ACARINES, 3: 65-71, 2009

Ecological, Biological and Control Studies on the Leaf Coating and Webbing Mite *Cisaberoptus kenyae* Keifer (Eriophyoidea: Eriophyidae) in Egypt

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ABSTRACT

The leaf coating and webbing mite *Cisaberoptus kenyae* Keifer was observed for two years in an abandoned mango orchard in Egypt. The eriophyid mite was fed upon by the two predatory phytoseiid mites *Typhlodromips swirskii* (Athias-Henriot) and *Typhlodromus mangiferus* Zaher and El-Borolossy. Population dynamics of the eriophyid mango prey were affected by climatic conditions, predation, shady and sunny zones and vertical distribution. About 16 & 18; and 15 & 13 generations were recorded for *C. kenyae* on cvs. «Hindi and Alphonso» during two successive years, respectively. Leaves at bottom levels of both mango cultivars were found preferable to the mite feeding than those at the top and middle. Higher temperature enhanced faster development of *C. kenyae*. A control measure of one treatment with acaricides in the winter after budding resulted in effective control.

Key Words: Ecology, Biology, *Cisaberoptus kenyae*, Eriophyidae, Phytoseiidae, Phytophagous and Predacious mites.

INTRODUCTION

The leaf coating and webbing mite or blotch leaf miner mite, *Cisaberoptus kenyae* Keifer causes injury to mango foliage. It can be found under the epidermis of the upper surface of young leaves, raising the epidermal cells. Symptoms are more easily seen on mid–level leaves which turned to silvery appearance. Leaf damage is most severe at the base of the petiole and around the sides of the central veins. Narrow patches may be seen bordering the leaf margins and are weblike and somewhat thickened.

Recently, curling and browning spots on the undersides of mango leaves, due to feeding by large numbers of this mite on the upper surfaces are more noticeable, particularly on cvs. Hindi and Alphonso. Therefore, the aim of the present study is to find out an efficient control method based on ecological approach.

MATERIALS AND METHODS

Ecological studies:

Ecological studies on the leaf coating and webbing mite *C. kenyae* and its predators, *Typhlodromus mangiferus* Zaher & El-Borolossy & *Typhlodromips swirskii* (Athias-Henriot) were carried out in abandoned mango orchard (*Mangiferae indica* L.), 13 years old, near Cairo, for the two years 2003 and 2004. In order to provide comparative measures of the eriophyid prey and its predacious mites under different conditions, two groups, each consist from five mango trees, from Hindi and Alphonso cultivars of similar size, vigor and shape were selected. Samples of 25 leaves were taken from each cultivar at random every week. Eriophyid and predatory phytoseiid mite populations were estimated by examining leaf surfaces. Eriophyid occurrence was also recorded by examining a sample of 25 leaves of the sunny terminal parts of the shrub branches and another from the shady central core of the same shrubs of each cultivar, every other week during summer months.

To study the comparative abundance of *C. kenyae* and its vertical distribution, 60 leaves were collected randomly from the top, bottom and middle of each mango cultivar. Observations were made for two years, from January to December. Sampling was performed on the 15th of every month. In the present investigation, leaves of mango trees from the upper branches, represented the « top-level leaves » while those on the branches of the trees up to a height of 150-200cm above ground level, represented the «bottom-level leaves ». The foliage between the top and the bottom level was regarded as «middle-level leaves ».

Chemical control:

An area of the same abandoned mango trees, with a history of eriophyid mite infestations was selected. Abamectin (Vertimec 1.8% EC at the rate of 27 oz., 764 g/ha), Chlorfenapyr (Chalenger 36% Sc at the rate of 34 oz., 955 g /ha), Sulphur (Micronized sulpher 99.8% at the rate of 169 oz., 4775 g /ha), Azadirachtin (Achook at the rate of 135 oz., 3820 g/ha), Methoxyfenozide (Runner 24% Sc at the rate of 68 oz., 1910 g/ha) and Spinosad (Tracer 24% Sc at the rate of 34 oz., 955 g/ha) were applied.

