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Kearney Plant Protection Group

PLANT PROTECTION QUARTERLY

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James J. Stapleton, Charles G. Summers, Beth L. Teviotdale, Peter B. Goodell, Timothy S. Prather, Editors

IN THIS ISSUE

ARTICLES

ALMOND LEAF SCORCH FOUND IN TULARE COUNTY

Beth L. Teviotdale, U. C. Kearney Ag Center

Almond leaf scorch (ALS), also known as golden death or almond decline, was identified by Dr. Alex Purcell, UC Berkeley, on two cultivar Mono almond trees in a Tulare County orchard in September 1994. This is the first report of naturally-occurring ALS in the San Joaquin Valley south of the Cortez area of Merced County. The trees appear to have been infected for at least two years.

The most characteristic symptom of ALS is a marginal scorching of leaves that begins as early as July and continues to develop during the summer. A golden yellow band develops between the brown necrotic edge and the inner green tissues of the leaf. Disease symptoms usually appear first on one branch or a portion of one scaffold. As years go by, more and more of the tree is affected until the whole canopy is involved. The name 'golden death' describes the golden yellow color of the canopy of a severely infected tree but trees with ALS usually survive for many years. Infected trees have less stored nutrients so bloom and leaf out later than healthy trees, are stunted, less productive, and have reduced terminal growth.

First year symptoms are confined to a few inches from the infection site and may not be noticed for two or three years. Movement within a tree is slow and several years are required to infect the entire tree. If discovered early

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and only in one branch, the infection can be removed by pruning well below visible symptoms.

Almond leaf scorch is caused by the bacterium *Xylella fastidiosa* which also causes Pierce's disease of grapevines and alfalfa dwarf disease. Many common weeds and riparian plant species including Bermuda grass, rye, fescue grasses, watergrass, blackberry, elderberry, cocklebur and nettle also are hosts and serve as reservoirs of inoculum. The bacteria inhabit the xylem and are vectored by xylem-feeding suctorial insects (certain leafhoppers and spittlebugs). The most probable vectors for almond are the red-headed and green sharpshooters. The insects acquire the pathogen from wild hosts then spread the bacteria to grape, alfalfa

The symptoms of salt burn often are confused with the marginal scorching caused by ALS. Salt burn usually has an abrupt margin between the necrotic and healthy tissue with little or no intermediate yellowing. ALS necrosis usually progresses from the leaf tip back to the base of the leaf and is not uniform along the leaf margins whereas salt burn is more evenly distributed along the margins as well as at the tip. Also, the pattern of symptom development over the years and distribution within the tree and within the orchard, along with leaf nutrient analysis, should help distinguish the two. or almond. Spread from alfalfa fields to grape or almond also occurs but secondary spread within grape or almond does not seem to be common or important.

The sharpshooter populations increase slowly and the insects disperse slowly. Grass-feeding sharpshooters require year-round access to plants on which they can feed and reproduce. Clean cultivation of almond orchards for a six week period at any time of the year (for instance during harvest) should prevent the establishment of in-orchard vector populations. Thus, cover crops in almond orchards should not pose a threat. The most common habitats for sharpshooters in the central valley are irrigated pastures, alfalfa fields with grass weeds and permanent cover crops. The grass weeds are the key in any of these locations.

ALS occurs infrequently. In the past, the disease was most severe in Contra Costa County and occasionally moderate to severe in San Joaquin and Stanislaus Counties. Recently, ALS has been observed in scattered trees from Modesto north, and Pierce's disease of grapevines is rare in the central valley.

Dr. Purcell postulates that the absence of ALS in southern valley orchards may be explained by an inability of the strains of *X. fastidiosa* present in the Southern San Joaquin Valley to overwinter in almond trees.

