use appropriate chemical treatments. *Once deficit irrigation is initiated, frequent (perhaps daily) irrigation may lessen the chance of root intrusion compared to more widely spaced irrigation.*

Fig. 1. Pattern of fruit SSC development in 2003 early cutback trials.

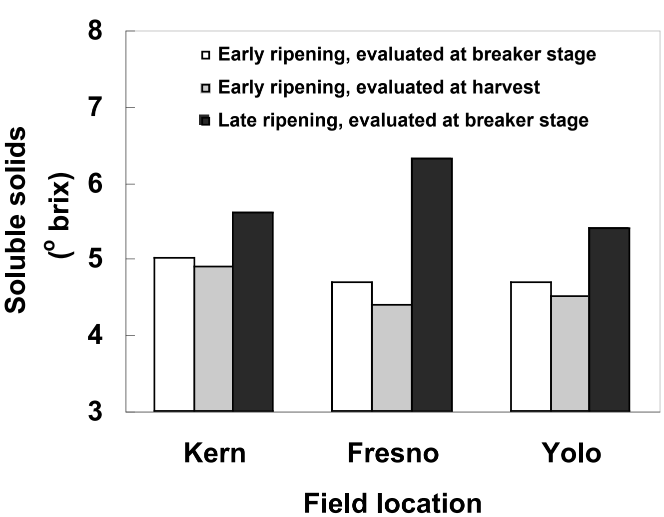


Table 1. Effects of early irrigation cutback

Year	Location	Comparison to more heavily watered treatment *	
		° brix increase	Yield reduction (T/A)
1999	Sutter	0.2	0
2000	Sutter	0.2	1
	Yolo	0.3	0
2001	Sutter	0.2	2
	Yolo	0.4	3
2002	Yolo	0.3	4
2003	Kern	0.2	4
	Fresno	0.2	5
	Yolo	0.2	5
	Ave	**0.2**	**2**

***comparison treatments generally fully watered until cutoff 2-3 weeks preharvest**

Evaluating Salinity in Irrigation Water

Michael Cahn, Irrigation and Water Resource Advisor, Monterey and Santa Clara Counties

Dissolved salts in irrigation water present numerous challenges to growers. Salts reduce the osmotic potential of water, increasing the energy that plants use to extract moisture from soil, and making them more susceptible to wilting. In addition to contributing to water stress, some constituents of salts such as sodium, chloride and boron, are toxic if they accumulate in the leaves and stem. High sodium levels can also reduce the rate that water infiltrates into soil. Soils irrigated with alkaline water (high bicarbonate) may have reduced availability of micronutrients such as iron, copper, manganese, and zinc. Lastly, salts can affect irrigation equipment by causing plugging of drip line emitters or by causing corrosion of metal fittings. All of these effects of salinity need to be considered when assessing the suitability of a water source for irrigation.

Various measurements are used to characterize the salinity of irrigation water. The main parameters tested are:

1. **Total dissolved solids** (TDS), a measure of the bulk salinity often determined indirectly by measuring electrical conductivity of the water
2. **Sodium adsorption ratio** (SAR), the ratio of sodium to the sum of calcium and magnesium, and
3. **Alkalinity,** a measure of the bicarbonate dissolved in the water (Table 1).

TDS and EC are useful for evaluating the osmotic effects of salts on crop growth. SAR is useful for assessing if infiltration rates will be reduced or if sodium has the potential to build up in the soil. Measurements of alkalinity are used to assess if there is potential for calcium and magnesium carbonate to precipitate inside pipes and drip lines, or affect the pH of the soil. *While these three measures of salinity can give a general assessment of the suitability of water for crop production, the principal cations and anions also need to be determined to know which types of salts are present in the water.*

Table 1. Major parameters for evaluating salinity in irrigation water.

Water Quality Measurement	Symbol	Formula [1]/Units	What it measures
Sodium Adsorption Ratio	SAR	$SAR = \frac{Na}{\sqrt{\frac{Ca + Mg}{2}}}$	ratio of the concentration of sodium to the sum of the concentration of calcium and magnesium in water
adjusted Sodium Adsorption Ratio	SAR_{adj}		same as SAR, but the calcium concentration is adjusted for the level of bicarbonate and EC of the water
Electrical Conductivity	EC_w	dS/m [2], mmhos/cm	measure of bulk salinity in water
Total Dissolved Solids	TDS	ppm [3], mg/L	measure of bulk salinity in water
pH	pH	$pH = -\log(H^+)$	concentration of protons (acidity) in water
Alkalinity		ppm or mg/L of $CaCO_3$	concentration of bicarbonate in water, usually expressed in equivalents of $CaCO_3$

1. SAR, SAR_{adj}, and pH are expressed without units
2. dS/m = deciSiemens per meter, mmhos/cm = millimhos per centimeter, 1 dS/m = 1 mmhos/cm
3. 1 ppm = 1 mg/L

Salts dissolve into water to form pairs of positively (cation) and negatively (anion) charged ions. The main cations and anions in ground water, listed in Table 2, should be included in water tests. *Although, iron and manganese are usually present at low concentrations, they should be also included in water tests because they can form oxides that clog drip emitters.* Test results are usually expressed in units of parts per million (ppm) or milliequivalents per liter (meq/L). Parts per million is also the same unit as milligram per liter (mg/L). Conversion between ppm and meq/L is often necessary because thresholds for plant response may be expressed in either unit. The factors for converting from ppm or mg/L to meq/L are also listed in Table 2.

