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

IN THIS ISSUE

ARTICLES

OLIVE KNOT CONTROL AND ASSESSMENT OF COPPER RESISTANCE IN *PSEUDOMONAS SAVASTANOI.* *Beth L. Teviotdale, UC Kearney Agricultural Center, and Bill Krueger, UCCE Glenn County.*

Introduction

Olive knot is a bacterial disease caused by *Pseudomonas savastonoi*. Bacteria are spread about by wind and rain and enter the tree through openings such as leaf scars, pruning wounds, and frost cracks. The severity of the disease can be generally correlated with rainfall, being more severe in higher rainfall areas. Of the commercially grown canning varieties, Manzanillo is the most susceptible. Increased Manzanillo acreage in the Sacramento Valley and late season rains have made the disease more noticeable in recent years.

The disease is controlled by fall application of copper-containing bactericides which are the only materials registered for control of olive knot. However, control is often less than desirable. There are several possible

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explanations for this, including inadequate efficacy, resistance to copper in the bacterial population, improper timing, and systemic invasion of the tree by the pathogen.

Attempts to improve the efficacy of copper materials were investigated in earlier studies. Leaves were pulled from twigs and immediately treated with copper, alone or in combination with various amendments. After the treatments dried, the treated twigs were inoculated with suspensions of the pathogen. Among the amendments tested, a significant improvement in disease control occurred when the spreader CS7 was added to the copper and further improvement resulted when a combination of iron chloride and magnesium sulfate was added. Control of other bacterial plant diseases (walnut blight, tomato spot, tomato speck) has been improved by the addition of maneb to copper, zinc compounds, and the biological control agent *Pseudomonas fluorescens* (Blight Ban) has shown promise in the control of other *Pseudomonas* diseases.

The apparent increased severity of olive knot observed recently in several orchards suggests the possibility that copper tolerance may have developed in some populations of *P. savastanoi*. The repeated use of copper over many years could provide the environment in which resistant populations would thrive. Copper resistance has been documented for other bacterial pathogens such as *Xanthomonas campestris* pv. *juglandis*, the walnut blight pathogen, but has not been identified in the olive knot pathogen.

Trees are at most risk of infection when wounds of any sort are numerous. Leaf scars are the most common site of infection, and these remain susceptible for 7 to 10 days after the leaf falls. One application probably cannot be expected to protect trees from olive knot under prolonged conditions favorable for disease development. Another period when many small wounds are made is during harvest. As fruit are pulled from the tree, leaves fall or are torn and shoots are abraded. These many wounds are potential sites of infection, especially if rain soon follows. Immediate post harvest treatment may be important to help prevent infection. Wounds during harvest operations could become a more serious problem if mechanical harvesting is adopted.

Objectives

1. Test copper amended with iron chloride and magnesium sulfate or CS7 using whole tree treatments and natural infections, and screen other candidate materials for efficacy against olive knot.

2. Survey orchards in the olive growing areas of California for copper tolerance in *P. savastanoi*.

Methods and Results

All experiments were conducted on cv Manzanillo trees.

Objective 1: Copper amendments-- In the winter and spring of 1996-97, trees in Corning were treated with 1) Kocide, 2) Kocide + CS7, 3) Kocide + CS7 + $FeCl_3$, 4) Kocide + CS7 + $FeCl_3$ + $MgSO_4$, and 5) untreated control. Materials were applied once (16 November 1996) or twice (16 November 1996 and 5 February 1997) to 5 single tree replications using a hand gun sprayer. Twenty, one-year-old shoots having no evidence of disease were tagged on each tree at the beginning of the experiment. Prior to the second application, ten leaf pairs were removed from 5 of these shoots on each tree. The number of knots observed on all 20 shoots per tree were counted on 21 August 1997.

None of the additives improved control compared to copper hydroxide alone (Table 1). When the treatments were combined and a comparison was made between one and two sprays, there was a consistent trend for lower disease with two sprays for total number of knots, number of knots per shoot, and percent infected shoots in non defoliated shoots (Table 2). For the defoliated shoots, the percent infected leaf scars was numerically less and the percent infected shoots was significantly lower for two sprays compared to one spray.

Screening: Kocide + Manex, zinc lignosulfate, Blight Ban (*P. fluorescens*), and the copper amendment treatments listed above were tested. Ten leaf pairs were removed from one-year old shoots, the defoliated shoots treated with the chemicals, the materials allowed to dry for approximately one hour, and the shoots inoculated with a suspension of 10^8 cfu/ml copper sensitive strain of *P. savastanoi*. Identical treatments, using the same trees, were inoculated with a strain of *P. savastanoi* resistant to copper. Chemicals and inoculum were applied using hand-held hand pump atomizers. There were seven single-tree replications (one shoot per tree for each chemical and bacterial stain) arranged in a randomized complete block design. The experiment was initiated on 29 May 1997 and evaluated (number knots per shoot counted) on 21 August 1997.

