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EFFICIENCY OF THE PREDATORY MITE, CHEYLETUS MALACCENSIS OUDEMANS ON *Tetranychus cucurbitacearum* (SAYED) (ACARI: CHEYLETIDAE & TETRANYCHIDAE)

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ABSTRACT

Developmental time, consumption rate and fecundity of Cheyletus malaccensis Oudemans were studied on different stages (eggs, immatures and adults) of Tetranychus cucurbitacearum (Sayed) at laboratory conditions, 32±2°C and 50±10% R.H.

Data analysis revealed a significant effect among different stages except for incubation period at both sexes. Life cycle of female was longer than of male. Duration of female was 28.7, 20.4 and 23.4 days and 17.79, 18.15 and 20.9 days for male when fed on the three preys, respectively. The adult longevity of female showed longer duration (52.4 days) when fed on eggs than male (18.9 days) fed on the same prey. The number of prey consumed and the fecundity were significantly lower when fed on T. cucurbitacearum (immatures and adults) compared to eggs of the same prey.

Data provide fundamental information for understanding the effect of different prey on development of C. malaccensis.

Keywords: *Cheyletus malaccensis*, *Tetranychus cucurbitacearum* Evaluation, Prey range.

INTRODUCTION

Cheyletid mites have a worldwide distribution and they occur on all the continents. Species of Cheyletidae occupy a great variety of habitats. Some of them are free-living predators inhabiting plants, soil and plant debris, others are living in nests of birds and small mammals and insect colonies. A small group is dwelling into the feather quills of birds. Investigation on cheyletid mites is very interesting because it could help us to understand the origin and the mechanism of evolution in parasitism (Beklemishev, 1970). Cheyletid mites may actively search for prey or use a stationary ambush behavior. Gerson *et al*., (2003) categorized the ambush behavior of *Cheyletus Latreille* species and this method of feeding allows adults, nymphs, and larvae to feed, even if the prey is larger.

Both arrhenotokous and thelytokous cheyletid species are known (Barker, 1992 and Ray & Hoy, 2014), with a typical acarine life cycle, developing through egg, larval, and nymphal stages to adults (Volgin, 1987). The number of nymphal stages may vary, for example, in *C. malaccensis*, the females have two nymphs, whereas the males have a single nymphal stage only (Palyvos and Emmanouel 2009).

The mite, *C. malaccensis* is like many other arrhenotokous animals, has diploid females and haploid males (haplodiploidy). Moreover, virgin females always produce males, whereas fertilized females produce progeny of both sexes. Haplodiploidy is common among prostigmatic mites, including Cheyletidae, Tarsonemidae, Pyemotidae and Tetranychidae (Summers and Witt, 1973; Regev, 1974; Hughes, 1976; Roy *et al*., 2003; Palyvos & Emmanouel, 2004 and Palyvos *et al*., 2008). The mite, *C. malaccensis* is the dominant followed by *C. eruditus* (Schrank), the most frequent species. It has been regarded as an important biological control agent for pest mites able to control plant mite pests, but only at temperatures above 17 °C (Saleh *et al*., 1986 and Pekar & Hubert, 2008).

Several species of *Cheyletus* found associated with and feed on mites, acarid eggs, stored grain and small insects such as eggs, young larvae or nymphs of moths and beetles (Zaher & Soliman, 1971; Hughes, 1976; Yousef *et al*., 1982; Sinha, 1988; Nangia *et al*., 1994 Hubert *et al*., 2006 and Cebolla et al., 2009).

Therefore, the present work aimed to evaluate, *C. malaccensis* when fed on three types of food (eggs, immatures and adults) of *T. cucurbitacearum* at laboratory conditions, 32±2°C and 50±10% RH..

