LIFE HISTORY OF PREDATORY MITE *PULAEUS MARTINI* (DEN HEYER), (ACARI: PROSTIGMATA: CUNAXIDAE) FED ON DIFFERENT DIETS

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Abstract

This work aimed to study different biological aspects of the predatory mite, *Pulaeus martini* (Den Heyer) when fed on different diets mainly free living nematode, *Rhabditella muscicola* Chitwood and two different fungi (*Fusarium oxysporum* Schlechtendahl and *Pythium spinosum* Sawada at 20, 25, 30 and 35 $\pm$ 2 °C and relative humidity 75$\pm$5% R.H. in laboratory. Obtained data indicated that the different biological aspects of *P. martini* was significantly affected by different mentioned diets and temperatures. The male lasted shorter time than female in different periods. The life periods of individuals increased as well as temperature increased from 20 up to 35 ºC. The lowest period of life cycle recorded when the male fed on free living nematode (10.89 days) at 35 ºC, while it elongate to (23.89 days) was male reared on *F. oxysporum* at 20 ºC. Female longevity recorded the longest period when it fed on *F. oxysporum* at 20 ºC (37.21 days) while the shortest longevity period recorder at 35 ºC. (12.16 days). On the other hand the free living nematode elongated the life span time for predatory mite females at 20 ºC it lasted 62.48 days, but the shortest time was recorded when female individuals fed on *F. oxysporum* at 35 ºC (37.89 days). From the obtained results also, it was noticed that the best diet for rearing the cunaxid mite *P. martini* was *F. oxysporum* at 25 ºC where it recorded the highest number of deposited eggs (73.79) but the least favorable one for feeding was the fungus *P. spinosum* at 35 ºC (48.71 eggs).

Key words: Cunaxid mite -*Pulaeus martini* - development- diets- temperatures

INTRODUCTION

Mites belonging to the family Cunaxidae are well known predators of other harmful mites and small soft bodied insects, Smiley (1992). Very little is known about the biology of the *Pulaeus* Den Heyer species. Walter & Kaplan (1991) reported them feeding on larvae of rootknot nematodes (*Meloidogyne* spp.). Schruft (1971) reported that Cunaxoides *oliveri* is a predator of grape wine mite *Clepitrimerus vitus.* Walter and Kaplan (1991) found *Coleoscirus simplex* colonizes greenhouse pot cultures of root knot nematodes (*Meloidogyne* spp.) in Florida where it feeds on vermiform nematodes and other soil arthropods. They also studied the feeding behavior of Cunaxidae. Arbabi *et al*., (2002) reported the family Cunaxidae as in important predatory family from Sistan Baluchestan and Hormozgan provinces of Iran. Tagore and Putatunda (2003) reported that cunaxid mites were important predators in the ornamental plants in Haryana. De-Oliveira and Daemmon (2003) found that cunaxid mites are important component of fauna in the dust samples from the rural dwellings of Zona da Mata region Brazil. Very little is known about the biology of the genus *Pulaeus* Den Heyer. Walter and Kaplan (1991) reported them feeding on larvae of rootknot nematodes (*Meloidogyne* spp.). About 26 species of *Pulaeus* Den Heyer are known all over the world., De Castro and Den Heyer (2004).In the presence of more than two prey species, a generalist predator should select the one that assures higher fitness, Charnov (1976). Therefore, the prey preference of a predator may be affected not only by characteristics of a prey item as food, but also by the microenvironment or architecture produced by a prey species (Furuichi *et al.,* 2005). This is the report of *Pulaeus* biology in Egypt, where very little is known about its diversity and behavior. The life cycles of only 6 of the nearly 260 described Cunaxid species have been studied (Schruft 1971, Zaher *et al.*, 1975, Taha *et al.*, 1988, Walter and Kaplan 1991, Sathiamma 1995, Arbabi and Singh 2000, Tatiane *et al.*, 2010. These studies have shown the ability of cunaxids to prey upon mites of the Tetranychoidea and Eriophyoidea, as well as other small arthropods and nematodes. Therefore, the present work was undertaken to introduce a detail study on the biological aspects of the cunaxid mite, *Pulaeus martini* (Den Heyer) when fed on different diets, free living nematode, *Rhabditella muscicola* Chitwood and two different fungi (*Fusarium oxysporum* Schlechtendahl and *Pythium spinosum* Sawada) under laboratory conditions.