No reduction in disease, compared to the inoculated control, by any treatment was observed for either the copper sensitive or copper resistant strain of inoculum (Table 3). Where the copper sensitive strain was used, all treatments, including the inoculated control had significantly more olive knot than the uninoculated control. However, where the copper resistant strain was used, all treatments, including the inoculated control had significantly less olive knot.

Objective 2: Survey orchards in olive growing areas of California for copper tolerance.

Samples from 14 orchards (7 Sevillano, 5 Manzanillo, 1 Ascolano, and 1 Mission), all from Glenn County, were submitted from which bacteria were cultured. These were challenged with 1, 10, and 30 ppm copper and all but one were sensitive to copper at all levels. The one resistant isolate was the resistant strain used in the experiment in objective 1 above. It is not only resistant to copper but also nonpathogenic and a potential bio-control agent. Samples from a wider geographical range need to be included in the survey before it is complete.

Discussion

We were unable to confirm the improvement in control found using magnesium and iron salts as additives to copper reported in earlier research. If anything, there was a tendency for control to deteriorate as more ingredients were added to the copper. The failure of copper to reduce infection over that in the inoculated control may have resulted from our use of a high inoculum concentration. However, the concentration we used, 10^8 cfu/ml, has been used successfully in other experiments. The apparent control of natural infection found with the copper resistant cultivar is worth further study. Strains of *P. savastanoi* that are non pathogens but show some protective capacities in laboratory tests, but not in the field, have been reported elsewhere.

Table 1. Efficacy of amendments to copper for control of olive knot disease, Tehama County, 1997

Treatment[1]	Not defoliated: Avg. no. knots per shoot	Not defoliated: Infected shoots %	Defoliated % Infected: Leaf scars	Defoliated % Infected: Shoots
Kocide	8.0	20.4 b[2]	8.8 b	47.1 b
Kocide + CS7	13.2	31.1 a	6.6 b	47.0 b
Kocide + CS7+$FeCl_3$	14.9	28.1 ab	7.5 b	46.0 b
Kocide + CS7+$FeCl_3$+$MgSO_4$	14.3	40.4 a	6.2 b	49.1 b
Control	17.1	36.8 a	18.0 a	85.5 a
	NS			

[1]Materials applied by hand-gun sprayer, whole-tree replications.
[2]Numbers followed by different letters are significantly different at the 5% level using Duncan's multiple range test.

Table 2. One vs. two applications for control of olive knot disease, Tehama County, 1997

Treatment	Not defoliated: Number knots Total	Not defoliated: Number knots per shoot	Not defoliated: Infected shoots %	Defoliated % Infected: Leaf scars	Defoliated % Infected: Shoots
1X, 11-16-96	15.6	14.4	34.8	12.3	64.6 a
2X, 11-16-96 + 2-5-97	11.4	10.5	27.9	6.5	45.3 b
	NS	NS	NS	NS	

Rainfall 11-16-96 to 2-5-97 = 318.008 mm
After 2-5-07 to 8-21-96 = 106.68 mm

Table 3. Efficacy of various materials for control of olive knot disease, Tehama County, 1997

Treatment[1]	Infected leaf scars (%): Copper sensitive	Infected leaf scars (%): Copper resistant
Kocide	63.6 a[2]	1.8 b
Kocide + Manex	54.3 a	0.0 b
Kocide + CS7	62.8 a	1.8 b
Kocide + CS7 + Fe	72.1 a	1.8 b
Kocide + CS7 + Fe + Mg	70.0 a	4.5 b
Zinc lignosulfate	77.1 a	9.4 ab
Blight Ban (day 0)[3]	65.0 a	9.7 ab
Blight Ban (24 hr)	62.1 a	12.5 ab
Inoculated control	59.3 a	5.6 b
Uninoculated control	22.8 b	20.1 a

[1]Materials applied by hand-held hand pump atomizer to shoots from which 10 pairs of leaves were removed.
[2]Numbers followed by different letters are significantly different at the 5% level using Duncan's multiple range test.
[3]Inoculated with *P. savastanoi* on day of treatment (day 0) or 24 hr later.

THE USE OF SAN JOSE SCALE MONITORING TECHNIQUES IN ESTABLISHING A RELATIONSHIP BETWEEN SPRING MALE SCALE POPULATIONS AND SPRING CRAWLER ABUNDANCE IN ALMONDS: INTERIM REPORT. *Walt Bentley, Lonnie Hendricks, Roger Duncan, James Brazzle, Mario Viveros, and Cressida Silvers, UC Kearney Agricultural Center, UCCE Merced County, UCCE Stanislaus County, UCCE Kern County, and UC Riverside.*

One of the key insect pests of deciduous tree fruit and nut crops is San Jose scale, *Quadraspidiotus perniciosus* (Comstock). It has traditionally been managed with a dormant oil and organophosphate spray. Recently, water in the Sacramento and San Joaquin Rivers has been found to have residues of some organophosphate insecticides. This contamination has been attributed to dormant spray runoff from orchards. Samples of collected water have been found to be toxic to a key indicator species, *Ceriodaphnia dubia*, a species of fresh water shrimp. The California Department of Food and Agriculture is now looking into methods of reducing dormant organophosphate sprays. Restrictions on the use of an organophosphate in the dormant spray could impact management of this key pest in deciduous fruit and nut crops.

