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Biological Aspects of *Autoplusia egena* (Guenée) (Lepidoptera: Noctuidae, Plusiinae)

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Aspectos Biológicos de *Autoplusia egena* (Guenée) (Lepidoptera: Noctuidae, Plusiinae)

RESUMO - *Autoplusia egena* (Guenée) é uma mariposa distribuída em todo continente americano. Suas lagartas alimentam-se de plantas pertencentes a diversas famílias incluindo cultivos de grande importância como soja e feijão. Objetivando contribuir para o conhecimento da sua biologia em laboratório, considerando duração e morfometria de cada fase de desenvolvimento, foi realizada uma criação laboratorial a 25 ± 1°C, 70 ± 10% UR e 14h de fotofase. As lagartas foram alimentadas com folhas de feijão-preto e os adultos com solução de mel a 10%. Os resultados expressos pela média (± EP) para os períodos de cada estágio, em dias, foram: ovo 3,0 ± 0,00; lagarta 15,7 ± 1,25; pré-pupa 1,9 ± 0,05; pupa 8,8 ± 0,09 e adulta: longevidade 12,1 ± 0,95, pré-oviposição 5,4 ± 0,50, oviposição 6,3 ± 1,10 e pós-oviposição 1,4 ± 0,87. As lagartas passaram por cinco ínstares cujos valores médios das larguras das cápsulas cefálicas, em mm foram 0,302 ± 0,001; 0,500 ± 0,003; 0,854 ± 0,008; 1,424 ± 0,011 e 2,744 ± 0,053. As pupas apresentaram comprimento, largura e peso médio de 16,965 ± 0,003 mm, 4,674 ± 0,040 mm e 0,217 ± 0,003 g, respectivamente.

PALAVRAS-CHAVE: Desenvolvimento, inseto, morfometria, *Phaseolus vulgaris*, falsa-medideira

ABSTRACT - *Autoplusia egena* (Guenée) is a moth distributed throughout the Western hemisphere. The larvae have already been found feeding on several different plant families, including important crops such soybeans and beans. To contribute to the knowledge of its biology in laboratory conditions, and considering the duration and the morphometry of each development stage, a laboratorial rearing was accomplished at 25 ± 1°C, 70 ± 10% RH and 14h photophase. The larvae were fed with black bean leaves and the adults were fed with a honey solution at 10%. The results, expressed by the mean (± SE), for the periods of each stage were: egg 3.0 ± 0.00 d; larva 15.7 ± 1.25 d; pre-pupa 1.9 ± 0.05 d; pupa 8.8 ± 0.09 d and adult: longevity 12.1 ± 0.95 d, pre-oviposition 5.4 ± 0.50 d, oviposition 6.3 ± 1.10 d and post-oviposition 1.4 ± 0.87 d. The larvae went through five instars, for which the mean width of the cephalic capsules were 0.302 ± 0.001 mm; 0.500 ± 0.003 mm; 0.854 ± 0.008 mm; 1.424 ± 0.011 mm and 2.744 ± 0.053 mm. The average length, width, and weight of the pupae were 16.965 ± 0.003 mm, 4.674 ± 0.040 mm and 0.217 ± 0.003 g, respectively.

KEY WORDS: Development, insect, morphometric, *Phaseolus vulgaris*, semi-looper

The subfamily Plusiinae (Lepidoptera: Noctuidae) is comprised of moths with a robust body, small to average size, usually with a characteristic metallic spot in the center of the forewing. Their larvae, known as semi loopers, are characterized by the combination of biordinal crochets with the first two pairs of prolegs, on abdominal segments three and four, absent or vestigial, which determines their locomotion as "measuringworms" (Eichlin & Cunningham 1978, Lafontaine & Poole 1991).

Most of these species are economically important because the larvae feed on several crops of substantial economic value, such as bean, *Phaseolus vulgaris* L., soybean, *Glycine max* L. (Merrill), and several aromatic and oleraceous plants (Eichlin & Cunningham 1978, Lafontaine & Pooole 1991). Additionally, recent studies have shown their usefulness as environmental indicators (Kitching *et al*. 2000, Miller *et al*. 2003). However, to better manage the pest species or, to use them in ecological studies, basic knowledge of these species is necessary.

Autoplusia egena (Guenée) is distributed throughout the Western Hemisphere, from the United States (Eichlin & Cunningham 1978, Lafontaine & Pooole 1991) to Uruguay (Biezanko *et al*. 1957, Biezanko *et al*. 1974). In the United States the larvae, commonly referred to as the "bean leafskeletonizer" are moderately serious pests that attack bean and soybean crops (Eichlin & Cunningham 1978, Lafontaine & Poole 1991).

Among the information available for this species, are descriptions of the larvae (Crumb 1956, Eichlin & Cunningham 1978, Lafontaine & Poole 1991), the adults (Eichlin & Cunningham 1978, Lafontaine & Poole 1991), and their host plants (Silva *et al*. 1968, Biezanko *et al*. 1974, Eichlin & Cunningham 1978, Lafontaine & Poole 1991).

