Mites Inhabiting Date Palm Trees and their Dynamics with Reference to Reproduction and Life Table Parameters of *Raoiella indica* Hirst (Tenuipalpidae) at Three Different Temperatures

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ABSTRACT

Twenty six mite species in 22 genera and 17 families were collected from date palm trees in two Egyptian Governorates during 2012 and 2013. Population dynamics of mites associated with date palm leaves were reported. Biological aspects of *Raoiella indica* on leaves of *Phoenix dactylifera* L. were studied under laboratory conditions of 15, 20 and 25±2°C and 60 ± 5% RH. Feeding at 15± 2°C significantly prolonged predator longevity (42.38 & 37.26 days), for females& males, respectively and caused a higher rate of fertility averaged 96 egg through an average oviposition period of 28 day. Life table parameters showed that the highest intrinsic rate of natural increase (r_m) was reached as 0.149 at 20°C, respectively. This range of temperature was considered as the optimal range for this mite. Lower r_m value as 0.115 was obtained at 15°C. Time for population doubling was determined as 6.05, 4.65 and 4.83 at studied temperatures, respectively.

Key Words: Date palm trees, *Raoiella indica*, Life table parameters, Mite populations.

INTRODUCTION

Pests attacking date palm trees are key factors affecting to great extent the degradation of both quality and quantity of date yield as well as longevity and survivor of perennial tree. In Egypt some studies were carried out by Sallam and Yassin (2005) , Sallam *et al.* (2007) and El-Sanady and Mohamed (2013) to study incidence and population dynamics of certain mite species on date palm in different governorates of Egypt.

In 2004, *Raoiella indica* (Acari: Tenuipalpidea) was reported for the first time in the new world. This species has spread throughout the Neotropics and has gained economic importance, especially because of the damage it inflicts on coconut palms (*Cocos nucifera*), other palm species (*Areca catechu*, *Phoenix dactylifera*), and bananas, all important sources of nutrition and income for people inhabiting the tropical world, Kane and Ochoa (2006).

Raoiella indica (Hirst) may represent a threat to the ornamental palms industry and to date palm and banana crops. It is commonly known as the red palm mite, leaflet false spider mite, frond crimson mite, or scarlet mite, important pest of date palms and other palm species, as well as a pest of bananas, beans, in different parts of the world (Pena *et al.* 2006).

The main objective of this study was to shed light on distribution, some ecological aspects and population dynamics of mites inhabiting date palm trees all over Sharkia and Giza Governorates, Egypt to review all available information about mites that have been reported in association with *R. indica* and explain importance of biological control to manage population of phytophagous mites. Biological aspects and life table parameters were conducted to design a better strategy for decreasing the population of *R.indica* pest attacking date palm trees.

MATERIALS AND METHODS

I-Ecological-Studies:-

Mites inhabiting date palm (leaves, fruits and soil) were surveyed during two successive years, 2012 and 2013. Samples were collected from two governorates, Giza and Sharkia (Belbies, Enshass, Abou Hammad, Hehia,Zagazig, Minea El-Kamh). Samples were sent to laboratory at Sharkia for mites count**.**

II-Population Dynamics:-

Monthly samples of 40 leaves each for population dynamics were collected from the two locations (i.e. Sharkia and Giza). Population densities of phytophagous mites were estimated as mites present on one square inch (= 2.6 cm) of the upper leaf surface while predacious mites were also counted by examining both leaf surfaces.

III-Biological-studies and life table parameters of *Raoiella indica* :-

This study was conducted at three constant temperatures of 15, 20 and 25 ± 2°C and 60% RH. Stock culture was obtained from heavily infested date palm leaves obtained from Plant-Protection-Research-Institute-Dokki, Giza. The duration of developmental stages was studied on excised leaf disc in the laboratory. Before rearing mites, it was ensured that all unwanted organisms were removed from leaves by thoroughly brushing the leaves and by examining under stereo-microscope. Square leaf

discs, each 3cm in diameter were placed on a cotton wool bed in Petri dishes (5 X 6 cm) with the lower surface upwards, the cotton bed was soaked with water twice daily so that the discs remained fresh.

Two *R. indica* adult females were transferred from the stock culture to each disc for laying eggs. After 3-6 days, eggs were seen on each of the excised leaves, and thus 40–80 freshly laid eggs were available and all belonged to the same age. Observations were recorded until larvae hatched. Each larva was kept separately on a disc for recording duration of different biological aspects. Old leaves were replaced with fresh ones when needed. For determining the fecundity of unfertilized females, the female deutonymphs, before molting to adults were kept separately without allowing them to mate. For determining the fecundity of fertilized females, each female deutonymph was kept with a male. The number of laid eggs was counted till end of female oviposition period.