There is no need for alarm, but we should be alert to other occurrences of ALS. Dr. Purcell is extremely interested in determining the extent of infection in almond orchards. If you find trees that you suspect may be infected, please submit samples to Dr. Purcell according to these instructions:

1. From symptomatic branches, collect 3 or 4 young twigs, 4 to 6 inches long, with green leaves attached.

2. Mark the tree so that it can be identified later if necessary.

3. DO NOT ALLOW WOOD TO DRY OUT.
4. Store in sealed plastic bag and mail immediately (do not store for several days).

5. At the beginning of the week, collect samples and ship or mail over-night express to:
   Dr. Alex Purcell
   201 Wellman
   University of California
   Berkeley, CA 94720-3112
   510-642-1603
   2 - ALS94.DOC

WEEDSEEKER SPRAYER EVALUATION

Tim Prather and Kurt Hembree, U. C. Kearney Ag Center

The Weedseeker sprayer is a new technology that uses light reflected from plants to determine when to apply herbicide. The sprayer shines light on the berm and if green plants are present, the green light reflects back to a sensor on the sprayer. The sensor then signals a solenoid that opens, allowing herbicide to flow through the nozzle. The response time is very short and so the speed of travel is limited by ground conditions, vehicle capabilities, and driver ability rather than the ability of the sprayer. Spraying postemergent herbicides only to the plants and not to bare ground should reduce the amount of herbicide applied and save money. We conducted two studies to evaluate the sprayer. In the first study, the objective was to determine the actual output from the sprayer for a range of berm area covered by weeds, expressed as % cover. Our objective remained the same for the second study but we were able to control the % cover by planting tomatoes in flats and thinning them to achieve a range of % cover.

Methods - Study 1

Our experiment was conducted on the Kearney field station in a new planting of peaches and nectarines. Every tree row was sampled and the percentage of ground that was covered with weeds was recorded. The amount of water in a small tank was weighed before and after spraying each tree row. The sprayer applied water to each side of the berm twice to ensure a measurable decrease in the weight of the small tank. The relationship between the amount of water applied and the % cover by weeds was determined using regression analysis. Roundup was then applied to the berms as a 2% solution. The higher rate of Roundup was used because the weeds were large at the time of application. The herbicide application was evaluated by measuring the percentage weed cover, 2 to 3 weeks after spraying. The sprayer then was used in two established orchards to determine weed control over an entire orchard.

Results - Study 1

We found that above 40% cover the sprayer functioned as a normal sprayer. Below 40% cover the Weedseeker did not spray constantly, resulting in less water applied (Figure 1). In fact, at 5% cover the sprayer applied a third of the amount of water it did at 40% cover.

Weed control was at least 95% despite the presence of tall weeds (2 feet tall) and up to 100% vegetative cover. Several large lambsquarters plants survived herbicide application but did not continue to grow. Occasionally, the sprayer did not apply herbicide to oat plants on the berm.

The sprayer was not as effective in the established orchards. The peach trees often had branches low to the ground so the sprayer could not be used near the bases of these trees. In addition, it was difficult to maneuver around the trees and still remain close to the berm. These problems would not occur for crops like almonds or walnuts. Tree and vine crops with branches close to the ground would require a modification of the sprayer and/or changes in pruning to eliminate vegetation at the base of the tree or vine crop. The sprayer also applied herbicide to moss growing on the berms. We do not know if this problem can be overcome without removing the moss.

(Figure not available)

Figure 1. Effect of weed cover on the amount of water applied to a berm.

Methods - Study 2

Control over % cover was desirable so in the second study we used tomatoes that we could thin to achieve a range of % cover (0 to 100%). Flats containing tomato plants were placed in a row, 2 flats wide (2.6 feet) by 100 feet long. The sprayer travelled along both sides of the flats, yielding a plot 200 feet long. The 5 gallon spray tank on the sprayer was weighed before and after the tomatoes were sprayed with water. Three replications were made at each % cover. Tomatoes were thinned by hand, guided by a grid placed over the flat that allowed removal of tomatoes in 4% cover increments.

Results - Study 2

The sprayer applied an average of 8.5 gallons at 100% cover. At 10% cover the sprayer applied 3 gallons, resulting in a 65% decrease in water applied (Figure 2). The tomatoes were 8 to 12 inches tall at the time the study was conducted. The plants were tall enough to hide open areas in the plant canopy from the sprayer, resulting in nearly a plateau at 10 to 20% cover (Figure 2). Herbicide savings would be greatest when weeds are small to minimize the number of nozzles that are activated at each interception of a plant. In addition, the maximum output at 8.5 gallons has limitations for the application of some materials that are more efficacious at higher water volumes (Poast for example).

(Figure not available)

Figure 2. Amount of water applied at a range of vegetative covers ranging from 0 to 100% of the ground covered with vegetation.