Treatments were carried out when eriophyid mite populations started to increase. Each treatment was replicated four times and every replicate consisted of two mango trees (cv. «Alphonso»). Treated and untreated replicates were represented, each by 25 leaves. Pre–spray counts were made for all treatments and replicates to determine the initial distribution and density of the mites. Observations were made one & three days and eight weeks post treatments. Reduction percentage was estimated according to the formula of Henderson and Tilton (1955). Spray was applied with a conventional high pressure spray motor and hand spray gun.

Adult stage of the predatory phytoseiid mites was mounted in Hoyer's solutions, as modified by Schuster and Pritchard (1963), for identification. Records of the daily temperature and relative humidity, prevailing at the locality and corresponding to sample periods, were taken from the Central Meteorological Department, Ministry of Scientific Research.

Biological studies:

The method described by Abou-awad *et al.* (2005) for rearing the eriophyid mites was followed to study mite biology. Fifty newly mated females of *C. kenyae* were obtained from infested mango leaves, and placed singly on the leaves of cuttings of soft lateral branches by mean of a human eyebrow, fastened to a handle. Each female was allowed to deposit one or two eggs, then one of the two was removed. According to ecological study, treated cuttings were placed in incubators at different temperatures and relative humidities (10±1 °C & 85% R.H.; 15±1 °C & 75% R.H.; 20 ± 1 °C & 70 % R.H.; 25±1 °C & 60% R.H.; 30±1 °C & 55% R.H.; and 35±1°C & 50% R.H.). Developmental observations were recorded twice daily.

RESULTS AND DISCUSSION

Seasonal variations:

The population dynamics of *C. kenyae* and its predatory mites for a 2-year study on the mango trees (cvs. Hindi and Alphonso) and weather records are presented in figs. 1 and 2.

Eriophyid mite *C. kenyae* was the prominent acarine pest on succulent young and intermedium mango leaves. Climatic conditions, the occurrence under the epidermis of the upper leaf surface and prevailing natural enemies during a whole year may have a role to play. Two annual peaks of seasonal abundance on Hindi and Alphonso cultivar were recorded. The highest populations occurred in January (winter) and August (summer) of the two study years, averaging 31.0 & 31.5 mite individuals per Hindi mango leaf in 2003 at average temperature 17.5 & 29.5 ^{O}C and 63.0% & 59.0% relative humidity (R.H.). In 2004 34.0 & 24.0 individuals per leaf were recorded per leaf at 16.5 & 32.0 ^{O}C and 58.5% & 58.0% R.H. respectively. Similar trend was noted in mango Alphonso cultivar, recording averages of 32.0 & 49.0 *C. keryae* individuals in January and August 2003 and 45.0 & 27.5 in 2004 at nearly average temperature of the former cultivar.

To determine the number of annual generations of *C. kenyae* under the local environmental conditions, the percentage of immature stages was estimated weekly. The time at which the highest percentage of the immature stages occurred represented the beginning of a new generation. About 16 & 14 generations of *C. kenyae* were recorded on Hindi and 15 & 13 on Alphonso in 2003 and 2004 respectively. The longest generations for *C. kenyae* were that, which passed throughout late spring and fall and lasted for about five and eight weeks, while the shortest generations occurred in winter and summer and lasted for about two and three weeks intervals for both cultivars during the two successive years. This confirms again that the changeable environmental factors had a generally poor effect on *C. kenyae* and this is possibly due to that its motile stages live under the epidermis cells, as a protective coat, throughout the year.

A great difference was noted between numbers of motile stages of *C. kenyae* on leaves of sunny and shady zones of cvs. «Hindi and Alphonso» during the two summer seasons of 2003 and 2004. The central cores always tend to harbour a higher significant mite population than the sunny terminal during late spring and summer (April–August) average number of motile individuals per 25 leaves ranged from 206.6 as minimum on sunny to 455.7 as maximum on shady for Hindi cultivar and from 140.7 on sunny to 349.0 on shady Alphonso leaves (Table 1).

Table (1): Mean number of the leaf coating mite *C. kenya* infesting sunny and shady leaves of Hindi and Alphonso mango trees during April–August 2003-2004.