Most almond growers annually apply a dormant oil and organophosphate spray to control San Jose scale (SJS) and peach twig borer (PTB). The registration of spinosad (Success®) has allowed almond growers to use this new product for PTB control, however, many are still using organophosphates in the dormant spray to better control SJS. Being able to predict the need to control their SJS would be of value to growers who wish to reduce their use of organophosphates. The purpose of this study was to investigate the relationship between the abundance of male scales captured in pheromone sticky traps and the wood infesting crawler. If a relationship between these parameters exists, SJS pheromone traps could then be used to predict the need for control. This paper reports the results of studies conducted in 1997.

Methods and Results

As part of a San Joaquin Valley Almond Pest Management Demonstration program performed in 1996 and 1997 in Stanislaus, Merced, and Kern counties, studies were conducted to evaluate the impact of reducing organophosphate and carbamate sprays. In this program orchards sprayed with broad spectrum sprays were compared to adjacent blocks left unsprayed with these types of insecticides. A variety of pests were monitored during the year and pest infestation was also evaluated. In four of these side by side comparisons, SJS males and crawlers were monitored. In each of the eight orchards (four sprayed and four unsprayed) three Trece Pherocon® tent traps baited with Pherocon® San Jose scale controlled release septa were placed on March 11. The septa were loaded with the standard rate of 300 micro grams/lure of the synthesized pheromone. The rubber septa were changed every four weeks and the traps were monitored and changed weekly throughout the season. Figure 1 presents the results of male scale trapped during the season from the four individual comparisons as well as the average of the comparisons. The average number of male scale trapped in the unsprayed orchards was 184 per trap per season compared with 1471 in the sprayed orchards. Although this difference seems striking, the high amount of variation between sites made this difference statistically non-significant.

In addition to trapping male SJS, the scale parasitoid, *Encarsia perniciosi*, was also monitored. This key parasitoid is attracted to the same pheromone traps as male SJS. Figure 2 presents the trapping data for *E. perniciosi* in the individual orchards as well as the four orchard averages. Despite more male SJS being trapped in the sprayed orchards, an indication of higher population, the unsprayed orchards averaged 3769 *E. perniciosi* while the sprayed comparisons averaged 1485 per trap per season. The presence of the higher number of *E perniciosi* in the unsprayed orchards could help explain the generally low SJS populations found in them. *E. perniciosi* abundance might also be incorporated into a threshold for spray application.

Although the variation in populations of both SJS and *E. perniciosi* was great, the low density of scale and uniform abundance of *E. perniciosi* in these orchards seemed to indicate that annual dormant organophosphate or pyrethroid sprays were not needed. First flight abundance of San Jose scale males in pheromone traps was therefore correlated to the abundance of crawlers found on double sided sticky tapes during the spring crawler emergence period of April and May. This was done in six of the eight orchard. In each of these six almond orchards, crawler abundance was determined during a 4 week period of peak emergence from April 20 through May 20. Crawlers were monitored on four trees located at each of the four compass points around the tree and immediately next to the tree where the pheromone trap was placed. Prior to placing double-sided sticky tape around a branch, the branch was wrapped with a 2 inch wide strip of duct tape. The double sticky tape was then wrapped around the duct tape. Only one limb from each of the four trees was wrapped with the sticky tape. This was done at head height (ca. 6 feet). Circumference of these limbs ranged from 6 to 14 inches and the crawlers were reported as number per inch of tape during the 4 week period. The spring crawler emergence would be unaffected by hullsplit sprays but these sprays do influence both later male scale populations and populations of *E. perniciosi* which parasitize scale.

A regression analysis was performed using data from six orchards in the above study. The independent variable was the spring San Jose scale males trapped during March. The dependent variable was the number of crawlers per inch of tape caught between April 20 and May 20. A linear relationship between these two variables was found ($P<0.05$). The regression equation was # = 0+.008*X. The r^2 value was 0.72. The relationship between spring male scale trapped in pheromone traps and spring crawler emergence in this initial study should not be used as a predictor of the severity of scale populations, but to demonstrate a relationship between the number of males trapped and the number of crawlers found during a uniform period of emergence. Further work will be done to establish this relationship and to incorporate wood death along with the presence of parasitoids into a decision model for treatment.