ABSTRACTS

AMERICAN PHYTOPATHOLOGICAL SOCIETY, Albuquerque, NM, August, 1994

Using an asymptotic parameter to revise weibull model. *Chang-Lin Xiao, K. V. Subbarao, and Shi-Mai Zeng. U. C. Plant Pathology Department @ U.S. Agric Res. Stn., Salinas, and Beijing Agric. Univ., Beijing, P. R. China*

Traditional growth curve models used in the analysis of plant disease epidemics assume an asymptote and a maximum disease severity (K_{max}) of 1.0. It often is inappropriate to assume K_{max}=1.0, especially for disease progress curves that have low asymptotic values in which rates of disease increase are underestimated (Phytopath. 75:786-791; Phytopath. 82:811-814). Neher and Campbell (1992) discussed a K_{max} parameter used with Monomolecular, Gompertz and Logistic growth models in describing epidemics, but did not include Weibull model in their studies. Weibull is a flexible growth model that describes both the general population growth and plant disease progress. But lack of an asymptotic parameter has limited its wider applications, especially those using the absolute numerical data to describe organism growth (eg. lesion expansion). For this reason, we incorporated an asymptotic parameter K to the Weibull model, written as: $y = K\{1-\exp[-((t-a)/b)^c]\}$ in which a, b, c and K are location, scale, shape, and asymptotic parameters, respectively. Describing disease progress using the above model allows retention of flexibility in the original Weibull model because the value of parameter K may fluctuate with different epidemics (each season with one value). However, we propose that there is a K_{max} representing the maximum level of disease that is an intrinsic constant for a given pathosystem. The computational method, Marquardt was used in the nonlinear regression procedure to estimate the four parameters simultaneously. The disease progress and lesion expansion data from tomato late blight (*Phytophthora infestans*) epidemics fitted to the model confirmed both the appropriateness and flexibility of Weibull model with four parameters.

Effects of broccoli residue on *Verticillium dahliae* microsclerotia and wilt incidence in cauliflower, *K. V. Subbarao, J. C. Hubbard, and S. T. Koike. Dept. of Plant Path., Univ. of California, Davis, c/o U. S. Agric. Res. Stn., Salinas, CA*

Wilt incited by *Verticillium dahliae* has become an important disease on cauliflower in the Salinas Valley in recent years. Although broccoli is closely related to cauliflower, wilt has not occurred on this host. The *V. dahliae* isolates from cauliflower were weakly pathogenic on broccoli. We therefore determined the effectiveness of broccoli residues on propagule attrition and wilt incidence on cauliflower in a field with known infestation by *V. dahliae* microsclerotia. The treatments in the experiment were broccoli residue with tarp, broccoli residue without tarp, methyl bromide + chloropicrin, vapam, control with tarp, and control without tarp, and were arranged in a randomized block design with four replications. Approximately 200 Kg chopped broccoli (in 36 m^2) was uniformly spread and incorporated into the corresponding plots by disking. For treatments with tarping, clear plastic was spread over the plots and sealed at the edges. Tarps were removed after two weeks. Pre- and post-treatment densities of *V. dahliae* microsclerotia were determined at 0, 35, 95, and 150 days using the modified Anderson sampler technique. Plant height, number of marketable heads, head weight, and wilt severity were determined at maturity. The number of *V. dahliae* propagules in broccoli-treated plots were lower than the control plots and were comparable to that of the fumigated plots. Similarly, plant height, marketable heads, and head weight were significantly higher in broccoli treatments than in check plots. Tarping alone did not reduce the number of propagules. These results suggest that broccoli residue has the potential to replace standard fumigants for Verticillium wilt control. The ideal means of exploiting this may be by rotating cauliflower with broccoli.

