UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

UC PLANT PROTECTION QUARTERLY

APRIL 2006 VOLUME 16, NUMBER 2

Available online: www.uckac.edu/ppq

This newsletter is published by the University of California Kearney Plant Protection Group and the Statewide IPM Program. It is intended to provide timely information on pest management research and educational activities by UC DANR personnel. Further information on material presented herein can be obtained by contacting the individual author(s). Farm Advisors and Specialists may reproduce any portion of this publication for their newsletters, giving proper credit to individual authors.

Editors
James J. Stapleton
Charles G. Summers
Peter B. Goodell
Anil Shrestha

Cooperative Extension
Agricultural Experiment Station
Statewide IPM Program

This material is based upon work supported by the Extension Service, U.S. Department of Agriculture, under special project section 3(d), Integrated Pest Management

SHIFTING PATTERNS IN INSECTICIDE USE ON COTTON IN CALIFORNIA: 1993 TO 2004.

P.B. Goodell[1], G. Montez[2] and L. Wilhoit[3]; [1]University of California, Davis, Statewide IPM Program, [2]University of California, Riverside, Department of Entomology (both at Kearney Agricultural Center), and [3]California Department of Food & Agriculture, Sacramento.

Abstract
A subset of data from the California Department of Pesticide Regulation's pesticide use data base was used to develop insecticide use trends in cotton from 1993-2004. These data indicated a sharp spike in insecticide use in 1995 with a decline through 1999 and a leveling of use through 2004. The data are presented as *treatment acre* to reflect the number of applications applied to the acres of cotton planted. This approach removes the problem of fluctuating acres of cotton between years as well as the reduction of active ingredient per acre utilized by newer classes of insecticides. The leveling of insecticide use during the 2000's might reflect the shift in pest pressure later in the season and the demand to protect lint from aphid and whitefly honeydew. There was a substantial decline in high risk insecticides and a large increase in low risk insecticides, especially since 2000.

IN THIS ISSUE

Introduction

California has the largest and most complete pesticide use data base in the world. This database is maintained by the California Department of Pesticide Regulation (CDPR).These data provide an important record in pesticide use trends. Public concern about the environmental quantity and human health risks have caused cotton production to come under scrutiny in the past decade. California cotton has been noted as an intensive pesticide consumer (Sweezy and Goldman, 2002), particularly an increase in the amount of insecticides used in the 1990s (Kegley *et al*, 2000).

This overview will examine insecticide use in cotton from 1993 to 2004 in California. The question it seeks to answer is: what is the trend in insecticide use during the 1990s and what, if any, shift in products has occurred?

Approach

Pesticide use in California has been tracked for over 50 years. The current tracking system has been in place since 1990 (Montez and Grafton-Cardwell, 2004) and is overseen by the CDPR. During that period, CDPR has collected information on every pesticide application by growers and commercial pesticide control operators. The pesticide use reports (PUR) are used for a wide variety of environmental and public health purposes, including risk assessments, promoting farm worker health and safety, analyzing human exposure patterns, protecting threatened and endangered species, monitoring and investigating environmental issues, and improving pest management (Wilhoit *et al*, 2001).

The data are collected at the county level through the County Agricultural Commissioner offices as part of the pesticide permitting and reporting system. These data include specific location, commodity, product, rate, application method and permitee information. For PUR purposes, specific information is removed, but commodity, product (active ingredient), general location (township, section and range), application method, area treated, and pounds used are entered. This data base is filtered through extensive quality assurance processes. It is an extremely large data base and is accessible to the public. However, due to its size, it is unwieldy to the average user. To provide information to the public on pesticide use in California, CDPR issues an annual report summarizing pesticide use in by product, site and county, which is provided as a searchable data base (Anon., 2005).

The data base may be summarized in other ways as well. For this study, annual cotton data were extracted and summarized from 1993 to 2004 in an Excel spreadsheet. These data could be further organized by pounds applied or acres treated using searchable fields, including active ingredient type (herbicide, insecticide, etc), region (five in state), county and "risk". Risk categories consisted of high, low, adjuvant and other. High risk products contained active ingredients identified on lists including Proposition 65 hazards (chronic and reproductive toxicants), acutely toxic (cholinesterase inhibitors), groundwater hazards and toxic air contaminants (volatile organic chemicals). Low risk products were those active ingredients classified as reduced risk by EPA.