The above study does indicate that male SJS caught in standard monitoring traps over the first male scale flight does relate closely to the number of crawlers as trapped on double sided sticky tape during the spring emergence. Other factors can influence this relationship. Inclement weather such as heavy rainfall and prolonged periods of wind could impact the efficiency of pheromone traps since male scale are very weak flyers. These conditions existed in 1998, with active male scale flight during the spring completed within two weeks. Data from 1998 will be viewed to determine the impact of poor weather on the relationship between pheromone trap catch and crawler activity. This same relationship will be studied in prunes and peaches in coming years. This technique is more applicable in almonds since fruit infestation is of no concern as it is crops such as apples, peaches, pears, nectarines and plums, where fruit infestation occurs at a much lower level than that of tree damage.

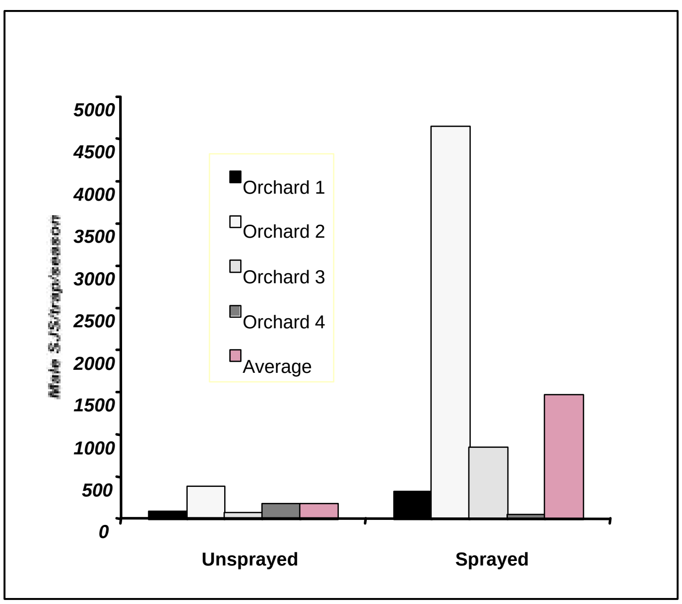
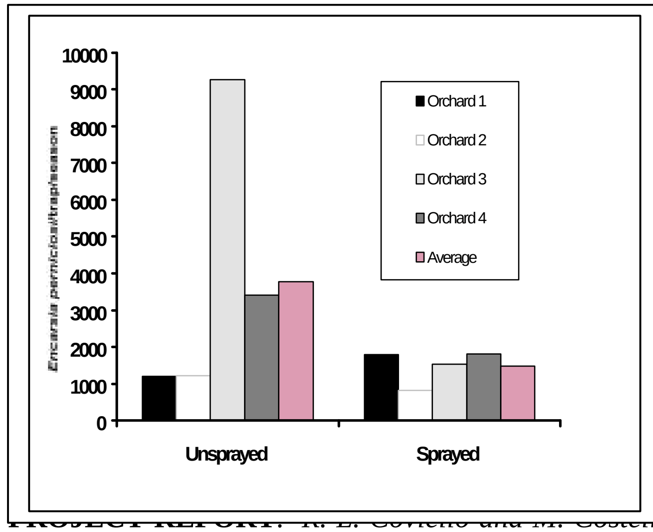


Figure 1 Seasonal abundance of male San Jose scale trapped in almonds utilizing two different pest management systems in the San Joaquin Valley, 1997.



UCCE, Fresno County.

Introduction

Omnivorous leafroller (OLR), *Platynota stultana* Walshingham, has been a lepidopterous pest of grapes in California since the 1960s. The larvae feed within the grape clusters, damaging the berries, capstems, and rachis of the bunch. The damage is particularly significant after berry softening when the wounds to the berries allow rot organisms to enter and bunch rot to develop. Control can be achieved with non-disruptive pesticides such as cryolite if applied at the optimum timing. Previous research has shown that the optimum treatment timing is at 700–900 degree-days (°Ds) after the biofix or onset of the adult flight, as monitored with pheromone traps (Coviello, et al., 1995, 1996, 1997). Previous work has also shown that OLR can be adequately controlled for the season by a treatment applied to the first generation of larvae (Coviello, et al., 1992). Recently, however, reports from Pest Control Advisors (PCAs) have indicated that, in some locations, either the first generation spray did not give adequate control or that the OLR population did not move into the vineyard until the second or later generations. The main objective of this experiment was to determine the level of control obtained from first and/or second-generation treatments. A secondary objective was to compare the efficacy of split applications of a low rate of cryolite, as used by some growers, with a single application at a higher rate. The rationale for this is that two applications should provide a longer residual period while not increasing the total amount of insecticide. This should then result in a larger proportion of larvae in each generation coming into contact with the residue.

