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Effect of Different Host Fruits on Certain Biological Aspects of Immature Stages of Two Fruit Fly Species

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Abstract

The present work was conducted to evaluate effect of five types of fruits (guava - apples - mango - citrus - pomegranate) on the Mediterranean fruit fly (Medfly), *Ceratitis capitata* (Wied.) and the peach fruit fly (PFF) *Bactrocera zonata* (Saunders) at the immature stages under laboratory conditions. Both species of fruit flies were insignificantly equal with those of the mixed individuals on certain biological aspects (pupation%, pupal mortality%, emerged flies%, mean number of emerge males and females, sex ratio as emerged males%), except for mango and pomegranate fruits pupation (%) of PFF recorded high significantly 93.3 and 81.3%, respectively. Also, in pomegranate fruits emerged flies (%) of PFF gave high significantly 81.3% and mean of emerged females in mango fruits 50.7. Medfly recorded the shortest larval and pupal duration in all tested hosts. So, it can be concluded that infection of orchards with Medfly in the tested host fruits must be calls faster control practices (partial spray) required due to the shortest larval and pupal duration of Medfly.

Key words: Ceratitis capitata, Bactrocera zonata, host plants

Introduction

Fruit flies (Diptera: Tephritidae) are the most serious insect pests of fruits and vegetables in tropical and subtropical areas of the world. They destroy horticultural products by oviposting in fresh fruit tissues while still on the plant causing serious economic losses (White and Elson-Harris, 1992). The Mediterranean fruit fly (Medfly), *Ceratitis capitata* (Wied.) was a highly polyphagous tephirtid species that reported as the major pest in Egypt early last century (El-Ghawabi, 1928). In 1990 another tephritid species, the peach fruit fly (PFF) *Bactrocera zonata* (Saunders) was recorded. Both flies have sources of food all year round due to mixed plantations of fruit species in the same area (Saafan *et al*., 2005). EPPO (2005) reported that main hosts of *B. zonata* are guava, peach and mango fruits. Secondary hosts include fig, citrus and apricot fruits. Medfly and peach fruit fly infest many commercial fruits such as guava, mango, peach, apple, citrus and apricot causing considerable and significant economic damage (Hashem *et al*., 2001 and Hanafy, 2003). Joachim-Bravo *et al*. (2001) tested the reared Medfly females for oviposition preference in apple fruits and ripe, unripe papaya fruits. El-Aw *et al*. (2003) recorded larval and pupal duration periods for peach fruit fly on navel orange, peach, banana and mandarin. Female and male longevities recorded of *Bactrocera cucurbitae* and *D. ciliatus* on pumpkin and squash as well as fecundity of *B. cucurbitae* on cucumber, pumpkin and squash were investigated (Vayssières *et al*., 2008). Number of produced pupae and percentage of adult emergence for peach fruit fly from guava, peach, pear, mangoes, mandarin, figs, apple and apricot recorded by Shehata *et al*. (2008), Sayed (2012), Sarwar *et al*. (2013) and Amin (2017). Pupae produced/host were reported by Rizk *et al*. (2014) and El-Gendy (2017) in peach, fig, mango, orange and vegetables fruits under laboratory conditions for *B. zonata*. Fruit preference and age-stage, two-sex life table traits of *B. dorsalis* on *Carica papaya* L., *Musa acuminata, Psidium guajava* L. and *Mangifera indica* L. under laboratory conditions were investigated (Jaleel *et al*., 2018 and Salina *et al*., 2018). Hemeida *et al*. (2019) recorded certain biological aspects of adult longevity and duration of egg deposition, pupal emergence, adult emergence percentages, the life cycle, fecundity and hatchability between three host fruits and larval artificial diet for *B. zonata*.

The present work was conducted to investigate some biological aspects of Medfly, *C. capitata* and PFF, *B. zonata* larvae under laboratory conditions (25±3ºC & 65±5%R.H.) in five types of fruits (guava, mangoes, citrus, pomegranate and apple).

Materials and Methods

The Med-fruit fly, *C. capitata* and peach-fruit fly, *B. zonata* used for laboratory experiments was obtained from a culture, continuously reared by Awadallah and EL-Hakim (1987) in Laboratory at Horticulture Insect Research Department, Plant Protection Research Institute (PPRI), Agriculture Research Center (ARC).

