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This newsletter is published by the University of California Kearney Plant Protection Group and the Statewide IPM Project. It is intended to provide UC DANR personnel with timely information on pest management research and educational activities in the South Central Region. DANR personnel desiring to be added to or deleted from the mailing list may contact the editors at Kearney Agricultural Center, 9240 S. Riverbend Ave., Parlier, CA 93648. In order to best serve you, comments and suggestions for improvement of this newsletter are invited. Farm Advisors and Specialists may reproduce any portion of this publication for their newsletters, giving proper credit to individual authors.

James J. Stapleton, Charles G. Summers, Beth L. Teviotdale
Editors

IN THIS ISSUE

ARTICLES

STATUS OF ORIENTAL FRUIT MOTH RESISTANCE TO AZINPHOSMETHYL IN CALIFORNIA

William W Barnett, Kearney Ag Center

Introduction

Oriental fruit moth (OFM) is one of the most serious pests of stone fruits in California. OFM can attack most stone fruits including almonds, apricots, prunes, and cherries. However, only peaches and nectarines annually suffer severe losses. Oriental fruit moth was first detected in California in the late 1930s. Specific control measures for this pest were not required until 1954, when an outbreak occurred in the Kingsburg area of Fresno and Kings Counties. The insect later spread to the Sacramento Valley, where in 1962 serious economic losses occurred. Although natural enemies are important in suppressing OFM, from one to four insecticide treatments may be required during the growing season to prevent economic losses.

Oriental fruit moth has 5 generations per year in most California growing areas. Thus, a minimum of 125 generations have been produced since it became an economic pest in the Sacramento Valley. Research in 1964 indicated that the organophosphate insecticides, particularly azinphosmethyl (Guthion), were effective in controlling OFM. In most orchards in the Sacramento Valley, Guthion was the insecticide of choice and was the only material used by many

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

growers. Because of heavy exposure, there have been concerns for several years about OFM developing resistance to Guthion.

Many factors have been reported to affect the development of insect resistance to pesticides. The most obvious factor is the amount of exposure an insect receives to a particular chemical or class of chemicals. If one assumes 3 to 4 applications each year, as is common in some areas on late maturing varieties, it is estimated that 75 to 100 of the 125 generations have been treated with Guthion between 1964 and 1990. In 1985, fieldmen reported failures of OFM control with Guthion in the Lomo, area just north of Yuba City in the Sacramento Valley. Studies were conducted from 1987 to 1990 to determine if OFM was resistant to Guthion, and if so, the magnitude of the problem. In 1987, field experiments were conducted by Frank Zalom (Entomology/IPM, UCD) in a peach orchard where field failures had been reported. His data indicated that labeled rates of 1 lb. Guthion per acre, normally used by growers, resulted in only a 70% reduction in the number of OFM shoot strikes compared to a 90-95% reduction previously experienced. In the same test, it was shown that 4 times the normal rate of Guthion was needed to equal control achieved with a 2 oz. per acre rate of the pyrethroid Pounce (Zalom, unpublished data).

Riedl et al. (1985) developed a bioassay method to test resistance using adult male moths caught in pheromone traps. In 1988-89 we refined and tested this method to determine if populations of OFM were resistant to Guthion. Briefly, the method consisted of removing all but a thin layer of adhesive from Trecé pheromone trap bottoms. Traps containing a fresh OFM lure were hung in an orchard just before sundown and collected early the following morning. Various rates of Guthion were then applied to the thorax of trapped moths. Treated moths were then incubated for 24 hours and the percentage killed was compared to that of untreated moths.

Results of field and laboratory tests during the first 3 years of the study showed OFM in the area where field failures have been reported to exhibit about a 3-fold level of resistance when compared to those in orchards in the San Joaquin Valley which had been treated less intensively. Although this level of resistance was not high, it was enough to result in field failures. It appeared that resistant OFM populations were limited to the Yuba City area, except for one suspected case in Stanislaus County.

