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Scientific note

Tenebrio molitor (Coleoptera: Tenebrionidae) as an alternative host for the parasitoid *Trichospilus diatraeae* (Hymenoptera: Eulophidae)

Tenebrio molitor (Coleoptera: Tenebrionidae) como un huésped alternativo para la cría de *Trichospilus diatraeae* (Hymenoptera: Eulophidae)

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Abstract: The aim of this work was to verify if *Trichospilus diatraeae* (Hymenoptera: Eulophidae) was able to parasitize and develop in pupae of *Tenebrio molitor* (Coleoptera: Tenebrionidae). The parasitism rate and emergence of *T. diatraeae* on pupae of *T. molitor* was 80% and 50%, respectively. The total number of individuals emerged per pupae on this host was 97.06 ± 17.50 with a sex ratio of 0.94 ± 0.02. The longevity (in days) of females and males of this natural enemy was 18.15 ± 0.99 and 11.67 ± 0.62, respectively. The high reproductive performance of *T. diatraeae* shows the adequacy of *T. molitor* pupae for this parasitoid. This is the first report of *T. molitor* pupae as an alternative host for rearing *T. diatraeae*.

Key words: Biological control. Parasitism. Pupae parasitoid. Reproductive potential.

Resumen: El objetivo de este trabajo fue verificar la capacidad de *Trichospilus diatraeae* (Hymenoptera: Eulophidae) de parasitar y desarrollarse en pupas de *Tenebrio molitor* (Coleoptera: Tenebrionidae). Los porcentajes de parasitismo y emergencia de *T. diatraeae* sobre pupas de *T. molitor* fue de 80% y 50%, respectivamente. El número total de individuos emergidos por pupa de este huésped fue 97,06 ± 17,50, con una proporción sexual de 0,94 ± 0,02. La longevidad (días) de hembras y machos de este enemigo natural fue de 18,15 ± 0,99 y 11,67 ± 0,62, respectivamente. El alto rendimiento reproductivo de *T. diatraeae* muestra la adecuación de las pupas de *T. molitor* para este parasitoide. Este es el primer registro de pupas de *T. molitor* como un huésped alternativo para la cría de *T. diatraeae*.

Palabras clave: Control biológico. Parasitismo. Pupas parasitoide. Potencial reproductivo.

Introduction

Trichospilus diatraeae Cherian and Margabandhu, 1942 (Hymenoptera: Eulophidae) is a gregarious endoparasitoid that preferentially attacks Lepidoptera pupae. It was first reported on *Diatraea venosata* Walker, 1863 (Lepidoptera: Crambidae) and dates from 1942 (Bouček 1976). In Brazil, the first occurrence was on pupae of Arctiidae (Paron and Berti-Filho 2000), but recently it was also reported attacking species of Oecophoridae (Oliveira *et al.* 2001), Geometridae (Pereira *et al.* 2008; Zaché *et al.* 2010) and Pyralidae (Melo *et al.* 2011).

One the most important issues in a program of biological control of insect is to find an adequate alternative host to rear the natural enemy. This host should be reared with low production costs and without affecting the efficiency of natural enemy in the field (Zanuncio *et al.* 2008). *Tenebrio molitor* Linnaeus, 1758 (Coleoptera: Tenebrionidae) is easy and inexpensive to rear in mass (Otuka *et al.* 2006) and shows very good results to rear pupae parasitoids (Zanuncio *et al.* 2008). For this reason, the parasitism of *T. diatraeae* on *T. molitor* pupae was studied.

The experiment was carried out in an acclimatized room, under the following conditions: mean maximum temperature of 25.88 ± 0.18 ºC and minimum of 24.12 ± 0.16 °C, maximum relative humidity of 62.33% ± 1.15 and a minimum of 55.63% ± 1.00 and photophase of 12 hours. Forty pupae of *T. molitor* 24 hours old and weighing between 0.11 g and 0.14 g were individualized in glass tubes (2.5 x 8.5 cm) and exposed to parasitism by 20 *T. diatraeae* females with age between 48 and 72 hours. The experiment was set up in a completely randomized design. There were evaluated the duration of the life cycle (egg to adult), the percentage of parasitism discounting host natural mortality (Abbott 1925), the percentage of parasitoid emergence, the number of parasitoids per pupa of *T. molitor*, the longevity of males and females and sex ratio (rs= number of females/number of females + males).