IIII-Statistical analysis

Data were subjected to the statistical analysis. Monthly average minimum and maximum temperatures (°C) and average relative humidity (R.H%) prevailing in the area during the study were obtained from site http://www.wunderground.com

RESULTS AND DISCUSSION

I-Ecological-Studies:-

During this study, 26 mite species in 22 genera and 17 families were collected. These mites were classified according to their feeding habits.

(1)Phytophagous mites

Members of the families Tetranychidae, Tenuipalpidae and Phytoptidae are plant feeders of considerable economic importance. Of these, six mite species belonging to five genera in three families were recorded (Table 1)**.**

Family- Tetranychidae Donnadieu: The date palm leaf brown mite, ***Eutetranychus orientalis*** **(Klein)** causes injury to leaves by feeding on the upper leaf surface. It was recorded from Hehia-district at Sharkia in high number on date palm leaves.

Family Tenuipalpidae (Berlese): The incidence of date palm mite, ***Raoiella indica*** (Hirst) was recorded in high numbers on leaves at Dokki-Giza.

Brevipalpus obvatus (Donnadieu) infested leaves and fruits preferring the lower surface around the midrib. Injured areas become pale then change to rusty brown at heavy infestation and brownish areas appear on date fruits. This species was recorded in high number on leaves of date palm in Minea El-Kamh.

Brevipalpus phoenicis **(Geijskes)**

It was recorded in low numbers infesting the lower surface of leaves and the fruits in moderate numbers.

Phyllotetranychus aegyptiacus **(**Sayed**)** was recorded in moderate number on leaves and in low numbers in fruits at Garden of the Faculty of Agricultural-Cairo-University Giza.

Family: Phytoptidae Murray

The mite, ***Mackiella phoenicis*** **(Keifer**) was recorded in moderate numbers on inner fronds, causing malformation of old fronds, then the leaves became dry and fell off.

(2) Predaceous mites

Twelve predaceous mite species of ten genera in eight families were collected (Table 2).

Family – Phytoseiidae (Berlese) Members of the family Phytoseiidae were common and expected to be found associated with both mites and insects infestations. Phytoseiid mites are important mortality factors of *R. indica.*

Amblyseius hutu **(Pritchard &Baker)** was recorded in high numbers on leaves and fruits in all areas of Sharkia governorate expecting to play an important role in controlling acarine pests.

A. swirsikii **Athias –Henriot** was found on leaves and fruits in moderate numbers in Giza.

A. cydnodactylon **Shehata and Zaher** was found in moderate numbers on leaves in Giza and Sharkia.

Family- Stigmaeidae Oudemans are potential predators of various phytophagous mite species.

Agistemus exsertus **(Gonzalez)** seemed to be the most important stigmaeid mite on date palm trees occurring in all areas of the study. It was recorded in moderate numbers on leaves in Giza and Sharkia.

Family Scutacridae : *Scutacrus sp*. only one female was found associated with fallen leaf.

Family Bdellidae: *Spinbdella cortices* (Ewing) was found on leaves in moderate numbers at Giza.

Family Cunaxidae: *Pulaeus glebulentus* **(Den Heyer)** was found on leaves at Sharkia in low numbers.

Family Smarididae: only one mite, ***Samaris cristatus*** **(Gray**) found on soil.

Family Macrochelidae: *Macrocheles glaber* **(Müller)** was found on fallen date (soil) in moderate numbers in both Giza & Sharkia.

Family Cheyletidae: ***Cheletogens ornatus*** **(Canestrini &Fanzago)** was found combined with phytophagous mites and scale insects infestation. It

Table (1) Incidence of phytophagous mites associated with date palm trees

Families	Species	Localities	Habitat and abundance
Tetranychidae	*Eutetranychus orientalis* (Klein)	Sharkia	Leaves +++(high)
Tenuipalpidae	*Raoiella indica* (Hirst)	Giza	leaves +++(high)
	Brevipalpus obovatus Donnadieu	Sharkia	Leaves+++ (high)& Fruits +(low)
	B. pheonicis (Geijskes)	Sharkia	Fruits ++ (moderate) &Leaves +(low)
	Phyllotetranychus aegyptiacus (Sayed)	Giza	Leaves++(moderate) & Fruits +(low)
Phytoptidae	*Mackiella phoenicis* (Keifer)	Giza	Leaves ++(moderate)

