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Relative susceptibility of some fruits to the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) and peach fruit fly, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae) in Egypt

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Abstract
The Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) and the peach fruit fly, *Bactrocera zonata* (Saunders) are two of the serious pests of different fruits and vegetables in the world inflicting economic damages. Four species of fruits were selected to study their suitability as hosts to *C. capitata* and *B. zonata*. These fruits were peach *Pruns persica* L., apricot *P. armeniaca* plum, *P. salicina* Lindl and apple *Malus domestica* Borkh. Suitability was determined by three experiments, the first experiment was studied the population of density by pheromone traps in the four orchards. The second experiment was evaluating field infestation rates of different host-fruit by incubation samples of infested fruits. The third experiment was studied the performance of *C. capitata* and *B. zonata* that reared in laboratory on these hosts by no-choice and free choice tests. Populations of the two fruit flies were higher in the peach orchard than the other orchards. Therefore in the incubation infested fruits the highest mean number of pupae and adults per fruit were observed in peach fruits, while the lowest was observed on apple fruits. The highest emergence rate per fruit was observed in apricot fruit followed by peach, plum and apple. Susceptibility was determined by counting and comparing the number of puparia recovered from the different fruit after exposure to the flies in boxes. Apricot was found to be the most susceptible, followed by peach, plum and apple.

Keywords: apple, apricots, *Bactrocera zonata*, *Ceratitis capitata*, peach, plum.

1. Introduction
Fruit flies of the family Tephritidae constitute a group of agricultural pests of worldwide importance that attack a wide range of fruits and vegetables. The larvae of the fruit flies feed on the pulp of ripe fruits forming tunnels inside them causing a great damage and make fruits unfavorable for marketing and exportation [1]. In Egypt, the most harmful tepheritid pests are the peach fruit fly, *Bactrocera zonata* (Saunders), and the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) which infesting many commercial fruits, mango, guava, apricot, peach, apple and citrus all over the year causing considerable damage which inflicts significantly economic losses [2]. The peach fruit fly and the Mediterranean fruit fly almost have the same host plants, particularly peach, guava, mango, and citrus [3]. The Mediterranean fruit fly, *C. capitata* one of the world's most well-known and damaging pests of fruit crops. It is considered one of the most important fruit pests because it develops in fruit species, most with high commercial value [4], this species extended first to the Mediterranean region during the early 19th century, and from there to the rest of the world [5]. *C. capitata* is a highly polyphagous species, having more than 300 host fruits [6]. Among the most frequent host fruit species of the medfly: plum, *Prunus domestica*; peach, *Prunus persica*; apple, *Malus sylvestris*; sweet oranges, *Citrus sinensis*; sweet lime, *Citrus aurantifolia*; grapefruit, *Citrus paradise*; coffee, *Coffea Arabica*; mango, *Mangifera indica*; feijoa, *Feijoa sellowiana*; avocado, *Persea americana*; and papaya, *Carica papaya* [7-13]. The peach fruit fly, *B. zonata*, is a serious polyphagous pest originated in the South and South-East Asia where it attacks more than 50 host plants, including guava, mango, peach, apricot, fig and citrus [1, 14].
Determination of alternative hosts of fruit fly and when these plants are fruiting is one of the key steps in managing fruit flies [15]. The oviposition behavior in insects is connected with the insect's specificity to determine the host plants, changes in host and insect plant co-evolution [16]. How the females select the appropriate host for oviposition is a quite complex phenomenon.

The physical and chemical factors associated with plants influence the choice and the balance between positive and negative stimuli that determine the final selection of the appropriate host [17-21]. Keeping in view the mode of damage and host range of fruit flies, the present study attempts to highlight the population abundance and infestation levels of both fruit flies and evaluate host preference of some fruits under field and laboratory conditions.

