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Cooperative Extension
Agricultural Experiment Station
Statewide IPM Program

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IN THIS ISSUE

ABSTRACTS

SOCIETY OF NEMATOLOGISTS, JULY 12-17, 2003, Ithica, New York

Nematicidal Activity of Walnut Extracts Against Root-Knot Nematodes

M.V. McKenry and S.A. Anwar. Nematology, University of California, Riverside, Kearney Agricultural Center

Reducing branches, limbs, trunks, and roots of *Juglans* spp. to a powder of less than 100-mesh can provide a water extractable tea. The powder exhibits a specific gravity greater than 1.0, enabling easy separation of particulates from the tea. *Juglans* spp. contain antioxidants, phenolic compounds, tannins, and other soluble ingredients that, in combination, produce a nematicidal effect. A bioassay was performed to investigate the nematicidal activity of walnut extract against second stage juveniles (J2) of *Meloidogyne incognita* at 24, 48, and 144 hours after exposure to various extract concentrations. Freshly hatched J2 were placed into sealed plastic vials at four concentrations of *Juglans* tea, including 50, 25, 10, and 2.5 g/l. The three higher concentrations consistently caused greater mortality, compared to the 2.5 g/l concentration and a water control. Forty-eight hours later, the two higher concentrations resulted in 100% nematode mortality with vacuoles observed in the intestinal region. The 10 g/l concentration took 96 additional hours to produce 100% nematode mortality. By comparison, synthetic juglone provides 100% kill after 48 hr exposure to 1 g/l. In a microplot setting, newly planted grapevines inoculated with *M. incognita* J2 received 50 g/l *Juglans* tea six times over a two-year period. Nematode control approximated 75%, equivalent to the standard phenamiphos comparison. Phytotoxicity was not observed with repeated applications of the tea. This tea product provides the opportunity for delivery of botanically derived nematicidal agents deep into the soil profile around roots of perennial crops.

Mechanisms that Reduce Nematode Development in New Grape Rootstocks

S.A. Anwar and M.V. McKenry. Nematology, University of California, Riverside, Kearney Agricultural Center

A decade-long search among *Vitis* spp. for broad and durable nematode resistance culminated in the finding of five new sources from four different parentages. Experiments were initiated to quantify and observe nematode/host interactions during nematode penetration, development, and reproduction. The five sources of resistance were effective against all aggressive *Meloidogyne* populations but also nematodes of other genera. What features were common to the new resistance sources? All the new sources display a plant hypersensitive response (HR) that reduces entry of infective juveniles at the root tip. This HR involves a greater number of plant cells than previously available among commercial *Vitis* rootstocks. Contemporary *Vitis* resistance yields only enough HR to stop the first four or five infective juveniles but aggressive populations enter in greater numbers. The root tip is also a favored feeding site of *Xiphinema index*, another reason to locate adequate HR there. During the period from nematode feeding to reproduction these five new resistance sources also exhibit additional defense mechanisms unavailable in contemporary grape rootstocks. Several resistance sources induced necrosis of feeding tissues within cortical cells, which restricted female development and overall egg production. One source resulted in a dissolving of the adult female within newly formed galls. Several sources limited the size of the syncytium and gall thus limiting long-term feeding by *Meloidogyne* to young roots. Selection for multiple resistant mechanisms in multiple locations along the root and over time provides resistance to a broader collection of nematode genera including aggressive *Meloidogyne* populations, *X. index*, *Pratylenchus vulnus*, and *Tylenchulus semipenetrans*. Resistance to this many different nematode species has not previously been available.

PACIFIC BRANCH, ENTOMOLOGICAL SOCIETY OF AMERICA, June 21-23, 2004, Bozeman, Montana

Impact of Organophosphate Insecticides on Cotton Insect Management

P.B. Goodell, Statewide IPM Program, University of California, Kearney Agricultural Center

Multiple insect classes attack California cotton including Hemiptera (*Lygus hesperus)*, Homoptera (*Aphis gossypii* and *Bemisia argentifolii*), Lepidoptera (*Spodoptera exigua*, *Pectinophora gossypiella*), Thysanura (*Frankliniella occidentalis)* as well as spider mites (*Tetranychus spp)*. This broad range of pests has various feeding habits, attacks all parts of the plant and occurs throughout the season. Managing such an array of insect and mite pests has been a major challenge since synthetic pesticides were introduced into the production system in the 1950s. The organophosphate insecticide class has been utilized in cotton pest control since the 1960s playing a key role as a replacement for the organochlorines such as DDT and toxaphene.

