Proc. Fla. State Hort. Soc. 118:228-234. 2005.

MANGO BUD MITE, *ACERIA MANGIFERAE* BIONOMICS AND CONTROL UNDER FLORIDA CONDITIONS

JORGE E. PEÑA,[1]* ERIC PALEVSKY,[2] GABRIEL OTERO-COLINA,[3]
RONALD OCHOA[4] AND CHARLES W. MEISTER[5]
[1]*University of Florida, IFAS*
Tropical Research and Education Center
18905 SW 280th Street
Homestead, FL 33031

[2]*ARO, Volcani Center*
Bet Dagan, Israel

[3]*Colegio Post-Graduados*
Montecillo, Mexico

[4]*USDA, ARS-West, SEL, BARC*
Beltsville, MD 20705

[5]*UF/IFAS, Food Sci. and Nutrition*
Gainesville, FL 32611

Additional index words. Mangifera indica, Eriophyidae, cultivars, sampling

Abstract. **The densities of the mango bud mite, *Aceria mangiferae* Sayed were inspected on 22 mango cultivars from December 1997 to June 1998. Cultivars 'Keenan', an unknown cultivar, 'cv. 9819', 'Brander', and 'Bombay Green' had significantly more mites than cvs. 'Joellen', 'Duncan', 'Red Itamaraca', 'Smith', 'Wally' and 'Hindi'. During this study, *A. mangiferae* was found most frequently on apical growing buds rather than on the lateral dormant buds. Lower numbers of *A. mangiferae* were found from March through July 2003 compared to higher mite densities from September to February. Higher numbers of *A. mangiferae* were found in peripheral scales of the bud than in the scales forming the meristematic dome within the apical bud. The spatial distribution of *A. mangiferae* within the tree showed more mites on the upper and middle tree canopy than on lower portions of the canopy. The species exhibited aggregated patterns of spatial distribution. Sample size requirements for fixed levels of precision were determined by using variance-mean relationships. We determined that the proportion of mite-infested buds can be used to monitor populations of *A. mangiferae* in commercial mango orchards. The results of an experiment testing the effectiveness of different acaricides and their effect on mite densities in Florida are discussed.**

The mango bud mite, *Aceria mangiferae* Sayed is reported to attack buds and inflorescences of mango, *Mangifera indica* L. (Keifer et al., 1982; Ochoa et al., 1994). According to Jeppson et al. (1975) this mite stunts and induces witches broom, causing bud proliferation, and appears to be responsible for necrosis of bud tissue cells (Varma et al., 1974). *A. mangiferae* was described from Egypt, but currently it has been found everywhere mangoes are grown (Denmark, 1983; Doreste, 1984; Sayed, 1946). There has been controversy regarding the role this mite plays in the formation of floral and foliar galls, known as mango malformation (Denmark, 1983; Narasinhan, 1959; Ochoa et al., 1994; Prashad et al., 1965; Sayed, 1946; Sternlicht and Goldenberg, 1976; Summanwar 1967; Summanwar and Raychoudhury, 1968). However, recent studies indicate that *A. mangiferae* does not cause mango malformation, but may play a role as carrier of the fungal pathogen *Fusarium mangiferae* which is recognized as the causal agent of mango malformation (Freeman et al., 2004; Varma et al., 1974).

The latter findings have left some questions unanswered regarding *A. mangiferae* injury to mango and its importance as a pest of mango. Therefore, we first evaluated if some mango cultivars contain higher densities of the mite. Next, we determined the presence of *A. mangiferae* in vegetative and floral buds, within-tree dispersion of *A. mangiferae* in mango trees and finally we determined any possible association between *A. mangiferae* and necrosis of mango buds. Finally, we determined the effectiveness of acaricides against *A. mangiferae* under Florida conditions and the effect of *A. mangiferae* on yield of Keitt mangoes.

Materials and Methods

Frequency of Mites on Different Mango Cultivars. A preliminary survey for the presence of *A. mangiferae* was conducted in the mango germplasm collection of the University of Florida, Tropical Research and Education Center, Homestead, Fla. Monthly samples were taken for a period of 9 months, starting in December 1997 and ending in June 1998. No symptoms of mango malformation were observed during this study. Twenty-two mango cultivars were selected at random. On each sampling date, a 17-25 cm shoot was removed from each tree totaling 6 samples per cultivar. Shoots were placed individually in plastic bags and transported to the laboratory. A sampling protocol was established along buds in order to reflect a gradient of mite infestation. For instance, mites were counted on buds starting at the apex to the 4th lateral bud (Fig. 1) using a binocular microscope. The average number of mites per bud was assessed and number of mites averaged for all sampling dates.

Frequency of Mites Related to the Position Inside the Apical Vegetative Bud. To determine the frequency of mites inside each bud, 20 apical resting buds from cv "Keitt' were selected. According to Davenport and Nuñez Elisea (1997) an apical resting bud has a number of performed nodes, each of which contains a leaf bract or bud scale and a lateral meristematic primordium, ending in an apical dome or meristem (Fig. 2). To simplify our sampling protocol, bud scales were considered external, if they were located in the outer border of the bud; middle if they were located next to the external buds; and internal, if they surrounded the apical dome or meristem. Each bud scale was removed and divided into two main regions. The basal region, characterized for being more succulent and absent of trichomes (smooth), and the apical region, characterized by presence of trichomes (pubescent). The number of mites in each region of the bud or in each area within a bud scale was recorded using a dissecting microscope.

