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RESPONSE OF THE OLIVE FRUIT FLY, *Bactrocera oleae* ROSSI TO SOME AMMONIUM COMPOUNDS AND CERTAIN FOOD ATTRACTANTS UNDER FIELD CONDITIONS IN OLIVE ORCHARDS

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ABSTRACT

The olive fruit fly, *Bactrocera oleae* Rossi is a serious pest attacking olive fruits causing a quantitive and qualitative damages. The response of olive fruit fly adults to some ammonium compounds and certain food attractants was evaluated under field conditions throughout two experimental trails. The study was carried out at olive orchards of Dakhlia governorate by using the modified Nadel traps during the period of July 2011 until January 2012. The obtained results illustrated that the olive fruit fly, *B. oleae* exhibited different responses to the tested compounds depending on the average temperature and used concentration. For the 1st trail, six local ammonium compounds including ammonium acetate, di-ammonium phosphate, ammonium chloride, ammonium carbonate, ammonium hydroxide and ammonium bicarbonate were evaluated as lures for *B. oleae* adult flies. Four concentrations (1,2,3 and 4%) of each compound were evaluated during months of July, September and October 2011. Among all tested ammonium compounds, two concentrations of Ammonium acetate (3 & 4%) exhibited the highest efficiency and lured ,8.25 & 8.00 flies/ trap/14 days. In the second trial, certain food attractants were evaluated in comparison with diammonium phosphate and ammonium acetate (at 1, 2, 3 and 4 %) during October, December 2011 and January 2012. The tested food attractants included Buminal, Prolure and Conserve (GF-120) at concentrations of 2.5, 5 and 10%. In addition Torula yeast was also evaluated at rates of 2, 3 and 4 pellets of Torula yeast /300 cm^3 water. Diammonium phosphate 2, 3, 1% and Buminal 2.5% recorded the highest efficiency with 19.58, 18.58, 17.08 and 16.52 flies/trap/ 14 days, respectively. The obtained results indicate that di-ammonium phosphate and ammonium acetate could be involved in population monitoring and mass trapping technique of *B. oleae* as a part of its integrated control program due to their superiority in female attractancy of *B. oleae* and lower cost when compared with other food attractants.

Keywords: *Bactrocera oleae* , lures , attractants, ammonium, olive, fruit fly, evaluation.

INTRODUCTION

Olive fruit fly, *Bactrocera oleae* Rossi (Diptera, Tephritidae), is a very serious pest of olive fruits wherever olives are grown in the Mediterranean basin (southern Europe, the Near East and Northern Africa) where the vast majority of the world's olives are produced (Costa, 1998). The larvae are monophagous, larvae cause huge economic damages causing fruit dropping, Also, an indirect damage can be measured through decrease of olive oil quality as a result of larvae activity inside the fruit, that suffers by nutritional changes of mezocarp degradation and oxidation process and increase of oleic free acids (Bjeliš *et al.*, 2003 and Bjeliš, 2009).

To avoid the undesirable effects of *B.oleae* chemical control methods, some alternative techniques are devolved including the mass-

trapping technique. Mass trapping technique represents preventive control measure which is based on attraction and killing olive fruit fly adults, subsequently, avoidance of infestation occurrence. It has proven to be a powerful weapon in the control of *Ceratitis capitata* (Wiedemann) and olive fruit fly, *B. oleae* (Broumas *et al.* (2002) and Bjeliš (2009). Female-targeted and male-targeted lures could be included as a component of an Integrated Pest Management program (IPM) using the mass trapping technique. Its application in Mediterranean countries has currently increased notably as a control method (Navarro-Llopis *et al*. 2008).

Ammonia is the primary attractant for tephritid fruit flies, and traps baited with synthetic attractants using ammonia formulations have been highly successful in capturing these pests. Commercial formulations of ammonium acetate and ammonium bicarbonate are available as lures for use in fruit fly traps (Heath *et al.* 2007). The ammonium bicarbonate decomposes slowly to ammonia, a powerful food attractant for all the fruit flies (Ragoussis, 2002). Numerous researchers investigated the efficiency of ammonium compounds as attractants to *Bactrocera zonata* (Saunders) and *C. capitata* (Hanafy *et al.,* 2001, Saafan 2005, Abd El-Kareim *et al.,* 2008, Moustafa and Ghanim 2008 and Kheder *et al.* 2011). Saafan (2005) and Ghanim (2009) mentioned that Buminal was the main food attractant used in attracting fruit flies. Ammonium compounds are more attractive for *C. capitata* and *B. zonata* than Buminal or Torula yeast (Hanafy *et. al*, 2001, Quilici *et al*. 2007 and Amin & El-Metwally 2011).