MATERIALS AND METHODS

The cunaxid mite, *Pulaeus martini* was extracted from soil under maize and cotton plants in El-Menofia Governorate. Three adults female and males of the mite were placed in screening cells (2.5 cm in diameter), with a layer of mixture of Plaster of Paris and Charcoal (9:1) on its bottom to depth 5 mm and covered with slide cover and binded by robber band. The cells were supplied with food and kept at 25 ºC and about 75±5% R.H. Water drops were added when needed. For individual unit rearing, newly deposited eggs were transferred each to a rearing plastic cell. Each newly hatched larva was supplied with different tested food free living nematode, *Rhabditella muscicola* Chitwood and two different fungi (*Fusarium oxysporum* Schlechtendahl and *Pythium spinosum* Sawada rent fungi (*Fusarium oxysporum* and *Pythium spinosum* and consumed food was replaced every 2-3 days interval with another new one till reaching maturity stage. The stock of the three different diets already obtained from Plant Pathology Research Institute, Agricultural Research Center under laboratory conditions were conducted at 20, 25, 35 and 35 ºC and relative humidity 75 % R.H. All obtained data are presented as means $\pm$ S.D.of twenty replicates and all observation recorded by helping stereomicroscope. The obtained data were subjected to one-way analysis of variance (ANOVA) and means were separated by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Behavior: Life history of females and males of *Pulaeus martini* pass through one larval and three nymphal stages (protonymph, deutonymph, tritonymph) before reaching adulthood. Active immature individuals usually enters a resting or quiescent stage before entrance the following stage.

Mating: Laboratory observations showed that adults tended to mate immediately after their emergence. The male is able to copulate more than one female, but the females accepted one copulation. Just before mating, the male showed more activity by running around the female, and then it manipulated itself underneath the female, bending its opithosomal region upward and forward to meet that of female, usually lasted about 5-7 minutes

Oviposition : Females of *Pulaeus martini* usually deposited its eggs singly after preoviposition period between 2.48-5.98 days. Newly laid eggs were creamy in color.

Hatching: As incubation proceeds, the embryo grows and limits itself to any of the egg sides, then a longitudinal slit occurs medially and hatching larvae crawls outside the egg shell.

Moulting: During this study, it was noticed that before moulting, each immature stage of the cunaxid mite, *Pulaeus martini* enters into a quiescent stage during which, the mite stop feeding and moving. The individuals stretch their chelicera, palps backwardly along the sides of the body. Immediately before moulting a dorsal transverse rupture occurs between the propodosoma and hysterosoma. The mite tries to disengage itself from the old skin by twisting movements and subsequently withdraws the forelegs and the anterior part of the body outside. Afterwards, the mite crawl forwardly trying to get ride of the posterior part of the exuvia. Color of the newly emerged larva is usually orange, then changes gradually darker after feeding.

Incubation period: The tabulated data in Table (1) indicated that the different temperatures and tested diets had significant affected on the incubation period of the cunaxid mite, *P. martini.* It was found that this period took (5.97, 5.87 & 5.81), (4.88, 4.96 & 491), (3.87, 3.94 & 3.80), (2.99, 2.87 & 2.84) days when the mite males fed on free living nematode, *Fusarium oxysporum* and *Pythium spinosum* at 20, 25, 30 and 35 ºC, respectively. However, this period in case of females lasted (5.98, 5.94 & 5.8), (4.84, 4.96 & 4.92), (3.76, 3.88 & 3.76), (3.13, 3.34 & 3.27) days at the same conditions, respectively. From the same table, it was observed that there was highly significant differences between the different mites fed on different diets at different temperatures, L.S.D. at 0.05 level = 0.059 & 0.0789 and 0.018 & 0.02 for both temperature and diet effects for males and females, respectively.