+ = Low (1-2 individuals Leaf) ++=Moderate (3-4 individuals Leaf +++= High (more than 5 individuals /Leaf)

Table (2) Incidance of predaceous mites associated with date palm trees

Families	Species	Localities	Habitat and abundance
Phytoseiidae	*Amblyseius hutu* (Pritchard&Baker)	Sharkia(All areas)	Leaves+++(High) & Fruits
	A.swirsikii (Athias – Henrio)	Giza	Leaves & Fruits (moderate)++
	A.cydnodactylon(Shehata and Zaher)	Giza & Sharkia	Leaves (Moderate)++
Bdellidae	*Spinibdella cortices* (Ewing)	Giza	Leaves(Moderate)++
Cunaxidae	*Pulaeus glebulentus* (Den Heyer)	Sharkia	Leaves(low)+
Macrochelidae	*Macrocheles glaber* (Müller)	Giza & Sharkia	Fallon date (moderate)++
Stigmaeidae	*Agistemus exsertus* (Gonzalez)	Giza & Sharkia	Leaves(Moderate)++
Scutacridae	*Scutacrus sp*	Sharkia	(Fallon date) + one female
Smarididae	*Samaris cristatus* (Gray)	Sharkia	(Fallon date) (low)+
Cheyletidae	*Cheletogens ornatus* (Canestrini &Fanzago)	Giza	Leaves+++ (high)
	Hemicheyletia bakeri (Ehara)	Sharkia	Leaves (low)+
	Eutogens africaus (Wafaa&Soliman)	Giza & Sharkia	Leaves(low) +

+ = Low (1-2 individuals Leaf) ++=Moderate (3-4 individuals Leaf) +++= High (more than 5 individuals /Leaf).

Table (3) Incidence of mites of miscellaneous feeding habits associated with date palm trees

Family	Species	Area	Habitat and abundance
Tarsonemidae	*Tarsonemus stifer* (Ewing) & *T. gladifer* (Mahunka) & *Stenotarsonemus spirifix* (March)	Giza&Sharkia	Leaves (high)+++
Tydeidae	*Orthotydeus californicus* (Banks)	Giza&Sharkia	Leaves (moderate)++
Acaridae	*Tyrophagous putrescentiae* (Schrank)	Sharkia	Leaves (low) + Fallon date (moderate)++
Glycyphagidae	*Blomia freemani* (Hughes)	Sharkia	Fallon date +(low)
Oppiidae	*Oppia sticta*(Popp)	Giza	Fallon date +(low)
Oribatulidae	*Zygoribtula sp*	Sharkia	Fallon date +(low)

+ = Low (1-2 individuals Leaf) ++=Moderate (3-4 individuals Leaf +++= High (more than 5 individuals /Leaf)

Table (4): Correlation coefficient between, predaceous mites, temperature, relative humidity and phytophagous mite populations in Sharkia Governorate from Apr. 2012 till Mar. 2014

Correlation Coefficient values (r)	First year			Second year		
	R. indica	*B. pheonicis*	Crawlers of Scale insect	*R. indica*	*B. pheonicis*	Crawlers of Scale insect
Phytoseiidae	0.005n.s	0.873***	0.921***	_0.182 n.s	0.115 n.s	0.552*
Cheyletidae	0.899***	_0.0438n.s	0.530 *	0.610 *	_0.132n.s	_0.756 **
Stigmaeidae	0.851***	_0.157 n.s	0.454 n.s	0.464 n.s	0.299 n.s	_0.877***
Max.T.	_0.802**	0.645 *	0.197 n.s	_0.897***	0.689*	0.327 n.s
Min.T.	_0.722**	0.796 **	0.338 n.s	_0.843***	0.774**	0.104 n.s
R.H%	0.689*	0.256 n.s	0.774**	0.442 n.s	_0.109n.s	_0.176 n.s

Table (5):-Correlation coefficient between predaceous mites ,temperature, relative humidity and phytophagous mite populations in Giza Governorate from Apr. 2012 till Mar. 2014

Correlation coefficient values (r)	First year			Second year		
	R. indica	*B. pheonicis*	Crawlers of Scale insect	*R. indica*	*B. pheonicis*	Crawlers of Scale insect
Phytoseiidae	0.836***	_0.826***	_0.335n.s	0.641*	0.333n.s	0.627*
Cheyletidae	0.919***	_0.759**	_0.091 n.s	0.932***	_0.127n.s	0.953***
Stigmaeidae	0.868***	_0.795***	0.056 n.s	0.741**	_0.128n.s	0.835***
Max.T.	_0.747**	0.687*	_0.212n.s	_0.527*	0.019n.s	_0.770**
Min.T.	_0.651*	0.576*	_0.364n.s	_0.039***	0.220n.s	0.954***
R.H%	0.439 n.s	_0.566*	_0.741**	0.229n.s	_0.068 n.s	0.422n.s