The present study aims to determine the efficacy of some local ammonium compounds and certain food attractants (Buminal, Prolure, Consereve and Torula yeast) as lures for detecting and monitoring adult population of olive fruit fly, *B. oleae* in olive orchards under field conditions and different population level.

MATERIALS AND METHODS

The experimental area.

Trials were conducted in olive orchard (about two feddans) located in Dakahlia Governorate, Aga district (30.96°N, 31.26°E) during the growing season 2011 & 2012.

A. The first trail tested compounds:

Six local ammonium compounds from El-Naser for Drugs and Chemicals Co. were selected; Ammonium acetate CH_3COONH_4, Di-ammonium phosphate $(NH_4)_2\ HPO_4$, Ammonium chloride $NH_4\ Cl$, Ammonium carbonate $(NH_4)_2\ CO_3$, Ammonium Hydroxide $NH_4\ OH$ and Ammonium bicarbonate $NH_4\ HCO_3$. Four concentrations of each compounds were evaluated (at 1,2,3,4%). The experiment was conducted during the months of July, September and October 2011.

B. The second trail tested compounds:

According to results obtained from 1st trail, Ammonium acetate and Di-ammonium phosphate (four concentrations of each compounds were evaluated, (1,2,3,4%), Protein hdrolyzate attractants, Buminal, Prolure and Conserve (GF-120), (three concentrations of each compound 2.5, 5.0 and 10

% were used). In addition Torula yeast was evaluated by using three concentrations, 2, 3 and 4 pellets (each pellet = 5 gm of Torula yeast/ borax 55:45 by weight) dissolved in 300cm^3 of water. Where the standard bait solution consisted of three 5 gm Torula yeast/ borax (55:45 by weight) pellets dissolved in 300cm^3 of water (Thomas and Robacker 2006). This experiment was conducted during October, December 2011 and January 2012**.**

Used trap :

The modified Nadel traps (described by Hanafy *et al.,* 2001) were used in this experiment. Five traps (as replicates) for each tested attractant compound were distributed randomly where the distance between every two adjacent traps was about 20 meters to avoid interaction between lures. All traps were hanged at a height of 2 meter above ground in a shaded place of trees. Traps were inspected every 7 days and the attractant solution was renewed every 14 days. Captured flies were collected, inspected and counted in laboratory.

Daily records of temperature degrees were obtained from the Agro Meteorological Station at El-Mansoura region during period of studies.

Statistical analysis :

The statistical analysis was done as one way ANOVA and means separated was conducted by using L.S.D. at the probability of 5% (Costat. 1990).

RESULTS

A. The 1st trail :

A.1. Population levels of *B. oleae***:**

Figure (1) show that mean numbers of captured *B. oleae* within 14 days at all treatments were low during July (0.39 fly/trap) and September (1.84 flies/trap), while, it was high during October (5.01 flies/trap). The daily mean recorded temperatures were 28.0, 26.3 and 23.9ºC during July, September and October, respectively.

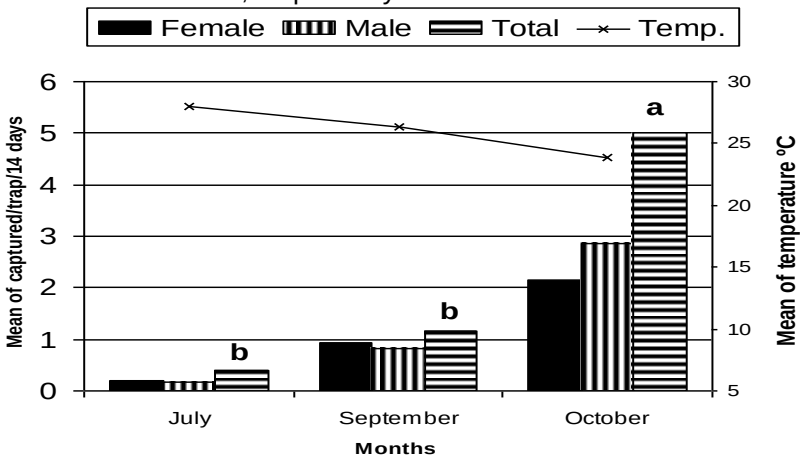

Figure (1): Mean number of females, males and total adults of *B. oleae* over 14 days lured by all tested ammonium compounds in olive orchards (for total, L.S.D= 1.79, p=5%).

