ENVIRONMENTAL MANAGEMENT AND BIOLOGICAL ASPECTS OF TWO ERIOPHYOID FIG MITES IN EGYPT: *ACERIA FICUS* AND *RHYNCAPHYTOPTUS FICIFOLIAE*

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ECOLOGY
BIOLOGY
CONTROL
FIG ORCHARD MITES
PHYTOPHAGOUS ACARI
PREDACIOUS ACARI

SUMMARY: Mites from abandoned fig trees in Egypt were observed for 2 years, during which species diversity, seasonal fluctuations and biological aspects of common eriophyoid species were studied. Three phytophagous species—the fig bud mite *Aceria ficus* (Cotte), the fig leaf mite *Rhyncaphytoptus ficifoliae* Keifer and the two-spotted spider mite *Tetranychus urticae* Koch, representing a basic trophic level—were fed upon by three predacious mites—*Pronematus ubiquitus* (McGregor), *Amblyseius swirskii* Athias-Henriot and *Agistemus exsertus* Gonzalez. Population abundance of the injurious mites were affected by climatic conditions, predation and leaf age. A control measure of one summer pesticide (abamectin) application seemed to be the most successful management of the harmful mites. Life table parameters showed that the population of *A. ficus* multiplied 28.52 times in a generation time of 17.90 days, while the *R. ficifoliae* population increased 16.50 times in a generation time of 14.61 days. Field and laboratory studies indicated that viviparity is a typical character in the reproduction of *R. ficifoliae*.

ÉCOLOGIE
BIOLOGIE
CONTRÔLE
ACARIENS DU FIGUIER
ACARIENS PHYTOPHAGES
ACARIENS PRÉDATEURS

RÉSUMÉ : Les acariens des vergers abandonnés de figuiers en Égypte ont été suivis pendant deux ans : la diversité, les fluctuations saisonnières et la biologie des espèces des ériophyoidés communs ont été étudiés. Trois espèces phytophages : l'acarien des bourgeons, *Aceria ficus* (Cotte), celui des feuilles *Rhyncaphytoptus ficifoliae* Keifer et *Tetranychus urticae* Koch ont été utilisés pour nourrir trois espèces prédatrices (*Pronematus ubiquitus* (McGregor), *Amblyseius swirskii* Athias-Henriot, *Agistemus exsertus* Gonzalez). L'abondance des déprédateurs est affectée par les variations climatiques, la prédation et dépend de l'âge des feuilles. Une application estivale d'abamectin apparît la plus efficace pour le traitement des acariens phytophages. Les paramètres des tables de vie montrent que *A. ficus* se multiplie au rythme de 28,52 par génération (17,90 jours) tandis que la population de *R. ficifoliae* est multipliée par un facteur de 16,50 par génération (14,61 jours). Les études de terrain et de laboratoire montrent que la viviparité est typique de *R. ficifoliae*.

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Introduction

Phytophagous mites, especially the eriophyoid bud and leaf mites, are injurious in fig orchards in Egypt. The infestations of these pests have increased to significant rates in the last few years. The most familiar symptoms caused by these mites are rusting or surface browning, bud blasting, impedance of new growth, bud distortion and leaf chlorosis. Severe infestation may result in defoliation of branches or whole trees. The pesticides used in fig orchards destroy the predacious mites, which are most important in controlling the phytophagous species (Abdel-Khalek, 1993). Over the years, investigators have repeatedly warned for the need of minimising the adverse side-effects of pesticides and have recommended use of biological control. The number of species and the relative abundance of the prevailing predacious mites can be integrated with a pesticide to reach a successful pest management.

This study is an ecological investigation to develop a method of controlling mite populations infesting fig trees. The different biological aspects of the life history of fig bud and leaf eriophyoid mites were also studied.

