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ENVIRONMENTAL FACTORS AFFECTING THE IMMATURE STAGES MORTALITY OF *Bacrocera papayae*

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ABSTRACT

Three major parasitoids of *Bacrocera papyae* (Drew) were recorded in papaya , *Biosters vandenboschi, B. longicaudatus* and *B.arisanus*.Relationships between total initial hosts (*B.papayae* immatures) and total hosts killed by each parasitoid species good correlation and parasitoids relationships were not density dependent. The percentage of the larvae that survived through fruit factors was 84.2% in soil, the soil factors reduced survival to 21.3%, amongst the soil, weather accounted for 45.5% biotic factors 16.5 and physical factors 2.5%.While predator ant (*Dolicholderus* and *Componotus sp*.) 19.1% of mortality.

INTRODUCTION

Bacrocera papayae immatures in the fruit are exposed to various natural hazards such as attacked by braconid parasitoids and pathogenic microorganism before the fruit ripen or dropped. These caused immature mortalities. The pathogenic microorganisms and saprophytic fungi will effect the immature as long as the immatures remains in the fruits. However, the parasitoids only killed the immatures at the pupal stage. Other predators affect dropped fruits. Ants and birds were the main predators of *B.papayae* immatures in the University Putra Malaysia's (UPM) fruit farm in Serdang and University Malaysia's (UM) fruit farm in the campus

The immatures inside the fruits find refuge from physical and climatic factors outside. When out side outside the fruits they become vulnerable to effects of extreme heat and dryness, drowning toxic chemicals and pathogenic organisms and their toxic that are associated with soil. Bagle and Prasad (1983), Liu(1982)and Fitt(1981)
found that the amount of the rainfall showed a significant effect on immatures

Under the subtropical condition(such as in Hawaii, Taiwan and North India) both *B.papayae* population and hosts fluctuate with weather. Foliaki and Armstrong.(1997), Fullerton *et al*., (1997), Armstrong (1997), Vargas *et al*., (1990), Bagle & Prasad (1983), Liu (1982), Newel and Haramoto (1968) and Bee and Haramote (1961) found that 75% to 80% of larvae present in fruits at time the fruits fell to the ground did not produce adult flies or parasites even in absence of predator due to fruit decay caused by fungi. In orchards, the spraying of insecticide may cause a high mortality to pupating larvae and pupae in soil.

The aim of this study was to evaluate the contribution of factors mentioned to the mortalities of immatures of *B.papayae*. Many environmental factors were involved. Some were interdependent to one anther and this made analyses and interpretation difficult.

MATERIALS AND METHODS

The field study was conducted in Serdang (UPM farm) and Kuala Lumpur (UM farm) and was carried out into stages. In the first stage, damaged ripen papaya fruit in various types of cages were exposed to the wet and dry seasons of the year to assess the effects of biotic factors and weather on the immature mortalities of *B.papayae*. In the second stage, the immature mortality in the soil was evaluated.

Cages: The cages used in the experiment were made of grids from wood of thickness 2.5cm and dimension 40x40cm^2 square x 12.0cm high. Cage 1 was prepared from two grids, one as cover and other as base. Three types of cages (i.e., 2,3,4)were prepared. For cage 2 the cover and base were separate in order to facilitate opening. A fine copper mesh with diameter of 0.5mm was greased and nailed at all sides. For cage 3 the cover and base were not separate but fixed with a gap of 3.0cm in between. The gap was covered completely with fine mesh 1.0mm the diameter and nailed at all sides. Mesh was nailed to cover at two sides (one for each cover and base) where the grease was not used. The other sides of mesh were flexible and were reinforced with a thicker wire (2.0mm diameter). The flexible sides were used as the opining. For cage 4 the cover and base were not flexible to one another, therefore, separable. A fine cover mesh (1.0mm diameter) was nailed at all sides to cover where the grease was not used.

The purpose of using the copper mesh were (i) ventilation and allowed free interaction between biotic and a biotic factors from outside and larvae in inside the cage, (ii) prevent larvae, adults and parasitoids in cage to escape (iii) the fine mesh (i.e., with diameter 5.0mm) was used to isolate ants from the cage while the thicker mesh (i.e., with diameter 1.0mm) allowed ants to inter the cage.

