CHAPTER 3: Host preference: Choice between red, green chillies and duration of oviposition with or with out egg deposition

3.1 INTRODUCTION

The tephritid fruit flies are plant feeders. Many species of this family are of great economic and agricultural importance in tropical, subtropical and temperate regions. In Malaysia and other parts of the oriental regions, fruit flies of genus *Bactrocera* infested a great variety of fruit and vegetable crops.

The economically important hosts of *B. papayae* include papaya (*Carica papaya* L.), chilli (*Capsium annuum* L.), banana (*Musa* spp.), mango (*Manigifera indica* L.), guava (*Psidium guajava* L.), tomato (*Lycopericum esculenta* Miller), and ciku (*Manikara zapota* L.).

Different species were attracted to different colour; for example dark red and black sphere were found to be attractive to apple maggot fly, *Rhagoletis pomonella* (Walsh and Prokopy, 1968), and green sphere attracts walnut husk fly *Rhagoletis completa* Cresson (Riedal and Hislop, 1985), similarly black, red and yellow sphere to *B. oleae* (Gmelin, *et al.*,1975), and black or yellow to mediterranean fruit fly (*Cerattis capitata)* (Cytrynowic *et al.,* 1982; and Kring, 1970;) Robacker,(1992)found that a combination of red sticky spheres and yellow sticky rectangles was effective in trapping *R. pomonella.* and red colour were attractive to Mexican fruit flies, *A. ludens* (Loew). The stimuli that influence acceptance or reflection of potential host fruit after landing are relatively complex. They include shape, size, colour, surface texture and chemical composition (Light and Jang, 1987; Crnjas *et al.,* 1988a, 1989b).

The purpose of this study is to examine the role of red or green chillies on the oviposition rate of *B. papayae*. It is hoped that such basic research will contribute to the

formulation of more effective management of pest in Malaysia and other parts of the world where the fruits are produced.

3.2 Material And Methods

The chillies were grown in Institute of Biological Science Experiment Farm (IBSEF) experimental farm of the University Malaya (UM). Experiments were conducted in the Laboratory of Entomology (Faculty of Science, UM). The fruit flies used in these experiments were wild flies collected as larvae from infested chilli fruits from the farm (IBSEF). The sample was placed in a plastic container (10×10×10cm) containing sterile clean sand. For pupation, the larva were transferred into cage (30 × 30 × 30 cm) in which food are provided (sugar and protein hydrolysate in proportion of 3: 1 and water). The females and males of ages 24 - 26 days were taken from these cages for the experiments. They were grouped into single, 2, 3, and 4 pairs of fruit flies of the same age. When they reached sexual maturity, they were placed in separate cages. Four different treatments of chillies (red and green riped fresh uninfested and unsprayed same size) were supplied for each set of flies. The chillies were hanged about 5 cm from the ceiling for testing the oviposition. Every 3 days the food and water were changed. The chillies was changed daily. The parameters used to compare the treatments were the total means of eggs and larvae, for the red and green chillies.

Ten days old females were kept separately in cage provided with food (honey, water and peptone) and was supplied with uninfested unsprayed 10 red chillis for oviposition. The time for females to insert its ovipositor into the fruit until its withdrawal was recorded.

Five gravid females with normal oviposition kept in cage with fresh chilli fruits were suspended on the ceiling of the cage three replicates were set up for each experiment. Observation was from 10-12 hours records on the oviposition behaviour

were based on activities surface examination by tarsal, proboscis and antennal, contact probing with the ovipositor (ovipositor insertion), lapping around ovipuncture with proboscis (touching with proboscis) and cleaning of the ovipositor. All of which took place on the fruit. The duration for each activity was recorded. A comparison was made on total time spent on each of the above activities.

The laboratory studies were performed at (25 - 27 C^0), relative humidity 79 - 85 RH % and natural light intensity. The data were analysed using the Statgraphics Statistical Package.