No. per 25 leaves			
2003		2004	
Sunny	Shady	Sunny	Shady
Hindi			
251.0	455.9	206.6	370.1
Alphonso			
140.7	311.6	221.3	349.0

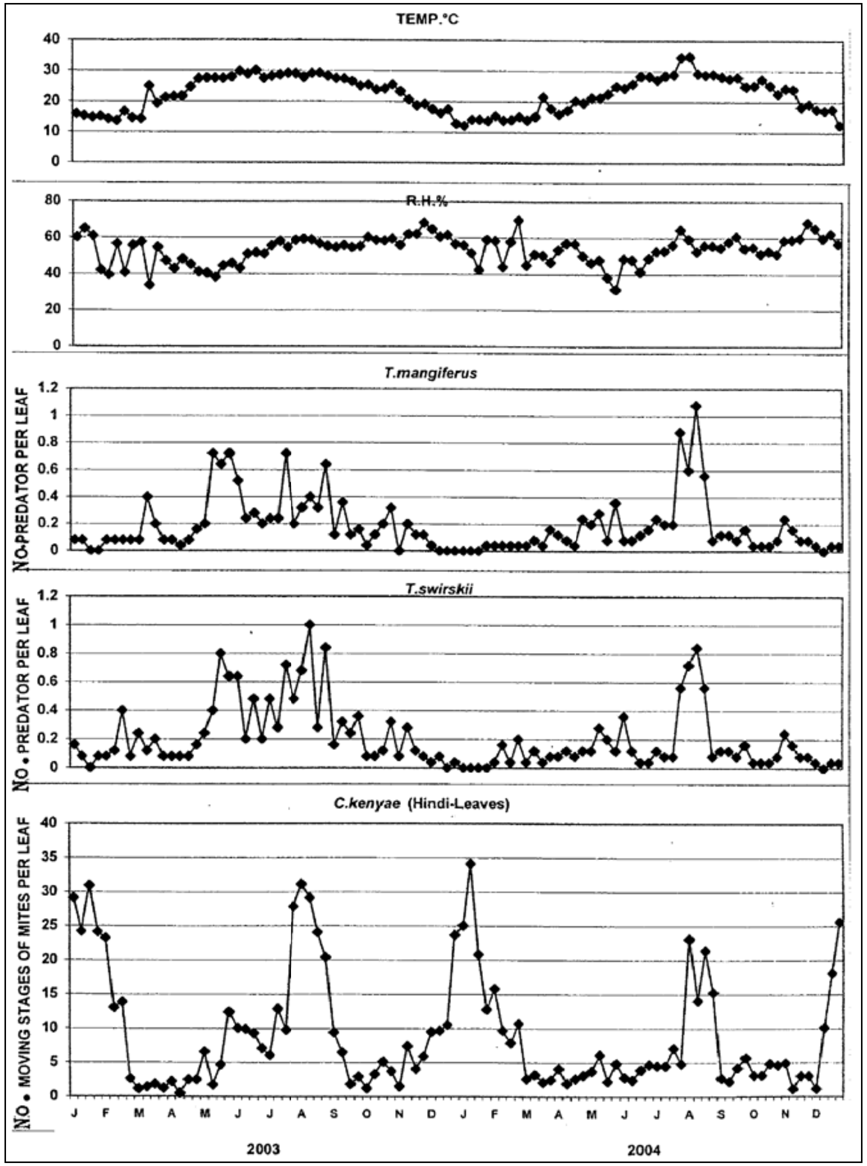

Fig.1.Population density of the leaf coating mite, *C. kenyae* and their phytoseiid predators *on Hindi mango leaves* in abandoned orchard.

