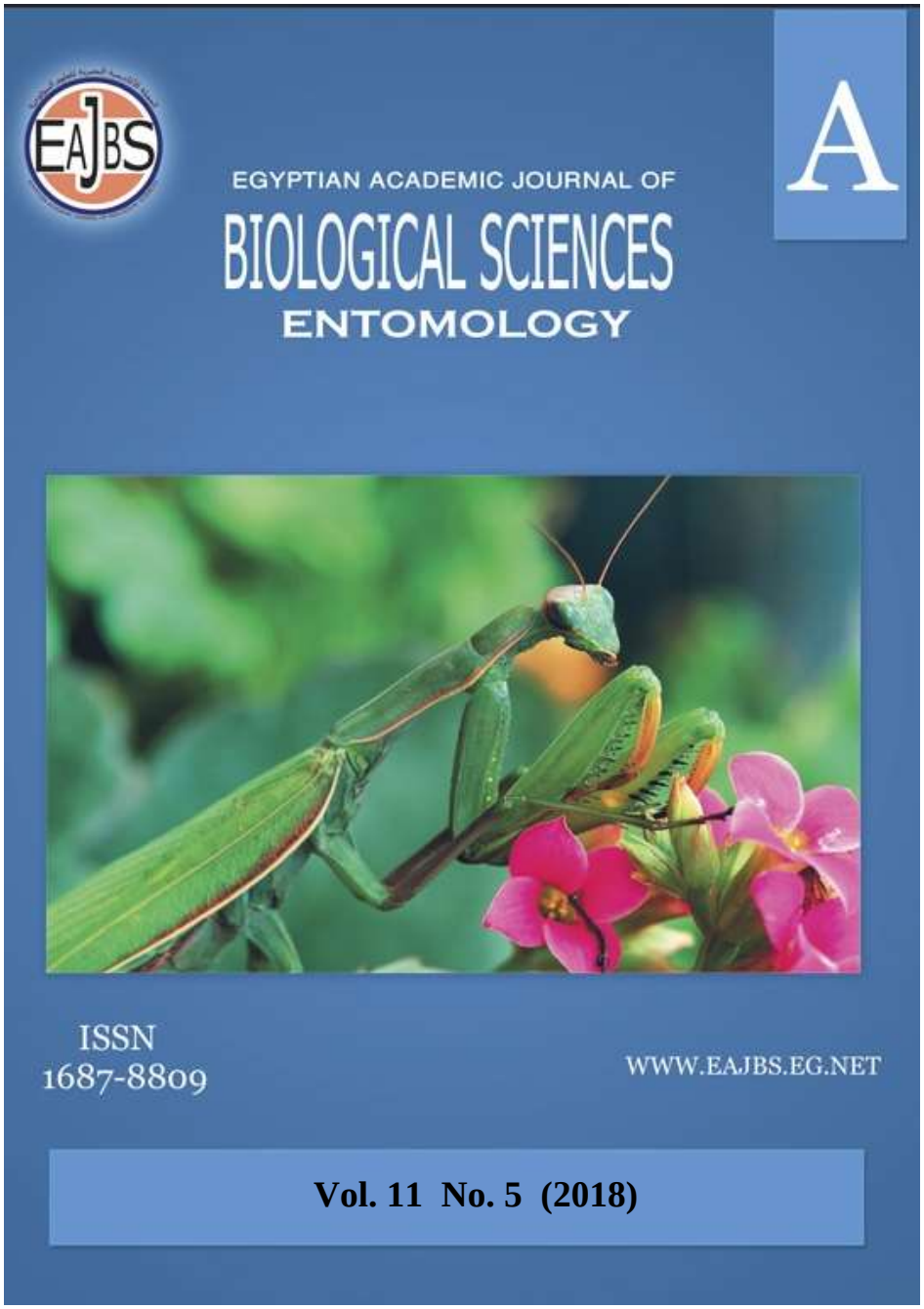

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Biological Studies on Cheyletid Predator Mite, *Cheletogenes ornatus* (Canestrini & Fanzago) when Fed on the Different Preys

