



Field evaluation for response of Mediterranean fruit fly *Ceratitis capitata* and peach fruit fly *Bactrocera zonata* (Diptera: Tephritidae) by tested attractant materials

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Abstract:

Recently, the peach fruit fly *Bactrocera zonata* (Saunders) (Diptera: Tephritidae) is recognized as causing fruit damage on a range of fruits and other economic host plants. Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae) is recorded in Egypt early last century and considered as a serious pest of fruits. The present investigation was conducted in two locations with two crops (peach and mango), to study response of fruit flies *B. zonata* and *C. capitata* to different chemical compounds. The obtained data indicated that 3% Diammonium phosphate recorded the highest mean numbers of weekly captured to *B. zonata* and *C. capitata*, followed by 10% Amunum-Acetate and Trimethylamine (TMA) recorded a moderately attractiveness and other chemical compounds treated was less attractants. While 5% Buminal recorded the highest attractants to attract female *C. capitata* captured. But 10% Urea Fertilizer [CO(NH₂)₂] recorded the highest attractants to attract female *B. zonata*. Data presented showed that the females number of *B. zonata* and *C. capitata* were more attracted than male flies to tested different chemical compounds, also the number of attracted flies of *B. zonata* and *C. capitata* to plastic bottles traps (liquid trap) was highest than to using plastic containers (dry trap).

Introduction

Peach fruit fly *Bactrocera zonata* (Saunders) (PFF) and Mediterranean fruit fly *Ceratitis capitata* (Wiedemann) (MFF) (Diptera: Tephritidae) are the most serious pests of fruits. The peach fruit fly *B. zonata* is considered one of the most important economic pests for several kinds of fruits in

temperate, tropical and subtropical countries (Younes *et al.*, 2009). Also *B. zonata* has been recorded in Egypt since 1990 and it is widely spread recently in all Egyptian provinces attacking several fruits (Shehata *et al.*, 2006). It has been recognized as a serious insect pest during the last decade attacking a wide range of fruits in Egypt (Fahmy *et al.*, 2013) and is

a highly polyphagous species infesting more than 50 host plants, including peach, guava, mango, apricot, fig and citrus (Peña *et al.*, 1998). This pest is difficult to be controlled by the traditional chemicals due to the behavior of its larvae that hide inside the fruits or its pupae that pupate in the soil (Saleh *et al.*, 2018). The Mediterranean fruit fly, *C. capitata* is a serious pest and worldwide pest attacking a wide range of different crops. It attacks many fruit species and some vegetable crops such as tomato, pepper and eggplant (Kapoor and Agrawal 1982; El-Minshawy *et al.*, 1999 and and Ghanim, 2009) . Lures for capturing female fruit flies are based on food or host odours. Historically, liquid protein baits have been used to catch a wide range of different fruit fly species , liquid protein baits capture both females and males, with a higher percent of females captured , trimethylamine results in a highly attractive female lure for medfly which is being used in early detection trapping networks. This synthetic food lure is more specific than the liquid protein baits and is capable of detecting female medfly at a lower level compared to the male specific attractant (IAEA , 2003) . The aim of the present work is to study response of fruit flies *B. zonata* and *C. capitata* to different chemical compounds.

Materials and methods

1. Experimental area:

This investigation was conducted in two locations in the desert back in Shebin El-Qanater and Tookh districts, Qalyoubia Governorate with two crops, peach and mango , respectively, cultivated in the sandy soil .The first experiment was carried in Shebin El-Qanater district in the farm cultivated peach 6 years age during the period from the end of third week of May to 18th June 2018 with high population density of Mediterranean fruit fly, *C. 40* males / trap / day , while the number of captured flies per trap per day

(CTD) for peach fruit fly, *B. zonata* 0.28 males / trap / day.The second experiment was carried in Tookh district in the farm cultivated mango 20 years age , during the period from 12th July to 9th August 2018 , with CTD 35.7 and 10 males / trap / day for , PFF and MFF respectively

2. Used Trap :

Two trap types were used to catch fruit flies , attractant materials were used in two forms (dry paste and liquid form). The first one , plastic bottles (measuring 16 cm in height and 7 cm in diameter) used four holes numbers were made at the end of the upper third of the bottle were fixed by a metallic wire , as the liquid trap. The second trap was plastic containers (measuring 13 cm in height and 11 cm in diameter) with four holes numbers were made at the end of the upper third of the bottle fixed by a metallic wire , as the dry trap (Figure, 1). Inner cover of plastic containers was covered with 2% Lmbada pesticide to catch fruit flies .The dry paste is composed using cotton wick and clink paper saturated with the same concentration inside perforated paper bags put inside trap.

