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 4, No. 2
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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

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Citrus Research Growers' Seminars 2006
CRB & UC Cooperative Extension

Santa Paula **Friday, July 14** **9:00 A.M. – 1:30 P.M.**

New Location → Logsdons-at-the-Airport, 824 E. Santa Maria Street

- Sensory Evaluation: What is this developing area of science, and how do California citrus growers stand to benefit?
- Recent Research on Human Health Benefits of Citrus
- Soil Moisture Monitoring in Citrus Irrigation Management
- Weed Management: The role of the "weed seed bank" and herbicide resistance

Exeter **Tuesday, August 8** ***9:00 A.M. – 1:30 P.M.**

Exeter Memorial Building, 324 N. Kaweah

Bakersfield **Wednesday, August 9** ***9:00 A.M. – 1:30 P.M.**

Kern Agricultural Pavilion, 3300 E. Bell Terrace (S. Mt. Vernon exit off Hwy. 58)

**** Bonus session from 8:00 – 9:00 A.M.*** *Citrus disease report from Brazil, direct from the field. Come early for a briefing from California plant pathologists who have just returned from Brazil; find out what they saw and heard from growers there who are contending with numerous citrus diseases*

- Research on Navel Maturity Standard and Consumer Acceptability, plus background on the science of sensory evaluation
- Information from Rootstock Research at Lindcove
- Research toward Development of Robotic Harvester for Fresh Market Citrus
- Soil Moisture Monitoring in Citrus Irrigation Management

Chico **Friday, October 13** **9:00 A.M. – 1:30 P.M.***

Chico Masonic Family Center, 1110 W. East Avenue

- Sensory Evaluation – What is this developing area of science, and how do California citrus growers stand to benefit
- Soil Moisture Monitoring in Citrus Irrigation Management
- Refresher on the Basics of Citrus Tree Physiology
- Research on Non-Destructive Detection of Frost Damage

* *Bonus session – Update on Mandarin Rind Breakdown Research*

Indio **Tuesday, October 31** **9:00 A.M. – 1:30 P.M.***

Indian Palms, 48630 Monroe Street

- Judicious Use of Chemicals
- Perchlorate: Fundamental Human Exposure Issue
- PGRs: Refresher and Update
- Soil Moisture Monitoring in Citrus Irrigation Management

* *Bonus session – Update on New Lemon Trials*

Pala/Temecula **Wednesday, November 1** **9:00 A.M. – 1:30 P.M.***

Pala Casino Hotel, 11154 Highway 76, Pala

- Update on Diaprepes in Southern California
- Soil Moisture Monitoring in Citrus Irrigation Monitoring
- PGRs: Refresher and Update
- Sensory Evaluation – What is this developing area of science, and how do California citrus growers stand to benefit? (Including report on navel maturity research and consumer acceptability)

