Topics in Subtropics Newsletter

University of California Cooperative Extension

Fresno, Kern, Madera, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, Tulare, & Ventura Counties

News from the Subtropical Tree Crop Farm Advisors in California

Volume 6, No. 1
January – March 2008

Editor's Note:

Please let us know if your mailing address has changed, or you would like to add someone else to the mailing list. Call or e-mail the farm advisor in the county where you live. Phone numbers and e-mail addresses can be found in the right column.

Please also let us know if there are specific topics that you would like addressed in subtropical crop production. Copies of Topics in Subtropics may also be downloaded from the county Cooperative Extension websites of the Farm Advisors listed.

Neil O'Connell
Editor of this issue

Topic **Page**

Farm Advisors

Gary Bender – *Subtropical Horticulture, San Diego*
Phone: (760) 752-4711
Email to: gsbender@ucdavis.edu
Website: http://cesandiego.ucdavis.edu

Mary Bianchi – *Horticulture/Water Management, San Luis Obispo*
Phone: (805) 781-5949
Email to: mlbianchi@ucdavis.edu
Website: http://cesanluisobispo.ucdavis.edu

Ben Faber – *Subtropical Horticulture, Ventura/Santa Barbara*
Phone: (805) 645-1462
Email to: bafaber@ucdavis.edu
Website: http://ceventura.ucdavis.edu

Neil O'Connell – *Citrus/Avocado, Tulare*
Phone: (559) 685-3309 ext 212
Email to: nvoconnell@ucdavis.edu
Website: http://cetulare.ucdavis.edu

Craig Kallsen – *Subtropical Horticulture & Pistachios, Kern*
Phone: (661) 868-6221
Email to: cekallsen@ucdavis.edu
Website: http://cekern.ucdavis.edu

Eta Takele – *Area Ag Economics Advisor*
Phone: (951) 683-6491, ext 243
Email to: ettakele@ucdavis.edu
Website: http://ceriverside.ucdavis.edu

Mark Freeman – *Citrus & Nut Crops, Fresno/Madera*
Phone: (559) 456-7265
Email to: mwfreeman@ucdavis.edu
Website: http://cefresno.ucdavis.edu

Evaluation of Insecticides for Citrus Thrips Control, using Blueberries as a Crop Surrogate

David R. Haviland, University of California Cooperative Extension, Kern County
Joseph G. Morse, Department of Entomology, University of California, Riverside

During the past few years citrus thrips have become the most significant insect pest of blueberries in the San Joaquin Valley. Citrus thrips are found at high levels throughout the growing season from June through October, and cause significant damage by feeding on the new flush throughout this period. Since population levels in blueberries are consistently very high (much higher than are typically found in citrus), and the crop is harvested by mid-June, blueberries present an excellent opportunity to conduct insecticide efficacy trials for this pest without having to deal with crop destruct issues for unregistered products.

An insecticide trial was conducted in southern Tulare County during the summer of 2006 to evaluate the effects of 13 insecticides and an untreated control on the density of citrus thrips in blueberries. Data from these trials should parallel the results that would be seen if these products were used on non-bearing citrus, and give some insights into the relative effectiveness of these products on bearing citrus. Plot size in the trial was 44 ft (4 rows) by 88 feet long, replicated 5 times, and treatments were applied on July 31, 2006 with a commercial over-the-top sprayer with wrap-around arms to cover two rows at a time. Initial thrips populations at the time of spraying were just over 30 thrips per beat sample (one tap of the terminal 6 inches of growth onto a 12 x 12 piece of black acrylic).

Table 1 and Figure 1 show the results of the trial, with the best products starting from the top and left respectively. Carzol, which had previously never been used at this site, provided the best control. This product is registered for use in citrus, though documented resistance and its propensity to flare other pests, such as mites, has led to reduced Carzol use. The next best treatments were Radiant, Success, and Assail. Radiant is a new macrocyclic lactone (same class of chemistry as Success and Agri-Mek) from Dow Agrosciences (that will be registered on citrus under the name Delegate). In multiple trials on several crops it has longer residual persistence than Success, and does so with only half the amount of active ingredient. Assail is a neonicotinoid that proved effective against thrips in this trial, and is registered on citrus. It has value in a resistance management program as a rotational product for Success. However, those that use this product should watch their red scale populations, as Assail appears to flare red scale. The next most effective product was Agri-Mek, which also has some value as a rotational product with Success in citrus, although preliminary data has suggested there may be cross resistance between these two materials – thus, Carzol and Assail are better rotation choices.