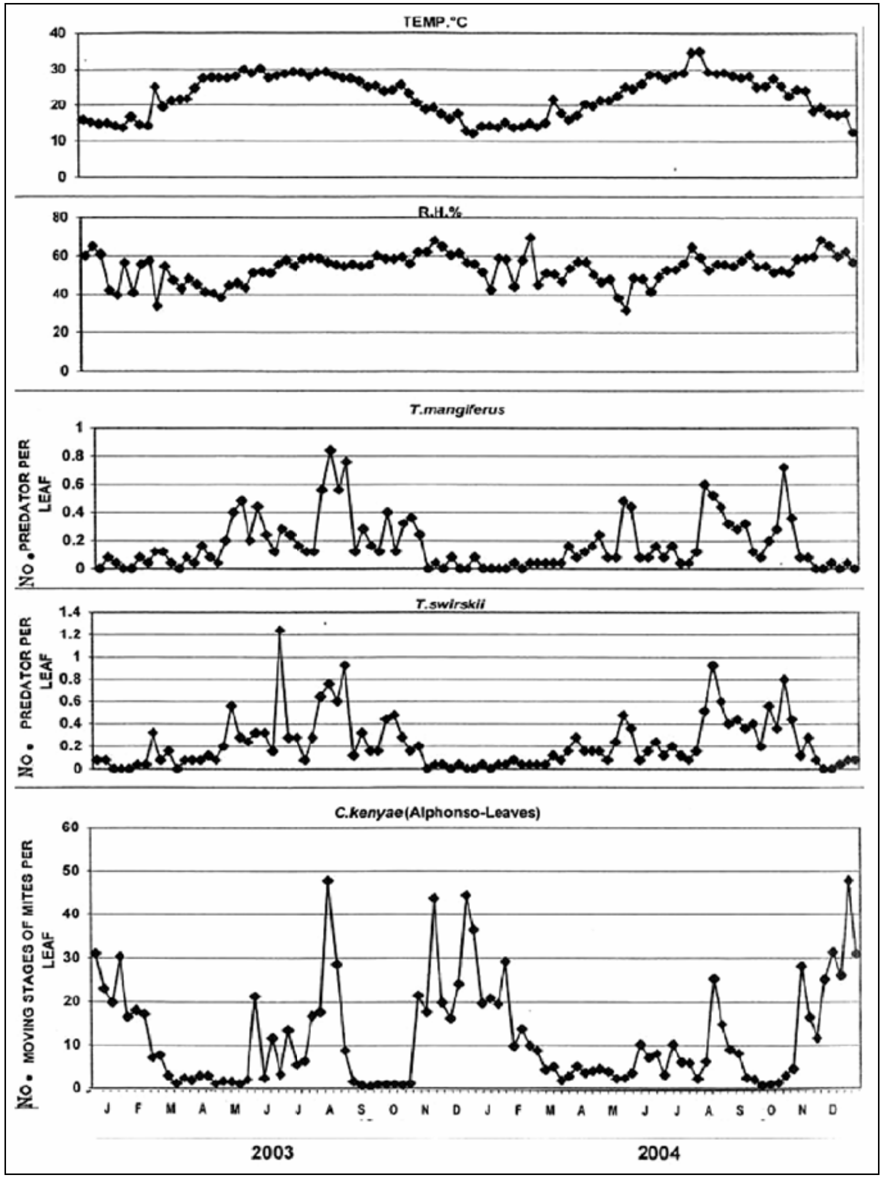

Fig. (2): Population density of the leaf coating mite, *C. kenyae* and their phytoseiid predators *on Alphonso mango leaves* in abandand orchard.

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The numerical changes in vertical distribution of the mite *C. kenyae* on Hindi and Alphonso mango trees for the two successive years, with temperatures and relative humidities for the corresponding periods are given in figures 3 and 4. Tracing up the population trend at top and middle it was found that its peak mostly occurred during January, then declined till April and May on Hindi leaves and April on Alphonso. Its density exhibited a gradual increase and decrease throughout summer and winter and still remained at a noxious level during these intervals. At the bottom level, leaves of both cultivars had significantly more numbers of mite species in comparison to the top and middle levels, particularly cv. «Alphonso». The data suggest that the bottom leaves were preferable to the mite feeding and are useful for sampling of the eriophyid mite population to evolve suitable strategies for the application of chemical control.

Predacious mites:

Eriophyoid mites have recently become very important acarine pests infesting fruit trees. In nature, these acarine pests are only a part of biological complex of which predacious mites, particularly phytoseiid group, could be of value in checking infestations. Several workers have reported that phytoseiids have a role to play in the control of acarine pests (McMurtry *et al*., 1970; Abou–Awad *et al*., 1989; Sany Soo and Palk , 1999 & Rasmy *et al*., 2003). Therefore, it was of interest to study the population dynamics of phytoseiid predators during the two successive years 2003 and 2004. *T. swirskii* (Athias-Henriot) and *T. mangiferus* Zaher and El-Borolossy were relatively numerous and widely distributed on cvs Hindi and Alphonso, associated with the leaf coating and webbing mite *C. kenyae*. The population density of the former predatory mite proved to be greater than the latter. Their population density started to increase in May then fluctuated till reached a peak in August, then tailed off in December. The predators populations positively correlated with that of *C. kenyae*. Their densities averaged from zero to 1.2 individuals (Figs. 1 and 2). This may indicate that eriophyid prey probably play an important part of the predator diet.