Effects of irrigation methods on disease management in lettuce, *K. V. Subbarao, J. C. Hubbard, and K. F. Schulbach. Dept. of Plant Pathology, University of California, Davis, c/o U. S. Agricultural Research Station, Salinas, CA*

Subsurface drip and furrow irrigation were evaluated on cultivar ’Salinas’ for their effects on yield, and incidence and severity of three important diseases in spring and winter crops of lettuce in the Salinas Valley. The diseases examined included lettuce drop (LD) (*Sclerotinia minor*), downy mildew (DM) (*Bremia lactucae*) and corky root (CR) (*Rhizomonas suberifaciens*). Replicated plots of subsurface drip and furrow irrigation were arranged in a randomized block design and irrigation treatments were begun immediately after thinning. The furrow plots were irrigated once a wk and the drip plots twice a wk. Plants in all plots were inoculated with *S. minor* by placing a mixture of sclerotia and oat infested with mycelium in the ’competence zone’ (*sensu* Grogan). Plots were not inoculated for DM and CR. Plots were evaluated for LD and DM at weekly intervals until maturity, and yield and CR were determined at maturity. Lettuce drop incidence and CR severity were significantly lower, and yields higher in plots under subsurface drip irrigation compared with furrow irrigation. Incidence and severity of DM were not significantly different between the two irrigations. The differential moisture levels in the soil profile created by the two irrigation methods resulted in the observed effects. The differential ecoclimates created by the two irrigation treatments did not affect DM infection because the macroclimate is usually favorable in the Salinas Valley. Subsurface drip irrigation has the potential to be a viable, long-term strategy for soilborne disease management in lettuce.

Fungicide resistance in California isolates of *Sclerotinia minor*, *J. C. Hubbard and K. V. Subbarao. Dept. of Plant Pathology, University of California, Davis, c/o U.S. Agricultural Research Station, Salinas*

The dicarboximide fungicides iprodione and vinclozolin are used for control of lettuce drop, incited mainly by *Sclerotinia minor* in coastal California. To investigate if the apparent loss of effectiveness of these chemicals is due to fungicide resistance in *S. minor* populations, 20 isolates were tested for resistance to iprodione. Both young and mature vegetative mycelium of each isolate was plated on potato dextrose agar (PDA) amended with 0, 1, 5, 10, 25, and 100 μg/ml of the fungicide. Radial growth was measured, and all wild-type isolates tested were sensitive. However, within 2 wk, all isolates produced measurable growth at $\leq$5 μg/ml of iprodione. After 5 wk, nine isolates produced growth on plates amended with 100 μg/ml. Germination of sclerotia was tested on similarly amended media, and after 2 wk, 18 isolates had at least 1% germination at 5 μg/ml. After 5 wk, 19 isolates had at least 1 % germination at 100 μg/ml. Seventy-three iprodione-resistant cultures derived *in vitro* were transferred to PDA, and then plated on media amended with 5 μg/ml of either iprodione or vinclozolin. Seventy-one retained resistance to iprodione and, of these, 70 were also resistant to vinclozolin. Greenhouse and field experiments are in progress to evaluate fungicide sprays on lettuce inoculated with fungicide-resistant cultures and wild-type sensitive isolates. Results may provide information about causes for the perceived loss of effectiveness of these chemicals in some lettuce fields in coastal CA.

Verticillium wilt of cauliflower: A new disease in California. *S. T. Koike, U.C. Cooperative Extension, Monterey County, and K. V. Subbarao, U. C. Dept. Plant Pathology, Salinas, CA.*

In 1990, commercial cauliflower plantings in the Salinas Valley showed symptoms of a vascular wilt disease. Symptoms consisted of chlorosis, defoliation, stunting, wilting, and vascular discoloration of the root and stem. Surveys indicated that incidence of symptomatic plants in affected fields could be as high as 95%. This problem was initially detected in a few fields in two counties. Presently the disease is widely distributed in five coastal counties. *Verticillium dahliae* (Kleb.) was consistently isolated from cauliflower stem tissue, and pathogenicity tests using root dip techniques confirmed that this fungus was the causal agent. Other crucifers grown in the Salinas Valley, such a bok choy, cabbage, and Chinese cabbage, are also susceptible to this pathogen. However, commercial broccoli fields remained unaffected, even though such crops were planted in highly infested soils. Soils from Salinas Valley were assayed for microsclerotia by plating dried soil onto NP-10 selective media using a modified Anderson sampler. Propagule counts show that *V. dahliae* is widely distributed in the region, having populations as high as 93 microsclerotia/g soil. All commercially available cauliflower cultivars were susceptible to the pathogen, though they varied in the degree of symptom severity. Soil fumigants (chloropicrin, chloropicrin + methyl bromide, Vapam, Mocap) injected into pre-formed beds but left untarped failed to significantly reduce soil inoculum or increase yields. The ability of *V. dahliae* to survive in soil for long periods of time, lack of resistant cultivars, and prohibitive costs of standard tarped soil fumigation applications make this disease a serious threat to the cauliflower industry in California.