Treatments: In the first stage of the study, four treatment; were employed(1)a control, (2) using type 2 cages to isolate all predators from larvae,(3) using type 3 cages to allow only the ants act on the larvae, and (4) using type 4 cages to expose larvae to all predators. Tree replications were carried out.

The papaya fruits of the same ripeness and size collected from the trees and distributed at random in four treatments of the experimental set. A total of three papaya fruits were used for each treatment. Three replicates of experimental set were placed at each site (i.e., UM and UPM farms experiments). Each cage was dug into the soil cover just the base portion of the cage, exposing only its cover. The soil in enclosed by each cage was filtered to eliminate live larvae and pupae in it. For the soil in Type 2 cages, ants were being eliminated. All covers were placed at their respective position except for the cage Type 4, which was left uncovered. In addition the contact points between the base and cover for Type 2 cages were greased to prevent reinvasion by ants. Concurrent to this preparation which was followed by a testing period the soil was allowed to return normal conditions for 2 – 3 days before papaya fruits where placed into cage.

After placing papaya fruit into all cages, Type 2 cages were greased at points of contact between their base and cover and the cover of it bound with affine wire to their base. Type 3 cages, the flexible sides of copper mesh were secured with a fine wire to cover. Type 4 cages were uncovered for three days to allow predators (including livestock and ants) to feed on the fruit and larvae. During the three days of exposure, the cages and the fruits were examined or inspected twice per day to ensure that the fruits were fed by predator. Throughout the experiment, if any of the Type 2,3,and 4 cages were reinvaded by ants, they were either repaired replaced or repositioned but within the limits of the experimental spot.

After three days of complete exposure ,Type 4 cages were covered for three days. During this period, the larvae escaped from the fruits to pupate. Covering was necessary to prevent the pupating larvae from escaping. After three days of covering one fruit per cage from Type 4 cages was examined for the presence of larvae. Types 2 and 3 cages were not examined for the presence of larvae because they were covered throughout the experiment. If larvae were present, the cage would remain covered until all the larvae inside the fruits had escaped. This normally took 5 to7 days fro the first day of exposure. In the absence of larvae in the fruits, the Type 4 cages were uncovered for two days so that larvae and pupae would be exposed to predators again. During this period Type 4 as well Type 2 and 3 were examined on alternate days.

In the laboratory, 18 sticky traps prepared. At beginning of the second week of fruit exposure, one stick trap was put into each Type 2, 3 and 4 cages. It was used to trap adult flies and parasitoids during emergence. At the end the second week the traps were inspected on alternate day. The total adult and parasitoids were recorded and removed from the traps (parasitoids identified to their species with the help of a magnifying glass). Trap inspection continued for about another week. Therefore, one experiment would last between 3 to 4 weeks. Fruit used for control treatments were brought to laboratory to be cultured. They were maintained under the laboratory condition (i.e., temperature 25 – 27 ^{O}C and 79±85 % RH) separately in the plastic container (35 × 2o × 28 mm). When the matured larvae came out from fruits they transferred into small plastic container (10 × 10 × 10 cm) that contained clear sterilized sand for pupation. After about a week of culture the fruits were dissected to look for the presence of alive and dead larvae. In absence of alive larvae, the fruits were discarded. The total number of mature larvae and pupae died and total number of adult flies and parasitoids emerged from the pupae were recorded for each fruit.

The experiment was repeated three times in wet season (i.e., from September to November 2002 and 3 times in dry season (i.e., from mid of December 2002 to mid of March 2003) in the field, for every experiment, the spots were shifted within a season. However the same spots used for experiments were also used in the other season, though the position of cages within a spot were never repeated throughout all the six experiments.

The second stage of the study started a month after the completion the first stage. In the second stage, the soil from each experimental spot of the first stage was collected to the depth of about 3 cm. Soil was to

laboratory for the autoclaved at 120 ^{O}C for 30 minutes. Autoclaving helped to reduce microorganism and denatured their toxins. After autoclaving, the soil was left overnight under the laboratory conditions before used. The other half of the soil was not autoclaved and used as untreated (i.e., Treatment 3). For the control (i.e., Treatment 1). Fine sand taken from a clean area (i.e., free contamination by any insecticides and human waste) was used. This sand was soaked overnight in distilled water and was repeated three times to reduce possible presence of toxic substance in soil. After soaking, the sand was autoclaved at 120 ^{O}C for 30 minutes.

