Nota / Note

BIOLOGICAL ASPECTS OF THE IMMATURE STAGES OF *Ceraeochrysa everes* (BANKS) (NEUROPTERA: CHRYSOPIDAE)

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ABSTRACT: A knowledge of the behavior and biological aspects of natural enemies is extremely important for the establishment of biological control programs. Biological aspects of the larvae, pre-pupae and pupae of the predator *Ceraeochrysa everes* (Banks) were studied. Larvae of the adult F_1 generation were reared in the laboratory (25 ± 2°C, 65 ± 10 % RH and 14h photophase) on eggs of the Angoumois grain moth *Sitotroga cerealella* (Olivier). The duration and viability of the embryonic period, development of the immature stages and egg-adult period were evaluated. The mean embryonic period was 5.0 days, while the mean durations of the first, second and third instars were: 5.1 ± 0.03; 4.3 ± 0.05 and 4.5 ± 0.05 days, respectively, with viability exceeding 90%. Duration of the larval, pre-pupal and pupal stages averaged 13.9 ± 0.07; 5.7 ± 0.07 and 9.6 ± 0.12 days, respectively. Duration of the biological cycle was 34 ± 0.11 days on average. *S. cerealella* eggs were not suitable for rearing *C. everes* under laboratory conditions because they affected predator development.
Key words: insecta, predator, biology, green lacewing

ASPECTOS BIOLÓGICOS DOS ESTÁGIOS IMATUROS DE *Ceraeochrysa everes* (BANKS) (NEUROPTERA: CHRYSOPIDAE)

RESUMO: Para o estabelecimento de um programa de controle biológico, o conhecimento de alguns aspectos biológicos e de comportamento dos inimigos naturais é de extrema importância. Os aspectos biológicos do desenvolvimento larval e pupal do predador *Ceraeochrysa everes* (Banks) foram estudados. Larvas oriundas de adultos da geração F_1 foram mantidas em laboratório a 25 ± 21°C, 70 ± 10 % UR e fotofase 14 horas, sendo alimentadas com ovos de *Sitotroga cerealella* (Olivier). A duração e viabilidade do período embrionário, estágios imaturos de desenvolvimento e o período de ovo a adulto foram avaliados. O período embrionário foi em média de 5,0 dias, enquanto que as durações médias para o primeiro, segundo e terceiro instares foram de 5,1 ± 0,03; 4,3 ± 0,05 e 4,5 ± 0,05 dias, respectivamente, com viabilidade superior a 90 %. Os estágios larval, pré-pupal e pupal apresentaram duração média de 13,9 ± 0,07; 5,7 ± 0,07 e 9,6 ± 0,12 dias, respectivamente. A duração do ciclo biológico foi de 34 ± 0,11 dias em média. Ovos de *S. cerelella* não foram adequados para a manutenção de *C. everes* em laboratório, por interferir no desenvolvimento do predador.
Palavras-chave: insecta, predador, crisopídeo, biologia

INTRODUCTION

The abusive use of agricultural pesticides has contributed to ecological degradation, contaminating the environment, promoting the development of insect pest resistance and the reduction of natural enemy populations, thus justifying the adoption of other pest control methods. In this context, the use of certain species of chrysopids as biological control agents has received considerable attention, because they are voracious predators and exhibit a high potential in reducing populations of many pest insects (Ridgway & Jones, 1969; Scopes, 1969; Hagley, 1989; Gravena & Cunha, 1991).

The duration of development and the survival of green lacewings are influenced by a number of factors, such as temperature, relative humidity, photoperiod, and food quality and quantity (Canard & Principi, 1984). The influence of these factors was studied by Núñez (1988), for *Ceraeochrysa cincta*, and Silva et al. (1994) and Santa-Cecília et al. (1997) for *Ceraeochrysa cubana*.

Although the systematics and the biology of several groups have been intensely studied, the investigation of different species of Neuroptera, including some families that have not been adequately studied, should be considered (Stelzl & Devetak, 1999). Considering that information on the biological aspects of lacewings is a pre-requisite for success when using these predators in biological control programs, the objective of this project was to study the larval and pupal developments of *C. everes* in laboratory conditions.

MATERIAL AND METHODS

The experiment was set in the Chrysopid Biosystematics and Mass Rearing Laboratory (25 ± 2°C;

65 ± 10% RH; 14-hour photophase), of the Plant Protection Department at "Faculdade de Ciências Agrárias e Veterinárias, UNESP Jaboticabal", using F_1 generation insects. The insects were identified by Dr. Sérgio de Freitas and the stock rearing was kept by using ten insect couples enclosed in a PVC tube cage 10 cm in diameter and 23 cm in height, lined with a sheet of white paper as substrate for oviposition. Adults were fed a yeast + honey (1:1) mixture, offered through a piece of plastic foam plugged to a 10 mL glass container. The eggs were collected daily and kept within plastic tubes (5.5 cm in height and 8.0 cm in diameter) at a density of 10 eggs per container. The newly-hatched larvae were fed eggs of the lepidopteran *Sitotroga cerealella* (Olivier, 1819), which were glued to 6.3; 12.3, and 18.8 cm^2 pieces of poster board, and offered to first, second and third instar larvae, respectively. A total of 148 eggs were placed in glass vials (2.5 cm diameter and 8.5 cm height), sealed with pin punctured PVC film. The larvae were fed with moth eggs these vials til adult emergence. The following parameters were recorded daily: embryonic period and egg viability, duration and viability of each larval instar, pre-pupal and pupal stages, and period from egg to adult. The period (days) was registered pre-pupal stage, from the beginning of cocoon spinning to the last larval exuvia, observed inside the cocoon.