Table 2. List of anions and cations commonly found in ground water.

Cation			Anion		
Name	Symbol	Mg/meq [1]	Name	Symbol	Mg/meq
Calcium	Ca^{2+}	20	Chloride	Cl^-	35
Magnesium	Mg^{2+}	12	Sulfate	So_4^{2-}	48
Sodium	Na^+	23	Bicarbonate	HCO_3^-	61
Potassium	K^+	39	Carbonate	CO_3^{2-}	30
			Nitrate	NO_3^-	62
			Boron	B	-- [2]

1 conversion between mg/L and meq/L; (eg. 100 mg/L Ca = 100/20 = 5 meq/L)
2 Boron can be in several anionic and neutral forms in water

Consider 4 QUESTIONS When Evaluating Water Test Results

Question #1. Will the bulk salinity of the water reduce the yield of the crop?

Thresholds of salinity that cause yield loss are listed in Tables 3 and 4 for several fruit and vegetable crops. These thresholds should be used as rough guides, since actual values could vary significantly depending on climate, soil type, irrigation method, development stage of the crop, and the salt constituents. Crops often can tolerate higher levels of salinity if calcium, magnesium, sulfate, and/or bicarbonate represent a significant portion of the bulk salinity in the water. This is because calcium and magnesium tend to precipitate out of the soil solution as the soil dries. Plants can often tolerate higher salinity levels in climates with low evapotranspiration demands, such as near the coast. Also mature plants are usually more tolerant to salinity than seedlings.

Table 3. Tolerance of vegetables to salinity in soil and water, expressed as electrical conductivity.

	100% Yield Potential		90% Yield Potential	
Crop	EC_{soil}	EC_{water}	EC_{soil}	EC_{water}
	------------------------dS/m---------------------------			
Squash, Zucchini	4.7	3.1	5.8	3.8
Beet, Red	4.0	2.7	5.1	3.4
Squash, Scallop	3.2	2.1	3.8	2.6
Broccoli	2.8	1.9	3.9	2.6
Tomato	2.5	1.7	3.5	2.3
Cucumber	2.5	1.7	3.3	2.2
Spinach	2.0	1.3	3.3	2.2
Celery	1.8	1.2	3.4	2.3
Cabbage	1.8	1.2	2.8	1.9
Potato	1.7	1.1	2.5	1.7
Corn, Sweet	1.7	1.1	2.5	1.7
Sweet Potato	1.5	1.0	2.4	1.6
Pepper	1.5	1.0	2.2	1.5
Lettuce	1.3	0.9	2.1	1.4
Radish	1.2	0.8	2.0	1.3
Onion	1.2	0.8	1.8	1.2
Carrot	1.0	0.7	1.7	1.1
Bean	1.0	0.7	1.5	1.0
Turnip	0.9	0.6	2.0	1.3

adapted from FAO Irrigation and Drainage Paper 29, 1985 pp. 31-33.

Table 4. Tolerance of fruit crops to salinity in soil and water, expressed as electrical conductivity.

	100% Yield Potential		90% Yield Potential	
Crop	EC_{soil}	EC_{water}	EC_{soil}	EC_{water}
	------------------------dS/m---------------------------			
Grapefruit	1.8	1.2	2.4	1.6
Orange	1.7	1.1	2.3	1.6
Peach	1.7	1.1	2.2	1.5
Apricot	1.6	1.1	2.0	1.3
Grapefruit	1.5	1.0	2.5	1.7
Almond	1.5	1.0	2.0	1.4
Plum	1.5	1.0	2.1	1.4
Blackberry	1.5	1.0	2.0	1.3
Boysenberry	1.5	1.0	2.0	1.3
Strawberry	1.0	0.7	1.3	0.9

adapted from FAO Irrigation and Drainage Paper 29, 1985 pp. 31-33.

Question #2. Are concentrations of sodium, chloride, boron, or bicarbonate at levels that would be toxic to a crop?

Potential restrictions of water use due to specific ion toxicities are summarized in Table 5. Sodium, chloride and boron can accumulate in the stem and leaf tissues and build up to toxic levels. Tissues where the most water loss occurs will often show toxicity symptoms first. Short season crops, such as many vegetables, may not show toxicity symptoms to sodium and chloride while perennial crops may develop symptoms of toxicity after several seasons. Chloride toxicity often appears in leaves as interveinal chlorosis (yellowing) and marginal burning as the toxicity becomes more severe. Leaf burning can also be caused from absorption of these ions through the leaves during sprinkler irrigations. Try to avoid overhead sprinkling during periods of high evaporations, such as windy or hot conditions. Sensitivity to boron varies greatly between crops. Perennial crops such as trees and vines are usually more prone to boron toxicity than vegetable crops. Boron toxicity symptoms include the yellowing of leaves and marginal burns. Tree crops may not show leaf symptoms but may have twig dieback or gum on the limbs and trunk.