The life cycle (egg to adult) of *T. diatraeae* in pupae of *T. molitor* took 26.14 ± 0.99 days, being longer than on *Diatraea saccharalis* (Fabricius, 1794) (Lepidoptera: Crambidae) 19.8 ± 0.7 days, at 25 °C, RH of 70 ± 10% and 14 hours photophase (Paron 1999). This may be due to a better adaptation of this parasitoid to pupae of the host. Although important, it is not the only factor responsible for variations on the development of this parasitoid. Also, it is affected by temperature, humidity and photoperiod (Zago *et al.* 2006).

The percentages of parasitism and emergence of *T. diatraeae* were 80 and 50%, respectively from pupae of *T. molitor*. The total number of individuals emerged per pupa of this

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host was 97.06 ± 17.50 and with 4.62 ± 0.87 females produced per female of this parasitoid with a sex ratio of 0.94 ± 0.02. The longevity (days) of females and males of this natural enemy was 18.15 ± 0.99 and 11.67 ± 0.62, respectively. Paron and Berti Filho (2000) also reported high parasitism of *T. diatraeae* on pupae of *D. saccharalis* and some Noctuidae (Lepidoptera) such as *Spodoptera frugiperda* Smith, 1797, *Anticarsia gemmatalis* Hübner, 1818, *Heliothis virescens* (Fabricius, 1781). These authors used one and several females**,** without mentioning clearly the number of parasitoids used. *Trichospilus diatraeae* is a gregarious parasitoid, which makes necessary to determine the ideal density of its females per pupa to increase the efficiency of production techniques in the laboratory. The progeny of *T. diatraeae* per pupa of *T. molitor* was higher than that reported for *Palmistichus elaeisis* Delvare and LaSalle, 1993 (Hymenoptera: Eulophidae) (70.07 ± 2.50) with this host (Zanuncio *et al.* 2008), but this latter parasitoid has greater body size than the first. However, the number of individuals of this parasitoid emerged per pupa of *S. frugiperda* (208.3 ± 4.5), *D. saccharalis* (194.7 ± 6.8), *A. gemmatalis* (186.7 ± 2.8) and *H. virescens* (170.5 ± 1.3) (Paron and Berti-Filho 2000) was higher than that of this work. These variations can be attributed to host size (bigger pupae can support the development of more immature), hardness of pupae integument (Godfray 1994) and the methodologies used.

The sex ratio of *T. diatraeae* produced per pupae of *T. molitor* was similar to that of *P. elaeisis* on this host (0.94 ± 0.01) (Zanuncio *et al.* 2008) what shows the high reproductive capacity and great potential of both parasitoids. The higher number of females is an important issue, especially in a system of mass rearing and in the selection of individuals to release in the field, because the predominance of females can increase the number of individuals produced in the following generation (Pereira *et al*. 2009). The high sex ratio of *T. diatraeae* from *T. molitor* pupae, also, indicates that this host is adequate for this parasitoid. The survival of females and males of *T. diatraeae* from *T. molitor* pupae in the laboratory may be sufficient for this parasitoid to copulate, find and parasitize hosts in the field. The longevity of *T. diatraeae* was lower in pupae of *T. molitor* than that of *P. elaeisis* with this host (Zanuncio *et al.* 2008). This may be due to food competition between immature because *T. diatraeae* produced more offspring per pupa of *T. molitor* than *P. elaeisis*. The temperature also affects the longevity but its impact differs between parasitoids species. The longevity of insects is also related to factors such as diet, environment conditions and energy spent during copulation and oviposition (Kapranas and Luck 2008).

The high reproductive performance of *T. diatraeae* shows the adequacy of *T. molitor* pupae for this parasitoid. This is the first report of *T. molitor* pupae as an alternative host to rearing *T. diatraeae*. As this natural enemy preferentially attacks Lepidoptera pupae; the qualitative and quantitative biological characteristics of this parasitoid may increase with the number of generations due to a better conditioning in this Coleoptera pupa. This can be explained by the fact that the experiment was developed with *T. diatraeae* reared with pupae of *T. molitor* between the second and third generation in the laboratory. The low cost of producing *T. molitor* allows the use of this host to mass rearing *T. diatraeae* for biological control programs of lepidopterous.

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