



### **Biology of *Aculops Guajavae*, A New Species (Acari: Eriophyidae) Infesting Guava Trees**

Badawi A. Abou-Awad<sup>1</sup>, Mahmoud M. Al-azzazy<sup>2</sup> and Sahar I. Afia<sup>1</sup>

<sup>1</sup>Plant Protection Department, National Research Centre, Dokki, Cairo, Egypt

<sup>2</sup>Dept. of Agric. Zoology and Nematology, Fac. Agric., Al-Azhar Univ., Cairo, Egypt

**Abstract :** Guava mite, *Aculops guajavae* (Acari: Eriophyidae) is delineated and illustrated as a new species in Egyptian fauna. It had been found in Behera province in spring and summer seasons totally on the lower aspect of succulent terminal guava leaves (*Psidium guajava* L.), preferring the lower leaf surfaces. *A. guajavae* successfully developed from egg to adult stage once reared on succulent guava leaves at totally different temperatures between 15 - 30°C and 75% R.H. The impact of temperatures on the biological aspects was demonstrated. At 7°C the activity of the guava mite was ceased, whereas at 36°C the new virgin adults died. Males started depositing spermatophores inside 24 hours when changing into adults, with general average 12 a day. Female longevity at 15°C averaged 22.91 days, about 1.48 times as long as at 30°C. Oviposition rate was highest at 30°C (43.18 eggs/♀). Population of guava mite increased 19.22 times in an exceedingly generation of 14.67 days at 30°C and 75% R.H.

**Key words:** taxonomy; biology; *Aculops guajavae* sp. n.; Eriophyidae; Acari; phytophagous mite.

#### Introduction

Guava (*Psidium guajava* L.) is one amongst the foremost economically necessary fruit in Myrtaceae. It has become naturalized in tropical and subtropic regions throughout the world. The leaves and bark guava tree have a long history of medical uses that are still used to day<sup>1</sup>. The most constituents of guava are essential oils, vitamins, phenolic compounds, tanins, flavonoids and alcohols. These necessary chemical compounds are associated with several health effects of guava<sup>2</sup>.

Guava trees are attacked by variety of insects, diseases and nematodes. Trees are also infested by some species of eriophyid mites like *Abacarus uruetae* K.<sup>3</sup>, *Rhynchus haramotomis* K.<sup>4</sup> and *Eriophyes biopsidia* K.<sup>5</sup>. Described new guava mite, in this study, is typically example of genus *Aculops*<sup>6</sup>. It is chiefly characterized by having lobe of anterior shield usually more acuminate and always lacks the small anterior-projecting spinules. Dorsal shield tubercles with transverse axes on the rear margin, and setae directed divergently to the rear. Strong tergal-sternal ring differentiation. All measurements are in micron (um). Type materials are deposited in the collection of N.R.C.

The present study was designed to describe *A. guajavae* as a new species of the Egyptian fauna of the eriophyid mites and to investigate the effect of totally various temperatures on the biological aspects of the new guava mite. Thermal requirements and measures of the life tables were conjointly achieved.

#### Materials and Methods

Biological study of guava eriophyid mite *A. guajavae* was carried out in Cairo at the Faculty of Agriculture, Al-azhar University. The rearing substrate was clean leaf discs (1.5cm in diameter) of

succulent terminal leaves of guava (*Psidium guajava* L.) placed upper surfaces downwards in Petri dishes (5cm in diameter) with water saturated cotton. Fifty newly mated adult females of *A. guajavae* were obtained from heavily infested guava leaves in the farm of El-Fath, belonging to Modern Agriculture Company at Tahrir province, El-Behera Governorate, and placed singly on the above mentioned leaf discs by mean of a human eyebrow, fastened to a handle. Each female was allowed to deposit one or two eggs, then it was removed, dishes were placed in the incubator at different constant temperatures (7-12-15-20-25-30-33-36)°C and 75% relative humidity and a 16/8 h light/dark period.

Mite development was observed twice daily. After the last moult of either sex and to insure insemination by spermatophores produced by males, each newly emerged protogyne female was transferred, for 24 h, to a leaf, previously inhabited an adult male, then females and males were transferred, back to their original leaf discs. <sup>7</sup>three-step recipes for fixation and embedding were used. Spermatophores were picked off the terminal succulent leaves with a glass needle. Observations were made by placing the detached spermatophores in a small drop of distilled water on a microscope slide. Life table parameters were calculated according to <sup>8</sup>.