2. Materials and Methods

2.1 Field studies

The field experiment was carried out during 2014 and 2015 seasons on four insecticide free fruit orchards: Desert Red peach cultivar, *Pruns persica* L.; apricots, *Prunus armeniaca* cultivar Canino; plum, (*Prunus salicina* cultivar Santa Rosa) and Anna apple cultivar, *Malus domestica* at Nobaria district, Beheira Governorate, Egypt, to study the population density of Mediterranean fruit fly (MFF), and the peach fruit fly (PFF) by using Jackson traps [22] baited with the sex attractants, trimedlure and methyl eugenol in capsule lure, respectively, (supplemented by Plant Protection Institute). All of these trees were grown under the same ecological conditions and homogenous in age (twelve years-old). The capsule was fixed in the trap sticky board, each sticky board was replaced weekly with new one. The capsule lure was exchanged regularly every 3 weeks. The traps were randomly distributed throughout the four orchards, each orchard has an equal number of traps for each fly species (three traps). The traps were fixed at 1, 2 and 3 meter height. The baited traps caught adult males of *C. capitata* and *B. zonata*. Male adults which have been attracted in the traps were counted weekly and recorded as CTD (captured males/trap/day).

2.2 Laboratory studies

2.2.1 Incubation samples infested fruits

During fruit harvest, samples of ripe fruit were randomly taken from trees, as well as of some fruit that had recently fallen, to determine infestation by allowing the fruit flies to develop. Twenty fruits from every fruit species (Peach, plum, apricot and apple) were collected and incubation at the laboratories. Incubation was by way of placing the fruits on 4 plastic jars as a replicates (5 fruits/ one plastic jar) containing sawdust at the bottom (for pupation) covered with blotting paper (to absorb excess moisture). The maggots, which developed in the fruits, exited to pupate in the sawdust. Pupae were collected and the number of pupa that emerged from each fruit was counted. Observations were recorded pupae, dead pupae, emerged adults and sex ratio for each fruit. The data were tabulated and analyzed using analysis of variance, with *F*-tests. Similar technique was established by many authors [23-25].

2.2.2 Choice and no-choice experiments

The second experiment is to determine susceptibility to infestation by allowing the fruit flies to fruits which collected during the last three weeks of fruit maturity, i.e., June. For each species, 20 non infested fruits were collected from the orchard and immediately brought to the laboratory. In the laboratory, the test fruits were washed and examined with a hand lens for visible signs of oviposition punctures then placed in the boxes for the experiments (five fruits for each box). The fruit flies used in this study were obtained from the stock culture supplemented by the Plant Protection Institute. Fruit flies adults (10 males and 10 females) of 7-14 days old were then introduced into the boxes with the fruits. For each type of the two flies, four boxes for each fruit type (no-choice test) and another four boxes for choice test. Flies were fed on 1:3 volume mixtures of hydrolyzed enzymatic yeast and sugar. Water was also provided on Petri dishes as soaked cotton wool. All treatments were replicated four times. Fruits and flies were left in the boxes for two days. After the first day, positions of fruits were changed to ensure that flies did not develop learned behaviours of finding a particular variety in one area of the box. After the 2-day exposure period, fruits were removed and incubated in separate plastic bowls, and the sand checked for puparia every day. All experiments were carried out under conditions of 25±2°C, 55-65% R.H. and 14:10 L: D photoperiod. Each fruit was replicated four times in four boxes in no-choice test and four fruits together were replicated four times (choice experiment).

2.3 Identification

Specimens of fruit flies were identified by the Systematic Research Department at Plant Protection Research Institute, Giza, Egypt for confirming the identification.