Material and Methods

Ecological studies of the fig bug mite *Aceria ficus* (Cott), the fig leaf mite *Rhyncaphytoptus ficifoliae* Keifer and the two-spotted spider mite *Tetranychus urticae* Koch, as well as their predators (*Pronematus ubiquitus* (McGregor), *Amblyseius swirskii* (Athias-Henriot), *Agistemus exsertus* Gonzales) were carried out in an abandoned fig orchard, 10 years old, in Magoal village at Qualiubia governorate, during two years (1989–1991). Twenty fig trees (*Ficus carica* var. *soltani*) of the same size, vigour and shape were selected. Two group samples of leaves, bud and fruits were collected at random every other week: a group from the sunny terminal parts of the tree branches from all directions at one meter height, and another group from the shady central core of trees at same height. Each group included 25 leaves, 20 buds and 10 fruits. Population densities of phytophagous mites were estimated as mites present on one square inch [2.6cm^2] of the leaf surfaces at base of each leaf corners (50 square inches represent the whole sample of each group). Adult stages of the predacious mites were counted by examining both leaf surfaces (25 leaves). Buds were cut to their leaf scales and examined to assess numbers of *A. ficus*.

Treatment: An area of the same abandoned fig orchard with a history of heavy infestation was selected. *Abamection* (*Vertimec E. C.* 1.8%) at the rate of 27 oz. [764 g] per hectare was used. Treatment was carried out when mite populations started to increase. It was replicated four times, with a replicate of four trees. Treated and untreated replicates were each represented by 20 square inches [51 cm^2] of leaves and 10 buds. A pre-spray count was made for all replicates to determine the initial distribution and density of the mites. Reduction percentage was calculated according to the formula of Henderson & Tilton (1955). Spray was applied with a conventional high-pressure spray motor and hand spray gun.

Life history study: Clean discs, 2 cm in diameter, of excised well developed uninfested fig leaves were carefully examined, placed upper surfaces downwards on water saturated discs, 2 cm in diameter, of plastic rubber foam beds in a large uncovered Petri dish, 15 cm in diameter, as described by El-Badry & El-Banhawy (1968). Fifty new adult stages of fig bud or leaf mites were obtained from heavily infested fig buds and leaves and placed, singly, on the surface of the rearing discs. Each female was allowed to deposit 1–2 eggs (*A. ficus*) or 1–2 first stage larvae (*R. ficifoliae*), then removed. Rearing leaf discs were renewed each other day and the development of mites was observed twice daily.

Insemination took place soon after male and female emergence. Replacement of leaf discs was conducted for 24 h to allow insemination of virgin females by the spermatophores on leaf discs, and each adult transferred back to its original disc.

Experiments were conducted under laboratory conditions of 29 ± 2° C, 70–80 R.H. and 12/12h light/dark periods. Adult stages of the predacious mites were mounted in Hoyer's solution, as modified by Schuster & Pritchard (1963), for identification. Adult stages of *R. ficifoliae* were mounted twice weekly in Keifer's (1954) solution during the two successive years to observe the males, pre-ovigerous, oviparous, ovoviviparous and viviparous females. Records for the daily rate of temperature and relative humidity prevailing at the locality and corresponding to sample periods, were taken from the Central Meteorological Department, Ministry of Scientific Research. Life table parameters were calculated according to a Basic computer program (Abou Setta *et al.*, 1986).

Results and discussion

Seasonal variations

The population dynamics of the phytophagous and predacious mites for a 2-year study on the fig trees along with the weather data for the corresponding period are given in fig. 1.

