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HOMOPTERAN AND MITE PESTS OF PAPAYA AND THEIR CONTROL

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Abstract. **Homopteran pests in papaya fields in Florida, include mealybugs, *Paracoccus marginatus* Williams and Granara de Willink, soft scales *Philephedra tuberculosa* Nakahara and Gill, *Coccus hesperidum* L. and armored scales, *Aspidiotus destructor, Acutaspis* sp., *Hemiberlesia* sp., aphids, *Myzus persicae* (Sulzer) and *Lipaphis erysimi* (Katenbach), leafhoppers, *Empoasca stevensi* Young and whiteflies *Trialeurodes variabilis* and mite pests *Tetranychus* spp., *Polyphagotarsonemus latus*. The frequency the homopterans in commercial papaya fields in Homestead, FL was investigated between November 2000 to October 2001. Results from chemical control tests against scales, mealybugs, and mites in papaya are reported.**

Papaya, *Carica papaya* L. is a major tropical fruit cultivated in frost-free areas. As with most tropical fruits grown in varied geographical regions, papaya is affected by several arthropods, that can be considered key or secondary pests. In different papaya growing areas, fruit flies, leafhoppers, mites, and scale insects are considered key pests requiring frequent pesticide applications. Among these, aphids and leafhoppers are important pests due to their vector capacity. Mites can reach a pest status in papaya if their natural enemies are eliminated. The first objective of this study was to identify homopteran pests in papaya fields in Florida, determine their frequency and presence of parasitoids, verify the presence of cicadellids in papaya, particularly, the absence of the leafhopper species *Empoasca papayae*. The second objective was to determine efficacy of pesticides against mealybugs, scales and mites infesting papaya.

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Materials and Methods

Homopteran Pests. A monthly survey for homopteran pests of papaya, var. 'Red Lady' was initiated in November 2000 through October 2001 in three commercial papaya fields located near Homestead, Fla. Two sampling methods were used. In each field, the first method consisted of collecting 10 leaves from the mid canopy of 10 papaya plants. Each leaf was then placed individually in a plastic bag and transferred to the laboratory for inspection and the presence of homopterans per leaf was recorded. Insects were stored in emergence vials and held to determine possible parasitism. The second method consisted of using a D-vac sampler (Modified CDC backpack aspirator-model 412). The collection device was held at about 1-1.5 m above ground and pointed toward the middle and bottom of the plant canopy. The operator moved clockwise around the tree. From this type of sampling, only cicadellids were collected, counted and adults sent for identification by Susan Halbert (FDOACS, Gainesville, Fla.). Coccidae and Pseudococcidae were identified by A. Hamon (FDOACS, Gainesville, Fla.) and parasitoids of the species under study were identified by G. Evans (FDOACS, Gainesville, Fla.).

Chemical Control of Scales and Mealybugs in Papaya, 2003. In mid July 2003, 120 papaya cv. 'Red Lady' plants were planted in 6 inch pots at the Tropical Research and Education Center, University of Florida/IFAS, Homestead, Fla. When plants were 8 inches tall, they were infested with the papaya scale *Philephedra tuberculosa* and papaya mealybug, *Paracoccus marginatus*, by placing a section of a scale and mealybug infested papaya leaf on each plant. Pretreatment counts were made 25 Aug. by collecting one leaf and by counting the number of scales and mealybugs on plant stems using a 10× hand lens. The plants were then blocked by treatment counts. All treatments were sprayed on 26 Aug. with a manual sprayer with a flat nozzle at approx. 50 psi to run off. Each treatment was replicated 10 times with each replicate being an individual plant. Post-treatment counts were made on 2, 10 and 18 Sept.

Chemical Control of Papaya Mealybug, 2005. Selected pesticides were evaluated for control of the papaya mealybug at the Tropical Research and Education Center, Homestead, Fla. Individual experimental units consisted of 10 cv. 'Red Lady' papaya plants, planted in 2 gal pots. The plants were fertilized once with Osmocote (14-14-14) and irrigated every other day. Plants were 2 ft. tall when we conducted the trial. Mealybugs were brought from the field and ovisacs placed on top of the leaves. Three weeks after infestation, an infestation index was developed as follows: 0 = no nymphal stages observed on the abaxial leaf surface; 1= nymphs observed on the abaxial leaf surface; 2 = nymphs observed, curling of the leaves begin to appear; 3 = adults, nymphs and ovisacs observed, curling of top leaves; 4 = adults, nymphs and ovisacs on leaves, petioles and stems; defoliation observed; 5 = severe defoliation, rotting of stems, mealybugs observed on stems, leaves and lateral buds. After the infestation rating two leaves with petioles were removed per plant and placed individually in a plastic bag, numbered and brought to the laboratory where mealybug density was counted under a dissecting microscope. A pre-treatment count was taken on 31 Mar. followed by a single application of the pesticides on 1 Apr. Spray treatments were applied using hand sprayers at approximately 25 psi at an application rate of 100 gal/acre. Admire 2F was applied as a soil drench, utilizing 0.4 mL per pot diluted in 1 gal of water. Each treatment was replicated 10 times with each replicate being an individual plant. Treatments were evaluated after 12 and 26 d.