We thank R. Duncan and J. Alegria for their technical assistance.
*Corresponding author; e-mail: jepe@ifas.ufl.edu

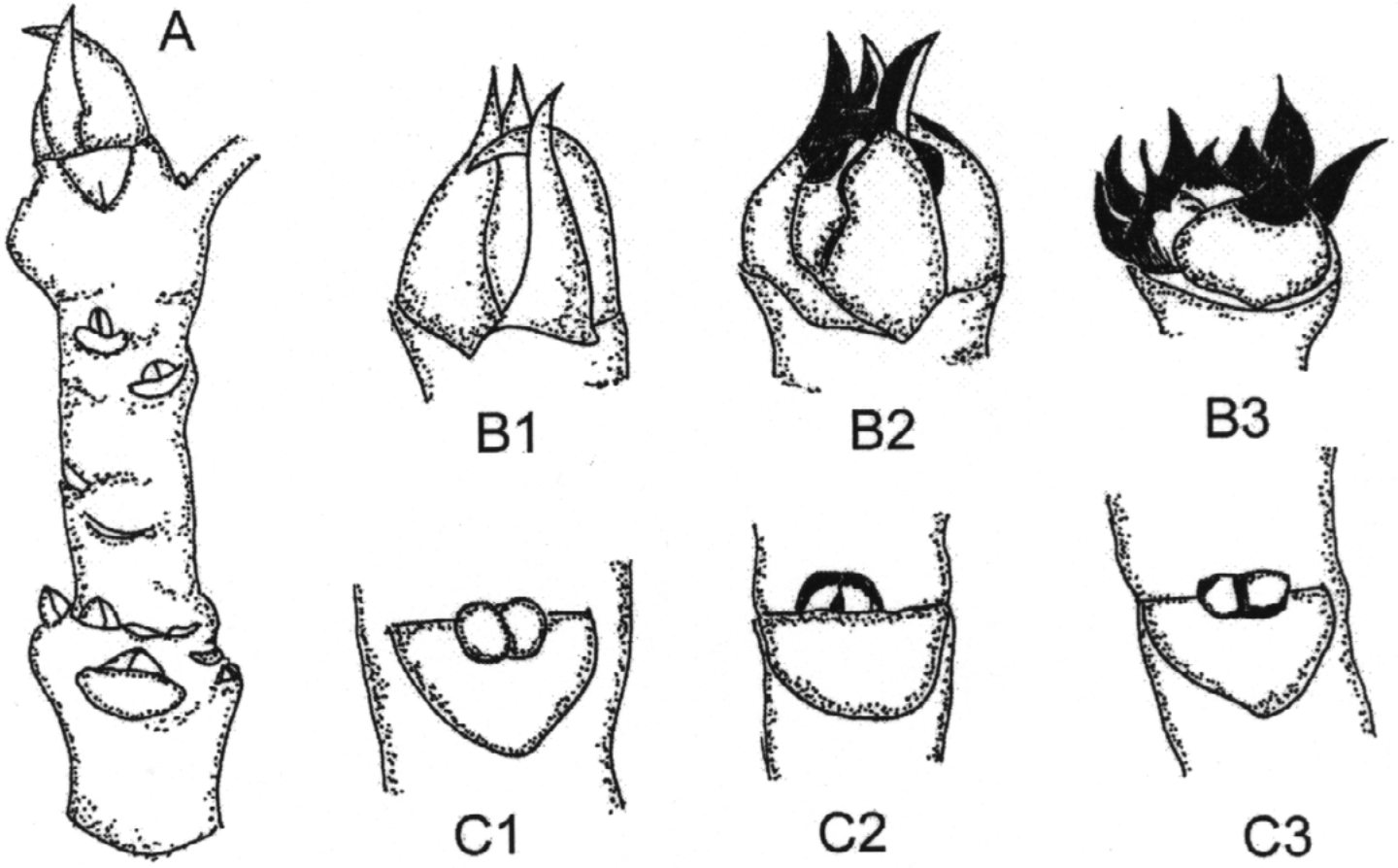

Fig. 1. Mango shoots, and bud characteristics. A) Apical buds and lateral buds; B1) Apical bud without necrosis; B2-B3) Apical Buds with 20-50% necrosis, respectively; C1) lateral bud without necrosis; C2-C3) lateral bud with necrosis.

Intratree dispersion, Mite seasonality. A study of the population dynamics of *A. mangiferae* was performed from 2002 through 2004 at the Tropical Research and Education Center, Homestead Florida. The experimental site was a 8-year-old cv. Keitt orchard ~1.1 has. in size with ~450 trees. No symptoms of mango malformation were observed during this study. Ten randomly selected trees were inspected monthly from September 2002 through January 2004. Each tree was visually divided into three strata (upper, 2.1-4.00 m; middle, 1.40-2.0 m; and lower, 0.2-1.39 m above ground level). On each sampling date, one 10 cm branch was removed from each stratum, totaling 3 samples per tree. Branches were placed in plastic bags, transported to the laboratory in an ice chest (7-10°C), and examined using a dissection microscope. The sampling protocol along each bud was the same as the one performed for cultivar evaluation. Means and variance were calculated from each sampling date. In addition to the mite evaluation, we visually estimated, the percent bud necrosis and recorded the number of scale insects, i.e., *Radionaspis indica* (Homoptera: Diaspididae) and other arthropods that were found on the buds. Necrosis on the buds was recorded following a damage index [0% = no bud necrosis, or necrotic areas (10-100%) observed on bud tips, basal areas of the bud, internal areas of the bud. Percent necrosis or damage was correlated with the number of mites observed per bud and or number of scales observed per bud.

