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COMMUNICATION I

Effects of Host Fruit and Larval Density on Development and Survival of *Bactrocera* sp. (Malaysian B). (Diptera: Tephritidae)

ABSTRACT

The effects of five fruits (guava, mango, papaya, starfruit and tomato) on the larval survival, adult eclosion and size of Bactrocera *sp. (Malaysia B) were investigated. The percentage pupation and adult emergence from pupae were not affected by different hosts, except for guava which gave the lowest percentage of adult emergence. Papaya and mango yielded the largest adult (>2mm head width). Comparison of composition of fruits indicates that a high percentage of carbohydrate and high pH in fruits would produce larger adults. High larval density reduced the percentage of larval survival, adult emergence and adult size.*

INTRODUCTION

In Malaysia, the two dominant tephritid fruit flies which cause serious damage to many types of fruits grown on a commercial scale belong to the *Bactrocera dorsalis* (Hendel) complex. These have been designated as *Bactrocera* sp. Malaysian A (Mal A) and Malaysian B (Mal B) (Drew 1991) until described formally. In local listerature, they have also been identified as *Bactrocera dorsalis* (Hendel) and *B. pedestris* (Bezzi) respectively (Ooi, 1981). Some of the fruits attacked by *Bactrocera* Mal B are guava (*Psidium guajava* L.), tomato (*Lycopersicum esculenta* Miller), chilli *(Capsicum annuum L.)*,mango (*Mangifera indica* L.), papaya (*Carica papaya* L.) and carambola (*Averrhoa carambola* L.). Carambola and guava are also infested by *Bactrocera* Mal A.

Of the two *Bactrocera* species, *Bactrocera* Mal B is a relatively less studied species in Malaysia. This is partly due to the difficulty in separating Mal A from Mal B because of their great morphological similarity. However there are vast differences in the chemistry of their rectal gland extracts (Perkins *et al.* 1990), and in the isoenzyme patterns (Ooi, 1991). Thus, information of *Bactocera* Mal B is scarce. Recently, Chua (1991a) published information on the demography of *Bactrocera* Mal B reared from guava.

This paper provides information on the effects of host fruits on development and survival of *Bactrocera* Mal B, especially that of larvae to adults and the adult size. The effect of larval density is also included.

MATERIALS AND METHODS

First generation of *Bactrocera* Mal B flies that emerged from field-collected starfruit were kept in wooden cages (1 m × 1 m × 1m) with fine wire mesh for the sides and a glass top. Separation of adult *Bactrocera* Mal B from *Bactrocera* Mal A was based on Drew's work (1991). When the flies were two weeks old, plastic tubes ("egg receptacles") with 260-290 pin holes and lined internally with guava medium were introduced into the cage to collect the eggs.

A fixed number of larvae, newly hatched from the eggs collected, were transferred with a camel hair paint brush on to a piece of fruit (ca. 4 × 2.5 × 2.5 cm) kept in a plastic bowl (9.5 cm top diameter, 7.5 cm bottom diameter, 6 cm high) with a mesh cover. To ensure an abundant supply of food for the larvae, fresh pieces of fruits purchased from the market were put daily on top of the old pieces for the larvae to move to, while old pieces which had no larvae in them were discarded later.

Five fruits were used: guava, mango, papaya, starfruit and tomato, while three larval densities (5,10 and 20) were tested for each fruit. Percentage of successful pupation (on moist paper towel), and adult emergence were recorded. The maximum head width of the adult flies (at least 3 individuals from each replicate) was also measured under the dissecting microscope. All treatments were replicated three times.

The experiments were conducted in the laboratory at 28-30°C and 70-80% R.H. Analysis of variance was carried out to determine the effects of host fruits and larval densities on pupation, adult emergence and size of adults. The treatment means were separated by Duncan's multiple range test at 5% level of significance (Duncan 1955).

RESULTS

There were no significant differences in pupation rates among larvae reared on different host fruits, although tomato gave the highest (71%) while starfruit the lowest (58%) values (Table 1). Similarly, density did not have any significant effect on the proportion of larvae that pupated (range 62-70%).

TABLE 1

Effects of different host fruits and larval density on pupation and adult emergence from puparia of *Bactrocera* Mal B.