Acaricide applications:

The population studies of the predacious mites and *C.kenyae* revealed that the phytoseiid predators were present in too small numbers after budding in early February (2005), and being ineffective in reducing the populations of the leaf coating eriophyid mite below the economic injury level . Thus, one application of safe compounds in early February, when *C. kenyae* population started to increase, was sufficient to suppress the pest population for the entire year. This also allowed for the longest possible period of the biological control.

Table 2 shows the effect of some pesticides on eriophyid mango mite during the season (2005). The results indicate that application of Abamectin resulted in a promising control against the eriophyid mango mite *C. kenyae* as it caused a reduction of 93.90% in its population during the 35-day period following application, followed by Chlorfenapyr, then Sulphur. Azadirachtin, Methoxyfenozide and Spinosad ranked the less effective. Similar effects of Abamectin against eriophyid mites were found on citrus in Florida (Childers, 1986) and on fig and olive trees in Egypt (Abou-Awad *et al*., 2000 and 2005).

Biology:

None of the techniques tried were successful mainly because *C. kenyae* can be found under the epidermis of the upper surface of well developed leaves, raising the epidermal cells. This behaviour caused difficulties for rearing *C. kenyae* which has

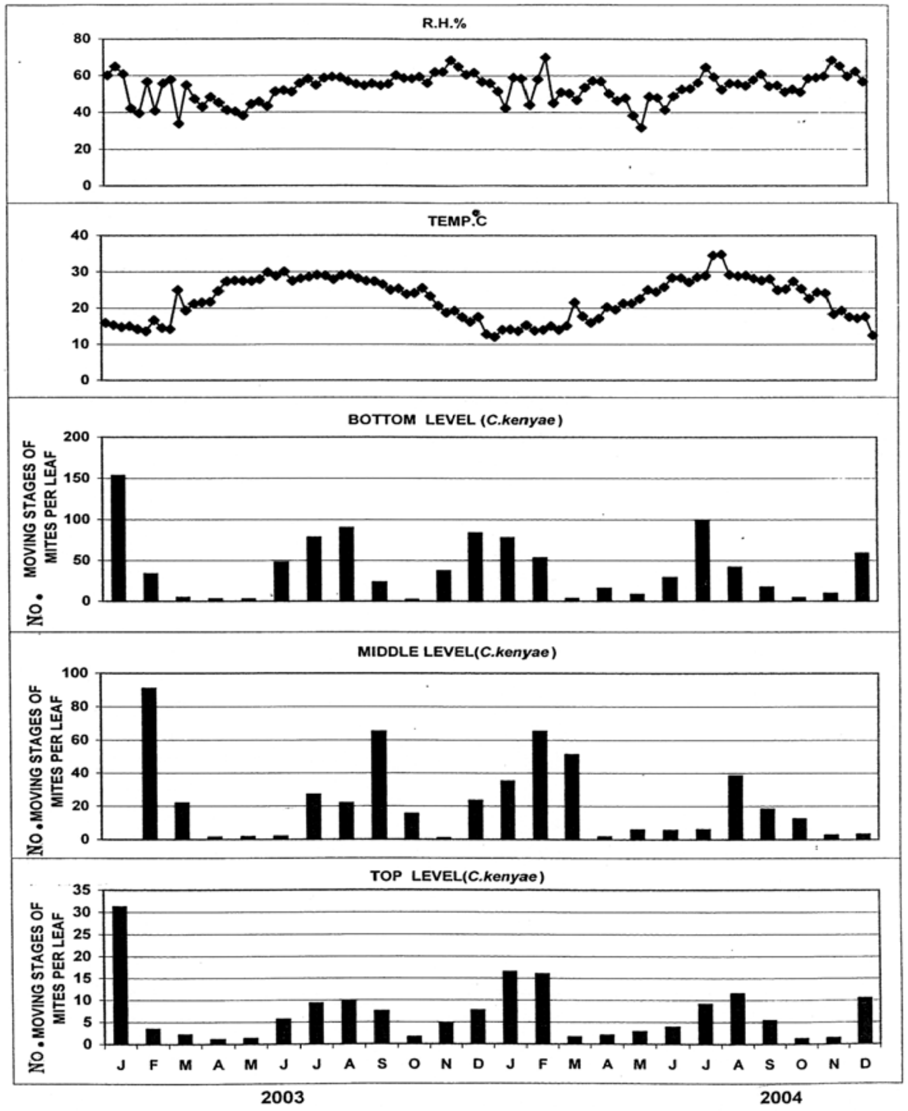

Fig. (3): Population trends of the leaf coating mite, *C. kenyae on Hindi* mango leaves in abandoned orchard from January to December and weather records.

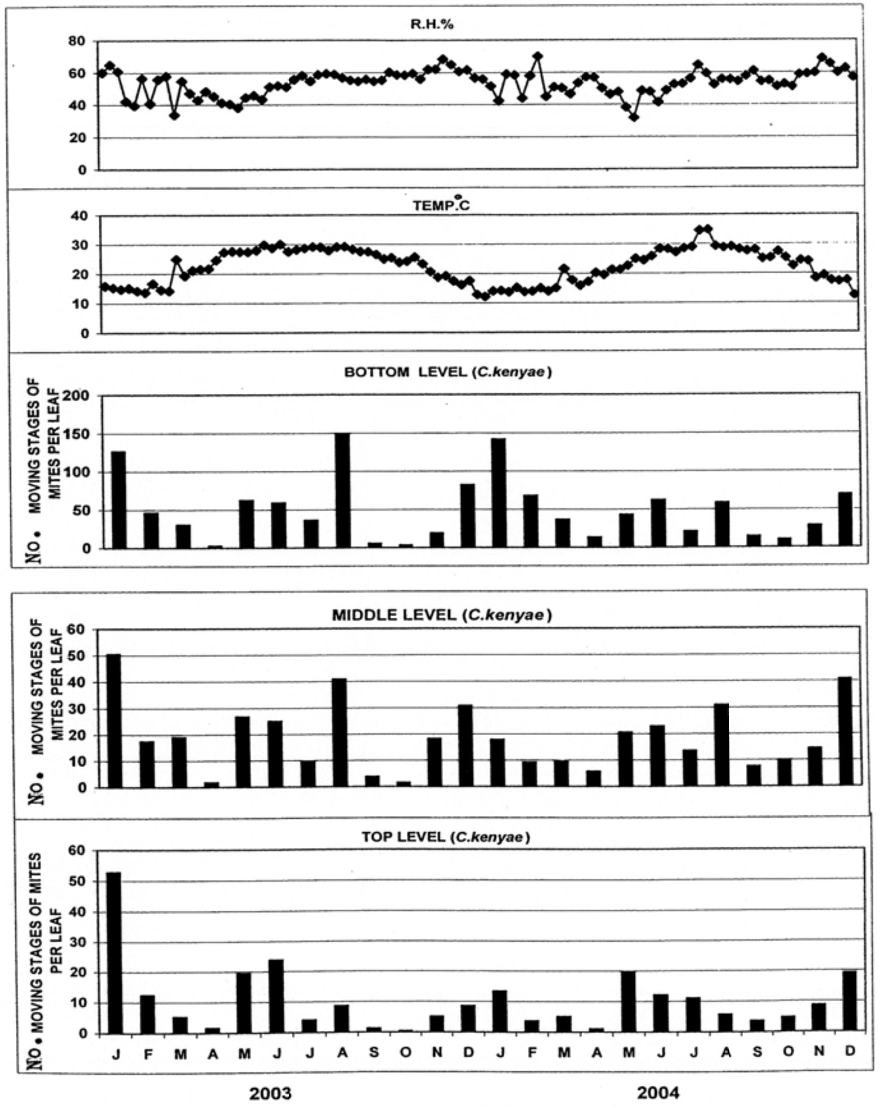

Fig. (4): Population trends of the leaf coating mite, *C. kenyae* on *Alphonse* mango leaves in abandoned orchard from January to December and weather records.

