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Egg Batch Size of the Carambola Fruit Fly, *Bactrocera* Sp (Malaysian A) (*Diptera Tephritidae*)

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ABSTRAK

Purata saiz kelompok telur untuk Bactocera *Malaysian A adalah seperti berikut: 4.67± 0.4 0 (julat 1-25) untuk keadaan ladang dan 4.18± 0.26 (julat 1-24) untuk keadaan makmal. Lebih banyak kelompok yang ada hanya sebiji telur dicatitkan di ladang (22% daripada jumlah kelompok dikaji) berbanding dengan 7.5% tercatit di dalam makmal. Dalam kedua-dua kes, mod frekuensi adalah terletak di kelas dua biji telur, dan kelompok yang ada lapan biji telur atau lebih adalah kurang. Dicadangkan bahawa taburan yang tak sekata ini akan meningkatkan kemandirian telur daripada parasitisme, sekiranya model mencari makanan (foraging) optimal boleh dikenakan disini dan parasit telur mengoviposit hanya dalam kelompok telur yang tinggi.*

ABSTRACT

The mean egg batch size for Bactrocera *Malaysian A under field and laboratory conditions was respectively 4.67 ± 0.40 (range 1 - 25) and 4.18± 0.26 (range 1-24). More single egg batches were observed in the field (22.0% of the total batches examined) compared to 7.5% in the laboratory. In both cases the mode was at 2 eggs, with batch size of 8 or more eggs fewer in number. It is suggested that such an uneven egg distribution would increase egg survival from parasitism, if the optimal foraging models apply and the egg parasite oviposits only in high egg batches.*

INTRODUCTION

In Malaysia, two tephritid species have been commonly recorded infesting starfruit or carambola (*Averrhoa carambola* L.), causing great damage to the fruits. They are *Bactrocera* sp. Malaysian A (Mal A) and Malaysian B (Mal B) of the *Bactrocera dorsalis* (Hendel) complex (Drew 1991). *Bactrocera* Mal A is the dominant species from carambola orchards in the Sungai Besi and Serdang areas and has often been referred to as the "carambola" fruit fly (Chua 1992a). Although *Bactrocera* Mal A is polyphagous and infests many other fleshy fruits, it may be said that carambola is one of its main hosts. It is therefore interesting to note that *Bactrocera* Mal A ex carambola was found to be more fecund and to live longer than those ex guava (Chua 1992b).

On the other hand, *Bactrocera* Mal B which is also polyphagous, is actually a major pest of banana, papaya, mango, guava and even tomato. Despite close morphological similarities between these two *Bactrocera* species, there are significant differences in the chemistry of their rectal gland extracts (Perkins *et al.* 1990), and in the isoenzyme patterns (Ooi 1991).

Female carambola fruit flies oviposit in batches of variable sizes in the host fruits. Unfortunately, information on the egg batch size of *Bactrocera* Mal A is not available in literature. The purpose of this study is to determine the batch size in the field as well as in the laboratory.

MATERIALS AND METHODS

To investigate the egg batches of *Bactrocera* Mal A under field conditions, ripening carambola fruits of different sizes were collected between April to July 1990 from several homes in Petaling Jaya which had carambola trees and from a carambola orchard at Balakong (30 km away from Petaling Jaya). Of the fruits collected, a total of

34 which had recent ovipuncture marks were retained for further study. Each fruit was then cut into several pieces, each piece containing and defined by a fresh or recent ovipunture mark on the fruit surface. Care was exercised during cutting to ensure that young larvae, if any, from each batch of eggs did not get mixed up with those from another batch. This was confirmed by checking the batch under the dissecting microscope and also counting the empty egg shells. When there were doubts or where the ovipunctures were too close, the fruit was discarded. The sum of unhatched eggs and empty egg shells/larvae (if any) from each fruit piece was considered to be the batch size.

For the laboratory studies, ten pairs of first generation laboratory-reared *Bactrocera* Mal A were caged soon after eclosion from the pupae, each pair in a separate plastic container (4 X 2.5 X 2.5 cm^3). The flies were given water, honey and protein hydrolysate as food every second or third day. Everyday at about 1000 hrs, a piece of ripe carambola fruit (*ca.* 5 cm long) was offered to each female for oviposition. This was done even during the pre-ovipositional period so that the flies were exposed to carambola after eclosion. After 24 h the piece of fruit was removed and dissected under the dissecting microscope to determine the number of eggs in each batch. The data used for analysis were for ovipositions made on day 14 to 29 of the adult age.

