University of California Cooperative Extension

Vegetable Crops Facts

Merced and Madera Counties

2145 Wardrobe Ave, Merced CA 95340 209-385-7403 http://cemerced.ucdavis.edu

EDITION #9: Fresh Tomato & Bell Pepper

Volume 8, Issue 3 March 2006

IN THIS ISSUE

SOURCES OF INFORMATION

Farm Advisors – Vegetable Crops San Joaquin Valley

FRESNO
Shannon Mueller (559) 456-7261
Kurt Hembree (559) 456-7556

KERN
Joe Nuñez (661) 868-6222

MERCED & MADERA
Scott Stoddard (209) 385-7403

SAN JOAQUIN
Brenna Aegerter (209) 468-2085

STANISLAUS
Jan Mickler (209) 525-6800

TULARE & KINGS
Michelle Le Strange
(559) 685-3309, Ext. 220

Newsletter Editor
Michelle Le Strange
4437-B S. Laspina Street
Tulare, CA 93274
E-mail: mlestrange@ucdavis.edu

Beware of Psyllids: Tomatoes, Peppers, Eggplant, & Potatoes at Risk

John Trumble, Entomologist, UC Riverside and Eric T. Natwick, UCCE Farm Advisor, Imperial County

The tomato psyllid, *Paratrioza cockerelli*, also known as the potato psyllid has been showing up in pepper fields throughout southern California. PCAs and growers should be aware that nymphs have been found infesting peppers and other crops in the family: Solanaceae, such as tomato, potato and eggplant are at risk of becoming infested.

Tomato psyllids resemble tiny cicadas with clear wings that rest roof-like over the back and are about 2 mm long. Adults are mostly dark brown or black with white markings and they jump when disturbed. Psyllids are related to whiteflies, aphids and leafhoppers. Eggs are deposited on the underside of the leaf along the edge and in the upper plant canopy. They are football-shaped and very small, a 10X hand lens is required to see them, and on a short stalk. Psyllid nymphs are flat, shades of light green to greenish-yellow, and fringed with short spines around the edge. They resemble immature soft scale, but unlike insects, they move when disturbed. The nymphs develop through five instars in as little as two weeks.

Damage is caused only by psyllid nymphs. They inject a salivary toxin that causes a plant response known as psyllid yellows. Symptoms include yellowing and an upward curling of leaflets nearest the stem on the top part of the plant. However, yellowing is the most common symptom, initially found on the leaf edges. Other symptoms include an overall yellowing with enlarged nodes, shortened internodes, and development of clusters of small leaves in the axillary buds that appear rosetted. If the nymphs are removed from the plant, the progression of the disease will stop.

There are no specific treatment thresholds established for tomato psyllids on tomatoes or peppers. Insecticides used for aphid control, such as pyrethroids, and Provado, also control psyllids.

Stink Bug Research in Tomatoes

Frank Zalom and Corin Peas, Dept of Entomology, UC Davis

CONSERVATION BIOLOGICAL CONTROL A study was conducted to assess feasibility of enhancing biological control of stink bugs by introduction and management of a nectar resource for parasitoids. Three sites were identified in March, 2003, on fresh market tomato farms that had a history of stink bug problems. Each site was planted with mixed heirloom tomato varieties and managed organically. Buckwheat, the nectar source we had intended to use, was broadcast seeded during the week of April 18-25 at the row ends of treatment plots, but two sites on silty soil failed to establish. Because of the time needed to re-establish buckwheat at other sites or to re-seed buckwheat at the two sites which failed to establish, alyssum was substituted. Alyssum had been studied previously with respect to its ability to provide a nectar source for biological control agents in other crops. One alyssum and one control plot were randomly placed along each selected border. Alyssum was transplanted at all three sites on May 20 and 21. Five alyssum plants spaced at 6 inches were planted on the row end of 15 rows in each treatment plot.

Sentinel egg masses were used to evaluate stink bug egg parasitism in treatment and control plots. The egg masses were from colonies established from stink bug adults captured in tomato fields earlier in the season. Paper towels within each colony served as an oviposition substrate. On July 3 and July 31, 8 sentinel egg masses were placed at 0, 20 and 50 feet from the alyssum and control borders of each study field. On Sept 5, 10 egg masses were deployed at each distance. The egg masses were retrieved a week after they were placed in the field, and placed individually into small perforated zip lock bags. The bags were kept at room temperature and observed for parasitism. Once signs of parasitism (black eggs) were observed parasitized egg masses were transferred to individual glass scintillation vials with a ventilated cap and held for parasitoid emergence.

Parasitism of consperse stink bug egg masses was observed in all treatment and control replicates (Table 1). Average parasitism rates ranged from approximately 4% to 50%. Significant differences in parasitism were detected in 2 of three sample periods. Sentinel egg mass parasitism was significantly higher ($p < 0.05$) 1ft from alyssum borders than 1ft from the control in the second and third sample periods (Jul 31-Aug 6, Sept 5-12). Parasitism was also significantly higher ($p < 0.05$) 20 ft from alyssum borders than in the control. No significant differences in parasitism were detected further than 20 ft from the border and during the first sample period. However, all dates and distances with the exception of two showed higher mean parasitism adjacent to alyssum than in the control, although not significant ($p > 0.05$).

This study shows promise for the use of in-field nectar sources for the enhancement of stink bug egg parasitoids. We suspect that actual parasitism could be even higher than we measured due to the artificial nature of our egg placement and other factors, and the affect of the nectar source in enhancing other parasitoids and generalist predators. However, the effect of field scale application of this technique on actual parasitism, fruit quality and other insects is not known.

Table 1. Stink bug egg parasitism measured by sentinel masses placed in fresh market tomatoes at 3 distances from borders during 3 sampling periods, 2003.
*Significantly different from control by t-test

PERCENT (%) of eggs parasitized

	Dist.	July 3-9			July 31 - Aug 6			Sept 5-12		
Treatment	Ft	%		SE	%		SE	%		SE
Alyssum	1	**11.4**	±	5.7	**53.3**	±	2.0 *	**43.3**	±	3.5 *
Control	1	**7.6**	±	7.6	**45.6**	±	2.9	**21.7**	±	7.0
Alyssum	20	**9.9**	±	1.6	**39.1**	±	6.6	**49.8**	±	8.2 *
Control	20	**4.1**	±	2.1	**46.1**	±	4.4	**17.7**	±	1.8
Alyssum	50	**4.3**	±	3.7	**49.2**	±	2.6	**27.5**	±	7.5
Control	50	**4.8**	±	4.8	**28.8**	±	11.9	**22.5**	±	9.5
Alyssum	All	**8.5**	±	1.9	**47.2**	±	3.2	**40.2**	±	5.6
Control	All	**5.5**	±	2.9	**40.2**	±	4.5	**20.7**	±	6.0

CULTURAL CONTROL RESEARCH

A study was conducted to assess the role of springtime weeds which host stink bugs on the stink bug densities later observed in adjacent tomato fields. Eight processing tomato fields that were scouted during March and April, 2003, were selected for this study. Each field had one adjacent border area that was comprised of greater than 50% weedy hosts (cheeseweed, wild radish and mustard) of stink bugs and an opposing border where the weeds had been controlled early in the spring.