Life cycle: The influence of different diets on *P. martini* life cycle can be summarized in Table (1) which revealed that the mean duration periods were shorter in case of male individuals then those of female individual where recorded (23.44, 23.84 & 23.34), (18.33, 17.97 & 18.62), (15.15, 15.21 & 15.69), (10.89, 10.94 & 10.95) days when the males fed on the above mentioned diets at 20, 25, 30 and 35 ºC, respectively. On the other hand the females lasted (26.94, 26.96 & 26.6), (24.61, 24.5 & 24.06), (19.17, 19.52 & 19.35), and (15.12, 15.7 & 15.06) days when fed on the same previously diets at the same laboratory conditions. The statistical analysis of current data revealed that there were very highly significant differences between the mite individuals when fed on the tested diets at the different temperatures, L.S.D. at 0.05 level = 0.056 and 0.052 for effect of diets and temperatures, in case of males, respectively and 1.59 and 0.176 in case of females individuals, respectively.

Longevity: As shown in Table (1), females and males longevity was maximal at 20 ºC and reduced at higher temperature. During this period, female lived longer at 20 ºC (37.21 days) on *F. oxysporum* than at 35 ºC (26.11 days) when it fed on *P. spinosum*. The longest period of male individuals was (29.2 days) when mites reared on *P. spinosum* at 20 ºC, and shorted to reached (16.6 days) at 35 ºC when fed on the same fungus. These results showed that the higher temperature decreased the *P. martini* longevity. The statistical analysis of obtained data in Table (1) showed that there were highly significant differences between individuals fed on different diets at different temperatures. L.S. D. at 0.05 level for male individuals was 0.197 and 0.222 for effect of temperatures and diets, respectively but recorded 0.248 and 0.282 for male individuals, respectively.

Preoviposition, oviposition and postoviposition periods: A general glance to the data in Table (2), revealed that *F. oxysporum* was the most favorable food for the mite, *P. martini* where it increased the oviposition period at 20 ºC (27.4 days), but the least favorable diet was recorded for the same fungus at 35 ºC (15.3 days).Female oviposition period elongated as well as temperature increased. However, it clear that preoviposition and oviposition periods were slightly affected with different diets at the tested temperatures.The preoviposition period lasted the longest period (4.86 days) when female fed on *F. oxysporum* at 20 ºC and decreased when it fed on the same diet at 35 ºC (2.55 days). Also, the postoviposition period had the same trend of preoviposition period where durated 4.86 days on *F. oxysporum* at 20 ºC and 3.31 days at 35 ºC on the same diet, Table (2).

Fecundity: As shown in Table (2), females didn't make any attempts to protect its eggs. Under the conditions used in this experiment, the number of *P. martini* eggs differed depending on whether the mites fed on any of the tested diets, Table (2). As shown by the obtained data the female deposited the highest number of eggs (74.0) at 25 ºC. On the other hand, the lowest number of deposited eggs was recorded at 35 ºC (50.30 eggs) on free living nematode. Statistical analysis of data showed that L.S.D. at 0.05 level = 0.487 and 0.548 for effect of temperature and diet, respectively. This result demonstrated that 25 ºC. was the most favorable temperature for rearing the cunaxid mite, *P. martina* and these results were coincident with those obtained by El-Khateeb (1998), where she mentioned that low temperature decreased female fecundity of the cunaxid mite, *Cunaxa setirostris* (Hermann).Also, Khalil *et al.*, (2009) reared the cunaxid mite, *Coleoscirus baptos* on different fungi and mentioned that 25 ºC was the most favorable temperature for rearing this mite where it deposited 95.6 eggs when fed on *Aspergillus niger*. The same results were observed but on different cunaxid species by Ghallab (2002) where she studied the biological aspects of three cunaxid species, *Coleoscirus simplex* (Ewing), *C. tuberculatus* Den Heyer and *Pulaeus subterraneus* Berlese when reared on the free living nematode, *Rhabditella muscicola* Chitwood under laboratory conditions at 27$\pm$ 1 ºC and 75-80 % R.H.The author mentioned that female life cycle was longer than male being 12.8, 13.1 and 15.6 days, while those of male were 12, 11.7 and 13.4 days, respectively. The coleoscirine cunaxid mite *C. simplex* colonizes greenhouse pot cultures of rootknot nematodes (*Meloidogyne* spp.) in Orlando, Florida, where it preyed on vermiform nematodes and soil arthropods, Walter and Kaplan (1991). This was the first report of nematophagy in a cunaxid mite. The authors added that the cunaxid mite *Pulaeus* sp. also fed on both arthropods and nematodes, but three species in the Cunaxidinae, *Dactyloscirus inermis*, *Dactyloscirus* sp. And *Cunaxa* sp. Fed only on arthropods. Also, Yassin (2006) investigated the effect of three diets mainly Collembola (*Neanurodes* sp.), free living nematode, *R. muscicola* and acarid mite, *Tyrophagus putrescentiae* (Schrank) on the biological aspects of the cunaxid mite, *Cunaxa capreolus* Berlese. He reported that Collembola proved to be the suitable prey where as female deposited high number of eggs and longer life span and this might be due to the collembolan contained the highest total sugar and higher relative concentration of glucose contents.