	% pupation $\bar{x} \pm$ S.E.*	%Adult emergence $\bar{x} \pm$ S.E.*
Fruit		
Guava	68.9 ± 7.5 a	59.0 ± 8.1 a
Mango	63.9 ± 6.7 a	90.6 ± 6.1 b
Papaya	63.3 ± 5.5 a	85.5 ± 4.0 b
Starfruit	57.9 ± 5.8 a	81.8 ± 4.0 b
Tomato	70.6 ± 4.5 a	85.5 ± 8.0 b
Larval density		
5	70.0 ± 5.4 a	86.0 ± 4.9 a
10	62.3 ± 5.1 a	85.8 ± 3.4 a
20	63.0 ± 3.7 a	70.3 ± 6.8 b

* Mean values along a column with different letters are significantly different from one another at P = 0.05, according to Duncan's multiple range test.

However, the percentage of adult emergence from puparia was affected significantly by both the host fruit ($F_{4, 27}$ = 5.48, P < 0.01) and the larval density ($F_{4,27}$ = 4.53, P< 0.05). Adult emergence was highest on mango (91%) and lowest on guava (59%) (Table 1). Similarly, at larval density of 20 per 4 × 2.5 × 2.5 cm host substrate, adult emergence was lowest (70%) compared to 86% at the lower densities.

The head width of adult flies was significantly affected by both the host fruit (female: $F_{4,62}$ = 8.22, P < 0.001; male: $F_{4, 56}$ = 21.45, P < 0.001) and the larval density (female: $F_{2, 62}$ = 10.37, P < 0.001; male: $F_{2, 56}$ = 17.06, P < 0.001). Largest adult fruit flies (with head widths of 2.1 mm or more for both sexes) were obtained from mango, guava and papaya as larval food, and also from larval density of 5 (female:2.18mm, male:2.12 mm) (Table 2).

TABLE 2

Effects of different host fruits and larval densities on the head width (mm) of *Bactrocera* Mal B.

	Female $\bar{x} \pm$ S.E.*	Male $\bar{x} \pm$ S.E.*
Fruit		
Guava	2.11 ± 0.03 a	2.05 ± 0.04 ab
Mango	2.24 ± 0.02 b	2.12 ± 0.01 c
Papaya	2.09 ± 0.03 a	2.17 ± 0.02 c
Starfruit	2.00 ± 0.04 c	1.94 ± 0.04 ad
Tomato	2.04 ± 0.03 ac	1.91 ± 0.03 ad
Larval density		
5	2.18 ± 0.02 a	2.12 ± 0.03 a
10	2.11 ± 0.03 a	2.08 ± 0.03 a
20	2.07 ± 0.02 b	2.01 ± 0.03 b

* Mean values along a column with different letters are significantly different from one another at P = 0.05, according to Duncan's multiple range test.

DISCUSSION

The present results indicate that papaya and mango were the best hosts for *Bactrocera* Mal B (in terms of percentage pupation, percentage adult emergence and adult size), while starfruit and guava were less suitable. This is to be expected as papaya and mango are actually the principal hosts of *Bactrocera* Mal B in Malaysia. On the other hand, starfruit and guava are the main hosts of *Bactrocera* Mal A, and tomato is the main host of *B. latifrons* (Hendel). It is clear that the ultimate effect of host is on the pupation rate of the larvae and the size of the emerging adults from the puparia.

Host fruits have been shown to have signifi-catnt effects on the biology of fruit flies. Carey *et al.* (1985) found that the host species affected the larval and pupal development, and the life history parameters in the melon fly, *B. cucurbitae* Coquillet, whose finite rate of increase (λ) varied from 1.08 to 1.12, depending on the host. Similarly, Chua (1991b) observed that *Bactrocera* Mal A reared from starfruit were more fecund, and had higher intrinsic rate of increase (r = 0.104) than those reared on guava (r = 0.059).

Ibrahim and Rahman (1982) had shown that different host fruits affected the development of *B. dorsalis* larvae (presumably *Bactrocera* Mal A) in terms of the weight of the puparia and duration of the life cycle. They found that suitability of fruits for larval development was in the order of papaya > carambola > banana > mango > watermelon > jackfruit > citrus > pineapple.

TABLE 3
Composition of the fruits used in the experiments.