Each border replicate was sampled using tray shake samples to determine stink bug densities in July and again in August or early September. Fruit damage estimates were made following the second sampling date. Five tray shake samples were taken at 8 monitoring sites along both treatment borders of each field. These in-field monitoring sites were within 60 feet (12 rows) of both opposing field margins, and nearer to the center of the border to avoid edge effects from other borders. At harvest, 200 fruit were sampled from each border area, and individual fruit scored for fruit damage by stink bugs. The 200 fruit were a composite of 25 fruit collected at each in-field monitoring site where the stink bugs were also sampled. Treatments were analyzed by one-way ANOV of treatments using each field as a replicate.

Stink bugs were detected in all 8 fields and fruit damage in the border areas sampled ranged from 9.5% to 67% (**Table 2**). The majority (81%) of the stink bugs found at all sites were the consperse stink bug. Most of the others captured were the red shouldered stink bug, *Thyanta pallidovirens,* however the data presented here is solely for the consperse stink bug. Four of the fields were treated with insecticides for stink bugs between the first and second sampling periods and these are noted in Table 2. Stink bugs were significantly higher ($p < 0.05$) in tomatoes adjacent to weedy host borders than in tomatoes adjacent to a non-host borders during the first sample period (**Table 3**). Average number of bugs per tray shake during the second sampling period and percent damage were higher in the host border treatment than in the non-host border treatment, but the differences were not significant (p>0.05).
The results of this study demonstrate the importance of spring weed hosts nearby tomato fields to the incidence of stink bugs in tomatoes. Stink bugs were not precluded from colonizing tomatoes near borders without weed hosts, yet the tomatoes adjacent to these borders had lower incidence early season. It seems clear that control of weeds nearby future tomato fields and on a greater landscape scale can be expected to reduce damaging populations in tomatoes. These weed hosts must be removed prior to tomato seedling establishment or transplanting of the fields. The results of this study suggests that management of weed hosts that may function as a trap crop for stink bugs could be beneficial for growers. However, there are certainly confounding factors that could play a role in the success of such an approach. Location of additional overwintering habitat outside of the immediate field borders that is beyond the grower's control, such as riparian areas and orchard floor vegetation, may also play a role.

Table 2. Number of stink bugs per tray shake and percent stink bug damage at field borders in relation to availability of an adjacent host.

Field	Treat.	# of bugs/ shake July	# of bugs/ shake Aug/Sept	% damage
7	Host	0.075	0.225	38.0
7	No host	0	0.100	25.5
11A	Host	0.075	1.950	58.5
11A	No host	0.025	0.875	51.5
1A	Host	0.150	0.100*	61.0
1A	No host	0.025	0.050*	40.5
1B	Host	0.050	0 *	32.5
1B	No host	0	0 *	23.5
B14	Host	0.200	0.025*	36.0
B14	No host	0.025	0 *	42.6
B2	Host	0.025	0.025*	45.5
B2	No host	0	0.125*	67.0
LT	Host	0.500	0.900	62.0
LT	No host	0.075	1.075	56.0
R1	Host	0.350	0.600	38.0
R1	No host	0.025	0.025	9.5

* fields treated with insecticide for stink bugs

Table 3. ANOV statistics for stink bugs per tray shake and percent stink bug damage at field borders in relation to availability of an adjacent host.

Treatment	*df*	*F=*	*p=*
Host vs Non Host (1st Sample Period)	1,14	6.84	0.02
Host vs Non Host (2nd Sample Period)	1,14	0.48	0.50
Host vs Non Host (% Fruit Damage)*	1,14	0.67	0.43

CHEMICAL CONTROL STUDIES

For the past several years, we have been evaluating alternative pesticides which could serve as a replacement for the organophosphates methamidophos (Monitor) and dimethoate for control of stink bugs. Insecticides tested include pyrethroids, neonicotinoids, insect growth regulators, and various tank mixes of products.

FIELD PLOTS

Stink bug populations were established in the tomato plots by artificial infestation using methods we developed for several years. The source of the stink bugs was a colony we established in spring from adults collected at several sites. For our field infestation, egg masses from the colony were collected during a 4 day period and taken to the field where the paper towel strips containing the egg masses were attached to the undersides of leaves within the plant canopy. One egg mass was placed for each 10 foot length of tomato row in the experimental planting between July 22 and July 25 which approximated the predicted harvest date for stink bugs in the Davis area using the degree-day phenology model developed by Cullen and Zalom. The model can be found at UCIPM (http://www.ipm.ucdavis.edu).

The insecticides tested were applied on July 12 (Fulfill and Platinum, only) or August 1. All treatments but Platinum were applied using an Echo Duster/Mister air assist sprayer at a volume equivalent to 50 gal/acre. Platinum was applied by spraying the product on the soil at the base of each plant in 4.25 oz. of water per plant using a Hudson pump sprayer. The plots were furrow irrigated the day after the soil application was made. Treatments were assigned to plots in a completely randomized design, with three replicates per treatment and six replicates of the untreated control. Stink bug treatment efficacy was evaluated by shake sampling and determining damage at harvest. Five shake samples were taken from each replicate on August 11, ten days following the application of most treatments. Fruit damage was evaluated on September 10, by scoring 100 red fruit that were randomly sampled from each replicate for stink bug feeding. One of the 6 untreated plots could not be evaluated because damage and secondary fungal infections were so high that only a few of the fruit maintained sufficient integrity to allow scoring to proceed.