Organophosphates still play a key role in cotton pest control for particular pests such as aphids, thrips and worms but are less effective against Lygus, mites and whiteflies. New classes of insecticides and miticides are being introduced that are reduced-risk and more selective, especially against worms. However, aphid management still relies on organophosphates, especially very late in the production system when exposed cotton lint is most vulnerable to honeydew deposition. The major pest management issue for the cotton industry has become ensuring quality cotton through the prevention of sticky cotton.

Managing late season aphid populations with organophosphate alternatives is a challenge. For example, chloronicotinyl insecticides that rely on trans-laminar movement can be less effective late in the season when leaves have aged or dust builds on the leaf surface. Even when reduced-risk products are used mid-season, many of the organophosphate alternatives are slower acting, suggesting that populations should be managed at much lower densities then current decision-making guidelines indicate. Finally, as more reliance is placed on new chemistry, organophosphates can play an important role in managing insecticide resistance for these reduced-risk products by providing rotation options that utilize different modes of action.

Managing Lygus in an Ecological Context

P.B. Goodell, Statewide IPM Program, University of California, Kearney Agricultural Center

Lygus hesperus, the western tarnished plant bug, is an indigenous species in the San Joaquin Valley (SJV) of California. As agriculture developed in the SJV, *Lygus* became a key pest in many of the food and fiber crops introduced into the SJV. In addition to its pest status in cotton, alfalfa seed, cowpeas, lima beans, lettuce, and stone fruits, *Lygus* populations can develop on a wide variety of plants including weeds and crops.

One key ecological principle is the recognition of source and sink relationships between host availability and *Lygus* population dynamics. *Lygus* population densities dip to low levels during the winter as the insects overwinter as presexual adults in the Valley and in the rim of hills surrounding the SJV. Populations increase through the spring and summer and decline in September when day-length triggers a weak diapause. *Lygus* populations initially develop on spring weeds and move into crops as these weeds become unsuitable. Rainfall patterns can influence the weed community in an area, the duration of host suitability and thus, the potential localized population density. In the Mediterranean climate of California, all non-irrigated plant hosts rapidly become unavailable by late spring, forcing *Lygus* into developing crop hosts.

The crop mosaic within an area is spatially unique through time. As population densities reach their maximum in summer, many acres of crop hosts are being removed from the system as a result of harvest, concentrating *Lygus* into the fewer remaining acres. July is the month in which *Lygus* are most problematic in cotton fields located in landscapes that have little alfalfa hay. Populations can exceed threshold and require applications of broad spectrum insecticides that can result in secondary pest outbreaks or increase the risk for the development of insecticide resistance in other pests.

Alfalfa hay is a preferred host and will retain *Lygus* populations if managed. When as little as 2.5% of the field is left unharvested, sufficient habitat will be provided to retain *Lygus* and prevent movement into adjoining cotton fields. The reasons for alfalfa preference by *Lygus* are not fully understood but may include dense plantings that allow nymphs easy movement between plants, high humidity that reduces physiological stress, and abundance of floral buds. Alfalfa hay is the only crop widely grown in which the vegetative portions are harvested instead of reproductive structures. This is important since it prevents plants from going into physiological stress prior to harvest. Thus the plants are suitable, vigorously growing hosts up to the moment of harvest. Cutting appears to reset the generational development by allowing concentration of adults and perhaps 5th instar as the surviving cohorts. When provided with minimal habitat refugia, movement from alfalfa to cotton by *Lygus* adults will be limited.

Our work continues to study the mosaic of crops that surround cotton fields and the influence of various crop associations on *Lygus* population densities and treatments in cotton. We are utilizing limited remote sensing but relying more on community participation to build current crop use maps and GIS mapping tools for analysis.