* *Bonus session – Report on Valencia Rootstock Trials*

Dry Root Rot in Citrus

Neil O'Connell
University of California Cooperative Extension
Tulare County

Dry root rot has been a problem in citrus orchards for many years. Although generally a problem in coastal and northern California counties it has been reported in other citrus producing areas of the state. When present it generally occurs as a chronic problem affecting only a few trees in the orchard. Trees may be invaded at any time from planting to maturity; frequently mature, good producing trees are invaded. Once infection has occurred, it may be several years before any symptoms are visible in above-ground portions of the tree. Symptoms may be a gradual leaf drop and twig dieback or a sudden death of leaves which dry and remain in place. The tree rapidly collapses as a critical mass of roots is damaged or the crown area is girdled. Investigations of declining trees in the past revealed decaying bark in the root system and/or crown area of the tree which was thought to involve brown rot gummosis caused by *Phytophthora* invasion. The decaying bark area eventually dried and cracked. No gumming was observed, however, as is typical of brown rot gummosis. A grey staining of the woody portion of root or crown tissue was observed which is not seen with *Phytophthora* where only the cambium tissue is affected. Further investigations by researchers revealed that in affected tissue in these declining trees *Fusarium solani* could be isolated. Other organisms including bacteria and weak parasites and saprophytes could be isolated as well. Tissue samples from affected trees have consistently yielded *Fusarium* spp. Microscopic examination of affected areas revealed a plugging of the water conducting xylem tissue. During high temperatures, this plugging could result in slight wilt or rapid collapse of the tree depending upon the percentage of water conducting elements affected in the roots or crown area. Early investigations in declining orchards identified stress factors which seem to predispose the tree to invasion by the organism which is not possible without one or more of these agents. Stress factors identified included environmental factors such as drought, cultural such as damage from fertilizer, herbicide, nematicide or waterlogging, and damage from rodents such as gophers. Chemical agents applied at critical periods or in excessive amounts appeared to be stressful to affected tissue thus rendering it susceptible to invasion. Water ponding next to the trunk of the tree or waterlogging of the roots was associated with invasion of root or crown tissue and later colonization by this wood rotting organism. Stress produced in the tree together with the presence of the dry root rot organism is thought to predispose the tree to invasion of the organism. Research involving the mechanisms of invasion of *Fusarium* involved exposure of seedlings to hot water and then the dry root rot organism which resulted in invasion where exposure to the organism without previous exposure to high temperature did not result in invasion. It was hypothesized that high temperatures may have interfered with natural defense mechanisms allowing invasion. Research has identified a relationship between *Phytophthora* and the vascular wilt causing Fusarium spp. *Phytophthora* lesions on roots favored the invasion of the Fusarium. Seedlings exposed to only the wilt causing organism were not invaded, but were invaded if exposed to *Phytophthora* and then the wood rotting organism. A relationship was established between temperature and invasion of *Phytophthora*. Seedlings were not invaded by *Phytophthora* in a medium at 75 or 65 degrees but were at 55 degrees. Results suggested that the seedling formed scar/callus tissue capable of excluding the organism at higher temperature but was unable to do so at the lower temperature. While most commercial rootstocks possess a moderate to high degree of tolerance to *Phytophthora* invasion, all rootstocks are thought to be susceptible to the dry root rot organism.

Earwigs Flying Under the Radar of Many Citrus Pest Control Advisors

Craig Kallsen, Citrus and Pistachio Farm Advisor
University of California Cooperative Extension
Kern County

Not too many years ago, most growers and pest control advisors were unaware that earwigs were a potential pest problem in citrus. Earwigs simply were not often found in large numbers in citrus orchards. Earwigs' increasing pest status is probably related to advances in integrated pest management techniques and attendant reductions in use of broad-spectrum organophosphate and carbamate insecticides for control of common citrus pests. On the plus side, fewer toxic, broad-spectrum pesticides treatments reduced the safety hazard for pesticide applicators, field workers and the environment and biologically integrated pest management has been effective for controlling most pests. However, once general broad-spectrum pest suppression was removed by significant reductions in these insecticides, some secondary pests, or insects that were not known to be pests, began to do serious economic damage to citrus under some conditions.

In April 2000, samples of earwigs collected in the act of chewing on citrus fruit by Robert Walther, private pest control advisor in Kern and Tulare Counties, were sent from the University of California Cooperative Extension Office in Bakersfield to the California Department of Food and Agriculture for identification. These earwigs were identified as the European earwig (*Forficula auricularia*). The adult

European earwig is about ¾ inch long, with a reddish brown head and darker body. A distinctive feature of the adult earwig is a pair of prominent appendages that resemble forceps at the tail end of its body. These forceps are straighter in the female and more curved in the male. The European earwig has wings hidden under short, hard wing covers. Earwigs are capable of flight, but when disturbed during daylight hours, usually scurry and hide under any available cover. Immature insects look like adults except are smaller and lack wings. Females lay eggs in the soil and produce a single, if somewhat extended, generation per year.