The competition of larval stage of both Medfly and PFF was tested under laboratory conditions (25±3ºC & 65±5%R.H.) in five types of medium sized fruits (guava - apples - mango - citrus - pomegranate) at the beginning of ripening were put

eggs within fruits. The used fruits were washed with water and sterilized with ethanol 10%. Each treatment had three replicates. One hundred eggs was used for each replicate. The treatments were eggs of each species separately and eggs of the two species together (at 1:1). Eggs were put inside as cavity in a fruit as 20 eggs/fruit for guava and apple, whereas in case of mango, pomegranate and citrus fruits, 50 eggs/fruit were used. Larval duration were determined, the pupation (%), pupal duration, pupal mortality (%) as well emergence (%) and both male and female emergence and sex ratio were recorded. Statistical analyses of the obtained results were conducted using SAS (2004) computer program. Statistical analyses included using ANOVA and regression models. Mean separation was conducted using LSD in the same program.

Results and Discussion

1- In Guava Fruits

Data tabulated in Table (1) revealed the effect of guava fruits on larvae of both PFF and Medfly on certain biological aspects. The duration of both larvae and pupae only significantly varied, where the larvae and pupae of PFF individually recorded the longest periods 9.2 and 9.1 days, respectively. But, those of Medfly showed the shortest ones (7.5 and 7.7 days, respectively). The presence of larval stage of the two tested species of fruit flies in the same fruit intermediately prolonged the duration of larvae and pupae (8.0 and 8.9 days, respectively). The other tested biological aspects such as pupation (%), pupal mortality (%),emergence (%) and means of emerged males and females as well as sex ratio showed insignificantly differences.

2- In Citrus Fruits

As shown in Table (2) both larvae and pupae of PFF and Medfly in citrus fruits behaved the same trend of guava fruits showing significantly differences, where the two stages of PFF individually recorded the longest periods (10.3 and 9.8 days, respectively), whereas larvae and pupae of Medfly showed the shortest periods of 7.6 and 7.7 days, respectively. Also, the other biological aspects statistically showed insignificantly differences.

3- In Mango Fruit

As shown in Table (3) the larvae of both fruit flies in mango fruits significantly recorded the longest period of 9.5 days that in significantly and nearly equalized to the period of larvae of PFF only (9.4 days). Larvae of Medfly only significantly recorded the shortest duration of 7.8 days. PFF gave only significantly the highest pupation (93.3%), whereas Medfly was only significantly the lowest one 75.3%. The larvae of both flies showed intermediate pupation (83.3%). Also, the mixed pupae recorded high significantly the longest duration of 10.0 days. Finally, PFF showed significantly the highest mean number of emerged females (50.7 individuals), whereas Medfly recorded the lowest mean number of 38.0 females.

4- In Pomegranate Fruits

Statistical analysis of variance proved that both larval and pupal durations as well pupation (%) and emergence (%) showed high significantly differences. The larval period of the two species of fruit flies increased the larval period to 10.1 days that significantly more than that recorded for PFF (9.4 days) and Medfly (7.9 days). But, PFF showed the highest values of pupation (81.3%), pupal duration (9.5 days) and % emergence (81.3%). The other tested biological aspects were statistically insignificant (Table, 4).

5- In Apple Fruits

Data in Table (5) statistically revealed that both larval and pupal durations only high significantly differed. The larval period of PFF showed only the longest period (8.8 days) that insignificantly equal with those of the mixed individuals. Also, pupae of the same species recorded the longest period of 9.6 days. Both larvae and pupae of Medfly showed only the shortest periods of 7.7 and 8.3 days, respectively. The differences between the other tested biological aspects were statistically insignificant.

Effect of different host fruits on stages immature of fruit flies on certain biological aspects was previously studied. Results of Joachim-Bravo *et al*. (2001) demonstrated that ripe papaya fruit was the best for larval performance of the Medfly, females showed a less preference for oviposition in apple opposed to papaya. Carey (1984) reported that larval development of the Medfly increased from one week in favorable hosts such as mango and tomato to more than three weeks in quinces. El-Aw *et al*. (2003) stated that the averages of larval duration periods of PFF when reared on navel orange, peach, banana and mandarin were 9.93, 10.64, 10.70 and 10.99 days, respectively. Also, the corresponding respective averages of pupal periods were 12.0, 11.14, 10.03 and 12.5 days. Shehata *et al.* (2008) recorded the highest number of produced pupae and percentage of adult emergence (93%) from pear fruits followed by guava, peach, apple and finally apricot. Also, Sayed (2012) recorded the highest number of PFF pupae/ 2 kg fruits randomly collected from the trees or fallen fruits under the trees from each host either matured and ripened fruits of 325, 229 and 134 pupae/ 2 kg fruits for mangoes, guava and apple, respectively whereas apricot, navel orange, mandarin, peach and fig fruits resulted in low numbers of pupae/ 2 kg fruits.