The Impact of the Loss of Organophosphate Insecticides on Citrus

E.E. Grafton-Cardwell, Entomology, University of California, Riverside, Kearney Agricultural Center

San Joaquin Valley California citrus has experienced a dramatic reduction (>70%) in the annual use of organophosphate (OP) and carbamate insecticides since 1997. The primary reason for the change was the replacement of methidathion, chlorpyrifos, and carbaryl with the insect growth regulator (IGR) pyriproxyfen for control of California red scale and the replacement of formetanate and dimethoate with spinosad for control of citrus thrips. A number of California red scale and citrus thrips populations throughout the region had developed high levels of resistance to OP and carbamate insecticides. In citrus, we have observed several dramatic changes in pest complexes due to the shift from an OP and carbamate chemical control system to IGRs, neonicotinoids, pyrethroids and miscellaneous ‘softer’ chemistries. First, several insects, notably forktailed katydid and citricola scale, that were coincidentally controlled by the OPs and carbamates applied for thrips and red scale have been released from control. These pests lack effective biological control and the new insecticides are generally less effective in controlling them. Chlorpyrifos is still the most effective control agent for katydids and citricola scale. Because OPs have been used for many years in citrus, many of the natural enemies have developed resistance to them. Thus, chlorpyrifos can be very selective and IPM-friendly if used at low rates. In addition, the predatory vedalia beetle, which has kept cottony cushion scale under control for many years, is very sensitive to many of the new insecticides. If vedalia is eliminated by the new insecticides, then organophosphate or carbamate insecticides are needed to control the cottony cushion scale.

Vedalia Beetle Population Response to Pest Management and Environmental Conditions

E.E. Grafton-Cardwell, Entomology, University of California, Riverside, Kearney Agricultural Center

Vedalia beetle, *Rodolia cardinalis* has been the primary natural enemy regulating populations of cottony cushion scale, *Icerya purchasi* Maskell in the San Joaquin Valley of California since it was introduced in the winter of 1888-89 from Australia. Periodically, vedalia populations have been disrupted by the introduction of new insecticides and outbreaks of cottony cushion scale resulted. For more than 30 years the primary insecticide classes used to control key pests of citrus have been organophosphates and carbamates. During 1997-2002, six new insecticides, toxic to vedalia, including the neonicotinoids imidacloprid and acetamiprid, the pyrethroids cyfluthrin and fenproparthrin, and the insect growth regulators pyriproxyfen and buprofezin, were registered and used for various pests in California citrus. Sporadic, serious outbreaks of cottony cushion scale occurred during this time and are likely to continue as vedalia adjusts to these insecticides. These recent cottony cushion scale outbreaks stimulated research on the environmental factors influencing the success of vedalia beetle in the San Joaquin Valley. This region experiences extremes of winter and summer temperatures. Vedalia beetle populations decline in June or July even in the presence of adequate prey. The decline appears to be related to increasing temperature and lack of adult stages of cottony cushion scale for egg laying. In addition, the arrival of vedalia beetle in citrus orchards in the springtime varies widely from year to year, possibly affected by winter temperature. Growers can maximize the predatory effect of vedalia by introducing them to new cottony cushion scale infestations and by avoiding pesticide use during the critical months (Mar-May) before summer heat reduces vedalia growth and development.