3 . Attracting compounds :

Six attractant materials were used in two locations on the peach and mango crops , every crop with two form liquid and dry traps, (10% Ammonium acetate , 10 % Urea Fertilizer [CO(NH₂)₂], Trimethylamine (TMA) (using cotton wick saturated with TMA), 1 % Dab Fertilizer (H₉N₂O₄P) , 3 % Di-ammonium phosphate and 5 % Buminal .The experimental conducted by using 4 traps × 6 tested materials and in each location, each treatment was replicated four times and distributed in a completely randomized design .

4 . Statistical Analysis:

Data was analysed by using ANOVA in SAS (SAS Institute 2003) .



Figure (1): Trap types

Results and discussion

1 . Response of fruit flies to the tested chemical compounds attractants in peach orchard :

This experiment was carried in peach orchard with high population density of Mediterranean fruit fly *C. capitata* CTD , 40 males / trap / day , while CTD for Peach fruit fly, *B. zonata* 0.28 males / trap / day , by using two traps types , plastic bottles with liquid form and plastic containers with dry form . The obtained results are summarized in Tables (1 and 2) as :

1.1. The peach fruit fly *Bactrocera zonata*:

Data in Tables (1 and 2) showed that mean of weekly captured *B. zonata* by different chemical compounds was nil because population abundance of *B. zonata* was obviously low in this period of the year according the environmental conditions especially temperature degrees. From the obtained results temperature plays a significant role in the population of *B. zonata* especially in summer season. These results support those obtained by (Amin, 2003) and (Afia, 2007) mentioned the lowest abundance was recorded in winter months at Fayoum Governorate and during spring season at Qalyobia and Giza

Governorates when temperature degrees higher 30°C; was suitable to increase the numbers of *B. zonata* , but below 30°C. *C. capitata* was usually the successful species. Hashem *et al.* (2007) reported that population density of *B. zonata* is highly affected by two factors, presence of the suitable host plant in addition to the adequate climatic factors especially mean temperature. Also *B. zonata* is more sensitive to low temperature than *C. capitata*, according to Nelson and Greeff (2009).

1. 2 . The Mediterranean fruit fly *Ceratitidis capitata*:

Data presented in Tables (1 and 2) showed that the mean of weekly captured *C. capitata* by different chemical compounds during the period from the end of third week of May to 18th June 2018 . Firstly, data in Table (1) showed the mean of weekly captured of *C. capitata* in peach orchard by using plastic bottles (liquid trap). Statistical analysis were highly significant between the different tested food attractants ; the highest mean numbers of weekly captured *C. capitata* was 111.7 and 90.5 flies / trap for Di-amunum phosphate and Amunum-Acetate attractants, respectively ; so it can be say 3% Di-amunum phosphate and 10 % Amunum- Acetate attractants preference to attract *C. capitata* . While 5 % Buminal , 1 % Dab Fertilizer (H9N2O4P) and Trimethylamine recorded a moderately attractiveness to attract *C. capitata* with mean numbers of weekly captured 87.5 , 78.31 flies and 68.75 / trap, respectively . While 10 % Urea Fertilizer [CO(NH2)2] was the less efficient in attracting of *C. capitata* , the mean numbers of weekly captured was 26.81 flies . Also the obtained data indicated that in Table (1) the females number of MFF were more

attracted than male flies to tested different chemical compounds with general average; the first level recorded highest mean females number of *C. capitata* 127.12 , 118.62 , 99.25 and 93.62 female / trap for 5% Buminal , 3% Di-amunum phosphate , 1 % Dab Fertilizer (H₉N₂O₄P) and 10 % Amunum- Acetate attractants, respectively and while the males of *C. capitata* were 47.87 , 104.75 , 53.37 and 87.37, respectively . The second level recorded less efficient in attracting mean females number of *C. capitata* 80.75 and 42.87 female / trap for Trimethylamine and Urea Fertilizer [CO(NH₂)₂], respectively ; but mean males number of *C. capitata* were 56.75 and 10.75, respectively . Secoundly, the obtained data in Table (2) indicated that by using plastic containers (dry trap); the numbers of attracted fruit fly to it was much lower than the numbers that were attracted to the plastic bottles traps (liquid trap); the mean of weekly captured of *C. capitata* in peach orchard and statistical analysis showed that highly significant between the different tested food attractants. Data were divided into three groups ; the first one was high attraction , the highest mean numbers of weekly captured *C. capitata* was 4.97 flies / trap Trimethylamine ; the second one was moderately attraction , the mean numbers of weekly captured *C. capitata* was 3.78 , 3.28 and 3.03 flies / trap for 3% Di-amunum phosphate , 10 % Amunum-Acetate and 5 % Buminal, respectively and the third one was less attraction recorded that 2.35 and 1.09 flies / trap for 10 % Urea Fertilizer [CO(NH₂)₂] and 1 % Dab Fertilizer (H₉N₂O₄P), respectively .