For each treatment, 9 plastic container (10 × 10 × 10 cm) were used. The containers contained clear sand (6 cm depth) and were moistened with sterilized distilled water. Twenty matured *B.papayae* larvae from a laboratory culture were placed into container. When larvae entered the soil the container was covered (i.e., the cover with window 4 × 4 cm from copper mesh 0.5mm) until the adult emergence. When all adults emerges from the soil, adult flies were counted and the soils were sieved to search for dead larvae and pupae. In this experiment it was difficult to find the exact number of dead larvae in the soil because dead larva would turn black and disintegrate. However dead pupae and pupal cases were easily observed. The total dead larvae were taken as the difference between the total placed and sum of dead pupae and pupal cases in container. Total adults died half emerged (which considered as pupal mortality) and total adult that emerged from pupae but died before escaping from the soil were also counted. The experiment was repeated twice each time using different samples.

RESULTS

Larval pupal mortality due to fruit factors:

The meanl number of *B.papayae* larvae in treatment 1 (i.e., 3 papya fruits) was80±2.9 and 98±10.6 during wet and dry seasons, respectively (Table 1).

Under Treatment 1, the mean number of flies and parasitoids emerged (under the treatment 1) during the wet season were 60±2.6 and 33.3±0.8 respectively. ANOVA showed that the mean was significantly different between seasons. During the dry seasons. The mean total adult flies and parasitoids were 70.3± 2.1 and 17.6±1.2 respectively (Table 1). The means total adult and parasitoids emerged were significantly different for both seasons. The means of total adult and parasitoids emerged during the wet season were significantly higher than during the dry seasons. The means of overall percentage larval pupal mortality (i.e., sum of larval and pupal mortalities) under treatment 1 were 19.7 and 21.9 during the wet and dry seasons, respectively, and mean for the dry season was higher than that during wet season.

Natural larval pupal mortality in the soil was 5.0% subtract the larval and pupal mortality from overall mortality under treatment 1. The remaining 15.8 % was therefore contributed by larval mortality in the fruits. In this study, the agent causing larval in the fruits (collectively termed as the fruit factors)

was mainly those that were associated with toxic substances. The percentage of larvae that survived through the fruit factors was 84.2% . The surviving larvae matured and left the fruits for pupation in the soil.

Natural larval pupal mortality in the soil:

In the second phase of the study for every 20 mature larvae used under Treatment I, 0.5±0.2 (2.5%) of them died at larval stages while 0.6± 0.2 (3.0%) died at pupal stage. The larval to pupal mortality was1.1 (5.5%). The mean of total adult flies emerged under treatment 1 was 19± 0.2 (95%) (Table 2). The mean of larval pupal mortalities and adult flies emerged were significant. The finding shows that 5.% of mature larvae in the soil failed to form adult flies even in absence of physical factors, biotic factors and the extreme weather condition of the soil. The percentage killed is therefore due to natural mortality in the soil. In the presence of natural mortality and fruit factors, only 95% of the larvae in the fruits could survival to adult flies and parasitoids.

Larval pupal mortality du to soil factors:

The overall condition of soil factors towards the immature mortality is currently derived from the differences in the percentage larval and pupal mortalities between Treatment I and II (Table 1). Under Treatment 1,2 and 3 (Table 2) natural mortality as well as the physical and biotic factors of Kuala Lumpur and Serdang soil were assessed separately.

Under Treatment II the mean of total adult flies and parasitoids that emerged during wet season were 22.3±0.3 and 12±0.7 respectively. During the dry season , the means were 25±2.9 and 7±0.6 respectively. The means of two seasons were not significantly different (Table 1). The means of total adult flies and parasitoids that emerged for the two seasons were also not significantly different. However, the means for Treatments I and II were significantly different in both seasons. Assuming that total larvae in Treatment II, III and IV were similar to that of treatment I, the means percentage larval pupal mortalities under Treatment II were 64.9±1.67 and 67.7±2.50 for the wet and dry seasons, respectively. The means were not significantly different. The different in percentage survivals for Treatment I and II was 81.9. The agents causing this mortality are collectively termed the soil factors, which included the biotic factors and extreme weather conditions of the soil. Since the mean percentage of larval pupal mortality for Treatment I and II were significantly different for both seasons, the overall contribution of soil factors towards larval pupal mortalities in Kuala Lumpur (UM farm) and Serdang (UPM farm) were therefore significant.