Table (6): Developmental durations in days± S.D. of *R.indica* when reared on three different temps and 60±5% R.H:

Temperature (º C)		Incubation Period	Duration			Life Cycle	Longevity	Life span
			Larva	Protonymph	Deutonymph			
15	♂	5.15 [a] ±0.29	4.58 [a] ±0.41	5.85 [a] ±0.	3.75 [a] ±0.44	19.33 [a] ±0.83	37.26 [a] ±1.48	56.59 [a] ±2.95
	♀	5.75 [a] ±0.46	6.95 [a] ±0.66	5.58 [a] ±0.57	4.43 [a] ±0.35	22.7 [a] ±0.95	42.38 [a] ±1.65	65.08 [a] ±3.55
20	♂	3.7 [b] ±0.26	4.23 [b] ±0.29	5.03 [b] ±0.25	3.5 [a] ±0.33	16.45 [b] ±0.54	30.4 [b] ±2.1	46.85 [b] ±1.18
	♀	4.63 [b] ±0.34	4.43 [b] ±0.57	5.28 [a] ±0.45	3.9 [b] ±0.34	18.03 [b] ±1.04	32.91 [c] ±1.43	50.94 [b] ±1.85
25	♂	3.3 [c] ±0.39	4.1 [b] ±0.28	3.4 [c] ±0.27	2.55 [b] ±0.31	13.33 [c] ±0.59	24 [c] ±2.67	37.33 [c] ±1.8
	♀	3.6 [c] ±0.31	4.4 [b] ±0.32	4.25 [b] ±0.42	2.75 [c] ±0.21	15 [c] ±0.68	29.9 [b] ±2.85	44.9 [c] ±2.38
Sig.		** *	** *	* **	* **	* **	* **	***

Means with different superscripts in the same row differ significantly (P < 0.05). ** = P<0.01, * =P < 0.05 and n.s= Not

Table (7): Effect of temperature on the red palm mite, *Raoiella indica* Pre-oviposition ,Oviposition and Post-oviposition periods

Different temps	Duration in days			No. of deposited eggs	
	Pre-oviposition	Oviposition	Post-oviposition	Fecundity	Daily rate
15± 2°C				96 [a] ±7.37	3.41±0.25
20± 2°C	6.13 [c] ±0.36	17.8 [b] ±1.14	8.98 [b] 8±0.32	76.9 [b] ±6.28	4.33±0.36
25± 2°C	3.8 [b] ±0.79	17.9 [b] ±1.66	8.1 [a] ±1.66	45 [c] ±6.32	1.49±2.48

Table(8):Life table parameters of *Raoiella indica* (Hirst) females at three different temperatures & 60 ±5 % R.H.

Parameters Prey species	15± 2°C	20± 2°C	25± 2°C
Mean generation time (T_c) [a]	32.3	23.71	20.95
Doubling time (DT) [a]	6.05	4.65	4.83
Net reproductive rate (R_o) [b]	40.55	34.96	20.29
Intrinsic rate of increase (r_m) [c]	0.115	0.149	0.144
Finite rate of increase (λ)	1.12	1.16	1.15
Gross reproduction rate (GRR)	56.61	49.3	32.31

