

**ECOLOGICAL STUDIES ON MEDITERRANEAN FRUIT FLY,
CERATITIS CAPITATA (WIED.) AND PEACH FRUIT FLY,
BACTROCERA ZONATA (SAUND.) IN MANGO ORCHARDS
AT FAYOUM GOVERNORATE (EGYPT)**

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Abstract

The population dynamics of Mediterranean fruit fly (MFF), *Ceratitis capitata* (Wied.) and Peach fruit fly (PFF), *Bactrocera zonata* (Saund.) were studied in mango orchards at Sinuris and Ibsaway districts, Fayoum Governorate (Egypt) during the two successive seasons, 2002 and 2003. In the meantime, rate of infestation in mango fruits with MFF and PFF together and separately were estimated in six locations. During the two successive seasons, MFF was very low compared to PFF population. Captured per trap per day "CTD" of MFF ranged between 0.09 - 0.81 fly, with a mean of 0.26 fly, and between 0.09 - 1.59 flies, with a mean of 0.57 fly, during the two successive seasons, respectively. The "CTD" of PFF ranged between 59.5 - 275.0 flies, with a mean of 129.49 flies and between 21.97 - 147.32 flies, with a mean of 95.79 flies, during the two successive seasons, respectively. Total percentages of infestation with MFF and PFF together at the six locations, during the 1st season ranged between 4.78 - 27.15 %, with a mean of 18.20 %. Percentages of infestation with MFF separately were zero % (because no any MFF was emerged from incubated mango fruits), and percentages of infestation with PFF were the same total percentages of infestation. During the 2nd season, total percentages of infestation with MFF and PFF together ranged between 8.75 % - 16.76 % with a mean of 13.17 %. Percentages of infestation with MFF ranged between 0.10 % - 0.34% with a mean of 0.16 %, and percentages of infestation with PFF ranged between 8.65 % - 16.65 % with a mean of 13.01 %.

INTRODUCTION

The Mediterranean fruit fly, *Ceratitis capitata* (Wied.) (Diptera : Tephritidae) is a major pest all over the world, as many as 200 tropical and subtropical fruit species are attacked (Christenson and Foote, 1960). In the Mediterranean basin, the pest attacks citrus, deciduous fruits (mainly stone fruits) and other cultivated hosts. Crop production is extremely affected and fruit infestation is as high as 80 % (Cramer, 1967).

The pest causes considerable damage which inflicts significantly economic losses to peach, apricot, guava, mango, fig and citrus all over the governorates of Egypt (Awadallah *et al.*, 1974, Saafan, 1986, Hashem *et al.*, 1987 and Saafan *et al.*, 1989).

During the 90's of the last century, the Egyptian ecosystem was attacked by one of the most harmful pest, the peach fruit fly, *Bactrocera zonata* (Saund.) to be a common pest in the south of Egypt. Saafan (1986) mentioned that the pest was first recorded in Egypt in 1924 (Elmatoun, 1924), but it haven't any distribution before the 90's of 20th Century.

Peach fruit fly (PFF) infests different fruit and vegetable hosts (*e.g.* mango, peach, fig, guava, apple, citrus, tomato, ... etc.) (Oakly, 1948; Narayane and Batra, 1960 and Kapoor *et al.*, 1982). El-Minshawy *et al.* (1999) mentioned that larvae of *B. zonata* were found seriously damaging guava fruits in Alexandria. Hashem *et al.* (2001) mentioned that PFF infested mango, apple, guava and citrus in Egypt, and they added that the population increased gradually with fruiting and ripening. Hashem *et al.* (1992) studied population fluctuation and rate of Medfly infestation in peach plantation during two successive seasons (1990 and 1991) at North Sinai Governorate, Egypt. They found that Medfly adults were much abundant during the fruit season (June and July) (CTD : 32 and 40 flies).

For peach fruit fly (PFF), Ahmed (2000) studied the population dynamics peach fruit fly on different host plants at Kalubia Governorate. He found that the "CTD" of PFF was ranged between 2.3 - 114.3 flies on mango plantation. Mohamed (2002) studied seasonal fluctuation of *B. zonata* at Sohag Governorate for three successive years 1999, 2000 and 2001 by using McPhail traps baited with diammonium phosphate 2 %. Through the first year (1999), the caught fly concentrated at August, September and October, while in the rest of year the flies disappeared or in a few numbers. The same trend mostly had occurred in the second (2000) and in the third (2003) years.

The aim of the present studies is to gain sufficient information about :

- Population dynamics of medfly (MFF) and peach fruit fly (PFF) in mango plantation at Sinuris and Ibshaway districts, Fayoum Governorate during the two successive seasons, 2002 and 2003.
- Percentages of infestation with MFF and PFF together and with MFF and PFF separately on mango fruits.

