EFFECT OF TEMPERATURE ON THE BIOLOGY OF THE PREDATOR MITE *CHELETOMORPHA LEPIDOPTERORUM* (SHAW) (ACARI:CHEYLETIDAE)

EL-NAGGAR, M. E.[1], Z. E. ABD AL-AAL [2], ZINAB M. EL-BASHEIR[2] AND AMIRA E. MESBAH[1]

1 Plant Protection Research Institute, ARC, Egypt
2 Fac. Sci., Zoology Dept., Zagazig Univ., Egypt.

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Abstract

The predatory cheyletid mite, *Cheletomorpha lepidopterorum* (Acari: Cheyletidae) reared on nymphal stages of acarid mite, *Tyrophagus ptrescentiae* at three different temperatures (15, 25 and 30 °C) and 65 ± 5 % R. H. in the laboratory. The tested temperatures showed a noticeable effect on the individually development of *Cheletomorpha lepidopterorum* .

•Females of *Cheletomorpha lepidopterorum* tended to deposit their eggs singly in scattered pattern and covered it by a network of fine webs. The temperature 35 °C induced shorter incubation period while at 15 °C gave the longest period. Average predator female passed through two nymphal stages while average predator male has only one nymphal stage. Both predators limited prey abundance. Cannibalism was usually noticed when the prey was absent or scarce. The raise of temperature from 25 °C to 35 °C did not show an obvious response on the biology of *Cheletomorpha* lepidopterorum.

A subequall values of the predator developmental stages and feeding capacity were generally recorded. However, temperature true induced a considerable negative effect on the predator fecundity, as the female laid a total average rate of 85.32, 80.27 and 70.35 eggs at 15, 25 and 35 °C, respectively. The average predator adult female devoured 90.26, 87.62 and 76.27 prey at the same mentioned temperatures, respectively. But these numbers were 26.02, 24.11 and 19.67 prey at the same conditions for males, respectively.

INTRODUCTION

The stored grains are liable to be attaked not only by insects but also by mites which cause direct injury by feeding and its contamination with deep mites and extra makes these sources of food undesirable in addition to digestion. Integrated pest control is a system in which part of control is obtained by biological agents. One of these agent predaceous mites which play a good part in biocontrol. Due to the importance of stored grains as a source of food and to eliminate the usage of chemical application in controlling pests, this study is concerned with the effect of different temperature on the biological aspects of the predator *Cheletomorpha lepidopterorum* (shaw) when using the pest, *Tyrophagus putrescentiae* as a prey.

In Egypt, mites belonging to family Cheyletidae was first recorded by El-Badry and Zaher (1960) who recorded the two species *Cheletogenes ornatus* (C. &F.) and *Eutegenes frater* Volgin. In (1976) Hassan reared *Hemicheyletia bakeri (* Ehara) and El-Enany *et al.* (1992) noticed that the feeding of *Cheletomorpha lepidopterorum* on *T. pytrescentiae* nymphs did not show an obvious response with the change of temperature from 24 to 30 °C .

MATERIALS AND METHODS

A pure culture of the predator mite *Cheletomorpha lepidopterorum was* maintained at Acarology Laboratory of Plant Protection Research Institute, Dokki, Egypt. Plastic sheets of 5 mm thick were cut into small pieces of 4 x 8 cm^2 each, where a hole of 1 cm in diameter and 5 mm deep was made in each, the hole bottom was covered with a layer of plaster of Paris (8 gypsum: 2 charcoal) to a depth of 1.5 cm. A pure culture of *C. lepidpteronum was* established for two successive generations on *Tyrophagus pytrescentiae* nymphs at 25 °C and constant relative humidity 65 $\pm$ 5 % R. H. Adults were sexed and left to deposited their eggs, newly hatched larvae were reared singly during all the predator life span in each of the previously mentioned mites. The predator was fed on *T.pytrescentiae* nymphs at 15, 25 and 35 °C and relative humidity 65 $\pm$ 5 % R. H.

The experimented mites were daily inspected at 8 a.m. and 4 p.m, where a known number of the prey immature was introduced to the predator individuals. The devoured individuals were counted and replaced by other ones. Other necessary data dealing with the predatory biology, fecundity and other biological aspects were continuously 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

Effect of temperature on *C. lepidopterorum* development. *C. lepidopteroum* (Shaw) fed, developed and reproduced with different rates when reared on nymphal stages of the acarid mite, *T. putrescentiae* at l 5, 25 and 35 °C and 65 + 5 % R. H.