The technique of using topically applied toxicants for treating moths appeared to be a viable method of detecting resistance. However, the need for specialized equipment and the time required limited its utility. In order to overcome these problems, we modified a bioassay technique that mixes the toxicant in the adhesive, (Haynes et al., 1987). This technique allowed us to survey for OFM resistance with a minimum of effort in a relatively short time. In 1990 sixteen peach, nectarine, and almond orchards between Fresno and Gridley in Butte County were tested for azinphosmethyl resistance.

Methods

Preliminary tests indicated that 100 µg of azinphosmethyl per gram of adhesive would kill about 99% of a population that had not been treated with azinphosmethyl for at least 8 years. This was chosen as a diagnostic dose. One g technical grade azinphosmethyl. was dissolved in 100 ml acetone. One ml of the 10 mg/ml acetone-azinphosmethyl solution was mixed for 6 to 7 minutes in 100 g adhesive. Approximately 4 g of the adhesive/azinphosmethyl combination was spread evenly over the center of clean standard Trecé IC wing trap bottoms (22.8 x 17.7 cm). Treated bottoms were placed in plastic containers and refrigerated at 10C until ready for use. Four g adhesive without azinphosmethyl was spread on clean trap bottoms as a control.

Insecticide-laced trap bottoms and tops were assembled and placed in the field just prior to dusk. Fresh OFM lures were placed in each trap. Codling moth lures also were added to increase OFM moth catch (Riedl, unpublished). A minimum of 6 insecticide laced and 6 control traps were alternated as they were placed in each orchard. There was a minimum of 200 feet between traps. Traps were retrieved early the following morning. Both control and insecticide-laced trap bottoms were placed in the same ice chests with enough wet paper towels in the bottom to keep humidity above 90%. One inch diameter corks were placed on each of 4 corners of trap bottoms to keep them from touching. Ice chests with trap bottoms were returned to the laboratory (always before 7:30 am PDT) and incubated at 23C for 24 hours. Moth viability was checked 24 hours later by probing them with a pencil. If moths showed any movement they were considered to be alive. Mortality was corrected using Abbott's formula (1925).

Moths for bioassay were collected between May 10 and May 17. The earliest collections were made in

Fresno County. An effort was made to test moths approximately 300 degree-days after the beginning of the second flight. The Butte County population was sampled on May 17.

Results

Survey data from 1990 indicated that the main area where OFM populations showed azinphosmethyl resistance was in the region north of Yuba City in Sutter County and across the Feather River in Yuba County. Five orchards in that area had corrected mortality ranging from 30-50% (Table 1). This compared to 98% mortality in an assumed susceptible population in the San Joaquin Valley (Table 1). The 1990 Butte County sample indicated resistance may also be increasing in that area, with corrected mortality of 60%. In 1991 Bill Olson, Butte County Farm Advisor, surveyed three orchards using Guthion laced adhesive traps and found percent mortality to range from 40-50%. This indicated resistance had also spread to the Gridley area.

It appears from these data that resistance is limited to the Sacramento Valley. However, one orchard in Merced County had only 57% mortality in the 1990 tests. This is a 4-year-old orchard, isolated from other peaches, although there are almonds in the area. The reason for the low mortality in this orchard cannot be explained, since the fieldman does not report failures with Guthion. At this time we assume an error in our sampling, but this orchard merits watching in the future.

Discussion

Experiments conducted in 1990 confirmed that we now have a relatively simple but effective bioassay method for detecting resistance to Guthion in OFM. Bill Olson demonstrated that this method can be used by Farm Advisors or fieldmen to verify resistance in orchards where Guthion failures have been experienced. It must be kept in mind that, as with all lab tests, data from these tests are only indications. However, if field failures have been experienced, and bioassays show low mortality, it can be concluded that resistance is probably present.