Table 5. General thresholds of specific ion toxicities for agricultural crops.

		Degree of Restriction on Use[1]		
Specific Ion Toxicity	**Units**	**No restriction**	**Slight to Moderate**	**Severe**
Sodium (Na^+)		***----- Trees, Vines, and other Sensitive Crops -----***		
Surface irrigation	mg/L	<70	70 - 200	>200
Sprinkler irrigation	mg/L	<70	<70	
		-------------- Vegetables---------------		
Sprinkler irrigation	mg/L	<115	115 - 460	>460
Chloride (Cl^-)				
		-----Trees, Vines, and other Sensitive Crops -----		
Surface irrigation	mg/L	<140	140 – 350	>350
Sprinkler irrigation	mg/L	<100	>100	
		-------------- Vegetables --------------		
Sprinkler irrigation	mg/L	<175	175 – 700	>700
		----------------All crops ----------------		
Boron (B)	mg/L	<0.7	0.7 – 3	>3
Bicarbonate (HCO_3^-)[1]	meq/L	<0.5	1.5 – 7.5	>7.5

1. Adapted From FAO irrigation and drainage paper 29, 1985
2. sprinkler irrigation only

Question #3. Will the infiltration rate be reduced?

High levels of sodium in the water can cause soil particles (aggregates) to disperse and form crusts on the soil surface that impede the infiltration of water. Irrigation water with a high electrical conductivity will tend to have fewer problems with infiltration than a low EC water (Table 6). Also, a water source with high levels of bicarbonate may have less calcium available to counter act the dispersion effects of sodium. An adjusted SAR should be calculated when levels of bicarbonate are greater than 1 meq/L.

Table 6. Thresholds for potential water infiltration problems.

	Degree of Restriction on Use[1]		
SAR	**No restriction**	**Slight to Moderate**	**Severe**
	---EC of irrigation water (dS/m)---		
0-3	>0.7	0.7-0.2	>0.2
3-6	>1.2	1.2-0.3	>0.3
6-12	>1.9	1.9-0.5	>0.5
12-20	>2.9	2.9-1.3	>1.3
20-40	>5.0	5.0-2.9	>2.9

1. Adapted from FAO irrigation and drainage paper 29, 1985

Question #4. Are there salt constituents that would lead to the clogging of drip emitters or micro-sprinklers?

The potential for precipitates is of special concern for micro-irrigation systems (Table 7). Injection of fertilizers can sometimes cause precipitates to form that clog drip emitters. Calcium and magnesium carbonate precipitates may develop if the pH of the water is raised through the injection of alkali producing fertilizers, such as Aqua ammonia. Also, the injection of fertilizers containing calcium can cause precipitates to form in water that is high in bicarbonate. Phosphorus fertilizers can create precipitates in water that is high in calcium. Low concentrations of iron and manganese can oxidize and form precipitates capable of plugging drip emitters. Often injecting upstream of a well designed filter system and using the appropriate combination of fertilizers can avoid many potential plugging problems.

Table 7. Thresholds for potential clogging in micro-irrigation systems.

		Degree of Restriction on Use[1]		
Potential Problem	**Units**	**None**	**Slight to Moderate**	**Severe**
Physical				
Suspended Solids	mg/L [2]	<50	50-100	>100
Chemical				
pH		<7.0	7.0-8.0	>8.0
Dissolved Solids	mg/L	<500	500-2000	>2000
Manganese	mg/L	<0.1	0.1-1.5	>1.5
Iron	mg/L	<0.1	0.1-1.5	>1.5

1. Adapted from FAO irrigation and drainage paper 29, 1985
2. 1 mg/L = 1 ppm

Conclusion

The quality of water needs to be evaluated in the context of the intended use. Testing water before designing a new drip system, purchasing or renting land, or switching to another vegetable crop may help you avoid potential production problems and wasting money. *For more information about water testing and salinity management consider obtaining UC Publication #3375, "Agricultural Salinity and Drainage*.

NEW DISCOVERY: The Hormone Ethylene is Necessary for Plant Resistance!

Dutch plant pathologists have shown that ethylene is vital for the protection of plants against bacteria and fungi. This is another function for the plant hormone already known to play a role in plant aging and fruit ripening.

Bart Geraats from Utrecht University demonstrated that plants which are insensitive for the hormone ethylene are hypersensitive to various microorganisms. The research implies that farmers and horticulturalists must be careful with substances that inhibit the effect of ethylene. Such substances could increase the susceptibility of plants to pathogens.