RESULTS

Differences between treatments were confirmed by 1-way ANOV for both number of stink bugs per tray shake sample and damage at harvest (**Table 4**). Significant treatment differences in number of stink bugs per tray shake relative to the untreated control were found for Dibrom, Warrior + Actara, Warrior + Platinum, F1785 (flonicamid, an unregistered product from FMC), MustangMax + F1785, Warrior + Assail, Lannate + Danitol, and Knack + Danitol. Significant treatment differences in damage at harvest relative to the untreated control were found for Warrior + Actara, MustangMax, MustangMax + F1785, Warrior + Assail, and Lannate + Danitol. That the combination of Lannate and Danitol was significant is interesting given that in field tests in 1986 and 1987 we showed that the combination of Lannate and Asana (a pyrethroid as is Danitol) also provided significant control of stink bugs. In those trials, neither Lannate nor Asana provided significant control of stink bugs when applied alone.

SUMMARY

These results confirm for the most part our previous observations that combinations of certain pyrethroid insecticides such as Warrior with a neonicotinoid pesticide afford better control of stink bug than do other alternatives.

Table 4. Number of stink bugs per 5 tray shake samples on August 11, percent damage at harvest (September 10) UC Davis, 2003.

Treatment	Rate (a.i./ac)	No. of bugs 5 tray shakes 8/11	% Damage at harvest 9/10
Untreated	NA	**2.3** ± 0.6	**73** ± 9
Dibrom 8	1 pt*	**0.9** ± 0.2 **	**57** ± 9
Fulfill[1]	2.75 oz*	**1.4** ± 0.4	**70** ± 16
Activol	3.00%	**2.1** ± 0.5	**65** ± 26
Warrior	3.84 oz*	**1.7** ± 0.6	**52** ± 5
Actara	4.0 oz*	**1.3** ± 0.4	**66** ± 18
Warrior + Actara	3.84 oz* + 4.0 oz*	**1.0** ± 0.4 **	**30** ± 18**
Platinum[1]	8.0 oz*	**1.2** ± 0.4	**69** ± 13
Warrior + Platinum[1]	3.84 oz* + 8.0 oz*	**0.5** ± 0.2 **	**49** ± 23
MustangMAX (L)	0.018 lb	**1.6** ± 0.9	**51** ± 22
MustangMAX (H)	0.025 lb	**1.5** ± 0.5	**46** ± 19**
F1785 (L)[2]	0.054 lb	**0.8** ± 0.3 **	**62** ± 21
F1785 (H)[2]	0.071 lb	**1.2** ± 0.3	**58** ± 18
MustangMAX (H) + F1785 (H)[2]	0.025 lb + 0.071 lb	**0.6** ± 0.3 **	**35** ± 06**
Assail 70WP	2.39 oz*	**1.8** ± 0.5	**65** ± 23
Warrior + Assail	3.84 oz* + 2.39 oz*	**0.7** ± 0.4 **	**31** ± 09**
Dimethoate 4EC	1.5 pts*	**1.8** ± 0.4	**76** ± 11
Lannate + Danitol	0.9 lb + 0.2 lb	**0.0** ± 0.0 **	**36** ± 04**
Knack 0.86 EC + Danitol	0.054 lb + 0.2 lb	**0.6** ± 0.2 **	**48** ± 28

Treatments applied on August 1, except as indicated.
1-way ANOV results:
F=1.719, df=21,38, p=0.0327 for tray shake samples; F=2.150, df=18,40, p=0.0220 for damage at harvest.

[1]Application date for this product: July 12.
[2]Not registered for use on tomatoes.
*Formulated rate/acre
**Means are significantly different (p<0.05) from untreated by t-test following log(x+1) transformation

Root-knot Nematode Resistant Tomatoes not always Resistant.

Antoon Ploeg, Nematology Specialist, UC Riverside

Root-knot nematodes (*Meloidogyne* species) are the most important nematode parasites of tomato, and although a large number of root-knot nematode species exist, only a few species are important. Warm-loving species such as *M. incognita* and *M. javanica* are usually found in greenhouse production in Northern California and in the field in Central and Southern California. Another common species, *M. hapla*, prefers cooler conditions and is more widely distributed in the Northern part of the state.

Nematodes multiply rapidly on their hosts when temperatures are favorable, and populations can increase from hardly detectable to very high levels (>10,000 per pint of soil) within one growing season. The nematodes are closely associated with the host roots, which they modify to produce typical galling. The developing nematodes initially occur within these galls, but later deposit numerous egg masses, containing up to 400 eggs, that are "glued" to the outside of the roots.

Nematodes take nutrients away from the plant, and the damaged roots become an easier target for infection by fungal and bacterial pathogens. In other crops (e.g. melon) it has been shown that nematode infection in the early stages of plant growth is particularly damaging, whereas established healthy plants can tolerate a certain level of nematode infection without plant growth becoming affected. However, even plants that initially escape nematode infection and show no obvious above-ground symptoms may still exhibit severe galling and harbor large nematode numbers at harvest time.

The use of fumigant nematicides has long been an important tool in nematode management, but fewer products are available, and costs may be prohibitive. Alternatively, nematode-resistant cultivars can be grown and fortunately, tomato is one of a few crops where nematode-resistant varieties are available.

Nematode resistance: In all nematode-resistant tomato varieties the resistance is based on one gene (*Mi*-gene). As a management strategy the use of nematode-resistant varieties has several advantages:

- it requires no major changes in farming practices,
- it reduces the need for chemical control,
- it is reliable, and
- it has a positive effect on a following nematode-susceptible crop because it lowers the nematode populations.