Azinphosmethyl is still the most effective organophosphate insecticide for OFM control in most California peach and nectarine orchards. However, if resistance is suspected, growers should consider not using the material. One option is to switch to other classes of materials. Most growers and fieldmen in the Sacramento Valley report that synthetic pyrethroids provide good control of resistant OFM, although mite flare-ups generally follow their use. Another alternative is to use mating disruption for OFM control. Experience with mating disruption has shown it to be a viable alternative to insecticides when used properly. The primary consideration when using mating disruption is orchard isolation. In orchards sufficiently isolated to prevent immigration by mated female moths, mating disruption can be a valuable, economically-feasible tool for resistance management. These methods of resistance management will help preserve the efficacy of our few remaining insecticides.

Literature Cited

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Table 1. Results of 1990 survey of OFM resistance using azinphosmethyl-laced adhesive in .pheromone traps.'

County	Location	Number Tested	Percent Mortality*
Tulare	Kingsburg (Ave. 400)	55	98.1
Fresno	Kearney Ag Center	52	89.4
	Selma (South Ave.)	84	92.3
Madera (almonds	Chowchilla	257	78.9
Merced	Ballico	821	54.5
Stanislaus (almonds)	Salida	138	94.0
San Joaquin	Linden	183	77.5
	Lockeford	352	94.5
Sutter	Rio Oso - 1	197	81.1
	Rio Oso - 2	83	73.5
	Lomo - 1	133	41.0
	Lomo - 2	460	34.5
	Lomo - 3	293	57.2
Yuba	District 10 - 1	386	30.6
	District 10 - 2	25	47.4
Butte	Gridley	401	61.9

*Mortality corrected using Abbott's Formula.
'Diagnostic dose 100 micrograms/gram adhesive.

ABSTRACT

SOCIETY OF NEMATOLOGISTS, Baltimore, MD, July, 1991

Selection of a cover crop and nematode management.
M. V. McKenry and T Buzo, U C Kearney Ag. Center

Microplots were planted to grape, *Vitis vinifera* cv. Colombard rootings and to individual cover crops. Host status of the following nematodes was evaluated: 1) *Meloidogyne hapla*, 2) *M incognita*, 3) *M javanica*, 4) *M. arenaria*, 5) *Xiphinema americanum*, 6) *X. index*, 7) *Pratylenchus vulnus*, 8) *Paratylenchus hamatus*, 9) *Tylenchulus semipenetrans*, and 10) *Criconemella xenoplax*. Sudan Grass, *Sorghum halepense* cv. Sudanense, hosted populations of species 2, 3, and 4; whereas species 1, 5, 7, 8, 9, and 10 declined in numbers. Chlorosis and stunting of the vine occurred. Barley, *Hordeum vulgare* cv. Columbia, supported populations of 1, 2, 3, 4, 8, and 10 but reduced populations of 7 and 9. By incorporating refuse before temperatures exceed 15'C barley can be a useful cover crop. *Bromus mollis* cv. Blando hosted 1, 3, 5, and 10; was a poor host for 2, 4, 6, and 8, and was antagonistic to 7 and 9 with only slight antagonism to the vine. *Vicia* sp. cv. Cahaba White Vetch was an excellent host for species 1, 8, and 10. Adult stages of 7 and 8 were endoparasitic but only 8 reproduced within roots. Populations of 2, 3, 5, 6, and 9 were not hosted by this legume, which is nonantagonistic to grape. Any cover crop also should be rotated every second or third year to avoid pest buildup. In a pre-plant setting rotations with sudan grass and barley or vetch have the potential to gradually reduce soil populations of nematodes.