Indexes of dispersion for *A. mangiferae* were calculated using Taylor (1961) and Iwao (1968) patchiness regression. The Taylor power law expresses the functional relationship between the variance (s^2) and the mean μ as $s^2 = a\mu^b$. The coefficient a and the exponent b are estimated by linear regression of log s^2 on $\log_x$ where s^2 and x are the sample variance and sample mean, respectively. The parameter b is a measure of aggregation, and the parameter a is a scaling factor related to the sampling procedure, and sampling unit employed (Taylor, 1961). The Iwao patchiness regression relates mean crowding [$m^* = x + (s^2/x) - 1$] and x using a simple linear regression as $m^* = \alpha + \beta x$. The intercept α is an index of basic contagion and the slope β has the same interpretation as the exponent b in the Taylor power law (Iwao, 1968). A t test was used to determine significance of departure from randomness for both methods (SAS, Institute 1987).

The coefficients from Taylor's power law regressions were used to determine sample size requirements necessary for estimating populations means. Precision was defined as $D = s/x$ where s is the standard error of the x. Estimations with standard error of 10 and 25% of their value are usually precise enough for intensive and extensive sampling. Thus, we chose D = 0.10, 0.15 and 0.30 for use in this study.

The binomial procedure (Bliss and Fisher, 1953) was used to determine egg distribution Bliss and Fisher (1953) stated that the negative binomial can be defined by the mean (μ) and the exponent k. k is determined by using the formula, $k = m^2/(s^2 - m)$, where s^2 is the sample estimate of the population variance. Then the basic proportion of sampling units with no eggs present [$p(0)$] at a given m is $p(0) = (1 + m/k)^{-k}$, then the

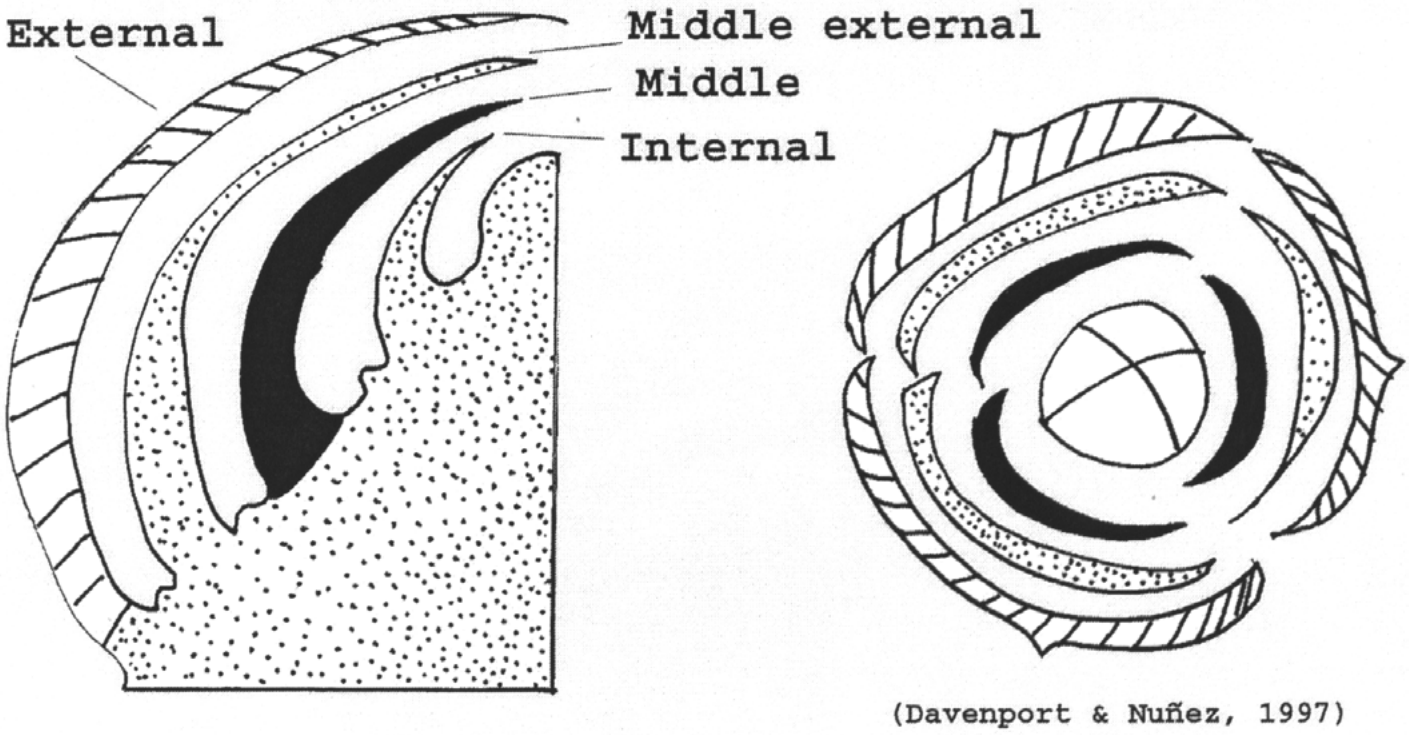

Fig. 2. Arrangement of bud scales in an apical bud (After Davenport and Nuñez, 1997); External bud located in the periphery; Middle buds between the periphery and the meristem; internal bud or the bud surrounding the meristem or dome.

proportion of units infested [$p(I)$] is $p(I) = 1- p(0)$, therefore, we determined the proportion of mite infested buds to use as field a technique to monitor *A. mangiferae* infestation in Florida's mango.