The data searches were limited to insecticides. The focus was on acres treated rather than pounds applied and data is reported by *treatment acre*. Treatment acre is the number of acres treated with a product or risk class divided by total acres of cotton planted. When tank mixes are used (e.g. mix of two active ingredients), it is reported as two applications.

This approach provides a useful evaluation of insecticide use and IPM. It removes the fluctuation caused by differences in annual planting acreage. It improves the estimate over "pounds on the ground" by eliminating the bias introduced when products used at high rates (e.g. sulfur dust) are replaced by products used at very low rates. For example, the number of applications used to treat spider mites might not change, but the amount of product could decline substantially. In evaluating IPM programs, the number of applications applied over time often reflects an increasing sophistication or can indicate the breakdown of an IPM program.

Results and Discussion

The trends in insecticide use in cotton were not different between acres treated and pounds applied (Figure 1). Insecticide use spiked in 1995, due primarily to widespread treatments for *Lygus*, cotton aphids and spider mites (Hardee and Herzog, 1996; Goodell *et al*, 1997). Insecticide use dropped steadily after 1995 and leveled off after 1999. The number of pounds applied appears to continue to decline slightly more than acres treated, due perhaps to the change in products, formulation and reduce amount of active ingredient per acre.

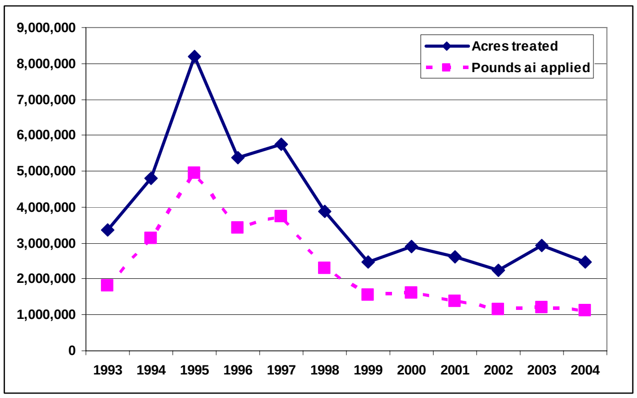

Figure 1. Insecticide use in cotton, 1993 to 2004.

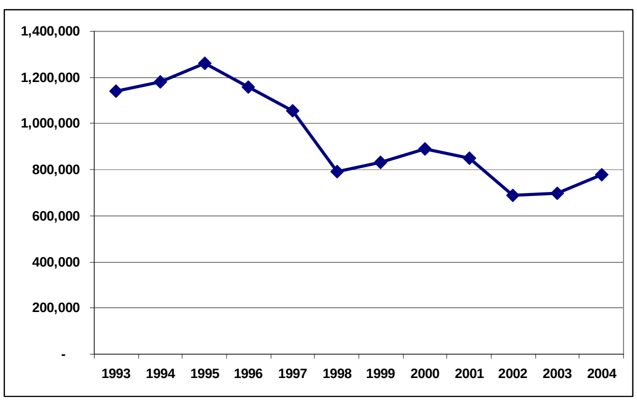

Figure 2. Cotton acres in California, 1993-2004.

The number of acres of cotton planted has also declined during this period (Figure 2) and might explain some of the decline in insecticide use. However, when the number of acre treatments is tracked (Figure 3), the trend demonstrates the same spike in 1995 followed by a decline and leveling after 1999 at about 3 treatments/acre of cotton to a level similar to that prior to 1995. This leveling of insecticide use might reflect the more conservative approach to sticky cotton prevention (Godfrey *et al*, 2003; 2005) adopted by California cotton industry. The increase in 2003 is attributable to increased insect pressure (Adamczyk and Burris, 2004) while the decline in 2004 reflects a reduction in overall insect pest pressure (Adamczyk and Burris, 2005).