3. Results and Discussions

3.1 Population density of *C. capitata* and *B. zonata*

The population density of the Mediterranean fruit fly, *C. capitata* (Wiedemann), and peach fruit fly, *B. zonata*, were studied in 2014 and 2015 seasons in four fruit orchards (Peach, apricot, plum and apple) in Nobaria district, using Jackson traps baited with the male specific parapheromone trimedlure and methyl eugenol, respectively. This experiment was carried for a period of about five months from February to July (from blooming to harvest time). Data presented in Tables 1 and 2 show that the mean numbers of CTD (captured males per trap per day) for *C. capitata* and *B. zonata* were significantly different between the four orchards, during the dates of inspections for the two years. During the first season the general mean of CTD in case of *C. capitata* have been recorded 4.4 males/trap/day in the peach orchard followed by 3.98 males in apricot orchard, 2.12 flies in plum orchard and 1.33 males/trap/day in the apple orchard. The results also indicated that *C. capitata* male's population during the second season, 2015 was high than it's in the first season; where's the CTD were 5.18, 4.57, 2.72 and 1.6 in peach, apricot, plum and apple orchards, respectively. Population of *B. zonata* was lower than *C. capitata* where's the means of CTD of *B. zonata* through the first season were 2.29, 1.73, 1.22 and 1.01 in peach, apricot, plum and apple orchards, respectively. In the second season these means decreased in contrast with *C. capitata* and reach to 1.78, 1.36, 0.79 and 0.58 in the four orchards, respectively. Also, the results indicated that the peak periods of the two types of flies were coincided with the ripening of fruits and *C. capitata* was more dominant on the four orchards than *B. zonata*. Populations of the two flies were high in the peach orchard may be due to the long period of peach fruits that are acceptable for egglaying than apricot, plum and apple fruits. Drew and Hooper [26] stated that the fruit flies tend to remain or very near fruiting host plants so long as the fruit is acceptable for egg laying. They add, if the plants are non-host or hosts with low quality fruit, the mature females arrive in low numbers and/or emigrate rather rabidly, and in some species may fly considerable distance before finding host plants with acceptable fruits. In our study *C. capitata* was more prevailing than *B. zonata* in agreement with Darwish [27] who study the seasonal activity of PFF and MFF at Nobaria and Abou El-Matamer at El-Beheira, Egypt, through 2004/05 and 2005/06 seasons and found that the MFF had higher density than PFF during the tested periods, this may be as a result of suitable both climatic conditions and hosts for the

MFF. Also, El-Gendy and Nassar [28] in thirteen districts of El-Beheira governorate and over two successive years; 2012 and 2013 found the same results.

The results (Table 3 & 4 and Fig. 1&2) on the mean number of adult males of fruit flies at different heights of 1, 2 and 3 meters from ground level indicated that a significantly higher number of flies were captured in the traps that hung at 3 meters followed by 2 meters and 1 meters. Therefore, it is obvious from these results that to control or monitoring the fruit flies, traps should be placed at 3 meters from the ground level. Siddiqui *et al*. [29] placed traps at 2, 4, 6, 8 and 10 feet from the ground level in the guava orchard in Pakistan and found that a significantly higher number of flies were captured in the traps hung at 10 feet height (about 3 meters).

Table 1: The mean number of captured *C. capitata* males per trap per day (CTD) in peach, apricot, plum and apple at Nobaria district, El-Beheira Governorate, Egypt during 2014 and 2015 seasons.

The 1st season, 2014					The 2nd season, 2015				
Date	**apple**	**Plum**	**Apricot**	**Peach**	**Date**	**Apple**	**Plum**	**Apricot**	**Peach**
07/02/2014	0.00	0.00	0.00	0.00	06/02/2015	0.00	0.00	0.00	0.00
14/02/4014	0.00	0.00	0.00	0.00	13/02/4015	0.00	0.00	0.00	0.00
21/02/2014	0.00	0.00	0.00	0.10	20/02/2015	0.00	0.00	0.00	0.00
28/02/2014	0.00	0.00	0.05	0.43	27/02/2015	0.00	0.00	0.00	0.33
07/03/2014	0.00	0.00	0.10	1.05	06/03/2015	0.00	0.00	0.29	0.71
14/03/2014	0.00	0.00	0.33	1.62	13/03/2015	0.00	0.24	1.05	1.33
21/03/2014	0.00	0.10	1.05	2.86	20/03/2015	0.48	0.57	1.57	3.00
28/03/2014	0.14	0.29	2.19	3.67	27/03/2015	0.76	0.62	2.86	3.81
04/04/2014	0.52	0.33	3.05	3.52	03/04/2015	1.05	1.14	3.43	4.57
11/04/2014	0.76	0.90	2.76	4.86	10/04/2015	1.33	1.81	4.43	5.14
18/04/2014	1.24	1.71	3.29	5.67	17/04/2015	1.62	1.62	5.05	5.19
25/04/2014	1.33	2.29	3.29	6.38	24/04/2015	1.81	2.10	5.95	6.43
02/05/2014	1.81	2.95	4.57	6.90	01/05/2015	2.00	3.33	5.57	7.95
09/05/2014	2.10	3.43	5.43	8.52	08/05/2015	2.29	4.10	7.10	11.00
16/05/2014	2.10	4.48	7.57	8.48	15/05/2015	2.81	4.81	9.29	12.10
23/05/2014	2.76	4.71	9.10	10.05	22/05/2015	3.19	7.71	9.76	11.33
30/05/2014	3.38	5.52	10.81	8.67	29/05/2015	3.95	7.95	9.71	9.81
06/06/2014	3.76	5.90	9.71	7.38	05/06/2015	4.43	6.48	9.14	10.10
13/06/2014	3.62	4.62	8.24	5.38	12/06/2015	3.71	5.62	7.62	6.81
20/06/2014	2.57	4.10	6.81	3.95	19/06/2015	2.43	4.95	7.38	5.33
27/06/2014	1.81	3.29	5.14	2.95	26/06/2015	1.76	4.05	5.67	3.81
Mean±SD	1.33± 1.33^{b}	2.12± 2.14^{b}	3.98± 3.57^{a}	4.4± 3.2^{a}	Mean±SD	1.6± 1.43^{c}	2.72± 2.7^{bc}	4.57± 3.54^{ab}	5.18± 4.03^{a}
L. S. D.	L.S.D.=1.66105 F=6.191				L. S. D.	L.S.D.=1.89681 F=5.993			

