Proc. Fla. State Hort. Soc. 105:286-287. 1992.

CHEMICAL CONTROL OF AVOCADO AND LIME PESTS

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Additional index words. Pseudacysta perseae, Brevipalpus phoenicis, Phyllocoptruta oleivora, Panonychus citri.

Abstract. **Laboratory and field experiments were conducted to test efficacy of insecticides for control of avocado lace bug *Pseudacysta perseae* (Heidemann). The performance of chlorpyrifos, permethrin, pyrethrin and malathion provided satisfactory control of avocado lace bug under field conditions. The effect of weathered residues of different pesticides on *Brevipalpus phoenicis* (Geijskes), *Phyllocoptruta oleivora* (Ashmead), *Panonychus citri* (McGregor) and *Planococcus citri* Risso was determined in limes (*Citrus latifolia* Tanaka). Effect of different pesticides on these lime pests is discussed.**

The avocado lace bug, *Pseudacysta perseae* (Heidemann) has become the most frequent pest of avocado, *Persea americana* Miller (Mead and Pena, 1991). Since the time of its description in 1908, the avocado lace bug has been regarded as being of only occasional minor economic importance. Recently, damage has increased in Florida, and within the last two years damaging populations have been reported for the first time in Puerto Rico (Medina-Gaud et al., 1991) and the Dominican Republic (Abud-Antun, 1991). The avocado lace bug causes yellowish or brownish necrotic areas on avocado leaves, and severe infestation may be related with tree defoliation. It has been suggested by Mead and Pena (1991) that injuries from lace bug activities provide the infection court for the anthracnose fungus, *Colletrotichum gloeosporioides* Penz.

The rust mite, *Phyllocoptruta oleivora* (Ashmead), the citrus red mite, *Panonychus citri* (McGregor), the citrus mealybug, *Planococcus citri* Risso, and the flat mite, *Brevipalpus phoenicis* (Geijskes) are recognized as important pests of lime (*Citrus latifolia* Tanaka) (Jeppson et al., 1975; Knapp, 1985). In recent years, the population and importance of the flat mite have escalated from occasional pest to common pest of lime. Research has been done to show the efficacy of insecticides against citrus pests (Knapp, 1987; Pena, 1988); however, very few tests have been conducted in lime. Moreover, to my knowledge, no current work has been done to show efficacy of insecticides against avocado lace bug. My objectives were to compare the efficacy of insecticides on the avocado lace bug and the lime pests mentioned above.

Materials and Methods

Avocado lace bug laboratory tests. Avocado lace bug adults were collected from an infested avocado orchard located in Princeton, Florida. Uninfested avocado leaves were dipped for 1 min in solutions of different pesticides. Leaves were allowed to dry for 10 min and placed individually in 1-liter plastic containers. A single adult lace bug was placed in each container. Subsequently, the container was covered with cheesecloth to allow proper ventilation. Each treatment was replicated 20 times. Lace bug mortality was observed 24 hr after treatment.

Avocado lace bug field test. Trials were conducted to evaluate insecticide treatments for control of avocado lace bug infestation in a 15-year-old avocado orchard. Treatments were applied to four-tree plots replicated three times. One unsprayed buffer tree separated trees within rows and one tree separated trees between rows. Sprays were applied with an airblast sprayer at 170 psi, 2000 rpm. Five leaves were examined at random for adults and nymphs around the canopy 14 days before treatment and 4 and 11 days after treatment.

Lime pests field tests. Impact of field-weathered residues of seven pesticides on lime pests was evaluated from 10 October through 10 December 1991 and from 30 March through 20 May 1992 in a 15-year-old lime orchard. Treatments were applied twice in a 30-day interval to three-tree plots replicated four times. One unsprayed buffer tree separated trees between rows and one tree separated trees within rows. Sprays were applied with an airblast sprayer at 160 psi, ca. 2 gal/tree. Five fruits were examined at random around the canopy of each tree. Treatment effect on survival of pests was evaluated 8 days before treatment and 3 consecutive weeks after treatment.

Results and Discussion

Avocado lace bug tests. Data from the laboratory test experiment are summarized in Table 1. At 24 hr after treatment mortality of lace bug adults ranged from 70% to

Table 1. Mortality of avocado lace bug adults under laboratory conditions.

Treatment	Rate/100 gal	% Mortality	Actual mortality
Permethrin	2.56 fl oz	100	95
Methomyl	2 pt	100	95
Pyrethrin	2 pt	75	70
Malathion	1 pt	100	95
Chlorpyrifos	1 pt	100	95
Check		5	0

Table 2. Survival of avocado lace bug after application of chemical treatments.