The researchers produced modified tobacco plants which were insensitive to ethylene. These plants were spontaneously diseased and wilted when grown in ordinary compost. Various fungi and fungi-like microorganisms in the compost attacked the ethylene-insensitive tobacco. These microorganisms do not usually cause diseases in unmodified plants. Furthermore, various tobacco pathogens caused considerably more damage in the modified that in the unmodified tobacco plants. **This showed that plants must be able to detect ethylene in order to protect themselves against infections caused by various microorganisms.**

Efforts to make the ethylene-insensitive plants more resistant were not successful. The administration of chemical substances which normally activate disease resistance in plants provided no increased resistance to the microorganisms in the compost. Treating the roots with harmless or even 'healthy' bacteria gave no protection either. These bacteria should have competed with the pathogenic microorganisms or could even have increased the disease resistance of the plants. **Ethylene therefore appears to play a key role in activating the resistance mechanism against infectious microorganisms.**

For further information contact Bart Geraats (Department of Phytopathology, Utrecht University) e-mail: b.p.j.geraats@bio.uu.nl. The doctoral thesis was defended on 17 March 2003.

2003 Statewide Processing Tomato Variety Evaluation Trials

Scott Stoddard, Gene Miyao, Bob Mullen, Mike Murray, Janet Caprile, Jan Mickler, and Joe Nuñez, Farm Advisors
Jesús Valencia, former Farm Advisor, and Diane Barrett, Food Science & Technology Specialist, UC Davis

Four early and 8 mid-maturity variety tests were conducted throughout the major processing tomato production regions of California during the 2003 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. All of the major production areas had at least one test to identify tomato cultivars appropriate for that specific region. Both replicated and observational lines were evaluated.

These tests are designed and conducted with input from seed companies, processors, and other allied industry and are intended to generate information useful for making intelligent management decisions.

Procedures

Early maturity tests were planted in February or early March and mid-maturity lines were planted from March to May. New varieties are typically screened one or more years in non-replicated observational trials before being included in the replicated trials. Tests were primarily conducted in commercial production fields with grower cooperators (the Fresno trials were located at the West Side Research and Extension Center near Five Points).

Each variety was usually planted in one-bed wide by 100 foot long plots (Fresno used 75 foot long plots). Plot design was randomized complete block with four replications for the replicated trial. The observational trial consisted of one non-replicated plot directly adjacent to the replicated trial. 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 furrow irrigated.

Early Trials

All of the early-maturity tests were direct seeded. For the *replicated early lines*, highest yields occurred with AP 957, H 9997, and H 9280 (52.5, 48.7, and 48.0 tons per acre, respectively). AP 957 had a relatively low °Brix of 4.9, well below the group average of 5.2. When averaged across all four locations, there were no significant differences among the *early-maturing observation varieties* for yield, °Brix, Brix yield, color, or pH. Greatest yields occurred with UG 8168, HyPeel 45, and H 9280.

Midseason Trials

Transplants account for about half the production acreage in the state—with a greater percentage in the northern and central production areas (Merced County northward). In three of the mid-maturity tests transplants were used based on grower preference (Colusa, Yolo, and Merced); in Colusa and Yolo counties, both mid-maturity transplant and direct seeded trials were evaluated (in separate fields).

In the *replicated mid-maturity trials*, highest yields occurred with H 8892, U 941, and AB 5 at 43.3, 41.8, and 41.7 tons per acre. The lines with the best °Brix were CPL 155, CXD 221, and H 2801, which all averaged more than 5.5% soluble solids. The overall highest yielding lines for the *mid-maturity observation test* were CXD 223, H 8892, U 729, Sun 6360, HMX 2855, Sun 6324, H 2401, and U 886 ranging from 43.4 to 38 tons per acre. There were no significant differences with °Brix, which averaged 5.4 across all locations.

Participating counties and Farm Advisors are listed below. 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 2003 Statewide Processing Tomato Variety Evaluation Trials. Or call a Farm Advisor and ask them to mail you a copy.*

Table 1. Location, Advisor, Planting Date and Method (S = direct seed, Tr = transplant) for the 2003 Regional Processing Tomato Variety Trials.

County	Advisor	Early Maturity Plant Date	Mid-Maturity Plant Date
Colusa	Mike Murray	Feb 11 (S)	Mar 11 (S) & May 9 (Tr)
Yolo	Gene Miyao	Feb 10 (S)	Mar 28 (S) & Apr 23 (Tr)
Contra Costa	Janet Caprile & Bob Mullen	Mar 6 (S)	
Stanislaus	Jan Mickler & Bob Mullen		Mar 19 (S)
Merced	Scott Stoddard		May 5 (Tr)
Fresno	Jesús Valencia	Feb 20 (S)	Mar 13 (S)
Kern	Joe Nuñez		Mar 19 (S)