2. Response of fruit flies to the tested chemical compounds attractants in mango orchard :

This experiment was carried in mango orchard with population density of ctd for peach fruit fly *b. Zonata* 35.7 males / trap / day and while mediterranean fruit fly *c. Capitata* ctd , 10 males / trap /day by using two trap types as already mentioned. .

2.1. The peach fruit fly *Bactrocera zonata*:

Data obtained in Table (3) showed that the mean of weekly captured *B. zonata* by different chemical compounds by using plastic bottles (liquid trap) showed that 3% Di-amunum phosphate was highly significant attractant to *B. zonata* than other chemical compounds attractants recorded 15.43 flies / trap during two weeks , while there were no significant differences between these other attractants chemical compounds. Mean of weekly captured *B. zonata* for 10 % Urea Fertilizer [CO(NH₂)₂] recorded 7.56 flies / trap relatively high comparing with other attractants chemical compounds. While 5 % Buminal recorded lower attractants to attract *B. zonata* than other chemical compounds attractants recorded 1.25 flies / trap . The obtained data in Table (4), the using plastic containers (dry trap) indicated that the numbers of attracted fruit fly to it was much lower than the numbers that were attracted to the plastic bottles trap , showed that 10 % Amunum-Acetate was highly significant attractant to *B. zonata* than other chemical compounds attractants recorded 2.78 flies / trap and while there were no significant differences between these other attractants chemical compounds . The second high attractant to attract *B. zonata* , 10 % Urea Fertilizer [CO(NH₂)₂] recorded 1 fly / trap .

2 .2 . The Mediterranean fruit fly *Ceratitis capitata*:

Data obtained in Table (3) showed that using plastic bottles (liquid trap), the highest mean of weekly captured of *C. Capitata* was recorded for 5 % Buminal

and 3% Di-amunum phosphate gave the same result 1.43 flies / trap , followed by Trimethylamine recoded 1.25 flies / trap , while 10 % Amunum-Acetate , 1 % Dab Fertilizer (H₉N₂O₄P) and 10 % Urea Fertilizer [CO(NH₂)₂] recorded lower attractants to attract *C. Capitata* , 0.75 , 0.43 and 0.31 flies / trap respectively . Data obtained in Table (4) showed that using plastic containers (dry trap), the highest mean of weekly captured of *C. Capitata* was recorded for Trimethylamine recoded 0.71 flies / trap , followed by 10 % Amunum- Acetate , recorded 0.56 flies / trap , while 3% Di-amunum phosphate and 5 % Buminal recorded less of weekly captured of *C. Capitata* 0.37 and 0.28 flies / trap respectively , but 1 % Dab Fertilizer (H₉N₂O₄P) and 10 % Urea Fertilizer [CO(NH₂)₂] recorded the lower attractants to attract *C. Capitata* . In this investigation , the females number of *B. zonata* and *C. capitata* were more attracted than male flies to tested different chemical compounds. These results are agreement with those obtained by Saafan (2005), Afia (2007) and Moustafa and Ghanim (2008) reported the number of *B. zonata* and *C. capitata* females attracted to food attractants are significantly higher than males, also Sameh (2009) mentioned that all of the tested preparations were attracted *B. zonata* and *C. capitata* females with a significantly high numbers in comparison to males. However, Makkar *et al.* (2017) mentioned that females of *C. capitata* were more attracted than males in all treatments , also Ben Jemaa *et al.* (2010) found that the percentage of captured *C. capitata* females was significantly higher than that of males in mandarin and washengton navel orange orchards. The present data here showed that the number of attracted flies to plastic

