



## EFFECT OF ADULT FEEDING ON PROGENY PRODUCTION AND SEX RATIO OF *DINARMUS BASALIS* (ROND.) (HYMENOPTERA: PTEROMALIDAE)

MJ Haque, W Islam\*

*Institute of Biological Sciences, University of Rajshahi, Rajshahi 6205, Bangladesh*

### Abstract

**Context:** *Dinarmus basalis* (Rond.) is a larval-pupal ectoparasitoid of the pulse beetles, *Callosobruchus* (Coleoptera: Bruchidae). This parasitoid could be used in suppressing the pulse beetle populations in stored conditions.

**Objective:** To observe the influence of different food supplements on the progeny production and sex ratio of *D. basalis* when exposed to the pulse beetles separately.

**Materials and Methods:** Mated females of *D. basalis* were introduced into separate Petri dishes (9.5 cm diam) containing 50 mature mung seeds infested with *C. chinensis* and *C. maculatus*. The parasitoids were provided with host and honey, host and sugarcane, host and egg yolk, host and yeast and host and agar, and host without food individually. After 24 h, the parasitized larvae with seeds were changed and the female parasitoids were provided with foods daily until adults died. After emergence total number of hosts and parasitoids were counted. The sex ratio of *D. basalis* were also calculated and their chi-squared tests were made.

**Results:** The mean number of progeny production of *D. basalis* on *C. maculatus*-infested blackgram was significantly greater than those reared on *C. chinensis*-infested mug in all food regimes (Table 1). The progeny production on two host beetles differed significantly in relation to different foods ( $F= 4.85, P<0.01$ . *C. chinensis*;  $F= 38.34, P<0.01$ , *C. maculatus*). The most effective food supplement was honey, which enhanced offspring production of *D. basalis* on both the hosts, and egg yolk was the least effective. The percentage of progeny was more or less female-biased in all the treatments except the control.

**Conclusion:** Food supplementation of *D. basalis* will significantly increase the efficiency of the parasitoid against storage pests including the pulse beetles.

**Keywords:** Food supplements, *Dinarmus basalis*, *Callosobruchus*, progeny production, sex ratio.

### Introduction

Many adult parasitoids, particularly Braconidae, Encyrtidae, Eulophidae, Ichneumonidae, Pteromalidae and Trichogrammatidae require nutrients in the form of nectar, pollen or both for optimum progeny production (Jervis *et al.* 1996). Sugar-rich nectar or honeydew contain low levels of amino acids, proteins and lipids and they might contribute to egg maturation (Wackers 2003). The family Pteromalidae is the largest among the Chalcids and is cosmopolitan in distribution. Its members affect almost all orders of insects either as parasitoids or hyperparasitoids and act as biological control agents. It is known that the synovigenic ectoparasitoid *Dinarmus basalis* (Rond.) is a promising control agent against *Callosobruchus chinensis* (L.) (Islam and Kabir 1995) and *C. maculatus* (F.) and *Bruchidius atroleatus* (Pic) (Quedrago *et al.* 1996, Sanon *et al.* 1998) and is also reported on *C. subnotatus* (Pic), *Acanthoscelides obtectus* (Say), *Zabrotes subfasciatus* (Boheman) and other grain-attacking beetles (Rasplus 1989).

Pteromalid parasitoids which feed on floral nectar in field crops and flowering vegetation have high fecundity and effective parasitism rate (Jervis *et al.* 1996, Zhao *et al.* 1992). These parasitoids may also feed on the haemolymph of their hosts. In some of these hosts feeding species, nectar is taken during early adult life, whereas host feeding occurs only after the ovaries have developed sufficiently (Flanders 1935). The vast majority of adult parasitoids require sugar solutions that can increase number of eggs laid (Olson and Andow 1998, Schmale *et al.* 2001).

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\*Corresponding author Email: mwislam2001@yahoo.com

Food supplements are reported to affect the sex ratio, behaviour, growth and development of *Anisopteromalus calandrae* (How.) parasitoid of *Sitophilus granarius* L. (van den Assem *et al.* 1984). Information of the various food-sources on progeny production and sex ratio of *D. basalis* is not available. This lead to the present study.

## Materials and Methods

Newly emerged *D. basalis* adults were collected from the stock cultures and kept in the glass jars for 20-24 h for mating. The stock cultures were maintained in the control temperature (CT room,  $30\pm 0.5^{\circ}\text{C}$ ) on mung and black gram seeds infested by *C. chinensis* and *C. maculatus* separately. Single mated females of *D. basalis* introduced into a petri-dish containing 50 mung seeds infested by 12-24-day-old *C. chinensis* larvae. Similarly, single mated female parasitoid were individually kept in petri-dish containing 20-22-day-old *C. maculatus* larvae in black gram seeds. Honey, sugarcane stalk, egg yolk, yeast and agar were supplied to the female parasitoids on cotton wool. Control were provided with cotton wool soaked in distilled water.