The present investigation is one of a serial investigations carried out on mango plantation (very high population of PFF), on citrus plantation (low population of PFF) and on apricot plantation (medium population of PFF).

MATERIALS AND METHODS

Studies were carried out on mango plantations at Sinuris and Ibshaway districts, Fayoum Governorate during the two successive seasons, 2002 and 2003.

Mediterranean fruit fly will be prefix in MFF and peach fruit fly in PFF.

A- Population studies

Eight mango locations (orchards) were chosen at Sinuris and Ibshaway districts to study MFF and PFF population fluctuation. Eight Jackson sticky traps (Harris *et al.*, 1971) baited with trimedlure (pheromone of MFF), and another eight traps baited with methyl eugenol (pheromone of PFF) were distributed in the eight chosen mango locations at a rate of one trap for MFF and one trap for PFF per one location. Traps were inspected weekly, replaced the sheets, and replenished by pheromone and counted the captured male flies. Mean catch per trap per day "CTD" calculated and recorded to compare between population fluctuation of MFF and PFF.

B- Fruit incubation and rate of infestation

Because the symptoms of infestation by MFF or PFF can't be detected separately, the following procedures were conducted:

Six mango locations (orchards) were chosen in the two districts to be the orchards of gathering fallen fruits. In every location, five mango trees were selected, and marked. All the fruits on every selected tree were counted. A cloth bag was hung on every selected tree for gathering the fallen fruits, also label was hung neighbouring to the cloth bag for recording number of fallen fruits.

Every two weeks, fallen fruits were transferred to Plant Protection Research Institute (PPRI) at Giza for fruit incubation in a special wood cages. The produced pupae from the incubated fallen fruits counted and reserved in plastic tube until emergence. The emerged flies were identified to MFF (males and females) and PFF (males and females).

The percentages of infestation in mango fruits with the two flies (MFF and PFF) can be estimated depending on the whole counted fruits on the selected trees and the fallen fruits.

The data obtained from incubation fallen fruits were :

- Number of emerged MFF and / or number of emerged PFF **(B)**.
- Total percentages of infestation with MFF and PFF together **(C)**.
- Total number of emerged flies (MFF and PFF together) **(D)**.

To estimate the percentages of infestation with MFF or PFF separately **(A)**

We applied the following equation :

$$A = \frac{B \times C}{D}$$

Degrees of temperature and relative humidity of Fayoum Governorate were obtained from Central Laboratory for Agricultural Climate, ARC, and the correlation coefficient between "CTD" values for MFF and PFF and degrees of temperature and relative humidity during population dynamics studies period on mango plantation were carried out.

RESULTS AND DISCUSSION

A- Population fluctuation : Population fluctuation of MFF and PFF (catch per trap per day "CTD") was studied on mango at eight orchards distributed in Sinuris and Ibshaway districts during the two successive seasons, 2002 and 2003.

1) The first season (2002) :

* **MFF population.** Data in Table 1 indicate that, MFF was very low compared to PFF population. Mean "CTD" was between 0.09 - 0.81 fly with a mean of 0.26 fly during the checking periods. It was noticed that the highest mean of "CTD" was at the end of July and beginning of August (CTD : 0.81 and 0.72 fly, respectively), while the lowest mean of "CTD" at the beginning of October (CTD : 0.09 and 0.00 fly, respectively).

* **PFF population fluctuation.** Data in Table 1 show that PFF population was very high during the whole period of study. Mean of "CTD" ranged between 59.5- 275.0 flies, with a mean of 129.49 flies. The population increased at the end of July and the beginning of August (CTD : 137.5 - 275.0 flies, respectively), while it decreased at the end of September and beginning of October (CTD : 743 – 59.5 flies, respectively).

Table 1 also shows that the correlation coefficient between values of "CTD" of MFF and temperatures was positively insignificant, while it was negatively significant with R.H. %. For PFF, it was positively significant between "CTD" values and the degrees of temperature, while it was negatively insignificant with R.H. %.

2) The second season (2003) :

*** MFF population fluctuation .** Table 1 shows that the comparison between captured MFF during the two successive seasons illustrate that MFF population during the 2nd season was twice the 1st season. In the same time, MFF population was very low compared to PFF population. Mean of "CTD" ranged between 0.09 - 1.59 flies, with a high mean of 0.57 fly during the checking periods. The highest population was during the 2nd week of July until the 1st week of August, where the mean of "CTD" was between 0.80 - 1.59 flies, while the lowest population occurred during the 3rd week of September until the 2nd week of October (CTD : 0.09 - 0.25 fly).

