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COMMUNICATION I

Biology of *Diachasmimorpha longicaudata*, A Parasitoid of Carambola Fruit Fly, (Diptera; Tephritidae)

ABSTRAK

Kajian telah dijalankan di makmal (26°C ± 1.5°C) bagi mengkaji edaran hidup, Diachasmimorpha longicaudata, *parasitoid pada larva lalat buah carambola,* Bactrocera *(B) sp. near* Bactrocera dorsalis *A. Terdapat 4 peringkat larva berasaskan kepada saiz peralatan mulut. Penjelmaan larva yang pertama berlaku dalam kepompong perumah yang baru dibentuk. Jumlah masa perkembangan ke dewasa jantan dan betina ialah 16.3 ± 0.8 hari dan 17.5 ± 0.8 hari. Purata keupayaan pembiakan semasa hidup ialah 92 ± 4.5 biji telur.*

ABSTRACT

The life cycle study of Diachasmimorpha longicaudata, *a larval parasitoid of* Bactrocera *(B) sp. near* Bactrocera dorsalis *A, was conducted in the laboratory (26°C ± 1.5°). There were 4 larval stages based on the size of the mouthhook. The first larval moult occurred in the newly formed puparium of the host. The entire developmental periods for males and females were 16.3 ± 0.8 day and 17.5 ± 0.8 days, respectively. The average reproductive capacity per female during the life-span was 92 ± 4.5 eggs.*

INTRODUCTION

The carambola fruit fly, *Bactrocera* (B) sp. near *Bactrocera dorsalis* A is a major pest of fruit crops (White and Elson Harris 1992). In Malaysia several species of opiine parasitoids including *Diachasmimorpha longicaudata* were recorded from species in *Bactrocera dorsalis* Complex (Ooi 1984; Rohani 1986, Serit *et al.* 1987, Serit and Tan 1990). *Diachasmimorpha longicaudata* (Braconidae: Hymenoptera) was introduced into Hawaii in 1947 from South Asia for the control of the oriental fruit fly, *B. dorsalis* (Hendel) (Clancy *et al.* 1952). This parasitoid also has been reported to parasitise other tephritids such as *Ceratitis capitata, Bactrocera latifrons* and *Anastrepha suspensa* (Baranowski 1974; Lawrence *et al.* 1976; Wharton and Gilstrap 1983; Vargas and Nishida, 1985; Wong and Ramadan 1987). Some aspects of the reproductive strategy and behavioral ecology of *D. longicaudata* have been studied (Greany *et al.* 1976 and Leyva *et al.* 1991; Ramadan *et al.* 1991). Recently effective trapping methods of *D. longicaudata* in the field was developed in Hawaii, (Wong *et al.* 1992; Messing and Wong 1992, Messing and Jang 1992).

In evaluating the potential of *D. longicaudata* in regulating the population of the carambola fruit fly in Malaysia, the knowledge of the biology of the indigenous parasitoid is important. The present work investigated the life history and fecundity of this parasitoid.

MATERIALS AND METHODS

The biological studies were conducted under laboratory conditions of 26.5° ± 1.5°C and 72.5 ± 7.5% RH at the Department of Plant Protection, Universiti Pertanian Malaysia. For life-cycle study, slices of ripe guava (var. Kampuchean) each measuring 4 x 5 x 1 cm placed in a shallow pan (5 cm diam.) were exposed to approximately 2000 females of carambola fruit fly for one hour for oviposition. The slices of guava were used because they could support the larval development of fruit fly. The fruit slices with the 3rd instar larvae were then exposed to 100 females of *D. longicaudata* in a cage measuring 20 x 20 x 20 cm for three hours. To determine the incubation period of parasitoid eggs, 100 parasitized larvae were dissected under the stereomicroscope commencing 22 h after exposure to the parasitoids. This was

done at hourly intervals until all the parasitoid eggs had hatched. After hatching another 100 parasitised hosts were dissected daily until all the parasitoid larvae had pupated. The parasitised pupae were kept until adult emergence.

To determine the reproductive capacity of *D. longicaudata*, pairs of newly emerged male and female parasitoids were confined in cylinderical plastic cages each measuring 4 cm tall and 4 cm diam. Each pair was offered daily a slice of guava fruit (2 x 2 x 1 cm) containing 50, 3rd instar larval of the fruit fly. An undiluted commercial honey was regularly streaked on the inner wall of the cage to serve as food for adult parasitoids. Hosts offered to 20 pairs of adult parasitoids were dissected daily to determine the fecundity of the parasitoids. The hosts exposed to another batch of 20 parasitoids were reared on artificial diets until the emergence of the parasitiods. Ten female parasitoids of known ages were also dissected daily to determine the number of mature eggs in their ovaries.

RESULTS AND DISCUSSION

Larval Development

Table 1 shows the entire developmental period of the parasitoid. The egg is hymenopteriform measuring 0.42 mm long and 0.09 mm wide when newly laid (Palacio *et al.* 1992). A fully incubated egg measured 0.71 mm long and 0.23 mm wide. This increase in size was also observed with other hymenopterans, (Hagen 1964; Clausen 1972). The mean incubation period of eggs was 53.48 h with 62.42% hatchability.

The first instar is hymenopteriform with a heavily sclerotised mandible measuring 0.09 mm long and 0.03 mm wide (*Fig.* 1). The newly hatched larva measured 0.74 mm long and 0.08 mm wide at the early stage increasing to 1.13 mm long and 0.31 mm wide at its late stage. This stage lasted 3 to 7 days with a mean of 4.8 d. The strong mandibles are used for separating their food (fatty tissues) from the internal structures of the host and in defence in the case of superparasitism (Willard 1927).