A.2. Efficiency of attractants :

The mean numbers of olive fruit flies (OFF) captured during July in the olive orchard are given in Table (I). Results indicated that the OFF adults showed different degrease of preference for some concentrations of tested ammonium compounds**.** With respect to the tested concentrations of each ammonium compound, data indicated that during July the di-ammonium phosphate 1%, followed by ammonium acetate 1%, recorded the highest efficiency with 3.25 and 1.50 fly/trap/ 14 days, while ammonium bicarbonate followed by ammonium chloride recorded the lowest efficiency.

Table (1). Average number of *B. oleae* males, females and total adults captured into traps loaded with different ammonium compounds at Aga district during 2011.

Ammonium compounds	Concentration	Months of inspection											
		July			September			October			Mean		
		♂	♀	♀♂	♂	♀	♀♂	♂	♀	♀♂	♂	♀	♀♂
Ammonium acetate	1%	0.75	0.75	1.50	0.75	2.5	3.25	5.50	2.25	7.75	2.33	1.83	4.16
	2%	0.00	0.00	0.00	1.00	1.50	2.50	2.7 5	2.75	5.50	1.50	1.42	2.92
	3%	0.50	0.25	0.75	1.50	1.50	3.00	12.50	8.50	21.00	4.83	3.42	8.25
	4%	0.00	0.00	0.00	4.25	2.50	6.75	9.50	7.75	17.25	4.58	3.42	8.00
Di-ammonium phosphate	1%	1.25	2.00	3.25	0.25	0.00	0.25	3.00	2.25	5.25	1.50	1.42	2.92
	2%	0.00	0.00	0.00	0.75	0.75	1.50	3.25	3.5	6.75	1.33	1.42	2.75
	3%	0.25	0.00	0.25	1.75	2.50	4.25	5.25	2.75	8.00	2.41	1.75	4.16
	4%	0.50	0.25	0.75	3.00	3..50	6.50	0.75	3.00	3.75	1.41	2.42	3.83
Ammonium Chloride	1%	0.00	0.25	0.25	0.00	0.50	0.50	0.50	1.25	1.75	0.16	0.67	0.84
	2%	0.00	0.00	0.00	0.00	0.50	0.50	5.50	2.50	8.00	1.83	1.00	2.83
	3%	0.25	0.25	0.50	0.00	0.00	0.00	2.00	0.75	2.75	0.75	0.33	1.08
	4%	0.00	0.25	0.25	2.25	2.50	4.75	2.00	1.00	3.00	1.42	1.25	2.67
Ammonium carbonate	1%	0.25	0.25	0.50	0.25	0.00	0.25	1.75	2.00	3.75	0.75	0.83	1.58
	2%	0.00	0.00	0.00	0.25	0.00	0.25	1.25	0.75	2.00	0.50	0.25	0.75
	3%	0.00	0.00	0.00	0.00	0.25	0.25	1.75	1.00	2.75	0.58	0.42	1.00
	4%	0.00	0.00	0.00	1.00	1.00	0.25	1.75	1.75	3.50	0.92	0.92	1.84
Ammonium hydroxide	1%	0.00	1.00	1.00	0.25	1.25	1.50	4.25	2.50	6.75	1.50	1.58	3.08
	2%	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.25	2.25	0.33	0.75	1.08
	3%	0.00	0.00	0.00	0.50	0.75	1.25	0.75	1.00	1.75	0.42	0.58	1.00
	4%	0.00	0.00	0.00	0.25	0.25	0.50	2.00	1.75	3.50	0.75	0.67	1.42
Ammonium bicarbonate	1%	0.00	0.00	0.00	0.75	1.25	2.00	0.50	0.75	1.25	0.42	0.67	1.09
	2%	0.25	0.00	0.25	0.75	0.25	1.00	0.00	0.50	0.50	0.33	0.25	0.58
	3%	0.25	0.00	0.25	0.00	0.50	0.50	0.50	0.25	0.75	0.25	0.25	0.50
	4%	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.25	0.75	0.17	0.08	0.25
L.S.D 5%		**0.65**	**0.73**	**1.13**	**1.53**	**1.89**	**3.12**	**4.91**	**3.17**	**7.77**	**1.71**	**1.35**	**2.91**

