Effect of Different Prey Mites on the Biological Aspects and Life Table Parameters of the Cunaxid Mite, *Cunaxa setirostris* (Hermann) (Cunaxidae)

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ABSTRACT

The effect of different preys on the biology, consumption rate and life table parameters of the predator, *Cunaxa setirostris* (Hermann) was investigated at 22±2°C and 75±5% R.H. *C. setirostris* was able to feed and complete its development on the three mite species *Tetranychus urticae* Kock, *Tydeus californicus* (Banks) and *Eutetranychus africanus* (Tucker). Predator female recorded the longest and the shortest life cycle, with larva and three nymphal stages within 31.5 and 23.9 days, when fed on *E. africanus* and *T. californicus*, respectively. The generation period ranged from 26.6 to 34.7 days when fed on *T. californicus* and *E. orientalis*, respectively. Its fecundity averaged of 52 and 18 eggs when fed on *T. urticae* and *E. orientalis*, respectively. The mean generation time (T) was (42.62, 38.62 and 48.54); the doubling time (DT) was (7.49, 7.42 and 4.31); the intrinsic rate of natural increase (r_m) and finite rate of increase (λ) were (0.09, 0.093 and 0.16) and (1.07, 1.08 and 1.04), respectively; while the net reproductive rate (R_o) was (24.35, 17.55 and 8.1); and gross reproductive rate (GRR) was (27.58, 22.01and 24.5) for *C. siterostris* fed on *T. urticae*, *T. californicus* and *E. orientalis,* respectively.

Key Words: *Cunaxa setirostris*, Biological aspects, Life table parameters.

INTRODUCTION

The family Cunaxidae was erected by Thor, (1902) as free living predatory mites that capture their prey with silk traps (Alberti and Ehrnsberger, 1977; Sergeyenko, 2009). Walter & Kaplan, 1991 reported that cunaxid mites were recorded in both tropical and arctic regions, feeding on harmful mites, nematodes and small arthropods, although some species occasionally consume honeydew (Smiley, 1992; Gerson *et al*., 2003; Zhang, 2003; Bashir, *et al*., 2010).

Cunaxa is the largest genus of this family, comprising over 50 known species (Bashir, *et al*., 2011). Very little is known about the biology of cunaxids as the life cycle of only seven of nearly 260 described cunaxid species have been studied (Castro & Moraes, 2010).

In Florida, Walter & Proctor (1999) studied the feeding behavior of Cunaxidae, fed on nematodes and other soil arthropods. In India, Tagore and Putatunda (2003) reported that cunaxid mites were important predators in ornamental plants. Arbabi and Singh (2000) studied the biological aspects of *Cunaxa setirostris* fed on *Tetranychus ludeni*.

In Egypt, Soliman, *et al.* (1975) and Zaher, *et al*. (1975) studied the feeding habits and biology of the predaceous mite, *Cunaxa capreolus* Berlese on booklice (Psocoptera) and *Eutetranychus orientalis* (Klein).

Therefore, the present study aims to add highlight on the biological aspects and life table parameters of the cunaxid, *C. setirostris* fed on different preys under laboratory conditions.

MATERIALS AND METHODS

Predatory mite rearing:

Pure culture of *C. setirostris* was collected from mango leaves in Abou- Hammad, Sharqia governorate, Egypt. It was mass cultured on castor leaves, *Ricinus communis* infested with *T. urticae* as prey under laboratory conditions 22±2°C and 75±5% RH.

The predator was reared singly in small hemispherical plastic cells of 1/2 inch in diameter and 1/4 inch in depth. Mixture of plaster of Paris, clay and charcoal (5:4:1) was placed on the bottom at 3 mm depth and the top of each cell was covered with a small glass slide. Suitable moisture was maintained by adding 3 drops of water in every cell daily. The study was initiated with eggs of the predator (12 hs old) obtained in the laboratory. Eggs were carefully transferred singly to experimental units. Fifteen replicates were used for each prey species. Prey mites *Tetranychus urticae* Koch, *Tydius californicus* (Banks) and *Eutetranychus africanus* (Tucker), were daily obtained from leaves of castor plants, mango and neem trees to feed *C. setirostris*. The units were kept at laboratory conditions, 22±2ºC and 75±5 R.H. and examined daily. Surplus known numbers of the preys were introduced to each predator and the devoured ones were daily replaced by others.

