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# A New Laboratory Host Record, *Ephestia cautella* Walker (Lepidoptera: Pyralidae) for an Egg-larval Parasitoid, *Chelonus oculator* Panzer (Hymenoptera: Braconidae) and a Possible Rearing Method of the Parasitoid on the New Host

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**Abstract:** Host suitability of *Ephestia cautella* Walker (Lepidoptera: Pyralidae) was tested for an egg-larval parasitoid, *Chelonus oculator* Panzer (Hymenoptera: Braconidae) at the laboratory conditions. Eggs of *E. cautella* were successfully parasitized by *C. oculator* and fertile offsprings were produced. *Chelonus,* in the experiment, eclosed from 80% of parasitized hosts. No significant difference was found between development times of male and female parasitoids. Average development of the parasitoid was completed in 43.91 and 44.31 days in males and females. These results showed that *E. cautella* was a new laboratory host for *C. oculator*. In addition, some biological characteristics and a possible rearing method of the parasitoid on the laboratory host were studied. All experiments were conducted at 25±1°C, 60-70% relative humidity, with a photoperiod of 16:8 h (L: D). *C. oculator* was able to parasitize young (0-24 h) and older stage (48-72 h) of *E. cautella* eggs and completed its development successfully. The reproduction of the parasitoid is arrhenotoky, in which male progeny develop parthenogenetically from unfertilized eggs and female progeny develop from fertilized eggs. The first possible rearing method of *C. oculator* on the new factitious host, *E. cautella* showed that the parasitoid was successfully reared in thirty generations. There has still been lack of important knowledge about biology of *C. oculator*. However, the parasitoid can be a candidate for future research as a biological control agent against some important lepidopteran pests and *E. cautella* may be a suitable laboratory host for mass rearing of *C. oculator*, a critical step in any field release program.

**Key words:** *Chelonus oculator*, egg-larval parasitoid, new laboratory host, *Ephestia cautella*, rearing method

## INTRODUCTION

The solitary egg-larval parasitoid, *Chelonus oculator* Panzer (Hymenoptera: Braconidae) may be a candidate for future research as a biological control agent. Because some important lepidopterous pests were identified as hosts of the parasitoid. Five families of Lepidoptera (Noctuidae, Phycitidae, Pyraustidae, Coleophoridae and Tortricidae) are listed as hosts for *C. oculator*[1]. The parasitoid wasp was recorded from five noctuid species: *Spodoptera exigua* Hb., *Helicoverpa armigera* Hb., *Heliothis viriplaca* Hfn., *H. peltigera* Den. and Schiff., *Photedes elymi* Tr.; a phycitid: *Etiella zinckenella* Tr.; a pyraustid: *Pyrausta sticticalis* L.; a coleophorid: *Coleophora anatipennella* Hb. and a tortricid: *Zeiraphera isertana* F. The parasitoid was reported from Caucasus, Kazakhstan, Central Asia, Western Europe, North Africa and Iran.

No laboratory studies had previously been found about *C. oculator*, an egg-larval parasitoid of some lepidopteran pests before 1998. In June 1998, average 300 young larvae of *Spodoptera littoralis* (Boisd.) (Lepidoptera: Noctuidae) were collected from cotton fields in Adana (south part of Turkey). The larvae were cultured in an insect rearing laboratory at Department of Plant Protection, University of Ankara, Faculty of Agriculture. Following the observation of the culture of *S. littoralis*, an adult braconid wasp was observed. Then laboratory colonies were established from resulting parasitoid adults using eggs of *S. littoralis* and *Ephestia kuehniella* Zeller (Lepidoptera: Pyralidae). The parasitoid was identified as *C. oculator*. *S. littoralis* and *E. kuehniella* were recorded as new hosts for the parasitoid[2].