Chemical Control of Mango Bud Mite. A 'Keitt' grove located at the Tropical Research and Education Center in Homestead, Florida was used for this study. Plots consisted of four groups of 4 trees, with 2 plants serving as sample trees. Treatments (Table 1) consisted of one application of Agrimeck, Envidor, Kanemite, Acramite, Zeal, Danitol, Fujimte, Diamond and a non sprayed control. Applications of test materials were made with a hand-gun sprayer during October 2004. The sprayer was calibrated to deliver approx. 100 gpa at 2.2 mph. Mite populations were evaluated 1 day before the treatment and monitored weekly by collecting 10 apical buds per tree. Buds were taken to the laboratory and each bud bract dissected. Then, the number of motile mites and predacious mites were counted under a microscope. All data were subjected to two-way ANOVA and means separated by SNK ($P < 0.05$).

Table 1. Products tested against the mango bud mite, *Aceria mangiferae.*

Product Name	Dose/100 gal
Agrimek	4 oz. + oil 1%
Envidor SC 240	18 fl oz
Kanemite SC = Arvesta = TM41301	31 fl oz
Acramite 50 WS	1 lb
Zeal 72 WDG	3 oz
Danitol 2.4 EC (fenpropathrin)	1 pt
Fujimite 5% EC	2 pts
Diamond 0.83 SC	10.9 oz

Results and Discussion

Frequency of Mites on Different Mango Cultivars. The cultivars, 'Keenan 1972', an unknown cultivar, 'cv., 9819', 'Brander 1972', and 'Bombay Green' had significantly more mites than 'Joellen 1972', 'Duncan', 'Red Itamaraca', 'Smith' and 'Wally' (Table 2). Bindra and Baketta (1969) studied the variation of *A. mangiferae* infestations on different varieties of mango in India. They concluded that *A. mangiferae* densities varied in different localities and indicated that there was no resistance observed in any of the cultivars. Rebelles et al. (1970) determined that cv 'Haden' had a higher density of *A. mangiferae* than a non-commercial cv 'Augusta' in Brazil and suggested that the latter may be a possible source of resistance. However, this suggestion is based on evaluations conducted during a short sampling period of 4 consecutive days, which may not have been sufficient to conclude that cv 'Augusta' is more resistant. Any field study of resistance to *A. mangiferae* needs to be conducted for several years or under a severe mite pressure to provide definitive conclusions of resistance. For instance, mite densities vary according to season and sampling unit. During the sampling dates (December 1997-February 1998) *A. mangiferae* were collected mainly on the apical growing buds than on the lateral dormant buds; this pattern was reversed between March and May, 1998 (Fig. 3).

Frequency of Mites Related to the Position Inside the Apical Vegetative Bud. The highest densities of *A. mangiferae* mites were found in the middle bud scales and peripheral bud scales within an apical bud. Lower densities of the mite (Table 3; Fig. 4) were found in the meristematic region. This result suggests that for sampling schemes, it may be simpler to look for mites in the middle and peripheral bud scales rather than in meristematic bud scales. Secondly, *A. mangiferae* distribution

Table 2. Mean number of *A. mangiferae* per bud on different mango cultivars at the University of Florida, Homestead, Fla.

Species	Cultivar	Mean number of Mites/Bud ± SE
Mangifera indica	Alice 1972	0.49 ± 0. 06 bc
	Nam Tam Teen	1.20 ± 0.10 b
	Lathrop 1972	0.47 ± 0.07 bc
	Lucille	1.28 ± 0.15 b
	Stringless Peach	0.78 ± 0.30 bc
	Sandersha	0.50 ± 0.20 bc
	Joellen 1972	0.00 ± 0.00 c
	9819	2.73 ± 0.45 a
	Keenan 1972	7.70 ± 1.20 a
	Duncan 1972	0.04 ± 0.03 c
	Pillsbury	0.25 ± 0.11 bc
	Unknown	4.22 ± 2.68 a
	Safeda Lucknow	0.91 ± 0.85 b
	Bombay Green	1.71 ± 0.64 b
	Rockdale Saigon 1972	0.18 ± 0.07 bc
	Red Itamaraca	0.07 ± 0.07 c
	Hindi 1972	0.11 ± 0.04 bc
	Smith	0.07 ± 0.03 c
	Wally	0.11 ± 0.08 bc
	Herman	1.42 ± 0.68 a
	Brander	2.53 ± 0.73 a
M. odorata		0.42 ± 0.21 b

Numbers followed by a different letter were significantly different (Student-Newman-Keuls test, P < 0.05).

pattern may be due to the propensity of eriophyids to avoid parts of the bud with excessive r.h., i.e., water condensation. There may be several reasons for this, first of all, the middle and peripheral bud scales do not hold as much water condensation as the meristematic scales and dome. Mango meristematic buds appear to be more tender, compact and contain more water from guttation than the more lignified middle and peripheral bud scales. In comparison, Courtin et al. (2000) observed in onion, that while r.h. close to 100% is required for a high percentage of egg hatching of the eriophyid *Aceria tulipae* (K.), water condensation is harmful to this species. The results indicate the need for further studies on the effect of r.h. and survival of *A. mangiferae*. Within each bud scale, mite eggs were mostly found in the pubescent area while the motile stages were observed in the basal, non-pubescent area (Fig. 5). This trend may reflect oviposition behavior of *A. mangiferae* females when they are colonizing buds. More mites were observed on vegetative buds than on floral buds (Fig. 6). The behavior of *A. mangiferae* and its preference for vegetative buds over floral buds need to be elucidated.