Statewide Fresh Market Tomato Variety Trials

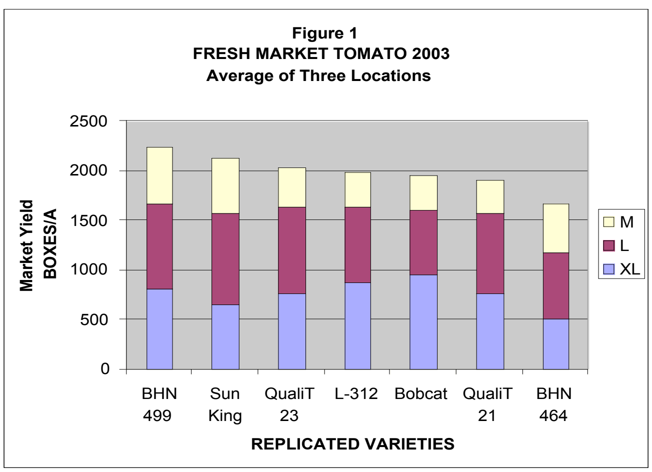
Michelle Le Strange, Scott Stoddard, Bob Mullen, and Jan Mickler, UCCE Farm Advisors, and Marita Cantwell, Postharvest Specialist, Vegetable Crops Dept, UC Davis

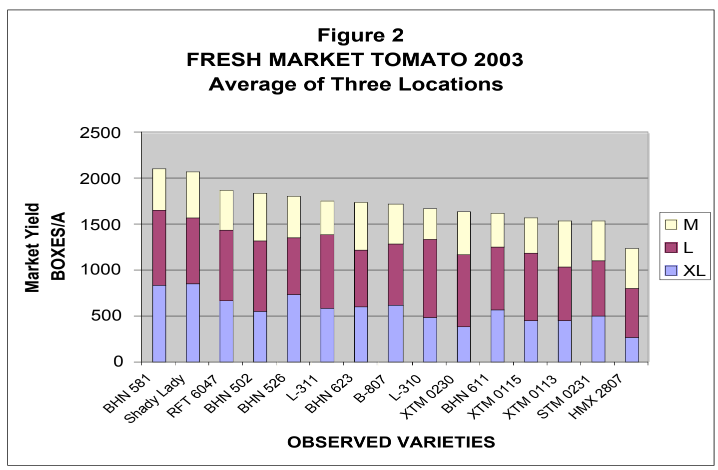
Introduction: Fresh market tomato variety trials are conducted in major tomato-growing regions in California to evaluate the performance of new varieties and breeding lines from commercial plant breeder programs and universities. It is important to test the varieties in several areas to assess performance under different climatic conditions and soils. The objective is to identify dependable, higher yielding and higher quality variety releases that can be grown over a wide geographic area under varying environmental conditions. To determine which varieties/lines are tested, growers/packers/shippers and seed company representatives are surveyed throughout the state. Replicated varieties have been previously tested in grower fields in California. Observed lines usually represent the plant breeder's most promising lines for California's commercial growing conditions and markets.

Trial Locations: County farm advisors conduct statewide variety trials in a uniform fashion so that local results can be compared with other locations. Three round variety trials and one roma variety trial were grown and harvested in commercial fields in 2003.

- **Kings County: April 16 - July 17** (92 days) with Jones Farms (O.P. Murphy & Sons) near Kettleman City -- Michelle Le Strange, Farm Advisor
- **Merced County: May 13 - August 4** (83 days) with Live Oak Farms in LeGrand -- Scott Stoddard, Farm Advisor
- **San Joaquin County: June 16 - Sept. 15** (90 days) with George Perry & Sons (San Joaquin Tomato) on Stewart Tract; round and roma trials -- Bob Mullen and Jan Mickler, Farm Advisors

The three round tomato variety trials had 7 replicated and 15 observed (non-replicated) varieties in common. Postharvest samples from all replicated varieties were collected from all trials at the time of harvest and transported to the Mann Laboratory at UC Davis for color, firmness, and composition evaluations at the table-ripe stage. Fruit were harvested as mature greens, but some cultivars were also harvested as vine ripe. A complete summary of all results are available from the participating farm advisors.





Research Reports Available from UCCE Fresno County

Reports from melon variety and insecticide evaluations conducted at the Westside Research and Extension Center during the 2003 production season are available. They can be accessed via the Fresno County Cooperative Extension website – **cefresno.ucdavis.edu**. Click on Ag and Natural Resources, select Vegetable Crops, and scroll down to 2003 Melon Research Reports. If you prefer that a copy be mailed to you, then contact Christi Hansard at the Fresno County Cooperative Extension office. Call 559-456-7553 and leave a message with your name, address, phone number and the reports that you are interested in receiving.

Large Watermelon Variety Trial
Mini/Personal Watermelon Variety Trial
Honeydew Variety Trial
Cantaloupe Variety Trial
Late Cantaloupe Insecticide Trials
Thrips Control in Onions

Herbicides to Control Yellow Nutsedge and Nightshade in a Processing Tomato/Cotton Production System in Salty Soil

Scott Stoddard, UCCE Farm Advisor, Merced and Madera Counties

INTRODUCTION

Yellow nutsedge and nightshade are two dominant weed problems for processing tomato growers. Some herbicides that offer control or suppression of these weeds in tomatoes in California include Dual Magnum (metalochlor), Tillam (pebulate), Eptam (EPTC), Sencor (metribuzin), Matrix (rimsulfuron), and Sandea (halosulfuron). Of these, Matrix targets nightshades, while Sandea is almost exclusively a nutsedge material. In 2003, Dual Magnum and Sandea received full registration for use on tomatoes in California.