Table 1. The competitiveness between *C. capitata* and *B. zonata* under laboratory conditions in guava fruits

FLY	Parameters							
	Mean larval duration(days)	Pupation (%)	Mean Pupal duration (days)	Pupal mortality (%)	Emerged flies (%)	Mean of male emergence	Mean of female emergence	Sex ratio as % emerged male
Mixed	8±0.1 b	90.3±5.5	8.9±0.1 a	0.7±1.2	89.7±4.9	44.7±3.1	45±5	49.9±3.6
Fruit fly	7.5±0.2 c	94±4	7.7±0.4 b	0±0	94±4	46±7.2	48±5.3	48.8±6.5
Peach fly	9.2±0.3 a	90.7±9	9.1±0.4 a	0±0	90.7±9	46±3.5	44.7±6.4	50.9±2.7
F values	54.93**	0.29 n.s.	13.66**	1 n.s.	0.38 n.s.	0.07 n.s.	0.14 n.s.	1.07 n.s.
LSD at 0.05	0.3906	-	0.6887	-	-	-	-	-
Pr > F	0.0001	0.7583	0.0058	0.4219	0.6987	0.9307	0.8681	0.4141

Means in the same row followed by the same letter are insignificantly differed (P > 0.05).

Table 2. The competitiveness between *C. capitata* and *B. zonata* under laboratory conditions in citrus fruits

FLY	Parameters							
	Mean larval duration(days)	Pupation (%)	Mean Pupal duration(days)	Pupal mortality (%)	Emerged flies (%)	Mean of male emergence	Mean of female emergence	Sex ratio as % emerged male
Mixed	9±0.2 b	82.7±3.5	8.6±0.1 b	0±0	82.7±3.5	43±6	39.7±8.1	52±8.3
Fruit fly	7.6±0.2 c	82±4	7.7±0.3 c	0.7±1.2	81.3±5	42±3.5	39.3±3.1	51.6±2.5
Peach fly	10.3±0.2 a	84.7±11.7	9.8±0.1 a	0.7±1.2	84±10.6	39.3±4.2	44.7±7	46.9±2.7
F values	132.75**	0.10 n.s.	107.14**	0.51 n.s.	0.11 n.s.	0.49 n.s.	0.64 n.s.	0.94 n.s.
LSD at 0.05	0.4009	-	0.3586	-	-	-	-	-
Pr > F	<.0001	0.9023	<.0001	0.6229	0.9003	0.6325	0.5586	0.4412

Means in the same row followed by the same letter are insignificantly differed (P > 0.05).

Table 3. The competitiveness between *C. capitata* and *B. zonata* under laboratory conditions in mango fruits

FLY	Parameters							
	Mean larval duration(days)	Pupation (%)	Mean Pupal duration(days)	Pupal mortality (%)	Emerged flies (%)	Mean of male emergence	Mean of female emergence	Sex ratio as % emerged male
Mixed	9.5±0.1 a	83.3±4.9 ab	10±0.1 a	0.3±0.6	83±4.4	41.3±2.5	41.7±2.1 ab	49.8±1.6
Fruit fly	7.8±0.2 b	75.3±6.4 b	9.1±0.1 c	0.7±1.2	74.7±6.1	36.7±7.6	38±3.5 b	48.8±7.1
Peach fly	9.4±0.1 a	93.3±8.1 a	9.8±0.1 b	1.3±1.2	92±8.7	41.3±4.2	50.7±7 a	45±3.7
F values	122.34**	5.59*	62.77**	0.70 n.s.	5.11 n.s.	0.81 n.s.	5.82*	0.99 n.s.
LSD at 0.05	0.2936	13.20	0.1978	-	-	-	9.347	-
Pr > F	<.0001	0.0456	<.0001	0.5324	0.0506	0.4895	0.0393	0.424

Means in the same row followed by the same letter are insignificantly differed (P > 0.05).

Table 4. The competitiveness between *C. capitata* and *B. zonata* under laboratory conditions in pomegranate fruits

FLY	Parameters							
	Mean larval duration(days)	Pupation (%)	Mean Pupal duration(days)	Pupal mortality (%)	Emerged flies (%)	Mean of male emergence	Mean of female emergence	Sex ratio as % emerged male
Mixed	10.1±0.1 a	75.3±2.1 b	9.1±0.1 b	0±0	75.3±2.1 b	40.7±6	34.7±4.2	54±6.3
Fruit fly	7.9±0.1 c	70±2 b	8.2±0.1 c	0±0	70±2 b	33.3±4.2	36.7±4.2	47.7±5.8
Peach fly	9.4±0.2 b	81.3±4.2 a	9.5±0.1 a	0±0	81.3±4.2 a	38.7±1.2	42.7±5	47.7±3.6
F values	291.20**	11.27**	225.46**	-	11.27**	2.35 n.s.	2.60 n.s.	1.45 n.s.
LSD at 0.05	0.229	5.844	0.1528	-	5.844	-	-	-
Pr > F	<.0001	0.0093	<.0001	-	0.0093	0.1762	0.1537	0.3074

Means in the same row followed by the same letter are insignificantly differed (P > 0.05).

