

Bionomics of the Predatory Mite *Acaropsis sollers* (Actinedida: Cheyletidae), as Egg Predator of Two Bruchid Beetle Species Infesting Stored Legumes

Salem, S.E.¹, A.M. Zaki¹, and M.A.M. Abou-Tayesh²

¹Dept. of Econ. Entomol. & Agric. Zool., Fac. of Agric. Menoufia Univ., Egypt.

²Agric. Res. Station, Sakha, Kafr El-Sheikh, Egypt.

ABSTRACT

The developmental periods, adult longevity and life span of the predatory mite *Acaropsis sollers* (Rohd.) were studied on eggs of cowpea beetles for the first time. Females and males were reared on eggs of the southern cowpea beetle, *Callosobruchus maculatus* (Fabr.) and the pulse cowpea beetle, *Callosobruchus chinensis* (L.) under the laboratory conditions of 25°C ± 2 °C and 65% ± 5% R.H. As results of the experiments and observations the following points had been established and clarified:

- 1- The incubation periods of the predatory mite eggs averaged 5.7 and 4.7 days for females, 5.7 and 4.0 days for males on eggs of *C. maculatus* and *C. chinensis*, respectively.
- 2- The hatching larvae survived a few hours, did not feed and remain near the eggshells.
- 3- The nymphal stage of the predatory mites lasted 9.3 and 9.0 days to reach the adult female, while for adult male averaged 9.0 and 6.3 days on eggs of *C. maculatus* and *C. chinensis*, consecutively. In fact, there is only one nymphal morph for both female and male.
- 4- The longevity of adult male is shorter than that of the adult female. It averaged 6.3 and 6.0 days, while for female averaged 15.3 and 14.3 days on eggs of *C. maculatus* and *C. chinensis*, respectively.
- 5- The life cycles of females were 15.0 and 13.7 days, while for male averaged 6.3 and 11.0 days on eggs of *C. maculatus* and *C. chinensis*, respectively.
- 6- Life span: for females averaged 30.3 and 28.0 days, while for male averaged 18.7 and 17.0 days on eggs of *C. maculatus* and *C. chinensis*, successively.

Additional key words: Developmental periods, *Callosobruchus maculatus* and *C. chinensis*.

INTRODUCTION

Legume crops are by far among the important sources of human dietary protein, calories, and for export in Egypt as well as many countries of the world (Bressani, 1985; Hammad, 1997; Hashem and Risha, 1998 and Harminder and Ramzan, 2001).

Storage is an important factor in the production and usage of grain legumes, seeds and food products. These crops and bi-products are liable to infestation by some pests in fields and stores. Utilization of crops in many countries is reduced due to destruction by larvae of the southern cowpea beetle, *Callosobruchus maculatus* (Fabr.) and the cowpea beetle *Callosobruchus chinensis* (L.) (El-Sawaf, 1956; Pankiewicz et al., 1984, Messina and Renwick, 1985 and Shaaya et al., 1997).

Hafez (1977) recorded 12 parasitic and predatory mite species associated with stored seeds and food products in stores and flourmills in Cairo. Amongst *A. sollers* was the most common species, which was found in all types of

stored products. **Al-Badry et al. (1980)** indicated that ***A. sollers*** was the most common predators associated with almost all stored types of stored products. **Al-Yossif and Soliman (1983)** recorded seven species of cheyletid mites in Saudi Arabia, the only species of economic interest was ***A. sollers***, which was found associated with acarid mites in stored barely. **Eliopoulos et al. (2002)** recorded ***A. sollers*** for the first time in Greek stored products.

Classical biological control is based on the importation of exotic natural enemies-parasites, predators or pathogens-and their permanent establishment in new habitats. This has been the most rewarding approach to the utilization of natural enemies in pest management to date and has resulted in hundreds of successful projects (**Clausen, 1978** and **Rosen and Huffaker, 1983**).

Information on biological aspects of the predatory mite ***Acaropsis sollers*** (Rohd.) was insufficient. Thereby, the present study is an attempt to contribute to the bionomics of this predacious mite species in controlling two species of cowpea beetles i.e., ***C. maculatus*** and ***C. chinensis*** for the first time under laboratory conditions of $25^{\circ}\text{C} \pm 2$ and $65\% \pm 5$ R.H.

MATERIALS AND METHODS

The laboratory experiments were carried out at the laboratories of Economic Entomology and Agricultural Zoology Department, Faculty of Agriculture, University of Menoufia, Shebin El-Kom and the Agricultural Research Station, Sakha, Kafr El-Sheikh from March to June 2003.