Post-emergence sprays of Matrix target nightshades. Efficacy is improved if it can be water incorporated within 5 days of application. As more of the processing industry uses transplants rather than direct seed, however, sprinkle irrigation is no longer a necessary practice, which may reduce both use and effectiveness of Matrix.

Sandea is a new nutsedge control material that has shown good control of yellow nutsedge in several UCCE trials at Davis (Dr. Tom Lanini), San Joaquin County (Bob Mullen), and Fresno County (Kurt Hembree). Its main drawbacks are that some tomato varieties are more tolerant to it than others, and cotton is also very sensitive and there could be problems with drift or plant-back. Tomato sensitivity may be related to soil conditions that reduce crop vigor. In Merced County, tomato/cotton rotations are very common, and the main production areas are also in salty soil. Thus, Sandea needs to be evaluated in this area.

To address these issues, a herbicide trial was conducted to evaluate control of nightshade and yellow nutsedge. The objectives were:

- To evaluate tomato tolerance to the herbicide treatments,
- To evaluate herbicide efficacy, and
- To evaluate persistence or spray drift problems in the adjacent cotton crop.

METHODS

The trial was located on San Juan Ranch, near Dos Palos in Merced County in a commercial processing tomato field. Variety was H 2501. The previous crop was cotton, and the 2005 crop is scheduled to be planted to cotton again. The field had not received any herbicide applications prior to this test.

Treatments 2, 3, and 10 were applied using a back pack sprayer to a clean bed on May 20 about 10 days after the field had been transplanted, then were incorporated with ranch equipment (power mulcher) that same day. The remaining treatments were applied with a back pack sprayer on June 13, 2003 with 30 gals water equivalent. Weeds were sprayed when most nightshade was at cotyledon to 1 leaf and nutsedge was at 2 – 4 true leaves.

RESULTS

At the first weed evaluation on June 13, Tillam, Eptam, and Dual Magnum all had significantly less weed pressure than the untreated control or the other treatments (Fig 1A). (Post emergence applications had not been made at this time). In general, these pre-plant incorporated (PPI) treatments provided good initial suppression of both weed species, but the control diminished by the last evaluation on August 12 (Fig 1C). Weed growth in the furrows, where the product had not been incorporated, became troublesome late in the season.

Best control of both weed species was obtained with the Matrix + Sandea combination. Not only did this treatment provide fairly quick burn-down of the weed species, but lasted through the growing season. Sandea alone did a good job of controlling nutsedge but had no effect on nightshade, while Matrix did a very good job of controlling nightshade and had a slight suppressive effect on nutsedge. Sencor did a good job of burning down both weed species if they were small, but nightshade larger than the cotyledon stage had renewed growth, and much of the nutsedge recovered. The additon of an adjuvant slightly improved control for Matrix and Sandea.

No phytotoxicity problems were seen with any of the Sandea treatments on the tomatoes or the adjacent cotton. (The tomato variety was H 2501).

Significant differences were found for tonnage between the treatments, which best yields occurring in the Sandea+Matrix combination and Sencor plots at about 56 tons/acre. There were no significant differences with the other treatments, but the control plot was almost lowest yielding at 37.2 tons/acre. There were no differences in the fruit quality measurements.

These results show that most currently registered tomato herbicides can be used effectively in a tomato/cotton rotation typical of Westside Merced and Fresno Counties. Sandea + Matrix combinations look especially promising, as this treatment provided excellent season-long control. Further research is needed to determine if rates could be adjusted to improve control or reduce costs and to evaluate other varieties for tolerance.