3.3 RESULT

Table 4. Illustrates the effect of colour ripeness of chilli on the number of eggs laid by *B. papayae*. When a single female was used the total number of eggs where laid increased with the increase number of red and green chillies this due to the area available host (chillies) increase. More eggs were deposited in red than green chillies i.e. statistically significant differences showed the number of oviposition by *B. papayae* in red chilli was significantly (P= 0.05) preferred over green ones. Also the table shows that the density of fruit flies increase and chillies number increase, the number of eggs deposited decreased. These results indicate a preference of the female *B. papayae* for the red where as green showed less preference.

Table 5. Show the comparison between larvae of red and green chilli. Red chilli were more significant than green. In case of low density of fruit flies (single pair) with increase density of fruit chillies the mean number of eggs laid by female increase and there was significant difference between red and green chillies.When the *B. papaya*

Table 4. Comparison number of eggs record in red (R) and green (G) chillies in choice experiments of different densities of fruit fly *B.papayae* a total of fifteen replicates was for each treatment

B.papayae	no. of chilli	total mean of eggs	mean eggs per chilli		sig. level
			R	G	
1fem.+ 1mal.	1R + 1G	6	4.30 ± 0.65	2.10 ± 0.47	< 0.05
	2R + 2G	11	6.36 ± 0.77	4.33 ± 0.49	< 0.05
	4R + 4G	23	13.80 ±1.44	9.40 ± 1.27	< 0.05
	8R + 8G	33	21.53 ±1.45	10.80 ± 1.07	< 0.05
2fem. + 2mal.	1R + 1G	17	11.27 ± 1.21	6.13 ± 1.04	< 0.05
	2R + 2G	16	11.40 ± 1.75	5.93 ± 0.76	< 0.05
	4R + 4G	12	7.12 ±1.09	4.60 ± 0.85	< 0.001
	8R + 8G	8	4.70 ± 1.08	2.90 ± 0.64	< 0.001
3fem. + 3mal.	1R + 1G	66	41.07 ± 1.74	24.80 ± 1.57	< 0.001
	2R + 2G	46	26.84 ± 1.84	18.73 ± 1.45	< 0.001
	4R + 4G	24	16.72 ± 2.49	6.33 ± 1.41	< 0.05
	8R + 8G	14	9.61 ± 1.52	4.47 ± 0.98	< 0.001
4fem. + 4mal.	1R + 1G	129	106.22 ± 2.49	22.40 ± 1.86	< 0.001
	2R +2G	63	54.67 ± 4.47	8.77 ± 0.95	< 0.001
	4R + 4G	32	24.67 ± 2.05	7.13 ± 1.62	< 0.001
	8R + 8G	17	13.89 ± 1.81	3.34 ± 1.06	< 0.001

fem. = female
mal. = male
sig. Level = significantly difference (P= 0.05)

females density of increase (2,3,4 pairs) and the number of chilli increase (1, 2, 4, 8 pairs as shown in the table 5) the larvae number decrease due to larvae distributing on chilli which more evident in red than green chillies. The range of ovipositor was from 20 sec. to 191.67 ± 3.2 sec. (appendix 1). However the duration for successful oviposition averaged 199.66 sec. while pseudopuncture averaged 33.8 ± 3.2 sec. (Table 6). In all cases of successful oviposition only more than one egg was deposited in each ovipuncture.

3.3.1 Oviposition activities of flies on chilli fruit .

Figure (3) shows the general activities of *B. papayae* females on host fruit. A female fly display three behavioural phases upon arrival on a fruit.

(a) Surface examining

(b) Ovipositor probing and ovipositor insertion

(c) postoviposition

(a) Surface examining phase .