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ABSTRACT

The Cheyletid mite, Cheletogenes ornatus (C. & F.) (Actinidida: Cheyletidae) was reared at 20 and 25±2°C and 60-65% R.H. on eggs and immature stages of Astigmatid mite, *Acarus farrie* (Oudemans). The predatory mite *C. ornatus* fed successfully on the tested food . Results indicated that female predator had two nymphal stages, while the male had one nymphal stage. It was significant differences between the male and female during immature stages and life cycle,; the longest period was 21.28 and 29.77 days for females which fed on immature stages of *A. farrie*, the shortest values was observed for males which fed on egg of *A. farrie* were 13.9 and 22.08 days, respectively. The longest Oviposition period observed was 22.52 days, at 25 °C while, the shortest period was 20.75 days at 20 °C when the adult female fed on eggs of *A. farrie*. Fecundity was significantly higher when the adult female fed on eggs of *A. farrie* at 25 °C and decreased to recorded the lowest number of deposited eggs at 20°C. There was significant different effect of the temperature on female and males food consumption during longevity,; the highest number consumed by female and male was recorded at 20 °C, whereas the lowest number was record at 25 °C.

INTRODUCTION

Stored product mites infest food during its storage (Franz *et al.,* 1997). Storage mites are mainly found in stored products such as dried eggs, ham, herring meal, cheese, and different kinds of nuts (Olsson and Van Hage- Hamsten, 2000).

The predatory mite *Cheletogenes ornatus* (Canestrini & Fanzago) inhabits fruit trees, field crops, vegetables and ornamental plants. It is usually found in association with scale insects and phytophagus mites, but most frequently in association with the former (Zaher 1984).

The mite infestation decrease food safety because mites are allergen products (Van Hage- Hamsten, and Johansson (1992) and transmit mycotoxin- producing fungi (Hubert *et al.,* 2003). Damage by insect, mites fungi, and sprouting causes hundreds of millions of dollars of economic losses to grain producers, merchandisers, and processors each year (Harein and Meronuck 1995). The mites cause direct and

indirect damage to stored grains and their products by raising their moisture content, generation sufficient heat for the growth of infection bacteria and fungi. Mites infected food products undergo a series of changes in their chemical composition and flour prepared from contaminated grains is more acidic, fusty smell and bitter taste. They contaminate the space between the products with their dead bodies, cast skin and with excrement mites will attack not only grain but cheese, flour, pet food, oil seeds, medicinal herbs, hay, and just about any food used by man.

Mite infestations on cheese can be recognized as a layer of grey dust and cavities on the surface of the cheese. Colonies usually include two or three species growing together. Protein break down during ripening makes old cheese a better source of nutrients, but old cheese also contains more fatty acids such as butyric acid which inhibits egg-laying by mites, (Sadasivan and Manickam, 1991).

The use of predatory mites as biological control agents in grain stores has been well documented by Zdarkova, (1986) and Zdarkova& Horak, (1990) who tested *Cheyletus eruditus* (Schrank) in the Czech Republic for controlling storage mite populations in grain stores. Many researchers studied the biology of cheyletid mites on stored products. For example, Zaher and Soliman (1971) reared *Cheyletus malaccensis* (Oud.) in the laboratory on *Caloglyphus* sp. Burnett (1977) studied The biological model of predation that developed using granular food held in closely packed gauze trays to propagate the grain mite *A. siro* L. and two of its predators, *Blattisocius dendriticus* (Berl.) and *Cheyletus eruditus*. Zaher *et al.,* (1981) studied the effect of food type on the development, feeding capacity and fecundity of *C. ornatus*, a predator of scale insects and phytophagous mites. Zdarkova and Feit (1999) investigated the role of the predator *C. eruditus* as a biological control agent against the grain mite *A. siro* L. under laboratory conditions of 20 °C and 75% RH on different types of food in plastic bags. Mesbah and Omar (2014) reared *C. ornatus* on three different types of food, eggs and immature stages of *Raoiella indica* (Hirst) (Tenuipalpidae), and crawlers of date- scale- insect, *Parlatoria blanchardii* (Targ) at laboratory conditions .