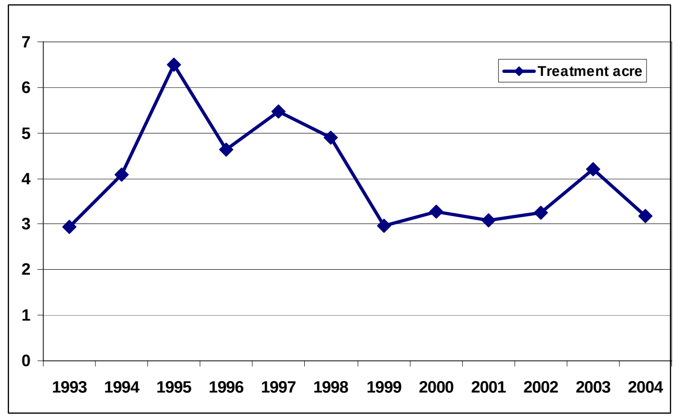

Figure 3. The number of insecticide applications per acre of planted cotton, 1993-2004.

We next examined the composition of the insecticide application by active ingredient risk category (Figure 4). High risk included carbamates and organophosphate while low risk included *Bacillus thuringiensis*, indoxocarb, spinosad, thiamethoxam, acetamiprid, and various insect growth regulators. There has been a steady decline in the use of high risk products, with the exception of oxamyl, which has increased since 2001 from 53,000 to 93,000 acres treated. Pyrethroid use also declined during this period. The increased use of oxamyl may be attributed to a shift in products for *Lygus* management.

Low risk insecticides have steadily increased from 2000 to 2004 (Figure 4). A steep increase occurred in 2002 as new products were registered for use. In 2004, thiamethoxam accounted for 22% of the low risk treatments applied and acetamiprid accounted for 42% (Figure 5). Acetamiprid is highly effective against aphids and whiteflies and has activity against *Lygus*. Overall in 2004, neonicotinoids accounted for nearly one in four insecticide applications. Although neonicotinoid use is not universal, the increasing dependence on this mode of action will continue as organophosphates continue to be restricted. An increased concern about the development of resistance to this mode of action will also continue (Palumbo *et al*, 2003).

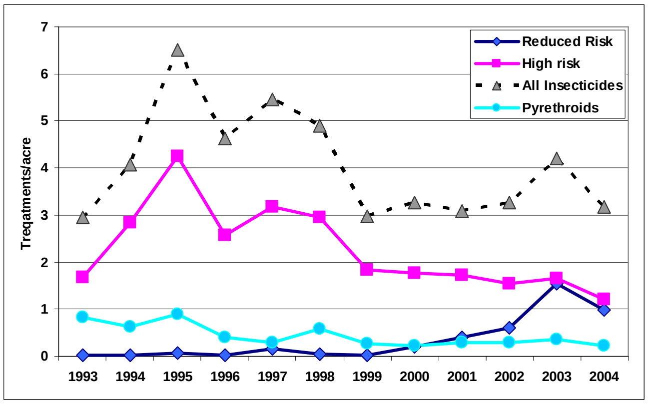

Figure 4. Insecticide use by risk category.

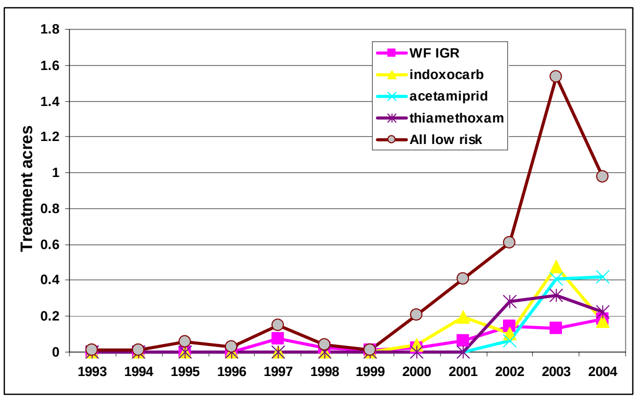

Figure 5. Number of treatments of reduced risk products applied to cotton, 1993 to 2004.