Table 1. Effect of different diets on the biological aspects of the predacous mite *Pulaeus martini* at different temperatures.

Biological aspect		20 °C			25 °C			30 °C			35 °C			L.S.D. at 0.05 level	
		A	B	C	A	B	C	A	B	C	A	B	C	Temp.	Diet
Incubation period	♂	5.97±0.05	5.87+0.04	5.81+0.07	4.88+0.05	4.96+0.04	4.91±0.05	3.87±0.03	3.94±0.03	3.80±0.02	2.99±0.02	2.87±0.02	2.84±0.03	0.059	0.078
	♀	5.98±0.20	5.94±0.14	5.8±0.2	4.84±0.1	4.96±0.11	4.92±0.1	3.76±0.12	3.88±0.13	3.76±0.1	3.13±0.1	3.34±0.1	3.27±0.12	0.018	0.020
Life cycle	♂	23.44±0.7	23.84±0.2	23.34±0.1	18.33±0.2	17.97±0.7	18.62±0.5	15.15±0.17	15.21±0.14	15.69+0.16	10.89±0.24	10.94±0.16	10.95±0.05	0.056	0.052
	♀	26.94±0.3	26.96±0.3	26.6±0.24	24.61±0.5	24.5±0.14	24.06±0.2	19.17±0.11	19.52±0.14	19.35±0.12	15.12±0.2	15.7±0.13	15.06±0.06	0.159	0.176
Longevity	♂	27.10±0.84	25.4±0.97	29.2±0.67	24.2±0.11	22.3+0.15	25.4+0.17	20.4±0.55	21.7+0.34	19.2±0.97	17.50±0.5	15.53±0.48	16.6+0.52	0.197	0.222
	♀	35.53±1.12	37.21±0.97	34.22±1.1	32.8±0.94	29.36±0.79	32.1±0.96	27.65±0.77	28.21±0.83	26.11±0.75	23.5±0.9	21.16±0.82	22.83±0.95	0.248	0.282
Life span	♂	50.54±0.77	49.24±0.6	52.54±1.0	42.53+0.6	40.24±0.75	44.02±0.7	35.55±0.39	36.91±0.56	34.89±0.84	28.39±0.84	26.44±0.68	27.55±0.63	0224	0251
	♀	62.48±1.31	61.1±1.27	60.82±1.1	57.41±1.2	53.86±0.96	56.±0.87	46.82±0.81	47.73±0.84	45.46±1.12	38.62±1.17	36.86±0.91	37.89±0.96	0.278	0.310

A= free living nematode B= *Fusarium oxysporum* C= *Pythium spinosum*

Table 2. Effect of different diets on the longevity and fecundity of the predacous mite *Pulaeus martini* female at different temperatures