[a] Days [b] per generation and [c] Individuals/female/ day

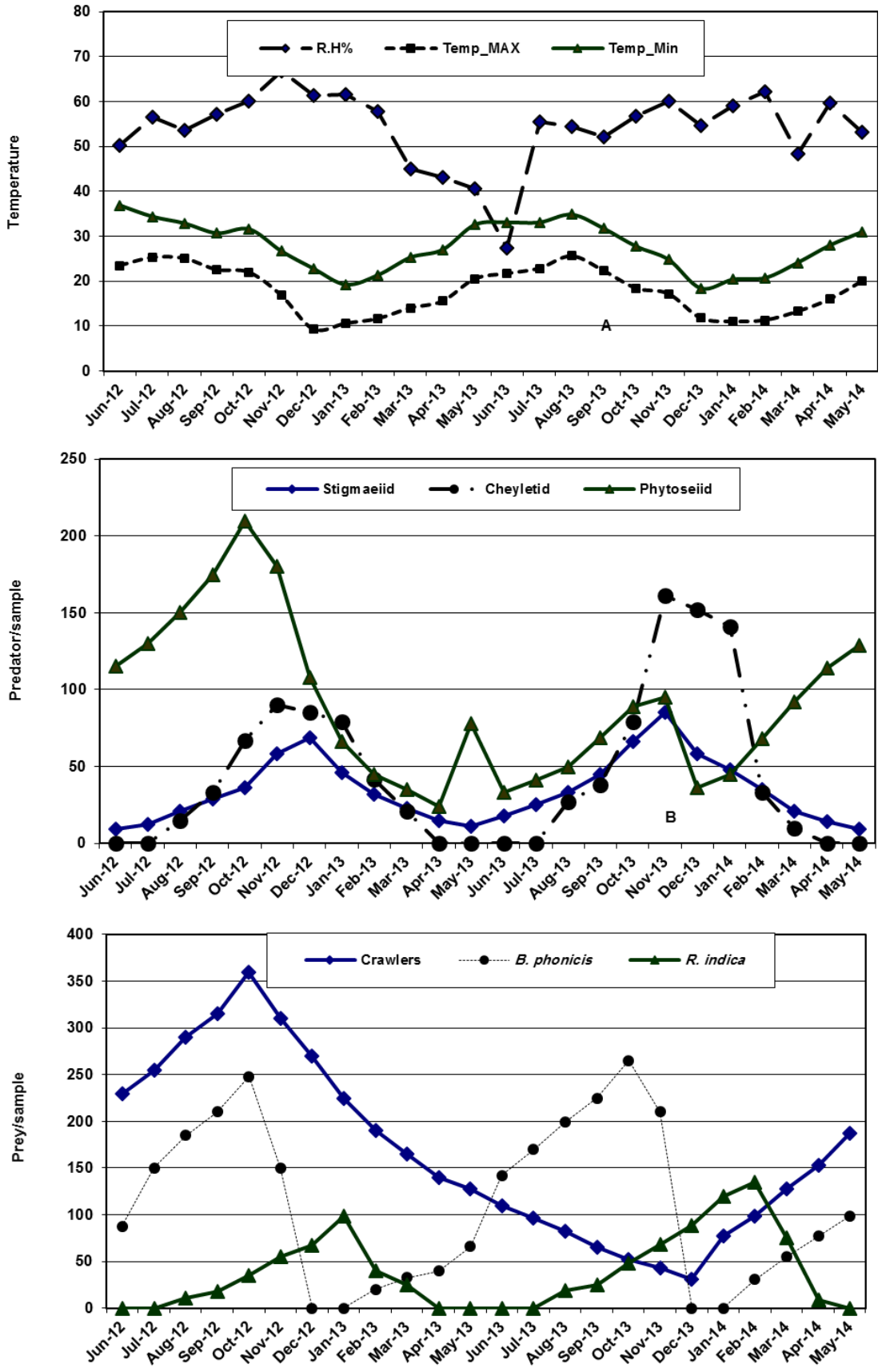

Fig. (1): (A,B,C):-Population dynamics of phytophagous mites and Predators associated with date palm leaves at Sharkia governorate during 2012-14.