The Impact of Loss of Organophosphate Insecticides on Almonds

C. Pickel, Statewide IPM Program, University of California UCCE Sutter-Yuba County

California is the only state in the United States to commercially produce almonds and they produce seventy-five percent of the world's production. California's almond acreage is estimated by California Agricultural Statistics Service at 696,424 acres in 2002. Approximately 50 varieties of almonds are grown commercially, with Nonpareil a soft shell variety that is more prone to insect damage, as the primary variety. The most significant pests include navel orangeworm (*Amyelois transitella)*, peach twig borer *(Anarsia lineatella)*, San Jose scale (*Quadraspidiotus perniciosus)*, ants (*Tetramerium caespitum* and *Solenopsis xyloni*) and webspinning mites (*Tetranychus spp.)*. These pests are present in all almond growing areas of the state. New pests are now emerging such as the oblique-banded leafroller *(Choristoneura rosaceana)*, european fruit lecanium (*Parthenolecanium corni)*, and oriental fruit moth (*Grapholita molesta)* due to the reduction of broad spectrum insecticides. According to Pesticide Use Reports published by California Department of Pesticide Regulation, pesticide use in California almonds continues to decline since 1997, the highest reported use. From 1999-2003, the California almond industry has reduced its annual use of all pesticides by almost 3 million pounds, a 20% reduction in pounds applied per acre. Almond growers have done this by relying more on winter sanitation, monitoring for pests, and softer insecticides. Almonds can be grown without organophosphates and increased crop loss but the soft chemical alternatives can increase costs from $72.00 to $206.00 per acre in a high pest pressure situation and more monitoring will be required to avoid loss from secondary pests.

The Impact of the Loss of Organophosphates on Grape Production

L.G. Varela, University of California Statewide IPM Program, UCCE Santa Rosa County

California ranks first in grape production in the United States and grapes are ranked second in value of all California agricultural commodities. Production is divided into fresh market/table, raisin and wine grapes. A total of 847,000 acres of grapes were harvested in 2002, of which 273,000 acres (32.2%) were planted with raisin grape varieties, 486,000 acres (57.4 %) were wine grapes and about 88,000 acres (10.4%) were table grapes.

There are four major areas of production in the state: the southern San Joaquin Valley (498,567 acres), northern San Joaquin and Sacramento valleys (107,354), coastal (213,419 acres) and desert (16,773 acres). The southern San Joaquin Valley produces 99% of California's raisins, 85% of table grape production and 60% of the wine grape crop. Coastal areas, northern San Joaquin and Sacramento valleys produce primarily wine grapes and the desert area produces table grapes.

Some of the more common pests include leafhoppers, spider mites, mealybugs, leafrollers, western grape sceletonizer, thrips, sharpshooters and phylloxera. The relative importance of these pests depends on the type of grape crop being produced and the region.

Eliminating organophosphate insecticides from grape production would have minor impact with the exception of vine mealybug control in some areas, ant control in vineyards with high populations of mealybugs, and root knot nematode in the southern San Joaquin Valley and the desert.

CALIFORNIA CONFERENCE ON BIOLOGICAL CONTROL IV, July 13-15, 2004, Berkeley, CA

Host Plant Influence on Glassy-winged Sharpshooter and its Natural Enemies

K.M. Daane, Center for Biological Control, Division of Insect Biology, University of California, Berkeley, Kearney Agricultural Center; M.W. Johnson, Entomology, University of California, Riverside, Kearney Agricultural Center; T. Ruiz, Division of Insect Biology, University of California, Berkeley, Kearney Agricultural Center; and J.M. Hashim, UCCE Kern County

We followed the abundance of glassy-winged sharpshooter and its natural enemies on different host plants in residential areas near Bakersfield, California. We also used potted plants to provide a replicated array of similarly-conditioned GWSS host species in order to follow GWSS host plant preference. Results show GWSS seasonal-long densities were influenced by host plant species, with oleander, Xylosma, and crape myrtle as some of the preferred host plant species for the spring and summer GWSS populations. GWSS preferred different host plant species for adult and nymph feeding as compared with egg-laying. The most effective natural enemies were mymarid parasitoids, with *Gonatocerus ashmeadi* and *G. triguttatus* reared from egg masses collected on most host plants. Predators were present, especially spiders, and often observed feeding on GWSS. However, results did not show any one predator species to be consistently associated with GWSS or with a reduction in GWSS densities.

Impact of Legally Compliant Organic Pesticides on Natural Enemies

M.W. Johnson and R. Krugner, Entomology, University of California, Riverside, Kearney Agricultural Center

Twenty-nine studies were reviewed that examined the impacts of four commercially produced insect pathogens, spinosad®, and neem / azadirachtin on 49 natural enemy species among 23 arthropod families (including insects, mites, and spiders). Results indicated that many toxins used in legally compliant organic pesticides have the ability to either kill or debilitate (via sublethal effects) many parasitoids and predators commonly found in agriculture. These results are mainly based on laboratory experiments with few studies conducted in the field. Greater than 20% mortality was caused to most species (42 of 49) by the compounds / pathogens examined. *Hippodamia convergens* and *Podisus maculiventris* were the only species tested in all three toxin categories without > 20% mortality, but the latter species did exhibit sublethal effects following neem / azadirachtin exposure.