Table 2: The mean number of captured *B. zonata* males per trap per day (CTD) in peach, apricot, plum and apple at Nobaria district, El-Beheira Governorate, Egypt during 2014 and 2015 seasons.

The 1st season, 2014					The 2nd season, 2015				
Date	**apple**	**Plum**	**Apricot**	**Peach**	**Date**	**Apple**	**Plum**	**Apricot**	**Peach**
07/02/2014	0.00	0.00	0.00	0.00	06/02/2015	0.00	0.00	0.00	0.00
14/02/4014	0.00	0.00	0.00	0.00	13/02/4015	0.00	0.00	0.00	0.00
21/02/2014	0.00	0.00	0.05	0.00	20/02/2015	0.00	0.00	0.00	0.00
28/02/2014	0.00	0.00	0.24	0.10	27/02/2015	0.00	0.00	0.05	0.00
07/03/2014	0.00	0.10	0.38	0.14	06/03/2015	0.00	0.00	0.05	0.10
14/03/2014	0.19	0.10	0.71	0.48	13/03/2015	0.10	0.00	0.24	0.05
21/03/2014	0.29	0.29	0.86	0.57	20/03/2015	0.10	0.14	0.48	0.38
28/03/2014	0.57	0.48	1.29	0.86	27/03/2015	0.24	0.19	0.76	0.43
04/04/2014	0.76	0.43	1.48	1.19	03/04/2015	0.33	0.38	0.76	0.90
11/04/2014	0.86	0.71	1.67	1.67	10/04/2015	0.33	0.48	1.05	1.52
18/04/2014	0.95	1.14	2.19	2.48	17/04/2015	0.43	0.76	1.29	2.05
25/04/2014	0.95	1.76	2.24	2.90	24/04/2015	0.62	0.81	1.67	2.24
02/05/2014	1.14	1.71	2.43	4.00	01/05/2015	0.67	0.90	1.67	2.57
09/05/2014	1.43	1.86	2.10	4.38	08/05/2015	0.76	1.43	1.95	3.33
16/05/2014	1.76	2.71	3.33	4.48	15/05/2015	1.05	1.76	2.76	3.52
23/05/2014	2.33	3.10	4.05	4.48	22/05/2015	1.14	1.95	3.52	3.76
30/05/2014	2.48	2.86	3.90	5.57	29/05/2015	1.62	2.19	3.76	4.81
06/06/2014	2.62	2.86	3.38	5.19	05/06/2015	1.71	2.24	3.19	3.76
13/06/2014	2.29	2.33	2.48	4.29	12/06/2015	1.29	1.43	2.48	3.14
20/06/2014	1.38	1.76	2.00	3.33	19/06/2015	1.00	1.05	1.67	2.71
27/06/2014	1.24	1.48	1.52	2.10	26/06/2015	0.76	0.86	1.29	2.19
Mean±SD	1.01± 0.884^{b}	1.22± 1.105^{b}	1.73± 1.27^{ab}	2.29± 1.96^{a}	Mean±SD	0.58± 0.55^{c}	0.79± 0.78^{bc}	1.36± 1.21^{ab}	1.78± 1.57^{a}
L. S. D.	L.S.D.=0.83745 F=3.705				L. S. D.	L.S.D.= 0.67595 F=5.215			