TABLE 1
Developmental parameters of *Diachasmimorpha longicaudata* Ashmead at 26.5 ± 1.5°C and 72.5 ± 7.5% RH

Stage[a]	Duration (days) range	mean	Survival (%) range	Mean
A. Egg:	2.00 - 2.75 (48 - 65 h)	1.12 (53.48 h)	45.00 - 80.00	62.42
B. Larval:	8.00 - 12.00	9.55	29.00 - 50.00	42.20
I:	3.00 - 7.00	4.80b		
II:	5.00 - 9.00	6.78c		
III:	6.00 - 10.00	7.69c		
IV:	7.00 - 13.00	9.76c		
C: Pupa:				
Female:	5.00 - 6.00	5.60	79.00 - 94.00	87.60
Male:	5.00 - 6.00	5.20	80.00 - 91.00	86.20
D. Entire Development:				
Female:	16.00 - 21.00	17.58		
Male:	15.00 - 20.00	16.35		
E. Sex Ratio:	1 female : 1 male			

[a]Determined from hourly dissection of 100 samples of parasitized hosts starting 22 h after oviposition for egg and daily for the succeeding immature stages.

[b]Duration after hatching
[c]Duration after oviposition.

The second instar is grub-like and the mandibles are unsclerotised. The larva measured 2.77 mm long and 0.98 mm wide. The third instar is similar to the earlier instar except that it increased in size to 4.07 mm long and 1.33 mm wide. The fourth instar larva measured 5.8 mm long and 8.22 mm wide. It lasted 4 d at least and occurred 7 to 13 d after oviposition.

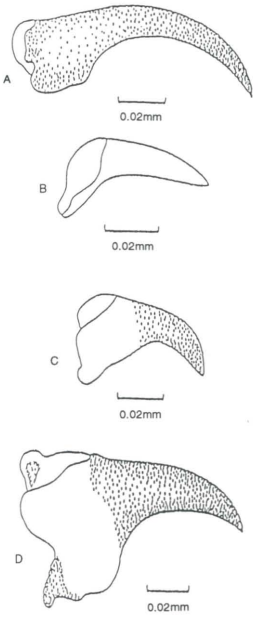

Fig. 1: Mandibles of the larvae of Diachasmimorpha longicaudata, *Ashmead; A -D, first through fourth instars*

The pupa is yellowish brown depending on the age. The female pupa measured 6.05 mm long and male 5.49 mm. The average durations of the female and male pupal stage are 5.6 and 5.2 d, respectively. The entire developmental period from egg to adult emergence averaged 17.5 d for female and 16.3 d for male. The overall survival rate was comparable for both sexes, 21.9% for female and 21.6% for male respectively. This larval parasitoid is a solitary; but superparisitism was commonly observed. *D. longicaudata* was also observed to superparasitise in *Anastrepha suspensa* (Lawrence 1988).

The newly emerged adults have a brown ovipositor shaft with swollen and quadrisinuate apex (Palacio 1991). Female adults measured 5.6 mm long from head to tip of abdomen and were 1.3 mm wide at the thorax. The male adults were 5.2 mm long and 1.2 mm wide.

Reproductive capacity

D. longicaudata commenced mating and oviposition on the same day of adult emergence. The highest daily mean fecundity/female occurred on the 4th day after emergence coinciding with the peak of ovarian egg dissected (*Fig.* 2). In Hawaii, peak ovarian maturation of *D. longicaudata* reared from *Bactrocera dorsalis* (Hendel) was on the 4th day posteclosion day (Ramadan *et al.* 1991). Production of adult offspring followed a similar trend to that of the eggs. The oviposition period lasted 27 d for *D. longicaudata.* The daily average number of eggs/female was 3.4. At this rate the expected total number of eggs produced over the life-span of this parasitoid is 92 eggs.

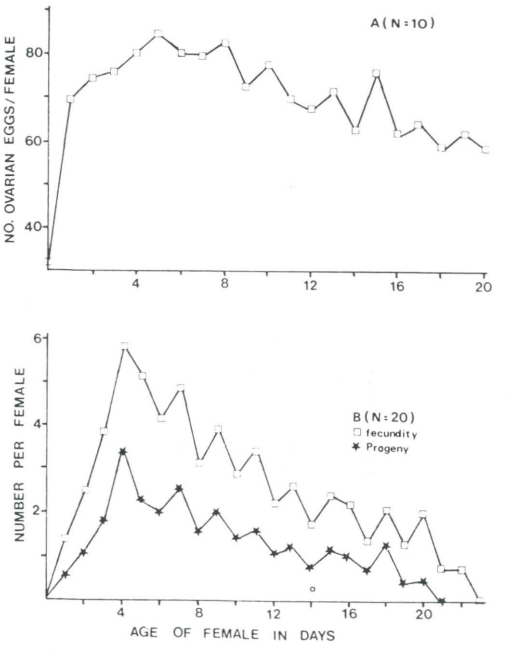

Fig. 2: (A) Daily mean mature ovarian dissected eggs, and (B) Fecundity and Progeny Production of Diachasmimorpha longicaudata *Ashmead*

Analysis of the reproductive data showed that the sex ratio was independent of the age of the ovipositing female, even though male offsprings were seemingly predominant over female at the beginning of reproductive period. As the females aged there was a slight predominance of female progenies. The overall sex ratio was 1 : 1. Similar observations were recorded by other workers (Ashley and Chambers 1979; Avilla and Albajes 1984).

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