Basic studies on biology conduced by Shorey & Hale (1965), Canerdey & Arant (1967), Khalsa *et al*. (1979) and Shour & Sparks (1981) relate to other species within the same subfamily. Because of the lack of basic biological information, our objective in this study was to understand some basic aspects of the biology of *A. egena*, especially duration and morphometry of each stage of development.

Material and Methods

Rearing was conduced at the CARVI/UCS Laboratório de Biologia at 25 ± 1°C, 70 ± 10% RH and 14h photophase. The colony started with five adults collected by the second author at the University campus, in Bento Gonçalves, RS, on October 20th, 2004.

Eggs were placed individually in petri dishes lined with filter paper, which were moistened daily with distilled water. The egg incubation time was recorded for each egg.

Groups of 20 neonate larvae, ecloded at the same day, were placed on black-bean plants (*P. vulgaris*), propagated individually in five 2 L vases. Each plant with the larvae was kept in an individual glass vessel (50 x 50 x 50 cm) whose surface was covered with plastic film. The bottom of the vessel was lined with filter paper to make it easier to clean and to collect the cephalic capsules on a daily basis.

Evaluation of larval growth was accomplished by cephalic capsule measurements of each individual. Measurements were conduced in a stereoscopic microscope with a micrometric ocular (0.01 mm resolution). To identify the instars, a frequency distribution (Parra & Haddad 1989) was determined and compared to Dyar's rule (Dyar 1890).

Prepupae were placed individually in 100 ml glass containers. After they transformed into pupae they were sexed (Butt & Cantu 1962), weighted (mg), and measured (length and width) (using a digital pachymeter, 0.01 mm resolution) two days after pupation. The pupae were kept individually in 100 ml glass vials on filter paper moistened daily until adult emergence.

The adults were placed in male-female pairs in cylindrical transparent PVC containers (12 cm diameter x 18 cm height). A petri dish was placed on the botton of the cage and the top of it was covered with white voile. The cages were covered internally with filter paper. For feeding, the adults were offered a solution of 10% honey in a hydrophilic cotton pad, in 5 ml glass containers. The containers were replaced daily. Longevity, pre-oviposition period (defined as the interval from adult emergence to the onset of oviposition), reproductive period (interval from the first to the last oviposition) and post-oviposition period (interval from the last oviposition to death), and the number of eggs per female were recorded.

All biological parameters were expressed by means and standard errors (SE). The weight and size means were compared through *t* test (P = 0.05). A chi-square test (χ^2, P = 0.05) was used to test deviation in the sex ratio.

A survey of the host plants was performed using information from Silva *et al*. (1968), which includes all information about Brazil's host plants up to 1962, Biezanko *et al*. (1974), which includes the host plants in Uruguay, and Eichlin & Cunningham (1978) which lists the host species in North America, north of Mexico. The nomenclature was updated according specially to Backes & Nardino (2001), and a list of the scientific and common names, families, and references was made.

Results and Discussion

The average duration of each development stage and its percentiles are listed in Table 1. The complete life cycle took 41.4 ± 3.76 days. The time required for the development of several stages was very similar to the averages for the majority of the Plusiinae species that occur in the United States (Eichlin & Cunningham 1978). They indicated three days for the egg stage, about 15 to 25 days for the larval stage, one to two days for the pre-pupa stage, and eight days for the pupa stage. Thus, the 29.3 days necessary for the

Table 1. Mean (± SE) in days and survival (%) of development phases of *A. egena*. Temp.: 25 ± 1ºC; RH: 70 ± 10% and photophase: 14h.

Phases	n	Mean (days ± SE)	Survival (%)
Egg (incubate/laying)	54	3.0 ± 0.00	7.24
Larval	172	15.7 ± 1.25	37.82
Pre-pupal	150	1.9 ± 0.05	4.51
Pupal	150	8.8 ± 0.09	21.19
Adult	16	12.1 ± 0.95	29.24
Pre-oviposition	8	5.4 ± 0.50	-----
Oviposition	8	6.3 ± 1.10	-----
Post-oviposition	8	1.4 ± 0.87	-----

development of an egg up to an adult for *A. egena* is very close to the 30 day average that is mentioned by Eichlin & Cunningham (1978).

A. egena underwent five larval instars (Table 2) with an average growth rate of 1.74, which was greater than that predicted by Dyar's rule (Dyar 1890). The fact that this species goes through five instars is in agreement which other Plusiinae species (Eichlin & Cunningham 1978).

In the laboratory, larvae of the *A. egena* fed on the leaf blade, leaving only the petiole and the veins of the bean leaves; this behavior is responsible for their common name, the "bean leafskeletonizer" (Eichlin & Cunningham 1978, Lafontaine & Poole 1991).