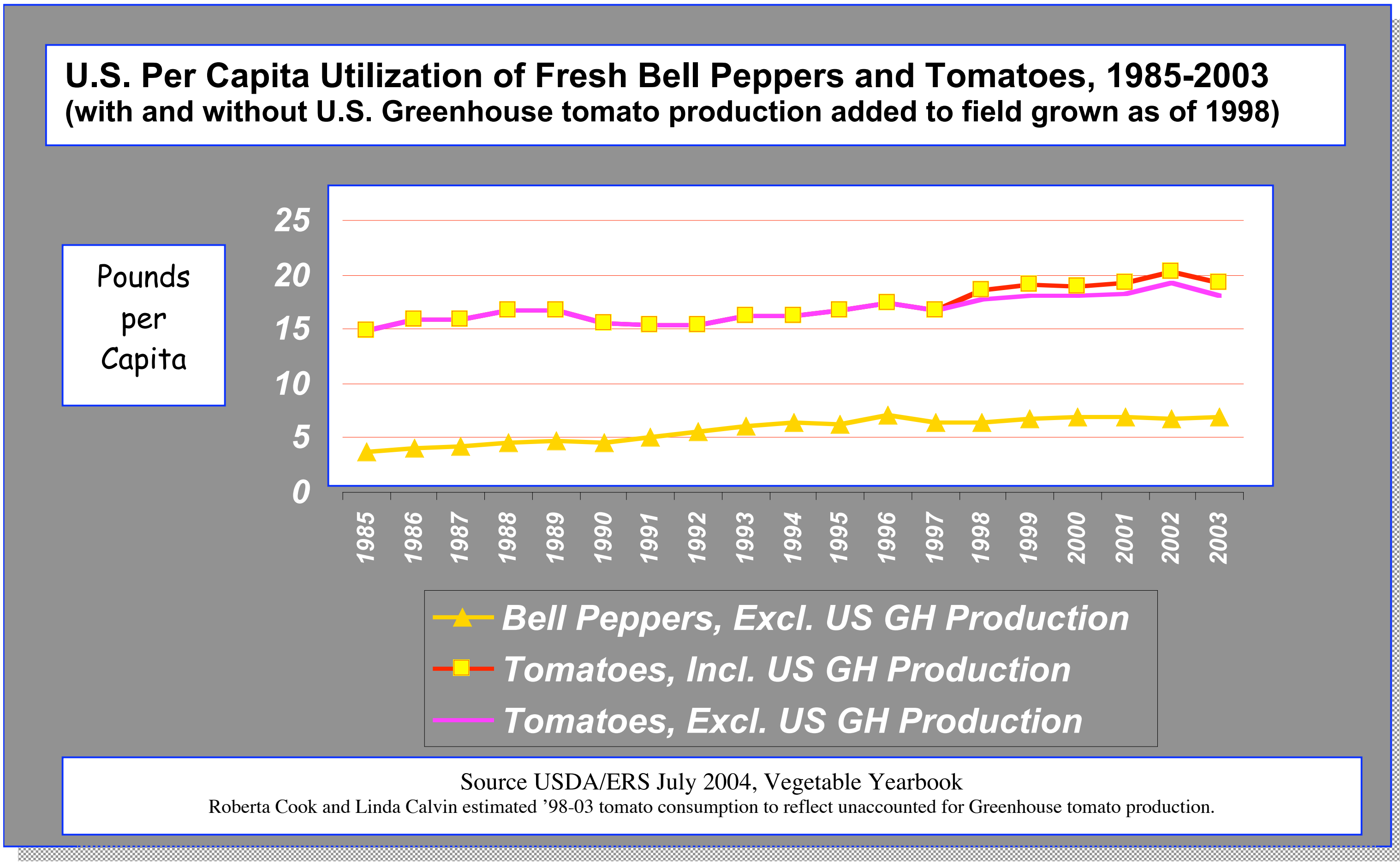
There are however a few drawbacks:

1) Although nematode-resistant tomato varieties are resistant to three very important warm-climate root-knot nematode species (*M. javanica, M. incognita, M. arenaria*), they are not resistant to *M. hapla*.
2) Resistance is specifically against root-knot nematodes, and not against other types of nematodes.
3) Resistance breaks down when soil temperatures reach 82°F, and thus may not be useful in hot desert-type conditions.
4) There are a limited number of resistant varieties, and thus for certain desired tomato types resistant varieties may not be available.

Grafting tomatoes? To circumvent this last limitation, susceptible tomato with the desired fruit type can be grafted onto nematode-resistant rootstocks. This practice is very common in high value greenhouse tomato production in Asian and European countries. Recently we studied the effect of grafting on fruit production and nematode population levels using a California root-knot nematode population (*M. incognita*), greenhouse tomato variety Blitz, and nematode-resistant rootstock variety Beaufort. As expected, on the non-grafted susceptible controls, fruit yields decreased, galling increased, and nematode populations were higher at harvest as nematode inoculum levels increased. The grafted tomatoes did not exhibit yield loss, even at high inoculum levels, but surprisingly, root galling and nematode levels were only slightly lower than on the susceptible controls. Soil temperature had remained below the critical level of 82F, the *Mi*-gene was present in the rootstocks, and the root-knot nematodes had not previously been exposed to resistant tomato. Therefore, high-temperature resistance breaking, a seed mix-up (the rootstock did not really contain the resistance gene), or the use of a highly virulent resistance-breaking population as reasons for the unexpected results were excluded.

In a second experiment, another nematode-resistant tomato variety (Hypeel45) was included as a rootstock, as well as another root-knot nematode population. Results from this experiment showed that both resistant rootstocks prevented yield loss at increasing inoculum densities, but that rootstock Beaufort again showed severe galling and allowed nematode multiplication. Rootstock Hypeel45 however only had very minor galling and only few nematodes were recovered from this rootstock, even at very high nematode inoculum densities.

Summary: We conclude that one of the "resistant" rootstocks (Beaufort) was tolerant rather than resistant, leaving a high nematode population behind at harvest. This may have important consequences for the performance of a following susceptible crop. At this moment we do not have an explanation for the difference in galling and nematode levels between the two "resistant" rootstocks both containing the nematode resistance *Mi*-gene.



U.S. Per Capita Utilization of Fresh Bell Peppers and Tomatoes, 1985-2003
(with and without U.S. Greenhouse tomato production added to field grown as of 1998)

Source USDA/ERS July 2004, Vegetable Yearbook
Roberta Cook and Linda Calvin estimated '98-03 tomato consumption to reflect unaccounted for Greenhouse tomato production.

Trials with Preemergence Herbicides in Transplanted Bell Peppers

Richard Smith and Michelle Le Strange, UCCE Farm Advisors, Monterey and Tulare & Kings Counties

INTRODUCTION

Peppers are long-season vegetables that have several weed control challenges: They compete weakly with weeds for the first 40 to 60 days following transplanting. They are a long-season crop in many production districts that can be subject to flushes of both winter and summer weeds over the course of their growing cycle.

The preemergence herbicides registered for peppers have gaps in the spectrum of weeds that they control. As a result, growers may spend from $200 to $350/acre on weed management. Field selection, field sanitation, cultivation and the use of plastic mulches are cultural practices that reduce weed pressure in production fields. Fumigation provides substantial weed control and is frequently used in conjunction with plastic mulches which improves the level of weed control provided by both techniques.

Goal Tender was registered in California in 2004 for use with plastic mulch and provides control of Little Mallow (*Malva parviflora*) which is only partially controlled by fumigants and other preemergence herbicides registered for use on peppers. However, many acres of peppers are not grown with plastic mulch, and weed control is a challenge. Devrinol, Prefar and Treflan are registered preemergence herbicides in peppers. Dual Magnum is registered under a 24C and provides good control of hairy nightshade (*Solanum sarrachoides*) and yellow nutsedge *(Cyperus esculentus)* which are not controlled by the other preemergence materials. Late season weed control is also an important issue in this crop.