Incubation period. The tested temperature showed a noticeable effect on the embryonic development of *C. lepidopterorum .*

The temperature 35 °C induced shorter incubation period, while 15 °C gave the longest period. However, the predator incubation period averaged 4.95, 4.11 and 3.00

days at each of 15, 25, and 35 °C, respectively, while male predator incubation period was 4.32, 4.00 and 2.83 days at the same temperatures, respectively (Table 1)

Immature stages. Both of the three tested temperatures induced subequal periods of female immature stages, although at 35 °C, the young stages gave slightly shorter duration than those obtained at 15 and 25 °C. The female active larva, protonymph, deutonymph and total immature stages lasted an average of 3.11, 2.05, 3.00 and 11.42 days at 15 °C changed to 2.92 , 1.9, 1.86 and 10.31 days at 25 °C and 2.71, 1.72 1.57 and 9.3 days at 35 °C, respectively (Table 1). The quiescent stages were around 1.42 days

On the other hand the male active larva, nymph and immature stages were 3.08, 2.37 and 8.55 days at 15 °C, 2.82,2.17 and 7.31 days at 25 °C and 2.60, 2.1, and 6.65 days at 35 °C, while the quiescent stages were around 1.26 days.

Life cycle. As shown in Table 1, the life cycle of female lasted 16.37, 14.42 and 12.3 days at 15, 25 and 35 °C, respectively. With regard to male, the temperature 35 °C accelerated. development 9.48 days when compared with 15 and 25 °C (12.87 and 11.31 days, Respectively) (Table 2) .The male adults emerged early than the female once. Average predator female had usually two nymphal stages (protonymph and deutonymph). In spite of the predator male has only one nymphal stage.

Life span. TPle female predator life span durated 46.38, 41.63 and 37.99 days at 15, 25 and 35 °C, respectively. On the other hand, the male predator life span durated 45.32, 41.92 and 36.81 days at the trend of temperature, respectively.

Adult longevity. During adulthood, it was clear that the female lived longer at 15 °C (30.01 days) when compared with 25 °C (27.21 days) and 'at 35 °C it was 25.69 days. This showed that the high temperature shorted the predator female longevity. On the other hand, the predator male longevity was 32. 11, 31. 15 and 27. 19 days, respectively.

Pre-oviposition period. It Lasted for 1.15, 1.21 and 1.71 days at 15, 25 and 35 °C, respectively (Table 3)

Oviposition period. It lasted for 24.95, 22.69 and 20.18 days at 15, 25 and 35 °C, respectively (Table 3)

Post-oviposition period. It averaged for 3.91, 3.31 and 3.80 days at 15, 25 and 35°C, respectively Table 3

predator female fecundity. As shown in Table 1 the female of the predatoy mite *C. lepidopterorum* deposited a total average of 85.32, 80.27 and 70.35 at 15, 25 and 35 °C, respectively.

Table 1. Effect of different temperature on the biological aspects of *C. Lepidopterorum* female when fed on *T. pytrescentiae* nymphal stages at relative humidity 65 ± 5 %

Biological aspects		15 °C	25 °C	35 °C
Incubation period		4.95 ± 0.68	4.11 ± 0.92	3.00 ± 1.00
Larva	a	3.11 ± 0.83	2.92 ± 0.91	2.71 ± 0.90
	q	1.40 ± 0.61	1.20 ± 0.35	1.09 ± 0.41
Protonymph	a	2.05 ± 0.81	1.90 ± 0.70	1.72 ± 0.54
	q	1.31 ± 0.50	1.12 ± 0.08	1.00 ± 0.05
Deutonymph	a	2.00 ± 0.43	1.86 ± 0.32	1.57 + 0.61
	q	1.55 ± 0.40	1.30 ± 0.52	1.21 ± 0.38
Total immature		11.42 ± 1.92	10.31 ± 1.22	9.30 ± 1.76
Life cycle		16.37 ± 2.93	14.42 ± 2.62	12.30 ± 1.98
Fecundity		85.32 ± 9.15	80.27 ± 7.03	70.35 ± 6.12

a: active
q: quiescent
± SE : Standard error

Table 2. Effect of different temperature on the biological aspects of *C. lepidopterorum* male when fed on *T. pytrescentiae* nymphal stage at relative humidity 65 ± 5%