Physical factors of soil:

Under treatment, 2 (Table 2) the means larval pupal mortalities were 0.8±0.2 (4.0%) respectively. Larval pupal mortality was 1.6 (8.0%). Therefore 15.0% of larval pual mortality in the soil occurred in the larval stages while the remaining 85.0% occurred in pupal stage. The of total adult flies emerged under Treatment 2 was 18.7± 0.2 (93.5%) (Table 2) this result show that 8.0% of matured larvae failed to form adult flies when they were allow to pupate in autoclaved experiments soil (UM, Kuala Lumpur and UPM, Serdang). However the means of larval pupal mortalities under Treatment 2 were not significant different (Table 1). The means of total adult flies and

parasitoids that emerged for the two seasons were also not significantly different. The difference in the percentage larval pupal mortalities between 2 and 3 (Table 2) was 7.5±0.1and 16.5±0.7 respectively. The difference in percentage larval pupal mortalities between two treatments was 9.2. The agents causing the mortalities are collectively termed as factors of the soil. They are mainly micro-organisms and their heat resistant toxin. Since all the differences in the larval and pupal mortalities as well as the larva pupal mortalities between 2 and 3 were significant the contribution of the biotic factor of the soil towards the immature mortalities was said to be significant different.

Larval pupal mortality due to predators:

The overall contribution of predators towards the immature mortalities of *B.papayae* in the area (Petaling jaya and Kuala Lumpur) of the experiment was derived fro the differences in the larval pupal mortalities between II, III and IV. This was due to the predacious ant species *Camponotus* sp., *Letogenys* sp. and *Dolichoderus* sp.

During the wet seasons the means the total adult flies and parasitoids emerged under Treatment III 19.1±0.2 and 7.0±0.4 respectively. The means were not significantly different. During the dry season, the means were 15.0±2.9 and 4.6±0.6 respectively (Table 1). The means were not significantly different. The means of total adult flies and parasitoids that emerged for two seasons were not significantly different under Treatment III.

The means of total adult flies and parasitoids emerged under Treatment IV (Table 1) were not significantly different during the wet season were 5.0±0.6 and 5.0±0.6 respectively. During the dry season the means were 5.0±0.6 and 1.7±1.5 respectively (Table 1). The means were not significantly different. The means of total adult flies and parasitoid emerged for two seasons were also not significantly different under Treatment IV. The means of total adult flies and parasitoids between III and IV were not significantly different for both seasons.

Under Treatment III the percentage larval pupal mortalities 71.2±0.9 and 80.4±2.8 during the wet and dry seasons respectively, the average for two seasons 75.8. The means were significantly different. Percentage larval pupal mortality under Treatment IV for wet and dry seasons were 92.2± 3.4 and 92.8±1.1 respectively and the average for two seasons being 92.6. The means were not significantly different. On overall, the difference in the percentage of the larval pupal mortalities between Treatment II and III as well as between III and IV were significantly different for both seasons.

Seasons differences in the larval pupal mortality:

The last 3 experiments during of wet season of the year were conducted between September and November 2002. During this period, it rained almost every day. Means of daily rainfalls during the first second and third experiments were 7.0±3.2, 13.0±2.1 and 12.3±3.4 mm, respectively. Daily air temperatures fluctuated between 23.1 ^{0}C and 32.6 ^{0}C while relative humidity fluctuated between 91 and 100 %. The means daily air temperature and humidity 27.9±4.8 ^{0}C and 95.6 ±4.0 %.

The last 3 experiments during dry season of year were conducted from December 2002 and mid March 2003. Daily air temperature and relative

humidity, on the other hand, did not fluctuate very much. The highest and lowest daily air temperature recorded during the experiment were 34.2 ^{0}C and 23.6 ^{0}C with means of 28.9±4.3. The highest and lowest daily relative humidity were 100 and 80.1 % with mean 88.4±1.3.