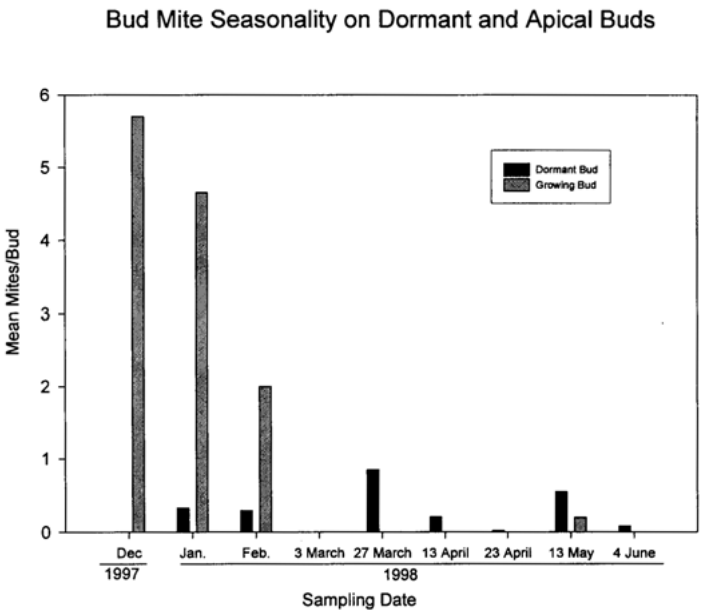

Fig. 3. Bud mite seasonality in dormant and growing buds, between December 1997 through June 1998.

Table 3. Frequency of Mites on peripheral, middle and meristematic bud scales.

Location of Bud Scales	Mean ± SE
Periphery	2.35 ± 0.47 a
Middle	3.13 ± 0.77 a
Meristem	0.15 ± 0.10 b

*Numbers followed by a different letter were significantly different (Student-Newman-Keuls test, P < 0.05).

Within-tree Dispersion of A. mangiferae. A. mangiferae was more common on buds located in the upper and middle tree canopy than on the lower canopy (Fig. 7). Lower numbers of *A. mangiferae* were found from March through July, 2003 compared to higher mite densities from September to February (Fig. 7). The Taylor power law provided a better fit to the data than Iwao's patchiness regression. The coefficient of determination (r^2) for the Taylor power law was 0.95 whereas r^2 for Iwao was lower (0.39); Both β value for Iwao and *b* values were higher than 1, indicating a degree of aggregation for the bud mite (Table 4).

For a given mean, and desired precision, different number of samples are required. For instance for a 10% precision and at 0.5 mites per bud density, approximately 220 samples need to be taken, whereas for a 30% precision at 0.5 mites per bud, only 25 samples need to be taken in the field (Fig. 8).

Estimation of Infestation of Mango Bud Mite Using the Negative Binomial Probability. Sampling small arthropods, such as mites, is operationally difficult and often time consuming. As a way to ease this burden, presence-absence, or binomial, sampling

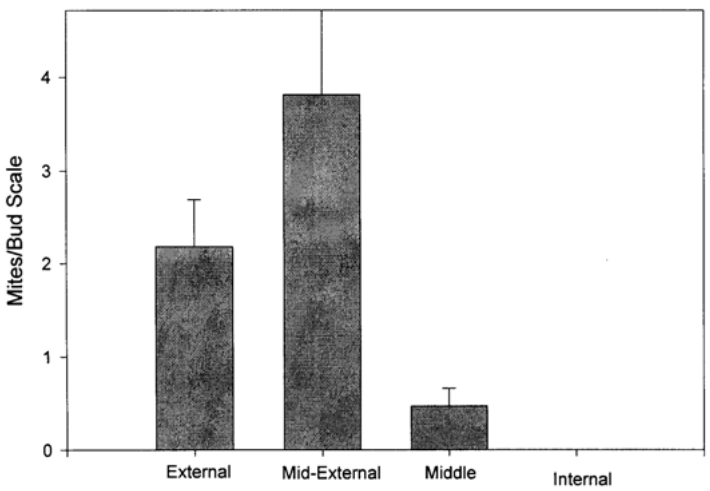

Fig. 4. Frequency of *A. mangiferae* on bud scales within a resting apical bud.

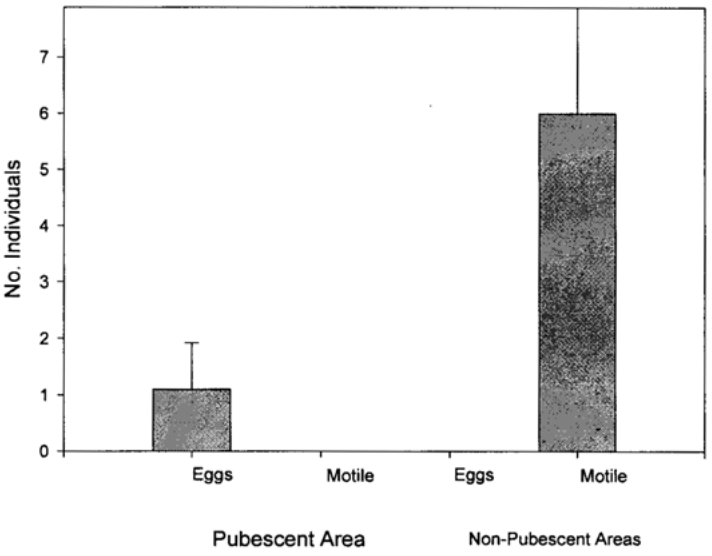

Fig. 5. Presence of *A. mangiferae* on pubescent and non-pubescent (hairless) areas of a bud scale.