AMERICAN PHYTOPATHOLOGICAL SOCIETY, St. Louis, MO, August, 1991

Physical Characteristics of Spray-Applied Polymer Mulches as Related to Potential Management of Soilborne Plant Diseases in the San Joaquin Valley
J. J. Stapleton, U. C Kearney Ag. Center

The versatility of sprayable polymer mulches may facilitate numerous uses in integrated crop management strategies, including control of plant diseases. Microplot experiments were conducted in different soil types during summer 1990 to evaluate physical characteristics of several latex and starch/resin spray mulches in comparison to those of conventional polyethylene films. Under test conditions, some spray mulches were nearly as effective as 4 mil polyethylene film for elevating soil temperature, retaining soil moisture, and reducing numbers of soilborne *Pythium* spp. by solarization. Performance of spray mulches on sandy loam soil were superior to those on clay loam, due to cracking of the heavier soil which destroyed mulch integrity. Development of biodegradable spray mulches could eliminate disposal problems encountered with polyethylene film.

Control of Alternaria Late Blight of Pistachio by Manipulation of Irrigation
Themis Michailides and D. Morgan, U. C Kearney Ag. Center

Skipping one "critical" irrigation in a flood irrigated pistachio (cv. Kerman) orchard in early August resulted in a significant ($P < 0.05$) reduction by 60% of fruit naturally infected by *Alternaria alternata* and a trend ($P < 0.10$) towards reduced disease levels on leaves. In blocks irrigated regularly, one application of Kocide 101 in mid-August reduced percentage of infected fruit by 31% ($P < 0.05$), infected leaves by 50% ($P < 0.10$) and propagules of *A. alternata* on fruit. In addition, skipping a sprinkler irrigation in early August in another orchard containing both Kerman and Red Aleppo pistachio trees significantly ($P < 0.05$) reduced the levels of infected fruit and rachises by 60-75 and 65-72%, respectively, in both cultivars. The incidence and severity of natural Alternaria late blight were significantly ($P < 0.05$) greater for Red Aleppo than for Kerman trees. In addition, leaves of Red Aleppo inoculated with a suspension of 10^5 *A. alternata* conidia per ml developed significantly ($P < 0.05$) more lesions than leaves of Kerman or Peters (male) trees. In general, propagules of *A. alternata* on pistachio fruit increased more in blocks irrigated on a regular grower's schedule than in blocks in which one irrigation was skipped in early August.

Positive Correlation of Fig Smut in Calimyrna Fruit with Amounts of Dust and Propagules of *Aspergillus niger* Accumulated on the Trees
Themis Michailides and D. Morgan, U. C Kearney Ag. Center

During 1986-1990 the California fig industry suffered increased levels of smut (caused by *Aspergillus niger)* and mold (caused by other fungi) which affected up to 17% of the fruit. To determine whether discing or noncultivation in fig orchards affected levels of fig smut, ten leaves each from six random trees in seven orchards were sampled periodically and the amounts of dust deposited on them were determined. In addition, the incidence of smut at the end of the season on fresh

and dried fruit was determined. Using data from five out of seven orchards, the percentage of smut (*Y*) in dried figs was linearly ($Y = 1.66 + 92.7X$) correlated ($r^2 = 0.947$) with the weight (g) of dust (*X*) accumulated per ten leaves from late July through mid August. The levels of smut determined on Calimyrna, fruit in late August in all seven orchards was linearly ($Y = -1.06 + 0.0075X$) correlated ($r^2 = 0.986$) with the number of propagules of *A. niger* deposited per ten leaves. However, data from six out of seven orchards showed that the relationship between the incidence of smut in dried Calimyrna figs and the number of propagules of *A. niger* per ten leaves was better described by $Y = -13.35 + 0.035X - 0.0000118X^2$ ($r^2 = 0.863$; $P < 0.01$).