## Results and discussion

### *Aculops guajavae* n. sp. (Fig. 1)

Guava eriophyid mite, *Aculops guajavae* n. sp. is a fusiform mite, narrowed posteriorly; yellow to light amber. Females are from 161 to 165 long and 51 to 55 wide. Rostrum regarding 17 long, protrusive down, chelicerae 14 long. The shield is subtriangular in form, 32 long and 48 wide, anterior lobe acuminate and short, central style obscure, disc restricted by faint incomplete median and sinuous admedian lines, submedian lines absent; sides with sinuous faint lines. Scapular tubercles on rear shield margin, large, 21 apart, scapular seta 7 long, projecting backward and divergent, reaching 5<sup>th</sup> dorsal annules. Leg I: 28 long, femur 8 long, basiventral femoral seta 7 long; genu 5 long, antaxial genual seta 22 long; tibia 7 long, without paraxial tibial seta; tarsus 6 long, outside seta 14 long. Claw 6 long, slight snaky and clear knob at tip. Axis of featherclaw undivided, 4-rayed on all sides, nearly equal calw. Leg II: 25 long, femur 7 long, basiventral femoral seta 7 long; genu 4 long, antaxial genual seta 21 long; tibia 6 long, while not seta; tarsus 6 long, outside seta 14 long. Claw 6 long, slight snaky and clear knob at tip. Axis of featherclaw undivided, 4-rayed on every aspect, nearly equal claw. Coxae I with few faint incomplete lines and enormus in size. Coaxl setae I slightly wider apart than seta II. Coxae II with one seta of 17 long. Tergites a lot of wider than sternites, 37 tergites and regarding 64 sternites present; breadth of tergites regarding 3. Rings fully microtuberculate little rounded ventrally and absent dorsally, placed on little posterior margins. Lateral thanosomal seta 9 long, on top of and behind reproductive organ seta, on regarding sternite 11; first ventral seta 25 long, surpassing the second ventral seta on about sternite 24; second ventral seta 11 long, on regarding sternite 38; Third or telesomal seta 17 long, on regarding sternite 59. Telosome with six rings, with fine striations ventrally. Accessory seta absent. Female genital organ 9 long, 15 wide and 16 irregular ribs that area unit either longitudinal or snaky, seta 6 long, arising from little tubercle.

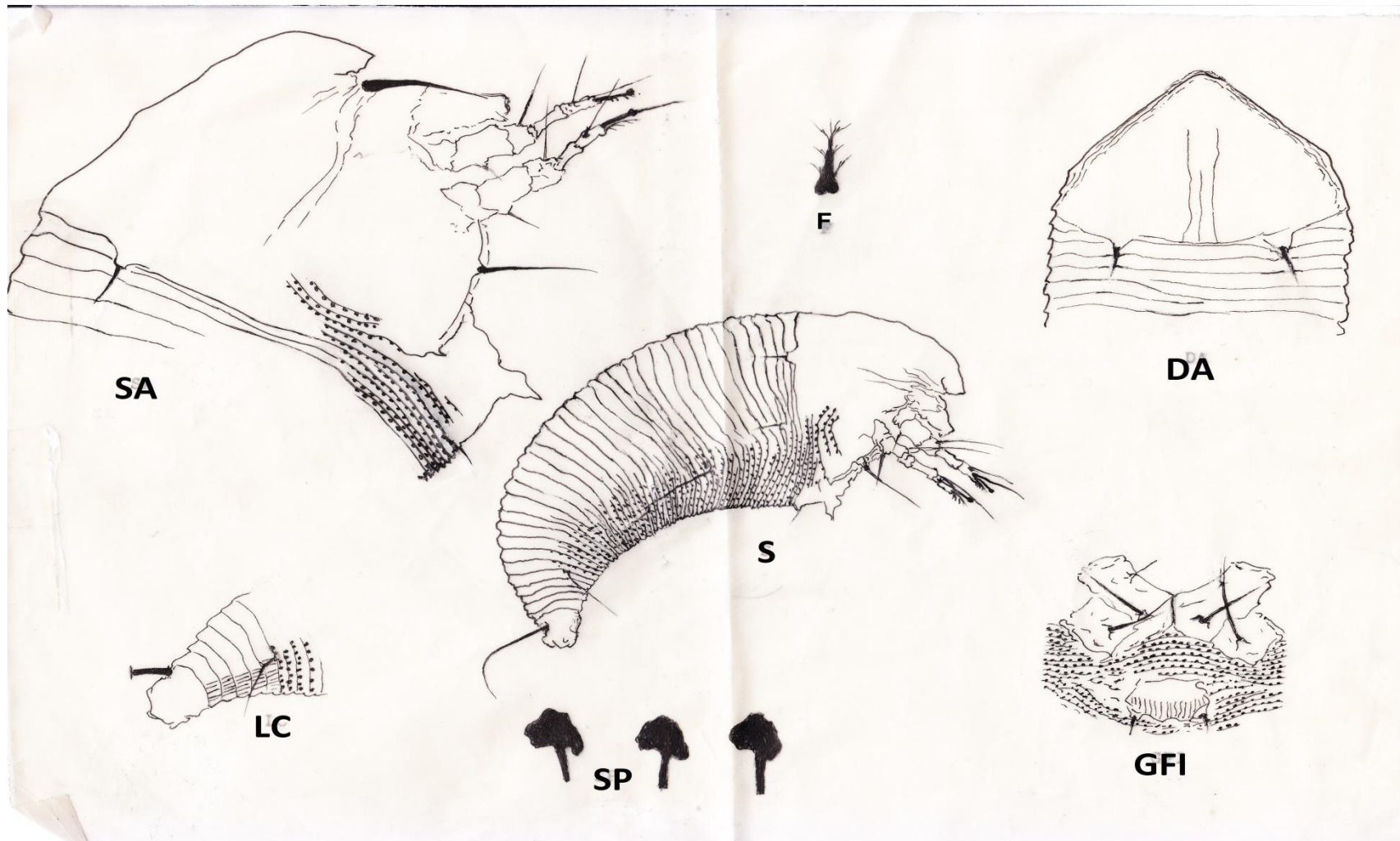
**Male-Similar to female, body fusiform, 160-163 long, 49-53 wide; privates 6 long, 13 wide; reproductive organ seta 7 long.**