Methods

A commercial Thompson Seedless vineyard near Fowler, California was selected for the trial. The vineyard was furrow irrigated, with no cover crop, and in 1997 was farmed for raisins. The experimental area was established in the southeast portion of the vineyard where the grower reported the highest level of OLR damage. Plots were laid out in a randomized complete block design with four replicates. Individual plots were seven rows wide by sixteen vines long and were approximately 1/4 acre in size. Treatments were as follows:

Treatment	No. of Sprays x Rate/Acre	Generation	Timing
1	2 x 3 lbs	1^{st}	700 + 900 °Ds
2	1 x 6 lbs	1^{st}	700 °Ds
3	2 x 3 lbs	2^{nd}	700 + 900 °Ds
4	1 x 6 lbs	2^{nd}	700 °Ds
5	2 x 3 lbs	$1^{st} + 2^{nd}$	700 + 900 °Ds
6	1 x 6 lbs	$1^{st} + 2^{nd}$	700 °Ds
7	Untreated control		

Treatments were applied with a tractor-mounted airblast sprayer calibrated to spray 50 GPA at 2 MPH. The treatment dates for the first generation were May 15 (approximately 700 °Ds) and May 27 (approximately 900 °Ds). Second generation treatment dates were July 9 and July 17 (700 °Ds and 900 °Ds, respectively). The grower treated the surrounding vineyard in both the first and second generations. Although all vines in each plot were sprayed, evaluations were made in the center 10 vines of the center three rows to avoid edge effects and overspray from adjoining plots. Evaluations were done by examining fifteen clusters from each of 30 vines per plot for a total of 450 clusters per plot or 1800 clusters per treatment. Each cluster was examined for the presence or absence of OLR larvae and/or damage. The evaluations were done on June 17, after the end of the first generation and August 17, after the end of the second generation.

Results and Discussion

Results of the OLR evaluations are shown in Table 1 and Figure 1. The first generation evaluation was not completed because the levels of OLR damage in the untreated plots were so low (Table 1) that it was felt that no statistical differences between treatments could be shown. All treatments significantly reduced OLR damage from the untreated control in the second-generation evaluation.

The results show that while some control of OLR was obtained with the first generation treatment, that timing was not as effective as the second generation spray and also that there was nothing to be gained by treating both first and second generations, i.e. the single second brood treatment was equivalent to the single treatment on both broods. The evaluation for the second objective indicated that, while not necessarily statistically different, there was no gain in control by applying insecticide twice in a generation. In fact, in all generation timings, the single high rate application performed numerically better than the two low-rate applications.

These results provide more questions than answers regarding timing OLR treatments during the season. The first generation treatment has generally worked because the population age structure is relatively uniform at that time of the season so that most larvae are in a susceptible stage to a well-timed spray. Also, berries are small, clusters are open and relatively little foliage is present to interfere with spray coverage. This strategy of treating the first generation with resulting season long control is based on the assumption that the population is essentially resident within the vineyard and only an insignificant migration of adults into the vineyard takes place later in the season. Very little damage was noted in the first brood evaluation, and damage measured at the second evaluation was significantly higher in those treatments which received only a first brood spray. This indicates that substantial movement of OLR into the vineyard took place during the season at this location. A further complication in some situations may be the presence of a cover crop, either native or cultivated, within the vineyard. OLR has an extremely wide host range and could easily sustain itself on many native and cultivated plants used as cover crops. These plants are not monitored for OLR presence and could be, in effect, a “Trojan horse”, allowing OLR to build up later in the season and spread into surrounding vineyards.

With regard to the second objective, the data indicate that splitting insecticide applications into two, low-rate sprays rather than a single higher rate application is, at the least, ineffective and may be counterproductive. It may be that low rate sprays result in residues which, while persisting longer, are only marginally lethal. It appeared that, in

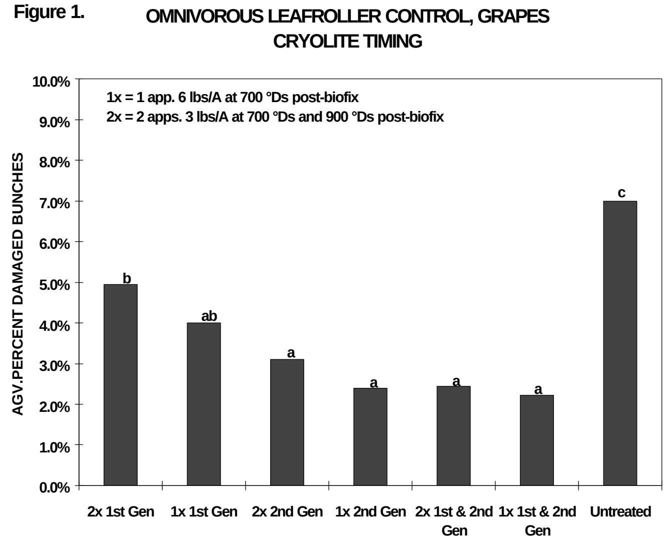
1998, growers were better off saving themselves the extra application cost of a second spray.

Table 1. Average percent of omnivorous leafroller damaged clusters

Treatments	Percent damage 1st Generation	2nd Generation
2 x 3 lbs,1st	—	4.9 b
1 x 6 lbs, 1st	—	4.0 ab
2 x 3 lbs, 2nd	—	3.1 ab
1 x 6 lbs ,2nd	—	2.4 a
2 x 3 lbs, 1st + 2nd	—	2.4 a
1 x 6 lbs, 1st + 2nd	—	2.2 a
Untreated control	0.28	7.0 c

Numbers followed by the same letter(s) are not significantly different (DMRT, p=0.05).