A.—Phytophagous mites: Three injurious mites were commonly found on the fig trees: the eriophyid fig bud mite *A. ficus*, the diptilomiopid fig leaf mite *R. ficifoliae*, and the two-spotted spider mite *T. urticae*. *A. ficus* was the most prominent in buds and on leaves, while *R. ficifoliae* and *T. urticae* came second and third in the order of abundance on leaves. The shady leaves harbour an almost equal population of eriophyoid mites as the sunny ones, but the reverse was observed for the two spotted-spider mite. The highest *A. ficus* population in buds occurred in late June, with 322 and 330 individuals per bud in two successive seasons (1989–1991), when temperature and relative humidity averaged 26.0° C, 59.7° C and 27.3, 51.9, respectively. In late July, the population suddenly decreased to 2.4 and 27.6 individuals per bud throughout the same seasons. The numbers of this mite varied greatly during fall and winter seasons. On leaves, the population density increased rapidly and peaked in late June and July during the two years, being 69 and 60 individuals per square inch of leaf when temperature and relative humidity averaged 26°C, 59.7°C and 27.6, 57, respectively. In early September and October, the population reached its minimum being 1.1 and 6.2 individuals per square inch of leaf during the two successive seasons. The population was positively correlated with prevailing temperature for two successive seasons, while no significant correlation was noted with the relative humidity (Table 1). The data obtained are in agreement with those reported by El-Banhawy (1973). During winter, all stages of the fig bud mite were present in and around buds. As soon as the new fig leaves appeared, usually in May, the mites were numerous and occurred in large numbers at the bases of new flower bud and among bud scales. The mites moved to the stems, young leaves and under apical fruit scales, and began laying eggs among lower leaf surface hairs in early June. The behavioural findings are in general agreement with those obtained by Whitehead *et al.* (1978) for the grape bud and erineum mite, *Eriophyes vitis* (Pagst.), in the western Cape of South Africa.

Phytophagous mites	Correlation coefficient values							
	1989–1990 season				1990–1991 season			
	Temperature		Humidity		Temperature		Humidity	
	Leaves	Buds	Leaves	Buds	Leaves	Buds	Leaves	Buds
Aceria ficus	0.410	0.294	-0.410	-0.112	0.781*	0.481	-0.072	-0.342
Rhyncaphytoptus ficifoliae	-0.328	—	-0.495*	—	-0.323	—	-0.214	—
Tetranychus urticae	0.309	—	-0.618*	—	0.351	—	-0.658*	—

Table 1.: Correlation coefficient between temperature, relative humidity and phytophagous mite populations in an abandoned fig orchard during two successive seasons (1989–1991) (* significant at 5% level).

The distribution of *R. ficifoliae* differed greatly from that of *A. ficus*. Three annual peaks of seasonal abundance were observed. The first peak, which was the highest, occurred in early June (1990 and 1991), the second in early July 1990 and late July 1991, while the third peak occurred in early November 1989 and late October 1990. Seasonal variations of the fig leaf mite were unpredictable (Fig. 1); mean densities/in^2 varied from 6–31 individuals at 24.3–25.3° C with 51.4–52.3% R.H., 15.0–17.0 individuals at 27.6–27.4°C with 57.0–62.3% R.H. and 2.0–9.0 individuals at 19.4–22.4° C with 65.4–65.1% R.H. during