Laboratory and storage room experiments were conducted to evaluate the biology of the predatory cheyletid mite ***A. sollers*** as a biological control agent on eggs of both bruchid beetle species, the southern cowpea beetle, ***C. maculatus*** and the pulse cowpea beetle, ***C. chinensis*** were evaluated. However, evaluation was run on the basis of developmental period, oviposition, fecundity and adult life span.

1. Mass culture for the predatory mite ***A. sollers***:

For mass rearing of the predatory mite the following method must be put in consideration. The Petri dishes edges were surrounded by Vaseline to avoid escaping of mites. These Petri dishes were provided with a layer of sterilized bran rice and placed in desecrators with well fitting and slightly greased cover were used. The desecrator and its contents was provided with a tray filled with water to be kept under laboratory conditions for 2 – 3 weeks to come into equilibrium with the atmospheric humidity (**El-Kifl and Metwally, 1971**). Some individuals of ***Tribolium castaneum*** (Herbst) were transferred into every Petri dish as preys. The mass rearing of the cheyletid mite was initiated two weeks later by transferred group of females and males using a camel's hair brush and placed into the greasy edges of the Petri-dishes. The media lasted for one month to obtain the culture of the predacious mites.

2. Collection method:

For this purpose, alive adults (females and males) of the predatory cheyletid mite ***A. sollers*** were collected from mass culture on bran rice. Tullgren

funnels were used to isolate the predatory mites into Petri dishes (10-cm in diameter), containing a layer of bran rice.

3. Rearing the predatory mite *A. sollers*:

To study the biology of this predacious mite, five adult females and/or two males (each alone) were placed in Petri dishes provided with certain number of both cowpea beetle species eggs on cowpea seeds and replicated three times. Mite females or males were left till the death under the laboratory conditions of $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and $65\% \pm 5\%$ R.H. The developmental periods, adult longevity, total life span and fecundity were counted and recorded.

RESULTS AND DISCUSSION

Biology of the predatory mite *Acaropsis sollers*:

The bionomics of *A. sollers* females and males were carried out for the first time on eggs of the bruchid beetles. However, because the authors did not find any reference explaining this point of study.

Results in Tables 1 and 2 showed the duration in days of females and males of the predatory mite *A. sollers*, which were reared on eggs of both *C. maculatus* and *C. chinensis*.

1. Developmental stages and life span on *C. maculatus* eggs:

Data shown in Table 1 indicated the developmental periods and life span in days of the predatory mite *A. sollers* females and males on eggs of the southern cowpea beetles, *C. maculatus*, which were reared on cowpea seeds from March to June 2003.

As results of experiments and observations on the biology of *A. sollers* the following points had been established and clarified:

Egg stage: Adult females deposit their eggs around the surfaces of the cowpea seeds near the eggs of preys. The incubation period ranged from 5 to 6 days with an average of 5.7 ± 0.3 days for females, while for males ranged from 5 to 6 days with an average of 5.7 ± 0.3 days. It noteworthy to mention that the developmental period of larval stage of *A. sollers* stays 2 – 3 hours to moult and reach the nymphal stage. However, the hatching larvae did not feed and remain near the eggshells.

Nymphal stage: It lasted from 9 to 10 days with an average of 9.3 ± 0.3 days to reach the adult female. The duration of nymphal stage of male ranged between 8 – 10 days and averaged 9.0 ± 0.6 . In fact, there is one nymphal form only for female and male.

Adult stage: Adult longevities of males are shorter than that of females. The male longevity ranged between 6 and 7 days and averaged 6.3 ± 0.3 days. Whilst, the female longevity ranged between 14 and 18 days with an average of 15.3 ± 1.3 days. The adult female longevity involves three periods:

- **Pre-oviposition period:** The pre-oviposition period lasted 4 – 5 days and averaged 4.7 ± 0.3 days.
- **Oviposition period and fecundity:** The oviposition period ranged from 4 to 6 days with an average of 5.0 ± 0.6 days. The average number of

eggs produced per one female ranged from 8.8 to 13.4 eggs/female and with an average of 11.3 ± 1.3 eggs/female at $25 \pm 2^\circ\text{C}$ and $65 \pm 5\%$ R.H.

- **Post-oviposition period:** The post-oviposition period lasted from 5 to 7 days and averaged 5.7 ± 0.7 days.

Life cycle: The life cycle of females ranged from 14 and 16 days and averaged 15.0 ± 0.6 days. While for male it ranged between 6 and 7 days and averaged 6.3 ± 0.3 days.