**Host:** *Psidium guajava* L. (Myrtaceae), guava.

**Relation to the host plant:** This mite was noticed infesting terminal leaves, preferring the lower surface among the hairs, making dark brown leaf spots and dried succulent terminal leaves at severe damage.

**Types:** Holotype female, allotype male, 11 paratype females, Tahrir province, El-behera region (Lower Egypt), May 13, 2013 by B. A. Abou-Awad.

**Remarks:** This species is close to *Aculops benakii* (Hatzinikolis)<sup>5</sup>. The design of dorsal shield, number tergites (37), number of longitudinal ribs (16) and lack tibial and accessory caudal setae, separate the new species.



**Fig. 1 – *Aculops guajavae*, SA. Side view of anterior section of mite; F. Featherclaw; DA. Dorsal view of anterior section of shield; S. Side view of adult female; LC. Latero-caudal view; SP. Spermatophores; GFI. Female genitalia and coxa.**

**Biology**

Guava leaf mite, *A. guajavae* was ready to develop with success from egg to adult through entire life history at different constant temperatures and 75% R.H. At 36 and 7°C mature stages began to cease their activities, then died (100% mortality). Immature stages have developed till a temperature of 12°C or 33°C, subsequently some new individuals adults died (50% mortality). The information obtained are in agreement with those according by<sup>9,10</sup> who found an equivalent impact of temperatures degrees for other allied eriophyid peach mite *Aculus fockeui* (N&T).

Eggs are spherical (45-53 in diameter), nearly clear once initial set, later changing into creamy color and opaque as a result of the embryo development inside the egg, then hatches into a primary arthropod nymph, that resembles the adult, however it is smaller, while not external privates. The initial nymph is translucent, 65-80 long. It passes through a nymphochrysalis before ecdysis into the second arthropod nymph, that is like the primary, yellow-white in color, 110-120 long and additional active. The second nymph passes through an imagochrysalis before hatching, giving rise to the adult.

Egg period belittled with a rise temperature up to 30°C. Eggs period at 15°C was regarding 1.9 times as long as that at 30°C. Nymphal durations conjointly step by step belittled with associate increase in temperature up to 30°C. The overall life cycle was completed in 13.02 and 12.35, 10.96 and 10.10, 9.07 and 8.44 and 7.04 and 6.49 days for females and males at 15, 20, 25 and 30°C, (Table one) respectively. Males developed quicker. Life cycle results of<sup>11</sup> on the apple rust mite *Aculus schlechtendali*(Nalepa) are nearly in agreement at a number of the previous temperatures.