The insect pathogens appeared to be the safer controls, however, there was much less data in this category. Spinosad appeared to be the greatest threat to the parasitoids. The predators were similarly impacted by spinosad and neem / azadirachtin. Because most of the data discussed originated from laboratory studies, it must be viewed with caution. We found no reported examples of actual pest resurgences or secondary pest upsets due to the destruction of natural enemy populations by applications of these compounds. The true impact of these compounds must be viewed in these terms. More field-oriented research is needed to determine if disruptions are actually happening in organic crops where legally compliant organic pesticides are used.

Constraints on the effectiveness of *Psyllaephagus bliteus* (Hymenoptera: Encyrtidae), a biological control agent for the red-gum lerp psyllid (Hemiptera: Psylloidea) in California

K.R. Sime, Division of Insect Biology, University of California, Berkeley; K.M. Daane, Center for Biological Control, Division of Insect Biology, University of California, Berkeley, Kearney Agricultural Center; D.L. Dahlsten, J.W. Andrews Jr., D. Rowney, Division of Insect Biology, University of California, Berkeley.

Psyllaephagus bliteus Riek (Hymenoptera: Encyrtidae) was released throughout California in 2000 and 2001 to control the red-gum lerp psyllid, *Glycaspis* *brimblecombei* Moore (Hemiptera: Psylloidea). A *Eucalyptus* feeder native to Australia, *G. brimblecombei* was first discovered near Los Angeles in 1998 and had spread throughout the state by 2000. The wasp established and quickly became effective in coastal areas but to date has had less impact inland. The experiments discussed herein were designed to address this problem and collect basic biological information that would improve the control program. The specific objectives were to determine adult longevity and fecundity, to determine host-stage preference for oviposition, and to compare parasitism rates in the field at inland and coastal sites. Maximum fecundity occurs at one to three weeks of age. Most eggs are recovered from 3rd instars, but oviposition is attempted into 3rd, 4th, and 5th instars equally. Observations of host-handling behavior suggest that the large lerps of 4th and 5th instars impede oviposition. In 2003, parasitism rates were lower at inland than at coastal sites at the same latitude; cage trials conducted during the summer suggest that the adults do not survive long and lay fewer eggs inland. We hypothesize that high summer temperatures inland limit the effectiveness of this wasp.

CALIFORNIA ORGANIC PRODUCTION AND FARMING IN THE NEW MILLENNIUM (CCBC IV), July 15, 2004, Berkeley, CA

Investigations in the Management of San Jose Scale *Diaspidiotus perniciosus* (Comstock) (Homoptera: *Diaspididae*) with Horticultural Mineral Oil

W. Bentley and L. Martin, University of California, Statewide Integrated Pest Management Program, Kearney Agricultural Center

San Jose scale *Diaspidiotus perniciosus* (Comstock) control was studied over a four-year period on four cultivars of plums in central California. The results of this study demonstrated that San Jose scale is effectively managed with a horticultural mineral oil application during the dormant season. No additional insecticide is required. Control of San Jose scale is influenced by the amount of oil applied per acre, the concentration of oil in the spray tank, and the timing of the application. In this study, best results were obtained with 8 gallons of horticultural mineral oil in a 400 gallon per acre mixture when applied in February. If 100 gallons per acre is applied, a minimum of 8 gallons of oil provided adequate control of San Jose scale. The harvest date of plums also influenced the severity of San Jose scale infestation. Plum varieties harvested in late June and early July are less infested than those harvested in August or September. Finally, preliminary studies resulted in a close relationship between infested spurs collected during the winter and fruit infestation with the late harvested Royal Diamond and Rosemary cultivars.