The objective of our present investigation was to study the biology of Cheletogenes ornatus at 20 and 25±2°C and 60-65% R.H. on eggs and immature stages of astigmatid mite, *Acarus farrie*.

MATERIALS AND METHODS

Actinedida predator mite, *Cheletogenes ornatus* was reared on eggs and all movable immature stages of *Acarus farrie* (Oud.) at 20, 25 °C and 60-65% R.H. for reproduction. For individual rearing, newly deposited eggs were transferred singly to rearing plastic cell . Each newly hatched larva was supplied daily with known number of *A. farrie* (eggs and immature stags) till reaching maturity. Emerged females were copulated and kept for oviposition. Observations concerning all biological aspects recorded during the predator life span.

Culture of the Prey, *Acarus farrie* (Oud.):

The astimatid mite *A. farrie* was extracted from stored dried milk, biscuit, dried fig at 6th October city, Dahshour, El-Baragil Giza Governorate by using modified Tullgren funnels.

Culture of the Predator, *Cheletogenes ornatus* (C.&F.)**:**

Females of cheyletid mites, C. ornatus were taken from wheat grains, peanut, lentil, dry molokhia and transferred to rearing in a small plastic cage. Females were left 24 hours and their oviposited eggs were used for biological aspects.

Methods and Techniques:

Reproduction studies were carried out by placing ten emerged females together with five newly immerged males in a small plastic cage (3cm. in diameter) and supplied with food. The reproductive experiments were repeated 5 times.After one month, the number of eggs, immature stages and adults were counted.

Females and males of the Cheyletid mite*, cheletogenes ornatus* were isolated from standing cultures and transferred into small plastic jars (5 cm in diameter, 4 cm in depth).The bottom of the jar was covered with a mixture of plaster of Paris: charcoal (9:1) and tightly covered by a piece of glass slide as mentioned by Rakha *et al.*, (1991) and Salem *et al*., (2005). The upper part of vial was surrounded by Vaseline to avoid escaping of mites. Newly hatched predatory nymphs (protonymphs and deutonymphs) were confined singly in other cells and supplied with a known number of *Acarus farrie* (eggs and immature stages). Numbers of consumed or destroyed prey eggs and immature stages were daily determined and replaced with fresh eggs and immature stages during the life of the predator. Drops of water were added daily to maintain suitable moisture. Emerging mite females were copulated with males and supplied with known number of eggs. All biological aspects of the predator were recorded.

Statistical Analysis:-

All presented 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

This study Was conducted at 20 and 25°C and relative humidity 60-65 % to study the different biological aspects of the predacious cheyletid mite, *Cheletogenes ornatus* (C.&F.) when fed on eggs and immature stages of *Acarus farrie* (Oud.).

Duration of the Different Stages of Predatory Mite *Cheletogenes ornatus* (C.&F.) When Fed on Eggs and Immature Stages of *Acarus farrie* (Oud.) at 20& 25°C and 60-65% R.H.

Incubation Period:

Incubation period of the predatory mite *Cheletogenes ornatus* significantly differed through the research and has been varied between the male and female and further more between the different temperature degrees. The tabulated data in Tables (1&3) showed that the incubation period of *Cheletogene ornatus* significantly differed when the individuals (males and females) fed on the two types of prey, as it recorded 8.37, 8.18 ; 4.58 and 4.53 days when female and male individuals fed on eggs of *A. farrie* at 20 and 25 °C, respectively, while these periods recorded 8.48, 8.2; 4.75 and 4.65 days when the same mites fed on the immature stages of the astigmatid mite, *Acarus farrie* at the same conditions.