Evaluation of Acaricides for Control of Two-spotted Mite in Papayas, Year 2002. A 2-year-old block of "Red Lady" papaya at Florida City, Fla. was used to determine efficacy of acaricides against the two-spotted mite, *Tetranychus urticae* Koch. Plots consisted of four groups of six trees, with five plants serving as sample trees. Treatments consisted of one application of milbemectin, sanmite, acramite and/or novaluron and a non sprayed control. Twenty two days after, all treatments were reapplied. Applications of test materials were made with a hand-gun sprayer. The sprayer was calibrated to deliver 100 gpa at 2.2 mph. Mite populations were monitored 2 d before the first treatment and monitored weekly by collecting two leaves per plant after the first and second spray treatment. One 5 cm diameter leaf disc was removed from each leaf and the number of motile mites and predacious mites were counted under a microscope. All data were subjected to two-way ANOVA means separated by LSD ($P = 0.05$).

Evaluation of Chemicals for Control of Two-spotted Mite in Papayas, Year 2003. Selected acaricides were evaluated for control of the two-spotted mite at the Tropical Research and Education Center, Homestead, Fla. Individual experimental units consisted of 15 cv. 'Red Lady' papaya plants, planted in ½-gal pots. The plants were fertilized once with Osmocote (14-14-14) and irrigated every other day, applying water to the soil. By the time we conducted the trial, the plants were moderately infested with two spotted mites. A lower leaf was selected per plant to monitor efficacy of the acaricides. The leaf was detached and placed in a paper bag, numbered and brought to the laboratory and number of mites determined under a microscope. A pretreatment count was taken on 27 May followed by a single application. Silwett L-77 was applied as surfactant at a rate of 1.18 $ml \cdot L^{-1}$. A double application of Acramite was conducted on 18 June to a set of plants previously treated on 27 May. Spray treatments were applied with using hand sprayers at approximately 25 psi. Each treatment was replicated 15 times with each replicate being an individual plant. Treatments were evaluated on the day before acaricide application and after 9, 23 and 36 d.

Evaluation of Chemicals for Control of Broad Mite, Polyphagotarsonemus latus *Banks, Year 2004.* The broad mite is a common pest of papaya seedlings in greenhouses and in a few instances can be found infesting papaya in the field. Selected acaricides were evaluated for control of the broad mite at the Tropical Research and Education Center, Homestead, Fla. Individual experimental units were similar to those explained above. Three week-old-plants were infested with field collected broad mites by placing infested leaves on the adaxial surface of the top leaves. Five days after, infestations were determined by detaching a top leaf, observing the damage index (0 = no deformation, 1 = some deformation or reduction of the leaf area, number of lobes reduced, leaf size ¼ of its normal size and 3 = 'monkey's paw' symptom or deformation and severe leaf size reduction). Leaves were placed in a paper bag, numbered and brought to the laboratory and number of mites determined under a dissecting microscope. A pre-treatment count was taken on 25 May and post-treatment counts were conducted on 29 May, and on 1, 8 and 16 June. Treatments were applied using hand sprayers at approximately 25 psi. Each treatment was replicated 15 times with each replicate being an individual plant.

Results and Discussion

Homopteran Pests. The following insects within the order Homoptera were found in Homestead, Florida in papaya from October 2000 to November 2001.

Philephedra tuberculosa Nakahara and Gill. This scale insect is a pest of papaya, sugar apple, *Annona squamosa* L., soursop, *Annona muricata* L. and several species of ornamentals (Abreu, 1994; Nakahara and Gill, 1985; Peña et al., 1987). Three types of damage have been documented by *P. tuberculosa*: 1) distortion of the apical point during the seedling stage; 2) flower and leaf drop occurs after heavy infestations (Peña et al., 1987; Peña and McMillan, 1986); cosmetic damage if the females attach to the fruits (Abreu, 1994; Medina and Franqui, 1999; Peña et al., 1986). Damage to fruits is of considerable importance as affected fruits are unmarketable, however the pest status of this insect remains unsolved.