Table 3: Effect of height of trap on the catches of adults of *C. capitata* in peach, apricot, plum and apple in 2014 and 2015 seasons

Season	Host	1 M	2 M	3 M	L. S. D.	F
2014	Peach	3.27±2.66^{b}	4.32±3.27^{ab}	5.6±3.83^{a}	2.03115	2.648
	Apricot	2.84±2.89^{b}	3.88±3.62^{ab}	5.21±4.29^{a}	2.25115	2.236
	Plum	1.26±1.39^{b}	2.39±2.39^{ab}	2.72±2.7^{a}	1.38055	2.475
	Apple	0.912±1.03^{b}	1.27±1.2^{ab}	1.8±1.8^{a}	0.87135	2.229
	Mean	2.07±2.34	2.97±2.995	3.84±3.62		
2015	Peach	3.33±2.65^{b}	5.33±4.36^{ab}	6.88±5.25^{a}	2.6085	3.741
	Apricot	3.45±2.72^{b}	4.24±3.32^{ab}	6±4.67^{a}	2.2619	2.683
	Plum	2.197±2.57	2.77±2.69	3.19±3.01	1.6911	0.695
	Apple	0.966±1.06^{b}	1.59±1.44^{ab}	2.24±1.87^{a}	0.923	3.833
	Mean	2.48±2.5	3.48±3.39	4.58±4.32		

Means followed by the same letters, within a row, do not significantly differ at the 5% level according to the LSD test.

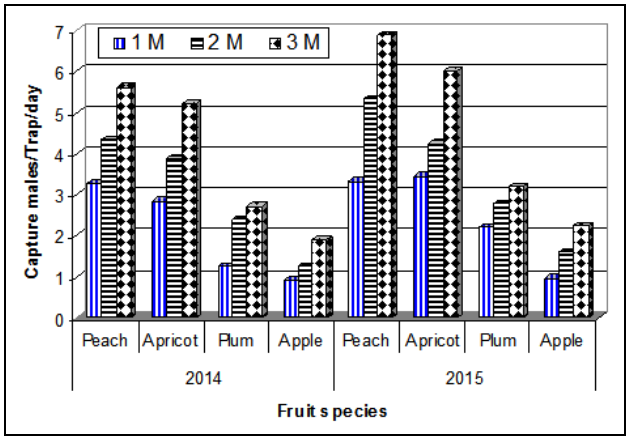

Fig 1: Effect of height of trap on the catches of adults of *C. capitata* in peach, apricot, plum and apple in 2014 and 2015 seasons

Table 4: Effect of height of trap on the catches of adults of *B. zonata* in peach, apricot, plum and apple in 2014 and 2015 seasons.

Season	Host	1 M	2 M	3 M	L. S. D.	F
2014	Peach	1.55±1.45^{b}	2.37±2.01^{ab}	2.96±2.47^{a}	1.2467	2.577
	Apricot	1.2±0.94^{b}	1.84±1.39^{ab}	2.14±1.5^{a}	0.8497	2.83
	Plum	0.99±0.97a	1.17±1.1^{a}	1.5±1.3^{a}	0.6993	1.984
	Apple	0.79±0.7^{a}	1.088±1.01^{a}	1.15±0.98^{a}	0.5618	0.906
	Mean	1.136±1.07	1.62±1.5	1.94±1.77		
2015	Peach	1.29±1.22^{b}	1.789±1.54^{ab}	2.28±2^{a}	0.999	1.974
	Apricot	0.946±0.971	1.456±1.45	1.69±1.29	0.775	1.918
	Plum	0.47±0.49^{b}	0.795±0.8^{ab}	1.1±1.06^{a}	0.3546	3.106
	Apple	0.374±0.403^{b}	0.537±0.567^{ab}	0.823±0.711^{a}	0.16325	3.285
	Mean	0.7687±0.907	1.14±1.25	1.47±1.44		

Means followed by the same letters, within a row, do not significantly differ at the 5% level according to the LSD test.