Fruit	percentage						pH
	moisture	protein	fats	fibre	total carbohydrate	acid	
Guava*	84	0.76	0.95	5.57	7.99	2.45	4.5+
Papaya*	88	0.50	0.05	0.66	10.29	0.07	5.5+
Starfruit*	82	0.71	0.75	1.23	3.40	0.78	3.5+
Mango*	79	0.92	0.15	1.10++	14.60	0.37	4.9++
Tomato**	94	1.00	0.20	0.80	4.10	-	4.0+

*Popenoe (1974) **Knott and Deanon (1967)
+ present experiment ++ Bose (1985)

An examination of the composition of fruits (Table 3) indicates that the total carbohydrate and acidity (or pH) are the important nutrient factors in influencing the development and the resultant size of adult fruit flies. Papaya and mango which have the highest percentage of carbohydrate (mainly in the form of invert sugars for papaya and sucrose for mango) and highest pH (least acidic) provide good larval food for the development of the fruit flies.

High larval densities increased the frequency of mutual contacts between larvae since the host arena was small and this ultimately affected the percentage pupation, percentage adult emergence and adult size. The competition for space appeared critical for density of 20 larvae per piece of fruit which was equivalent to 4 larvae per 5 cm^3 of fruit. Ibrahim and Rahman (1982) reported a decrease in pupal size and adult emergence in *B. dorsalis* (presumably *Bactrocera* Mal A) for larval densities of 20 or more per 20 g of papaya, while Palaccio *et al.* (1989) showed that increasing larval density from 300 to 900 per 50 g artificial diet had reduced the pupal weight from 17.0 to 9.7 mg. Similarly, Debouzie (1977) reported that pupal mortality of *Ceratitis capitata* (Wiedemann) increased with larval density within a host. In all these experiments, there was competition for food as well as for space.

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REFERENCES

BOSE, T. K. 1985. *Fruits of India-Tropical and Subtropical.* India: Naya Prokash.

CAREY, J.K., E.J. HARRIS and D.O. MCINNIS. 1985. Demography of a Native Strain of the Melon Fly, *Dacus cucurbitae,* from Hawaii. *Entomol. Exp. Appl.* **38**: 195-199.

CHUA, T.H. 1991a. Demographic Parameters of *Bactrocera* sp. (Malaysian B) (Diptera: Tephritidae). *J. Plant Prot. in the Tropics* (In press).

CHUA, T.H. 1991b. Comparison of Demographic Parameters in Wild *Bactrocera dorsalis* (Hendel) from Different Hosts (Diptera: Tephritidae). *J. Plant Prot. in the Tropics* (In Press).

DEBOUZIE, D. 1977. Study of Competition among *Ceratitis capitata* Larvae (Diptera: Tephritidae). *Arch. Zoo. Exp. Gen.* **188**:315-334.

DREW, R.A.I. 1991. Taxonomic Studies on Oriental FruitFly. *Proc. 1st Int. Symp. Fruit Flies in Tropics,* ed S. Vijaysegaran and A.G. Ibrahim p. 63-66.

DUNCAN, B.B. 1955. Multiple Range and Multiple F Tests. *Biometrics* **11**: 1-42.

IBRAHIM, A.G. and M.D.A. RAHMAN. 1982. Laboratory Studies of the Effects of Selected Tropical Fruits on the Larva of *Dacus dorsalis* Hendel. *Pertanika* **5**: 90-94.

KNOTT, J. E. and J.R. DEANON Jr. 1967. *Vegetable Production in South East Asia.* University of the

Philippines.

OOI, C.S. 1991. Genetic Variation in Populations of Two Sympatric Taxa in the *Dacus dorsalis* Complex and their Relative Infestation Levels in Various Fruit Hosts. *Proc 1st Int. Symp Fruit Flies in Tropics,* ed S. Vijaysegaran and A.G. Ibrahim p. 71-80.

OOI, P.A.C. 1981. *Dacus* spp Reared from Carambola Fruits in Malaysia. *Malays. Agric. J.* **53**: 15-19.

PALACCIO, I. P., R. IBRAHIM and A.G. IBRAHIM. 1989. Larval Diet for the Oriental Fruit Fly, *Dacus dorsalis* Hendel (Diptera: Tephritidae). *Malays. Appl. Biol.* **18**: 9-14.

PERKINS, M.V., M.T. FLETCHER, W. KITCHING, R.A.I. DREW and C.J. MOORE. 1990. Chemical Studies of Reactal Gland Secretions of some Species of *Bactrocera dorsalis* Complex of Fruit Flies (Diptera: Tephritidae). *J. Chem. Ecol.* **16**: 2475-2487.

POPENOE, W. 1974. *Manual of Tropical and Subtropical Fruits.* New York: Hafner Press.

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