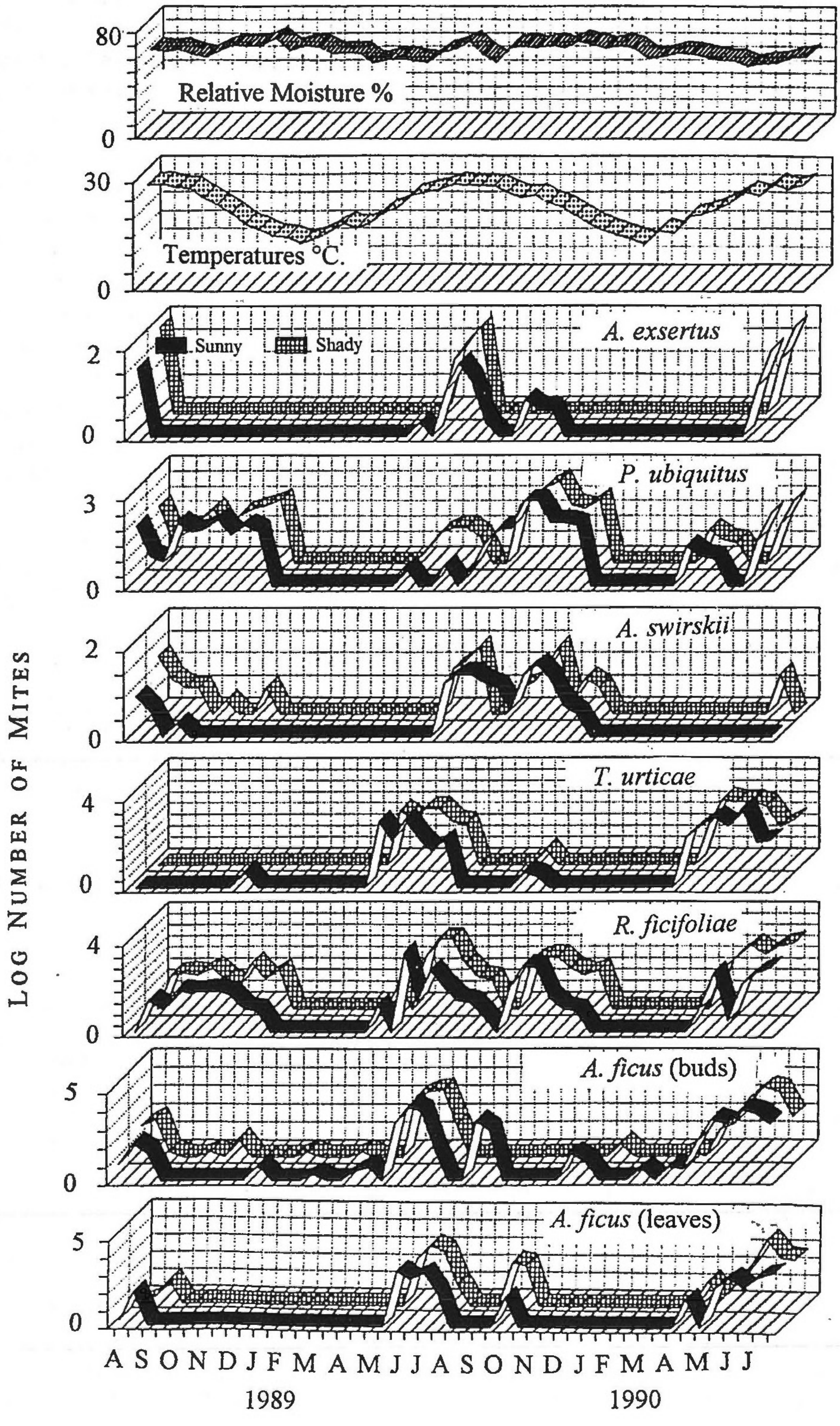

FIG. 1: Population trends of phytophagous and predaceous mites associated with fig trees in relation to temperature and relative humidity over a two-year period (1989–1991).

the two successive years, respectively. The mite population was negatively correlated with the prevailing temperatures and relative humidity of the two successive years (Table 1). The sudden increase or decrease in population density can not always be explained. MEYER (1981) reported the same behaviour by the citrus grey mite *Calacarus citrifolii* Keifer, showing the possible role of climatic conditions and growth cycles of citrus.

The two-spotted spider mite, *T. urticae*, was only active during the summer. A great difference was observed in the mite population of both sunny and shady trees. The mite population exhibited a gradual increase from late April and reached its peak in June, being 14.0, 37.0 and 5, 11 individuals/in^2 of leaf on the sunny and shady zones for two successive seasons when temperature and relative humidity averaged 25.3°C, 27.3°C and 52.3, 51.5, respectively, and started to decline sharply from July onwards (Fig 1). The population of *T. urticae* was insignificantly correlated positively with the prevailing temperatures for two successive seasons. The effect of humidity on the development is not yet well defined for most spider-mite species (CROOKER, 1985). No significant correlation was noted with relative humidity during two successive seasons (Table 1).

Population levels of the eriophyoid and tetranychid mites on fig fruits are given in Table 2. The difference in mite densities on sunny and shady trees was not significant. Fruits that are slightly damaged ripen normally, but those with severe mite infestations become bronzed. Following the population trend (from May to August 1991), both *A. ficus* and *T. urticae* populations started in May and increased rapidly, peaked in late June; they then tailed off at the end of July. No infestation on fruits by *R. ficifoliae* was observed during growing seasons, except for a few recorded in late May on terminal fruits.