RESULTS AND DISCUSSION

Mean duration of the embryonic period was 5 days (Table 1). Similar results were obtained by Moraes & Carvalho (1991) and Silva et al. (1994) for *C. cubana* kept at 25°C and RH 70 ± 10%, and for *C. cincta* (Núñez, 1988), with an average of 6 ± 2.1 days when the eggs were placed at 25.3°C, which indicates the occurrence of a slight variation of the embryonic period for different species of this genus. The average viability for this period was 80.4%, lower than that (97.7%) found for *C. cubana* by Silva et al. (1994), but close to the 79% related by Moraes & Carvalho (1991).

When the larvae were fed eggs of *S. cerealella* the average duration of the first, second and third instars were: 5.1 ± 0.03; 4.3 ± 0.05 and 4.5 ± 0.05 days, respectively (Table 1). Moraes (1989), studying *C. cubana* larvae fed *A. kuehniella* eggs plus *Toxoptera* sp. and maintained at 24°C, measured an average first instar duration of 4.7 days, while Silva et al. (1994) verified an average duration of 4.0 days. Results for the second instar are similar to those found by Santa-Cecília et al. (1997) for *C. cubana* larvae fed *A. kuehniella*, and to those obtained by Núñez (1988) for *C. cincta* larvae fed *S. cerealella*. For the third instar, the average duration in *C. everes* was different from the duration found by Núñez (1988).

The mean duration for the larval stage was 13.9 ± 0,07 days (Table 1). For *C. cubana* this value stage was 12.7 days (Santa-Cecília et al., 1997), and 15 days (Venzon & Carvalho, 1993). These divergent values found for species of the genus *Ceraeochrysa*, should be due to differences in the environmental conditions under which the experiments were carried out, and to the capacity of each species to efficiently utilize a given type of prey. The viabilities for the instars and the larval period were higher than 90%, thus showing that the diet and the temperature, humidity and photophase were fairly suitable for larval development.

The mean duration of the pre-pupal stage was 5.7 ± 0.07 days (Table 1). A lower value (one day) was obtained by Núñez (1988) for the pre-pupal stage in *C. cincta*. The mean viability for the pre-pupal stage in *C. everes* (91.9%) was lower than that (100%) observed by Venzon & Carvalho (1993), for *C. cubana* maintained at 20; 25; and 30°C, regardless the diets tested.

In the pupal stage the mean duration was 9.6 ± 0.12 days (Table 1). The 66.7% viability obtained for this stage was close to that found by Venzon & Carvalho (1993) for *C. cubana* maintained at 20°C. A higher viability was obtained by Santa-Cecília et al. (1997) when *C. cubana* larvae were fed *A. kuehniella* eggs and maintained at 25°C.

Table 1 - Mean duration in days (± SE), range (days) and viability of the different developmental stages of *C. everes* Temperature 25 ± 2°C, RH 65 ± 10% and 14h photophase).

Development	n	Duration	Range	Viability
		days		--------- % --------
Embryonic period.	148	5.0 ± 0.00	(5-5)	80.4
1st instar	119	5.1 ± 0.03	(5-7)	93.3
2nd instar	111	4.3 ± 0.05	(4-5)	100
3rd instar	111	4.5 ± 0.05	(4-6)	100
Larval stage	111	13.9 ± 0.07	(13-19)	93.3
Pre-pupal stage	102	5.7 ± 0.07	(4-7)	91.9
Pupa	68	9.6 ± 0.12	(6-11)	66.7
Period from egg to adult	47	34.0 ± 0.11	(33-36)	31.7

SE = Standard error of the mean n = number of insects used

The average duration of the period from egg to adult was 34 ± 0.07 days (Table 1). Similar results were found by Núñez (1988) for *C. cincta* maintained at 25.3°C, and by Silva et al. (1994) for *C. cubana* in the F2 generation, at 25°C. Although the *C. evere* larvae fed *S. cerealella* eggs showed high viability values for the different instars, there was malformation of pupae and consequently lower emergence of adults (33%). This suggests the need to supplement this diet. Santa-Cecília et al. (1997) verified that the percentage of adults of *C. cubana* emerging was 75 and 95% when the larvae were fed eggs of *A. kuehniella* only or supplemented with the *Pinnaspis* sp. (Hemiptera: Diaspididae) However, when this lacewing was fed *Pinnaspis* sp. only, the viability was 50%, thus showing the importance of food during the larval stage upon the subsequent stages.

The avid consumption of some species of prey by green lacewings does not necessarily indicate that those prey species are nutritionally adequate. This was evidenced when eggs of *S. cerealella*, a highly accepted prey by the three instars of *C. everes*, induced high pupal mortality.

CONCLUSION

Considering the mass rearing of *C. everes*, *S. cerealella* eggs were not suitable for maintaining these insects in the laboratory, because they interfere with the predator development. The results demonstrate the need for food supplementation or even the use of other prey. However, *C. everes* possesses a potential that remains to be explored.

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Received September 19, 2001