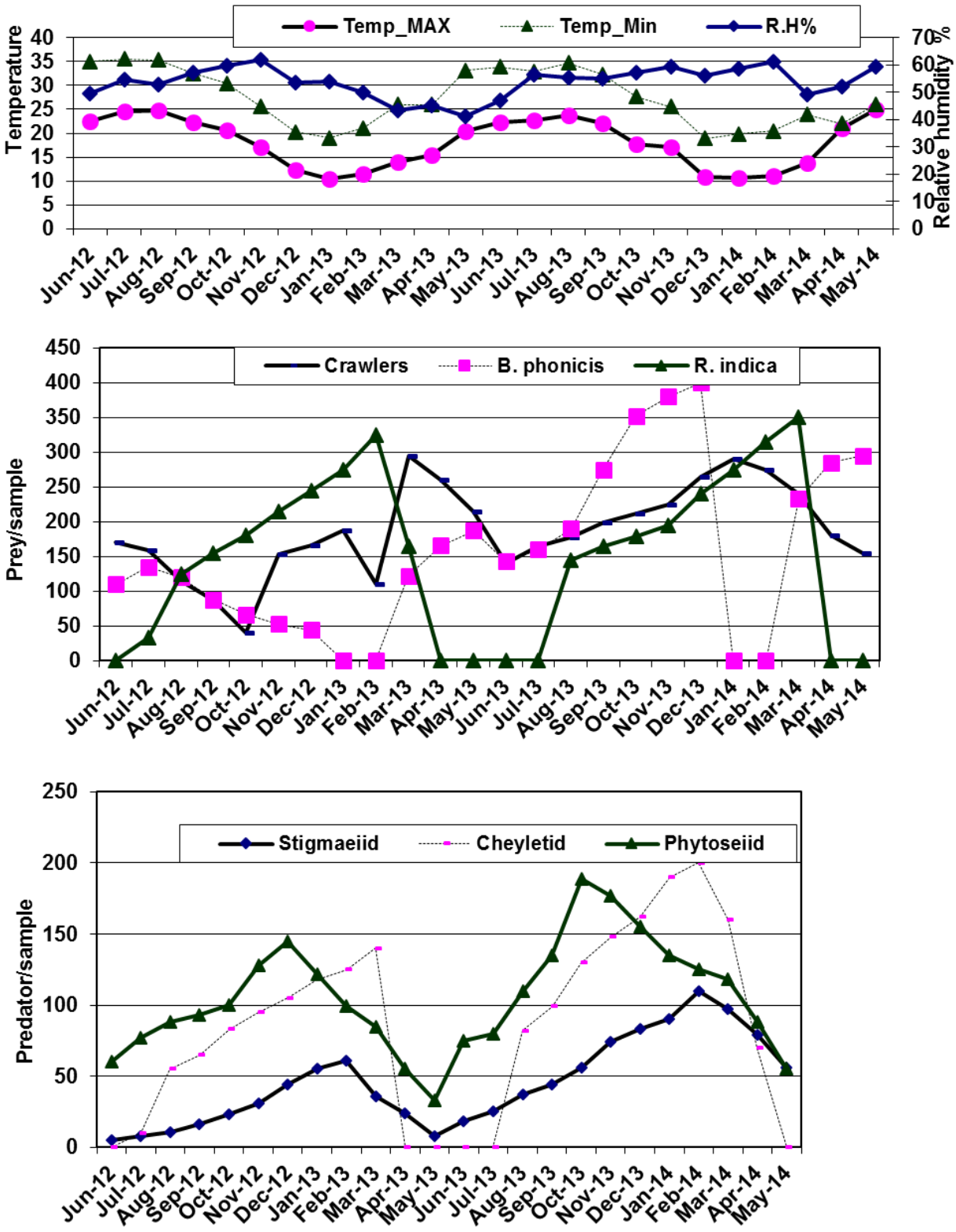

Fig. (2): (D,E&F):-Population dynamics of phytophagous mites and predators associated with date palm leaves at Giza governorate during 2012-14.

was found in high numbers in Giza.

***Hemicheyletia bakeri* (Ehara)** was found on leaves in low numbers at Sharkia.

***Eutogens africaus* (Wafaa & Soliman)** was found in low numbers on leaves at Giza &Sharkia.

(3) Miscellaneous mites

During this study, **eight** species belonging to **seven** genera in **six** families were recorded (**Table** 3)**.**

Family Tarsonemidae: ***Tarsonemus stiffer*** (Ewing), ***T. gladifer*** (Mahunka) and ***Stenotarsonemus spirifix* (**March**)** were recorded in high numbers from leaves and stored dates in different localities of date palm trees.

Family Tydidae Kramer: ***Orthotydeus californicus*** (Banks) was found in moderate number**s** on leaves in the two governorates.

FamilyAcaridae Leach: ***Tyrophagous putrescentiae*** (McGregor) was recorded in moderate number on leaves and soil in Sharkia.

Family-Glycyphagidae: only one female ***Blomia freemani* (Hughes)** was found on fallen date.

Family_Oppiidae & Orbatulidae: *Oppia sticta* (Popp) and *Zygoribtula* sp were found on fallen date in low numbers.

Twelve species of predatory mites in eight families have been reported in our research in association with *R. indica* and other phytophagous mites in the two governorates.

Similar results were obtained by, El-Halawany *et al*. (2001) who collected 16 species of mites belonging to 11 families and classified according to their feeding habits to 7 species plant feeders, 6 species predacious and 3 species of miscellaneous feeding habits. Sallam and Yassin (2005) found 36 different mite species belonging to 33 genera of 18 families associated with date palm at El-Wahat El-Baharia Oasis, Egypt.