Aspergillus Species Associated with Pistachio Nuts in California Orchards

Mark Doster and Themis Michailides, U. C Kearney Ag. Center

The following *Aspergillus* species were isolated from pistachio nuts collected from orchards in 1990: *A. amstelodami, A. flavus, A. japonicus, A. melleus, A. niger, A. ochraceus, A. oryzae, A. parasiticus*, and *A. wentii* In addition, extensive isolations were made from pistachio nuts gathered in December after harvest from eight commercial orchards in Madera Co. A total of 1062 nuts were surface sterilized and plated on a medium of 6% NaCl and 0.5% agar. The following *Aspergillus* species were isolated (with the percentage of nuts with that species): *A. niger* (4.6%), *A. japonicus* (0.2%), *A. flavus* (0.1%), *A. wentii* (0.1%), and *A. amstelodami* (0.1%). *Aspergillus* spp. were isolated more frequently from nuts with visible insect damage (15.4%) than from nuts with no such damage (2.4%). However, approximately the same percentage of nuts had *Aspergillus* whether the nut was collected from the tree (2.9% and 15.1%, for nuts with and without insect damage, respectively) or from the ground (1.8% and 15.8%, with and without insect damage, respectively). The growth of *Aspergillus* species in nuts left in the orchard after harvest could be important for the increase of mold levels in harvested nuts in the following year.

XII INTERNATIONAL PLANT PROTECTION CONGRESS, Rio de Janeiro, Brazil, August, 1991

Possible Integrated Management of Grape Powdery Mildew (*Uncinula necator*) with Leaf Removal in the San Joaquin Valley

J.J. Stapleton; G. M Leavitt, and P. S. Verdegaal, U. C Kearney Ag. Center

Removal of basal leaves in the cluster zone of wine grapes (*Vitis vinifera*) has been successful in altering canopy microclimate for non-chemical management of bunch rot diseases in several climatic regions of California [Gubler, et al, Plant. Dis. 71:599 (1987); Stapleton, et al, Calif. Agric. 44:15 (1990)], and has reportedly aided in powdery mildew (*Uncinula necator*) control in the coastal Napa Valley. Four replicated field experiments were conducted in 1989-90 to test leaf removal, with and without conventional fungicide programs, for effect on grape powdery mildew in the northern and central San Joaquin Valley. Experimental grape cultivars included mildew-susceptible Carignane and Chardonnay, under varying cultural conditions and historical mildew pressure. Results indicated that under moderate to heavy disease pressure, leaf removal did not provide acceptable disease control, as compared to fungicide programs. Under light to moderate pressure, however, significant reduction of powdery mildew was observed at one of two sites. Studies are underway to determine if powdery mildew fungicide use can be minimized by integrating leaf removal with reduced fungicide applications under San Joaquin Valley conditions.

23rd AGRICULTURAL PLASTICS CONGRESS OF THE AMERICAN SOCIETY FOR PLASTICULTURE, Mobile, AL., Sept.-Oct, 1991

Behavior of Sprayable Polymer Mulches Under San Joaquin Valley Conditions: Potential for Soil Solarization and Soil Sealing Applications

James J. Stapleton, U. C Kearney Ag. Center

Application, durability, and effect on soil physical characteristics of several formulations of sprayable, latex and starch/resin mulching materials was evaluated in microplots under the hot, and environmental conditions characterizing the San Joaquin Valley of California in March-October. Comparison of temperature and moisture dynamics of soil mulched with 1:1 aqueous dilutions of sprayable latex or starch/resin films, or 4-mil polyethylene were emphasized, as were responses of certain soil-borne,

phytopathogenic fungi. Results showed increases in soil temperature under black-pigmented spray mulches that were approximately half those generated under clear polyethylene film. Clear spray mulches did not markedly increase soil temperature. Latex materials generally raised temperatures more than did the starch/resin products. None of the spray mulches were as efficient in retaining soil moisture as the clear or black polyethylene films. Spray mulches performed much better in relatively sandy soils than in heavier clay soils, especially when irrigated, primarily due to undesirable cracking of the clay soils (and mulch) as they dried.