During November 2000, a maximum of 12 *Philephedra tuberculosa* (Homoptera: Coccidae) were collected per leaf (Fig. 1). Densities of *P. tuberculosa* declined thereafter. Two parasitoids of the genus *Metaphycus* sp. {Hymenoptera: Encyrtidae} were collected parasitizing this scale. According to Dr. G. Evans (pers. comm.; DPI, Gainesville), they appear to be two species, not yet identified. Previously, *Coccophagous lycimnia* (Walker) (Hymenoptera: Aphelinidae) and *Trichomastus portoricensis* Crawford (Hymenoptera: Encyrtidae) were collected as parasitoids of *P. tuberculosa* in Florida (Peña et al., 1987). The collection of *Metaphycus* sp. (n = 7) indicate that other parasitoids are using *P. tuberculosa* as their host in Florida. Parasitism by *Metaphycus* sp., was approx. 3% when the scale density peaked during November 2000.

Coccus hesperidum L. and Diaspidids *Aspidiotus destructor*, *Acutaspis* sp., and *Hemiberlesia* sp. increased in February and April and during July and August 2001 (Fig. 2).

Papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink, is a pest of papaya, cassava (*Manihot esculenta* Crantz), *Hibiscus* spp., eggplant (*Solanum melongena* L.), avocado (*Persea americana* Mill.), annona (*Annona* spp.), and

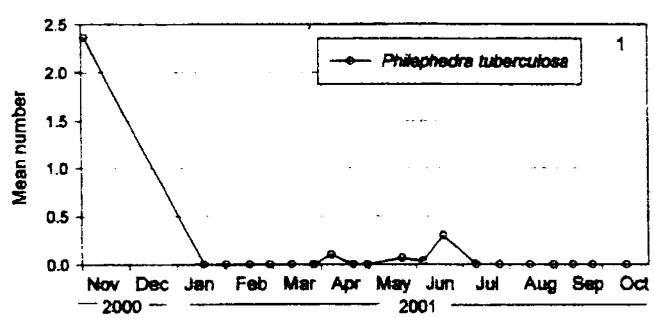

Fig. 1. Dynamics of *Philephedra tuberculosa* in Homestead, Florida, 2000 to 2001. Y axis = Mean number per leaf; x axis = Sampling time. Y axis represents mean number of individuals per sample.

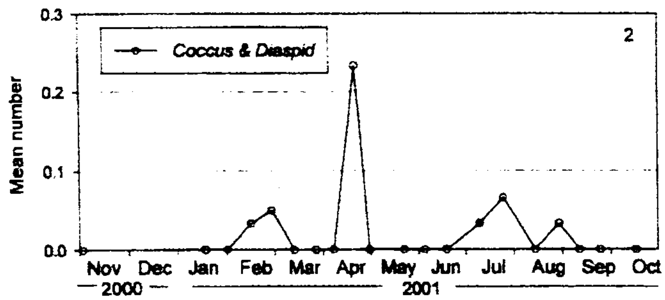

Fig. 2. Dynamics of Coccus sp., and several Diaspididae in papaya in Homestead, 2000 to 2001. Y axis = Mean number per leaf; X axis = Sampling Time. Y axis represents mean number of individuals per sample.

sweetpotato (*Ipomoea batatas* (L.) Lam.). The insect has been reported from papaya in Baja California and from cassava in the central valleys of Mexico. The papaya mealybug occurs in tropical and subtropical climates, principally in the coastal states of Mexico (Williams and Granara, 1992). The papaya mealybug has been reported since 1994 in the Caribbean islands of Antigua, Belize, British Virgin Islands, the Dominican Republic, Guatemala, Haiti, Nevis, St. Kitts, Puerto Rico, the US Virgin Islands and Costa Rica, and from the continental USA (Florida) since 1998 (Miller et al., 2000).

The insects feed on leaves, stems, fruits and even on seedlings. Mealybugs cause deformation, wrinkling and rolling of the leaf edges and early leaf drop (Miller et al., 2000). Attack to unripe fruits causes sap running and blemishes, a source of fruit downgrading. Papaya fruits can be heavily infested with mealybugs, becoming white and essentially inedible. Under heavy infestations, the abaxial leaf surface can be covered with insects that congregate near the main vein.