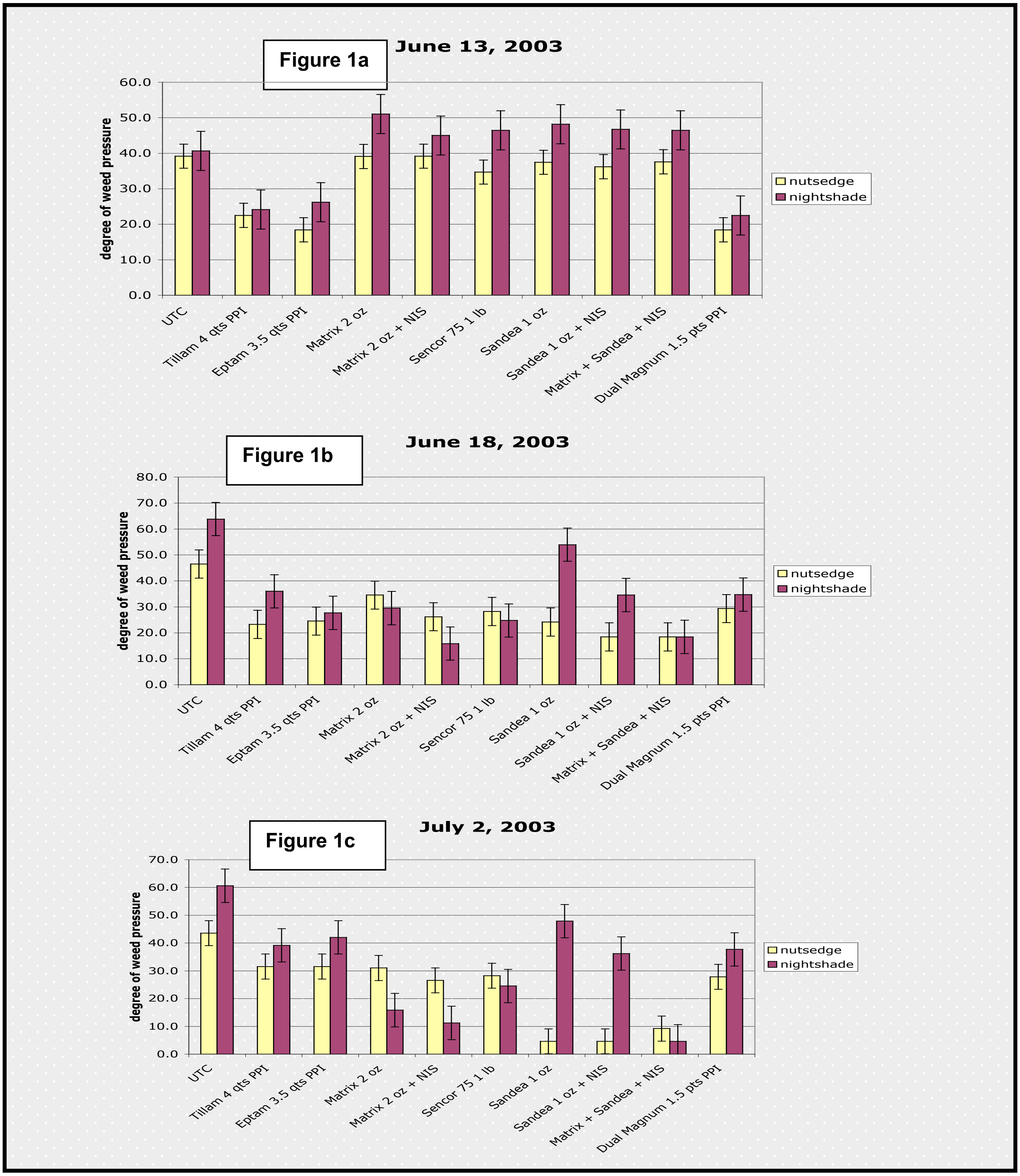
Table 1: Herbicide Treatments:

1.	Untreated control (UTC)	
2.	Tillam 6E	4 qts/A post plant incorporated
3.	Eptam 7E	3.5 qts/A post plant incorporated
4.	Matrix	2 oz/A alone post plant over-the-top
5.	Matrix	2 oz/A + NIS (R11) post plant over-the-top
6.	Sencor 75	1 lb/A post plant directed
7.	Sandea	1oz/A post plant directed
8.	Sandea	1oz/A + NIS post plant directed
9.	Matrix	2 oz/A + Sandea 1 oz/A + NIS post plant directed
10.	Dual Magnum	1.5 pints/A post plant incorporated (std)

FIGURE 1:

Degree of weed pressure as affected by herbicide treatment.

Error bars represent LSD 0.05



Alternatives for Purple and Yellow Nutsedge Management

Milton E. McGiffen, Jr., Dept. of Botany and Plant Sciences, UC Riverside

Purple and yellow nutsedge are problem weeds throughout California, with purple nutsedge predominating in the southern half of the state. These perennials survive adverse conditions and then grow explosively when the land is irrigated. Losses result when nutsedges compete with crops to decrease yield or damage below-ground plant parts such as onion bulbs. Nutsedge can even decrease property values, because potential tenants know that it is nearly impossible to eradicate the weed once established.

Nutsedge tubers: Nutsedges produce both seeds and tubers, but most reproduction is by tubers. The tubers may be thought of as a resting stage that allows the weeds to survive adverse conditions. A large percentage of tubers are often killed during dormancy, but even 1% of the tubers from a previous infestation are more than enough to bring back the population of these prolific weeds.

Understanding nutsedge control begins with the realization that tubers are the key to the weed's survival. Prevent tuber production, and you eliminate the weed. Even though tubers can remain dormant and impervious to pesticides for years, control programs should be aimed at preventing the formation of tubers through prevention of growth of nutsedge plants. If no new tubers are formed, tuber mortality will eventually eliminate nutsedge problems.