has been used in place of complete counts for estimating or classifying densities of these organisms. Binomial sampling is founded on defining the proportion of one or more individuals (the incidence PI) and the density of animals (m) per sampling unit. Since the mango bud mite has a clumped distribution with a ratio from the variance to the mean higher than 1, the negative binomial was used to test its fit to the mango bud mite data sets. According to Jones (1993), Bliss and Fisher stated that the negative binomial can be defined by the mean (μ) and the exponent *k*. *k* is determined by using the formula, $k = m^2/(s^2 - m)$, where s^2 is the sample estimate of the population variance. The basic proportion of sampling units with no mites present [$p(0)$] at a given m is $p(0) = (1 + m/k)^{-k}$, then the proportion of units infested [$p(I)$] is $p(I) = 1-p(0)$. The values of P(0) for various means by using the above mentioned formula are shown in Fig. 8. At densities of 3 and 10 mites per bud we observed p(0) values of 0.71 and 0.42; According to the equation, P(I) = 0.28 + 0.01 (Mites/bud) an infestation level above 10 mites per bud or a P (I) above 0.38 could be used as the nominal threshold (Fig. 9).

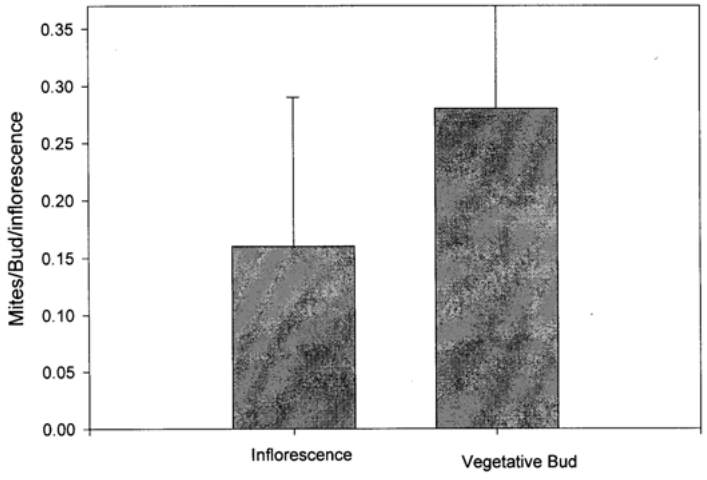

Fig. 6. Frequency of *A. mangiferae* on vegetative buds and inflorescences.

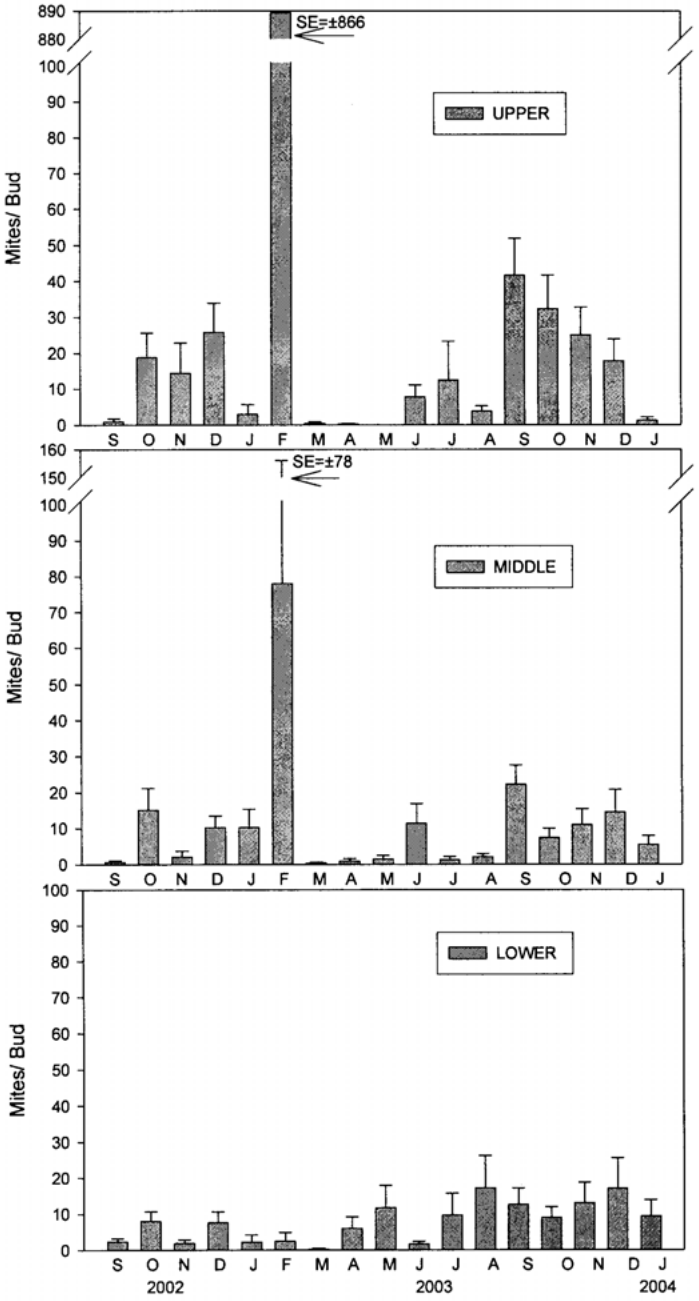

Fig. 7. Intra-tree dispersion and seasonality of *A. mangiferae* on cv. Keitt, 2002-2004.