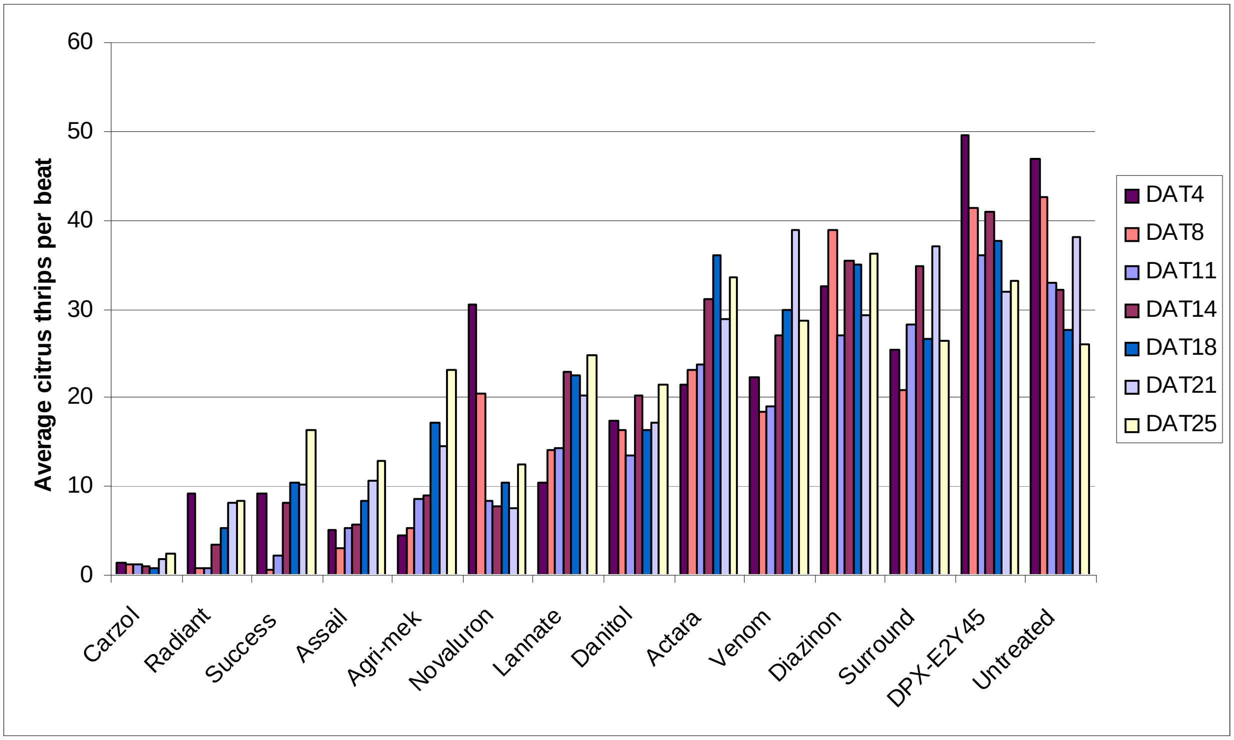
Insecticides with moderate effectiveness against thrips included Novaluron, Lannate, and Danitol. Novaluron (not registered) is a slow-acting insect growth regulator that produced results similar to that of Assail from 14 to 28 days after treatment. Lannate (a carbamate) and Danitol (a pyrethroid) both reduced thrips populations by about 50% for a couple of weeks.

Other insecticides currently registered for citrus, but were not evaluated in this trial are Veratran D (sabadilla) and Baythroid (cyfluthrin). Each can be used in citrus as a rotation for Success. Veratran D is a botanical stomach poison that works best when mixed with molasses or sugar to encourage feeding (formulated Veratran D is 80% sugar to begin with). Baythroid is a pyrethroid that can be effective against citrus thrips, but that is also known for its broad-spectrum effects on insects, regardless of whether they are beneficial or not. This is also true of Danitol but this pyrethroid has somewhat greater activity against many mite species.