Date of sampling	Number of mite stages/10 fruits of					
	Terminal zone (sunny)			Central core (shady)		
	A. ficus	*R. ficifoliae*	*T. urticae*	*A. ficus*	*R. ficifoliae*	*T. urticae*
May 10	22	0	16	26	0	2
25	16	54	16	16	0	4
June 10	282	0	20	22	0	14
25	796	0	78	258	0	38
July 10	618	0	12	424	0	10
25	78	0	12	195	0	8
Aug. 10	0	0	0	0	0	0
25	0	0	0	0	0	0
Mean	302*	54	25.7*	156.8*	0	12.7*

TABLE 2: Population of *Aceria ficus*, *Rhyncaphytoptus ficifoliae* and *Tetranychus urticae* on sunny and shady zones of fruits of abandoned fig trees during the 1991 season (* Insignificant ($P<0.05$, t-test)).

The degree of infestation with phytophagous fig mites is probably correlated with leaf age. Individuals of *A. ficus* preferred the immature leaves to mature ones, while the mature leaves were preferred for oviposition throughout the season. Leaf injury resulting from excessive mite feeding may also affect the pest population adversely, as noted on the immature or young leaves (Table 3). The reverse occurred with *R. ficifoliae* individuals, while eggs and moving stages of *T. urticae* were frequently found on both immature and mature leaves.

B.—Predacious mites: The general trends in the occurrence and the abundance of the predator mites *P. ubiquitus*, *A. swirskii* and *A. exsertus* are given in Fig. 1. *P. ubiquitus* was the most predominant in fig orchards and was found in 82% of the samples containing predators. *A. swirskii* came second in the order of abundance (71%) and *A. exsertus* third, forming only 29% of the total samples.

Populations of *P. ubiquitus* began to increase on leaves from July reached a peak in early November 1989 and 1990, with 4 and 22 individuals per leaf, respectively. A positive relationship was noted

Date of Sampling	Number of mite stages/100 in^2 of leaves									
	A. ficus				*R. ficifoliae*		*T. urticae*			
	Mature		Immature		Mature	Immature	Mature		Immature	
	Eggs	M.	Eggs	M.	M.	M.	Eggs	M.	Eggs	M.
May 10	18	53	0	515	140	8	523	488	748	533
25	205	23	0	2418	1433	50	720	1103	1020	635
June 10	488	25	0	2753	1440	70	325	855	283	690
25	475	0	0	3485	805	383	610	2653	888	1508
July 10	480	0	0	4648	2748	0	393	1105	390	1180
25	78	0	0	383	4243	0	105	83	108	90
Aug. 10	0	0	0	0	1890	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0
Mean	351.0a	33.7a	0b	2367.0b	1814.0a	102.8b	446.0a	1047.8b	572.8a	772.7b

TABLE 3: Population of *Aceria ficus*, *Rhyncaphytoptus ficifoliae* and *Tetranychus urticae* on both mature and immature leaves of abandoned fig fruits during the 1991 season (M.= Moving stage. Different letters in a horizontal column denote significant difference (P<0.01, t-test)).

between the incidence of the two eriophyoid mites and *P. ubiquitus* on the same leaves, while the reverse was the case with the two-spotted spider mite (Table 4). In June and July 1991, when the percentage of leaves infested with *A. ficus* and *R. ficifoliae* reached its maximum; this was followed by an increase in the percentage of the leaves harbouring the predator during July. A gradual decrease in the percentage of the infested leaves followed. *T. urticae* reached its maximum in late May and during June. An almost negative relationship was noted between the incidence of leaves infestation with *T. urticae* and *P. ubiquitus* on the same levels (Table 4). Such a distribution suggests that it would be possible for the predator to achieve control of the eriophyoid pests. The data are in accordance with those reported by BAKER (1939) and ABDEL-KHALEK (1993).

Date of sampling	% Occurrence of associated mites							
	A. ficus		*R. ficifoliae*		*T. urticae*		*P. ubiquitus*	
	ML	IL	ML	IL	ML	IL	ML	IL
May 10	0	0	20	20	60	70	30	20
25	20	30	40	20	100	100	30	10
June 10	20	100	60	10	90	100	0	0
25	20	100	50	10	90	100	10	20
July 10	0	100	100	0	50	90	90	100
25	0	80	100	0	50	60	100	100
Aug. 10	0	60	20	10	0	0	40	20
25	0	20	0	0	0	0	20	0

TABLE 4: Percentage occurrence of *Aceria ficus*, *Rhyncaphytoptus ficifoliae* and *Tetranychus urticae* and the predatory mite *Pronematus ubiquitus* in abandoned fig leaves during the 1991 season (ML = Mature leaves; IL = Immature leaves).