bottles traps (liquid trap) was highest compared to plastic containers (dry trap). These results are agreement with El-Abbassi *et al.* (2014) found that the performance of tested attractant materials in a liquid form was better than the attractant materials prepared in a dry form. Also in the present investigation , in peach orchard Di-amunum phosphate recorded the highest mean numbers of weekly captured *C. capitata* was 111.86 flies / trap in the plastic bottles (liquid trap) .While 5 % Buminal recorded the highest attractants to attract female *C. capitata* captured 127.12 females / trap weekly compared with 47.87 males . While in mango orchard in the same traps (plastic bottles) 3 %Di-amunum phosphate recorded the highest attractants to attract *B. zonata* recorded 15.43 flies / trap weekly , in the same trend 3 % Di-amunum phosphate and 5 % Buminal recorded the highest attractants to attract *C. capitata* recorded 1.43 flies / trap weekly . But 10 % Urea Fertilizer [CO(NH₂)₂] recorded the highest attractants to attract female *B. zonata* recorded 14.47 females / trap weekly compared with 0.25 males. However, 5 % Buminal recorded the highest attractants to attract female *C. capitata* captured 2 females / trap weekly compared with 0.87 males . These results are agreement with those obtained by Hanafy *et al.* (2001) and Amin (2003) found that Di-ammonium phosphate was the best compound for attracting PFF in comparison with the other tested compounds. Also Amin (2003), Saafan (2005) and Afia (2007) found that Buminal was the best food attractant used in attracting fruit flies *B. zonata* and *C. capitata*.

Table (1): Mean number of fruit flies *Bactrocera zonata* and *Ceratitis capitata* captured in the plastic bottles infesting peach orchard during the period from 21st of May and 18th of June 2018.

Date	Mean No. of Flies									
	PFF					MFF				
	after one week		two weeks		Mean	after one week		two weeks		Mean
♂	♀	♂	♀	♂		♀	♂	♀		
10%Ammon. acetate	0	0	0	0	0	101.5	54.75	73.25	132.5	90.5
10 % Urea	0	0	0	0	0	12.25	24	9.25	61.75	26.81
TMA	0	0	0	0	0	97.75	55.75	15.75	105.75	68.75
1 % Dab	0	0.25	0	0	0.06	81.5	56.5	33.25	142	78.31
3%Di-ammo. phos.	0	0	0	0	0	145.25	66	64.25	171.25	111.7
5%Buminal	0	0	0	0	0	48	55.75	47.75	198.5	87.5
Mean	0	0.04	0	0	0.01	81	52.13	40.58	135.33	
L S D SEX						24.5				
L S D Treat.						42.46				

PFF : *Bactrocera zonata* , MFF : *Ceratitis capitata*, 10%Ammon. Acetate: 10 % Amunum- Acetate, 10 % Urea: 10 % Urea Fertilizer, TMA: Trimethylamine, , 1 % Dab : 1 % Dab Fertilizer, 3%Di-ammo. phos.: 3 % Di-amunum phosphate

Table (2): Mean number of fruit flies *Bactrocera zonata* and *Ceratitis capitata* captured in the plastic container infesting peach orchard during the period from 21st of May and 18th of June 2018.

Date	Mean No. of Flies																	
	PFF									MFF								
	after one week		two weeks		three weeks		four weeks		Mean	after one week		two weeks		three weeks		four weeks		Mean
♂	♀	♂	♀	♂	♀	♂	♀	♂		♀	♂	♀	♂	♀	♂	♀		
10%Ammon. acetate	0	0	0	0	0	0	0	0	0	6.25	5.5	2.5	6	1.75	3.75	0	0.5	3.28
10 % Urea	0	0	0	0	0	0	0	0	0	2.5	5.5	1	4.75	1.5	2.25	0	1.25	2.35
TMA	0	0	0	0	0	0	0	0	0	7.25	8.25	6	6.25	1.5	8.5	0	2	4.97
1 % Dab	0	0	0	0	0	0	0	0	0	1.75	1.25	0.75	1.5	1.25	1.75	0	0.5	1.09
3%Di-ammo. phos.	0	0	0	0	0	0	0	0	0	2.75	8	3	5.5	0.5	9	0.25	1.25	3.78
5%BuMinal	0	0	0	0	0	0	0	0	0	2	8.5	1.5	6.25	0.25	5	0.25	0.5	3.03
Mean										3.75	6.16	2.46	5.05	1.12	5.04	0.08	1	
L S D SEX										0.654								
L S D Treat.										1.133								