Table 1.		Mean number of citrus thrips per beat sample							
Treatment/ Formulation	Rate Formulated Product Per Acre	Pre	DAT 4	DAT 8	DAT 11	DAT 14	DAT 18	DAT 21	DAT 25
Carzol 90SP	1 lb	30.0 a	1.5 a	1.2 a	1.2 a	1.1 a	0.8 a	1.8 a	2.6 a
Radiant SC	6 fl oz	33.0 a	9.2 bc	0.8 a	0.9 a	3.5 ab	5.2 b	8.2 b	8.4 b
Success 2SC	6 fl oz	31.3 a	9.3 bc	0.7 a	2.3 ab	8.2 bc	10.4 bc	10.2 bc	16.4 cd
Assail 30SG	6 oz	31.1 a	5.0 ab	3.1 ab	5.3 bc	5.8 bc	8.4 b	10.6 bcd	12.8 bc
Agri-Mek 0.15EC	15 fl oz+1%v/v oil	31.3 a	4.5 ab	5.2 b	8.7 cde	9.1 c	17.2 def	14.6 cde	23.2 de
Novaluron 0.83EC	12 fl oz	34.1 a	30.5 def	20.4 cd	8.4 cd	7.8 bc	10.5 bcd	7.6 b	12.5 bc
Lannate 90SP	1 lb	35.4 a	10.4 bc	14.2 c	14.4 ef	22.9 de	22.6 efg	20.4 ef	24.8 ef
Danitol 2.4EC	16 fl oz	36.8 a	17.5 cd	16.5 cd	13.5 def	20.2 d	16.3 cde	17.2 de	21.6 de
Actara 25WG	4 oz	23.8 a	21.4 de	23.2 d	23.8 gh	31.1 efg	36.0 h	28.1 fg	33.5 fg
Venom 70SG	3 oz	32.4 a	22.3 de	18.5 cd	19.0 fg	27.0 def	30.0 gh	39.0 g	28.6 efg
Diazinon 50WP	2 lb	34.8 a	32.6 efg	38.9 e	27.1 hi	35.3 fg	35.1 h	29.3 fg	36.3 g
Surround WP	25 lb	34.8 a	25.4 de	21.0 cd	28.3 hi	34.8 fg	26.6 fgh	37.1 g	26.5 efg
DPX-E2Y45	4 oz	29.7 a	49.6 g	41.4 e	36.0 i	41.0 g	37.7 h	31.9 g	33.2 fg
Untreated		31.3 a	46.9 fg	42.5 e	32.9 i	32.1 efg	27.6 gh	38.1 g	26.1 ef
F		0.53	13.16	30.58	33.18	23.84	16.90	21.08	14.59
P		0.89	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Means in a column followed by the same letter are not significantly different (*P* > 0.05, Fisher's protected LSD) after square root (x + 0.5) transformation of the data. Untransformed means are shown.

Figure 1. Effects of insecticide treatments on citrus thrips in blueberries



The Silver Mite Workgroup

Ben Faber

Phyllocoptruta oleivora, citrus rust mite in orange and silver mite in lemon, is typically an occasional pest in coastal and inland areas of California. Treatments for red scale and bud mite in the past have also helped keep populations low. The mite feeds on rind cells and the surface becomes silvery on lemons and rust brown on mature oranges. Most damage occurs in the spring and late summer. In summer, a generation may be completed in one to two weeks, so their growth can be explosive.

Beginning in 2002, there were reports from parts of Ventura and Santa Barbara Counties of increasing mite damage and that successive spray of previously effective materials like chlorpyrifos (Lorsban) and abamectin (Agri-Mek) were not controlling the pest. Pest control advisors were rotating through materials like fenbutatin oxide (Vendex), oil and pyridaben (Nexter) with equally poor results. The following year, the mite became more extensive and in some orchards it became the dominant pest to control. In some groves virtually every fruit was scarred. There were also reports coming from Riverside and San Diego Counties that this was a bigger problem than in the past.