Earwigs are active and feed mostly at night, especially during hot days in spring, summer and fall. They prefer to inhabit cool, moist and dark places. Generally, earwigs will return to the ground before daylight after feeding in citrus at night. During the day they are often found in tree wraps commonly placed on the trunks of young citrus for frost protection and under heavy leaf litter adjacent to irrigation emitters in mature orchards. High populations of earwigs do not normally develop in citrus unless protective, shaded habitat is present. Earwigs damage citrus leaves and small-diameter developing fruit. Often growers and pest control advisors do not correctly identify earwig damage as such, and snails, citrus cutworms, leaf rollers, katydids, other chewing insects or wind damage are often incorrectly blamed. Examples of earwig, citrus cutworm, katydid and similar scarring can be viewed in the University of California Agriculture and Natural Resource publication #8090 " Photographic Guide to Citrus Fruit Scarring" that is available at UC Cooperative Extension Offices and downloaded at http://anrcatalog.ucdavis.edu/pdf/8090.pdf.

For earwigs to be an economic problem in citrus, they usually have to be present in large numbers. Fifty earwigs in a tree wrap is not an unusual find in infested young orchards. In young trees, earwigs are capable of causing severe defoliation. Buds, newly expanded leaves and soft, fully expanded leaves are all susceptible. Earwigs gouge leaves, and chew irregular holes in leaves and around the edges of leaves. Recently expanded spring flush leaves can be chewed down to the midrib Heavy infestations of earwigs in newly planted trees may require treatment, in that severe defoliation may result from their feeding activities.

In mature orchards the principal damage results from the earwigs chewing newly developing fruit in April and May. This damage is typified by holes gouged at the base of the fruit near the attachment to the stem or shallow crescent or star shaped slashing marks across the fruit. Badly damaged fruitlets will fall from the tree, but the scars on fruit that remain on the tree continue to expand as the fruit grows, and the fruit will not be marketable. Earwigs usually stop feeding on fruit larger than about an inch in diameter.

Pruning citrus so that branches do not contact the ground and blowing or raking leaf litter from under the tree into the row middles away from the wetted irrigation pattern can reduce earwig populations in mature orchards. In young orchards, simply removing trunk wraps can remove the earwig problem. Finding pesticides specifically labeled for control of earwigs in citrus may be difficult. Some growers have observed that after treating an ant infestation with an appropriately labeled chlorpyrifos formulation, that earwigs are effectively controlled as well.

New Tools Available for Spider Mite Management in 2006

David Haviland- Entomology Farm Advisor, UCCE Kern County

During the past few years the number of miticides registered for California crops has increased dramatically. These products represent not only new formulations of existing products, but also completely new active ingredients and modes of action. These new miticides are also considered relatively reduced-risk with many offering shorter re-entry and pre-harvest intervals than most existing products. New miticide registrations also greatly enhance our ability to use rotation of materials as a viable strategy for the management of resistance.

Table 1 lists the predominant miticides used in California crops. Relatively new members of this list include Acramite, Desperado, Fujimite, Kanemite, Oberon, Onager and Zeal. Some of these products contain active ingredients that were previously available (i.e., Desperado is the active ingredient of Nexter plus sulfur whereas Onager is an EC formulation of the active ingredient of Savey) and others offer completely new active ingredients and modes of action.

Each of these new miticides has something to offer to mite management in California; the trick is to figure out which miticide will work best under which situation, and to determine how to best fit them into resistance management plans and the economics of the crop. In some cases research is readily available to document the effects of these products, and in other cases our knowledge of the best fit of these products is still in its infancy.

Despite new miticides, IPM is still the Key

While the new miticides offer new options in managing mites, the backbone of any integrated pest management program should always be monitoring, proper identification

and rational action thresholds. Most species of spider mites thrive under hot, dry conditions, especially when leaves become dusty and cultural practices to mitigate these conditions should be the first line of defense. Dusty conditions can be avoided by managing road surfaces with water, oils or other dust-reducing products as well as by driving slower.

Plant stress is another common cause of mite flareups. This stress can be accidental as a the result of improper fertilization or inadequate irrigation, or can be a planned yearly phenomenon for crops like almonds, winegrapes, or early-harvested navel oranges where backing off of water is part of standard harvest preparations. The key to managing mites in these situations is to promote biological control early so that it is in place by the end of the season when temperatures rise and plant stress increases. If cultural and biological controls are insufficient, then miticides may be warranted.