Mites and their Relation to Bud Necrosis. There was a low relationship between the percentage of necrosed tissue per bud (y) and the number of mites per bud (x) ($y = 19.40 + 0.69$ (x), $r^2 = 0.30$) (Fig. 10). There are two possible pitfalls in this study: 1) Other arthropods may be responsible for this type of necrosis, i.e., mites, *Tarsonemus confusus* (Ewing) and armored

Table 4. Dispersion indices for the mango bud mite, *Aceria mangiferae.*

Iwao's	Patchiness	Regression	Taylor's	Power	Law
α	β	r^2	loga	B	r^2
17.98	2.44	0.39	2.01	1.83	0.95

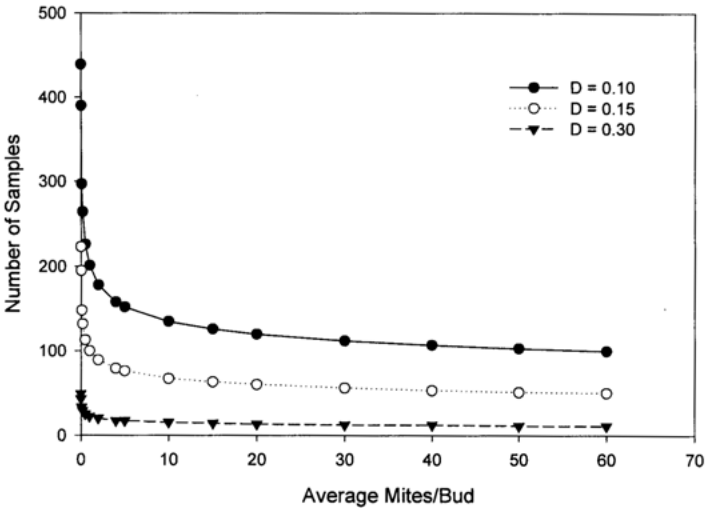

Fig. 8. Sample size requirements for *A. mangiferae* using different precision levels D = 0.10; D = 0.15 and D = 0.30.

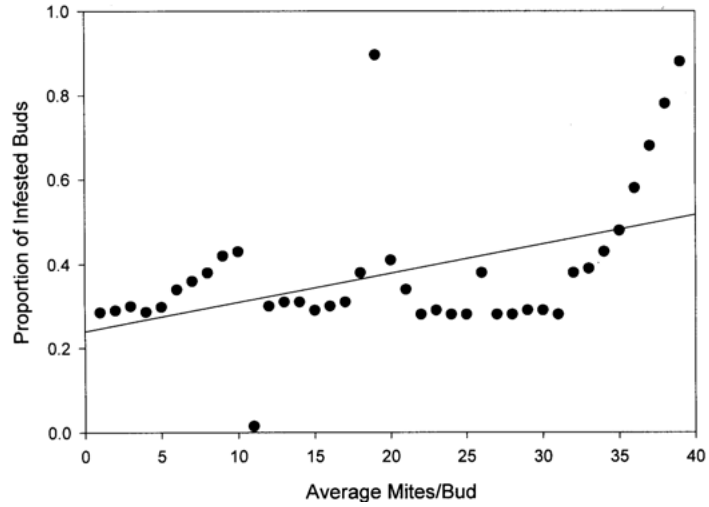

Fig. 9. Proportion of buds infested with *A. mangiferae,* determined from the average of mites per bud.

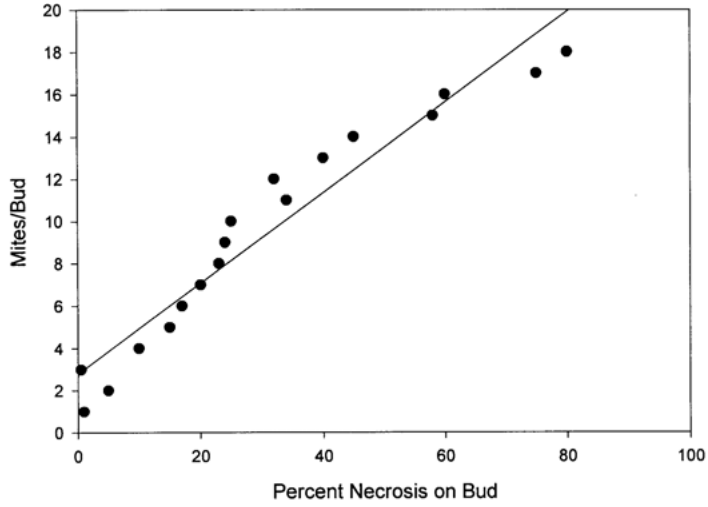

Fig. 10. Relationship between *A. mangiferae* densities and percent necroses per bud.

Table 5. Eriophyid mites per mango bud.

Treatment	Before spray	6 DAS*	12 DAS*	26 DAS*
Agrimeck + oil	1.13 a	0.00 a	0.33 b	0.00 b
Envidor	9.87 a	0.20 a	3.40 b	1.00 b
Kanemite	15.67 a	0.93 a	0.40 b	0.33 b
Acramite	3.20 a	1.20 a	0.80 b	1.27 b
Zeal	4.13 a	1.93 a	1.67 b	0.80 b
Danitol	8.00 a	0.07 a	0.13 b	1.07 b
Fujimite	6.33 a	0.33 a	0.27 b	0.93 b
Diamond	5.93 a	0.20 a	2.27 b	2.13 b
Control	8.80 a	1.46 a	20.60 a	7.00 a

*DAS = Days after spray.
**Numbers followed by a different letter were significantly different (Student-Newman-Keuls test, P < 0.05).

Table 6. Predatory mites per mango bud.