Biological aspects		15 °C	25 °C	35 °C
Incubation period		4.32 ± 0.72	4.00 ± 0.95	2.83 ± 0.41
Larva	a	3.08 ± 0.75	2.82 ± 0.70	2.60 ± 0.66
	q	1.50 ± 0.32	1.02 ± 0.34	1.00 ± 0.33
Nymph	a	2. 37 ± 0.51	2.17 ± 0.65	2.10 ± 0.51
	q	1.60 ± 0.12	1.30 ± 0.51	0.95 ± 0.11
Total immature		8.55 ± 3.01	7.31 ± 2.11	6.65 ± 2.60
Life cycle		12.87 ± 3.51	11.31 ± 2.97	9.48 ± 3.17

a: active
q : quiescent
± SE : standard error

Table 3. Effect of temperature on adult longevity and life span of *C. Lepidpterorum* when fed on *T. pytrescentias* at relaive humidity 65 ± 5% R. H.

Temp. °C	Duration of different periods in days ± SE						
	Female					Male	
	Preovip osition	Oviposition.	Postovip osition	Longevity	Life span	Longevity	Life span
15	1.15 ± 0.3	24.95 ± 9.1	3.91 ± 1.1	30.01 ± 9.1	46.38 ± 11.2	32.11 ± 7.4	45.32 ± 13.1
25	1.12 ± 0.3	22.69 ± 8.5	3.31 ± 1.1	27.21 ± 6	41.63 ± 12.1	31.15 ± 8.1	41.92 ± 14.5
35	1.71 ± 0.4	20.18 ± 8.0	3.8 ± 0.9	25.69 ± 7.8	37.99 ± 10.2	27.19 ± 7.3	36.81 ± 13.1

± SE : Standard error

Effect of temperature on the feeding capacity of *C. Lepidopterorum* Immature stage. From Table 4 it seems that the increase of temperature decreased the total average of consumed prey nymph, except for the predatory protonymph in case of female. Accordingly:

1) The total average of attacked prey individuals per female predator larva was 3.33, 3.22 and 1.4 prey at 15, 25 and 35 °C, respectiveily.

2)The protonymph devoured 2.72, 2.6 and 3.5 prey of *T. putrescentiae,* at 15, 25 and 35 °C., respectively

3) For predator deutonymph, these values changed to 3.72, 3.62 and 3.00 prey at 15, 25 and 35 °C, respectively.

4) The female immature stages consumed a total average of 9.77, 9.44 and 7.90 prey individuals per predator at 15, 25 and 35 °C, respectively. On the other hand the male immature stages consumed a total average of 6.60, 6.31 and 4.55 of prey individuals at 15, 25, and 36 °C, respectively. At the same time male young stages proved to be less efficient than those of female (Table 3).

Adult stage. During adult hood, the raise of tmperature slightly decreased the total number of attacked prey nymphs Table 2. During adult female longevity the total average of consumed prey individuals was 90.26, 87.62 and 76.27 at 15, 25 and 35 °C ,respectively, while during the life span these numbers were 99.93, 97.06 and 84.12 prey individuals at the same temperatures, respectively.

The male followed a similar trend of the female. The adult male fed on a total average of 26.02, 24.11 and 19.67 prey individuals at 15, 25 and 35 °C, respectively (Table 3). The raise of temperature from 25 to 35 did not show obvious effect on the biology of *C. Lepedopterorum*, as sub- equal values of the predator developmental stages and feeding capacity were generally recorded. Howerer, temperature true induced a considerable negative effect on the predator fecundity. Fluids of the attacked preys were Completely or less completely sucked by the predator tended to puncture the victim' s body so as to obtain a small quantity of its contents.

Cannibalism was usually noticed when the prey was absent or scarce. The same phenomenon was observed by El-Duweini (1978) where the indivduals of *Cheletomorpha Cauoasica* Rolgin, *Cheletomorpha eckerti* Summer and Price, *Acaropselline docta, Cheyletus Malaccensis*, fed on their eggs or own species in the absence of pery. Youssef *et al.* (1982) reported that *Cheyletus malaccensis* attacked a number of *T. putrescentiae* highly greater than each of the book lice and house fly eggs and fist instar larvae, but the later prey stage highly increased the predadtory fecundity, while EL- Enany *et al.* (1992) mentioned that during the period of *C. Lepidopterorum* immature stages and adulthood, the female devoured 9.2 of 93.25 preys of *T. putresc*entiae and 5.75 or 64.38 eggs on the aforementioned prey species, respectively. Females of *C. Lepidopterorum* tended to deposited their eggs singly in scattered pattern and covered it by a network of fine webs. This agree with the findings of mohamed (1976), EL-Duweini (1978) Hassan (1976) and El- Enany *et al.* (1992) with regard to *C. Lepidopterorum, C. caueasica, C. eckerti, Aearopsellina docta and Lepidocheyla* sp.