Figure 1.



Columns with same letter(s) are not significantly different, Fisher's Protected LSD (p=0.05).

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ABSTRACTS

PACIFIC BRANCH, ENTOMOLOGICAL SOCIETY OF AMERICA, Honolulu, Hi, June, 1998

Bionomics of *Phytocoris relativus (Hemiptera: Miridae*) in Central California. *R. E. Rice and R. A. Jones, UC Kearney Agricultural Center.*

Phytocoris relativus is distributed in pistachio orchards throughout the central valley of California. Initially categorized as a serious pest causing epicarp lesion on pistachio nuts, *P. relativus* is now considered to be a zoophytophagous species. Insect hosts include navel orangeworm eggs, aphids, and scales. Adult longevity improved on a mixed diet of NOW eggs and plant material. *Phytocoris* spp. are cryptic, nocturnal, and not readily observed or recognized on host plants. *P. relativus* overwinters as eggs in soft plant tissue. Beating tray sampling at Parlier, CA in 1987 showed three generations per year on stone fruits; pheromone trapping in 1997 confirmed this observation. *P. relativus* has been collected in pheromone traps in numerous crops and ornamental hosts, including pistachios, almonds, plums, prunes, kiwis, peaches, persimmons, grapes, apples, walnuts, lemons, and pyracantha. Its plant and prey host range will surely increase with additional survey trapping and biological studies.

Management of Silverleaf Whitefly and Aphid-Borne Virus Diseases Using Reflective Mulches. *C. G. Summers and J. J. Stapleton, UC Kearney Agricultural Center.*

It is difficult to grow many fall vegetables, particularly cucurbits, in the San Joaquin Valley due to the high incidence of aphid-borne virus diseases and infestations of silverleaf whitefly, *Bemisia argentifolii*. Insecticides are ineffective in controlling aphid vectors and reducing the incidence of disease. Silverleaf whitefly control requires frequent insecticide applications with the development of resistance posing a substantial risk. Placing reflective (metalized) plastic mulch over the planting beds prior to seeding has been shown to significantly reduce the incidence of alate aphid alighting and to delay the onset of several non-persistently transmitted virus diseases by up to 6 weeks in pumpkins, zucchini squash, and cucumbers. Colonization by silverleaf whitefly was also delayed and the incidence of silverleaf symptoms in squash and pumpkins reduced by up to 80%. Both yield and quality were significantly enhanced in vegetables grown over the reflective mulches. Vegetables matured 2-3 weeks earlier when grown over reflective mulches than when grown over bare soil. The mulches reduced irrigation needs and eliminated most annual weeds.

SOCIETY OF NEMATOLOGY, St. Louis, MO, June, 1998

Efficacy of Five Postplant Nematicides Applied via Drip Irrigation to First-Year *Prunus* Spp. *M. McKenry, T. Buzo, and S. Kaku, UC Kearney Agricultural Center.*

Prunus spp. were planted in a nursery setting involving sandy loam soil infested primarily with *Pratylenchus vulnus*. A dripper system delivering 4 liters/hr every 3.3 m in distance provided irrigation to each tree at 4 hr increments. At the end of one year the untreated check revealed 448 *P. vulnus*/250 cm^3 soil. Monthly applications of oxamyl at 1.12 kg/ha resulted in 12 *P. vulnus*/250 cm^3 soil sample. Methyl isothiocyanate at 10 ppm (w/v) applied three times before summer and twice at 20 ppm during summer resulted in visible tree damage. At sampling time this treatment averaged 102 *P. vulnus*/250 cm^3 soil. Three treatments that did not provide significant population reductions included sodium tetrathiocarbonate at 700 ppm in spring and 500 ppm in fall; three applications of DiTera at 22.4 kg a.i./ha rate; and 2000 ppm peroxyacetic acid plus biological additives applied seven times per year. Even the best treatment cannot be considered as a "stand alone" replacement for a good preplant treatment. The future of carbamate nematicides such as oxamyl, even when used on nonbearing fruit trees, is in doubt as a result of interpretations of the new Food Quality Protection Act.

Field Performance of Two Genetically Transformed Grape Rootstocks against Two Root-Knot Nematode Populations. *S. A. Anwar and M. V. McKenry, UC Kearney Agricultural Center.*

Freedom grape rootstock was developed for its resistance to a mix of *Meloidogyne* spp. Root-knot nematodes penetrate, establish feeding sites and develop to adult females, but reproduction does not occur. The insertion of a *Bacillus thuringiensis* (Bt) gene or genes encoding the Snowdrop lectin (GNA) halted penetration and establishment by a mixture of *Meloidogyne* spp. In the presence of a pathotype of *M. arenaria* that specifically reproduces on Freedom, population levels of 27 females/g root were counted 90 days after inoculation. Freedom transformed with Bt and GNA genes reproduced 59 females/g and 14 females/g root, respectively. Brown to black lesions of variable sizes occurred around the infection courts of females on both transformed plants compared to the non-transformed. A nine month field evaluation in the presence of *M. arenaria* pt. Freedom revealed no resistance to any of the rootstocks tested.