Control of Codling Moth in Organic Pear Orchards from 1991-2004

R.B. Elkins, UCCE Lake County; C.A. Ingels, UCCE Sacramento County; R.A. Van Steenwyyk, Dept. of Environmental Science, Policy and Management, U.C. Berkeley; and L.G. Varela, UCCE Santa Rosa County

Codling moth (*Cydia* (Laspeyresia) *pomonella*) (CM) mating disruption (MD) has become the standard practice in the California pear industry. Organic growers are currently permitted to utilize only hand-applied dispensers. In 1991, 2001, and 2003 potentially effective, organically acceptable alternative insecticides were tested to supplement CMMD. Various combinations of CMMD and *Bacillus thurengiensis* (BT), petroleum based oils, CM Granulosis Virus (CMGV), spinosad, pyrethrum and kaolinic clay were applied in ten replicated trials in Lake, Mendocino, Sacramento and Solano counties. Trials were either grower or handgun applied and all conducted in orchards with a history of CM damage. Materials were applied 3-11 times, depending on the trial. In most cases MD alone was the control treatment. Completely untreated controls were included in two trials. Overall results showed that MD alone provided about 60% added control. MD plus supplemental insecticides provided an average of 69% control above MD alone and 89% above untreated plots. Of the materials tested, only the commercial pyrethrum product, Pyganic®, failed to provide significantly more control versus MD alone. Entrust® simultaneously controlled pear slug (*Caliroa cerasi*) in one trial, while counts of European red mites (*Panonychus ulmi*) were significantly higher in plots treated with Surround® in two trials. While many applications may be required in high population orchards, results showed that several new materials are available to organic pear growers to supplement CMMD.

Soil Solarization in Organic and Conventional Production Systems in Warmer Areas of California

R.H. Molinar, UCCE Fresno County; J.J. Stapleton, University of California Statewide IPM Program, Kearney Agricultural Center

Limited resource growers, many of them ethnic minorities, and organic farmers in the San Joaquin Valley and other agricultural areas in California are at a disadvantage when it comes to economically viable options for pest management. Research and implementation projects conducted at UC Kearney and on-farm in surrounding areas near Fresno over the past 10 years have provided guidelines and technical support for growers wishing to implement solarization and related techniques to provide non-chemical soil disinfestation for a wide variety of specialty crops. Research trials with parsley and strawberries confirmed that soil solarization in the warmer climates of California can provide fumigant-like control of weed and other pest infestations in shallow-rooted crops, without the need for chemical pesticides.

Manipulating Microenvironments for Ecological Weed Management

A. Shrestha, University of California Statewide IPM Program, Kearney Agricultural Center; M. Fidelibus, Dept. of Viticulture and Enology, University of California, Davis, Kearney Agricultural Center

Weeds require similar resources as crops; light, water, and nutrients. If one or more of these resources are limiting, weeds will compete with crops. Competition implies reduced crop yields, but 'weed-suppressive' cropping systems might be achieved by creating microenvironments that limit the weeds' ability to obtain necessary resources. In this paper we present three examples of microenvironmental manipulations (light or water) to create weed suppressive cropping systems. In the first study, we found that row orientation affected the quantity of light beneath grapevine (*Vitis vinifera* L.) canopies, thus altering the light environment of weeds. The different light environment influenced weed growth and development. Grapevines on a Y-shaped trellis were used in the study. Rows were oriented East-West (EW) or North-South (NS) in a randomized complete block design. In both row orientations, PAR at the weed canopy zone decreased as the vine canopy developed, but peak PAR was generally less than 75 $\mu mol \cdot m^{-2} \cdot sec^{-1}$ in EW rows, whereas in NS rows, PAR was between 200 to500 $\mu mol \cdot m^{-2} \cdot sec^{-1}$ in the morning and afternoon. The ratio of red to far-red light was also lower in EW rows than in NS rows in the morning and afternoon. Moreover, at those times, nightshades (*Solanum* sp.) in EW rows had lower photosynthetic rates than nightshades in NS rows. Weeds growing in EW rows compensated for low light levels by producing larger, thinner leaves and they partitioned less resources to roots compared to weeds in NS rows. Thus, selection of row orientation during vineyard design might have important implications for future weed management. In a separate experiment, early canopy closure and reduced weed biomass was obtained by planting cotton (*Gossypium hirsutum* L.) in double rows instead of single rows. A third experiment showed that, weed populations could be reduced by use of sub-surface drip irrigation instead of a furrow irrigation system in processing tomato (*Lycopersicon esculentum* Mill.) because the drip system created a microenvironment that was too dry for weeds to establish in the furrows. Such responses of weeds to their microenvironments may have important implications for ecological weed management.