During this study, the papaya mealybug, *Paracoccus marginatus* Williams & Granara de Willink was observed in low densities from November through June and peaked in July and September (Fig. 3). The parasitoid, *Acerophagus nubilipennis* Dozier (Hymenoptera: Encyrtidae), was recovered parasitizing the mealybug. A hyperparasitoid, *Cheilonerus* sp., emerged from *A. nubilipennis*.

Aphids (Homoptera: Aphididae). Aphids do not colonize papaya plants and are considered minor pests, but several species, *Aphis coreopsidis* (Thomas), *Aphis nerii* Boyer de Fonscolombe, *Aphis gossypii* Glover, *Aphis spiraecola* Patch, *Myzus persicae* (Sulzer) and *Toxoptera aurantii* (Boyer de Fonscolombe) can be found on papaya plants (Abreu, 1994; Medina et al., 1999; Namba and Higa, 1981) or collected on water pan traps in papaya fields. Aphids are considered a serious threat to papaya production due to their ability to transmit diseases, in particular papaya ringspot virus (PRSV) and the papaya mosaic virus (Adsuar, 1947a,b; Becerra, 1987; Ishii and Holtzmann, 1963; Khurana and Bhargava, 1971; Nariani, 1956; Pontis, 1953). Several aphid species (*M. persicae, M. euphorbiae, A. spiraecola* (=*A. citricola*), *A. gossypii, A. craccivora, A. nerii, R. maidis, and Toxoptera auranti* (Boyer de Fosc) are capable of transmitting PRSV to papayas in Hawaii (Higa and Namba, 1971; Ishii and Holtzmann, 1963; Labonne et al., 1992; Namba and Kawanishi, 1966; Namba and Higa, 1981), Mexico (García, 1987), and Puerto Rico (Adsuar, 1946; Martorell and Adsuar, 1952; Schaeffers, 1969). During this study, the aphids, *Myzus persicae* (Sulzer) and *Lipaphis erysimi* (Katenbach) were frequent on leaves of papaya plantings in south Florida. These species increased from November 2000 to March and peaked again in May 2001 (Fig. 4).

Leafhoppers (Homoptera: Cicadellidae). Nine cicadellid species from three genera (*Empoasca, Poeciloscarta* and *Sanctanus*) can affect papaya (Pantoja et al., 2002). Leafhoppers cause two types of damage: direct feeding and secondary damage as vectors. Symptoms of leafhopper feeding include tip burn, wrinkling and cupping of the leaves, burning of leaf margins in large trees, and stunting of smaller plants (Ebesu, 1985; Medina et al., 1999). Leafhoppers are more important for their vectoring ability than for the mechanical damage.

During this survey, *Empoasca stevensi* Young was the only cicadellid species collected from papaya leaves or from the samples using the D-Vac. *E. stevensi* densities increased from April to June and reached small peaks during July and August (Fig. 5A, B).

Symptoms of *E. stevensi* feeding are similar to the familiar "hopperburn" associated with feeding by other *Empoasca* species (Ebesu, 1985). In Hawaii, egg incubation requires 7 to 14 d and the nymphal period is approximately 12 d. Adult feeding results is more severe injury than nymphal feeding (Ebesu, 1985). The finding in this study is in agreement suggesting that the principal vector of papaya bunchy top, *E. papayae*, does not occur in Florida. However, *E. stevensi* is reported to be a papaya bunchy top vector in Trinidad (Haque and Parasram, 1973).

Whiteflies, Trialeurodes variabilis. The whitefly, *T. variabilis* is commonly recorded from *Acer mexicana* (Aceracea), *Manihot glaziovii, M. esculenta* (Euphorbiaceae), *Coccoloba floribunda* (Polygonacea), *Gardenia* sp., (Rubiaceae), *Citrus paradisi, C. reticulata* (Rutaceae) with a distribution in the USA

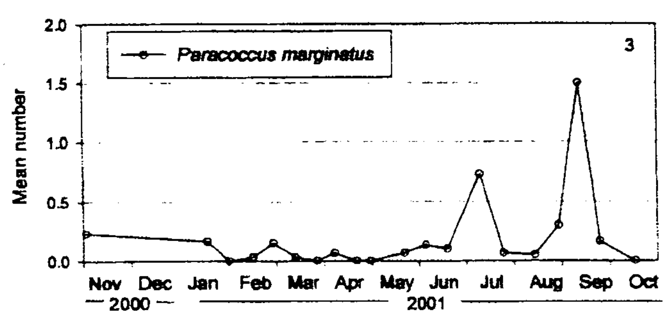

Fig. 3. Dynamics of the papaya mealybug in Homestead, FL from Nov. 2000 to Oct. 2001. Y axis = Mean number per leaf; X axis = Sampling time. Y axis represents mean number of individuals per sample.