	Days after treatment					
	−14		+4		+11	
Treatment[z]	Adult	Nymph	Adult	Nymph	Adult	Nymph
Pyrethrin	0.02 b[y]	0.37 b	0.40 b	2.28 bc	0.55 a	0.55 b
Permethrin	0.21 ab	2.13 ab	0.08 b	0.07 d	0.30 ab	0.85 b
Malathion	0.18 ab	1.70 ab	0.20 b	2.91 b	0.12 ab	1.07 b
Chlorpyrifos	0.55 a	1.78 ab	0.17 b	0.42 cd	0.00 b	1.12 b
Check	0.60 a	2.58 a	1.05 a	6.58 a	0.55 a	3.53 a

[z]Pyrethrin, 2 pt/100 gal; Permethrin, 2.56 fl oz/100 gal; Malathion 57 EC, 1 pt/100 gal; Chlorpyrifos 4E, 2 pt/100 gal.
[y]Mean separation within columns by Duncan's multiple range test, 5% level.

Florida Agricultural Experiment Station Journal Series No. N-0074. This project was supported by the Florida Lime and Avocado Committee.
[1]Chemicals used for research purpose only. No endorsements or registration implied herein.

Table 3. Effect of pesticides on lime pests and predaceous mites, Fall 1991.

Treatment	Dose/ 500 gal	Average no./fruit Rust mites	Red mites	Flat mites	Mealybugs	Predaceous mites
Lorsban 4E	2.5 pt	0.21 a[z]	0.003 a	0.17 b	0.16 b	0.03 b
Ethion 4M	2.5 pt	0.08 a	0.000 a	0.15 b	0.35 ab	0.03 bc
Citrus Oil	0.5 %	0.10 a	0.000 a	0.26 b	0.29 ab	0.06 ab
Copper Sulfate 24%	4 lb	0.27 a	0.003 a	0.61 a	0.24 ab	0.02 c
Supracide	2-5 pt	0.18 a	0.002 a	0.42 ab	0.34 ab	0.03 bc
Microflow Sulfur 52%	25 lb	0.03 a	0.000 a	0.14 b	0.43 ab	0.03 bc
Kelthane 1.6 8 C	1 gal	0.19 a	0.005 a	0.05 b	0.46 a	0.01 c
Control		0.04 a	0.000 a	0.23 b	0.18 b	0.08 a

[z]Mean separation within columns by Duncan's multiple range test, 5% level.

95%. The most effective insecticides were permethrin, methomyl, malathion and chlorpyrifos, followed by pyrellin. During the field test all pesticide treatments significantly reduced the adult population density 4 days after treatment, but with the exception of chlorpyrifos, failed to reduce adult density 11 days after treatment. Only pyrellin reduced the nymphal population 4 days after treatment, and all treatments had significantly lower immature populations 11 days after treatment (Table 2). More laboratory and field experiments must be conducted to determine whether chemicals can be combined with other strategies, i.e., biological and cultural control, to control the avocado lace bug.

Lime tests. Rust mite and red mite density were negligible during the 1991 experiment. Application of copper sulfate appeared to increase flat mite density, whereas mealybug density increased after applications of Kelthane. Lowest populations of predaceous mites were obtained after applications of Kelthane and copper sulfate (Table 3). During the spring 1992, plots sprayed with Supracide and pyrellin had two to three times more rust mites than the control plots (Table 4). The lowest population of rust mites was observed after application of Avid, followed by Ethion and Lorsban. With the exception of Avid, all pesticides reduced red mite density (Table 4). Sulfur, Lorsban and Supracide were ineffective against flat mites (Table 4). Populations of mealybugs were low during the winter and spring of 1992. All pesticides maintained mealybug populations below the control (Table 4). Density of predaceous mites was lower on sulfur and pyrethrin-sprayed plots than on chlorpyrifos, Ethion and oil-sprayed plots (Table 4). More experimentation is necessary to ascertain the rate at which chemicals should be sprayed to obtain control of pests and maintain predator numbers under field conditions.

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Table 4. Effect of pesticides on lime pests and predaceous mites, Spring 1992.

Treatment	Dose/ 500 gal	Rust mites	Red mites	Mealybugs	Predaceous mites
Chlorpyrifos	2.5 pts	2.49 b[z]	0.021 b	0.021 b	0.013 a
Ethion	2.5 pts	2.40 b	0.008 b	0.05 ab	0.013 a
Citrus Oil	0.5 %	3.54 b	0.60 b	0.02 b	0.008 a
Agrimek	0.31 pts	0.61 b	1.20 a	0.05 ab	0.004 a
Supracide	2.5 pts	16.02 a	0.04 b	0.08 ab	0.008 a
Microflow Sulfur 52 %	25 lbs	5.13 b	0.05 b	0.04 b	0.00 a
Permethrin	1.25 gal	12.44 a	0.02 b	0.03 b	0.00 a
Control		5.68 b	0.03 b	0.11 a	0.008 a

[z]Mean separation within columns by Duncan's multiple range test, 5% level.

Proc. Fla. State Hort. Soc. 105:288-289. 1992.

A NEW DISEASE OF MANGO IN COSTA RICA CAUSED BY AN *ERWINIA*-LIKE BACTERIA

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Additional index words. mango, *Erwinia*, bacteria.