These data (Figure 4) indicated a general decline in the use of insecticides in cotton from 1995 to 2000 and a leveling of use to 3-4 treatment acres from 2000 to 2004. This level is higher then the estimated 1.5 applications reported in the mid-1980's (Goodell, *et al*, 1997), prior to universal pesticide reporting. The probability of reducing the number of insecticide applications is limited due to introduction of silverleaf whitefly and the absolute requirement for honeydew-free cotton. The introduction of effective, reduced-risk products has provided replacement alternatives to organophosphate and carbamate chemistry and has allowed a substantial reduction in high risk insecticides between 1995 and 2004. However, the risk for developing tolerance and resistance to the neonicotinoid class requires the continued development of biologically reliant IPM and improved understanding of the agro-ecosystem in which cotton is embedded. Product replacement is only a temporary fix; the long term solution is improved pest management over the wider landscape.

References

Adamczyk, J.J. and E. Burris. 2004. 57th Annual conference report on cotton insect research and control. Proceedings Beltwide Cotton Conferences. Pp. 1209-10.

Adamczyk, J.J. and E. Burris. 2005. 58th Annual conference report on cotton insect research and control. Proceedings Beltwide Cotton Conferences. Page 1846.

Anonymous. 2005. Pesticide Use Report, www.cdpr.ca.gov/docs/pur/purmain.htm

Godfrey, L. D., K. E. Keillor, P. B. Goodell, M. R. McGuire, J. Bancroft, R. B. Hutmacher. 2003. Management of Late-Season Insect Pests for Protection of Cotton Quality in the San Joaquin Valley. In Proceedings Beltwide Cotton Conferences. Pp. 1189-94.

Godfrey, L.D. and D.D. Reisig. 2005. Factors influencing honeydew deposition by cotton aphid and silverleaf whitefly and incidence of sticky cotton in California cotton. . Proceeding Beltwide Cotton Conferences. Pp. 1787-1982.

Goodell, P.B., E.E. Grafton-Cardwell, and L.D. Godfrey. 1997. Maintaining an IPM program in a shifting pest environment. 1997 Proceedings of the Beltwide Cotton Conferences (Vol. 2). Pp. 1146-1148.

Hardee, D.D. and G.A, Herzog. 1996. 49th Annual conference report on cotton insect research and control. Proceedings Beltwide Cotton Conferences. Page 645.

Kegley, S., S. Orme and L. Neumeister. 2000. Hooked on Poison Pesticide Use in California:1991–1998. 84 pages. Pesticide Action Network. www.Panna.org

Montez, G.H. and E.E. Grafton-Cardwell. 2004. Preparation, management and analysis of the California Department of Pesticide Regulation pesticide use database for agricultural researchers. UC Plant Protection Quarterly. Vol. 4:1:1-5. http://www.uckac.edu/ppq/

Palumbo, J. C., P. C. Ellsworth, T. J. Dennehy, R. L. Nichols. 2003. Cross-commodity Guidelines for Neonicotinoid Insecticides in Arizona. University of Arizona, Cooperative Extension, IPM Series No. 17. 4 pp. http://cals.arizona.edu/pubs/insects/az1319.pdf

Sweezy, S.L. and P. Goldman. 2002. Cotton yields, quality and insect abundance in the northern San Joaquin Valley, CA, 1996-2000: Comparison between organic, conventional and grower-led reduced-input production systems. Proceeding Beltwide Cotton Conferences. Pp. 802-806.

Wilhoit, L. M. Zhang and L.Ross. 2001. Final Report to the California Department of Food and Agriculture for Contract Agreement No. 98-0241.
http://www.cdpr.ca.gov/docs/pur/dataq_rpt.pdf

This paper was published in the Proceedings for the Beltwide Cotton Conferences, Insect Research and Control Conference, San Antonio, Texas, January 2006, Paper 4640.

NEW TOOLS AVAILABLE FOR SPIDER MITE MANAGEMENT IN 2006. *David Haviland, University of California Cooperative Extension, 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 many existing products. New miticides also greatly enhance our ability to use the rotation of materials as a viable strategy for resistance management.