Life Cycle:

The prey and temperature suitability clearly affects the life cycle of the cheyletid mite, *C. ornatus***.** From statistical analysis of the obtained data, Tables (1&3) showed that the life cycle averaged 29.25, 22.08; 17.47 and 11.92 days when fed on eggs of *A. farrie* at 20 and 25 °C, for females and males respectively. On the other hand, when the immature stages of *A. farrie* were used as food type, the predatory mite *C. ornatus* life cycle lasted 29.77, 22.43; 17.18 and 12.87 days for the females and males, respectively, at the same conditions.

It was significant differences between the male and female during immature stages and life cycle; the longest period was 21.28 and 29.77 days for females which

fed on immature stages of *A. farrie*, and the shortest values observed for males which fed on egg of *A. farrie* were 13.9 and 22.08 days, respectively (Table 1).

It can be concluded that the tested temperatures were affected negatively the duration of egg, larval and nymphal stages.

Life Span:

Accordingly, the life span of *C.ornatus,*was also highly affected by types of food and temperature differences, The life span of this mite was 63.4, 54.8; 48.2 and 35.6 days when the females and males of the predatory mite, *C.ornatus* fed on eggs of *A. farrie* at 20 and 25 °C, respectively. On the other hand, when the immature stages of the astigmatid mite, *A. farrie* were used as food source, the life span of *C. ornatus* took 63.7; 57.3 and 48.9, 37.2 days, for females and males, respectively at the same used conditions, Table (1 &3).

Longevity:

Concerning the adult female longevity of *C. ornatus* , Tables (1, 2, 3 and 4), it was observed that this period was affected by the type of food , reached to the highest level when the female individuals fed on eggs of *A. farrie* at 20 °C recorded 34.18 days and showed the lowest period when the males fed on eggs of *A. farrie* at 25 °C (23.68 days). Statical analysis proved that non-significant differences between females predator fed on eggs and immature stages of *A. farrie* were present during preovipostion, ovipostion and post-ovipostion periods at two temperatures 20 and 25°C.

Table (1) Duration of the different stages of predatory mite *Cheletogenes ornatus* (C.&F.) when fed on eggs and immature stages of *Acarus farrie* (Oud.) at 20°C and 60-65% R.H.

Prey Stages	Eggs of *A. farrie*		Immature stages of *A. farrie*		L.S.D. at 5%
	Female Mean ±SD	Male Mean ±SD	Female Mean ±SD	Male Mean ±SD	
Incubation period	8.37±0.36a	8.18±0.39a	8.48±0.48a	8.20±0.52a	0.53
Larva	7.90±0.51a	7.70±0.40a	8.13±0.55a	7.82±0.48a	0.58
Protonymph	6.28±0.41a	6.20±0.43a	6.40±0.38a	6.42±0.34a	0.46
Deutonymph	6.70±0.51a	-	6.75±0.62a	-	0.72
Immature stages	20.88±0.66a	13.90±0.71b	21.28±1.06a	14.23±0.67b	0.95
Life cycle	29.25±1.01a	22.08±0.64b	29.77±1.41a	22.43±0.85b	1.22
Longevity	34.18±2.08a	32.78±1.76a	33.93±1.77a	34.60±1.37a	2.11
Life span	63.40±1.32a	54.87±2.27b	63.70±2.25a	57.03±1.94b	2.38

Means followed by the same letter in the same raw are not significantly different at the 0.05 level.

Table (2)Effect of food on female longevity and fecundity of predatory mite *Cheletogenes ornatus* when fed on eggs and immature stages *Acarus farrie* (Oud.) at 20°C and 60-65% R.H.

Prey Stages	Eggs of *A. farrie* Mean ±SD	Immature stages of *A. farrie*Mean ±SD	L.S.D. at 5%
Pre-ovipostion	5.63±0.30a	5.53±0.40a	0.53
Oviposition	20.75±1.08a	21.50±1.0a	1.94
Post-ovipostion	7.80±0.53a	7.23±0.51a	0.89
Longevity	34.18±1.54a	34.27±1.1a	2.35
Fecundity	44.50±3.0a	47.33±3.11a	5.06
Dail rate	2.16±0.22a	2.21±0.14a	0.32

Means followed by the same letter in the same raw are not significantly different at the 0.05 level.