The objective of these studies was to examine at transplant and layby herbicide combinations for peppers that can provide long-term and economical weed control for peppers grown without plastic mulch. The herbicides tested included: Dual Magnum 7.62 (s-metolachlor), Goal Tender 4F (oxyfluorfen), Outlook 6.0 (dimethenamid), flumioxazin (Chateau) impregnated on fertilizer, and Dacthal 75W (DCPA).

METHODS

Field trials were conducted on the Central Coast (Monterey and Santa Clara Counties) and Fresno County in 2005 to provide an evaluation of the test herbicides over a wider range of growing conditions and weed spectra.

Central Coast Trial: The trial was conducted with a cooperating grower in Gilroy. Goal Tender treatments were applied onto shaped beds two weeks prior to transplanting the peppers on April 28. The field was transplanted on May 13. The at-planting treatments were applied over-the-top of the plants immediately following transplanting. Sprinkler irrigation was started 5 hours following transplanting applying 0.38 inch of water. Layby applications were made on June 16 and the material was incorporated with the last sprinkler irrigation before the field was switched to drip irrigation. The plots were hand weeded on June 3 and the July 1 weed evaluations reflect newly sprouted weeds following the layby application. The plots were not cultivated prior to the July 1 weed evaluation. Each plot was one 40-inch bed wide by 25 feet long and replicated four times in a randomized complete block design (RCBD). All sprayed treatments were applied to the entire bed in 74 gallons of water per acre with two passes of a one nozzle wand with an 8008E teejet nozzle at 30 psi. Flumioxazin on fertilizer granules was spread by hand on the bed top immediately following transplanting. Soil type was Pacheco silt loam and the variety was Baron.

Fresno County Trial: The field trial was conducted on a Panoche clay loam soil at the UC West Side Research and Extension Center (WSREC) near Five Points. On June 7 the bell pepper variety "Jupiter" was transplanted in single rows into 40" beds. Within row plant spacing was 10". Plot size was two 40-inch beds x 70 feet of row length and replicated 4 times in a RCBD.

Preplant applications of Goal Tender were made onto shaped beds on May 10, 28 days prior to transplanting the peppers and incorporated with 0.50 inches of rainfall. The at-planting treatments of Dual Magnum, Outlook and flumioxazin were applied over the top of the plants and the field was sprinkler irrigated applying 0.50 inches of water immediately following transplanting. Sprinkler irrigation continued as needed for a few weeks and then switched to furrow irrigation. On July 25 the field was machine cultivated before layby applications of the herbicides were made as a directed spray to the base of the plants. These applications were incorporated by sprinkler irrigation.

All sprayed treatments were applied to the entire plot in 30 gallons of water per acre using a CO_2 backpack sprayer @30 psi and a 2 nozzle boom with 8003evs tips. Flumioxazin on fertilizer granules was hand broadcast over the top of the peppers. There were two untreated checks: one was handweeded twice in addition to layby cultivation and the other was allowed to grow weedy all season.

Plots were evaluated for phytotoxicity to the peppers and weed control on July 1, July 22, and August 12. Pepper stand counts were made on July 13. A portion of each plot (25' row) was hand harvested on August 23 (west bed) and on September 8 (east bed) and the yields were combined for total yield. Tables 2 & 3 list treatments and evaluations.

RESULTS AND DISCUSSION

Central Coast: Hairy Nightshade was the dominant weed at this site. The best weed control was provided by Outlook, then by Dual Magnum and Goal Tender on the 21 days after treatment (DAT) (Table 1). Flumioxazin impregnated on fertilizer provided good weed control in two treatments, but not on one. This may be due to problems with obtaining an even distribution of this dry granular material on the top of the bed. Devrinol was at a distinct disadvantage at this site because Hairy Nightshade was the main weed at this site and it did not control it. Outlook caused stunting of the plants 21 DAT, and while the stunting was reduced 28 DAT, it was still quite noticeable. There was no difference in the stand among treatments, but there were some instances of burned pepper plants in the flumioxazin treatment, presumably where a prill of the material lodged against the stem of a plant. All herbicides except Devrinol reduce time to weed the plots, but Goal and flumioxazin on fertilizer tended to take more time than Dual Magnum and Outlook. There were no differences in weed control among the layby applications (data not shown) and this test did not provide a good opportunity to evaluate the long-term weed control system for peppers. There were no significant differences in yield among the treatments (data not shown) which indicates that the initial phytotoxicity observed on the Outlook treatments did not translate to reduced yield.

Fresno: June 1, 2005 - Goal Tender provided very good weed control prior to transplanting peppers.

Fresno County: Because of excessive rainfall many weed seeds germinated in the untreated area of the field after the preplant treatments of Goal Tender but before the peppers were transplanted. Goal Tender was extremely effective in controlling all of the weeds (see photo). However, prior to transplanting it was necessary to cultivate and reshape the beds, thus destroying the herbicide layer and the effectiveness of Goal Tender. Weed control ratings on July 1 and July 22 (a few days before layby) showed how Goal Tender was no longer effective (Table 3).

Weeds were vigorous and abundant throughout the season and included several broadleaf species and virtually no grasses except for occasional jungle rice *(Echinochloa colonum)*. The major broadleaf weeds were prostrate, tumble, and redroot pigweeds (*Amaranthus blitoides, A. albus,* and *A. retroflexus*); primarily black nightshade (*Solanum nigrum*), but also some hairy nightshade (*S. sarrachoides*) and lanceleaf groundcherry (*Physalis lanceifolia*); common lambsquarters (*Chenopodium album*); and purslane *(Portulaca oleracea)*. Mustards, shepherds-purse (*Capsella bursa-pastoris*) and London rocket (*Sisymbrium irio*), were initially present prior to layby, but were taken out with the layby cultivation and were not serious competitors. Puncturevine (*Tribulus terrestris*) was also scattered throughout the experimental site but was not included in the weed counts because its populations were too random.

At planting applications: Although weed control was initially excellent, Outlook really hurt the peppers with an over the top application and many plants remained stunted for the entire season. Pepper yields were extremely reduced. As the season progressed weeds germinated and the small pepper plants offered little competition. Flumioxazin provided good weed control and only slight pepper phytotoxicity was observed using the dry granular formulation, although some care was given to try to keep the prills off of the pepper plants during the broadcast application. Weed control is probably compromised by this method of application due to the difficulty of obtaining uniform coverage. Dual Magnum provided the best weed control. A little damage was seen on the peppers, but yields were not affected.