IPM ISSUES & UPDATES

EMERGING ISSUES IN IPM. *Peter B. Goodell and Frank G. Zalom*

Several issues are emerging in IPM that require the attention of Farm Advisors, Specialists, and AES researchers. Hereafter, we present these as separate issues, but in reality they are interlinked and influence one other. The issues include:

1. GPRA (Government Performance and Results Act) reporting for Smith-Lever (3d) IPM extension funds
2. Revised Request for Proposals for Statewide IPM Project Smith-Lever IPM funds to confirm to GPRA reporting requirements
3. Indicators of IPM use, and measuring changes in practices
4. IPM food labeling and positive points systems

Reporting on the Government Performance and Results Act

California receives federal formula funds for Smith-Lever (3d) Extension IPM program each year. In order for the University of California to receive these funds, the Statewide IPM Project has always been directed to produce a comprehensive annual report of activities which includes narratives of results and outcomes of IPM implementation projects. Beginning in 1998-99, the Federal government has initiated a new reporting system for these funds to comply with the Government Performance and Results Act (GPRA). GPRA is a federally mandated reporting system aimed at evaluating outcomes of Federal programs by establishing baselines for performance indicators, and then measuring changes in those indicators. As part of the evaluation process, a list of indicators is being develop by Dr. Mike Fitzner, Extension IPM Program Leader, and a committee of State IPM Coordinators from all four USDA regions. The basic approach will be for each state to pick and choose from the indicators, develop a baseline for a particular crop, commodity, or project, estimate the change from the baselines, and eventually report on actual changes. The indicators are still under development but are expected to be in place for reporting during the Federal fiscal year 1999-2000.

These indicators will report both *activities* and *outcomes*. Outcomes will be measurable by examining changes over time. Indicators should:

- Represent a meaningful outcome or result that reflects strategic program objectives and performance goals.
- Represent a quantitative, program-related outcome.
- Be targetable. In other words, a level must be established so that changes in that level can be measured over the life of the program being evaluated.
- Be influenced by the allocation and expenditure of Smith-Lever program funds.
- Have currently available data to set baselines.
- Be comparable across years within the same state or region.

Let’s consider an example. Suppose a commodity workgroup defines IPM as a list of practice that includes 20 separate activities. They expect that growers who practice a minimum level of IPM should use at least 50% of the activities on their practice list. Further, they set a baseline by estimating that 30% of the growers currently employ 50% of the activities on the practices list. The IPM team estimates that through the application of IPM Extension funds, they anticipate that in 3 years 60% of the growers will be using 50% of the activities from the list. This can be measured through the use of surveys.

Concurrent to the team’s educational effort a new practice is introduced. Measuring the number of people who adopt this practice and any other outcome such as reduced risk, increased profit, or reduction in products targeted by FQPA could become an additional team goal. Another measure might be the percentage of growers who use 90% of the practices on the list, an amount identified by the team as more intensive IPM. By doing this, not only might the team measure an increase in the number of growers using the minimum set of practices, but also the percentage who are practicing more intensive IPM.

The measurement of changes in practices could also result in increased use of biologically integrated practices or reduction in pesticides. The effect of their use may be additional measures of program outcomes. The concept of an IPM continuum that stretches from No IPM to entirely biologically based pest management is a paradigm being employed by a number of people and groups interested in quantifying the impact of IPM. This concept is discussed under IPM Measurements.

<u>Revised Request for Proposals for Smith-Lever Extension IPM Competitive Grants</u>

GPRA requires a far more extensive emphasis on evaluation activities than had been the case in past years. The Statewide IPM Project is in the process of developing an Evaluation Center at KAC to support the GPRA reporting activities, while also developing evaluation methodologies and data sets to assess the impact of a broader range of DANR’s IPM activities.

A Request for Proposals, due October 30, 1998, was distributed to academic units throughout DANR, and is posted on the IPM Project’s World Wide Web site. The call is divided into two phases, the first being planning; the second being developing of baselines, delivery of educational products, and measuring the outcome of the effort. The example given in the preceding section provides a framework, but it represents only one possible model. In general, proposals should define what a basic IPM program looks like, provide a description of the program, and measure changes that result from the program.

The 1998-99 RFP called for people to form IPM teams to develop a plan describing how they would develop an organized IPM delivery project, and describe the indicators they would use to measure outcomes. Up to $10,000 per project was available to offset the cost of meetings and travel, and to help prepare a phase 2 proposal. If the phase 2 proposal was successful, funds would be available for multiple years to deliver the IPM education program.