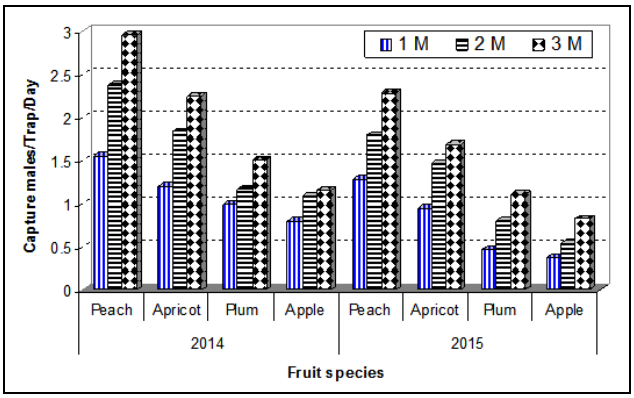

Fig 2: Effect of height of trap on the catches of adults of *B. zonata* in peach, apricot, plum and apple in 2014 and 2015 seasons

3.2 Incubation of infested fruits

This experiment was achieved by incubation the infested fruits that randomly taken from trees, as well as some fruit that had recently fallen, to determine infestation by allowing the fruit flies to develop. As shown in Table 5, the mean number of pupae of the two fruit flies per fruit were very irregular, differing significantly between the four host-fruit species. The highest mean number of pupae (16.9) per fruit were observed

in peach fruits, while the lowest was observed in apple fruits (3.65). Similar results were obtained in the second season, 2015, where's the means numbers of pupae per fruit were recorded 14.3, 10.95, 10.2 and 3.6 pupae/fruit on peach, apricot, plum and apple, respectively. The highest mean number of adults of *C. capitat* /fruit (7.05) were observed in peach fruits, while the lowest was observed in apple fruits (1.15). However, no significant correlation was observed between sex ratio in different fruits. Similar results were obtained in the second season, 2015.

Table 5: Mean number of pupae, adults obtained per fruit and sex ratio of the adults of *C. capitata* and *B. zonata* observed in four host fruit species.

Season	Host fruit	Mean no. of pupae/fruit	Emerged adults	*C. capitata*		*B. zonata*	
				Mean no. of adults/fruit	Sex Ratio %	Mean no. of adults/fruit	Sex Ratio %
2014	Peach	16.9±1.09^{a}	13±0.91^{a}	7.05±0.68^{a}	49.02±2.66^{a}	5.95±0.597^{a}	51.915±3.285^{a}
	Apricot	11.65±1.83^{b}	10.35±2.01^{b}	5.3±1.465^{b}	49.024±4.182^{a}	5.05±0.597^{b}	51.946±7.503^{a}
	Plum	10.3±0.66^{b}	7.5±0.6^{c}	3.5±0.622^{c}	47.33±6.313^{a}	4±0.163^{c}	52.37±7.54^{a}
	Apple	3.65±0.81^{c}	1.95±0.41^{d}	1.15±0.443^{d}	46.54±11.27^{a}	0.8^{d}	56.67^{a}
	L. S. D.	1.8262	1.789	1.3766	10.65925	0.6745	10.63445
	F	84.633	66.467	31.925	0.121	105.287	0.446
2015	Peach	14.3±1.85^{a}	11.35±1.02^{a}	7.25±0.823^{a}	50.154±2.911^{a}	4.1±0.739^{a}	52.42±7.83^{a}
	Apricot	10.95±1.6^{b}	9.8±1.36^{b}	6.55±1.063^{a}	47.05±4.67^{a}	3.25±0.525^{b}	50.52±4.969^{a}
	Plum	10.2±1.14^{b}	7.45±0.77^{c}	4.5±0.503^{b}	48.3±6.38^{a}	2.95±0.3^{c}	52.3±8.183^{a}
	Apple	3.6±0.33^{c}	2±0.43^{d}	1.55±0.34^{c}	48.84±10.03^{a}	0.45±0.1^{d}	54.167±8.33^{a}
	L. S. D.	2.0932	1.4764	1.1365	10.20795	0.7402	11.489
	F	43.461	72.995	48.054	0.151	42.668	0.16

Means followed by the same letters, within a column, do not significantly differ at the 5% level according to the LSD test.

Concerning *B. zonata*, the same trend was obtained where's the mean number of adults per fruit were different significantly between the four fruit species (Table 5). The highest mean number of adults per fruit were observed in peach fruits (5.95 pupae/fruit), while the lowest was observed in apple fruits (0.8 pupae/fruit). However, no significant correlation was observed between sex ratio in different fruits. Similar results were obtained in the samples of infested fruit that incubated in the second season, 2015.