Layby applications: After layby there was not a lot of new weeds that germinated however, weeds that were missed by cultivations continued to grow. Dual, Outlook, and Dacthal all provided good to excellent weed control when applied at layby. All of the Goal Tender preplant plots and the flumioxaxin at planting plots were improved with the layby applications. Dual, Outlook, and flumioxazin were effective on nightshades, and reduced pigweeds, purslane, and lambsquarters populations to varying degrees, although none of these products provided complete control of these weeds in this experiment. Still a hand weeding crew would have been able to clean up the field in a relatively short time, if the pepper field had been treated with almost any of these combinations.

CONCLUSION

The Central Coast trial provided evidence that Goal Tender applied to shaped beds prior to transplanting (and subsequently not worked prior to transplanting) provided acceptable safety to the peppers and good weed control. This use pattern could provide an alternative "at planting" treatment and can provide weed control for the first 30 days following transplanting. Outlook was applied over-the-top in both trials, but was more damaging to the peppers in the Fresno trial. This material did not reduce yields in the Central Coast trial and should be further examined as a pretransplant application. Both trials showed that flumioxazin impregnated on fertilizer has promise as a post transplant application on peppers. The Fresno Trial showed that Dual Magnum, Outlook and Dacthal all provided good layby weed control. Dacthal is already registered for this use, but the Dual Magnum label would need to be adjusted to allow this use.

In summary, these trials showed promise for developing a weed control system to provide early and late season weed control for peppers grown without plastic.

Table 1. Central Coast Trial. Post transplant evaluations

Code	Applications	Lbs a.i./A	Material/A	Night-shade 21 DAT	Total Weeds 21 DAT	Phyto 21 DAT	Phyto 28 DAT	Plants per plot 21 DAT	Time to weed (hrs/A) 21 DAT
1	Dual Magnum 7.62 *Fb* Dual Magnum 7.62*	1.43 *1.43*	1.50 pts *1.50 pts*	0.5	0.5	0.3	0.0	36.8	1.6
2	Dual Magnum 7.62 *Fb Outlook 6.0*	1.43 *0.60*	1.50 pts *0.80 pt*	0.8	0.8	0.8	0.3	35.5	1.3
3	Dual Magnum 7.62 *Fb Dacthal 75W*	1.43 *7.00*	1.50 pts *9.3 lbs*	1.3	1.3	0.3	0.1	36.0	1.3
4	Goal Tender 4F[1] *Fb Dual Magnum 7.62*	0.50 *1.43*	1.00 pt *1.50 pts*	2.3	3.3	0.8	0.4	35.3	3.6
5	Goal Tender 4F[1] *Fb Outlook 6.0*	0.50 *0.60*	1.00 pt *0.80 pt*	2.5	2.8	0.3	0.0	35.0	3.3
6	Goal Tender 4F[1] *Fb Dacthal 75W*	0.50 *7.00*	1.00 pt *9.3 lbs*	2.3	2.3	0.5	0.0	35.8	2.8
7	Outlook 6.0 *Fb Dual Magnum 7.62*	0.60 *1.43*	0.80 pt *1.50 pts*	0.3	0.3	1.0	1.3	34.8	1.2
8	Outlook 6.0 *Fb Outlook 6.0*	0.60 *0.60*	0.80 pt *0.80 pt*	0.3	0.3	1.5	0.8	35.3	1.2
9	Outlook 6.0 *Fb Dacthal 75W*	0.60 *7.00*	0.80 pt *9.3 lbs*	0.5	0.5	1.3	0.8	36.5	1.1
10	Flumioxazin impregnated on fertilizer *Fb Dual Magnum 7.62*	0.094 *1.43*	188 lbs *1.50 pts*	1.0	1.3	1.3	1.0	35.0	2.2
11	Flumioxazin impregnated on fertilizer *Fb Outlook 6.0*	0.094 *0.60*	188 lbs *0.80 pt*	1.0	1.0	1.5	1.0	35.5	2.2
12	Flumioxazin impregnated on fertilizer *Fb Dacthal 75W*	0.094 *7.00*	188 lbs *9.3 lbs*	4.0	4.0	0.8	0.5	36.5	3.4
13	Devrinol *Fb Dacthal 75W*	1.50 *7.00*	3.0 lbs *9.3 lbs*	11.8	12.0	0.0	0.0	35.8	8.4
14	Untreated	---	---	11.8	13.3	0.0	0.0	36.3	7.7
	LSD (0.05)			3.8	3.7	1.4	1.0	NS	2.5

1 – applied 16 days prior to transplanting. * *Fb = Followed by*

Table 2. Fresno Trial. Weed control ratings and Weed counts

	Applications			Weed CONTROL Ratings *			Weed Counts per plot				
	Preemergence Herbicides	Lbs a.i. per Acre	Material per Acre	----- all broadleaf weeds ----- 24 DAT	45 DAT	67 DAT	August 12, 2005* (67 DAT) Pig	Night	Purs	Lamb	TOTAL Brdlvs
1	Dual Magnum 7.62 *Fb Dual Magnum*	1.43 *1.43*	1.5 pt *1.5 pt*	9.8 a	9.2 a	9.6 ab	10.7	0.0	6.7	2.0	19.3 ab
2	Dual Magnum *Fb Outlook*	1.43 *0.60*	1.5 pt *.75 pt*	10.0 a	9.5 a	8.5 bc	15.0	0.3	3.7	3.0	22.0 ab
3	Dual Magnum *Fb Dacthal*	1.43 *7.00*	1.5 pt *9.5 lb*	10.0 a	9.5 a	9.7 a	13.0	0.3	3.7	0.0	17.0 a
4	Goal Tender 4F[1] *Fb Dual Magnum*	0.50 *1.43*	1 pt *1.5 pt*	1.3 c	4.0 c	8.7 abc	13.7	7.0	2.3	0.7	23.7 ab
5	Goal Tender[1] *Fb Outlook*	0.50 *0.60*	1 pt *.75 pt*	1.5 c	6.2 b	9.3 abc	6.0	2.3	2.7	1.7	12.7 a
6	Goal Tender[1] *Fb Dacthal*	0.50 *7.00*	1 pt *9.5 lb*	1.0 c	4.0 c	8.8 abc	13.7	2.7	2.0	0.3	18.7 ab
7	Outlook 6.0 *Fb Dual Magnum*	0.60 *1.43*	.75 pt *1.5 pt*	10.0 a	9.0 a	8.3 c	32.3	0.0	5.3	4.0	41.7 bc
8	Outlook *Fb Outlook*	0.60 *0.60*	.75 pt *.75 pt*	10.0 a	9.6 a	8.5 bc	21.7	0.0	3.7	5.7	31.0 ab
9	Outlook *Fb Dacthal*	0.60 *7.00*	.75 pt *9.5 lb*	9.7 a	9.5 a	7.0 d	37.0	1.0	9.7	8.3	56.0 c
10	Flumioxazin impregnated on fertilizer *Fb Dual Magnum*	0.094 *1.43*	150 lbs *1.5 pt*	7.7 b	8.3 a	9.0 abc	15.0	0.0	3.0	4.7	22.7 ab
11	Flumioxazin *Fb Outlook*	0.094 *0.60*	150 lbs *.75 pt*	9.7 a	8.7 a	8.8 abc	20.7	0.0	3.3	5.0	29.0 ab
12	Flumioxazin *Fb Dacthal*	0.094 *7.00*	150 lbs *9.5 lb*	8.2 b	8.3 a	8.8 abc	18.3	1.3	4.7	2.0	26.3 ab
13	Untreated - *weeded*			0.7 c	8.3 a	6.7 d	32.3	19.7	3.3	1.7	57.0 c
14	Untreated - *weedy*			1.0 c	1.7 d	0.7 e	64.3	24.0	24.7	17.0	130.0 d
	LSD (0.05)			1.0	1.5	1.2	20.5	4.0	5.3	6.5	24.4