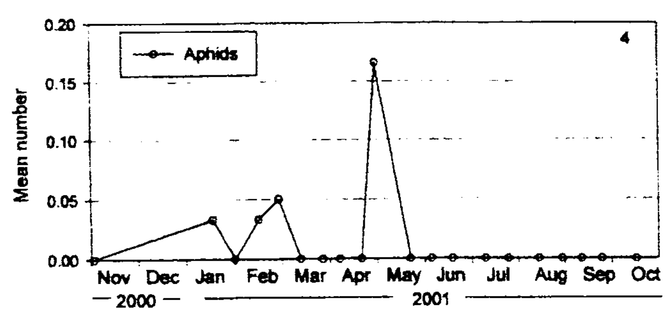

Fig. 4. Dynamics of aphids collected from papaya foliage in Homestead, FL, Nov 2000 to Oct. 2001. Y axis = Mean number per leaf; X axis = Sampling time. Y axis represents mean number of individuals per sample.

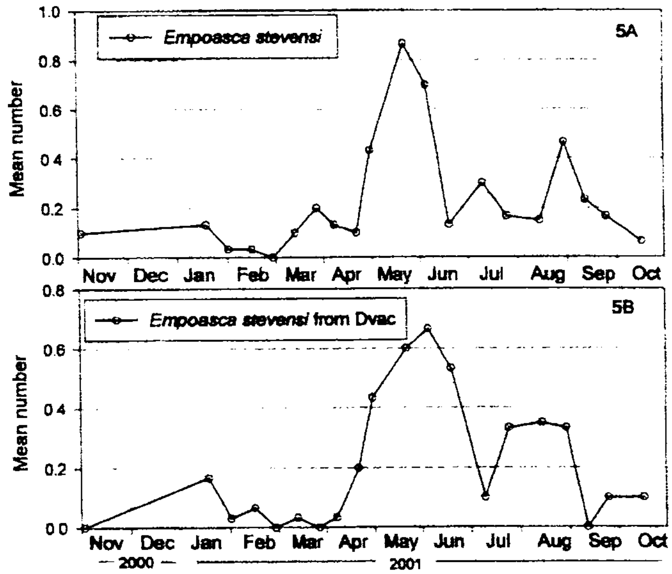

Fig. 5. *Empoasca stevensi* collected manually from papaya foliage (5A) and with a D-VAC (5B) on papaya foliage in Homestead, FL, Nov. 2000 to Oct. 2001. Y axis = Mean number per leaf; X axis = Sampling time. Y axis represents mean number of individuals per sample.

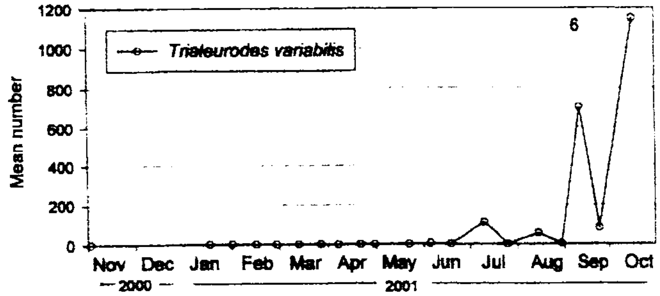

Fig. 6. Mean number of whiteflies collected per leaf from Nov. 2000 through Oct. 2001. Y axis = Mean number per leaf; X axis = Sampling time. Y axis represents mean number of individuals per sample.

(Florida), Mexico, Guatemala, Honduras, Costa Rica, Cuba, Jamaica, Puerto Rico, St. Croix and Trinidad (Vargas and Bellotti, 1983). Damage to cassava is characterized by yellowing and curling of apical leaves and by the presence of sooty mold on leaves (Vargas and Bellotti, 1983).