It's obvious from previous results that the increase in population of the two fruit flies in peach orchard than it's populations in apricot, plum and apples orchards lead to the increasing in recovered pupa of fruit flies in the samples of the infested fruits that have been incubated from this fruits than other fruits. Also, this relation very clearly in case of peach fruit flies where it's population was higher in the 1st year than 2nd year which lead to the lowest number of pupa in the second season than the first season in the incubation fruits.

3.3 Choice and no-choice experiments

Data presented in Table (6 and 7) show results of fruit susceptibility to *B. zonata* under no choice (each fruit was exposed separately) and free choice conditions. In the case of no choice test, the statistical analysis showed that apricot had the highest pupa per fruit (19.65 pupa/fruit) while apple had the least pupa per fruit (4.8 pupa/fruit). Also, adult emergence percentage was significantly higher in apricot (91%) compared to the other fruits. The sex ratio also varied but insignificantly, maximum population percentage of females was observed in peach (49.46%). The same trend was obtained for the free choice test where the highest means pupa per fruit is, mean no. of adults per fruit and emergence rate were recorded in apple fruit. The development time for *B. zonata* also depended on host fruit species, but varied significantly. The shortest development time was observed for *B. zonata* grown on peach fruits and, the longest on apple, followed by apricot.

Table 6: Mean number of pupae and adults obtained per fruit, emergence rate and sex ratio of the adults of *B. zonata* observed in four host fruit species under no choice test.

Host	Mean no. of pupae per fruit	Mean no. of adults per fruit	Emergence rate %	Sex Ratio %	Development Time
Peach	15.7±1.428^{b}	13.35±1.427^{b}	85.001±3.562^{ab}	49.46±3.758^{a}	18.18±0.552^{c}
Apricot	19.65±1.436^{a}	17.9±1.739^{a}	91±3.87^{a}	48.736±2.82^{a}	25.07±1.92^{a}
Plum	13.05±0.806^{c}	10.8±0.489^{c}	82.98±5.88^{b}	48.69±3.614^{a}	22.089±0.81^{b}
Apple	4.8±0.52^{d}	3.35±0.574^{d}	69.46±5.79^{c}	47.96±5.96^{a}	25.61±0.72^{a}
L. S. D.	1.7257	1.8283	7.5412	6.47495	1.74725
F	125.785	105.283	13.811	0.083	36.17

Means followed by the same letters, within a column, do not significantly differ at the 5% level according to the LSD test.

Table 7: Mean number of pupae and adults obtained per fruit, emergence rate and sex ratio of the adults of *B. zonata* observed in four host fruit species under choice test.

Host	Mean no. of pupae per fruit	Mean no. of adults per fruit	Emergence rate %	Sex Ratio %	Development Time
Peach	19.25±1.68^{b}	15.85±1.417^{b}	82.36±2.42^{b}	52.16±1.897^{a}	17.46±0.603^{b}
Apricot	22.55±1.94^{a}	20.2±1.2^{a}	89.74±2.93^{a}	52.08±2.99^{a}	23.05±0.9^{a}
Plum	14.5±1.67^{c}	11.65±1.01^{c}	80.65±4.92^{b}	52.68±2.247^{a}	20.98±1.82^{a}
Apple	2.2±0.432^{d}	1.35±0.25^{d}	61.66±5.5^{c}	52.05±10.67^{a}	21.57.±1.71^{a}
L. S. D.	2.3843	1.6408	6.3928	8.8298	2.09595
F	132.828	229.633	33.257	0.011	12.134

Means followed by the same letters, within a column, do not significantly differ at the 5% level according to the LSD test.

Data presented in (Table 8 and 9) show results of host preference for *C. capitata* under no choice and free choice conditions. Statistical analysis showed that the apricot fruits were the most susceptible fruits for *C. capitata* whereas the highest pupal recovery (16.45 pupa/fruit) was recorded in apricot followed by peach (13.75) then plum (13.45) and finally apple (4.15). Also, adult emergence percentages reach to 93.27% in apricot, 85.66% in peach, 83.27% in plum and 73.34% in apple fruits. Similar results were observed by Medeiros *et al*. [13] when they studied the suitability of seven species (hot pepper, loquat, cattley guava, sweet orange, mandarin, feijoa and peach) as hosts to *C. capitata* and found the most suitable host for *C. capitata* was peach fruits. The means of development times ranged from 17.37 days for flies emerged from peach to 24.75 for those emerged from apricot in agreement with Krainacker *et al*. [7] study the effect of larval host on life history traits of the Mediterranean fruit fly, *C. capitata* and found plum are the host that produced the longest lived flies.