During 1998-99, cotton and stone fruits (including almonds) are developing baseline indicators and delivering IPM education using the model described previously. We developed the core list of IPM practices under a short deadline last year through the use of a small committee of Farm Advisors and Specialists. Participating teams will be expanded and interested people can be brought into this process.

It is the strong belief of the IPM Project that this activity should not be driven solely by Federal reporting needs. Rather, we believe, as do our Federal partners, that characterizing IPM systems is useful -

- to appreciate the extent and level of IPM being practiced by clientele,
- to identify constraints, if any, that prevent more IPM practices from being adopted, and
- to measure changes in grower use of IPM practices.

Identifying IPM Indicators and Measuring Changes

How can changes in IPM use be measured, and what do these changes mean? These questions go beyond the scope of the Smith-Lever IPM Extension program, and are the subject of discussion among many organizations with multiple goals. For example, measurements of changes in indicators are useful for comparing different IPM approaches, and to determine use patterns across regions or crops. Measurement is essential for certification-labeling programs such as those found in New York State and the Netherlands.

The Statewide IPM Project has an interest in being able to define and characterize an IPM program in a crop or on a commodity to improve resource allocation for program delivery. Once indicators are identified and baselines established, changes in practices can be used to measure program adoption. We hope that by systematically approaching program evaluation, key factors can be identified to compare different IPM systems.

This past June, a workshop was held in Chicago to review the state of IPM measurement. Participation was by invitation only and included non-government organizations, EPA, USDA, and Land Grant Universities. The goal was to bring together an international panel of experts in the area of IPM measurement. A number of examples were discussed including:

- the Wisconsin effort to reduce pesticide and fertilizer inputs and provide quantifiable approaches to measuring change
- the Netherlands "yardstick" approach in which points were assigned to product toxicity in an effort to reduce their use on fresh food products.
- the Federal IPM program's PAMS (Prevention, Avoidance, Monitoring and Suppression) approach in which growers are asked about specific practices during the annual NASS (National Agricultural Statistics Service) survey.
- community based programs such as BIOS and BIFS approaches to measure changes

No specific recommendations regarding the best approach were presented. Rather highlights of these programs were identified, and their strengths and weaknesses discussed. A report from the Workshop is available from American Farmland Trust. For a review of current IPM system measurement activities, visit the web site of Pest Management at the Crossroads (http://www.pmac.net/measind.htm).

IPM Labeling for Food Products and Positive Points System

Interest in labeling food or products as *"IPM or ecologically produced"* has been very strong in recent years, and has been raised on several recent occasions in California. The subject was addressed during the 1998 Pomology Education Continuing Conference (PECC), during which overviews of national and international programs were discussed. One California program which was highlighted was the Central Coast Vineyard Team's development of Positive Points System which is a measure of adoption of environmentally enhancing farming practices over time. Consisting of 1000 points spread over six categories, this report card encourages producers to improved their annual scores from year to year. Another 1998 conference was held in Sacramento to explore the concept of Eco-labeling. Events such as these raise questions as to whether there is general support for such programs, and what is the appropriate role of the University?

The former question is complex. The desire for a product with a 'green' label varies with commodity, region and interested party. For some, the label supports the concept of a product produced in the most environmentally sound way. Examples include the SAFE salmon program in the northwest and the CORE Values program in the northeast. For others, it provides an opportunity for education and recognition of producers who have adopted the approach. Examples include the Wegman's Market/Cornell University IPM labels, and the Massachusetts Partners with Nature program. Others, such as the Netherlands effort, use it to measure the use reduction of high-risk materials. For the Central Coast Vineyard Team, the desire is to measure shift toward more environmentally enhancing practices.

In 1997, we approached 26 California commodity commissions with examples of IPM labeling used elsewhere, and asked them if there would be an interest in developing a label for their commodities and what, if any, help they might desire from the IPM Project. With one exception, the response was universally to wait and see how the issue developed. Concerns expressed in the responses included:

- establishing certification guidelines
- who would do the certification
- what value the label would add to the product
- what new regulations might be imposed
- who would pay for the certification
- shifting already limited resources of the IPM Project away from core activities

A similar response was generated from members of the California League of Food Processors, many of whom felt that it would be difficult to explain to some groups why any pesticides, even at reduced levels that might accompany an intensive IPM program, were being applied to a crop.

The IPM Project stands ready to help develop IPM guidelines if there is a desire on the part of California producers to have such a program. However, the involvement would be clearly in an educational rather than in a regulatory role.

CORRECTION: *In the article "Management of Vegetable Insects Using Plastic Mulch: 1977 Season Review" by C.G. Summers and J.J. Stapleton appearing in the January/April (Vol. 8, No. 1&2) of PPQ, the reflective metalized plastic "Brite'nup" was incorrectly listed as a product of and supplied by Sonoco. Brite'nup is a tradename of Adcock Mfg. Corp. and the correct identification and credit should have read "Brite'nup â (Adcock Mfg. Corp., Gardena, CA)." The authors apologize for the error.*