Statistical analysis:

The results were statistically analyzed by using the analysis of variance according to Sendecor and

Cochron (1982) using the computer program SPSs (1997). The life table parameters: the intrinsic rate of natural increase (r_m), net reproductive rate (R_o), mean generation time (T), doubling time (DT), gross reproduction rate (GRR) and finite rate of increase (λ) were estimated according to Birch (1948) using the GW Basic computer program of Abou –Setta, *et al.* (1986).

RESULTS AND DISCUSSION

The cunaxid mite, *C. setirostris* successfully developed when reared on the three prey species. The female passes through egg, larva, three nymphal stages and adult. Each moving stage is preceded by a quiescent one**.**

Effect of prey type on the developmental stages of the predator:

Investigation showed that the prey type had a highly significant effect on the biological aspects of the predator, *C. setirostris*. The mean durations of the different stages of the female predator are shown in tables 1 and 2.

The incubation period was the longest stage. It averaged between 7.8 to 9.1 days when fed on nymphs of *T. californicus* and *T. urticae*, respectively.

Female larval, protonymphal, deutonymphal and tritonymphal stages averaged (4.2, 3.9, 3.7 & 4.1), (6.6, 5.2, 4.8 & 6.9) and (6.1, 4.8, 3.8 & 5.7) days when fed on nymphs of *T. californicus*, *E. africanus* and *T. urticae*, respectively.

The life cycle and the generation period were the longest (31.5&34.7 days) when fed on *E. africanus*; and the shortest (23.9&26.6 days) when fed on *T. californicus*, respectively (Table 1).

The maximum amount of feeding occurred during ovipositional period (34 days) with an average fecundity of 73±2.11 eggs/ female when fed on *T. urticae*, with an average prey consumption of 178±6.25 nymphs. While the minimum amount of feeding occurred during ovipositional period (47 days) with an average fecundity of 18±1.15 eggs/ female when fed on *E. africanus* with an average prey consumption of 79±4.16 nymphs. So, the feeding capacity and fecundity decreased as the oviposition period increased with a highly significant effect (Table 2).

The fecundity/female/day was (1.53, 1.01 and 0.38 eggs) when feeding on *T. urticae*, *T. californicus* and *E. africanus*, respectively.

Life table parameters:

The calculated life table parameters were constructed using the survival data of specific age class and (LX) and the female offspring produced per female in each age class (mx). The net reproductive rate (R_o), the mean generation time (T), the intrinsic rate of increase (r_m), the finite rate of increase (λ), Doubling time (DT) and Gross reproduction rate (GRR) were estimated (Table 3).

The population of the predator *C. setirostris* had the capacity to double (DT) every (7.49, 7.42 and 4.31 times) within a single generation when fed on *T. urticae, T. californicus* and *E. africanus*, respectively. The intrinsic rate of increase (r_m) was 0.09, 0.093 and 0.16 individual/day, while the finite rate of increase (λ) was (1.07, 1.08 and 1.04 female daughters/female/day) for *T. urticae*, *T. californicus* and *E. africanus*, respectively. On the other hand, it could be observed that the net reproduction rate (R_o) varied being (24.35, 17.55 and 8.1 times) during the mean generation time (T) 42.62, 38.62 and 48.54 days for *T. urticae*, *T. californicus* and *E. africanus*, respectively. Gross reproductive rate (GRR) was (27.58, 22.01 and 24.5) times/female/day.

C. setirostris is able to feed and develop on the three prey mite species. The female of this species pass through egg, larva, three nymphal stages and adult. Similar findings were reported for other cunaxid species revealed that *C. capreolus* Berlese successfully developed on diets of booklice (Psocoptera) and the citrus brown mite, *Eutetranychus orientalis* (KLEIN); Soliman, *et al*. (1975); Zaher, *et al*. (1975) and Arbabi&Singh (2000).

The incubation period was the longest immature stage, lasting 9.1, 7.8 and 8.1 day when fed on nymphs of *T. urticae*, *T. californicus* and *E. africanus*, respectively. These results were similar to those of Castro (2008) and Castro&Moraes (2010).