The value of phytoseiid and stigmaeid mites for controlling eriophyoid and tetranychid mites has been well documented by several authors (ZAHER & EL-BADRY, 1961; SCHUSTER & PRITCHARD, 1963; MCMURTRY *et al.*, 1970; SOLIMON, 1975; RICE *et al.*, 1976; YOUSEF *et al.*, 1982; ABOU AWAD, 1983; EL-BAGOURY & REDA, 1985; KROPERYNSKA & TUOVINEN, 1988; AMANO & CHANT, 1990; ABOU-AWAD & EL-SAWI, 1993). The distribution pattern of the phytoseiid mite, *A. swirskii*, varied greatly from that of the stigmaeid mite, *A. exsertus*. Its population was noted from July and reached a peak in early November, being 1.4 individuals per leaf, without strictly correlated with the abundance of different phytophagous mites, while *A. exsertus* showed a sharp peak in late July and early August, with 3.3 individuals per leaf, and its predacious feeding habits have been reported in association with eriophyoid and tetranychid mites.

It can be concluded that the population dynamics of eriophyoid and tetranychid mites on abandoned fig trees were affected by prevailing climatic conditions, action of predatory-prey relationship and leaf age. Predatory mites are regarded as an important factor for controlling the populations of different harmful mites during most months of the year. However, it is difficult to sort out the precise reasons for fluctuations of these predacious mites and their relative numbers because of the complexities involved in the multiple predator-prey relationships. A species such as *Amblyseius hibisci* (Chant) (McMurtry *et al.*, 1970) is reported to utilise eriophyids as a food source, but it does not reduce them satisfactorily, nor does it do well on tetranychid species, such as *T. urticae*, which produce heavy webbing (McMurtry & Scriven, 1964).

Pesticide management of mite populations

The long-term use of certain pesticides in chemical programs in Egypt may be partially responsible for the increase of injurious mite numbers on cultivated crops. These adverse changes can be minimized by delaying application to allow native bio-control agents to have an affect. On the basis of a population dynamics study, the suitable timing of pesticide application to suppress the out-break of phytophagous mites can be approached. Study reveals that the different predacious mites of the fig orchard are ineffective in reducing the populations of the eriophyoid and tetranychid species to below economic injury levels. The pesticide abamectin (Vertimec E.C. 1.8%) is a streptomycete-derived macrocyclic lactone, originally isolated as an antiparasitic agent (Burg *et al.*, 1979). It is effective on mites at very low dosages (Putter *et al.*, 1981; El-Banawy & Anderson, 1985) and slightly toxic by contact to predacious mites (Crafton-Cardwell & Hoy, 1983; Hoy & Cave, 1985; Reda & El-Banhawy, 1988). The data of the present work showed that one summer application of abamectin in early June, when the mite populations start to increase, was sufficient to control phytophagous mites for the entire year. This allows for the longest possible period of biological control, especially because the predacious mites were almost absent or present in very low numbers at the time of application.

Table 5 shows the effect of abamectin on different injurious mites in Qualubia fig orchard during 1991. The results indicate that abamectin is a promising control against the two-spotted spider mite, whereas it had less effect on the fig bud and leaf mites. It caused a reductions of 86%, 75% and 68% or 63% in the populations of *T. urticae*, *R. ficifoliae* and *A. ficus* on buds or leaves, respectively, during the 60 days following applications. Similar affects of this product against eriophyid mites have been found on citrus in Florida orchards (Childers, 1986). Many workers (such as Lord *et al.*, 1959 ; Hoyt, 1969; Whitehead *et al.*, 1978; Ball, 1982; Easterbook, 1984) have shown that if spray could be eliminated, or at least greatly reduced, orchard mites would not be a problem.