In most California crops, predatory mites, thrips, small hemipterans (such as minute pirate bugs), and some ladybird beetles are the backbone of biological control. In most cases, however, information is not yet available on the effects of miticides on each of these predators. Until this has been developed, it would be beneficial for all growers using these products to keep track of the populations of these predators not only before applications (when determining the need to spray or not), but also afterwards to learn how they influence biocontrol as part of a comprehensive IPM program.

Resistance management

One of the biggest potential winners with the recent registration of so many miticides is resistance management. Tables 1 and 2 both list the mode of action number, as designated the Insecticide Resistance Action Committee (IRAC) for each of the most common miticides in California. In the tables, any two miticides with the same IRAC number are considered to have the same mode of action and should not be used back to back during the same season.

Table 2 also includes a brief description of how each miticide works. This is important because different miticides work in different ways and on different life stages. For example, a PCA needs to know that a mite growth regulator that inhibits molting will not immediately kill adults or eggs just as a product that causes adults to produce sterile eggs may have little effect on the juvenile mite stages. Additionally, one would expect that each of these products will work completely differently than a miticide with strictly contact activity. Because of details like these it is important to know the modes of action when deciding which miticide is needed (in cases where one is needed at all), as well as understanding observations made during follow-up visits to the field.

Conclusion

The recent registration of several new reduced-risk miticides, some of which represent completely new modes of action, should be considered a great opportunity and challenge for anybody battling mites. It is now up to us as Growers, Pest Control Advisors, UC Extension and Chemical Company Representatives to become good stewards of the products. The trick will be to figure out how to use these products to enhance our IPM programs, and to avoid increased reliance on miticides at the expense of ever-important cultural and biological control.

Table of Some of the Most Common Miticides for Use Against Spider Mites[1] in California (Version 1, Nov. 2005)[2]

David Haviland; Entomology Farm Advisor, UCCE- Kern County

Miticide	Active Ingredient	Producer	Targeted life stages and mode of action	IRAC Number[3]
Acramite	bifenazate	Chemtura	contact toxin on all stages by unknown mechanism in nervous system	25
Agri-Mek	abamectin	Syngenta	contact or ingestion toxin that paralyzes juveniles and adults; death by starvation	6
Apollo	clofentezine	Makht.-Agan	growth regulator of mite eggs and some nymphs	10A
Carzol	formetanate	Gowan	contact toxin that inhibits acetylcholinesterase (carbamate)	1A
Comite	propargite	Chemtura	contact on juveniles and adults by inhibition of ATP synthesis	12C
Danitol	fenpropathrin	Valent	nerve toxin to juveniles and adults by modification of sodium channels (pyrethroid)	3
Desperado	pyridaben/sulfur	BASF	contact on juveniles and adults by inhibition of energy production, plus sulfur	21
Dicofol	dicofol	multiple	contact toxin of juveniles and adults with unknown mode of action	UNC
Envidor	spirodiclofen	Bayer	contact on all mite stages by inhibiting lipid biosynthesis; most effective on juveniles	23
Fujimite	fenpyroximate	Nichino	contact toxin to eggs, juveniles and adults; inhibits electron transport in the mitochondria	21
Kanemite	acequinocyl	Arysta	contact toxin to eggs, juveniles and adults; inhibits electron transport in the mitochondria	20B
Kelthane	dicofol	Dow	contact toxin of juveniles and adults with unknown mode of action	UNC
Nexter	pyridaben	BASF	contact on juveniles and adults by inhibition of energy production	21
Oberon	spiromesifen	Bayer	contact on all mite stages by inhibiting lipid biosynthesis; most effective on juveniles	23
Omite	propargite	Chemtura	contact on juveniles and adults by inhibition of ATP synthesis	12C
Onager	hexythiazox	Gowan	mite growth regulator; adult females lay sterile eggs; contact toxin on eggs and juveniles	10A
Savey	hexythiazox	Gowan	mite growth regulator; adult females lay sterile eggs; contact toxin on eggs and juveniles	10A
Vendex	fenbutin-oxide	Du Pont	contact toxin to juveniles and adults by inhibition of ATP synthesis	12B
Zeal	etoxazole	Valent	contact toxin on eggs; inhibits molting of juveniles; adult females produce sterile eggs	10B
Zephyr	abamectin	Syngenta	contact or ingestion toxin that paralyzes juveniles and adults; death by starvation	6