Densities of the whitefly *Trialeurodes variabilis* in papaya increased from 40 per leaf during July 2001 to an average 700 whiteflies per leaf during August 2001 and an average of 1200 per leaf during October 2001 (Fig. 6). The parasitoids *Amitus fuscipennis* MacGown & Nebeker, *Amitus* sp. (probably a new species, very similar to *E. bennetti* or *A. aleuroglanduli*) and *Encarsia tabacivora* Viggiani were collected as a natural enemy of this species. *Amitus fuscipennis* was a new state record as it is found in Texas and it is commonly reared in several neotropical countries (G. Evans, pers. comm.).

Chemical Control of Scales and Mealybugs in papaya, 2003. Heavy phytotoxicity of Novaluron was observed throughout the trial. The scale density in all plants was negligible (Table 1). However, Esteem, Applaud 1x and 2x gave good mealybug population suppression during 6 and 22 d after treatment (Table 2). With the exception of the untreated control, all treatments reduced number of mealybugs per leaf throughout the trial. The number of mealybugs per stem was negligible.

Chemical Control of Papaya Mealybug, 2005. All products except Applaud reduced the total number of mealybugs per plant 12 d after treatment (Table 3). All products resulted in a significant reduction of mealybugs 26 d after treatment. All

Table 1. Average number of scales per papaya leaf.

		Mean scales/leaf			
Treatment	Dose/100 gal	1 DBT*	6 DAT**	14 DAT	22 DAT
Untreated	—	1.80 a	6.50 a	13.50 a	2.90 a
Knack 0.86	5 oz	0.00 a	0.00 a	0.00 a	0.00 a
Applaud 70 WP + Citrus oil	1.14 oz	0.00 a	0.00 a	0.50 a	0.30 a
Applaud 70 WP	2.28 oz	0.00 a	0.00 a	0.00 a	0.00 a
Admire 1.6	16 oz (drench)	0.00 a	0.00 a	0.00 a	0.00 a
Novaluron 0.83 EC	14 oz	1.70 a	7.10 a	7.60 a	2.80 a

*DBT = Days before treatment.
**DAT = Days after treatment.
Means within a column followed by a similar letter are not significantly different (P < 0.05) LSD.

Table 2. Average number of mealybugs per leaf.

		Mean mealybugs/leaf			
Treatment	Dose/100 gal	1 DBT	6 DAT	14 DAT	22 DAT
Untreated	—	15.80 a	10.90 a	3.30 a	27.10 a
Knack 0.86	5 oz	33.90 a	4.50 ab	1.60 a	0.40 b
Applaud 70 WP + Citrus oil	1.14 oz	32.30 a	7.30 ab	4.40 a	8.30 b
Applaud 70 WP	2.28 oz	32.10 a	4.60 ab	3.11 a	2.50 b
Admire 1.6	16 oz (drench)	16.60 a	0.80 b	0.90 a	0.60 b
Novaluron 0.83 EC	14 oz	17.20 a	1.50 b	2.10 a	6.70 b

*DBT = Days before treatment.
**DAT = Days after treatment.

Table 3. Total papaya mealybugs per leaf before and after application of pesticides, 2005.

Treatment	Dose/100 gal	Total mealybugs/leaf Day 0	Day 12	Day 26
Untreated		133.1 a	1540.1 a	519.3 a
Assail 70 WP	2.3 oz	170.3 a	8.5 b	0.0 c
Assail 70 WP × 1.5	3.4 oz	118.0 a	1.4 b	0.0 c
Admire 2	4 ml/pot	179.6 a	102.2 b	0.0 c
Actara	2 oz	144.4 a	15.0 b	7.5 c
TD2480 30SG	8 oz	150.9 a	7.6 b	0.0 c
Enviro Biowash 1227	5%	215.1 a	48.1 b	102.7 c
Applaud	2.28 oz	100.4 a	1242.0 a	260.6 b
P <		0.3192	0.0001	0.0001

Numbers within each column followed by a different letter were significantly different by LSD (P = 0.05).

Table 4. Damage index rating before and after application of pesticides against papaya mealybug, 2005.

Treatment	Day 0	Day 12	Day 48
Untreated	4.4 a	4.4 ab	5.0 a
Assail 70 WP	3.4 a	3.8 abc	0.7 c
Assail 70 WP × 1.5	3.1 a	2.4 d	1.0 c
Admire 2	3.7 a	4.5 ab	0.0 c
Actara	3.2 a	4.0 abc	0.6 c
TD2480 30SG	3.5 a	3.1 c	0.0 c
Enviro Biowash 1227	3.2 a	4.8 a	3.6 b
Applaud	2.8 a	3.6 bc	4.5 ab
P <	0.5070	0.0001	0.0001

Numbers within each column followed by a different letter were significantly different by LSD (P = 0.05).

products, except Applaud had a significantly lower damage index rating 26 d after treatment. The highest damage (5) rating 26 d after treatment was observed in the untreated plants followed by Applaud and Enviro Biowash 1227. The lowest damage rating (0) was observed on Admire and TD2480 30SG treated plants (Table 4).