Biology

1. — The fig leaf mite, *Rhyncaphytoptus ficifoliae* Keifer

Eriophyoid mites are usually oviparous. Sometimes, the egg may start to cleave, and an embryo may develop into a first stage larvae which hatches inside

Mites	Abamectin concentration %	Number of mites/bud or one square inch of leaf		
		Pre-spray count	Average post-spray count*	Reduction **
Tetranychus urticae	0.04	35.10	2.04	86.2 a
Rhyncaphytoptus ficifoliae	0.04	2.35	5.23	75.3 b
Aceria ficus (leaf)	0.04	0.55	4.12	63.2 c
Aceria ficus (bud)	0.04	5.40	7.60	68.4 bc

Table 5: Abamectin effect on the phytophagous mites in the Qaliubia orchard within 60 days after application treatment in 1991 season. (* Counts made 1,3 days and 8 weeks post treatment. ** Mortality values calculated with Henderson-Tilton equation).

Mite stage	Sex	*A. ficus*	*R. ficifolia*
		Mean ± S.D.	
Egg	Female Male	2.75 ± 0.08 2.80 ± 0.08	— —
First stage larva	Female Male	2.50 ± 0.13 2.25 ± 0.08	2.55 ± 0.14 2.45 ± 0.14
Quiescent larva	Female Male	1.65 ± 0.11 1.30 ± 0.08	0.85 ± 0.11 0.75 ± 0.08
Second stage nymph	Female Malc	2.95 ± 0.14 2.55 ± 0.12	1.75 ± 0.15 1.70 ± 0.08
Quiescent nymph	Female Male	1.90 ± 0.12 1.70 ± 0.11	1.15 ± 0.58 0.80 ± 0.08
Total	Female Male	11.75 ± 0.13 10.60 ± 0.07	6.50 ± 0.19 5.70 ± 0.17
Pre-oviposition or-LP*	Female	0.70 ± 0.08	0.65 ± 0.08
Oviposition or-LP*	Female	10.30 ± 0.37	11.30 ± 0.26
Total fecundity	Female	36.40 ± 0.89	23.30 ± 0.47
Post-oviposition or-LP*	Female	1.20 ± 0.08	1.20 ± 0.13
Life span	Female Male	23.95 ± 0.46 22.20 ± 0.20	19.45 ± 0.02 16.10 ± 0.10
% surviving	Female Male	100 100	100 100
Number of observations	Female Male	29 21	27 23

TABLE 6: Average duration (in days) of various stages and oviposition rate of *Aceria ficus* and *Rhyncaphytoptus ficifoliae* at 29° C, 70–80% R.H. and 12/12 h light/dark periods (* larval production).

female's body. This reproductive behaviour has been reported by several authors (NALEPA, 1889, BOCZEK, 1961; SHEVTSCHENKO, 1961; HALL, 1967; BRIONES & McDANIEL, 1976; ABOU-AWAD, 1981; DE LILLO, 1991). On the basis of these observations, some species of eriophyoids are considered to be ovoviviparous. JEPPSON *et al.* (1975) proposed several hypotheses to explain this behaviour. On the other hand, viviparity is observed in *Aculus uleae* Boczek and *Rhyncaphytptus ulmivagrans* Keifer, without any details being known about this phenomenon (CHANNABASAVANNA, 1966). However, the present ecological and biological studies revealed that *R. ficifoliae* is a viviparous form, lacking the egg stage. It was also observed that the females mounted on slides, during either population dynamic studies or laboratory rearing, did not have eggs or chorion residues inside their bodies. Thus, viviparity is a typical character in the reproduction of the fig mite *R. ficifoliae*.

Females produced their living young or larvae singly along the veins. Larvae were very small, fastened to the plant surface and motionless. After some hours they moved and became able to obtain nourishment. Each female produced 1–3 first stage larvae daily and sometimes stopped for 1–3 days before starting production again. Larvae do not resemble the second stage larvae or nymph. The nymph is readily distinguished, as it covered by a flocculent coating of white, waxy material. An average of 0.85, 0.75 and 1.15, 0.80 days were spent in the female and male larval and nymphal chrysalis or quiescent stages, respectively. It was noted that during the quiescent stages, the individual stretched its legs directly forward parallel to each other, and the mite fastened its self slightly to the plant surface at any site of leaf disc. Whereas the normal active mite has a flesh-like colour, the moulting form has a pearly lustre and is motionless. In the moulting process, a transverse rupture occurred at the anterior region behind the cephalothoracic shield, hence legs and the cephalothorax were the first parts to the plant surface; the anterior parts were then elevated and mite moved to get rid of the exuvia.