Ventura PCAs, growers and the local farm advisor were flummoxed on how best to control the pest, so in response a local Silver Mite Workgroup was organized to share information. Out of these discussions, it was decided that the group would collaborate on a trial to evaluate the efficacy of various materials and that all in the group would help in the trial. The group consisted of 12 PCAs, with one taking the lead in organizing the group for the field applications and evaluations. Thirteen materials were identified for evaluation including traditional materials, two unregistered ones for lemon, a new formulation of abamectin and a new oil. This meant that at a sampling date there would be 780 fruit on which mite counts would need to be made. The fruit averaged anywhere from just a few mites to over a thousand per fruit on some of the treatments, meaning a whole lot of hours would be required to make the counts. But having a crew of dedicated PCAs to do the sampling, the counts could usually be finished in three hours and people could go back to their real jobs. Sampling was done over a five month period nine times, some very good results were obtained and backup information became available for the full registration of the two softer, unregistered materials.

These are the results of the trial (Table 1). As can be seen, there were very robust populations and all treatments started out at comparable levels. All treatments had some initial control with some treatments breaking after eight weeks, and after a while we stopped counting those treatments that were no longer working. The good news was that abamectin, spirodiclofen (Envidor) and diflbenzuron (Micromite) were quite good materials and they also tend to be softer on beneficials. There was an outbreak of red mite in the fall on the trees treated with diflubenzuron.

Another result is that it showed that a local group like this could pull together to perform a viable research project. The following year 2005-2006, application was made to the Citrus Research Board for funding to continue the study, evaluating the products and rates of application. That spring it was hard to find the mite anywhere and the trial was postponed until the following year – another year that the mite did not show up again. We have seen a bit of activity this year, but nothing like the infestation we had before. Regardless of the current state of the pest, we are now better able to respond, if and when it becomes a problem again.

The Silver Mite Workgroup was comprised of:
Jane Delahoyde, Ben Faber, Rick Harrison, Bob Hill, David Holden, Dave Machlitt (crew leader), Debbie Morgan, Joe Morse, Terry Nelson, Emilio Quezada, Tom Roberts, Marcos van Wingerden, and Josh Waters.

Reference to chemical brand names is not an endorsement of those products.

Table 1. Average Live Mites per Fruit
after Treatments (UTC=control)

Silver Mite Working Group -- Spring 2005 Materials Trial

	TREATMENTS	4/15		4/29		5/22		6/10		7/1		7/22		8/12		9/2		9/23	
Material1	Material2	-1 day		2 wks		5 wks		8 wks		11 wks		14 wks		17 wks		20 wks		23 wks	
UTC		87.4	a	102.8	a	182.9	a	168.3	a	244.6	a	202.4	a	441.3	a	173.4	a	115.0	a
440 oil, 1.4%		90.6	a	21.4	b	22.6	b	14.4	b	31.5	b	30.1	b	88.1	bc				
455 oil, 1.4%		91.8	a	8.2	b	16.2	b	29.0	b	55.5	b	5.1	b	65.6	bc				
470 oil, 1.4%		89.5	a	4.8	b	0.6	b	9.3	b	57.5	b	7.4	b	47.1	bc				
440 oil, 1.4%	AgriMek 10 oz/A	90.5	a	8.0	b	1.6	b	6.8	b	0.2	b	4.3	b	14.3	c	52.7	b		
440 oil, 1.4%	AgriMek 10 oz/A, NF	89.9	a	6.5	b	0.6	b	0.6	b	0.1	b	1.6	b	12.0	c	63.6	b		
440 oil, 1.4%	Lorsban 8 pts/A	91.2	a	1.9	b	1.9	b	41.2	b	9.8	b	29.4	b	83.4	bc				
440 oil, 1.4%	Envidor 17 oz/A	87.2	a	15.1	b	7.7	b	2.3	b	7.0	b	1.9	b	12.3	c	54.7	b		
	Envidor 17 oz/A	89.6	a	4.9	b	2.8	b	0.4	b	0.2	b	1.3	b	7.3	c	10.9	b	19.6	b
	Micromite 80WGS, 6.25 oz/A	89.2	a	40.4	b	9.9	b	13.2	b	0.9	b	9.1	b	21.1	c	20.4	b	46.2	ab
	Thiolux 80%S, 20 #/A	89.3	a	1.3	b	0.8	b	4.4	b	25.1	b	25.0	b	173.3	b				
	Sulfur 97%, 40 #/A	85.4	a	1.5	b	0.1	b	0.1	b	1.6	b	17.3	b	75.0	bc				
	Sulfur 97%, 60 #/A	89.9	a	0.6	b	0.1	b	3.2	b	3.2	b	18.1	b	166.5	b				

Average live silver mite per fruit sample, based on 60 fruit total.
Means follow ed by same letter do not significantly difffer (P=.10, Duncan's New MRT).