The female life cycle and the generation time were longest when feeding on *E. africanus*, while the shortest on *T. californicus*. This coincides with the results obtained by Zaher, *et al.* (1975) who reared *C. capreolus* on booklice (Psocoptera) and *E. orientalis* at 30ºC, the predator completed its generation in about 4 weeks; Arbabi and Singh (2000) stated that *C. setirostris* female completed its life cycle on *T. ludeni* within 27.51 days, with one larval stage followed by three nymphal stages.

On the other hand, Zhang (2003) reported that the generation time of *Coleoscirus simplex* (Ewing) lasted two weeks, with the daily rate of deposited eggs 4.4 egg/ female.

Table (1): Mean developmental times in days of *C. setirostris* fed on different preys at 22±2ºC and 70±5% R.H.

	Incubation period	Larva	Protonymph	Deutonymph	Tritonymph	Life cycle	Generation
T. urticae	9.1±0.82[a]	6.1±0.74[a]	4.8±0.79[a]	3.8±0.79[b]	5.7±0.67[b]	29.4±1.71[b]	31.3±1.67b
T. californicus	7.8±0.63[b]	4.2±0.79[b]	3.9±0.88[b]	3.7±0.86 [b]	4.1±0.74[c]	23.9±2.18[c]	26.6±2.46[c]
E. africanus	8.1±0.81[b]	6.6±0.69[a]	5.2±0.92[a]	4.8±0.79[a]	6.9±0.73[a]	31.5±1.9[a]	34.7±2.11[a]
Sig.	**	**	**	*	***	***	***

Means with different superscripts in the same row differ significantly (P < 0.05).

Table (2): Mean durations of adult stage and fecundity of *C. setirostris* fed on different preys at 22±2ºC and 70±5 % R.H.

	Preoviposition	oviposition	postoviposition	Adult longevity	Fecundity	eggs/female/day	consumption oviposition period
T. urticae	1.9±0.32[b]	34 ±0.82[c]	4.4±0.52[b]	40.3±0.95[c]	73±2.11[a]	1.53±0.08[a]	178±6.25[a]
T. californicus	2.7±0.67[a]	39±2.45[b]	5.1±1.1[b]	46.8±2.86[b]	39±2.00[b]	1.01±0.08[b]	83±7.69[b]
E. africanus	3.2±0.79[a]	47±1.63[a]	8.2±0.63[a]	58.4±2.22[a]	18±1.15[c]	0.38±0.03[c]	79±4.16[b]
Sig.	*	***	*	***	***	***	***

Means with different superscripts in the same row differ significantly (P < 0.05).

Table (3): Life table parameters of *C. setirostris* fed on different preys at 22±2ºC and 70±5 % R.H.

Parameters	*T. urticae*	*T. californicus*	*E. africanus*
Mean generation time (T)[a]	42.62	38.62	48.54
Doubling time (DT)[a]	07.49	7.42	4.31
Net reproductive rate (R_o)[b]	24.35	17.55	8.1
Intrinsic rate of increase (r_m)[c]	00.09	0.093	0.16
Finite rate of increase (λ-e^{rm})	0 1.07	1.08	1.04
Gross reproduction rate(GRR)	27.58	22.01	24.5

[a] Days [b] Per generation [c] Individuals/female/ day

Maximum prey consumption during oviposition period for *C. setirostris* was 178 nymphs with 73 eggs/female when fed on *T. urticae*; while the minimum was 79 nymphs with 18 eggs/female when fed on *E. africanus*. Similar findings were reported by Soliman, *et al.* (1975); Taha, *et al.* (1988); Castro and Moraes, (2010).

On the other hand, Arbabi and Singh (2000) found that the maximum amount of feeding occurred during oviposition period for the predator, *C. setirostris* fed on *T. ludeni*.

The intrinsic rate of increase (r_m) was low. It ranged between 0.09 to 0.16 individual/day suggesting that those prey species may not be suitable for the predator. Similar results were obtained by Castro and Moraes (2010); Castro (2008) suggesting that life table parameters of *Estudos taxonômicos* had low biotic potential on *Tenuipapus heveae* Baker. He reported that the factors that could determin the estimated low biotic potential were the long developmental time from egg to adult (about 33 days), mainly because of the long duration of the egg stage (about 17 days), the low viability of the immature phase (10%) and the low fecundity (12 eggs per female).

Therefore, it could be concluded that the predacious mite, *C. setirostris* could be considered useful agents against phytophagous mites.

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