The different effect of dry and wet seasons on the immature mortalities *B.papayae* in Kaula Lumpur (UM) and Serdang (UPM) was derived from the differences in the percentage larval pupa mortalities during the different seasons for the same treatment. Under Treatment I, the difference in the percentage larval pupa mortalities between the two seasons was 2.2. Therefore, the increase in the percentage larval pupa mortality from wet to dry season was 12.2%. In the field the different in percentage larval pupa mortalities between the two seasons under Treatment II, III and IV were 2.8, 9.2 and 0.6 respectively. Therefore the average difference in the percentage larval pupa mortalities in the field between two seasons were 4.2 while the average increase was 5.95%. This study showed that the all the percentage larval pupa mortalities were higher during the dry season. However, The overall differences in larval pupa mortalities for the two seasons were not significant and that effects of wet and dry seasons on larval pupa mortalities in Kaula Lumpur (UM) and Serdang (UPM) were therefore similar.

Table 1. Predation of *B.papayae* (means + s.e) in Petaling jaya (UM) and Serdang (UPM)

Seasons	Treatment*	Mean Larval**	Adults	Parasitoids	% larval pupal mortality
Wet	I	80 ± 2.9 a	60 ± 2.6 b	33.3 ± 0.8 a	19.7 ± 2.6 d
	II	68 ± 1.6 b	22.3 ± 0.3 cd	12.0 ± 0.7 c	64.9 ± 1.7 c
	III	66 ± 0.4 b	19.1 ± 0.2 cd	7.0 ± 0.4 d	71.2 ± 0.9 f
	IV	65 ± 1.9 b	5.0 ± 0.6 e	5.0 ± 0.4 e	92.2 ± 3.4 a
Dry	I	98 ± 10.6 a	70.3 ± 2.1 a	17.6 ± 1.2 b	21.9 ± 2.1 e
	II	78 ± 1.9 b	25.0 ± 2.9 c	7.0 ± 0.6 d	67.7 ± 2.5 c
	III	78.3 ± 9.6 b	15.0 ± 2.9 d	4.6 ± 0.6 d	80.4 ± 2.8 b
	IV	70 ± 2.9 b	5.0 ± 0.6 e	1.7 ± 0.5 e	92.8 ± 1.1 a

*** I = control, II = Absence of ants and fowls, III = Presence of ant and IV = presence of both ants and other soil fauna**

**** Mean larvae per treatment and each treatment was replicated 18 times per season, total larvae in the treatment**

I, II, III and IV were considered equal. Same alphabet in a column were not significantly different as P = 0.05.

Table 2. Larval and pupal mortalities (means + s.e)# of *B.papayae* in soil in Petaling Jaya and Serdang

Soil* Treatments	Total** larvae	Larval mortality	Pupal mortality	Adults	% larval pual mortality
1	20	0.5 ± 0.2 b	0.6 ± 0.2 b	19.0 ± 0.2 a	5.0 ± 0.1 b
2	20	0.8 ± 0.2 b	0.8 ± 0.2 b	18.7 ± 0.2 a	7.5 ± 0.1 b
3	20	1.0 ± 0.3 b	2.3 ± 0.6 a	16.7 ± 0.5 b	16.5 ± 0.7 a

 # Means with similar alphabet were significantly different at P = 0.05

*** 1 = Control treatment (clear soil, autoclaved)**

2 = Autoclaved soil

3 = untreatment soil

**** Total larvae per treatment and each treatment was replicated 9 times.**

DISCUSSION

Inherent difficulties encountered in this study were many and they imposed serious problem on the reliability of the result obtained. Firstly, *B.papyae* is multi-voltine species and is generation are overlapping. Since it was impossible to evaluate the immature mortalities under the condition of overlapping generations, the first step in mortality assessment was to isolate on cohort of the stage of development (in this study, the larvae) from the rest.