**Table 1. Duration (in days) of different stages and fecundity of *Aculops guajavae* at constant temperatures and 75% R.H.**

<i>A. guajavae</i> Mean ± SD		Temperatures (°C)			
Developmental stages	Sex	15	20	25	30
Egg	♀	5.40 ± 0.12	4.27 ± 0.16	3.81 ± 0.24	2.90 ± 0.17
1 <sup>st</sup> stage nymph	♀	5.01 ± 0.20	4.16 ± 0.12	3.67 ± 0.72	2.40 ± 0.41
	♂	3.15 ± 0.11	2.97 ± 0.13	2.41 ± 0.28	1.96 ± 0.17
Nymphochrysalis	♀	3.11 ± 0.09	2.90 ± 0.16	2.11 ± 0.14	1.90 ± 0.11
	♂	0.62 ± 0.02	0.42 ± 0.04	0.43 ± 0.05	0.26 ± 0.02
2 <sup>nd</sup> stage nymph	♀	0.62 ± 0.02	0.36 ± 0.09	0.36 ± 0.04	0.26 ± 0.07
	♂	3.43 ± 0.22	3.00 ± 0.11	2.12 ± 0.11	1.70 ± 0.12
Imagochrysalis	♀	3.21 ± 0.17	2.30 ± 0.17	2.00 ± 0.13	1.71 ± 0.17
	♂	0.42 ± 0.07	0.30 ± 0.02	0.30 ± 0.04	0.22 ± 0.02
Total	♀	0.40 ± 0.08	0.38 ± 0.09	0.30 ± 0.07	0.22 ± 0.01
	♂	13.02 ± 0.36a	10.96 ± 0.42b	9.07 ± 0.64b	7.04 ± 0.86c
Pre-oviposition Generation	♀	12.35 ± 0.42a	10.10 ± 0.53b	8.44 ± 0.53b	6.49 ± 0.66c
	♂	3.00 ± 0.19	2.33 ± 0.25	1.90 ± 0.38	1.20 ± 0.26
Oviposition	♀	16.02 ± 0.74a	13.29 ± 0.84b	10.97 ± 0.64b	8.24 ± 0.78c
	♂	15.91 ± 1.17a	15.29 ± 1.53a	14.12 ± 1.20a	12.21 ± 0.97b
Total fecundity	♀	8.20 ± 0.61a	24.60 ± 0.88b	31.15 ± 1.25c	43.18 ± 2.13d
	♂	4.00 ± 0.34	3.10 ± 0.16	3.00 ± 0.42	2.00 ± 0.23
Post-oviposition Longevity	♀	22.91 ± 1.76a	20.72 ± 1.88b	19.02 ± 2.05b	15.41 ± 0.98c
	♂	20.11 ± 0.92a	18.70 ± 1.21b	18.05 ± 1.11b	14.21 ± 1.03c
Life span	♀	35.93 ± 1.91a	31.68 ± 2.04b	28.09 ± 2.14b	22.45 ± 2.33c
	♂	32.46 ± 2.11a	28.80 ± 1.81b	26.49 ± 1.66b	20.70 ± 1.38c
% living	♀	97	98	99	99
	♂	100	100	100	100
Number of observations	♀	33	35	37	35
	♂	17	15	13	15

Different letters in a horizontal columns denote significant difference (F-test, P<0.05, P<0.01).

Before mating virgin females and males, it is of interest to note that the existence of spermatophores within the superfamily Eriophyoidea was according by<sup>12 and 13</sup>.<sup>14</sup> indicated that the sperm nucleus is massive

and ellipsoid. Every spermatophore contains from 40 to 60 sperm; a female of *Aculus cornutus* (Banks) once sensing the proximity of a gametophore can move up over it and then apparently squeeze the gamete from the sack on top of it; males should feed and lay down sperm sacks where females can realize them; female would visit recently deposited or 2-day recent spermatophores, but would not visit 4-,6- or 8-day recent gametophore; the production of female as a results of a visitation of either newly deposited or 2-day recent spermatophore indicated that sperm remained viable for at least 2 days in the spermatophore. Also,<sup>15</sup> mentioned that sperm remained viable within the spermatheca of the reproducing protogyne for many days and therein of the overwintering deutogyne for many months.