The phase includes : -

1.the period from the arrival of female on a fruit until the first extrusion of the ovipositor

2.the period between ovipositor insertions while on the same fruit (exclusive of time spent on lapping around ovipunctures, and ovipositor cleaning and probing with the ovipositor) in this phase, the female makes rather slow movement carefully examining

Table 5. Comparison number of larvae record in red (R) and green (G) chillies in choice experiments of different densities of fly *B.papayae* a total of fifteen replicates was for each treatment

B.papayae	no. of chilli	total mean larvae	mean larvae per chilli		sig. Level
			R	G	
1fem.+ 1mal.	1R + 1G	5.00	3.50 + 0.77	1.60 + 0.55	< 0.05
	2R + 2G	7.00	4.42 + 0.71	2.57 + 0.43	< 0.05
	4R + 4G	10.00	6.47 + 1.20	4.40 + 0.68	< 0.05
	8R + 8G	15.00	9.87 + 1.23	4.73 + 0.84	< 0.05
2fem. + 2mal.	1R + 1G	9.00	10.73 + 1.16	4.23 + 0.74	< 0.05
	2R + 2G	14.00	8.87 + 1.64	3.33 + 1.42	< 0.05
	4R + 4G	9.00	5.97 + 0.93	2.88 + 0.65	< 0.05
	8R + 8G	7.00	4.52 +0.83	2.35 + 0.54	< 0.05
3fem. + 3mal.	1R + 1G	57	35.93 + 1.81	20.60 +1.48	< 0.001
	2R + 2G	42	24.73 + 1.69	17.44 +1.42	< 0.001
	4R + 4G	20	15.22 + 2.18	5.35 +1.18	< 0.001
	8R + 8G	12	8.63 + 1.36	3.39 + 0.77	< 0.001
4fem. + 4mal.	1R + 1G	115.00	97.27 +2.68	17.40 + 1.47	< 0.001
	2R +2G	60.00	51.47 + 47	8.13 + 0.88	< 0.001
	4R + 4G	28.00	22.55 + 1.82	5.64 + 1.30	< 0.001
	8R + 8G	15.00	12.10 + 1.68	3.25 + 0.95	< 0.001

fem. = female
mal. = male
sig. level = significant (P= 0.05)

Table 6 : Relation between duration of (A) ovipositor insertion and (B) egg deposition.

(A)

Duration of ovipositor insertion	
Successful oviposition	Unsuccessful oviposition (pseudopuncture)
191	33

(B)

Total no.	Ovipuncture No. with more than 1. egg	Ovipuncture No. with out eggs
60	40	20

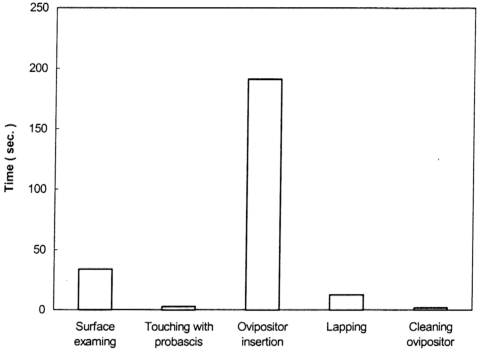

Fig. 3 : Duration ovipository activities of *B.papayae* female on chilli fruit

the surface of fruit through the tarsus proboscis and antennae. Generally the initial examining of the fruit involves walking constantly touching the fruit surface with the proboscis followed by antenna sensing during which the head is noticeably bent downwards and inwards so that the antennae touch the fruit surface. Following the antennating behaviour the fly usually proceeds to next phase of ovipositor probing. The surface examining phase lasts average of 33.8± 3.2sec. Some times this is interrupted by short bouts of feeding away from the fruit but such feeding bouts were not included as part of the surface examining phase.

(b) Ovipositor probing and ovipositor insertion phase.

A suitable site found following antenatal, the female protrudes her ovipositor walks forward arching her body, so that the ovipositor comes to form an angle of 80 - 90 with the surface at the point of contact. The female is engaged in a backward and forward action in which the ovipositor is extended and retracted a number of times one or a few spots before the ovipositor is successfully inserted into fruit. This action is called probing with the ovipositor. Normally ovipositor into the fleshy pulp ensues following ovipositor insertion.