Isolation of larvae was done through fruit sampling which contain eggs and larvae of *B.papayae* and through brief confinement of the fruits in cages, and all eggs would hatched into larvae. Therefore, in due time, immatures in the firsts were comprised only of various stages. This step follows by a series of evaluations on larval pupa mortality in the cages. However, the act of isolating larvae from other immatures is in itself a weakness in which the element of bias was incorporated into the study. This is so because in the process, the multiple overlapping generations of *B.papae* were conditioned into a single, non-overlapping one. The extent of bias involved in this study was immeasurable. Therefore, the larval pupa mortalities under the conditions of non overlapping and overlapping generations had to assumed similar.

Secondly, environmental factors interacting with *B.papayae* in the field many and most are closely a few could be evaluated separately. For instance larval and pupal mortalities in the soil could not be evaluated separately but combined as a larval mortality was that was derived from the difference between total in the control (i.e. Treatment I) and total adult flies that emerged subsequently. Again, to assume that total larvae in the field for Treatment II, III and IV as equal to that in the control (Treatment I) was also unrealistic (and therefore a bias). It was also impractical to count total larvae in the treatments (i.e., an absolute counting) without interfering with their survival because in doing so. Fruits had to be dissected and this would cause desiccation of fruit and larvae inside. Because larval mortality involved in absolute counting can cause greater error compared to in the larval estimation, the former is therefore preferred to the later. The basis for the above assumption was the random sampling in the distribution in to various treatments in each experimental set.

Lastly, to evaluate the effect of factor or a group of factors, a proper control treatment was needed as a control. However, control treatment was not always feasible. In the order to evaluate their effects, fruits should be sterilized as control treatment. To sterilize fruit without interfering with the larval inside was not feasible. Newell and Haramoto,(1968) sterilized guavas by dipping them in copper salt solution but the technique could not disinfect the fruits internally and therefore the fruits were not fully sterilized. There are numerous lesions on the fruits that could bacteria and fungus spores, spores and these would not be affect to any extent if disinfection was only externally done. Bactria and fungi could be also enter fruits by *B.papayae* females during oviposition and by parasitoids when the attack *B.papayae* in the fruits.

Various species of *Mucor* are common component of the soil flora, which are known to attack a variety of vegetables and fruits fungi cause a rapid breakdown of fruits which was proven detrimental to developing larvae inside (Newell and Haramoto, 1968). In the field as a result of dropping, the internal flesh of fruits was loosened this facilitates fruit decay. However, adirect mortality in larvae by *Mucor* species could also be due to toxic by product of fruit decomposition include by succinic lactic and oxalic acid, ethyl alcohol and ammonia Newell and Haramoto,(1968). Microorganisms in the fruits which include the bacterium, *serratia marcescens* Bizio, and other two fungi *Pencillium* sp.and *Aspergillus* sp. had only been reported to cause B**.**arianus (bibilo) injured mortality to eggs. Newell and Haramoto,(1968) suggest that 75 to 85 % of larvae in the fruits failed to from adult flies or parasitoids in the field even in the absence of predators. They also suggest that 80% of mortality were due to directly or in directly to action of *Mucor* spp. On the fruits The present study did not support this finding since the percentage of larvae died in the unsterilized papaya fruits was 14.7%.

In the soil the mature larvae and pupae were exposed to natural mortality. The larval pupa mortality in the clean sterilized soil was 5.0% (Table 2 treatment 1). In this soil, toxic substance were absent or minimal and living microorganisms were previously killed by autoclaving. Therefore, the percentage of larval pupal mortality in section of study could well be considered as due to the natural mortality in the soil. If the soil and predators were eliminated (i.e., under Treatment I) fruit factors and natural mortality alone could reduce the percentage of adult flies and parasitoids surviving from the total larvae in the fruits to 75 %. The matured larvae in the soil were not only exposed to the natural, but also variety of factors that reduce their survival. This group of factors, which caused immature mortality in the soil, is termed as the soil factors, which minimally include soil texture, toxic substance and weather conditions. However only a limited number of these factors could be evaluated (Table 2). The overall effect of the soil factors accounted for 45.5% of the immature mortality, and with fruit factors and natural mortality, their effects reducing the percentage of the adults flies and parasitoids surviving from the total larvae in the fruits to 33.3%.