In the present study, males of *A. guajavae* started depositing spermatophores inside 24 hours when changing into adults. They ranged between 4 and 20 a day, with a general average of 12 a day. Spermatophores measure 7-9 long and 2-3 in diameter. Depositing sperm packets stopped for 3 days before death of males. Males gave the impression to show traditional behaviour at 30°C. Belittled longevity of males were related to multiplied of temperature. Longevity at 15°C was 20.11 days, about 1.42 times as long as that at 30°C. Total spermatophores conjointly step by step belittled with multiplied of temperature. Males deposited associate average of 204, 192, 180 and 132 spermatophores, throughout longevity period that averaged 20.11, 18.70, 18.05 and 14.21 days at 15, 20, 25 and 30°C, respectively. Most popular sites for depositing spermatophores coincide with areas frequented by females. However, one male of the peach silver mite *A. cornutus* lived 20 days and deposited 614 sperm packets<sup>16</sup> and males of the citrus bud mite *Eriophyes sheldoni* Ewing deposited from 2 to 15 of the packets a day; the most variety a male bud mite deposited in regarding 39 days was 88 spermatophores<sup>13</sup>.

Longevity of oviposition females conjointly belittled with multiplied of temperature. At 15°C, it was 22.91 days, about 1.48 times as long as that at 30°C. Total fecundity step by step multiplied with multiplied of temperature. Females deposited associate average of 8.20, 24.60, 31.15 and 43.18 eggs, throughout associate oviposition amount that averaged 15.91, 15.92, 14.12 and 12.21 days and then survived for 4.00, 3.10, 3.00 and 2.00 days at previous temperatures, severally (Table 1). The highest variety of eggs per feminine was determined to be 43.18 at 30°C. It may be complete that 30°C as associate optimum temperature accelerated the speed development and induced bigger replica of guava mite. The greatest fecundity for ovipositing females of the peach silver mite, *A. fockeui* was 43.16 eggs at 29°C<sup>10</sup>, additionally as within the females of the tomato russette mite, *Aculops lycopersici*(Masse) was 51.7 eggs at 25°C<sup>17</sup>. It's potential, however, that the replica capability of associate eriophyid mite may be higher under favourable conditions. The life history took 35.93 and 32.46, 31.68 and 28.80, 28.09 and 26.49 and 22.45 and 20.70 days for females and males at an equivalent temperature, severally. In general, life histories studied by<sup>(18-21), 17, (22 and 10)</sup>are in agreement. A few days after fertilization by spermatophores, the progeny was predominantly females, with a sex ratio of (1.9:1) to (2.8:1), whereas sterile females created solely males (Table 2). Similar findings were reported on citrus rust mite *Phyllocoptruta oleivora* (Ashmed) and pink citrus rust mite *Aculus pelekassi* (Keifer)<sup>23</sup>, on fig bud mite *Aceria ficus* (cotte)<sup>21</sup>, on olive bud mite *A. oleae* and the olive rust mite, *T. hassani*<sup>22</sup> and the peach silver mite, *A. fockeui*<sup>10</sup>.

**Table 2. Life table parameters of *Aculops guajavae* survived on succulent terminal guava leaves at totally of constant temperatures and 75% R.H.**

<i>A. guajavae</i>				
Temperatures (°C)				
Parameters	15	20	25	30
Net reproduction rate (RO)	8.56	13.84	16.47	19.22
Mean generation time (T)	22.11	18.24	16.17	14.67
Intrinsic rate of increase (rm)	0.084	0.157	0.189	0.204
Finate rate of increase (e <sup>rm</sup> )	1.09	1.15	1.19	1.22
50% mortality in (days)	33	30	27	21
Sex ratio (female/total)	33/50	35/50	37/50	35/50
Sex ratio (female/male)	33/17 1.94:1	35/15 2.33:1	37/13 2.80:1	35/15 2.33:1

This study demonstrated that the thermal issue has a good influence on the life table parameters (Table 2). It showed that the intrinsic rate of natural increase (rm) multiplied with temperature to a most of 0.204 at 30°C. The population increased solely 19.22 times in an exceedingly generation time of 14.67 days at the same temperature. Therefore, an appropriate temperature within the guava orchards additionally as higher food conditions associated an absence of a natural enemy would have thought a few fast population, growth of the *A. guajavae* that is thought about to be injurious eriophid mite on succulent terminal guava leaves.

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