Just Because Spring is a Good Time to Prune Navel Orange Doesn't Mean You Should

Craig Kallsen

A sure way to generate controversy among citrus growers is to initiate a discussion on navel orange tree pruning. Some growers maintain that yield and fruit size is best maintained by minimal pruning, while others believe that the number of large fruit is increased when trees are severely pruned. A 'standard' manual pruning for navel oranges does not exist, but the closest thing to it is a procedure that involves pruning from the tree; 1.) shaded, dead branches 2.) branches which cross from one side of the tree to the other and 3.) green, triangular, juvenile shoots from the tree. This type of pruning commonly goes under the name of 'deadbrushing'. Deadbrushing is a relatively light form of pruning, and a trained crew usually spends less than 15 minutes per tree performing it. In addition to any manual pruning, most navel orange orchards in California are mechanically 'hedged' and 'topped' to provide continued access to trees and their fruit by equipment and people involved in orchard cultural and harvest activities. Although growers have been growing navel oranges in California for over one hundred years, surprisingly few experiments have been conducted to determine the effect of pruning on navel orange yield and quality.

To assist in providing some guidance related to pruning and its possible effects on fruit yield and quality, an experiment was established in 2000 in northern Kern County in an orange orchard that was typically harvested in late December or in January. In 2000, 2001, 2002 and 2003, yield, fruit quality parameters and manual pruning costs were compared among mature "Frost Nucellar" navel trees (90 trees/acre) having one of three topping-height treatments (14 ft, 16 ft, and untopped trees). In addition to a topping treatment, the experimental trees were given one of three levels of manual pruning 1.) removal of several large scaffold branches in March of 2000 followed by deadbrushing in 2001, 2002 and no manual pruning in 2003; 2. dead brushing only in 2000, 2001, 2002 and no manual pruning in 2003; or 3. no topping or deadbrushing). Data were collected from experimental trees surrounded by similarly topped and manually pruned border trees. Fruit weight, numbers, size, grade and color were determined the day after harvest at the University of California Research and Extension Center experimental packline near Lindcove, California. The year, in this report, refers to the year that the crop bloomed and not to the year of harvest.

As can be seen in Table 1, for the 2003 crop year, even after 4 years, trees that were severely pruned in the spring of 2000 produced less total yield and less fruit in the most valuable-size range (i.e. 88 to 48 fruit/carton) than trees that were deadbrushed or left unpruned. In 2003, differences in yield among manual pruning treatments were greater than in 2002 (data not shown) probably because of the higher yield potential that appeared to exist across the industry in 2003. The canopy of the severely pruned trees in 2003 had not yet retained the size of the deadbrushed or unpruned trees after four years, which limited their potential fruit production. In contrast, in 2001 only one year after the manual treatments were imposed and a year with high spring temperatures and very poor fruit set, no differences in yield were found among manual pruning treatments.

When the data of average individual tree performance are summed over the four years that this experiment was conducted (Table 1), the treatment that included removal of some major scaffold branches in March of 2000 with deadbrushing in 2001 and 2002, was inferior in terms of yield, fruit number, and number of valuable-sized fruit in the range of 88 to 48 per carton than to trees that were only deadbrushed or those that had no manual pruning. Most of the detrimental effects of severe pruning on yield (and on fruit quality) occurred at the December harvest following the severe pruning in March 2000. Over the four years of the experiment, the trees that were not manually pruned produced equal or better cumulative yields of fruit, equal or more valuable sized fruit, and fruit with equal grade (data not shown in Table 1 for grade) compared to deadbrushed or severely pruned trees. In Table 1, the percentage of the fruit on the tree larger than size 88 was greater in the severe pruning treatment, but because total fruit number per tree was less and more of this fruit was overly large (i.e. greater than size 48) the number of the most valuable-sized fruit/tree (sized 88 to 48) was less. Obviously, the trees that were not manually pruned had no associated manual pruning costs when compared to the other two pruning treatments. Manual pruning costs, from 2000 through 2003, not including stacking and shredding of pruned brush, were $8.50/tree for the deadbrushing treatment and $13.00/tree for the severe manual pruning treatment.