Effect of hull dehiscence and abscission of almond fruit and inoculum concentration on severity of hull rot disease caused by *Rhizopus stolonifer*, *Monilinia fructicola* and *M. laxa*, *B. L. Teviotdale and T. J. Michailides, U. C. Kearney Ag Center*

Hull rot disease of almond is caused by several fungi. The most common incitants are *Rhizopus stolonifer* and *Monilinia fructicola*. The pathogens cause lesions on the mesocarp (hull) after dehiscence and apparently produce a toxin which kills nearby leaves and shoots. Although *M. laxa* is not found frequently in hull rot lesions, the fungus is the principal cause of brown rot blossom and twig blight of almond. We inoculated fruit at three stages of hull abscission and dehiscence with water suspensions of 104 conidia of *M. fructicola* and spores/ml of *R.*

stolonifer. Percent death of leaves next to inoculated fruit decreased as hull abscission and dehiscence progressed, and *M. fructicola* caused higher average percent leaf death (47.8) than R. stolonifer (32.3). Inoculum concentration (103, 104, or 105 conidia of *M. laxa, M. fructicola* and spores of *R. stolonifer*/ml) did not affect percent leaf death near inoculated fruit. Average percent leaf death was greatest next to fruit inoculated with *M. laxa* (59.7), less with *M. fructicola* (45.8) and least with *R. stolonifer* (38.3).

Susceptibility of pistachio rootstocks to *Verticillium dahliae* and *Armillaria mellea*--A Progress Report. *B. L. Teviotdale, L. Epstein, L. Ferguson, B. Beede, and W. Reil, U. C. Kearney Ag Center, U. C. Berkeley, Kings and Yolo Counties*

Pistachio rootstocks were evaluated for susceptibility to *Verticillium dahliae* and *Armillaria mellea* each in separate field experiments. *Pistacia atlantica, P. integerrima, P. integerrima* x *P. atlantica, P. atlantica* x *P. integerrima*, nursery-budded with *P. vera* 'Kerman", were planted in 1992 in a field infested with *V. dahliae*. The microsclerotia level in the field was increased, prior to planting the trees, by discing in *V. dahliae*-infected tomato plants. In fall of 1992, there were approximately 25 microsclerotia per gram dry soil in three quarters of the trial and 13 microsclerotia in the fourth quarter. During the first two growing seasons, two trees on *P. atlantica* and one each on *P. integerrima* and *P. integerrima* x *P. atlantica* died. Verticillium wilt symptoms were present in 25 percent of trees on *P. integerrima* x *P. atlantica*, 3 percent of trees on *P. atlantica*, and 2 percent of trees on both *P. integerrima* and *P. atlantica* x *P. integerrima*. Susceptibility to *Armillaria mellea* was examined by planting *P. atlantica, P. terebinthus, P. integerrima* and *P. integerrima* x *P. atlantica* trees in orchard sites naturally infested with the pathogen. At the end of three years, all *P. terebinthus* trees were healthy whereas 33 to 44 percent of the other three rootstock trees had succumbed.

The development of Apothecia from stone fruit mummified and stromatized by *Monilinia fructicola* in California, *B. A. Holtz and T. Michailides, U. C. Kearney Ag Center*

Apothecia were produced in the orchard and laboratory from peach and nectarine fruit mummified by *Monilinia fructicola*. Fully stromatized and non-stromatized mummies were placed in the orchard either on the soil surface or completely buried 2-3 cm. Stromatized mummies consist of sclerotinized or resistant fungal tissue intertwined with decayed fruit tissue dried from 4-8 wk during the summer (Willetts & Haranda, Mycologia 76:314-325). Stromatized mummies were placed in the orchard from August 1993 to February 1994. Non-stromatized mummies, which decomposed rapidly and were soon unavailable, were only placed in the orchard in August and September. Apothecia were only found in February and early March from stromatized mummies that were placed in the field from October-December. More apothecia were produced from mummies placed in the field in November (11.0%) than in October (3.9%) or December (6.5%). There was no significant difference ($P < 0.05$ Student's *t* test) in the development of apothecia between mummies which were buried or left on the soil surface. Stromatized mummies placed in the field in August/September 1993 and January/February 1994 did not produce apothecia, presumably because they did not have the proper conditions for apothecial initiation and differentiation. Apothecia were never produced from non-stromatized mummies. Apothecia were produced in the laboratory from stromatized mummies which were incubated in moist sand (>95% R.H.) and in the dark for 8 wk at 2 C, and then for 2 wk in 15 C with a 12 h photoperiod.