Table 5. The competitiveness between *C. capitata* and *B. zonata* under laboratory conditions in apple fruits

FLY	Parameters							
	Mean larval duration(days)	Pupation (%)	Mean Pupal duration(days)	Pupal mortality (%)	Emerged flies (%)	Mean of male emergence	Mean of female emergence	Sex ratio as % emerged male
Mixed	**8.8±0.2 a**	**80±1**	**9±0.1 b**	**0.8±0.7**	**79.3±1.2**	**42.7±1.2**	**36.7±2.3**	**54.1±2.8**
Fruit fly	**7.7±0.1 b**	**82±14**	**8.3±0.04 c**	**0±0**	**82±14**	**40±8**	**42±6**	**48.6±1.5**
Peach fly	**8.8±0.1 a**	**81±9.01**	**9.6±0.3 a**	**1.6±0.3**	**80±8**	**40±9.2**	**40±15.6**	**50.9±16.2**
F values	**114.75****	**0.03 n.s.**	**35.26****	**2.39 n.s.**	**0.07 n.s.**	**0.14 n.s.**	**0.23 n.s.**	**0.25 n.s.**
LSD at 0.05	**0.2191**	**-**	**0.3955**	**-**	**-**	**-**	**-**	**-**
Pr > F	**<.0001**	**0.9672**	**0.0005**	**0.1726**	**0.9365**	**0.8697**	**0.802**	**0.7882**

Means in the same row followed by the same letter are insignificantly differed (P > 0.05).

On other hand the highest emerged adults (%) were investigated with mango, guava and apple fruits (93.53, 93.44 and 83.58%, respectively). Also, under laboratory conditions mango fruits based on the number of pupae, *B. zonata* produced/host (108.33 pupae/500g fruit), followed by apricot of 103.33 pupae (El-Gendy, 2017). Mango fruits showed the most preferred host for PFF due to the maximum number of pupae formed (173.17) and emergence of adult (84.53%) followed by peach and apple (Sarwar *et al*., 2013). The peach fruit fly also, showed high pupation percentages and adult emergence percentages from immature mangoes that kept 15, 10 and 5 days after harvesting than those freshly-harvested (Amin, 2017). Hemeida *et al.* (2019) recorded mangoes were the most suitable host where pupation and adult emergence percentages were more than that of fig fruits for the peach fruit fly (PFF). Pupation rates and larval developmental time of Medfly were higher for larvae implanted in apples compared to bitter oranges (Dionysopoulou *et al*., 2020)

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تأثير ثمار الفاكهة المختلفة على بعض السمات البيولوجية للأطوار الغير كاملة لنوعين من ذباب الفاكهة

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تم إجراء هذا العمل لتقييم تأثير خمسة أنواع من ثمار الفاكهة (الجوافة – التفاح – المانجو – الموالح – الرمان) على ذبابة فاكهة البحر المتوسط وذبابة ثمار الخوخ في أطوارها غير الكاملة في تحت ظروف المعمل. كان التأثير بين نوعي ذباب الفاكهة متشابهة بشكل ضئيل مع تلك الخاصة بالأفراد المختلطين في جوانب بيولوجية معينة (النسبة المئوية للتعذير و وفيات العذارى و الذباب الخارج و متوسط عدد الذكور والإناث الخارج و النسبة المئوية الجنسية من الذكور الخارجة) فيما عدا ثمار المانجو والرمان كانت نسبة ٪ التعذير من ذبابة ثمار الخوخ عالية معنويا حيث سجلت 93.3 و 81.3٪ على التوالي أيضا في ثمار الرمان كانت ٪ لذباب الخارج من ذبابة ثمار الخوخ مرتفعة معنويا مسجلة 81.3٪ ومتوسط ظهور الإناث في ثمار المانجو كان 50.7 من ناحية أخرى سجلت ذبابة فاكهة البحر الأبيض المتوسط أقصر مدة لتطور اليرقات والعذارى في جميع العوائل المختبرة لذلك يمكن الاستنتاج أن إصابة البساتين بذبابة فاكهة البحر المتوسط في ثمار الفاكهة المختبرة تستدعي عمليات مكافحة أسرع (الرش الجزئي) نظرًا لقصر فترة تطور اليرقات والعذارى لذبابة فاكهة البحر المتوسط.