OFF adults exhibited positive response to all tested ammonium compounds except, ammonium chloride 3% and ammonium bicarbonate 4% during September. With respect to the tested concentrations of each ammonium compound, at 4% concentration, ammonium acetate, di-ammonium phosphate and ammonium chloride recorded the highest efficiency with 6.75, 6.50 and 4.75 flies/trap/14 days, respectively, while all concentrations of ammonium carbonate recorded the lowest efficiency Table (I).

During October, OFF adults exhibited positive response to all tested ammonium compounds, the results render ammonium acetate as the most

powerful attractant, with respect to the tested concentrations of each ammonium compound, data indicated that ammonium acetate 3 & 4% recorded the highest efficiency with 21.00 and 17.25 flies/trap/ 14 days, while all concentrations of ammonium bicarbonate recorded the lowest efficiency.

Concerning the mean of three months, Ammonium acetate (at 3 & 4%) recorded the highest efficiency with 8.25 & 8.00 flyl/trap/14days followed by ammonium acetate (at 1%) and diammonium phosphate (at 3%) with the same efficiency (4.16 flyl/trap/14days). Ammonium bicarbonate at the tested concentration 4, 3 & 2% recorded the lowest efficiency with 0.25, 0.50 and 0.58 followed by ammonium carbonate 2% with 0.75 fly/trap/14days, respectively.

The relative attractancy of the evaluated compounds for attraction *B. oleae* adults during the experiments is shown in Table (2). The highest percentage relative attractancy of males, females and total adults during July belonged to di-ammonium phosphate (at 1%), which recorded 29.41, 38.09 and 34.21 % of the total catch, respectively.

Table (2). The relative attractancy of *B. oleae* males, females and total adults captured into traps loaded with different ammonium compounds at Aga district during 2011.

Ammonium compounds	Con.	Months of inspection											
		July			September			October			Mean		
		♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀
Ammonium acetate	1%	17.64	14.28	15.79	3.85	10.10	7.34	8.06	4.33	6.44	7.52	6.63	7.10
	2%	0.00	0.00	0.00	5.13	6.06	5.65	4.03	5.29	4.57	4.84	5.14	4.98
	3%	11.76	4.76	7.89	7.69	6.06	6.78	18.31	16.35	17.46	15.59	12.39	14.08
	4%	0.00	0.00	0.00	21.79	10.10	15.25	13.92	14.90	14.34	14.78	12.39	13.65
Di-ammonium phosphate	1%	29.41	38.09	34.21	1.28	0.00	0.56	4.39	4.33	4.37	4.84	5.14	4.98
	2%	0.00	0.00	0.00	3.85	3.03	3.39	4.76	6.73	5.61	4.29	5.14	4.69
	3%	5.88	0.00	2.63	8.97	10.10	9.60	7.69	5.29	6.65	7.78	6.34	7.10
	4%	11.76	4.76	7.89	15.38	14.14	14.69	1.11	5.77	3.12	4.55	8.76	6.53
Ammonium Chloride	1%	0.00	4.76	2.63	0.00	2.02	1.13	0.73	2.40	1.46	0.52	2.43	1.43
	2%	0.00	0.00	0.00	0.00	2.02	1.13	8.06	4.81	6.65	5.91	3.62	4.83
	3%	5.88	4.76	5.26	0.00	0.00	0.00	2.93	1.44	2.29	2.42	1.95	1.84
	4%	0.00	4.76	2.63	11.54	10.10	10.73	2.93	1.92	2.49	4.58	4.53	4.56
Ammonium carbonate	1%	5.88	4.76	5.26	1.28	0.00	0.56	2.56	3.85	3.12	2.42	3.01	2.69
	2%	0.00	0.00	0.00	1.28	0.00	0.56	1.83	1.44	1.66	1.61	0.90	1.28
	3%	0.00	0.00	0.00	0.00	1.01	0.56	2.56	1.92	2.29	1.87	1.52	1.71
	4%	0.00	0.00	0.00	5.13	4.04	4.52	2.56	3.36	2.91	2.97	3.33	3.14
Ammonium hydroxide	1%	0.00	19.05	10.52	1.28	5.05	3.39	0.73	4.81	5.61	4.84	5.72	5.25
	2%	0.00	0.00	0.00	0.00	4.04	2.26	0.00	2.40	1.87	1.06	2.72	1.84
	3%	0.00	0.00	0.00	2.56	3.03	2.82	0.73	1.92	1.46	1.35	2.1	1.71
	4%	0.00	0.00	0.00	1.28	1.01	1.13	0.73	3.36	2.91	2.42	2.43	2.42
Ammonium bicarbonate	1%	0.00	0.00	0.00	3.85	5.05	4.52	6.23	1.44	1.04	1.36	2.43	1.86
	2%	5.88	0.00	2.63	3.85	1.01	2.26	1.46	0.96	0.42	1.06	0.91	0.99
	3%	5.88	0.00	2.63	0.00	2.02	1.13	1.11	0.48	0.62	0.81	0.91	0.85
	4%	0.00	0.00	0.00	0.00	0.00	0.00	2.56	0.48	0.62	0.55	0.29	0.43
Total		100	100	100	100	100	100	100	100	100	100	100	100