Dynamics of fig wasp (*Blastophaga psenes*) population and incidence of fig endosepsis caused by *Fusarium moniliforme*. *T. J. Michailides and D. P. Morgan, U. C. Kearney Ag Center*

Propagules of *Fusarium moniliforme* are vectored on the body of the fig wasp pollinators and cause endosepsis disease in the syconia of male trees (caprifigs) and Calimyrna female figs (*Ficus carica*). Scanning electron microscopy showed that microconidia and mycelial fragments are attached to the wasps' bodies along with pollen grains picked up from the spring caprifig fruit crops (called preface). None of the adult wasps artificially removed from the flower-galls had propagules of *F. moniliforme* but 91-100% of those emerged from infected caprifig fruits were infested with *F. moniliforme*. Experiments over 2 years showed that more than twice as many preface caprifigs were infested by *F. moniliforme* after caprification with 5 or 10 mamme (winter crop) than with a single mamme caprifig. Presence of more preface caprifigs than were necessary for caprification resulted in more wasps entering the cavity of Calimyrna figs. The relationship between the number of wasps in the cavity of Calimyrna figs and disease levels was best described by a second degree polynomial (R^2 = 0.94-0.95; $P < 0.01$). These results suggest that proper management of fig wasp levels applying the appropriate quantities of caprifigs can reduce levels of Calimyrna figs infected *F. moniliforme*.

The influence of fruit contact on the susceptibility of French prune to *Monilinia Fructicola*. *T. J. Michailides and D. P. Morgan, U. C. Kearney Ag Center*

In prune (*Prunus domestica* 'French'), more than 50% of the brown rot infections caused by *Monilinia fructicola* and/or *M. laxa* initiated from fruit contact surfaces. Contact surfaces had microcracks (730-2,255 µm long) and lacked or had less epicuticular wax. About 87% of fruit in clusters retained water drops mainly on contact surfaces while only 12% of the single fruit had water droplets 4 h after spraying with water. Eighty-eight and 92% of the *M. fructicola* conidia placed on contact surfaces and 75 and 77% of those placed on non-contact surfaces germinated after 3 and 5 h, respectively. After spray-inoculation of mature fruit with $1.2X10^5$ conidia/ml of *M. fructicola*, significantly more (75 to 94%) fruit were infected when placed in groups of 4 to 5 fruits than (16 to 42%) single fruit after 4 days at 23 C and >97% relative humidity. Contact surfaces of mature fruit had more mycoflora (27--98 cfu, including *M. fructicola*/cm^2) than non-contact surfaces (only 7-29 fungal cfu/cm^2). Protection of fruit before it comes in contact should result in successful control of fruit brown rot in the orchard.

The relationship of the date for hull split to contamination of pistachio nuts by *Aspergillus* species. *M. A. Doster and T. J. Michailides, U. C. Kearney Ag Center*

Abnormal pistachio nuts with split hulls, called early splits (ES), frequently have kernels contaminated with *Aspergillus* molds. In 1993, most ES (55%) had their hulls split between 12 and 26 August, although only 18 and 27% split their hulls before and after this period, respectively (commercial harvests occurred in mid September). ES that split before 26 August showed more than four times greater incidence of *Aspergillus* species and ten times greater infestation by navel orangeworm (*Amyelois transitella*) than ES that split closer to harvest. In addition, most of the ES that split before 26 August had shriveled hulls at harvest time, while only 4% of the ES formed after 26 August did. Since both navel orangeworm infestation and shriveled hulls have been associated with high aflatoxin contamination of pistachio nuts, the ES with earlier hull split probably have more aflatoxin (produced by *Aspergillus flavus* and *A. parasiticus*). The physical characteristics were measured for ES formed during different periods. The ES that split earlier had smaller nut size, more external shell discoloration (including more staining along the suture), smaller fruit weights, and lower kernel moisture. Because these ES that split their hulls so early are very different from normal pistachio nuts, they can be removed during processing.