Biological aspect	20 °C			25 °C			30 °C			35 °C			L.S.D. at 0.05 level	
	A	B	C	A	B	C	A	B	C	A	B	C	Temp.	Diet
Preoviposition period	4.78±0.20	4.86±0.2	4.77±0.14	4.20±0.1	4.36±0.12	4.44±0.2	3.96±0.24	3.84±0.16	3.75±0.15	2.60±0.2	2.55±0.27	2.73±0.33	0.074	0.079
Oviposition period	25.6±1.87	27.4±0.9	24.9±0.94	22.3±0.8	20.9±0.76	23.7±0.8	19.7±0.84	20.6±0.86	18.4±0.79	17.5±0.6	15.3±0.58	16.6±0.6	0.207	0.232
Postoviposition period	5.14±0.96	4.86±0.9	4.55±0.83	4.30±0.1	4.10±0.19	4.0±0.2	3.99±0.24	3.77±0.27	3.96±0.25	3.4±0.3	3.31±0.25	3.5±0.3	0.164	0.179
Fecundity	55.8±1.97	56.7±1.22	56.40±1.1	73.2±1.5	73.79±1.6	74.0±1.4	66.1±1.14	67.33±1.13	66.7±1.32	50.30±1.5	52.14±1.8	48.71±1.6	0.487	0.548

A= free living nematode B= *Fusarium oxysporum* C= *Pythium spinosum*

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دورة حياة الاكاروس المفترس ***Pulaeus martini*** **(Den Heyer) (Acari: Prostigmata :Cunaxidae)** عند التغذية على أغذية مختلفة

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تهدف هذه الدراسة الى التعرف على المظاهر البيولوجية المختلفة للاكاروس *Pulaeus martini* المنتمى لعائلة Cunaxidae وذلك عند تغذيته على أنواع غذائية مختلفة وهى النيماتودا الحرة المعيشة *Rhabditella muscicola* ونوعين من الفطريات هما *Fusarium oxysporum* و *Pithium spinosum* وذلك عند درجات حرارة 20 و 25 و 30 و 35 م° ورطوبة نسبية 75 %. حيث دلت النتائج المتحصل عليها أن المظاهر البيولوجية لهذا الاكاروس قد تأثرت بصورة معنوية بنوع الغذاء ودرجة الحرارة. ولقد وجد أن الذكور اقل من الإناث في مراحل التطور وان درجة الحرارة 20 م° ذادت بشكل معنوي وواضح فى مدة حياة الأفراد مقارنة بدرجة الحرارة 35م° والتى قللت من طول هذه الفترات. ولقد استغرقت فترة دورة الحياة Life cycle للاكاروس فترة مقدارها 10.89 يوما عند تغذية الأفراد على النيماتودا الحرة المعيشة عند درجة الحرارة 35 م° بينما طالت هذه الفترة مسجلة زمنا مقداره 26.96 يوما عند تغذية الإناث على الفطر *F. oxysporum* عند 20 م°. من ناحية أخرى فقد سجلت أعلى فترة حياة للأفراد البالغة Longevity للإناث عند تغذيتها على الفطر *F. oxysporum* عند 20 م° (37.21 يوما) بينما قلت هذه الفترة ووصلت لأقل معدل لها مسجلة زمنا مقداره 21.6 يوما عند تغذية الأفراد الذكور على نفس الفطر ولكن عند 35 م° . ومن ناحية أخرى أثرت النيماتودا الحرة المعيشة على طول الفترة الكلية للأفراد Life span للإناث عند 20 م° حيث استغرقت هذه المدة أعلى زمنا ومقداره 62.48 يوما ولكن اقل فترة سجلت للأفراد الذكور عند تغذيتها على الفطر *F. Oxysporum* عند 35 م °مسجلة (26.44 يوما). ومن النتائج المتحصل عليها فى هذه الدراسة أيضا أتضح أن أفضل غذاء لتغذية هذا الاكاروس هو الفطر *F. oxysporum* عند 25 م° حيث وضعت الأفراد الإناث عددا مقدراه 73.79 بيضة مقارنة بالفطر *P. spinosum* والذى قلل من عدد البيض الموضوع حيث سجل 48.71 بيضة وذلك عند 35 م°.