*** PFF population fluctuation.** Data in Table 1 indicate that PFF population was very high compared to MFF population. In the same time, PFF population was relatively lower during the 2nd season than the 1st season. Mean of "CTD" was between 21.97 - 147.32 flies, with high mean of 95.79 flies during the checking periods. The high population occurred during the 2nd week of July until the 4th week of August (CTD : 127.68 - 147.32 flies), while the low population occurred during the 1st week of September until the 2nd week of October (CTD : 21.97-92.86 flies).

Table 1. Mean captured males per trap per day "CTD" of Mediterranean fruit fly (MFF) and Peach fruit fly (PFF) by pheromone traps distributed at eight mango orchards in Sinuris and Ibshaway districts, Fayoum Governorate, during the two successive seasons, 2002 and 2003.

Date of inspection		1 st season (2002)				2 nd season (2003)			
Month	Week	CTD		Average of		CTD		Average of	
		MFF	PFF	Temp. (°C)	R.H. (%)	MFF	PFF	Temp. (°C)	R.H. (%)
July	1 st	-	-	-	-	-	-	-	-
	2 nd	-	-	-	-	1.59	141.07	30.5	53.0
	3 rd	-	-	-	-	0.80	139.29	32.0	54.0
	4 th	0.81	137.5	32.4	48.0	1.00	144.64	31.5	53.0
August	1 st	0.72	275.0	32.7	50.0	1.09	141.97	31.0	54.0
	2 nd	0.11	151.8	32.8	53.0	0.63	147.32	32.5	54.0
	3 rd	0.05	149.1	32.7	53.0	0.37	142.95	32.5	54.0
	4 th	0.21	139.8	32.8	54.0	0.34	127.68	32.5	54.0
Sept.	1 st	0.18	99.3	32.8	53.0	0.47	92.86	32.0	55.0
	2 nd	0.18	115.2	32.7	50.0	0.52	50.00	31.5	52.0
	3 rd	0.14	93.4	29.4	56.0	0.25	31.25	27.5	58.5
	4 th	0.14	74.3	31.7	51.5	0.22	35.71	26.5	57.0
Oct.	1 st	0.09	59.5	26.3	55.5	0.09	28.57	26.3	55.5
	2 nd	-	-	-	-	0.09	21.97	27.5	55.5
Mean		0.26	129.49			0.57	95.79		
MFF "r"		0.28	-0.74			0.51	-0.46		
PFF "r"		0.53	-0.45			0.75	+0.54		

The same table also shows the correlation coefficient between values of "CTD" and temperature and relative humidity, during the study there was a positive correlation between "CTD" values of MFF and degrees of temperature, while it was a negative insignificant correlation between "CTD" values of MFF and R.H. %.

For PFF, there was significant positive correlation between "CTD" values and degrees of temperature, and also, there was significant positive correlation between "CTD" values and R.H. %.

B- Fruit sampling and rate of infestation :

During the study periods, fallen mango fruits were gathered twice a week from six mango locations (orchards) distributed at Sinuris and Ibshaway districts during the two successive seasons (2002 and 2003) to estimate the percentages of infestation of MFF and PFF together. The gathered fallen fruits incubated at Plant Protection Res. Institute laboratory to produce pupae and emerged MFF and PFF flies. The percentages of infestation due to MFF and PFF separately can be estimated.

1) The first season (2002). Table 2 illustrates data about incubation of mango fallen fruits. Total number of fruits on five trees at the six locations were 7940 fruits, and the total number of fallen fruits were 1135 fruits. Total percentages of infestation for the six locations ranged between 4.78 % - 27.15 %, with a mean of 18.20 %. Total number of produced pupae was 10562 pupae, and total number of emerged flies was 6656 flies, with a mean of percentages of emergence of 63.02 %. No any MFF fly emerged from the incubated fallen fruits, but all the emerged flies were PFF (6656 flies : 2983 males and 3673 females).

Table 2. Number of incubated fallen fruits which gathered from six mango orchards at Sinuris and Ibshaway districts, Fayoum

Governorate, during the 1st season, 2002.