PFF : *Bactrocera zonata* , MFF : *Ceratitis capitata*, 10%Ammon. Acetate: 10 % Amunum- Acetate, 10 % Urea: 10 % Urea Fertilizer, TMA: Trimethylamine, , 1 % Dab : 1 % Dab Fertilizer, 3%Di-ammo. phos.: 3 % Di-amunum phosphate

Table (3): Mean number of fruit flies *Bactrocera zonata* and *Ceratitis capitata* captured in the plastic container infesting mango orchard during the period from 12th of July and 9th of August 2018.

Date	Mean No. of Flies									
	PFF					MFF				
	after one week		two weeks		Mean	after one week	two weeks	two weeks		Mean
♂	♀	♂	♀	♂		♀	♂	♀		
Treatments	♂	♀	♂	♀	Mean	♂	♀	♂	♀	Mean
10%Ammon. acetate	0.5	4.75	0.5	6.25	3	0.5	2	0.25	0.25	0.75
10 % Urea	0.5	4.5	0	25.25	7.56	0	1.25	0	0	0.31
TMA	2.25	6	0.25	2.5	2.75	1.25	3.75	0	0	1.25
1 % Dab	2	4.75	1.25	8.75	4.18	0.25	0.25	1.25	0	0.43
3%Di-ammo. phos.	8.5	24.5	4.75	24	15.43	1.5	2.25	0.75	1.25	1.43
5%BuMinal	1.75	3	0.25	0	1.25	1.5	4	0.25	0	1.43
Mean	2.58	7.91	1.16	11.12		0.83	2.25	0.41	0.25	
L S D SEX	4.92					0.75				
L S D Treat.	8.53					1.31				

PFF : *Bactrocera zonata* , MFF : *Ceratitis capitata*, 10%Ammon. Acetate: 10 % Amunum- Acetate, 10 % Urea: 10 % Urea Fertilizer, TMA: Trimethylamine, , 1 % Dab : 1 % Dab Fertilizer, 3%Di-ammo. phos.: 3 % Di-amunum phosphate

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Table (4): Mean number of fruit flies *Bactrocera zonata* and *Ceratitis capitata* captured in the plastic containers infesting mango orchard during the period from 12 July to 9 August 2018.

Date	Mean No. of Flies																	
	PFF									MFF								
	after week	one	two weeks		three weeks		four weeks		Mean	after week	one	two weeks		three weeks		four weeks		Mean
♂	♀	♂	♀	♂	♀	♂	♀	♂		♀	♂	♀	♂	♀	♂	♀		
Treatments	♂	♀	♂	♀	♂	♀	♂	♀	Mean	♂	♀	♂	♀	♂	♀	♂	♀	Mean
10%Ammon. Acetate	4.75	3.75	4.75	2.75	2.5	1.75	0.25	1.75	2.78	1.25	1.25	0.25	0.75	0	1	0	0	0.56
10 % Urea	5.5	0.75	0.5	0.75	0.25	0.25	0	0	1	0	0	0	0	0	0	0	0	0
TMA	0.75	0.5	0.25	0.25	0.25	0.25	0	0	0.28	1.75	1	0	1	0.75	1.25	0	0	0.71
1 % Dab	2	0	0.75	0	0.25	0.5	0	0.25	0.46	0	0.25	0	0.25	0	0	0	0	0.06
3%Di-ammo. phos.	0.25	0	1.25	0.5	0.5	1	0.25	0.5	0.53	1.75	1	0	0	0	0.25	0	0	0.37
5%BuMinal	1.25	0.5	1.25	0.75	0.5	0.5	0.5	0	0.65	1	0.75	0.25	0.25	0	0	0	0	0.28
Mean	2.41	0.91	1.45	0.83	0.7	0.7	0.16	0.41		0.95	0.71	0.08	0.37	0.25	0.41	0	0	
L S D SEX	0.61									0.2								
L S D Treat.	1.07									0.35								

PFF : *Bactrocera zonata* , MFF : *Ceratitis capitata*, 10%Ammon. Acetate: 10 % Amunum- Acetate, 10 % Urea: 10 % Urea Fertilizer, TMA: Trimethylamine, , 1 % Dab : 1 % Dab Fertilizer, 3%Di-ammo. phos.: 3 % Di-amunum phosphate

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