Infested seeds having host larvae were changed daily and fresh unparasitized mature larvae were provided till female parasitoids died. The infested seeds containing parasitoid larvae were kept in individual vials (4 cm  $\times$  2 cm) for 20 days and the number of parasitoids and adult bruchids emerging out were recorded. Female parasitoids that did not produce offspring were not considered. Fifteen females were considered per treatment as replications. The male and female offspring from each replication was recorded separately for determining the sex ratio. The data were analysed by the Duncan's Multiple Range Test.

## Results

The mean number of progeny production of *D. basalis* on *C. maculatus*-infested blackgram was significantly greater than those reared on *C. chinensis*-infested mug in all food regimes (Table 1). The progeny production on two host beetles differed significantly in relation to different foods ( $F= 4.85$ ,  $P<0.01$ . *C. chinensis*;  $F= 38.34$ ,  $P<0.01$ , *C. maculatus*). The most effective food supplement was honey, which enhanced offspring production of *D. basalis* on both the hosts, and egg yolk was the least effective. The results indicated that lipids present in the egg yolk did not support more progeny production. Moreover, all food regimes except egg yolk increased the average lifetime progeny production of the parasitoid on both the hosts as compared with the control. The realized  $F_1$  progeny of *D. basalis* increased 2.22-fold on *C. chinensis* and 3.18-fold on *C. maculatus* when honey was provided. The percentage of progeny were more or less female-based in all the treatments except the control.

Table 1. Progeny production and sex ratio of *D. basalis* females fed with different food during oviposition period when exposed to *C. chinensis* and *C. maculatus* larvae.

Food	<i>C. chinensis</i>		<i>C. maculatus</i>	
	Number of parasitoids/ female (range)	Female (%)	Number of parasitoids/ female (range)	Female (%)
Honey	130.67 $\pm$ 18 (42-260)	65.97	444.53 $\pm$ 22 (279-58)	75.49
Sugarcane	111.47 $\pm$ 11 (58-191)	69.02	362.00 $\pm$ 27 (173-502)	73.30
Egg yolk	79.05 $\pm$ 7 (44-127)	61.18	144.93 $\pm$ 17 (30-277)	59.80
Yeast	91.13 $\pm$ 8 (47-146)	66.06	233.33 $\pm$ 21 (122-335)	70.94
Agar	77.08 $\pm$ 8 (36-130)	58.70	179.73 $\pm$ 21 (34-328)	57.64
Control	58.87 $\pm$ 8 (18-117)	55.83	140.53 $\pm$ 12 (46-209)	57.12

Treatments indicated by the same letter in each column do not vary significantly by DMRT

## Discussion

Food supplements significantly influenced the progeny production of *D. basalis*. The life time progeny production was the lowest on *C. chinensis* + agar, and the highest on *C. chinensis* + honey. The average number of F<sub>1</sub> progeny of *D. basalis* using *C. maculatus* as the host-feeding was the minimum when egg yolk was provided as food and it was the maximum on honey. The synovigenic *D. basalis* responded to a honey supplement with a 2.22-fold increase on *C. chinensis* and a 3.18-fold increase on *C. maculatus* in progeny production. Honey and sugarcane seemed to contain adequate nutrients for *D. basalis*. Schmale *et al.* (2001) reported that *D. basalis* and *Anisopteromalus calandrae* continued egg deposition on their host and translated into an increase of mean lifetime progeny production by the factors 1.5 and 2.5 respectively, which comply with the present findings. The potential fecundity of *Anagyrus pseudococci* (Girault), a primary parasitoid of mealybugs, *Planococcus citri* (Risso) and *Pseudococcus affinis* (Mask.), was examined on various food sources in the laboratory by Islam and Jahan (1992). They observed that fecundity was higher on the 50% honey fed parasitoids than those fed on honey dew and water.

In the present study, sugarcane seems to be less suitable than honey for *D. basalis*, Schmale *et al.* (2001) also obtained the same results. This is due to the fact that the sugar source solidifies when the sugarcane stem dries out, reducing food accessibility to the parasitoid (Wackers 2000). *C. maculatus* is considered superior to *C. chinensis* as a host for *D. basalis* since it produces a higher number of F<sub>1</sub> progeny over its life time, although this species is known to engage in host-feeding on *C. chinensis* (Wackers *et al.* 1998). The present experiment focussed that *D. basalis* produces sufficient progeny on both the hosts when used with suitable supplemental foods. The progeny production of *A. calandrae* increased with different seed-hosts as was noted by Heong (1981) and Smith and Press (1992), which comply with the present study.

Various additional food sources played a significant role on the sex ratio of *D. basalis*. The finding showed that food supplements could hold a great potential for improving this character. Morgan *et al.* (1981 a, b) recorded 53-66.66% female progeny production. This is in accordance with the present results. *D. basalis* is synovigenic requiring a source of protein for the continuous production of eggs through their effective adult life. In the present study, among different diets honey proved to be the best for its egg production. It indicates that a carbohydrate source was necessary for egg production. Besides, *D. basalis* is an arrhenotokous species. The sex-ratio is determined by the proportion of inseminated females, the ratio of diploid eggs they laid and extrinsic factors which differentially affected survival of eggs, larvae and pupae (Carton *et al.* 1986). Based on the above findings, *D. basalis* appears to be a promising candidate for biological control of pulse beetles.

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