Carrillio *et al*. (2012) reported sixteen predacious mite species belonging to six families in two orders in association with *R. indica*. AL-Jboory and Saleh (2001) surveyed mites living on date palm trees in Iraq during 2000 and 2001, revealed that 26 mite families containing 34 genera were collected. Majidi and Akrami (2013) surveyed mites inhabiting date palms (soil, leaves, fruits and trunk fibers) during 2009–2011and found 56 species belonging to 47 genera and 34 families.

II-Population Dynamics

Population dynamics of different mites associated with leaves of date-palm at Sharkia and Giza governorates during 2012 and 2013 years are illustrated in Figs.(1 & 2). Correlation between population densities of studied mites and weather factors at both governorates over the two years of study are presented in Tables (4 & 5).

1-Sharkia location: An increase in phytoseiid predator density was observed when population of crawlers of the scale insect *Parlatoria blanchardii* (Targ.) and *Brevipalpus phoenicis* (Geijskes) increased (r= 0.873***& 0.921***). Numbers of cheyletids and stigmaeids increased when *R. indica* populations increased especially with effect of temperature during the first year of study.

Statistical analysis results of *Raoiella indica* (Hirst) revealed high significant correlation between *R. indica* and each of cheyletid and stigmaeid mites (r = 0.899***&0.851***), while highly negative significant correlation with maximum and minimum températures (r= -0.802**** & -0.722****) and (-0.897***** &-0.843*****)** with population density of *R. indica* during the two successive years. However, relative humidity had positive correlation with mite population. The phytoseiid mites have non significant correlation affected on *R. indica* during the two successive years. While the cheyletid and stigmaeid mites had possitive affected on *R. indica* in the first year, while in the second year the stigmaeid mite non-significant positive affected on the *R. indica*.

Statistical analysis results of *B. phoenicis* and crawlers of scale insect:-

The tenuipalpid mite *B. phoenicis* population was significant positively correlated with temperature during the two successive years, but non-significant correlation between density of tenuipalpid mite and relative humidity, in the first year it was positive and in the second year it was negative.

The crawlers of scale insect, population had non-significant positive correlated with temperature during the two successive years, while highly positive correlation between density of *P. blanchardii* and relative humidity in the first year and non-significant negative correlated with population in the second year.

The phytoseiid mites seemed to be an important predators to suppress the population density of *B. phoenicis* and scale insect population. However the cheyletid mites affected on ,*R. indica* population during the two successive years (0.899*** & 0.610*), respectively.

2-Giza location:

An increase in cheyletid predator density was observed following decrease in the *R. indica* then numbers of cheyletid predators were still consistently low. Starting in April, there is normally a decline in

populations, which continues through July Cheyletids appeared in the same months from August till march with high numbers and the stigmaeid mites also occurred with high fluctuation densities that's gave importance for using predatory mites to control phytophagous mites. Several predators were found on the leaflets of date-palm preying on phytophagous mites. This agrees with, Mesbah and Omar (2014) showed high ability of the cheyletid mite, *Cheletogens ornatus* to suppress eggs and immature of *R.indica* populations on date palms. and Carrillio *et al*(2012) who reviwed all phytoseiid predators that can manage *R. indica* and observed *Hemicheyletia bakeri* Ehara feeding upon all stages of *R. indica* in Iran.

B-(I)-Statistical analysis of ***R.indica*** **results:-**

The correlation coefficient showed high significance between *R. indica* and the cheyletid predators (r=0.919*** & 0.932*) during first and second years, respectively. It showed also high significant correlation between each of phytoseiid &stigmaid predators (0.836 & 0.868), respectively in the first year.

On the other hand, statistical analysis of *B. phoenicis* (Geijskes) results showed negative high siginificant correlation with stigmaeid; phytoseiid & cheyletid mites (r=-0.795***; -0.826*** &-0.759**) and very low significant differences with minimum temperature.

Also, statistical analysis of scale insect, *P. blanchardii* there were negative nonsignificant difference between predators and scale insect during first year while in the second year it showed high significant difference between cheyletid (0.953***) and stigmaid (0.835***) predators.

Obtained results are in agreement with Taylor *et al*. (2011) and Vásquez and Moraes (2013) whom studied the seasonal fluctuation of the population of *R. indica* and associated mite species with reference to weather parameters and predator mites.

R. indica are generally abundant on date palm leaves from Aug. to Feb. Starting Mar., there is normally decline in populations, which continues through July. The lower leaves had high infestations ranging from 150-350 individuals. population of *R. indica* increased in Giza governorate was from 100-350 individual than in Sharkia Governorate (20-135) individual and in the second year than in first year of study. All of these results agree with finding of Pena *et al*., (2006) and Kane and Ochoa (2006).