[1] Spider mite species include *Tetranychus* spp. (Pacific, two-spotted, strawberry, McDaniel, Carmine spider mites), *Panonychus* spp. (European, citrus red mites), *Eotetranychus* spp. (Willamette, Yuma spider mites), *Eutetranychus banksi* (Texas citrus mite)

[2] Pesticide-related information is always changing. To recommend changes to the table please contact David Haviland. dhaviland@ucdavis.edu, 661 868-6215

[3] Insecticide Resistance Action Committee (IRAC) numbers used to denote different modes of action. Same number indicates same mode of action

Registration Status of Selected Miticides for Use Against Spider Mites[1] in California. (Current as of January, 2006)

David Haviland; Entomology Farm Advisor, UCCE- Kern County

Key: YES = fully registered for use NB = registered for use on non-bearing crops only No = not registered for use

	IRAC	Nut Crops			Stone Fruits					Citrus	Pome Fruits		Grape	Cotton
	Number[2]	Almond	Pistachio	Walnut	Apricot	Cherry	Peach	Plum	Nectarine		Apple	Pear		
Acramite	25	YES	YES	YES	NB	NB	YES	YES	YES	NB	YES	YES	YES	YES
Agri-Mek	6	YES	no	YES	no	no	no	YES	no	YES	YES	YES	YES	no
Apollo	10A	YES	no	YES	YES	YES	YES	no	YES	no	YES	YES	YES	no
Carzol	1A	no	no	no	no	no	YES	no	YES	No[3]	YES	YES	no	no
Comite	12C	no	no	no	no	no	no	no	no	no	no	no	no	YES
Danitol	3	no	no	no	no	no	no	no	no	YES	YES	No[3]	No[3]	No[3]
Desperado	21	YES	YES	YES	no	no	YES	YES	YES	no	no	no	no	no
Dicofol	UNC	no	no	YES	no	no	no	no	no	YES	YES	YES	YES	YES
Envidor	23	no	no	no	no	no	no	no	no	no	no	no	no	no
Fujimite	21	NB	NB	NB	NB	NB	NB	NB	NB	no	YES	YES	YES	YES
Kanemite	20B	YES	YES	no	no	no	no	no	no	YES	YES	YES	no	no
Kelthane	UNC	no	no	YES	no	no	no	no	no	YES	YES	YES	YES	YES
Nexter	21	YES	YES	YES	no	no	YES	YES	YES	YES	YES	YES	YES	no
Oberon	23	no	no	no	no	no	no	no	no	no	no	no	no	YES
Omite	12C	YES	NB	YES	NB	YES[4]	NB	NB	YES	YES[5]	NB	NB	YES	no
Onager	10A	YES	YES	YES	YES	YES	YES	YES	YES	NB	no	no	NB	YES
Savey	10A	YES	YES	YES	YES	YES	YES	YES	YES	NB	YES	YES	NB	no
Vendex	12B	YES	no	YES	no	YES	YES	YES	YES	YES	YES	YES	YES	no
Zeal	10B	YES	YES	YES	NB	NB	NB	NB	NB	NB	YES	YES	YES	YES
Zephyr	6	no	no	no	no	no	no	no	no	no	no	no	no	YES

[1] Spider mite species include *Tetranychus* spp. (pacific, two-spotted, strawberry, McDaniel, Carmine spider mites), *Panonychus* spp. (European, citrus red mites), *Eotetranychus* spp. (Willamette, Yuma spider mites), *Eutetranychus banksi* (Texas citrus mite)

[2] Insecticide Resistance Action Committee (IRAC) numbers used to denote different modes of action. Same number indicates same mode of action