Potential for Soil Biofumigation Using Residues of *Allium* spp. in Crop Rotation Strategies

J.J. Stapleton, University of California Statewide IPM Program, Kearney Agricultural Center; R.H. Molinar, UCCE Fresno County; Susan B. Mallek and Tarcisio S. Ruiz, University of California Statewide IPM Program, Kearney Agricultural Center

Laboratory microcosm studies demonstrated the potential of onion (*Allium cepa)* and garlic (*A. sativum)* residues to act as biofumigants for the control of weeds and nematodes. At ambient soil temperature (23 C), amendments of 'California Early' garlic and 'Mission' and 'Early Red Burger' onion had only modest effects on viability of barnyardgrass (*Echinochloa crus-galli*), black nightshade (*Solanum nigrum*), common purslane (*Portulaca oleracea*), and London rocket (*Sisymbrium irio*) seeds; or on Southern root-knot (*Meloidogyne incognita*) or lesion (*Pratylenchus neglectus*) nematodes. However, when the temperature of amended soils was raised to 39 ºC, the interactions of temperature and exposure time (2, 4, and 7 days), temperature and amendment (onion or garlic vs. nonamended), and temperature and amendment rate (1% and 3%) produced significantly deleterious effects on seed viability of the tested weed species. In a subsequent on-farm field experiment, biofumigation with 'Early Red Burger' onion residues alone again produced a modest effect on pest control, while soil heating (solarization) alone was more effective. Combining the onion residues with solarization did not statistically improve control of nematodes over that provided by solarization alone.

AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, July 17-20, 2004, Austin, TX

Evaluation of Plastic Reflective and Wheat Straw Mulches for Pest and Disease Control in Cucurbit Production Systems

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Trials were conducted in 2002 and 2003 in California's San Joaquin Valley to determine the efficiency of reflective plastic and wheat straw in managing silverleaf whitefly and aphid-borne virus diseases in late planted cantaloupes: In 2002, the incidence of aphid-borne viruses was lowest in plants growing over reflective plastic followed by those growing over wheat straw and then those growing over bare soil. Wheat straw mulch was as effective as reflective plastic during the early part of the growing season in reducing the incidence of virus disease, but by mid-season, the reflective plastic was superior. The incidence of virus diseases in plants growing over wheat straw significantly ($P <-0.05$) lower than that in plants growing over bare soil throughout the season. Whitefly numbers (nymphs per cm^2) and aphid numbers were significantly reduced on plants growing over both reflective mulch and wheat straw mulch compared to those growing over bare soil. Yields of all sizes of melons were significantly higher in the reflective mulch plots and yield for the straw mulched and bare soil plots were not significantly different. Results in 2003 were similar to those of 2002. Both whitefly numbers and aphid numbers were significantly lower in plants growing over both mulches than in those growing over bare soil. Virus incidence was initially low but following aphid flight in late August, the number of infected plants increased rapidly. Both the reflective plastic and straw provided equal protection from aphid-borne viruses throughout the growing season. Yields were highest in the reflective plastic plots, followed by the straw mulch and finally the bare soil. Differences were significant ($P < 0.05$) among all three treatments.

THE AMERICAN PHYTOPATHOLOGIAL SOCIETY ANNUAL MEETING, July 31-August 4, 2004, Anaheim, California

Evaluation of insecticide applications to reduce corn leafhopper populations and corn stunt disease

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Corn stunt disease, caused by *Spiroplasma kunkelii* and vectored by the corn leafhopper *(Dalbulus maidis)*, has become a significant problem in silage corn production in the southern portion of the San Joaquin Valley, California, since 1996. In large, replicated field trials, systemic seed treatments (imidacloprid in 2002 and clothianidin in 2003) reduced leafhopper numbers by about 50% compared to control plots. Disease incidence, based on symptom expression, was significantly reduced in each trial but not as much as leafhopper populations. Yields in the seed treatments were not significantly higher than the control treatment. In three large-scale replicated field trials in 2003, foliar pyrethroid insecticides applied after leafhopper populations were established were more effective than organophosphates in reducing leafhopper counts. Disease incidence was not significantly reduced in any of these foliar trials. However in two of the trials, insecticide treatments as a group had higher yields ($P = 0.02$ and $P = 0.06$) than the control with increases of 1.0 and 0.6 tons per acre (30% dry matter basis) respectively.