1- Applied 28 days before transplanting. * July 1=24 DAT; July 22=45 DAT; Aug 12=67 DAT. Aug 12 =18 days post layby application.

Table 3. Fresno Trial. Pepper yield, Stand counts, and Phytotoxicity ratings*

	Applications	Lbs a.i. per Acre	Material per Acre	Pepper Yield lbs/plot Good	Small	Sun-burn	Total	Peppers/plot 36 DAT	Phytotoxicity 24 DAT	67 DAT*
1	Dual Magnum 7.62 *Fb Dual Magnum*	1.43 *1.43*	1.5 pt *1.5 pt*	77.6 ab	18.7	15.9	112.2 ab	186.0 bcd	1.3 b	0.0 d
2	Dual Magnum *Fb Outlook*	1.43 *0.60*	1.5 pt *.75 pt*	71.3 ab	18.4	13.9	103.5 ab	184.5 cd	1.5 b	3.5 bcd
3	Dual Magnum *Fb Dacthal*	1.43 *7.00*	1.5 pt *9.5 lb*	61.0 ab	16.9	11.7	89.5 ab	194.5 abcd	1.0 b	0.0 cd
4	Goal Tender 4F[1] *Fb Dual Magnum*	0.50 *1.43*	1 pt *1.5 pt*	62.6 ab	20.7	14.3	97.6 ab	186.5 bcd	0.2 b	0.3 d
5	Goal Tender[1] *Fb Outlook*	0.50 *0.60*	1 pt *.75 pt*	91.6 a	12.6	11.8	116.0 a	196.5 abc	0.5 b	0.0 d
6	Goal Tender[1] *Fb Dacthal*	0.50 *7.00*	1 pt *9.5 lb*	66.0 ab	12.9	10.2	89.1 ab	200.0 ab	0.2 b	0.0 d
7	Outlook 6.0 *Fb Dual Magnum*	0.60 *1.43*	.75 pt *1.5 pt*	47.2 bc	8.9	9.5	65.5 bc	190.5 abcd	3.7 a	6.0 ab
8	Outlook *Fb Outlook*	0.60 *0.60*	.75 pt *.75 pt*	41.8 bc	10.7	13.7	66.2 bc	187.0 bcd	3.7 a	2.0 abc
9	Outlook *Fb Dacthal*	0.60 *7.00*	.75 pt *9.5 lb*	21.0 c	7.1	3.7	31.9 c	188.0 bcd	5.2 a	6.5 a
10	Flumioxazin impregnated on fertilizer *Fb Dual Magnum*	0.094 *1.43*	150 lbs *1.5 pt*	57.5 abc	15.5	11.3	84.4 ab	182.0 cd	1.0 b	1.0 cd
11	Flumioxazin *Fb Outlook*	0.094 *0.60*	150 lbs *.75 pt*	79.4 ab	15.4	17.6	112.3 ab	194.0 abcd	0.5 b	0.5 d
12	Flumioxazin *Fb Dacthal*	0.094 *7.00*	150 lbs *9.5 lb*	65.3 ab	16.3	7.3	89.0 ab	203.5 a	1.5 b	2.0 bcd
13	Untreated – *weeded*			78.4 ab	19.2	10.0	107.5 ab	181.5 d	0.3 b	0.3 d
14	Untreated – *weedy*			20.9 c	6.2	4.5	31.5 c	182.5 cd	0.0 b	0.0 d
	LSD (0.05)			39.8	8.8	9.1	47.4	14.6	1.9	2.8

1- Applied 28 days before transplanting. * July 1=24 DAT; July 13=36 DAT; July 22=45 DAT; Aug 12=67 DAT. Aug 12 = 18 days post layby.

Postharvest Handling Considerations for Grape Tomatoes

Marita Cantwell, UCCE Postharvest Vegetable Specialist, Mann Laboratory, UC Davis

During 2003 and 2004 postharvest research was conducted on grape tomatoes. These small grape-size tomatoes have high flavor potential and are now popular among consumers. As in other tomatoes, stage of maturity at harvest is critical to maximize eating quality. **Table 1** shows the difference in composition when the fruit were harvested at different maturity stages (3, 4, and 5) and ripened to full red color (table-ripe stage). Although the % soluble solids (°Brix) differed considerably among the 3 maturity stages, the actual sugar concentrations were much less different. As expected, sugars are correlated to % soluble solids. The fruit harvested at higher maturity stage had higher % titratable acidity in Test 1 but not Test 2. No significant differences were noted in Ascorbic acid (Vit. C) concentration among fruit ripened from different stages of maturity. There were no significant differences at the table-ripe stage in fruit weight, red color or firmness in relation to the 3 stages of harvest (data not shown).