Use of In-Season Polyethylene Mulching for Establishment of Deciduous Fruit and Nut Trees in the San Joaquin Valley: Effects on Pathogen Numbers and Tree Survival

J. J. Stapleton, R J. Wakeman and J. E. DeVay, U. C Kearney Ag Center

Field experiments conducted during the past several years in the northern San Joaquin Valley have shown that many species of deciduous fruit and nut trees can tolerate in-season polyethylene mulching with minimal apparent damage to tree growth. During the mulching period, soilborne populations of undesirable fungi, nematodes, and weeds were usually greatly reduced through the process of soil solarization, and soil moisture was conserved. In 1990, replicated, bareroot transplants of apricot and almond trees were mulched with either transparent or black, 4-mil polyethylene film, or not mulched, near Fresno in the hotter, central San Joaquin Valley. The soil was infested with the wilt pathogen, *Verticillium dahliae*. Mulched trees were not irrigated between planting and mid-August, while control trees were irrigated on an approximately bi-weekly schedule. At the end of the growing season, numbers of fungal propagules were significantly reduced in soil near almond trees and sometimes near apricot. In-season mortality of trees mulched with black film was no greater than the control; however, trees mulched with transparent film did not tolerate the treatment.

NEWS ITEMS

UCIPM Notes

Peter B. Goodell, U. C. Kearney Agricultural Center

Development of a System to Access California's Total Pesticide Reporting Data

A proposal to develop a central data storage facility for California's 100% pesticide reporting system was submitted by Frank Zalom, Mike Stimmann, and Joyce Strand. The proposal was submitted to and funded by NAPIAP (National Agricultural Pesticide Impact Assessment Program).

The objectives are to: 1) develop a system for on-line access of California's pesticide usage database; 2) develop supporting documentation for the database and associated software; and, 3) make the database and associated software available to campus-based researchers, county Cooperative Extension staff, and governmental agencies.

Since January 1990, CDFA has required that all pesticide usage be reported. Included in this reporting are formulation used, quantity applied, method of application, commodity treated, location (county, township, range, section), acres treated, purpose of application (ag, structural, vector control, or highway), and applicator. It is estimated that for 1990 there were 4.8 million records. While CDFA was required to summarize these data, it had no plans to provide a dynamic way in which to review and analyze the database. Since the database is estimated to exceed 600 megabytes annually, it is easy to understand why no such summary program was developed.

The proposal calls for developing an on-line system for accessing the pesticide data with software that performs common and straightforward queries to the very large database. In addition, the system would allow users to request manageable subsets of the data based on criteria specified by the user and move the data to their computers for further analysis.

A common request made to Advisors and Specialists is how many acres of commodity X were treated in 1990 in county Y for pest Z. Thus far, this information is nearly impossible to obtain in a timely fashion. The development of this central database could change all that. While one shortcoming of the reporting system is that it does not require the target pest to be reported, in many commodities the use pattern and time of application would allow for reasonable guesses to be

made. Access to such data would allow the development of baselines to follow the change in pesticide usage. It could help evaluate the change in pest control practices. It certainly would improve the data quality during NAPIAP's pesticide assessment process and make the process easier for those requested to provide data.

It is expected that the 1990 and 1991 data would be available in late 1992.

IMPACT Computer Training Available from Statewide IPM Project

Joyce Strand has announced the 1991-92 training schedule for IMPACT. IMPACT is the central IPM computer system containing weather, pest management guidelines, electronic mail service, data analysis, and simulation models. The training agenda is flexible but will include these topics as well as the fundamentals of telecommunications to connect to the Davis computer.

The schedule is as follows:

U.C. Riverside
November 19, 1991
January 7, 1992
April 7, 1992

U.C. Davis
February 4, 1992
May 12,1992

U.C. Kearney Ag. Center
January 21, 1992
May 5, 1992

U.C. Berkeley
March 3, 1992

Joyce reminds us that if there is sufficient interest in an IMPACT topic, she would make a special trip to a county. This includes Farm Advisors or individual clientele with contact through the Advisor. For more information about setting up such a meeting, contact Joyce Strand at 916 752-8350. To make reservations for any of the meetings list above, contact Suzanne Roodzant at the same number.