Table (3) Duration of the different stages of predatory mite *Cheletogenes ornatus* (C.&F.) when fed on eggs and immature stages of *Acarus farrie* (Oud.) at 25°C and 60-65% R.H.

Prey Stages	Eggs of *Acarus farrie*		Immature stages of *A. farrie*		L.S.D. at 5%
	Female Mean ±SD	Male Mean ±SD	Female Mean ±SD	Male Mean ±SD	
Incubation period	4.58±0.34a	4.53±0.40a	4.75±0.18a	4.65±0.21a	0.35
Larva	4.10±0.33a	3.88±0.50a	4.05±0.27a	3.83±0.48a	0.49
Protonymph	4.38±0.35ab	4.20±0.35b	4.60±0.23a	4.38±0.30ab	0.36
Deutonymph	4.40±0.25a	-	4.54±0.22a	-	0.35
Immature stages	12.88±0.67a	7.38±1.72b	12.43±1.95a	8.22±0.61b	1.65
Life cycle	17.47±0.62a	11.92±1.49b	17.18±1.94a	12.87±0.73b	1.58
Longevity	30.82±1.19a	23.68±1.51b	31.72±0.53a	24.33±1.45b	1.48
Life span	48.28±1.45a	35.60±2.73b	48.90±2.25a	37.20±1.67b	2.5

Means followed by the same letter in the same raw are not significantly different at the 0.05 level.

Table (4) Effect of food on female longevity and fecundity of predatory mite *Cheletogenes ornatus* when fed on eggs and immature stages *Acarus farrie* (Oud.) at 25°C and 60-65% R.H.

Prey Stages	Eggs of *A. farrie* Mean ±SD	Immature stages of *A. farrie*Mean ±SD	L.S.D. at 5%
Pre-ovipostion	3.67 ±0.27a	3.95 ±0.12a	0.32
Oviposition	21.82 ±0.62a	22.52 ±0.38a	0.93
Post-ovipostion	5.25 ±0.33a	5.38 ±0.38a	0.58
Longevity	30.73 ±0.63b	31.85 ±0.27a	0.99
Fecundity	71.50 ±2.33a	67.67 ±4.78a	7.1
Dail rate	3.28 ±0.12a	3.01 ±0.22a	0.32

Means followed by the same letter in the same raw are not significantly different at the 0.05 level.

Fecundity:

Mating is essential for egg deposition of *C. ornatus* eggs production in *C. ornatus;* it was influenced by the type of used food, Tables (2 and 4). Fecundity was significantly higher when the adult female fed on eggs of *A. farrie* and recorded 71.5 eggs/ female with daily rate 3.28 egg/female/day at 25 °C and decreased to recorded the lowest number of deposited eggs at 20°C when the females fed on eggs of *A. farrie* 44.5 eggs/ female with daily rate 2.16 egg/female/day Table (2 and 4).

The longest oviposition period observed was 22.52 days, at 25 °C while, the shortest period was 20.75 days at 20 °C when the adult females fed on eggs of *A. farrie*.

Effect of Different Foods (eggs and Immature Stages of *Acarus farrie*) on the Biological Aspects of Predatory Mite *Cheletogenes ornatus*:

From the tabulated data in Table (5), it could be observed that the duration of life cycle, longevity and life span for both sexes was highly affected by temperature the LSD at 0.05 level was 0.75, 1.36 and 1.34, respectively. On the other hand, it was found highly significant effect by sex female and male on the same previous stages. while there was non-significant different effect of food (egg and immature stages) on incubation period, life cycle, longevity, life span and fecundity. Whereas the fecundity was highly affected by temperature the LSD was 4.28.