In autoclaved soil, pupal mortality was 7.5%. If it could be assumed that all the living microorganisms were killed by autoclaving soil of the experiments soil should contain only the heat resistant toxic substances or chemicals (which were collectively termed the physical factors). When the natural mortality was subtracted from overall mortality in the autoclaved soil, the remainder (which 2.5%) should give the total mortality due to the physical factors of the soil. However physical do not include weather conditions of the soil since weather was not simulated in the laboratory. Since the percentage larval pupal mortalities in Treatment1 (i.e., natural mortality) and 2 (i.e., autoclaved of soil) were not significantly different at P =0.05, the effect of the physical factors of the soil on larval pupal mortality in Kuala Lumpur (UM) and Serdang (UPM) were not significant.

Further observation showed that an appreciable number of pupae died half emerged when trapped in the soil lumps. The matured larvae when they bored through the soil to pupate penetrate in all directions. But if they

penetrate into the soil lump and pupate there adult will not be fully emerge. However, in treatment 2 , most of the pupal mortalities (which may be the physical factors) were contributed by this type of pupal death. In the untreated experimental soil, the larval pupal mortality was only 16.5%. This mortality undoubtedly includes the natural mortality and mortalities due to the soil physical and biotic factors. If the natural mortality and mortality due to physical factors were subtracted from the total mortality in treated soil, the remainder (which is 9.0%) should give the mortality due to soil biotic factors.

One common observation amongst Treatment 1, 2, and 3 (Table 2) was that most of the matured larvae manage to pupate in the soil. Even in the untreated soil, there was 95.0% of the matured larvae pupated and most immature mortality in the soil occurred in the pupal stage. Most mature larvae that dropped to ground were able to pupate naturally in the field conditions.

If the mortalities due to soil physical and biotic factors are added together, they contributed 29.0 % to the mortality induced the soil factors. This that 71.0% of the mortality due to soil factors remained unaccounted for 2 factors (Table 2), however factors responsible for this mortality were not immediately known, principally because they could not be evaluated. However it is necessary to suggest some of the important factors that could have played significant role in it because they same soil under field conditions could a higher mortality when used in the laboratory.

One major difference between the laboratory and field conditions was that weather (which was the inherent part of the field condition) was not simulated in the laboratory. However it was not the only possible factor involved since there is also a possibility that the physical and biotic factors of the soil could become more detriment to larvae and pupae under the field conditions. The unaccounted mortality could also be due to some form of interactions between various factors such interactions could produce a stronger influence on the larval pupal mortality in the field. They may be other contributing factors but the following evidence strongly suggest that weather was main factor.

The first phase of this study was carried out during the extreme wet and dry seasons of year. When the three first experiments were carried out, heavy rain fell almost every day. Under this condition the mature larvae and pupae in the soil were mostly submerged in the water, which caused drowning of larvae and pupae. In addition, a constant wetness of the soil could lead to a more rapid decomposition of the fruits. The last three experiments were carried out during dry season of the year with little rain. The larval and pupal were never exposed to rain since it rained at the end the experiments (i.e., when emergence was almost completed). The matured larvae that dropped to the ground to pupate were immediately exposed t shock caused be extreme heat and low soil humidity. These shocks could desiccation of larvae and pupae in the soil. Larvae might die or at most if pupate, they would not form healthy pupae which died considered as the major factor subsequently.

The present study showed larval pupal mortalities during extreme wet and dry seasons in the tropic were equal detrimental to larvae and pupae in

the soil. This could well be causing the mortality and accounted for physical (non-climatic) and biotic factors of the soil.

At this juncture, it is necessary to point out that out the difference in the larval pupal mortalities between Treatment I for wet and dry seasons was not possibly due to weather since experiment were carried out under laboratory conditions. However, the difference could have been caused by competition amongst larvae abundance in the fruits during the dry season. Suitable host fruit during the dry seasons were few in number and more females had to oviposit on the fruit. These increases in larval abundance in the fruits during dry seasons.

The percentage of individuals surviving from the fruit and soil factors was 18.9, and this portion was predated upon by ant (*Camponotus*., *Leptogenys* and *Dolicholderus* sp.) which are common predator on larvae and pupae of *B.papayae.*

Newll and haramoto (1968) found that predators killed 40 to 60% of the individuals that survived through fruit and soil factors. *B.papayae* survival in the field. In the field, the ants were frequently carrying dead larvae and pupae. The mature larvae as they came from fruits would immediately jump up many times before the finally entered soil to pupate. Jumping could help them to escape from higher density of the predating ants. Sometimes, larvae could shake off some ants from their body by vigorous jumping. But, were caught, one ant would be sufficient to kill a larva.