Table 4. Effect of temperature on the efficiency of *C. Lepidopterorum* female immature stages fed on *T. putrescentaie* nymphs at relative humidity 65 ± 5 % R. H.

Temp. °C	Average number of devoured prey individuals by predator ± SE			
	Female			
	Larva	Protonymph	Deutonymph	Total immature stages
15	3.33 ± 1.19	2.72 ± 0.86	3.72 ± 2.62	9.77 ± 1.15
25	3.22 ± 1.11	2.60 ± 0.71	3.62 ± 2.35	9.44 ± 1.21
35	1.4 ± 0.92	3.50 ± 1.19	3.00 ± 1.56	7.90 ± 2.8

± SE: Standard error

Table 5. Effect of temperature on the efficiency of *C. Lepidopterorum* when fed on *T. putrescentaie* nymphs at relative humidity 65 ± 5% R. H.

Temp. °C	Average no. of devoured prey individuals/ predatory mole			Adult longevity		Life span	
	Larva	Nymph	Total immature stages	Female	Male	Female	Male
15 °C	3.00 ± 2.18	3.60 ± 1.95	4.55 ± 1.62	90.26	26.02	99.93	32.60
25 °C	2.81 ± 1.71	3.50 ± 1.72	6.31 ± 2.17	87.62	24.11	97.06	30.42
35 oC	1.79 ± 1.11	2.76 ± 1.51	6.60 ± 2.43	76.27	19.67	84.12	24.22

± SE : Standard error

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تأثير درجة الحرارة على بيولوجية المفترس الاكاروسى . *Cheletomorpha lepidopterorum* (Shaw) (Acari : Cheyletidae)

محمود السيد النجار[1] ، زين العابدين السيد عبد العال[2] ،
زينب محمد البشير[2] ، أميرة الدسوقى مصباح[1]

١ – معهد بحوث وقاية النباتات – الدقى – الجيزة – مصر
٢ – كلية العلوم – قسم علم الحيوان – جامعة الزقازيق – مصر

تتم تربية المفترس الاكاروسى *Cheletomorpha lepidopterorum* والذى ينتمى الى عائلة Cheyletidae على طورى الحورية المختلفة للاكاروس *Tyrophagus putrescentiae* عند درجات حرارة ١٥ و ٢٥ و ٣٥° م ورطوبة نسبية مقدارها ٦٥ ± ٥% فى المعمل حيث أوضحت درجات الحرارة تأثيرا واضحا على تطور الافراد .

ولوحظ ان إناث المفترس تميل الى وضع بيضها مبعثرة وتغطيها بطبقة من الخيوط الدقيقة وكانت درجة الحرارة ٣٥°م قد قللت من فترة حضانة البيض وعلى العكس من ذلك فقد أدت درجة الحرارة ١٥ °م الى زيادة هذه الفترة كما لوحظ ايضا ان المفترس يمر من خلال طورين من الحوريات بينما الذكر له طور واحد كما لوحظت ظاهرة Cannibalism لهذا المفترس حتى فى ظل غياب الفريسة . ولم يلاحظ اى تأثير لدرجة الحرارة حينما زادت من ٢٥ الى ٣٥°م على المظاهر البيولوجية للمفترس .

كما دلت الدراسة أيضا على ان درجة الحرارة أثرت بصورة سالبة على خصوبة الأنثى للمفترس حيث كان عدد البيض ٨٥,٢٢ ، ٨٠,٢٧ ، ٧٠,٣٥ بيضة عند درجة الحرارة ١٥ و ٢٥ و ٣٥°م على التوالى وكان معدل استهلاك المفترس للفرائس ٩٠,٢٦ و ٨٧,٦٢ و ٧٦,٢٧ فريسة فى حالة الفرد البالغ الانثى بينما كان ٢٦,٠٢ و ٢٤,١١ و ١٩,٦٧ فريسة على التوالى فى حالة الذكر .