Locations (orchards)	Total No. of fruits on five trees	Total No. of fallen fruits	Total % of infestation (MFF and PFF)	Total No. of produced pupae	Total No. of emerged flies	% Emergence	Total No. of MFF			Total No. of PFF		
							Male	Female	Total	Male	Female	Total
1	490	107	21.84	1444	820	56.79	0	0	0	370	450	820
2	710	152	21.41	3738	2003	53.58	0	0	0	802	1201	2003
3	1570	358	22.80	2278	1944	85.34	0	0	0	855	1089	1944
4	1105	177	16.02	1385	942	68.01	0	0	0	473	469	942
5	3450	165	4.78	704	385	54.69	0	0	0	184	201	385
6	615	176	27.15	1013	562	55.48	0	0	0	299	263	562
Total	7940	1135	-	10562	6656	-	0	0	0	2983	3673	6656
Mean	-	-	18.20	-	-	63.02	-	-	-	-	-	-

Table 3 clarify the percentages of infestation with MFF and PFF together and the emerged flies. Because no any MFF fly was emerged, percentages of infestation with MFF were zero %, and percentages of infestation with PFF were the same total percentages of infestation (ranged between 4.78 % - 27.15 %, with mean of 18.20 %).

Table 3. Percentages of infestation with MFF and PFF together and separately in mango fruits during the 1st season, 2002.

Locations (orchards)	Total % of infestation (MFF and PFF)	Total no. of emerged flies	% Emer- gence	MFF		PFF		% infestation with MFF	% infestation with PFF
				No. flies	% Emer- gence	No. flies	% Emer- gence		
1	21.84	820	56.79	0	0	820	56.79	0	21.84
2	21.41	2003	53.58	0	0	2003	53.58	0	21.41
3	22.80	1944	85.34	0	0	1944	85.34	0	22.80
4	16.02	942	68.01	0	0	942	68.01	0	16.02
5	4.78	385	54.69	0	0	385	54.69	0	4.78
6	27.15	562	55.48	0	0	562	55.48	0	27.15
Total	-	6656	-	0	-	6656	-	-	-
Mean	18.20	-	63.02	-	0	-	63.02	0	18.20

2) The second season (2003). Table 4 shows the data about incubation mango fallen fruits. Total number of fruits on five trees at the six locations were 15500 fruits, and the total number of fallen fruits were 1950 fruits. Total percentages of infestation (MFF and PFF) for the six locations ranged between 8.75 % - 16.76 % with a mean of 13.17. Total number of produced pupae was 26358 pupae and total number of emerged flies was 20817 flies, with mean of percentages of emergence of 79.3 %. Total number of emerged MFF flies was 246 flies (123 male and 123 females), and total number of PFF flies was 20571 flies (10074 male and 10497 females).

Table 4. Number of incubated fallen fruits which gathered from six mango orchards at Sinuris and Ibshaway districts, Fayoum Governorate, during the 2nd season, 2002.

Locations (orchards)	Total No. of fruits on five trees	Total No. of fallen fruits	Total % of infestation (MFF and PFF)	Total No. of produced pupae	Total No. of emerged flies	% Emergence	Total No. of MFF			Total No. of PFF		
							Male	Female	Total	Male	Female	Total
1	3600	315	8.75	8739	6887	78.8	37	42	79	3347	3461	6808
2	3200	413	12.91	4433	3378	76.2	24	20	44	1654	1680	3334
3	1800	261	14.50	4735	3740	79.0	17	15	32	1842	1866	3708
4	2000	304	15.20	2520	1986	78.8	11	15	26	948	1012	1960
5	2100	352	16.76	4292	3488	81.3	11	12	23	1677	1788	3465
6	3800	305	10.89	1639	1338	81.6	23	19	42	606	690	1296
Total	15500	1950	-	26358	20817	-	123	123	246	10074	10497	20571
Mean	-	-	13.17	-	-	79.3	-	-	-	-	-	-

Table 5 shows the percentages of infestation with MFF and PFF together and the emerged flies. By using the fore-mentioned equation (Materials and Methods), the percentages of infestation with MFF separately ranged between 0.10 % - 0.34 % with a mean of 0.16 %, and the percentages of infestation of PFF separately ranged between 8.65 % - 16.65 %, with a mean of 13.01 %.

From the fore-mentioned data, MFF population was very low compared with PFF population during the two seasons. In the same time, MFF population was twice in the 2nd season than in the 1st one, while PFF population was relatively lower during the 2nd season than the 1st season.

Percentages of infestation with MFF and PFF together were relatively higher in the 1st season than in the 2nd season. Percentages of infestation with MFF separately were zero % during the 1st season and 0.16 % during the 2nd season. Percentages of infestation with PFF were relatively higher during the 1st season (18.20 %) than the 2nd season (13.01 %).

The fore-mentioned results are in agreement with the findings of Ahmed (2000) who mentioned that the "CTD" of PFF was between 2.3 - 114.3 flies on mango plantation in Kalubia Governorate.

Table 5. Percentages of infestation with MFF and PFF together and separately in mango fruits during the 2nd season, 2003.