Fruit yield or quality was not different among topping heights in any of the four years of the experiment. Topping height did not affect yield, probably because of the wide spacing and tall trees in this orchard. The canopies of untopped trees had little fruit within 4 feet of the ground as a result of shading of the lower canopy by neighboring trees. Removing the top 4 feet from an 18-foot tall tree moved the fruit-bearing volume downward in response to greater light penetration into the lower canopy but did not decrease the volume of the tree that received sufficient light to produce fruit. This effect was in contrast to severe manual pruning, which reduced the volume of the unshaded canopy overall, limiting the volume available for fruit production. A highly significant positive-linear correlation was found in the data across the four years and treatments between the total numbers of fruit produced per acre versus the total number of fruit sized 88 to 48 per carton produced per acre. This functional relationship existed whether reductions in fruit numbers produced per acre were the result of severe pruning in March or from weather-related phenomena such as occurred in 2001, suggesting that anything that reduced fruit numbers below approximately 130,000 fruit per acre resulted in a decrease in the number of fruit sized 88 to 48 per carton in this orchard.

Of course, there are other reasons to manually prune orange trees, other than to improve fruit size. If certain insects, like California red scale or cottony cushion scale have been a problem, pesticide spray coverage may be improved by making the canopy less dense through pruning and fruit quality may be improved by making this investment. In general, what this pruning research has reinforced is the concept that growers should know why they are pruning orange trees and that manual pruning is unlikely to increase the number of fruit in the most valuable size ranges.

Table 1. Weight of fruit/tree, fruit number/tree, number of fruit sized 88 to 48/tree, and percent of fruit greater than size88 in 2003 and cumulatively from 2000 through 2003 for three manual pruning treatments of mature Frost Nucellar navel orange trees.

manual pruning treatment	fruit/tree pounds		fruit/tree number		fruit sized 88 - 48[1]/tree number		fruit greater than size 88[1]/tree percent	
	2003	2000-2003	2003	2000 - 2003	2003	2000-2003	2003	2000 - 2003
severe[2]	505 b	1502 b[3]	909 b	2456 c	798 b	1941 b	82 a	83 a
deadbrush	573 a	1788 a	1129 a	3340 b	966 a	2652 a	73 a	73 b
none	631 a	1932 a	1252 a	3681 a	1053 a	2864 a	72 a	70 b

[1]Fruit sizes refer to number of fruit that fit into a standard California 37.5 lb. carton.
[2] The severe treatment refers to the treatment that included removal of two or more major scaffold branches in spring 2000.
[3]Different letters following values within the same column denote significant differences by Fisher's protected LSD at (*$P \leq 0.05$*).

Brevipalpus Mites and Citrus Leprosis Virus Disease*

Neil O'Connell

Brevipalpus mite species belong to a larger group or family of mites the Tenuipalpidae, referred to as flat mites. The genus Brevipalpus is considered the most important one in the family. The mites are small ranging in size from 200-400 micrometers in length, flattened and frequently red in color. They have been under increasing investigation because of their potential as plant pests and their involvement with vectoring plant viruses. The three most important species are B.californicus(Banks), B.obovatus(Donnadieu), and B.phoenicis(Geijskes). All three species occur on citrus as well as many other host plants in the same areas worldwide. A fourth species B.lewisi (McGregor) is found in more arid climates. B.phoenicis is a pest of citrus, coffee, tea and passionfruit and numerous ornamental plants. B.californicus is a pest on orchids. B.lewisi is a pest on citrus, grapes, pistachio, walnuts and pomegranate. It has never been assessed as a possible vector of citrus leprosis or other related viruses.