In September, ammonium acetate 4% recorded the highest relative attractancy of males and total adult with 21.79 and 15.25 %, while the highest relative attractancy of females was recorded by diammonium phosphate 4% with 14.14% of the total catch. The highest percentage of males, females and total adults relative attractancy during October belonged to ammonium acetate 3% which recording 18.31, 16.35 and 17.46 21 % of

the total catch, respectively. Concerning the mean of three months, the highest percentage of males, females and total adults relative attractancy belonged to ammonium acetate 3%, which recording 15.59, 12.39 and 14.08 % of the total catch, respectively Table (2).

Data in (Table 3) indicate that, during July, September and October, there were no significant differences between males and females captured by all tested ammonium compounds except, numbers of females recorded by ammonium hydroxide during September which was higher than males.

Table (3). Attraction of different tested concentrations of ammonium compounds against the two sexes of olive fruit fly *B. oleae* in olive orchards.

Months	Sex	Ammonium acetate	Di-ammonium phosphate	Ammonium chloride	Ammonium hydroxide	Ammonium carbonate	Ammonium bicarbonate	L.S.D. 0.05
July	♂	0.31	0.50	0.13	0.00	0.06	0.13	0.35
	♀	0.25	0.56	0.18	0.25	0.06	0.00	0.44
	L.S.D. 0.05	0.46	0.69	0.27	0.39	0.18	0.17	--
September	♂	1.87	1.44	0.56	0.25	0.37	0.37	0.92
	♀	2.00	1.68	0.87	0.81	0.31	0.50	1.02
	L.S.D. 0.05	1.46	1.30	1.03	0.55	0.57	0.64	--
October	♂	7.56	3.06	2.50	1.94	1.75	0.37	2.71
	♀	5.31	2.87	1.43	1.62	1.37	0.43	1.76
	L.S.D. 0.05	4.99	2.20	2.09	1.71	0.90	0.55	--

Diammonium phosphate recorded the highest numbers for males and females followed by ammonium acetate During July. Ammonium acetate recorded the highest numbers for males and females followed by diammonium phosphate during September and October Table (3).

B- The 2nd trail :

B.1. Population levels of *B. oleae*:

As shown in Figure (2), mean total numbers of *B. oleae* captured over 14 days by all tested attractants were low during December and January (2.40 and 3.57 flies/trap) and high during October (16.01 flies/trap). The daily mean of temperatures were 23.2ºC, 14.8ºC and 13.8ºC during October, December and January, respectively.