Food Consumption of Predatory Mite *Cheletogenes ornatus* Predation Capacity of *C. ornatus* on Eggs of *A. farrie* at 20& 25 °C and 60-65 % R.H. :

The food consumption of the different predator stages increased with its growth. The predatory mite *C. ornatus* females preyed up on *A. farrie* eggs with an average of 53.8, 117.1 and 171 eggs of the astigmatid mite *A. farrie* during immature stages, longevity and life span respectively, while the males consumed

39.67, 81.6 and 121.3 eggs during immature stages, longevity and life span period, at 20°C, respectively. While the females consumed 44.83, 98.67 and 143.5 eggs, whereas male consumed 32.50, 73.33 and 105.83 eggs during immature stages, longevity and life span period, respectively at 25 °C, Table (6). Statistically, there were difference between the males and females; the highest consumption of predator was recorded for females while the lowest was record for males during all developmental stages.

Predation Capacity of *C. ornatus* on Immature Stages of *A. farrie* at 20&25 °C and 60-65 % R.H.:

The predatory mite *C. ornatus* fed successfully on the tested foods. The number of devoured preys of immature stages of *A. farrie* was 39.67& 34.33 and 30.17& 22.67 during immature stages of female and male at 20 and 25 °C, respectively.

On the other hand, there was significant different effect of the temperature on female and males food consumption during longevity; the highest number consumed by female and male was recorded at 20 °C was 98.17 and 70.50 preys during longevity stages. whereas the lowest number was recorded at 25 °C as 82.83 and 66.50 preys for male and female, respectively Table (7).

During life span the female devoured 137.83 and 117.17 preys at 20 and 25 °C while males devoured 100.67 and 89.17 preys at the same conditions, respectively.

Table (5) Effect of different foods (eggs and immature stages of *Acarus farrie*) on the biological aspects of predatory mite *Cheletogenes ornatus* (C.&F.), at 20, 25 °C and 60-65% R.H.

Biological aspect	Source	F-Test	Probability	L.S.D. at 0.05
Incubation period	Temperature	1242.4	0.000***	0.21
	Food	1.0	0.32 ns	
	Sex	2.18	0.14 ns	
Life cycle	Temperature	870.0	0.000***	0.75
	Food	1.05	0.310 ns	
	Sex	265.6	0.000***	
Longevity	Temperature	85.1	0.000***	1.36
	Food	1.33	0.255ns	
	Sex	31.8	0.000***	
Life span	Temperature	667.6	0.000***	1.34
	Food	3.07	0.086ns	
	Sex	219.0	0.000***	
Fecundity	Temperature	132.0	0.000***	4.28
	Food	0.06	0.810ns	

Table (6) Food consumption of predatory mite *Cheletogenes ornatus* (C.&F.), during its life span when fed on eggs of *Acarus farrie* (Oud.) at 20, 25 °C and 60-65% R.H.

Prey Stages	20˚C		25˚C		L.S.D. at 5%
	Female Mean ±SD	Male Mean ±SD	Female Mean ±SD	Male Mean ±SD	
Immaturestages	53.83±1.9a	39.67±1.0c	44.83±1.2b	32.50±1.8d	2.56
Longevity	117.17±5.5a	81.67±3.3c	98.67±4.1b	73.33±5.0d	6.74
Life span	171.00±4.0a	121.33±3.7c	143.50±5.0b	105.83±5.1d	6.88

Means followed by the same letter in the same raw are not significantly different at the 0.05 level

Table (7) Food consumption of predatory mite *Cheletogenes ornatus* (C.&F.), during its life span when fed on immature stages of *Acarus farrie* (Oud.) at 20, 25 °C and 60-65% R.H.

Prey Stages	20˚C		25˚C		L.S.D. at 5%
	Female Mean ±SD	Male Mean ±SD	Female Mean ±SD	Male Mean ±SD	
Immature stages	39.67±1.1a	30.17±0.9c	34.33±1.3b	22.67±1.3d	1.92
Longevity	98.17±1.8a	70.50±2.0c	82.83±2.4b	66.50±1.8d	3.12
Life span	137.83±2.2a	100.67±1.8c	117.17±3.5b	89.17±2.5d	3.9

Means followed by the same letter in the same raw are not significantly different at the 0.05 level.