MATERIALS AND METHODS

The suitability of the different stages (egg, immature and adult) of the phytophagous mite, *T. cucurbitacearum* as a food source for *C. malaccensis* is evaluated. Both predator and preys were collected from maize leaves, *zea mays* L. from Diarb Nigm, district, Sharkia Governorate. The predator reared on the different stages of *T. cucurbitacearum* under laboratory conditions of 32±2ºC and 50±10% R.H., at Plant Protection Research Institute, A.R.C., Zagazig, Egypt. Samples of plant leaves were collected in cellophane bags and brought to the laboratory for direct examination using stereoscopic binocular microscope. Some adult specimens were individually mounted in Hoyer's medium on glass slides for microscopic identification.

Predatory mite rearing:

For rearing experiments, about 30 copulated adult females of *C. malaccensis* were left 24 h. on leaf discs of mulberry leafs, *Morus* spp. infested with *T. cucurbitacearum* as prey and kept on moist cotton pad in Petri-dishes (15cm. in diameter), suitable moisture was added daily to keep leaf discs fresh for a longer time. Thereafter, when a sufficient number of eggs were laid, the adult females were removed and thus eggs of the same age were obtained to start the experiment. Observations were recorded each 12 hours intervals to observe if the eggs were hatched. As the eggs hatched into larvae, the larvae were transferred as individuals very carefully onto leaf disks of mulberry leaves (3cm. in diameter). Leaf discs were placed with the upper surface down on cotton layer in Petri-dishes (6cm. in diameter). Water was added when needed to maintain suitable moisture. The leaf margin was surrounded by a cotton strip to prevent the escape of mites. Twenty replicates were maintained for each experiment, three replicates on each Petri-dish. So, 21 Petri-dishes were maintained simultaneously and eggs of *T. cucurbitacerum* were given as food. This experiment was repeated with other stages of the tetranychid mite. Duration of the life cycle; longevity; life span; food consumption and fecundity were recorded by taking observations under a stereo binocular-microscope.

Statistical analysis:

Data were statistically analyzed using the analysis of variance according to Sendecor and Cochran (1982) using the computer program SPS_S (2006).

RESULTS

Developmental periods (in days) of different life stages of *C. malaccensis* on a diet of different stages (egg, immatures and adults) of *T. cucurbitacearum* at 32±2°C and 50±10% R.H. are presented in Tables (1-3).

Data analysis revealed a significant effect of different stages on all developmental life stages except of incubation period at both female and male.

***Developmental times and life cycle of C. malaccensis* :**

Individuals of *C. malaccensis* successfully developed from larva to adult when fed on *T. cucurbitacearum* eggs, while only completed its period to the protonymphal stage when fed on immature and adult stages of female (Table 1). In contrast, the male predator was successfully developed from larva to adult when fed on any of the three prey (Table 2).

The total developmental time from egg to adult emergence was (25.25±0.83, 16.7±1.01 and 19.8±3.74 days) for the predator females when

fed on the three prey of *T. cucurbitacearum*, respectively. While this period was (14.18±1.12, 14.7±0.72 and 17.35±0.63 days) for male when fed on the same preys, respectively.

Life cycle of *C. malaccensis* females was longer than that of males. Durations were 28.7±0.90, 20.4±1.05 and 23.4±3.55 days for females and 17.79±1.21, 18.15±0.63 and 20.9±0.66 days for males when fed on eggs, nymphs and adults of the prey, respectively. The shortest life cycle of both sexes were (20.4±1.05 & 17.79±1.21 days) for female and male, respectively, recorded when the predator fed on immatures and eggs, respectively.

Adult longevity of C. malaccensis:

Feeding on *T. cucurbitacearum* eggs, elongated the predatory female life cycle, significantly compared with other prey, while fed on immatures and adults distinctly shortened the female longevity, but no oviposition occurred.

Regarding to the adult longevity of the *C. malaccensis* mite fed on *T. cucurbitacearum* (eggs, nymphs and adults), the female predator showed a high longer duration of the adult period (52.4±091 days) fed on eggs than male (18.9±0.99 days) fed on the same prey.

The consumption rate and fecundity of C. malaccensis:

Prey also influenced the total eggs laid per female and the number of consumed prey eggs. The consumption *rate* of *C. malaccensis* obviously reflected the preference of feeding on *T. cucurbitacearum* eggs comparing to other preys (Table 3). *Female predator oviposited* within 4.65±0.34 days *after emergence*, when fed on *T. cucurbitacearum* eggs. The oviposition period was 17.2±*0.92 days*, and then the female stopped to deposit eggs before death.