Pupa weight and size were not significantly affected by sex ($n = 75$, $P < 0.05$). The mean and standard errors of length, width and weight were, respectively, 17.0 ± 0.07 mm, 4.7 ± 0.04 mm and 0.22 ± 0.00 g. These results indicate that this species, in the pupal stage, does not exhibit the same sexual dimorphism as *Pseudoplusia includens* (Walker) (Shour & Sparks 1981) and *Trichoplusia ni* (Hübner) (Shorey *et al*. 1962, Henneberry & Kishaba 1966) do, where the males were heavier.

The sex ratio obtained from 181 pupae does not differ significantly of the 1:1 ratio ($\chi^2 = 0.049$, $P < 0.05$). The average time for pre-oviposition (Table 1) of *A. egena*, compared to that of the *T. ni, P. includens* and *Rachiplusia ou* (Guenée) (Canerday & Arant 1967) was almost twice as great, while the period of the oviposition was very similar. The greater oviposition period is attributed to reproductive failure.

Table 2. Mean width (± SE) in mm of cephalic capsules, and increase rate of *A. egena*. Temp.: 25 ± 1ºC; RH: 70 ± 10% and photophase: 14h.

Instars	n	Mean (mm ± SE)	Increase rate
I	61	0.30 ± 0.002	-----
II	66	0.50 ± 0.003	1.656
III	54	0.85 ± 0.008	1.707
IV	20	1.43 ± 0.011	1.668
V	20	2.74 ± 0.053	1.926

From the eight male-female pairs examined, an average of 143.8 ± 12.45 eggs were obtained and none was viable. The complete absence of spermatophores in the female genitalia indicated that none of them had been fertilized. The number

Table 3. *A. egena* host plants referred to by: 1. Silva *et al*. (1968); 2. Biezanko *et al*. (1974); 3. Eichlin & Cunningham (1978), with Brazilian common names.

Scientific name	Common name	Family	Reference
Agapanthus sp.	Agapanto	Liliaceae	3
Althaea rosea Cav.	Altea	Malvaceae	3
Apium graveolens L.	Aipo	Apiaceae	3
Brassica oleracea L.	Couve, repolho	Brassicaceae	3
Chrysanthemum sp.	Crisântemo	Asteraceae	3
Chrysanthemum frutescens L.	Margarida	Asteraceae	3
Daucus carota L.	Cenoura	Apiaceae	3
Delphinuim sp.	Esporinha	Ranunculaceae	3
Glycine max (L.) Merril.	Soja	Fabaceae	2,3
Malva sp.	Malva	Malvaceae	3
Melissa officinalis L.	Erva cidreira	Lamiaceae	1,2
Mentha piperita L.	Hortelã pimenta	Lamiaceae	1,2
Mentha pulegium L.	Poejo	Lamiaceae	1,2
Mentha spicata L.	Hortelã	Lamiaceae	3
Ocimum basilicum L.	Manjericão	Lamiaceae	2
Ocimum selloi Benth.	Anis	Lamiaceae	2
Phaseolus lunatus L.	Feijão de lima	Fabaceae	3
Phaseolus vulgaris L.	Feijão	Fabaceae	2,3
Senecio sp.	Maria-mole	Asteraceae	3
Symphytum sp	Confrei	Boraginaceae	3
Tagetes erecta L.	Cravo-de-defunto	Asteraceae	3

of eggs was very small when compared to other species of the group, such as *P. includens* females, which frequently lay more than 500 eggs (Jensen *et al*. 1974) or *Autographa precationis* (Guenée), which lays 2,000 eggs (Khalsa *et al*. 1979). The nourishment source a 10% honey solution should have been sufficient, considering that most studies with species of this subfamily successfully used this solution. Therefore, we believe the small number of eggs is because the females were not fertilized. Jensen *et al*. (1974) showed that fertilized females, especially with multiple mating, produced more eggs.

The failure of fertilization may be related to the presence of only one pair per cage, because in previous experiments evaluating adult diets with only one couple of *P. includens* per cage, Jensen *et al*. (1974) observed that fewer than 50% of the females were successfully fertilized.

This work presents relevant contribution on the bionomics and lists all host plants referred to *A. egena.* The immature development of this species is similar to the development of others Plusiinae already studied.

We concluded that the development of *A. egena* is similar to the ones of other representatives of the subfamily, concerning to duration of the immature and number of instars. To better evaluate the reproductive performance, we recommend that in future works, two or more couples are kept in each breeding cage in order to get a greater number of copulas, thus increasing both, fecundity and fertility.

Even though only three plants are reported as hosts in Brazil (Silva *et al*. 1968), our constructed list included 21 taxa belonging to nine families (Table 3), confirming that this species has a wide host range of herbaceous plants (Crumb 1956, Eichlin & Cunningham 1978, Lafontaine & Poole 1991).

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