These results are agree with these documented by Zaher and soliman, (1972) observed that *C.ornatus* occurs widely throughout Egypt on fruit trees and ornamental plants and plays an important role in control scale insects, females laid an average of 16.8 eggs each, the oviposition period ageraged 12.8 dayes. Moraes *et al.*(1989) reported biology *C.ornatus,* the most common predator of Pinnaspis aspidistrae (Signoret) in Brazil. At 28 C^0 the duration of the life cycle was 40.6 and 31 days for males and females respectively and duration of female immature stages slightly shorter than mentioned by Mesbah and Omar (2014**)** reared *C. ornatus* on three different types of food, eggs and immature stages of *Raoiella indica* (Hirst) (Acari: Tenuipalpidae), and crawlers of date- scale- insect, *Parlatoria blanchardii* (Targ) at laboratory conditions . Predation potential was greatest for larva, followed by protonymphs, then deutonymphs. Predator consumed an average of 106.8 & 158.2 preys for male and female during its life span, respectively.

Zaher *et al.,* (1981) study the effect of food type on the development, feeding capacity and fecundity of *Cheletogenes ornatus* (C. & F.), a predator of scale insects and phytophagous mites, was investigated in the laboratory in Cairo, Egypt. In individuals reared on eggs and immature stages of the scale insects *Parlatoria oleae* (Colv.) and *Chrysomphalus aonidum* (L.), and of the mites *Tetranychus urticae* Koch and *Cenopalpus pulcher* (C. & F.), the female had 2 nymphal instars and the male had one. Development was more rapid, adult life and oviposition period longer, and fecundity greater in predators fed on eggs, especially those of *Tetranychus* and *Cenopalpus*. Male predators usually emerged as adults before the females. *C. ornatus* attacked greater numbers of prey mites than of scale insects and laid more eggs when reared on mites. The most suitable and preferred prey was *C. pulcher*, followed by *T. urticae, P. oleae* and *C. aonidum* in order of preference. The predator was unable to develop or survive when only plant substances such as maize pollen or date palm pollen, plant sap or honeydew from mealy bugs were provided as food; larvae died within 9 days and adults after 1-14 days, without ovipositing.

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ARABIC SUMMERY

دراسات احيائية على المفترس الأكاروسى المنتمى لعائلة الكيليتدى *Cheletogenes ornatus* عند تغذيته على الفرائس المختلفة

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تم تربية المفترس الأكاروسى الكليتدى *Cheletogenes ornatus* التابع لرتبة أمامية الثغور على درجة حرارة ٢٠، ٢٥°م، ورطوبة نسبية 60-65% على بيض والأطوار الغير كاملة من الأكاروس عديم الثغر *Acarus farrie* . . نجح المفترس الكيليتدى في التغذية على الفرائس المقدمة له. تشير النتائج المتحصل عليها أن للإناث طورين للحورية أما الذكور فلها طور واحد فقط. أظهرت الدراسة وجود فروق معنوية بين الذكور والإناث خلال مرحلة التطور للأطوار للغير الكاملة ودورة الحياة، فكانت أطولها ٢١,٢٨، ٢٩,٧٧ يوما للإناث المتغذية على الأطوار الغيرالكاملة للأكاروس عديم الثغر *A. farrie*، وأقصرها على الذكور المتغذية على بيض الأكاروس *A. farrie* كانت ١٣,٩، ٢٢,٠٨ يوماً على التوالي. سجلت أطول فترة لوضع البيض ٢٢,٥٢ يوما على درجة ٢٥°م، بينما كانت الاقصر فترة لوضع البيض 20.75 يوما على درجة حرارة 20°م عند تغذية المفترس على بيض *A. farrie*. سجلت أعلى خصوبة للإناث المتغذية على بيض *A. farrie* على درجة حارة ٢٥°م و تناقصت لتسجل اقل معدل لها على درجة 20°م. تبين وجود فروق معنوية على معدل الافتراس الذكور والإناث لتأثير درجة الحرارة خلال فترة حياة الطور الكامل ، فسجل أعلى معدل افتراس للذكور والإناث على درجة حرارة ٢٠° م في حين سجل لاقل معدل للتغذية على 25° م.