Table (2): Pesticides effect on the leaf coating and webbing mite *C. kenyae* within 35 days after application in 2005 season.

Pesticides	Concentration (%)	Number of mites per leaf		
		Pre-spray count*	Average post-spray count	Reduction (%)**
Abamectin	0.04	23.22	0.80	93.90[a]
Chlorfenapyr	0.05	23.70	2.17	83.90[b]
Sulphur	0.25	21.52	2.17	82.30[b]
Azadirachtin	0.20	22.32	3.82	72.70[c]
Methoxyfenozide	0.10	23.42	4.22	71.30[c]
Spinosad	0.20	22.07	4.77	65.40[d]
Control	-	24.35	13.95	-

*Counts made1, 3 days and 5 weeks post treatment.

**Mortality values (Henderson–Tilton equation).

Different letters in vertical column denote significant difference (F-test, $P < 0.05$ $P < 0.01$).

Table (3): Average duration (in days) of immature stages of the leaf coating mite, *C. kenyae* at different temperatures and relative humidities.

Temp. (°C)± 1	R.H.%	Egg	First instar nymph		Second instar nymph		Life cycle
			M	N	M	I	
10	85	5.10 ±0.11	2.90 ±0.08	0.58 ±0.02	3.53 ±0.22	0.62 ±0.03	12.73 ±0.41
15	75	4.70 ±0.12	3.20 ±0.09	0.37 ±0.02	3.15 ±0.14	0.29 ±0.07	11.71 ±0.31
20	70	3.70 ±0.10	3.04 ±0.10	0.29 ±0.01	3.00 ±0.09	0.24 ±0.02	10.27 ±0.38
25	60	3.20 ±0.12	1.69 ±0.18	0.21 ±0.07	2.38 ±0.14	0.16 ±0.01	7.64 ±0.11
30	55	2.80 ±0.11	1.46 ±0.15	0.29 ±0.01	1.53 ±0.15	0.20 ±0.07	6.28 ±0.19
35	50	2.16 ±0.11	1.80 ±0.08	0.14 ±0.07	1.08 ±0.08	0.13 ±0.02	5.31 ±0.22

M: Moving stage N: Nymphochrysalis I: Imagochrysalis

not been reared before. The rearing technique required a great number of replicates as some adult females either escaped or died, due to being unable to make the epidermis cover under laboratory conditions. It was also observed that other virgin adults died within 3-5 days after being out complete cover of the epidermal cells. However, the mite was able to develop from egg to adult through entire life cycle at six different temperatures and relative humidities (Table 3).

Eggs are spherical, 20-24µ in diameter, translucent after being laid. Female lays eggs scattered along the main or lateral veins on the upper surface of the leaves and in the same place of mite feeding. The incubation period averaged 2.16 to 5.10 days at different temperatures and relative humidities.

The first instar nymph is translucent, 93-101µ long. It passes through nymphochrysalis before moulting into the second instar nymph which is very much similar to the first, 125-133µ long and more active. The second nymph also passes through an imagochrysalis before reaching the adult stage. About 3-15 hours were spent in the nympho and imagochrysalis. During the first quiescent stage, the nymphs appeared in a pearly luster and very light; while in the second quiescent stage the nymphs appeared in a pearly luster at the anterior portion and slight yellow at the posterior. Developmental duration from egg to adult averaged 12.73, 11.71, 10.27, 7.64, 6.28 and 5.31days at 10 & 85, 15 & 75, 20 & 70, 25 & 60, 30 & 55 and 35°C & 50% R.H., respectively (Table 3) These results are relatively similar to those recorded by Easterbrook (1978 & 1979) for the pear rust mite *Epitrimerus pyri* (Nalepa), the apple leaf and bud mite *Aculus schlechtendali* (Nalepa), respectively and the olive bud mite *Aceria oleae* Nalepa (Abou-Awad *et al*., 2005). Thus, it could be concluded that high temperature and low relative humidities enhanced faster development of *C. kenyae*.

It is worth mentioning that at 25°C and 100% R.H. no hatching of *C. kenyae* eggs was noted, while 100% of larva hatched at 25°C and 50-70 % R.H. Eggs apparently are fixed to the leaf surface which makes it difficult to be removed.

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