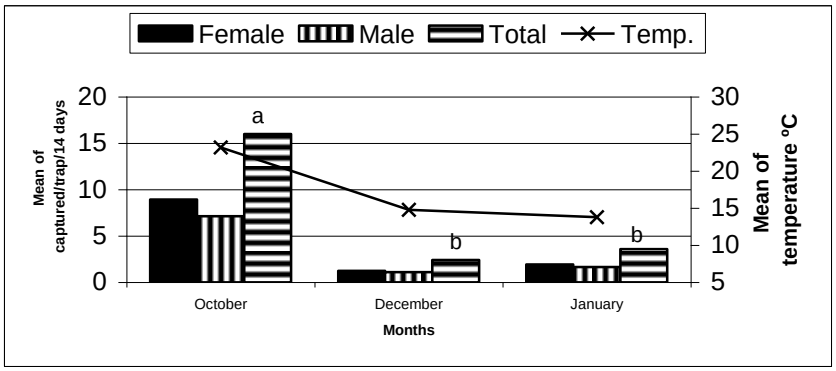

Figure (2): Mean number of females, males and total adults of B. *oleae* over 14 days lured by all tested compounds in olive orchards (for total, L.S.D= 3.71, p=5%).

B.2. Efficiency of attractants :

Attracttency of two ammonium compounds in comparison with certain food attractants against females, males and total adults of *B. oleae* is represented in in Table (4). Data show that di-ammonium phosphate 2,3 , 1% followed by buminal 2.5% during October recorded the highest efficiency with 52.25, 43.00, 40.00 and 36.75 flies/trap/14 days, respectively. While tested concentrations for Conserve followed by Prolure recorded the lowest efficiency.

Table (4). Efficacy of diammonium phosphate and ammonium acetate in comparison with certain food attractants in respect to different population levels against *B. oleae* at Aga district during season 2011 & 2012.

lures	Concentration	Months of inspection											
		October			December			January			Mean		
		♂	♀	♀♂	♂	♀	♀♂	♂	♀	♀♂	♂	♀	♀♂
Di-ammonium phosphate	1%	20.25	19.75	40.00	4.75	3.50	8.25	1.75	1.25	3.00	8.92	8.16	17.08
	2%	30.00	22.25	52.25	1.00	0.50	1.50	2.75	2.25	5.00	11.25	8.33	19.58
	3%	22.50	20.50	43.00	2.75	0.50	3.25	3.50	6.00	9.50	9.58	9.00	18.58
	4%	7.25	4.50	11.75	1.00	0.00	1.00	0.50	0.25	0.75	2.92	1.58	4.50
Ammonium acetate	1%	4.50	2.50	7.00	0.50	0.25	0.75	4.75	5.50	10.25	3.25	2.75	6.00
	2%	8.25	7.50	15.75	1.50	1.00	2.50	7.00	3.75	10.75	5.58	4.08	9.66
	3%	15.00	13.75	28.75	1.50	1.25	2.75	2.75	2.75	5.50	6.42	5.92	12.33
	4%	11.00	7.50	18.50	1.75	1.75	3.50	4.50	7.50	12.00	5.75	7.00	11.33
Buminal	2.5 %	21.50	15.25	36.75	3.75	4.75	8.50	3.25	1.00	4.25	9.5	2.41	16.50
	5 %	7.25	4.50	11.75	1.00	2.00	3.00	2.00	0.75	2.75	3.42	2.42	5.83
	10 %	3.00	1.50	4.50	0.75	0.00	0.75	2.00	0.25	2.25	1.92	0.58	2.50
Prolure	2.5 %	6.00	3.50	9.50	0.25	0.25	0.50	0.00	0.00	0.00	2.08	1.25	3.33
	5 %	1.00	1.50	2.50	1.00	2.00	3.00	0.25	0.00	0.25	0.75	1.16	1.92
	10 %	1.25	1.00	2.25	0.75	0.75	1.50	0.00	0.00	0.00	0.66	0.58	1.25
Conserve	2.5 %	1.00	0.50	1.50	0.50	0.25	0.75	0.00	0.00	0.00	0.5	0.25	0.75
	5 %	0.00	0.00	0.00	0.25	0.25	0.50	0.00	0.25	0.25	0.08	0.16	0.25
	10 %	0.75	0.00	0.75	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.08	0.33
Torula yeast	2P/300cm^3/water	12.25	8.50	20.75	0.00	0.50	0.50	0.00	0.25	0.25	4.08	3.08	7.16
	3P/300 cm^3/water	5.25	6.75	12.00	1.75	1.50	3.25	0.50	0.50	1.00	2.5	2.92	5.41
	4P/300 cm^3/water	0.75	1.50	2.25	1.00	1.25	2.25	3.00	0.50	3.50	1.58	1.08	2.66
L.S.D 5%		10.62	8.59	18.57	3.36	3.86	6.71	3.53	4.60	7.36	4.01	3.56	7.22