Treatment	Before spray	6 DAS*	12 DAS*	26 DAS*
Agrimek	0.00 a	0.00 b	0.00 a	0.00 a
Envidor	0.00 a	0.00 b	0.00 a	0.07 a
Kanemite	0.00 a	0.13 b	0.00 a	0.00 a
Acramite	0.07 a	0.06 b	0.00 a	0.07 a
Zeal	0.07 a	0.00 b	0.07 a	0.07 a
Danitol	0.07 a	0.06 b	0.00 a	0.00 a
Fujimite	0.00 a	0.00 b	0.00 a	0.00 a
Diamond	0.07 a	0.00 b	0.13 b	0.00 a
Control	0.00 a	0.00 b	0.00 a	0.00 a
Control 2	0.00 a	0.33 a	0.13 b	0.00 a

*DAS = Days after spray
**Numbers followed by a different letter were significantly different (Student-Newman-Keuls test, P < 0.05).

scales, i.e., *Radionaspis indica* (Marlatt) are found feeding in the same tissue as the eriophyid mite, or 2) the presence of a pathogen. The use of mite days units probably would correlate better with bud necrosis than mites per bud.

Chemical Control. No statistical differences were observed in the density of the mango bud mite on the treated trees compared with the untreated control, 6 d after application of acaricides (Table 5). All tested products resulted in statistically lower densities 12 and 26 d after spray compared to the untreated control, demonstrating that they were effective in reducing mango bud mite densities. Agrimek plus oil, Fujimite, Danitol resulted in the lowest mite densities, 12 d after application, and Agrimek plus oil, and Kanemite resulted in the lowest mite densities 26 d after treatment. The numbers of predacious mites (fam. Phytoseiidae) were reduced on all treated trees, 6 d after treatment, but their density was not significantly different between the untreated control and any of the acaricides tested 12 and 26 d after treatment (Table 6).

Literature Cited

Bindra, O. S. and D. Bakhetia. 1969. Investigations on the etiology and control of Mango malformation. 28:81-85.

Bliss, C. and R. Fisher. 1953. Fitting the negative binomial distribution to biological data. Biometrics 9:176.

Courtin, O., G. Fauvel, and F. Leclant. 2000. Temperature and relative humidity effects on egg and nymphal development of *Aceria tulipae)* (K.) (Acari: Eriophyidae) on garlic leaves (*Allium sativum* L.). Ann. Appl. Biol. 137:207-211.

Davenport, T. and R. Nuñez-Elisea. 1997. Reproductive Physiology, pp. 69-146. In R. E. Litz (ed.). The mango: botany, production and uses. CAB International, Wallingford, UK.

Denmark, H. 1983. *Eriophyes mangiferae* (Sayed) a pest of mango (Acarina: Eriophyidae). Entomol. Cir. FDACS. 2 pp.
Doreste, E. 1984. Acarologia. Instituto Interamericano de Cooperacion para la Agricultura. San Jose, Costa Rica. 391 pp.
Freeman, S., D. Klein-Gueta., N. Korolev, and A. Sztenjnberg. 2004. Epidemiology and survival of *Fusarium mangiferae*, the causal agent of mango malformation disease. Proc. VII Ison Mango. Ec. Pinto et al., eds. Acta Horticulturae 645:487-491.
Iwao, S. 1968. A new regression method for analyzing the aggregation pattern of animal populations. Res. Popul. Ecol. 10:1-20.
Jeppson, L. R., H. H. Keifer, and E. W. Baker. 1975. Mites injurious to economic plants. University of California Press, Berkeley, p. 441.
Jones, V. 1994. Sequential estimation and classification procedures for binomial counts, pp. 175-205. In L. Pedigo and D. Buntin, eds. Handbook of sampling methods for arthropods in agriculture. CRS Press, Inc., Boca Raton, Fla.
Keifer, H. H., E. W. Baker, T. Kono, M. Delfinado, and W. Styer. 1982. An illustrated guide to plant abnormalities caused by Eriophyid mites in North America. USDA, Agric. Handbook No. 573, pp. 74-75.
Narasinham, M. 1959. Control of mango malformation disease. Curr. Sci. 28:254.
Ochoa, R., H. Aguilar, and C. Vargas. 1994. Phytophagous mites of Central America: an illustrated guide. Centro Agronomico de Investigacion y Enseñanza, Technical Series 6. Turrialba, Costa Rica.
Prashad, A., H. Singh, and S. Sharda. 1965. Present status of mango malformation disease. Indian J. Hort. 22:254-265.
Rebelles, P., A. De Camargo, T. Igue, and C. Rossetto. 1970. Comportamento de variedades de mangueira [*Mangifera indica* L.] em relacao a *Aceria mangiferae* (Sayed) (Acarina: Eriophyidae). Rev. Agricultura (Piracicaba) 45:145-151.
SAS Institute. 1987. SAS/STAT user's guide, release 6.03 ed. SAS Institute, Cary, NC.
Sayed, M. 1946. *Aceria mangiferae* nov. spec. (*Eriophyes mangiferae* Hassan M.S.). Bul. Soc. Entomol. 30:7-10.
Summanwar, A. S. 1967. Mango malformation, serious economic consequences, Indian Hort. 11:12-16.
Summanwar, A. and S. Raychoudhury. 1968. The role of the eriophyid mite (*Aceria mangiferae*) in the causation of mango malformation. Indian Phytopathol. 21:463-464.
Sternlicht, M. and S. Goldenberg. 1976. Mango eriophyid mites in relation to inflorescence. Phytoparasitica 4:45-50.
Taylor, L. R. 1961. Aggregation, variance and the mean. Nature (London) 189:732-735.
Varma, A., V. C Lele, S. P. Raychoudhuri, A. Ram, and A. Sang. 1974. Mango malformation: a fungal disease. Phytopathol. Z. 79:254-257.