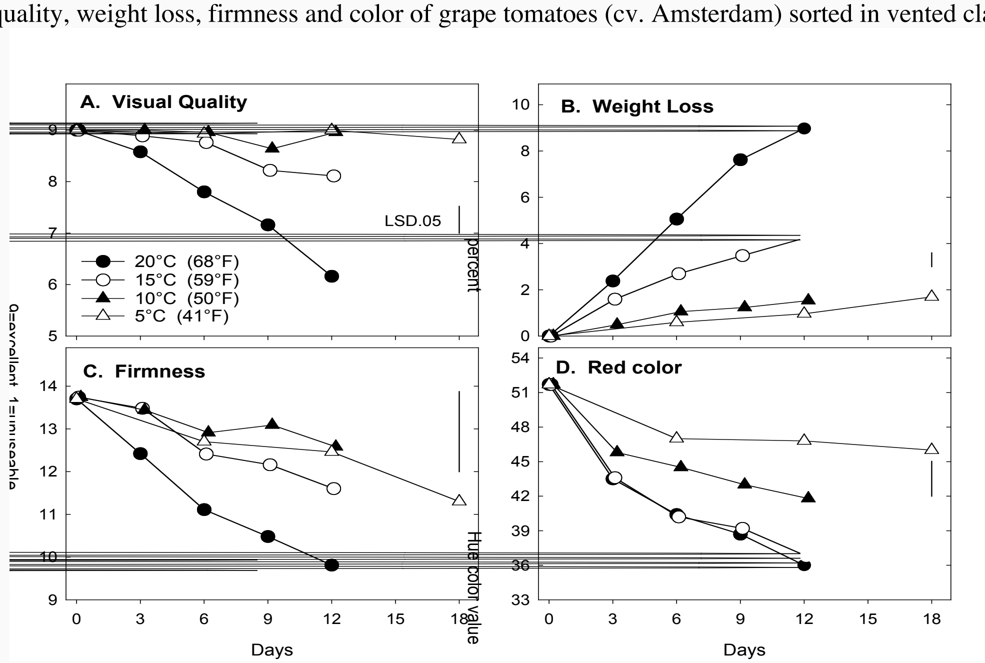
Storage temperature will be a critical factor in maintaining the postharvest quality of fruit. Changes in visual appearance, color (objective color value, the lower the hue value, the redder the fruit), firmness (the lower the value, the softer the fruit) and % weight loss of stage 4 fruit packaged in clamshells in relation to storage at 4 temperatures is shown in **Figure 1**. As with all tomatoes, a storage temperature of 41°F is too low as evidenced by the lack of color development. Storing at 50°F retarded color development. Firmness changes were similar among the fruit stored at 41, 50 and 59°F. In other tests, we stored fruit at 55°F and consider this the best storage temperature (slow softening and color change but not prevent eventual normal color development). Shrivel and firmness loss is closely correlated with % weight loss (data not shown).

A complete report is available at the Postharvest Website) http://postharvest.ucdavis.edu

Table 1. Composition of table-ripe grape tomatoes (cv Amsterdam) harvested at different stages of maturity and ripened at 69°F.

Initial color stage	% Soluble solids	Sugars mg/ml juice	pH	% Titratable acidity	SS:TA ratio	Vitamin C mg/100ml
Test 1						
Stage 3	5.5	30.1	4.37	0.51	10.8	92.6
Stage 4	6.0	30.7	4.36	0.53	11.3	90.4
Stage 5	7.5	33.6	4.49	0.57	13.2	85.8
LSD.05	0.8	2.8	0.12	0.05	--	ns
Test 2						
Stage 4	7.0	30.9	4.28	0.65	10.8	57.4
Stage 5	7.6	34.3	4.48	0.53	14.3	63.4
LSD.05	0.5	3.4	0.07	0.06	--	ns

Figure 1: Visual quality, weight loss, firmness and color of grape tomatoes (cv. Amsterdam) sorted in vented clamshells at 4 Temps.



SOURCES OF INFORMATION – TOMATOES & PEPPERS

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 Weed Research & Information Center:
(UC WRIC) www.wric.ucdavis.edu

UC Postharvest Technology:
http://postharvest.ucdavis.edu
(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

IPM Tomato Manual, #3274
IPM Tomato Pest Management Guidelines #3470
Identification & Management of Complex Tomato Diseases (available through UC VRIC)

Fresh Market Tomato Publication in CA, #8017
Processing Tomato Production in CA, #7228
Bell Pepper Production in CA, #7217
IPM Pepper Pest Management Guidelines #3460
Scheduling Irrigation: When & How Much, #3396

Mark Your Calendars
May 21-23, 2006
Renaissance Esmeralda Resort
Palm Springs, CA

www.internationalpepper.com

INDUSTRY ORGANIZATIONS

California Tomato Commission
www.tomato.org
Fresh Market Tomato Industry
1625 E. Shaw Avenue, Suite 106
Fresno, CA 93710
(559) 230-0116

California Pepper Commission
531-D North Alta Avenue
Dinuba, CA 93618
(559) 591-3925

WEATHER & IRRIGATION

CIMIS - CA Irrigation Management & Info System
CA Dept Water Resources - www.cimis.water.ca.gov

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

PESTICIDE LABELS

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

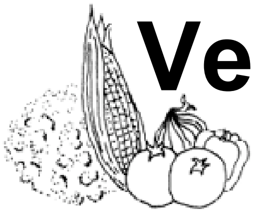
MARKET NEWS

http://www.produceforsale.com/producemarkets.htm

The Vegetable Notes Newsletter is available ONLINE.

To download this or previous editions go to
UCCE Tulare County website:
http://cetulare.ucdavis.edu/Vegetable_Crops/
You can also sign up to receive this newsletter online.
We welcome your comments. Send to newsletter editor:
mlestrange@ucdavis.edu

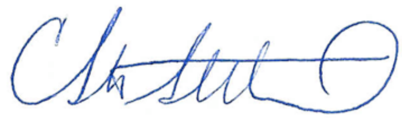
Other UCCE county websites in the SJV:
Fresno County: http://cefresno.ucdavis.edu
Kern County: http://cekern.ucdavis.edu
Kings County: http://cekings.ucdavis.edu
Merced County: http://cemerced.ucdavis.edu
San Joaquin County: http://cesanjoaquin.ucdavis.edu
Stanislaus County: http://cestanislaus.ucdavis.edu



Vegetable Crops Facts

UCCE Merced and Madera Counties

Scott Stoddard, Farm Advisor



Newsletter Volume 8, Issue #3:

Fresh Tomato & Bell Pepper Research Progress Reports

Cooperative Extension
University of California
2145 Wardrobe Ave.
Merced CA 95340

Nonprofit Organization
US Postage Paid
Merced, CA 95340
Permit No. 641