Table 8: Mean number of pupae and adults obtained per fruit, emergence rate and sex ratio of the adults of *C. capitata* observed in four host fruit species under no choice test.

Host	Mean no. of pupae per fruit	Mean no. of adults per fruit	Emergence rate %	Sex Ratio %	Development Time
Peach	13.75±2.03^{b}	11.85±2.45^{b}	85.66±5.23^{b}	55.5±4.6^{a}	17.37±0.72^{c}
Apricot	16.45±0.806^{a}	15.35±1.04^{a}	93.27±2.71^{a}	51.09±4.04^{ab}	24.75±1.52^{a}
Plum	13.45±0.97^{b}	11.25±0.81^{b}	83.66±1.6^{b}	52.05±4.99^{ab}	22.78±0.86^{b}
Apple	4.15±0.5^{c}	3.05±0.53^{c}	73.34±6.5^{c}	49.68±6.8^{b}	23.29±1.45^{ab}
L. S. D.	1.8806	2.177	6.8692	8.02845	1.8358
F	77.477	54.322	13.567	0.905	29.348

Means followed by the same letters, within a column, do not significantly differ at the 5% level according to the LSD test.

Table 9: Mean number of pupae and adults obtained per fruit, emergence rate and sex ratio of the adults of *C. capitata* observed in four host fruit species under choice test.

Host	Mean no. of pupae per fruit	Mean no. of adults per fruit	Emergence rate %	Sex Ratio %	Development time
Peach	12.2±1.1^{b}	10.15±0.806^{b}	83.29±2.61^{ab}	46.81±3.41^{a}	17.11±0.25^{c}
Apricot	15.95±1.01^{a}	14.4±0.864^{a}	90.34±3.45^{a}	48.27±4.54^{a}	23.29±0.95^{a}
Plum	12.15±0.55^{b}	9.8±0.432^{b}	80.77±5.06^{b}	48.93±2.72^{a}	20.08±1.06^{b}
Apple	2.55±0.619^{c}	1.55±0.674^{c}	59.75±7.735^{c}	50.297±11.52^{a}	23.91±0.88^{a}
L. S. D.	1.3141	1.0655	7.86305	10.11135	1.3004
F	180.228	241.456	26.623	0.194	55.609

Means followed by the same letters, within a column, do not significantly differ at the 5% level according to the LSD test.

The means of development times for the *C. capitata* in the free choice test ranged from 17.11 days for flies emerged from peach to 23.91 for those emerged from apple. Based on the results of the number of puparia recovered and emergence rate, it could be concluded that, apple was found to be the least susceptible fruit species to *B. zonata* and *C. capitata* followed by plum, peach and apricot was the most susceptible fruit species. McDonald and McInnis [30] stated that the number of eggs laid by *C. capitata* was higher in fruit with a larger diameter. However in present study this fact was not observed, since apple was the lightest fruit in diameter came in last place when considering the mean number of pupae per fruit.

The emergence rate of the adults of *C. capitata* and *B. zonata* were quite variable from one host fruit species to another. In contradictory results, Carey [31]. Found 64% emergence rate of *C. capitata* in peach fruits and Zucoloto [9]. Observed only 54% of emergence, however in agreement with the present results Medeiros, *et al*. [13] found that the adult emergence rate of *C. capitata* was superior to 93%. According to Zucoloto [9] differences in adult emergence rates can be due to variations in the populations of *C. capitata* used in the different studies, or caused by the fruit themselves, that can have different nutritive values depending of environmental factors.

4. Conclusion

Our investigation established that peach, apricot, plum and apple were more sensitive to the peach fruit fly than the Mediterranean fruit fly. Apricot fruits are the most preferable fruit for oviposition by peach fruit fly *B. zonata* and Mediterranean fruit fly, while apple fruits showed the least infestation.

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