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; Onager is an EC formulation of the active ingredient of Savey). 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 figuring 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 crop production. In some cases, research is readily available to document the efficacy of these products, and in other cases, our knowledge of the best fit for these products is still being developed.

Despite new miticides, IPM is still the Key

While the latest 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. 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 flare ups. 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, wine grapes, or early-harvested navel oranges, where backing off on water is part of a standard harvest preparation. 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 these predators. Until this information 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 in order 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 to use (in cases where one is needed at all), as well as understanding observations made during follow-up visits to the field.

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

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.

Table 2. Registration Status of Selected Miticides for Use Against Spider Mites[1] in California. (Current as of January, 2006)

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

	IRAC Number[2]	Nut Crops			Stone Fruits					Citrus	Pome Fruits		Grape	Cotton
		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.

Disclaimer: *Discussion of research findings necessitates using trade names. This does not constitute product endorsement, nor does it suggest products not listed would not be suitable for use. Some research results included involve use of chemicals which are currently registered for use, or may involve use which would be considered out of label. These results are reported but are not a recommendation from the University of California for use. Consult the label and use it as the basis of all recommendations.*

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 these 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 controls.

ABSTRACTS

BELTWIDE COTTON CONFERENCES, INSECT RESEARCH AND CONTROL CONFERENCE, January 2006. San Antonio, Texas

Measuring Localized Movement of *Lygus hesperus* into San Joaquin Valley Cotton Fields

P.B. Goodell and B. Ribeiro, Kearney Agricultural Center.

Lygus hesperus populations develop both externally and internally to the San Joaquin Valley in California. In certain years, weed hosts are favored by precipitation patterns and these can provide extended habitat on which *Lygus* populations can build. In 2005, tarweed, *Hemizonia kelloggii*, was abundant and widely distributed. *Lygus* populations were sampled weekly from tarweed on uncultivated rangeland and in the adjoining cotton. Both Pima and Acala upland cottons were sampled. In addition to tarweed, almonds (bearing and non-bearing), pistachios, onions and highway frontage were bordering cotton. Tarweed allowed population development into July before soil moisture was depleted and plants senesced. Cotton bordering tarweed did not show a *Lygus* population increase until this time. Other bordering crops and situations acted as substantial sources for *Lygus* adults illustrating the annual problem of pest buildup on internal crops as opposed to the infrequent movement from rangeland areas.

90th ANNUAL MEETING, PACIFIC BRANCH, ENTOMOLOGICAL SOCIETY OF AMERICA, March 5-8, 2006, Wailea, Maui, Hawaii

Implementing Biological Control of Oriental Fruit Moth in California Peaches

W.J. Bentley and S.B. Mallek, Kearney Agricultural Center.

Keywords: Biological control, Oriental fruit moth, *Macrocentrus ancylivorus*, peach pest management, sunflower moth, peach.

Macrocentrus ancylivorus, a parasitoid of Oriental fruit moth (*Grapholitha molesta*), was released at intervals in three consecutive plantings of sunflowers at KAC in both 2003 and 2004. Because *Macrocentrus* does not overwinter on OFM, the sunflower moth (*Homeosoma electellum*) functioned as an alternate overwintering host. Sunflowers were planted adjacent to an orchard of Crimson Lady peaches. Laboratory reared *M. ancylivorus* were obtained from the Colorado State Division of Agriculture, Biological Control Unit, in Palisade, Colorado. Pupae were allowed to hatch in the laboratory at KAC and then collected for release in the sunflower field. Each planting was infested with 1000 *Macrocentrus*. Sunflower heads were caged before and after infestation to monitor emergence of *Macrocentrus*. Emergence of *Macrocentrus* in the sunflowers in 2004 indicated a steady increase in parasitism levels through late season, achieving 100% in our sample populations of sunflower moth. As the plantings were consecutive, so were the *Macrocentrus* releases, resulting in a high degree of parasitism even in our control population. In 2004 *Macrocentrus* wintered on sunflower moth and emerged in the spring of 2005, coinciding with OFM emergence. Oriental fruit moth parasitism reached 95 % in the adjacent peach orchard.