Among the three major of environmental factors affecting the survival of the soil associated immature of *B.papayae,* soil factors played the most important role. These factors reduced the larval survival higher in dry than wet season (Table 1). The mean larval pupal mortality were higher in dry season. Within soil factors, weather conditions are probably the most important. Other important groups of environmental factors were the predators and fruits were affected on dry than wet season.

REFERENCES

Armstrong, J. (1997). Heat tolerances of immature stages of *Bactrocera facialis* and *B. xanthodes* (Diptera: Tephritidae). pp.239-246 in: Allwood, A.J., and Drew, R.A I.Management of fruit flies. in the Pacific. ACIAR Proceedings No 76. 267pp

Bagle,B.G. and V.G.Prasad (1983).Effect of weather parameters on population dynamics of oriental fruit fly,*Dacus dorsalis* Hendel. *J.Entomol*. Research, 7(2): 95-98.

Bee, H. A. and Haramoto (1961).Contributions to the biology and ecology of the oriental fruit fly, *Dacus dorsalis* Hendel (Diptera: Tephritidae), in Hawaii agriculture Experimental Station , *Technical Bulletin no*. 44 : 30pp.

Fitt,G.P.(1981). Responeses by female Dacinae to "male" lures and their to relationship patterns of mating behavior and pheromones response. *Ent. Exp. Appl*. 29 ; 87- 97

Foliaki, S.and Armstrong, J.(1997). Heat tolerances of immature stages of *Bactrocera facialis* and *B. xanthodes* (Diptera: Tephritidae). pp.239-246 in: Allwood, A.J., and Drew, R.A I., Management of fruit flies in the Pacific. ACIAR Proceedings No 76. 267pp. (Heat tolerance in Tonga).

Fullerton, R.A; Batchelor, T.A.and Lay-Yee, M.(1997). Quarantine heat treatments for *Bactrocera melanotus* (Coquillett) and *B. xanthodes* (Broun) (Diptera: Tephritidae) in Waimanalo papaya in the Cook Islands. pp.251-255 in: Allwood, A.J., and Drew, R.A I., Management of fruit flies in the Pacific. ACIAR Proceedings No 76. 267pp.

Liu,Y.C. (1982). Population studies on the oriental fruit fly, *Dacus dorsalis* Hendel. in Central Taiwan. Proceeding of the CEC/IOBC International Symposium, Athenes Greece, November 1982 (Ed. Cavallor.R.) 62 – 67.

Newell, I.M. and F.H. Haramoto (1968).Biotic factors influencing populations of *Dacus dorsalis* .Hawaii. *Entomol. Soci*., 20: 81 – 139.

Vargas, R.I.; D.stork and T. Nishida (1990). Population dynamic of oriental fruit fly and melon fly (Dipter : Tephrtidae) in an agricultural. *Environ. Entomol*. 19(6): 1820 – 1828.

عوامل بيئة مؤثرة علي الأطوار اليافعة لذبابة الباباظ *Bacrocera papayae*

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هناك ثلاثة متطفلات رئيسيه على حشره ذبابه الباباظ وهى *Biosters vandenboschi, B. longicaudatus* and *B.arisanus*. , و العلاقة ما بين كثافة الطور البالغ للعائل و الكثافة الكلية التي يقتلها كل طفيل تظهر بعلافه جيدة كما يبدو ان العلاقة ما بين هذه المتطفلات لا يعتمد علي كثافتها. ان نسبة حيوية اليرقات بالثمار بالتربة جاءت بحدود % 84.2 وهو ما يعني ان عوامل التربة ساهمت في تقليص هذه اليرقات بحدود % 21.3 فيما كان مساهمة الظروف البيئة في تأثيرها علي اليرقات بحدود 45.5% والعوامل الحيوية % 16.5 و العوامل الفيزيائية بحدود % 2.5 أما النمل المفترس (*Dolicholderus* and *Componotus* sp.) بحدود % 19.1 من موت هذه اليرقات.

قام بتحكيم البحث

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