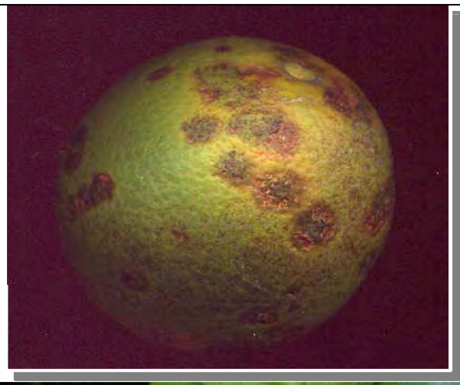
Typically, Brevipalpus mite development consists of a larval, protonymph, deutonymph and adult stage. The rate of development is strongly influenced by temperature, relative humidity and host plant. In developmental studies at eighty degrees Fahrenheit (F), development of B.obovatus was completed in 13 days with adult females living 40 days and depositing 50 eggs per female. In comparison, development of B.lewisi at 90 degrees and 35% relative humidity was completed in 17 days. Egg laying varied from six eggs per female per day at 90 degrees to 18 eggs per day at 80 degrees. Eggs were deposited in cracks or crevices on fruit surfaces.

Tenuipalpid mites inject toxic saliva into fruit, leaf, stem and bud tissues of citrus and other host plants. B.lewisi causes a russeting and cracking of the rind on pomegranate fruit, with damage first observed near the stem end. B.californicus feeding has been associated with severe stunting of citrus seedlings in Texas and corky swollen buds in Texas, Florida and Venezuela, a condition referred to as Brevipalpus gall. B.phoenicis has been associated with a fungal pathogen, *Elsinoe fawcetti* resulting in defoliation and death of citrus seedlings. Feeding damage by Brevipalpus mites on citrus in Texas is most prevalent on inside fruit in the lower tree canopy. Fruit lesions first appear as very slight yellowish circular areas in depressions on the fruit surfaces. These lesions gradually develop a central brown necrotic area and gradually become darker and corky in texture. The extent of this damage varies depending upon mite infestations and can cover half of the fruit surface. On some orange selections in Texas, lesions resulting from mite feeding have been referred to as leprosis-like spotting or nail-head rust, appearing as brownish blemishes on fruit particularly on the stylar end and on fruit in the inner canopy. Brevipalpus mites prefer damaged areas on citrus fruit or where depressions occur on the fruit surface; the mites tend to aggregate in these areas and lay their eggs. Brevipalpus lewisi and B.californicus feed primarily on citrus fruit. In Califonia, feeding injury by B.lewisi on citrus fruit results in scab-like isolated depressions. B.lewisi feeding in California pistachios results in dark, irregular and roughened scab-like blotches. In one observation in 2002 near Bakersfield, B.lewisi was readily found on the fruit in the outer canopy of Valencia trees with temperatures of 95-100 F and low relative humidity.

The most significant threat created by the three Brevipalpus mite species, B.californicus, B.obovatus, and B.phoenicis, is their involvement in vectoring a group of plant viruses. They have been identified from citrus in Brazil, Costa Rica, Honduras, South Africa, Florida and Texas B.phoenicis is recognized as the vector of citrus leprosis in Brazil, coffee ringspot virus, passionfruit green spot and various viruses of ornamental plants. In Argentina and Venezuela citrus leprosis was reportedly vectored by B.obovatus. B.californicus was the reported vector of leprosis in Florida.

Confusion has existed for decades concerning the differences between feeding injuries caused by Brevipalpus mites and leprosis virus infection on citrus. [The only accurate method for determination of infection by citrus leprosis virus is using transmission electron microscopy] [no longer true….there is a molecular method now available to identify presence of leprosis virus] to verify presence of virus particles or viral inclusion bodies. The abililty to correctly identify and separate Brevipalpus mite feeding injuries, citrus leprosis virus infections, and unrelated but similar maladies on citrus are essential for citrus producers, shippers and regulatory personnel involved in international movement of fruits and plants.

*Brevipalpus californicus, B.obovatus, B.phoenicis, and B.lewisi(Acari:Tenuipalpidae): a review of their biology, feeding injury and economic importance. Carl C. Childers, J. Victor French and Jose Carlos V. Rodrigues.



Citrus leprosis symptoms (Brazil):

- **Lesions on fruit, stems, & leaves**
- **Heavy fruit & leaf drop**
- **This is followed by stem dieback**
- **Can kill trees in 3 years**
- **Typical orchard life span of 8 years with mite control**

Rodrigues et al. 2003

UPR