Photo left: *Sunflowers, planted adjacent to an orchard of Crimson Lady peaches, were infested with laboratory reared Macrocentrus ancylivorus. M. ancylivorus overwintered on sunflower moth and emerged in the spring, coinciding with OFM emergence in the orchard.*

<u>Diaprepes Root Weevil Invasion of California</u>

E.E. Grafton-Cardwell, Kearney Agricultural Center, K.E. Godfrey, CDFA, and J.E. Pena, University of Florida.

Diaprepes root weevil, *Diaprepes abbreviatus* (L.) is a pest of numerous crops and ornamental plants. In Florida, where it is well-established, its larval stage causes significant economic damage to the root system of ornamentals, the tubers of crops such as sweet potato and it can girdle citrus trees. *Diaprepes* has been intercepted when entering California numerous times during the past 40 years. It can arrive in the adult stage on or absent from plant material or in the immature stages infesting soil and plant material delivered by trucks and planes. It has a very wide host range, more than 270 plant species in 59 families, and so nearly any ornamental plant can serve as mode of transportation for this pest. Early on, the interceptions originated from Puerto Rico. However, as this pest has expanded its range in Florida, interceptions from Florida have become more frequent and insecticide treatment of nursery material originating from *Diaprepes*-infested areas in Florida is mandatory. During 2001-04, the UC Exotic and Invasive Pest and Disease Program provided funds to U.C. Riverside and the U. of Florida to conduct research and develop brochures and an education program for the California citrus and ornamental nursery industries. Educational seminars for growers, nurserymen, extension personnel and regulators were held throughout California during 2002-04 and the information was incorporated into "First Detector Training". During the fall of 2005, two populations of *Diaprepes* were detected as a result of this educational program in urban neighborhoods in Newport Beach and Long Beach, California. The weevil likely arrived on landscaping plants and became well-established in these neighborhoods over a 3-5 year period. An eradication program is currently under review by the California Department of Food and Agriculture. The *Diaprepes* root weevil invasion provides a fascinating example of the sociological, economic, and regulatory issues involved in exotic pest invasions.

2006 ANNUAL MEETING OF THE WEED SCIENCE SOCIETY OF AMERICA, February 12-16, 2006, New York, New York

<u>Weed Density and Biomass Can Be Reduced By Sub-Surface Drip Irrigation in Conventional And Conservation Tillage Tomatoes</u>

A. Shrestha, J.P. Mitchell, Kearney Agricultural Center, and W.T. Lanini, U.C. Davis, Dept. of Plant Sciences.

Conservation tillage (CT) and subsurface drip irrigation (SDI) are methods currently being investigated in some vegetable crops in California to address environmental regulations that advocate efficient water use, soil conservation, dust emission reduction, and judicial use of pesticides. Because CT may limit weed emergence to the top few inches of soil and SDI may keep the soil surface too dry for weed emergence, these methods may have implications for development of weed suppressive cropping systems in arid regions. A two-year study was conducted at Five Points, CA to assess the effect of SDI and CT on weed densities and biomass in transplanted processing tomato (*Lycopersicon esculentum* Mill.) grown on raised beds. The experimental design was a split-split plot with four replications. Tillage system [CT vs. standard (ST)] was the main plot, irrigation system [SDI vs. furrow (FI)] was the sub-plot, and herbicide [herbicide (H) vs. no herbicide (NH)] was the sub-sub-plot. Weed evaluations were made on the beds and in the furrows twice during the growing season. First year results showed that tillage had no effect ($P>0.05$) on weed densities but SDI had 84 to 92% lower weed densities than the FI plots. In the second year, CT plots had 25% fewer weeds on the beds than the ST plots. Similarly, the SDI plots had 95% fewer weeds than the FI plots. Weed biomass at the end of the season was about 70% and 95% lower in the SDI than in the FI plots in 2004 and 2005, respectively. Total crop yield was not affected ($P>0.05$) by tillage or irrigation system.