Some females, having penetrated the fruit with the ovipositor may turn a round 180 and then lay eggs. Very often, ovipositor insertion occurs after the first probing but some times two or more attempts are needed. The duration of each ovipositor insertion period averaged 192 ± 0.83 sec. while the period of probing with ovipositor, is with few exception usually short 2.9 ± 0.12 sec. In this study the brief time spent on probing with ovipositor prior to its insertion .

(c) Postoviposition phase.

After withdrawing the ovipositor, the female may some times turn around and lap the juice exuding from the ovipuncture. She then dabs the fruit surface near the ovipunture

with her probosis. It was difficult to assess accurately and confidently the duration of postoviposition period because there was little difference between dabbing around the ovipuncture following the oviposition and dabbing during the beginning of next exploratory phase. In view of this, the time spent on oviposition lapping was only an estimate. A female spends an average 11.04 ±0.56-sec. Lapping at the ovipuncture and dabbing near the ovipuncture.

After ovipositor withdrawal and lapping (in some cases also after probing) cleaning the ovipositor with the posterior tarsi may be observed and this lasted an average of 1.9 ± 0.2 sec. Ovipositor cleaning marks the end of the postoviposition phase. The female continues its slow surface examining movements until a new attempt at ovipositon occurs.

3.4 DISSCUSION

The colours play an important role in the attraction of the fruit fly (Economopopculos, 1989). In choice study, *B. papayae* showed the oviposition preference for red over green chillies ripening. However, the number of eggs lay by female *B. papayae* depended on the offered number of chillies. More number of chillies (high density) lead to decrease of eggs at (2,3,4 females). Lew (1992) when offered different of carambola either 1,2,3,4, or 16 fruit to 5 pairs of *B.carambolae* in an experimental cage gave similar report. Nakajawa *et al.*, (1978), Cytrynowicz *et al.*, (1982), Katsoynnos, (1987) found that red colour was more attractive to *Cerattis capitata*. The studies were conducted in the filed and also (Greany *et al.*, 1987) found that the female of *C.rosa* prefered red and yellow, Robacker *et al.*, (1990) recorded red and yellow helped *B.dorsalis* to find ripe fruit for oviposition.

The number of larvae increased with the increase of host chillies fruits at 1 female density with 1,2,4,8 red and green chilli. Similarly Malvasi and Morgant,

(1981) found that larval and adult population of *Anastrepha fraterculus* (Wiedemann) increase with host availability .

B. papayae exhibited significant difference in the duration of ovipositor insertion between unsuccessful egg deposition. The time taken for ovipositor insertions which resulted in deposition was generally longer than that of pseudopunctures. Chiu and Chu, (1989) reported that the duration of ovipositor insertion during successful oviposition in *B. dorsalis* was 123 sec. This was lower than of *B. papayae* and may be due to more eggs being laid by *B. papayae* .

The oviposition bout is normally preceded by surface examination of the fruit. A female fly seems to be able to regulate egg laying according to availability of fruits. More eggs were laid with increasing density of chilli fruits (Table 4 single pair). This was also reported in *Ceratitis capitate* by Prokapy *et al.*, (1987). The female of *B. papayae* often make a quick walk up and down the length of the fruit during revisits and this indicate that *B. papayae* is generally able to assess the extent of infestation of fruit. The time spent on surface examination and ovipositor insertions are naturally also longer. The total time for probing was greater on 2 chilli fruits because the females probed more time when exposed to one pair fruit than eight pairs of fruits, the increased incidence of probing was attributed to testing of limited sites for oviposition. Oviposition sites were limited because of the smaller surface area of 2 chilli fruits which made more by greater number of eggs laid per fruit (32.3 vs. 6.4 table 4 single pair). The probing with the ovipositor is to test the exterior properties of the fruit, such as determining the hardness and softness of the site for penetration of the ovipositor and to determine its suitability for oviposition.