Evaluation of Acaricides for Control of Two-spotted Mite in Papayas, Year 2002. Milbemectin, Sanmite and Acramite had significantly fewer mite densities than the untreated control during 10 to 21 d after the first treatment application. Mite densities on papaya leaves treated with Novaluron did not decrease until 21 d following the first spray application. All treatments had significantly lower mite densities 10 d after the second spray application. Mite densities at 43 d following the first application [21 d after the second spray] were of too low intensity. However, despite the lower mite intensity during this date, Acramite had significantly less mite densities than the untreated control (Table 5). None of the treatments appeared to have any influence on the predacious mites (Table 6).

Evaluation of Chemicals for Control of Two-spotted Mite in Papayas, Year 2003. Acramite treatments significantly reduced the two spotted mite densities, 9 d after treatment application. There were no differences on mite densities among treatments and the control, at 23 d after application of acaricides. However, all treatments had lower mite densities per leaf at 36 d after spray. Double application of Acramite did not result in a marked reduction of mites, compared with a single application (Table 7).

Phytoseiid predator densities were significantly reduced for all treatments 9 and 36 d after application, compared to the untreated plants (Table 8).

Table 5. Effectiveness of acaricides against the two-spotted mite, *Tetranychus urticae.*

Treatment	Dose/acre	Mean mites/5 cm 2 DBT*	10 DAT**	21 DAT	Diameter 32 DAT (10***)	Leaf disc 43 DAT (21***)
Milbemectin 1% EC	30 oz	23.20 ab	6.60 b	4.5 b	1.5 b	0.1 ab
Sanmite 75%	0.29 lb	18.20 ab	8.60 b	3.7 b	0.4 b	0.2 ab
Acramite	1 lb	37.80 a	0.60 b	1.8 b	0.1 b	0.0 b
Novaluron	10.9 oz	12.60 b	20.20 a	7.5 b	5.9 b	0.2 ab
Untreated	—	34.23 a	21.22 a	22.0 a	14.3 a	0.6 a

*DBT = Days before treatment.
**DAT = Days after treatment.
***( ) = Days after second treatment application.
Means within a column followed by a similar letter are not significantly different (P < 0.05) LSD.

Table 6. Effect of acaricide on Predaceous mites, fam., Phytoseiidae.

Treatment	Dose/acre	Mean mites/5 cm 2 DBT*	10 DAT**	21 DAT	Diameter 32 DAT (10***)	Leaf disc 43 DAT (21***)
Milbemectin 1% EC	30 oz	0.00 a	0.03 a	0.00 b	0.03 a	0.08 a
Sanmite 75%	0.29 lb	0.00 a	0.03 a	0.00 b	0.05 a	0.05 a
Acramite	1 lb	0.03 a	0.00 a	0.00 b	0.00 a	0.00 a
Novaluron	10.9 oz	0.03 a	0.08 a	0.10 a	0.05 a	0.13 a
Untreated	—	0.03 a	0.08 a	0.00 b	0.10 a	0.02 a

*DBT = Days before treatment.
**DAT = Days after treatment.
***( ) = Days after second treatment application.
Means within a column followed by a similar letter are not significantly different (P < 0.05) LSD.

Table 7. Effectiveness of acaricides against the two-spotted mite.

Treatment	Dose/acre	Mites alive/leaf			
		1 DBT*	9 DAT**	23 DAT	36 DAT
Acramite 50 WS	16 oz	63.20 a	0.00 b	0.33 b	0.13 b
Acramite 50 WS	16 oz; 2 appl. 20 d apart	28.53 a	0.40 b	1.73 b	0.47 b
Acramite 4L SC	16 fl oz	36.13 a	0.27 b	0.07 b	4.20 b
Milbemectin 1% EC	30 oz	27.60 a	30.20 a	67.66 a	44.07 a
Untreated	—	33.73 a	36.70 a	2.20 b	46.27 a
Agrimek		50.40 a	0.33 a	0.00 b	1.06 b

*DBT = Days before treatment.
**DAT = Days after treatment.
Means within a column followed by a similar letter are not significantly different (P < 0.05) LSD.