Life span: The life span of females ranged from 28 to 33 days and averaged 30.3 ± 1.5 days. The life span of males lasted 17 – 20 days and averaged 18.7 ± 0.9 days. Also, the life span of females is longer than the life span of male under the same conditions.

2. Developmental stages and life span on *C. chinensis* eggs:

Data shown in Table 2 indicated the developmental periods and life span in days of the predatory mite *A. sollers* females and males on eggs of the pulse cowpea beetles, *C. chinensis*, which were reared on cowpea seeds from March to June 2003.

Egg stage: Adult females lay their eggs around the surfaces of the cowpea seeds near the eggs of preys. The incubation period ranged from 4 to 5 days with an average of 4.7 ± 0.3 days for females, while for males ranged from 4 to 5 days with an average of 4.0 ± 0.3 days.

Nymphal stage: It lasted from 8 to 10 days with an average of 9.0 ± 0.6 days to reach the adult female. The duration of nymphal stage of adult male ranged from 6 to 7 days and averaged 6.3 ± 0.3 days.

Adult stage: The duration of adult males is shorter than that of the adult female. The males longevity period ranged between 5 and 7 days and averaged 6.0 ± 0.6 days. Whilst, the females longevity period ranged between 13 and 16 days with an average of 14.3 ± 0.9 days. The adult females longevity period involves three periods:

- **Pre-oviposition period:** The pre-oviposition period lasted 4 – 5 days and averaged 4.3 ± 0.3 days.
- **Oviposition period and fecundity:** The oviposition period ranged from 4 to 5 days with an average of 4.3 ± 0.3 days. The average number of eggs produced per one female ranged from 7.8 to 10.8 eggs/female and with an average of 8.9 ± 1.0 eggs/female at $25^\circ\text{C} \pm 2$ and $65\% \pm 5$ R.H.
- **Post-oviposition period:** The post-oviposition period lasted 5 – 7 days and averaged 5.7 ± 0.7 days.

Life cycle: The life cycle of examined females ranged from 13 to 14 days and averaged 13.7 ± 0.3 days, while for males averaged 11.0 ± 0.0 days.

Life span: The life span of females ranged from 27 to 29 days and averaged 28.0 ± 0.6 days. The life span of males lasted 16 – 18 days and averaged 17.0 ± 0.6 days.

3. Comparison between bionomics of *A. sollers* on eggs of both bruchid beetle species:

Obtained results in Tables 1 and 2 indicated that the life span and fecundity of this predacious mite were differed during its rearing on eggs of both bruchid beetle species.

Results indicated that under the laboratory conditions the average of duration periods and life span of the predacious mite *A. sollers* differed when reared on eggs of the southern cowpea beetle, *C. maculatus* and the pulse cowpea beetle, *C. chinensis*. Whatever, the life span of males *A. sollers* was shorter than the span of the females.

On the other hand, as shown in Tables 1 and 2, the fecundity or the average numbers of eggs laid by *A. sollers* females were higher for females, which were reared on eggs of *C. maculatus* than that on eggs of *C. chinensis*.

As results of inspections and observations on the bionomics of this predacious mite species, it could be concluded that: 1- The life cycles of the predatory mite *A. sollers* females and males have three developmental stages i.e., egg, larva and nymph. In addition, larvae survived very a few hours only and did not feed. 2- Cannibalism was observed in the adult stages of this mite species especially at the time that the preys (eggs of insects, immature and adult stages of other mite species) were absent or in scarce numbers. The present results are in line with those of Kumar and Naqi (1990) who denoted that *A. sollers* consumed *C. malaccensis* and its own eggs. *A. sollers* is thus cannibalistic as well as being a natural enemy of some mite species.

Yousef *et al.* (1992) reared the predatory cheyletid *A. docta* (= *A. sollers*) under controlled conditions. Cannibalism was most frequently observed when *A. docta* was reared on 1st instar larvae of *T. castaneum*. Feeding on *T. castaneum* resulted in duration of egg incubation and development of female immatures averaging 9.76 and 26.45 days, respectively. The male passed through one nymphal stage (lasting 8.7 days) and emerged earlier than the female. Adult female and male longevity averaged 70.86 and 37.35 days, respectively.

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Table 1. Biology of the predatory cheyletid mite *A. sollers* reared on eggs of *C. maculatus* under laboratory conditions of $25^{\circ}\text{C} \pm 2$ and $65\% \pm 5$ R.H.