[3] Miticide is registered for the crop, but one or more spider mites are not listed on the label as target pests

[4] For use on non-bearing, or post-harvest on bearing

[5] For use on any non-bearing, or post-harvest on bearing navels or grapefruit

Product Testing

Guy Witney, Director of Industry Affairs,
California Avocado Commission
Ben Faber, Farm Advisor

Growers are faced with an ever-changing list of commercial "tools", each with the promise of providing some advantage to the farmer. Frequently, these are new fertilizer mixes presented as proprietary cocktails promoted and dispensed with promises of a multitude of profitable (yet improbable) benefits to the buyer. With the large number of new products available, and the number of salespeople promoting them, it is often difficult for growers to distinguish between products likely to provide real benefit, and those that may actually reduce the profitability of the farm.

In all situations when a company approaches the University or a commodity research board with a new product or technology for sale to California growers, these institutions act as grower advocates. They are charged with sorting through the available information; asking the right questions; getting the necessary research done if the available information warrants this pursuit; disseminating accurate information on these new technologies and products, and doing all that can help maximize grower profits now and in the future. When approached with a new product or technology it is obligatory to challenge claims with the following questions:

Is there some basic established and accepted scientific foundation on which the product claims are made? Language that invokes some proprietary ingredients or mysterious formulations, particularly in fertilizers mixes registered in the State of California, raises red flags. A wide range of completely unrelated product benefit claims (such as water savings, pesticide savings, increased earlier yield) raises more red flags. Product claims that fall well outside of any accepted scientific convention generally mean the product is truly a miracle, or these claims are borderline false to entirely fraudulent.

Has the product undergone thorough scientific testing in orchards? Frequently, products are promoted based on testimonials of other growers. While testimonials may be given in good faith, they are most often not backed up by any real scientific testing where a good control was used to compare orchard returns with and without the product.

A "test" where a whole block was treated with a product and which has no reliable untreated control does not meet accepted standards for conducting agricultural experiments. Also, a treated orchard cannot reliably be compared to a neighboring untreated orchard; and a treated orchard cannot be compared to the same orchard that was untreated the previous crop year. Even a test with half a block of treated trees and half untreated is not considered dependable by any known scientific standard of testing.

Only a well designed, statistically replicated, multi-year trial allows for direct comparison of untreated versus treated trees with statistical confidence. Verifiable data from tests that meet acceptable standards of scientific design, along with access to raw baseline (before treatment) yield data from the same trees (preferably for the two years prior) should be used to determine the validity of test results provided.

Are the test results from a reliable source? If the testing were not done by a neutral party, such as university scientists, agency, or a reputable contract research company using standard scientific protocols, this raises red flags. If the persons overseeing the tests have a financial interest in seeing positive results from the product, it raises red flags.

Does the product have beneficial effects on several unrelated farm practices? A product that increases production of trees, makes fruit bigger, reduces pests, reduces water use, and reduces fertilizer costs, is more than a little suspicious. In reality, if such a product really existed, it would not need any testing at all because its benefits would be so obviously realized by the grower community that it would spread rapidly by word of mouth and embraced by the entire grower community.

Are other standard and proven farm products put down in the new product sales delivery? f a new product vendor claims that their product is taken up 15 times faster than the one growers are currently using, or is 30 times more efficient, it probably costs 15 to 30 times more per unit of active ingredient than the standard market price. Growers should always examine the chemical product label to see what active ingredient they are buying. There has to be a very good reason to pay more for an ingredient where previously there had been no problem supplying the same ingredient at a cheaper price to trees in the past. There are impartial sources of such information available to farmers to help corroborate information provided by product vendors. Perhaps the most reliable and accessible impartial research and education resources for growers are their local Cooperative Extension Farm Advisors and commodity research boards.

When promising products emerge, local university Farm Advisors can advise growers on how to evaluate these products and may help design a small trial to test a

particular product on a few trees under local orchard conditions. If in these pursuits a truly promising new product or technology emerges, research board funding .

may follow but only on the recommendation of that board's Research Committee