Table 8. Effect of acaricides on predaceous mites, fam. Phytoseiidae.

Treatment	Dose/acre	Predaceous mites/leaf			
		1 DBT*	9 DAT**	23 DAT	36 DAT
Acramite 50 WS	16 oz	0.53 a	0.00 b	0.13 a	0.07 b
Acramite 50 WS	16 oz; 2 appl. 20 d apart	0.80 a	0.27 b	0.13 a	0.73 b
Acramite 4L SC	16 fl oz	0.00 a	0.20 b	0.00 a	0.33 b
Milbemectin 1% EC	30 oz	0.00 a	0.47 b	0.00 a	0.60 b
Untreated	—	1.00 a	3.60 a	0.00 a	2.53 a
Agrimek		0.07 a	0.13 b	0.07 a	0.33 b

*DBT = Days before treatment.
**DAT = Days after treatment.
Means within a column followed by a similar letter are not significantly different (P < 0.05) LSD.

Evaluation of Chemicals for Control of Broad Mite, Polyphagotarsonemus latus Banks *in Papayas, Year 2004.* There were differences in broad mite densities 7-14 d after treatment for the pesticides Acramite, Zeal and Fujimite (Table 9). Twenty two days after treatment, all treatments provided a lower damage index compared to the untreated control (Table 10). Predaceous mite (Phytoseiidae) densities were not significantly different between the untreated control and the treatments (Table 11).

Table 9. Broad mite densities in papaya following applications of acaricides.

Treatment	Dose/100 gal	Number of mites per leaf				
		1 DBT*	3 DAT**	7 DAT	14 DAT	22 DAT
Novaluron 0.83 EC	10.3 oz	173.3 b	86.4 a	149.2 a	75.6 a	14.9 b
Untreated	—	143.1 b	203.8 a	89.4 a	52.8 ab	25.1 b
Envidor SC	18.0 fl oz	102.1 b	108.8 a	4.1 b	0.2 b	3.5 b
Acramite 50 WS	1 lb	238.5 b	68.8 a	29.7 b	31.4 ab	47.1 b
Zeal 72 WDG	3 oz	179.8 b	173.4 a	0.8 b	0.0 b	0.0 b
Fujimite 5% EC	2 pts	248.4 b	0.8 a	0.0 b	0.0 b	0.0 b
Diamond 0.83 SC	10.9 oz	723.7 a	86.1 a	107.9 a	82.5 a	97.6 a

*DBT = Day before treatment.
**DAS = Days after treatment.

Table 10. Index damage for broad mite in papaya plants.

Treatment	1 DBT*	Damage Index			
		3 DAT**	7 DAT	14 DAT	22 DAT
Novaluron 0.83 EC	1.18 a	1.94 a	1.94 a	1.59 ab	2.00 b
Untreated	1.41 a	1.59 a	1.71 a	1.71 ab	3.00 a
Envidor SC	1.47 a	1.47 a	1.65 a	0.29 c	0.35 d
Acramite 50 WS	1.88 a	1.47 a	2.00 a	0.56 bc	0.71 cd
Zeal 72 WDG	0.59 a	0.47 a	0.35 a	0.24 c	0.18 d
Fujimite 5% EC	1.76 a	2.41 a	0.82 a	1.12 abc	0.06 d
Diamond 0.83 SC	2.47 a	2.94 a	2.18 a	2.06 a	1.56 bc

*DBT = Day before treatment.
**DAS = Days after treatment.

Table 11. Effect of acaricides on Phytoseeid predators.

Treatment	Mean Phytoseiid predators/leaf				
	1 DBT*	3 DAT**	7 DAT	14 DAT	22 DAT
Novaluron 0.83 EC	0.00 a	0.00	0.00 a	0.00 a	0.00 a
Control	0.00 a	0.41 a	0.41 a	0.00 a	0.06 a
Envidor SC	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
Acramite 50 WS	0.00 a	0.00 a	0.00 a	0.06 a	0.00 a
Zeal 72 WDG	0.00 a	0.00 a	0.35 a	0.06 a	0.06 a
Fujimite 5% EC	0.06 a	0.00 a	0.00 a	0.00 a	0.12 a
Diamond 0.83 SC	0.00 a	0.00 a	0.41 a	0.00 a	0.00 a

*DBT = Day before treatment.
**DAT = Days after treatment.

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