Developmental stages	*Average \pm S. E. and ranges of duration periods in days for females and males			
	Female		Male	
	Average	Range	Average	Range
Egg stage	5.7 ± 0.3	5 – 6	5.7 ± 0.3	5 – 6
Nymphal stage	9.3 ± 0.3	9 – 10	6.7 ± 0.3	6 – 7
Pre-oviposition	4.7 ± 0.3	4 – 5	-	-
Oviposition	5.0 ± 0.6	4 – 6	-	-
Post-oviposition	5.7 ± 0.7	5 – 7	-	-
Life cycle	15.0 ± 0.6	14 – 16	12.3 ± 0.7	11 – 13
Adult longevity	15.3 ± 1.3	14 – 18	6.3 ± 0.3	6 – 7
Life span	30.3 ± 1.5	28 – 33	18.7 ± 0.9	17 – 20

* Biological treatments of females and males based on 3 replicates and \pm S. E. = \pm Standard Error.

Table 2. Biology of the predatory cheyletid mite *A. sollers* reared on eggs of *C. chinensis* under laboratory conditions of $25^{\circ}\text{C} \pm 2$ and $65\% \pm 5$ R.H.

Developmental stages	*Average \pm S. E. and ranges of duration periods in days for females and males			
	Female		Male	
	Average	Range	Average	Range
Egg stage	4.7 ± 0.3	4 – 5	4.0 ± 0.3	4 – 5
Nymphal stage	9.0 ± 0.6	8 – 10	6.3 ± 0.3	6 – 7
Pre-oviposition	4.3 ± 0.3	4 – 5	-	-
Oviposition	4.3 ± 0.3	4 – 5	-	-
Post-oviposition	5.7 ± 0.7	5 – 7	-	-
Life cycle	13.7 ± 0.3	13 – 14	11.0 ± 0.0	-
Adult longevity	14.3 ± 0.9	13 – 16	6.0 ± 0.6	5 – 7
Life span	28.0 ± 0.6	27 – 29	17.0 ± 0.6	16 – 18

* Biological treatments of females and males based on 3 replicates and \pm S. E. = \pm Standard Error.

الملخص العربي

بيولوجية اللحم المفترس أكاروبسيس سولارس (الحلم الأكتينيديا : عائلة
كليتيدي) مفترس لبيض نوعان من خنافس البقول (غمدية الأجنحة: عائلة
خنافس البقول)

سعد السيد سالم ١ ، أمينة محمد زكي ١ ، محسن عطية محمد أبو طايض ٢

١- قسم الحشرات الاقتصادية والحيوان الزراعي ، كلية الزراعة جامعة المنوفية.

٢- محطة البحوث الزراعية بسخا ، كفر الشيخ .

- درست فترات للنمو لإناث وذكور اللحم المفترس *Acaropsis solers* لأول مرة بتربية على بيض خنفساء اللوبيا الغربية وخنفساء اللوبيا تحت الظروف المعملية عند درجة حرارة ٢٥ م° ± ٢ ورطوبة نسبية ٦٥% ± ٥ . وكننتيجة للتجارب والمشاهدات أمكن إيضاح النقاط التالية:
- ١- كان متوسط فترة حضانة بيض إناث اللحم المفترس ٥,٧ و ٤,٧ يوم وللذكور ٥,٧ و ٤ يوم على بيض خنفساء اللوبيا الغربية و خنفساء اللوبيا على التوالي .
- ٢- اليرقات تعيش لبضع ساعات ولا تتغذى.
- ٣- كان متوسط فترة طور الحورية للحلم المفترس ٩,٣ و ٩ يوم حتى تصل إلى الأنتى الكاملة ، بينما كانت للذكر بمتوسط ٩ و ٦,٣ يوم على بيض خنفساء اللوبيا الغربية و خنفساء اللوبيا على الترتيب . في الحقيقة كان لهذا اللحم طور واحد للحورية لكلا الجنسين.
- ٤- كان متوسط طول فترة حياة اللحم الكامل الذكر ٦,٣ و ٦ يوم أقصر منها للإناث الكاملة حيث كانت بمتوسط ١٥,٣ و ١٤,٣ يوم على بيض خنفساء اللوبيا الغربية و خنفساء اللوبيا على التوالي .
- ٥- كان متوسط نورة حياة الإناث ١٥ و ١٣,٧ يوم بينما للذكور كانت ٦,٣ و ١١ يوم على بيض خنفساء اللوبيا الغربية و خنفساء اللوبيا على التوالي .
- ٦- كان متوسط فترة الحياة الكلية (المنقضية) للإناث ٣٠,٣ و ٢٨ يوم في حين كان المتوسط ١٨,٧ و ١٧ يوم للذكور اللحم المفترس على بيض خنفساء اللوبيا الغربية و خنفساء اللوبيا على التوالي .