Biology of *C. oculator* on its two new hosts, *E. kuehniella* and *S. littoralis* were studied[3]. It was reported that the parasitoid had high reproductive rate

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and ease of rearing *on E. kuehniella* made this parasitoid a good agent for the biological control of lepidopterous pests. They found that a female produced average 2344 progeny on this host. The authors suggested that egg-larval parasitoid *C. oculator* represent a very successful effect in the sense of biological control. Because the parasitoid not only caused reduction of overall number of adult hosts emerging but, as observed *S. littoralis* it also led to a significant decrease in food consumption mainly due to absence of actively feeding last larval stadium[3].

Effects of adult nutrients on the longevity of *C. oculator* were studied[4]. They found that honey, glucose, fructose, lactose (10% solution) and sucrose (10% solution) increased the longevity 10, 5.9, 6.9, 3.1 and 1.1 times in male parasitoids and 8.3, 8.6, 8.7, 3.2 and 1.2 times in female parasitoids, respectively. In addition, the authors also found that mating and oviposition could affect the longevity of the parasitoids.

It was seen from literature that there has still been lack of important knowledge about *C. oculator*. This study investigates host suitability of *Ephestia cautella* Walker (Lepidoptera: Pyralidae) for the parasitoid. In addition, some biological characteristics and a rearing method of the parasitoid on *E. cautella* were presented. This investigation will enable us to evaluate the potential of *C. oculator* and will also provide important information for mass rearing this parasitoid in the laboratory.

## MATERIALS AND METHODS

*Ephestia cautella* Walker (Lepidoptera: Pyralidae) was supplied from Department of Plant Protection, Faculty of Agriculture, University of Ankara in 2000 and used as hosts. The host was reared in an incubator at 25±1°C, 65±5% Relative Humidity (RH). Culturing was undertaken using clear plastic containers (20x14x7 cm) on a 2: 1: 0.25: 0.50: 0.25: 0.25 mixture of rough wheat bran, corn flour, dry yeast, honey, milk powder, glycerin containing approximately 250 g sterilized food and 500 eggs. This procedure was repeated every four days. Development time of *E. cautella* from egg to adult completed in approximately 40 days at the condition of temperature, humidity and nutrition being used. Adult moths were collected with the help of an aspirator and transferred into ovipositing cages. Eggs of *E. cautella* were collected from the ovipositing cages with the help of a soft brush. A colony of *Chelonus oculator* for the experiments obtained from *Ephestia kuehniella* Zeller (Lepidoptera: Pyralidae).

Suitability of *Ephestia cautella* for the solitary egg-larval parasitoid, *Chelonus oculator* was investigated at 25±1°C, RH 60-70%, with a photoperiod of 16:8 h (L: D). In the experiment, 24-48 h old eggs of *Ephestia cautella* were used. To obtain singly parasitized host, eggs were presented individually to adult parasitoids. After parasitisation, host eggs were placed singly to vials with excess diet until parasitoid eclosion. As a host diet, 2: 1: 0.25: 0.50: 0.25: 0.25 mixture of rough wheat bran, corn flour, dry yeast, honey, milk powder, glycerin was used. Data were obtained from 100 parasitized host eggs. Parasitoid eclosion was checked several times during the day to ensure development time and mortality rate to be accurately recorded. After the eclosion, fertility experiment was conducted with the new eggs. In order to determine parasitoid reaction to different ages of the eggs, 0-24 h aged young and 48-72 h aged mature *Ephestia cautella* eggs were supplied to female *C. oculator* and parasitisation and development were observed. In addition, eggs of *E. cautella* were presented to mated and unmated female of *C. oculator* and the reproduction form of the parasitoid was defined.