In addition, data showed that the number of preys consumed and the fecundity were significantly lower when fed on *T. cucurbitacearum* (immature and adults) compared to eggs of the same prey.

The consumption rate increased through the developmental stages, respectively. The highest devoured when the predator fed on eggs while the lowest when fed on immatures of the tetranychid mite. Thus, the consumption rate was significantly more by the first (384.6±16.002 eggs) than the second (57.7±4.30 immatures). The females during oviposition consumed a significant higher number of prey for males (384 &217 preys, respectively) when fed on the tetranychid eggs, suggesting that females need extra food for egg production.

Table 3: Mean durations of consumption rate, fecundity of *C. malaccensis* fed on different stages of *T. cucurbitacearum* at 32± 2ºC and 50± 10 % R.H.

Preys / Period	Egg	Immature	Adult	Significant
Consumption rate	384.6±16.002 [a]	57.7±4.296 [b]	58.9±4.701 [b]	***
No. of eggs	30.9±2.685 [a]	0.0±0.0 [b]	0.0±0.0 [b]	***
Daily Rate	1.8±0.141 [a]	0.0±0.0 [b]	0.0±0.0 [b]	***

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

In addition, data showed that the number of eggs laid for *C. malaccensis* was significantly (30.9±2.69 eggs) per female with a daily rate 1.8 eggs when fed on *T. cucurbitacearum* eggs compared to other preys that did not put eggs.

DISCUSSION

Several researchers have studied aspects of the biology of *C. malaccensis* and different results were obtained, e.g., in developmental period, fecundity and prey consumption (Zaher & Soliman 1971; Summers & Witt 1973; Rizk *et al.* 1979; Yousef *et al.*1982; Saleh *et al*. 1986; Nangia *et al*. 1994; Pekar & Hubert 2008). These differences may be attributed to the occurrence of various biotypes in different regions of the world. Other sources of variation would be the ambient temperature or the predators food type (Palyvos & Emmanouel, 2004) . Some species may even have different reproductive patterns in different geographic regions. Temperature is the most important environmental factor regulating arthropod development and reproduction. While The influence of temperature on sex allocation in haplodiploid mites remains largely unexplored (Wrensch, 1993 and Roy *et al*. 2003).

Through observations of the cheyletid mite, *C. malaccensis* may actively search for prey, or it used a stationary ambush behavior. This remarkable agree with Gerson *et al*., 2003.

Development of all stages of both sexes of fertilized *C. malaccensis* were 25.25, 16.7 and 19.8 days at (32±2°C.), than that reported by (Saleh *et al*., 1986 and Ray & Hoy, 2014) at 32°C, using *Aleuroglyphus ovatus* as prey (20.8, 15.9 and 14.2 days, respectively). The optimum temperature for development of *C. malaccensis* appeared to be around 30–33.5°C (Lukas *et al*., 2007 and Palyvos *et al*., 2008).

Cheyletus malaccensis females and males completed development from egg to adult emergence at 32°C when fed on different preys, except for females fed on tetranychids (immatures and adults). In addition, males developed more quickly than females, at all experiments. These results are consistent with (Palyvos & Emmanouel, 2009). They declared that the immature development of both females and males was significantly different among the temperatures tested within the range of 17.5 to 35°C.. Moreover, mean developmental time of immature stages was longer at the low constant temperature of 17.5°C than at the other tested temperatures and shortest at 32.5°C.

The female predator oviposited within 4.65 days after emergence, when fed on *T. cucurbitacearum* eggs. The oviposition period was 17.2 *days*, and then the female stopped to deposited eggs before death. Summers & Witt, 1973 declared that the reproducing females of *C. malaccensis* begun as early as the fourth day after the final molt and ran its course in 40 to 56 days.