Abstract. **The bacterial disease appears as wilt, branch dieback, fruit rot and external fluxing of mango (*Mangifera indica* L.). All of the Florida mango cultivars, 'Tommy Atkins,' 'Keitt,' 'Kent,' and 'Irwin,' that are grown in Costa Rica show susceptibility to infection. Some of the local mango cultivars are susceptible while others are not. Trees affected by the bacteria show chlorosis and a general unthriftiness. Internally the trees have dark strands in the vascular tissues. Milky colored sap flows out of the trunks, branches, and panicles through cracks and wounds. The sap flows out over the trunk and branches and dries in long gummy strings. Panicle infection appears to come from an insect pollinator or from the branch vascular tissue. Infected fruits have a single lesion on or near the shoulder of the fruit. The brownish-black infected tissues can be traced back to the embryo and sometimes up through the stem and panicle.**

The mango, *Mangifera indica* L., is a popular tropical fruit in Costa Rica, and other Central and South American countries, as well as in Africa, Egypt, Israel, India, Pakistan, Taiwan, Mexico, and South Florida. The Florida cultivars, 'Tommy Atkins,' 'Keitt,' 'Kent,' and 'Irwin,' were introduced into Costa Rica in the mid 1950s. The University of Costa Rica and the University of Florida have since been instrumental in developing new cultivars with an array of colors, sizes, maturity dates, fibers, and soluble solids.

Wilting, gumming and dying plants were first observed in a commercial mango orchard in Costa Rica in 1982. Disease severity was low during the rainy season but reached a high level in April and continued through July as temperatures rose. An *Erwinia*-like bacteria was isolated from diseased trees. This report details symptomology, etiology, identification procedures, and the importance of this bacterial disease.

Materials and Methods

Identification of the mango pathogen. Diseased tree branches collected from a commercial mango orchard near Liberia, Costa Rica, were surface sterilized with 1.0% NaOCl for 1 min and the bark was aseptically cut away, revealing red streaks in the vascular tissue. The tissue surrounding and including the red tissue was cut away and suspended in sterile water for 4 to 6 hr. The resulting suspension was streaked onto nutrient-yeast-dextrose agar, King's medium B agar (King et al., 1954), and crystal violet pectate agar (Cuppels et al., 1974; Kelman et al., 1980) and incubated at 28C for 48 hr. Suspensions of the pure cultures were used individually to inoculate media for the biochemical differentiation of the bacteria that had been tentatively identified as a *Erwinia* sp. (Kelman et al., 1980). The bacteria was evaluated for aerobic or anaerobic growth, sensitivity to erythromycin, gelatin liquefaction, phosphatase activity, production of reducing substances from sucrose, and production of acid or gas from glucose lactose, palatinose, and -methylglucoside (Kelman et al., 1980). Bacterial isolates made from the mango cultivar 'Tommy Atkins' were made and forwarded to Dr. Robert Stall, University of Florida, Gainesville, Florida, for fatty acid analysis.

Inoculation of intact stems of plants. One-year-old mango cultivar seedlings, one per 30-cm pot, were stab inoculated by piercing with a sterile needle that had been dipped in a petri-plate culture of the bacteria. Disease ratings were made monthly based on gumming and plant necrosis.

Results and Discussions

Symptoms. Symptoms on infected trees consisted of an irreversible wilting of leaves and green stems. The foliage of diseased trees appeared pale and had a general unthriftiness. Occasionally branches died back and the leaves persisted for several weeks. Trees affected by the bacteria were found to have streaking in the outer sapwood and in the cambial or phloem regions. Trees showed a milky colored sap flowing out of the trunks, branches, and panicles through cracks and wounds. The sap flowed out over the trunk and branches and dried in long gummy strings. Infected fruits had a single lesion on or near the shoulder of the fruit. The brownish-black infected tissues were traced back to the vascular tissues and up through the stem and panicle.

The disease was very destructive to the commercial mango orchard, located near Liberia, Costa Rica. Over 80% of the trees are affected by the bacteria and approximately 1% to 2% of the trees have died. The orchard consists of 2 cultivars, 'Tommy Atkins' and 'Yellow Haden.'

Identification of the bacteria. The pectolytic, gram-negative, rod-shaped bacterium from mango was tentatively identified as an *Erwinia* sp. The bacterial isolate was a facultative anaerobe, tolerant to erythromycin and liquefied gelatin, did not produce reducing substances from

Table 1. Identification of a bacterial pathogen from mango (*Mangifera indica*) as *Erwinia* sp.

Biochemical Test	Mango Isolate
Sensitivity to erythromycin (mm of inhibition)	15
Reducing substances from sucrose	–
Phosphatase	–
Gelatin liquefaction	+
Gas from glucose	–
Acid from	
Lactose	+
a-Methyl glucoside	–
Palatinose	–

Florida Agricultural Experiment Station Journal Series No. N-00722.