Etienne and Fletchmann (2006) found *R. indica* infesting palms and Welbourn (2006) indicates that, *R. indica* dispersed by wind currents and transport of infested plants or leaves.

III-Biological studies

The present study was conducted to evaluate the effect of constant temperature on *R. indica* developmental life stages in days, life cycle, adult longevity, female fecundity and life-span.

Because of the importance of the date fruits as one of the "main crops in Egypt, it was found necessary to throw light on the biology of acarine pests before carrying out any control program, Zaher *et al.*, 1969; who carried out biological studies on the red palm, *R. indica* infesting date palm trees.

Incubation period:- Egg incubation period of *R.indica* was 3.6 days at 25**°C** while it were (5.75 &4.63) days at 15&20**°C**,respectively ; Table, 6.

Life cycle:-The mean developmental period from egg to adult (life cycle) was significantly influenced by temperature, RH and host plant.Female life cycle were (22.7; 18.03 & 15) days while male life cycle were (19.33; 16.45 & 13.33) days, at 15, 20, 25°C, respectively.

Therefore, the earlier results showed that the developmental time of *R. indica* was significantly affected by different temperature and lasted (65.08, 50.94; 44.9) days and (56.59, 46.85; 37.33) days during its life span, for females and males, respectively.

Therefore, feeding at 15±2°C significantly prolonged predator longevity (42.38 & 37.26 days), for females& males, respectively and caused a higher rate of fertility averaged (96 egg) through an average oviposition period of 28 day.

Pre-oviposition period averaged 6.6 days in winter at 15 °C and 6.13 days at 20° C and 3.8 days at 25° C in summer seasons. This agreed with, Jepson *et al*., 1975, who noticed that preoviposition period was 3 days in summer and 7 days during winter.

Pena *et al.,* (2006) studied the biology of *R. indica* at temperatures between 24-26°C and 60% RH, females completed their development in 24.5 days and males in 20.6 days; adult longevity was 50.9 days for females and 21.6 days for males. Fertilized females produced an average of 22 eggs and virgin females 18.4 eggs. Females lay an average of 2 eggs per day over an average oviposition period of 27 days for a total of about 50 eggs per female. The time for development of each life stage is: egg, 6.1-6.5 days; larva, 5.7-9.5 days; protonymph, 5.4-6.5 days; and deutonymph 4.1-10.5 days. The time required to

complete the life cycle is 21-33 days.

Galano *et al.* (2010) studied the development and reproduction of *R. indica* on *Areca catechu* under laboratory conditions at 25,42 ± 1,21°C and 57,54 ± 6,54% R.H. The experimental units were leaf discs of *A. catechu* in Petri dishes (10.5 cm diameter) with water-saturated cotton. Gravid females were transferred to experimental unit and allowed to lay eggs for five hours. The duration of each life cycle stages were registered. The larvae that emerged were transferred to individual arenas and observed until adult appearance. The average duration of the life cycle was 31 days. The egg stage was the longest, while that of protonymphs was the shortest. The preoviposition period averaged 4 days, while the oviposition period can last 17 days, with an average of 11 days and a female longevity of 30 days. Sex ratio was 56% females. The mortality of immature stages was: 14,6% for larvae; 7,3% for protonymphs, and 17,1% for deutonymphs, with 39% total mortality.

In order to develop an efficient method to rear the Red Palm Mite in quarantine for a classical biological control project, several banana and plantain varieties were tested as hosts for the RPM. Bananas are more desirable than coconut (a favored host plant) because bananas are easier to rear in small cages and will produce new shoots quickly after pruning, Cocco and Hoy (2009).

IIII-Life table parameters

The mean generation time (T) of *R. indica* was significantly affected by temperature (Table 8). Its life table parameters were as follow, (T as 32.31; 23.71 and 20.95 days); net reproductive rate (R_o) (40.55; 34.96 and 20.29) per generation; intrinsic rate of natural increase (r_m as 0.115 ; 0.149 and 0.144); finite rate of increase(λ) averaged (1.12 , 1.16 and 1.15) and gross reproductive rate (GRR) (57.29; 49.3 and 32.56) and doubling time (DT) values (6.05 ; 4.65 and 4.83) days when females reared on different temps (Table 8), respectively.

It can be concluded that no single factor is responsible for phytophagous mite population but all the factors work in compliment with each other. Therefore, it is suggested that climatic weather factors with predator mites should be considered before using any way of IPM-Programs for harmful pests.

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