In the rearing method of *C. oculator*, eggs of *E. cautella* were used as hosts. Studies were conducted at 25±1°C, RH 60-70%, with a photoperiod of 16:8 h (L: D). Newly (< 24 h) emerged ten pairs of *C. oculator* were transferred into clear plastic containers (20x14x7 cm). Pure honey was given to adult parasitoids by smearing a small amount on the lid of the containers. Parasitoids were left to mate and feed for 24 h before host eggs were supplied. Approximately 24-48 h old 500 eggs of *E. cautella* were glued on a paper sheet (1.5x10 cm) with the help of 5% Arabic gum solution and introduced into the container. The parasitoids were left to forage and oviposit for 6 h. Parasitized egg sheet was then transferred into another clear plastic container on a 2: 1: 0.25: 0.50: 0.25: 0.25 mixture of rough wheat bran, corn flour, dry yeast, honey, milk powder and glycerin containing approximately 250 g sterilized food. This procedure was continued thirty generations.

## RESULTS AND DISCUSSION

Host suitability studies showed that eggs of *Ephestia cautella* were successfully parasitized by *Chelonus oculator* and fertile offsprings were produced. Of the 100 parasitized host eggs, only 4 produced adult moths. A further 16 parasitoids died during the experiment. Suitability, as defined by Barbosa *et al.*[7], Mackauer[5], Vinson and Iwantsch[6] describes those host types which can successfully be parasitized and the degree to which they produce fertile offspring. Development time of the parasitoid from egg to adult lasted approximately 44.1 days. An ANOVA on the development time of *C. oculator* didn't reveal a

significant interaction between sex differences (F=0.26, df=1, p=0.614). Development time of the parasitoid was completed in 43.91 days in male and 44.31 days in females. As a result, suitability studies show that *Ephestia cautella* is new laboratory host for *Chelonus oculator*.

*C. oculator* was able to parasitize 0-24 h young and 48-72 h older stage of eggs of *E. cautella* and completed its development successfully. This result may be seen as an advantage for mass rearing of the parasitoid. The eggs were laid in the host eggs singly. The eggs of the parasitoid hatched in the host eggs and first and second instar of the parasitoid fed internally. In its third instar, the parasitoid larvae left the host to feed externally, consuming all except the skin and head capsule. The parasitoid then spanned its cocoon in the pupal cell previously prepared by the host larva. This result shows that *C. oculator* is a koinobiont parasitoid which allow its hosts to continue to feed and develop. Mated females produced male and female progenies. However, unmated females produced only male progenies. These sex differences of mated and unmated females' progenies shows that the reproduction of the parasitoid is arrhenotoky, in which male progeny develop parthenogenetically from unfertilized (haploid) eggs and female progeny develop from fertilized (diploid) eggs.

The first possible rearing method of the solitary koinobiont egg-larval parasitoid, *Chelonus oculator,* on the new factitious host, *Ephestia cautella* showed that the parasitoid was successfully reared in thirty generations. It was suggested that several factitious hosts were also successfully used for mass rearing of other *Chelonus* species in the laboratory for biological control programs. *Chelonus blackburni* Cameron was mass reared on *Corcyra cephalonica* (Stnt.) in the laboratory and released for the biological control of *Pectinophora gossypiella* (Saund.), *Earias vittella* (Fabricius) and *Helicoverpa armigera* (Hübner) on cotton[8]. *Chelonus* sp., a parasitoid of the coconut pest *Batrachedra arenosella* (Wlk.), was reared in the laboratory using *Phthorimaea operculella* (Zell.) as the host[9]. *Chelonus inanitus* (L.), one of the most effective parasitoids of the cotton pest *Spodoptera littoralis* (Boisd.), was successfully reared on *Ephestia kuehniella* Zeller[10]. *Chelonus* sp. near *curvimaculatus* Cameron originally reared from *P. gossypiella* was successfully reared on *P. operculella*[11]. *Chelonus eleaphilus* Silv., a parasitoid of *Prays oleae* (Bern.), was successfully reared on *Ephestia kuehniella* Zeller[12].

It appears that there has still been lack of important knowledge about biology of *C. oculator*. However, *C. oculator* can be a candidate for future research as a biological control agent against some important lepidopteran pests as mentioned in introduction section and *E. cautella* may be a suitable factitious host for mass rearing of *C. oculator*.

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