The female life cycle lasted 6.50 days, while the male developed faster (5.70 days) (Table 6). Insemination took place soon after female emergence from the last quiescent stage. It was noted that the mating process was essential for the maximum reproduction of the females, as unmated females produced lower numbers of larvae compared to mated ones. The female gave birth to an average of 23.30 larvae, during a reproduction period that averaged 11.30 days, and then survived for 1.20 days before death (Table 6).

2. — The fig bud mite, *Aceria ficus* (Cotte)

In studying the life cycle of the fig bud mite, BAKER (1939) reported that Petri dishes served quite well and terminal bud scales laid on moist blotting paper in the dishes made an excellent food source at ambient temperatures, but the excessive handling and transferring of mites from old to fresh scales often caused their death, and made it almost impossible to follow them through the entire life span. In the present study, *A. ficus* was able to develop successfully from egg to adult on well developed fig leaf discs.

In the light of the information obtained in this study, developmental times of *A. ficus* females were as follows: egg 2.75 days, larva 2.50 days, larval chrysalis 1.65 days, nymph 2.95 days and nymphal chrysalis 1.90 days. Males developed faster (Table 6), the total life cycle being completed in 11.75 and 10.60 days for female and male, respectively. It is of interest to note that the moulting process was similar to that of the fig leaf mite *R. ficifolia*. Insemination took place soon after female emergence from the last quiescent stage. Unfertilised females were found to produce only male offspring, while both males and females were produced by fertilised females. This is in agreement with the results reported for the citrus rust mites *Phyllocoptruta oleivorus* (Ashmead) and *Aculus pelekassi* Keifer (BURDITT *et al.*, 1963).

Females deposited an average of 36.40 eggs (Table 6), during an oviposition period that averaged 10.30 days, and then survived for 1.20 days before death. Rice & Strong (1962) reported that females of the tomato russet mite, *Aculops lycopersici* (Massee), laid 10–53 eggs, depending on environmental conditions. It is possible, however, that the reproductive capacity of *A. ficus* might be better in favourable conditions. The life cycle took 23.95 and 22.20 days for the female and male, respectively. In general, the life history results of RICE & STRONG (1962) and ABOU-AWAD (1979) are nearly in agreement.

Parameters	*A. ficus*	*R. ficifoliae*
Net reproduction rate (Ro)	28.52	16.50
Mean generation time (T)	17.90	14.61
Intrinsic rate of increase (rm)	0.19	0.19
Finite rate of increase (e^{rm})	1.21	1.21
50% mortality (in days)	25.0	22.0
Number of observed females	29	27
Sex ratio (female/total)	26/44	24/44
Sex ratio (female : male)	1.4 :1	1.2 : 1

TABLE 7: Life table parameters of the fig bud mite, *Aceria ficus*, and the fig leaf mite, *Rhyncaphytoptus ficifoliae*, at 29° C, 70–80% R.H. and 12/12h light/dark periods.

A comparison of the life table parameters of the two dominant eriophyoid species on fig trees (Table 7) revealed that the intrinsic rate of increase (rm) and the finite rate of increase (e^{rm}) for both *A. ficus* and *R. ficifoliae* were equal, while the other parameters varied greatly. For example, the population of the fig bud mite *A. ficus* multiplied 28.52 times in a generation time of 17.90 days. In regard to the fig leaf mite, *R. ficifoliae*, the population increased 16.50 times in a generation time of 14.61 days. Consequently, *A. ficus* is one of the most important and injurious species in the family Eriophyidae, because it is not only damages fig trees by feeding but it is also a vector of the fig mosaic virus disease (MAKLAD, pers. comm.).

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