Locations (orchards)	Total % of infestation (MFF and PFF)	Total no. of emerged flies	% Emer- gence	MFF		PFF		% infestation with MFF	% infestation with PFF
				No. flies	% Emer- gence	No. flies	% Emer- gence		
1	8.75	6887	78.8	79	1.15	6808	98.85	0.10	8.65
2	12.91	3378	76.2	44	1.30	3334	98.70	0.17	12.74
3	14.50	3740	79.0	32	0.86	3708	99.14	0.12	14.38
4	15.20	1986	78.8	26	1.31	1960	98.69	0.20	15.00
5	16.76	3488	81.3	23	0.66	3465	99.34	0.11	10.65
6	10.89	1338	81.6	42	3.14	1296	96.86	0.34	10.55
Total	-	20817	-	246	-	20571	-	-	-
Mean	13.17	-	79.3	-	1.18	-	98.82	0.16	13.01

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دراسات إيكولوجية على ذبابة فاكهة البحر المتوسط وذبابة ثمار الخوخ في حدائق امانجو بمحافظة الفيوم

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تعتبر ذبابة فاكهة البحر الأبيض المتوسط من الآفات الخطيرة في العالم نظراً لتعدد عوائلها والمدى الواسع لانتشارها. وفي مصر تسبب هذه الآفة خسائر كبيرة لثمار المانجو بالإضافة إلى الخوخ والمشمش والجوافة والتين والموالح. وفي التسعينات ظهرت حشرة جديدة تسمى بذبابة ثمار الخوخ وهي آفة تصيب كل عوائل ذبابة الفاكهة.

هذا البحث ضمن سلسلة أبحاث أجريت في محافظة الفيوم على المانجو والموالح والمشمش خلال المواسم ٢٠٠٢، ٢٠٠٣، و ٢٠٠٤. وهذا هو البحث الأول في سلسلة هذه الأبحاث وقد أجرى لدراسة تذبذب تعداد كل من ذبابة فاكهة البحر المتوسط وذبابة ثمار الخوخ في حدائق المانجو بمركزى سنورس وإيشواى بمحافظة الفيوم وذلك في موسمين متتاليين (٢٠٠٢، ٢٠٠٣). وفي نفس الوقت تم تقدير نسبة الإصابة بالحشرتين معا (ذبابة الفاكهة وذبابة ثمار الخوخ) في ثمار المانجو، وكذلك نسبة الإصابة بكل حشرة على حدة.

أظهرت النتائج أن تعداد ذبابة فاكهة البحر المتوسط قليل جداً إذا ما قورن بتعداد ذبابة ثمار الخوخ في كلا الموسمين. تراوحت قيم الـ "CTD" (عدد الذباب المنجذب للمصيدة الواحدة في اليوم الواحد) لذبابة الفاكهة ما بين ٠,٠٩ - ٠,٨١ ذبابة، بمتوسط قدره ٠,٢٦ ذبابة في الموسم الأول، وفي الموسم الثانى تراوحت قيم الـ "CTD" ما بين ٠,٠٩ - ١,٥٩ ذبابة بمتوسط قدره ٠,٥٧ ذبابة، وتراوحت قيم الـ "CTD" لذبابة الخوخ ما بين ٥٩,٥ - ٢٥٧,٠ ذبابة بمتوسط قدره ١٢٩,٤٩ ذبابة في الموسم الأول، وفي الموسم الثانى تراوحت قيم الـ "CTD" لذبابة الخوخ ما بين ٢١,٩٧ - ١٤٧,٤٢ ذبابة بمتوسط قدره ٩٥,٧٩ ذبابة.

تراوحت النسبة الكلية للإصابة في ثمار المانجو بالحشرتين معا ما بين ٤,٧٨ % - ٢٧,١٥ % بمتوسط قدره ١٨,٢٠ % في الموسم الأول، وكانت نسبة الإصابة بذبابة الفاكهة فقط صفر %. وفي الموسم الثانى تراوحت النسبة الكلية للإصابة بكل من ذبابة فاكهة البحر المتوسط وذبابة ثمار الخوخ ما بين ٨,٧٥ % - ١٦,٧٦ % بمتوسط قدره ١٣,١٧ %، وتراوحت نسبة الإصابة بذبابة فاكهة البحر المتوسط فقط ما بين ٠,١٠ % - ٠,٣٤ % بمتوسط قدره ١٣,١٧ %، وتراوحت نسبة الإصابة بذبابة ثمار الخوخ ما بين ٨,٦٥ % - ١٦,٦٥ % بمتوسط قدره ١٣,٠١ %.