RESULTS

Under field conditions, the mean egg batch size was 4.67 ± 0.40 compared to 4.18 ± 0.21 as observed in the laboratory (Table 1). The size ranges for both conditons were almost same, being 1 - 25 and 1 - 24 respectively. The general shape of the frequency histogram appeared to be similar (*Fig. 1*) except for the batches containing a single egg, the proportion of which for the field conditions (22.0% of the total) was almost three times that for the laboratory conditions (7.5%) (Table 1). In both cases, the mode was at batch size of 2 eggs, while batches with 8 or more eggs were fewer being 17.6% and 10.1% respectively.

DISCUSSION

Although direct comparison of the two sets of batch size data may not be possible as the conditions were not identical (one involving a daily of-

TABLE 1
Mean egg batch size and proportion of different batch sizes of *Bactrocera* Malaysian A ovipositing in carambola as observed in the field and in the laboratory.

	Field	Laboratory
n	132	266
Mean batch size	4.67 ± 0.40	4.18 ± 0.21
Range	1 - 25	1 - 24
Batches with :		
1 egg	22.0 %	7.5 %
2 eggs	23.5 %	25.9 %
3 eggs	11.4 %	21.8 %
4 eggs	5.3 %	17.8 %
5 eggs	9.1 %	10.5 %
6 - 10 eggs	18.1 %	13.6 %
11 -15	6.9 %	2.4 %
16 or more	3.9%	2.8%

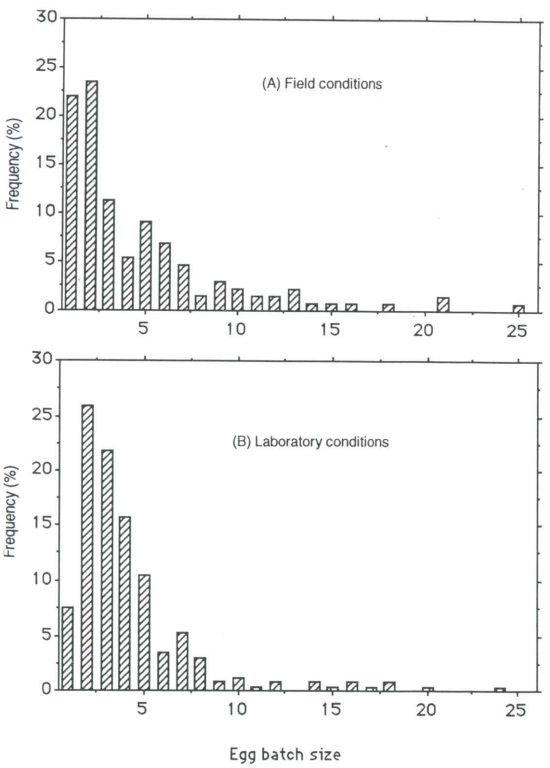

Fig. 1. Histogram of egg batch size for Bactrocera *Malaysian A ovipositing in carambola in the field and in the laboratory*

fering of a piece of fruit to an individual female *Bactrocera* Mal A, the other involving many fruits being available for oviposition by many females), similarity in both the histograms of batch size frequency is worth noting. On the other hand, two differences between the laboratory and the field data invite comment. The first is that the mean number of eggs per batch observed in the laboratory (4.18) was lower and this was due mainly to the slightly higher proportion of bigger batch size (6 or more eggs) recorded under field conditions (28.9% versus 18.8%). The second is that there were more single egg batches recorded in the field. In fact, the single and double egg batches predominated, constituting 45.6% of the total batches examined.

Up to now, only one egg parasitoid, *Biosteres arisanus* (Son.), has been recorded from *Bactrocera* Mal A. And it would be interesting to investigate (1) how the egg batches (varying from 1 egg to 25 eggs) of *Bactrocera* Mal A, which are essentially host patches of different sizes, would influence the pattern of parasitism, whether resulting in a density dependent or an inversely density dependent relationship, and (2) what the evolutionary advantages are to *Bactrocera* Mal A to have different egg batch sizes.

According the optimal foraging models of parasitoid searching for hosts distributed in patches, a parasitoid can enter a host patch either randomly (Charnov 1970) or non-randomly (Comins and Hassell 1979). In either case, a parasitoid will choose and oviposit only in those patches which offer the highest oviposition rate which will ultimately give the most progeny per patch. Consequently patch-leaving is non-random and occurs when another patch offers a higher oviposition rate. If these models hold, then it would appear to be advantageous to *Bactrocera* Mal A to lay eggs more in smaller batches (eg. 1 - 3 eggs) as observed under both field conditions (56.9%) and in the laboratory (55.2%), since these would be less preferred and less exploited by the parasitoid and hence have a greater chance of contributing to the recruitment of the next generation of host.

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