Total life span followed 81.16, 20.4 and 23.4 days for female fed on eggs, nymphs and adults of the prey species; while were 36.86, 29.8 and 39.2 for male predator, at 32°C and 60% R.H. respectively. This period averaged 64.7 days total adult life span, 3.1 days in the preoviposition period, and 50.9 days for the total nesting period, Summers & Witt, 1973.

Much information is available on the control of mites using the cheyletids (Zdarkova, 1998). Based on estimated values, *C. malaccensis* seems better adapted to higher temperatures than other cheyletid mites, and therefore may be a good candidate for biological control in drier and warmer ecosystems. The optimum temperature for development of *C. malaccensis* appeared to be around 30–33.5°C. It's more frequent and abundant than *other*'s in Greek (Lukas *et al*., 2007 and Palyvos *et al*., 2008).

The females during oviposition consumed a significantly higher number of prey for males (384&217 preys, respectively) when fed on the tetranychid eggs, suggesting that females need extra food for egg production. This information is in agreement with other findings of Kouhjani *et al*., 2009.

Obtained data provide fundamental information for understanding the effect of different preys on development of *C. malaccensis*. Future studies should further contribute to improvement of rearing of this predator. In addition, monitoring degree-days provides a practical method for predicting *C. malaccensis* population development in natural environment. So, better knowledge of the biology of *C. malaccensis* will increase its utility as a biological control agent.

CONCLUSION

From the previous results, it can be included that development and feeding capacity of developmental stages and adults of the predatory cheyletid mite, *C. malaccensis* was successfully developed when fed on *T. cucurbitacearum* egss. Consumed rate and fecundity were significantly lower when fed on immatures and adults from prey compared to eggs of the same prey.

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كفاءة المفترس الاكاروسى *Chelyetus malaccensis* Oudemans على *Tetranychus cucurbitacearum* (Sayed) (Acari: Cheyletidae & Tetranychidae)

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تم دراسة مدة التطور ومعدل الاستهلاك الغذائي والخصوبة للمفترس *Chelyetus malaccensis* عند تغذيته على الأطوار المختلفة (البيض-الأطوار غير الكاملة–الأطوار الكاملة) للنوع نباتي التغذية *Tetranychus cucurbitacearum* تحت ظروف المعمل ٣٢±٢°م و٥٠±١٠% رطوبة نسبية.

أظهرت النتائج ما يلى :

١ - وجود تأثير معنوي للأطوار المختلفة على تطور كل الأطوار الحية للمفترس باستثناء فترة حضانة البيض سواء للإناث أو الذكور.

٢ - دورة حياة الإناث أطول منها بالنسبة بالذكور. وكانت الفترات ٢٨,٧ ، ٢٠,٤ ، ٢٣,٤ يوم بالنسبة للإناث، و ١٧,٧٩ ، ١٨,١٥ ، ٢٠,٩ يوم للذكور عند التغذية على الثلاث فرائس على التوالي .

٣ - فيما يخص فترة حياة الطور البالغ ، كانت فترة عمر الأنثى أطول (٥٢,٤ يوم)عند التغذية على البيض مقارنة بالذكور (٣٩,٢) عند التغذية على الثلاثة أطوار للفريسة.

٤ - عدد الضحايا المستهلكة والخصوبة كان منخفض معنويا عند التغذية على الأطوار الغير كاملة والأطوار الكاملة للنوع *T. cucurbitacearum* مقارنة بالبيض لنفس الضحية .

٥ - أعطت البيانات معلومات جوهريه لفهم تأثير اختلاف الضحايا على تطور المفترس *C. malaccensis* .

التوصية: أظهرت النتائج المتحصل عليها أن المفترس *C. malaccensis* من عائلة كيليتيدى أمكنه التغذية والتطور بنجاح إلى الطور البالغ عند التغذية على بيض الفريسة من النوع *T. cucurbitacearum*. بينما كان معدل الافتراس والخصوبة منخفض عند التغذية على الأطوار الغير كاملة والأطوار الكاملة لنفس الفريسة مقارنة بالبيض. لذا هذا المفترس يمكن إدراجه فى المكافحة الحيوية لبيض هذه الفريسة.