XXII INTERNATIONAL CONGRESS OF ENTOMOLOGY, August 15-21, 2004, Brisbane, Australia

Grape IPM and Biological Control in California Organic Vineyards

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Development of novel approaches for Integrated Pest Management (IPM) systems has often relied upon research in organic or sustainable crops systems. California vineyards were at the forefront of many novel approaches developed in the 1950-70s, with vineyard insect pests the target of classical, augmentation, and conservation biological control, as well as many cultural control practices. Today, the practice of organic vineyard farming in California is jeopardized by a series of newly invasive pests, such as the glassy-winged sharpshooter and the vine mealybug. New control options currently developed for these pests include biological control, the use of area-wide management (glassy-winged sharpshooter) and mating disruption (vine mealybug). Nevertheless, these approaches have yet to be proven effective for organic producers that have infestations of these newly invasive insect pests. As a result, successful organic farming may rely more on pest species present, vineyard location and commodity (wine, raisin or table grape) than on implementation of sustainable insect management practices. I discuss both past and current insect pest management programs, as well as the outlook for organic farming in California vineyards.

Temperature-dependent Development of *Anagyrus pseudococci* on the Vine Mealybug

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The influence of temperature on *Anagyrus pseudococci* (Girault) development and overwintering was investigated to improve biological control of the vine mealybug, *Planococcus ficus* (Signoret), in California vineyards. We tested eight constant temperatures and show *A. pseudococci* completed development (egg to adult eclosion) between 14 and 34ºC. Development times ranged from 79.1 ± 1.0 days (14ºC) to 10.2 ± 0.3 days (34ºC). We determined optimal, maximum and minimum development temperatures as 24.7, 36.0 and 11.4ºC, respectively. The thermal constant is 231.9 degree-days. We compared these laboratory-derived temperature relationships with field activity of *A. pseudococci*. The parasitoid was reared from field-collected mealybugs between May and October. Laboratory-derived temperature-dependent development suggests there are seven to eight *A. pseudococci* generations during this period, two generations to each vine mealybug generation. Overwintering studies show that, regardless of when vine mealybugs were exposed to *A. pseudococci* (October 2001 to March 2002), emergence was concentrated over a 15 day period in early May. Results suggest that cues other than temperature are used to synchronize overwintered *A. pseudococci* adult emergence with field availability of vine mealybug. Results are discussed with respect to insectary rearing and augmentation of *A. pseudococci*.

Seasonal Fluctuations in Crop Damage of Hemipteran pests in California Pistachio

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California pistachios are attacked by a variety Hemiptera, most notably stink bugs such as the *Thyanta pallidovirens* and *Acrosternum hilare*, and a leaffooted bug (*Leptoglossus clypealis*). We clarified seasonal changes in nut damage using cages that isolated adult hemipterans on pistachio clusters for 7 day periods (fruit set – harvest). Results show early-season feeding does not result in crop loss because the pistachio compensates for dropped nuts. For example, pistachio clusters naturally declines from 80 to 20 nuts during the season. There are critical mid- and late-season periods when damage (epicarp lesions) because the natural nut drop has been completed and Hemiptera feeding impacts the cash crop. For example, in late-May and early-June trials, a single stink bug feeding for 7 days caused about 40 – 50% damage of the available nuts (dropped nuts or epicarp lesion) of cages nuts. Trials conducted later in the season, June to August, show fewer dropped nuts and epicarp lesion. Finally, after August, it was difficult to determine damage levels by examining nuts for epicarp lesions because feeding wounds did not form for many weeks or months while the internally-damaged nuts remained in the cluster. Results have been used to improve seasonal insecticide applications.