SECOND NATIONAL INTEGRATED PEST MANAGEMENT SYMPOSIUM/WORKSHOP PROCEEDINGS, Las Vegas, NV, April, 1994

Impact of armored scale pesticide resistance on citrus pest management. *E. E. Grafton-Cardwell, U. C. Kearney Ag Center*

California red scale, *Aonidiella aurantii*, and yellow scale, *A. citrina*, are key pests of citrus in the San Joaquin Valley. Biological control has historically not been sufficient to reduce these pests below economic thresholds in this region of California. Thus, growers have relied on organophosphate and carbamate insecticides to control scale for more than 30 years. Laboratory bioassays conducted on 85 populations of scale-infested lemons, navels, and Valencia oranges during 1990-1993 indicate the resistance is developing in both species of scale, in a portion of these populations, for the organophosphates; chlorpyrifos (Lorsban) and methidathion (Supracide) and to a lesser extent the carbamate; carbaryl (Sevin). The intensity of resistance was greatest for chlorpyrifos, which is the most widely used broad spectrum pesticide. The most highly resistant populations were found in regions of the Valley that have been most heavily treated with pesticides. New pesticides are not likely to be registered for armored scale control because of the high gallonage (and high rates) used to control scale in citrus (750-1500 gallons of water per acre). The only alternative to these broad spectrum pesticides is the use of narrow range petroleum oils and releases of *Aphytis melinus* parasitoids. The narrow range oils can be phytotoxic and the *A. melinus* are very sensitive to broad spectrum pesticides applied for scale, citrus thrips and other pests. Thus, if natural enemies are used for scale control, control tactics for all of the pests must change from broad spectrum pesticides to other pest management techniques. Some years, despite our best efforts, oils and natural enemies simply cannot reduce armored scale below an economic threshold. During these years growers tend to shift back to dependency on broad spectrum pesticides. However, detection of armored scale insecticide resistance, the lack of new insecticides, and the limited choice of pesticides for rotation of insecticide classes are strong motivating forces for change. Gradually, more and more of the citrus growers and Pest Control Advisors in the San Joaquin Valley are learning to rely on oils and natural enemies for armored scale control.

AMERICAN SOCIETY FOR MICROBIOLOGY, Las Vegas, NV, May, 1994

Aspergillus molds and aflatoxins in figs, *M. A. Doster, T. J. Michailides and D. P. Morgan. U. C. Kearney Ag Center*

Aspergillus molds frequently infect and develop inside fruits of Calimyrna figs before harvest in commercial orchards in California. For each of eight orchards, 1000 and 2000 fruits were examined in 1992 and 1993, respectively. At least 15 different Aspergillus species have been isolated from sporulating colonies inside figs. Although *A. niger* was the most common species (occurring in 6.7 and 3.5% of the figs in 1992 and in 1993, respectively), there is a special concern for *A. flavus* and *A. parasiticus* because these molds produce aflatoxins (potent toxins and carcinogens to humans and animals). *A. flavus* and *A. parasiticus* were found in 0.06% of the figs in both 1992 and 1993. A bright greenish-yellow fluorescence under UV light (365 nm) was associated with almost all figs infected by *A. flavus.* Aflatoxins were detected in most but not all infected figs tested. Many of the *A. flavus* isolates from fig fruits did not produce aflatoxins in a glucose-yeast medium. *A. flavus* and *A. parasiticus* were isolated from the soil of all eight orchards in 1992 (for section Flavi, 45, 36, and 19% were *A. flavus, A. parasiticus*, and *A. tamarii*, respectively). The second most common group with an Aspergillus anamorph consisted of *Eurotium* spp. (0.4% of the figs in 1993). Potential producers of ochratoxins in section Circumdati were found in 0.06 and 0.08% of the figs in 1992 and 1993, respectively. It is difficult for processors to remove moldy figs since most of the infections are inside the fruit with no external visible symptoms. Therefore, even though Aspergillus molds are relatively rare in figs, they represent a serious problem.