Crop competition: Nutsedge is susceptible to shading, and crops that quickly form a dense canopy can outcompete the weed. Sudangrass, corn, and wheat are suggested crops. Conversely, melons and other warm season crops that do not shade the ground may be overrun by nutsedge infestations. Sudangrass was planted as a rotational crop in a field so heavily infested it looked like a purple nutsedge lawn. By midsummer, the dense sudangrass canopy had killed emerged nutsedge. The field was then planted to winter vegetables. Growers have eliminated nutsedge as a pest by using summer rotations of competitive crops over several field seasons.

Tillage: To be effective at reducing nutsedge populations, tillage must be done thoroughly and often. It should not be so deep as to bring additional tubers close enough to the soil surface that they germinate. To prevent tuber formation, cultivation must be done frequently, before the plants are have more than three leaves. Field operations should be:

1) Form the beds.
2) Irrigate to germinate the tubers.
3) Cultivate to kill plants before they emerge.
4) Plant the crop to moisture.
5) Continue cultivation throughout the growing season.

Integrated weed control: Approaches that integrate several control methods have the best chance of effectively managing nutsedge. *Irrigation and tillage* can break tuber dormancy, encourage sprouting, and make nutsedge susceptible to fumigants and other herbicides. A control program recommended by the University of Arizona starts by fallowing the ground during July, when nutsedge is actively growing. Begin with a pre-irrigation to end dormancy and cause the tubers to sprout. This initial flush of nutsedge is allowed to grow until soil moisture is depleted, generally about 3 weeks after nutsedge emerges. Shallow tillage such as disking will kill emerged nutsedge and help desiccate shallow tubers. EPTC is applied to the dry soil at 3.5 pints per acre and immediately incorporated. Make two applications of EPTC to heavily infested soils. The ground is then prepared to establish the crop, and irrigation water applied. Consult the EPTC label for how long to wait before planting the crop, as EPTC injures many crops.

Rotating with crops that are fumigated or can use linuron, halosulfuron, and other nutsedge herbicides helps to reduce nutsedge. Halosulfuron is becoming available for use in sweet corn, tomatoes, melons, and other warm season vegetables under the trade name Sandea, and can be applied both pre- and post-emergent. Halosulfuron can persist in the soil to injure subsequent crops. Most cool season vegetables are susceptible to halosulfuron injury.

Biological control has also been tried for nutsedge, but has generally been ineffective. Many insects and diseases infest nutsedge, but none has been shown to kill enough plants to be an effective control, especially in our arid environment.

Fumigants are the principal weed control method in some vegetables and other high value crops. Fumigation will not kill dormant tubers. Efficacy can be improved if tillage and irrigation are used prior to fumigation to sprout dormant tubers. Tarping the field and applying Vapam through drip systems will also help kill tubers that are actively growing but buried deeper in the soil. Incorporating Vapam as it is applied also helps to evenly distribute it throughout the soil.

Solarization is a nonchemical soil sterilization method. A clear plastic tarp is used to cover the soil and raise temperatures high enough for pasteurization. Solarization is often reported as ineffective in controlling nutsedge. However, we observed significant control of emerged purple nutsedge in our Coachella Valley experiments, and other inland locations. It may be possible that by carefully timing when solarization is initiated will make it somewhat effective for nutsedge control.

Summary: Yellow and purple nutsedge are among the world's worst weeds. The key to nutsedge control is to prevent tuber production, and stimulate dormant tubers so that they will be susceptible to control. Eptam and fumigation treatments can give some control, but can only be used when no crop is present. The best cultural control is to grow a crop that forms a dense canopy during the summer when nutsedge is active. Halosulfuron, linuron, and other herbicides have some nutsedge activity. The weed susceptibility chart on the UC Weed Research and Information Center website lists how well nutsedge and other weeds are controlled by herbicides. Go to *http://wric.ucdavis.edu/information/weedchart.html* to download the chart and obtain more weed information.

SOURCES OF INFORMATION – TOMATOES

PUBLICATIONS FROM UC

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

IPM Tomato Manual, #3274
IPM Tomato Pest Management Guidelines
Identification & Management of Complex Tomato Diseases (available through UC VRIC)

Fresh Market Tomato Publication in CA, #8017
Processing Tomato Production in CA, #7228

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

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

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
CA Tomato Products, Colusa
Campbell Soup Company, Sacramento
Colusa County Canning Co., Williams
Con-Agra Grocery Products Co. (Hunt's), Oakdale and Helm
Del Monte Corporation, Hanford
Escalon Premier Brands, Inc., Escalon
H. J. Heinz Company, Stockton
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
Small Planet Foods, Atwater
Stanislaus Food Products Co., Modesto
Toma Tek, Firebaugh
Uni Lever Best Foods, 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

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Vegetable Crop Facts

UCCE Merced and Madera Counties

Scott Stoddard, Farm Advisor

Newsletter March, 2004

Tomatoes – Fresh Market & Processed in the San Joaquin Valley

Research Reports Available
Upcoming Meetings Announced