*** P.= pellet (5 gmTorula yeast/ borax)**

Table (4) shows also that Buminal 2.5% followed by di-ammonium phosphate 1% recorded the highest efficiency of attraction with 8.50 and 8.25 flies/trap/ 14 days during December, while all concentrations for Conserve followed by Prolure recorded the lowest efficiency. During January 2012, ammonium acetate (at 4, 2, 1%) and diammonium phosphate (at 3%) recorded the highest efficiency with, 12.00, 10.75, 10.25 and 9.50 flies/trap/ 14 days, respectively, meanwhile all concentrations for Conserve followed by Prolure recorded the lowest efficiency, with numbers ranged between 0.00 to 0.25 fly/trap/ 14 days (Table 4).Concerning the mean of three months, Diammonium phosphate 2, 3, 1% and Buminal 2.5% recorded the highest efficiency with 19.58, 18.58, 17.08 and 16.52 flyl/trap/14days, respectively. While three concentrations used for Conserve followed by Prolure recorded the lowest efficiency. The relative attractancy of the evaluated compounds for *B. oleae* adults during the experiments is shown in Table (5).

Table (5). The relative attractancy of diammonium phosphate and ammonium acetate in comparison with certain food attractants in respect to different population levels against *B. oleae* at Aga district during season 2011 & 2012.

Lures	Concentration	Months of inspection											
		October			December			January			Mean		
		♂	♀	♀♂	♂	♀	♀♂	♂	♀	♀♂	♂	♀	♀♂
Di-ammonium phosphate	1%	11.32	13.83	12.44	18.44	15.73	17.19	4.54	3.78	4.19	11.01	12.99	11.62
	2%	16.78	15.56	16.25	3.88	2.25	3.12	7.14	6.82	6.99	13.89	13.26	13.32
	3%	12.59	14.36	13.37	10.67	2.25	6.77	9.09	18.18	13.28	11.82	14.33	12.64
	4%	4.06	3.15	6.65	3.88	0.00	2.08	1.29	0.75	1.09	4.06	2.52	3.06
Ammonium acetate	1%	2.52	1.75	2.17	1.94	1.12	1.56	12.34	16.66	14.33	4.01	4.38	4.08
	2%	4.62	5.25	4.89	5.82	4.49	5.21	18.18	11.36	15.03	6.88	6.49	6.57
	3%	8.39	9.63	8.94	5.82	5.62	5.73	7.14	8.33	7.69	7.93	9.43	8.39
	4%	6.15	5.25	5.75	6.79	7.86	7.29	11.69	22.72	16.78	7.09	11.14	7.71
Buminal	2.5 %	12.03	10.68	11.43	14.56	21.38	17.71	8.44	30.03	5.94	11.73	3.84	11.23
	5 %	4.06	3.15	3.65	3.88	8.98	6.25	5.19	2.27	3.85	4.22	3.85	3.97
	10 %	1.68	1.05	1.39	2.91	0.00	1.56	5.19	0.75	3.15	2.37	0.92	1.70
Prolure	2.5 %	3.35	2.45	2.95	0.97	1.12	1.04	0.00	0.00	0.00	2.57	1.99	2.26
	5 %	0.56	1.05	0.77	3.88	8.98	6.25	0.65	0.00	0.35	0.93	1.85	1.31
	10 %	0.69	0.70	0.69	2.91	3.37	3.12	0.00	0.00	0.00	0.82	0.92	0.85
Conserve	2.5 %	0.56	0.35	0.46	1.94	1.12	1.56	0.00	0.00	0.00	0.62	0.39	0.51
	5 %	0.00	0.00	0.00	0.97	1.12	1.04	0.00	0.75	0.35	0.09	0.25	0.17
	10 %	0.42	0.00	0.23	0.00	0.00	0.00	0.00	0.75	0.35	0.31	0.13	0.22
Torula yeast	2P*/300cm^3/water	6.85	5.95	6.45	0.00	2.25	1.04	0.00	0.75	0.35	5.04	4.90	4.87
	3P/300 cm^3/water	2.94	4.73	3.73	6.79	6.74	6.77	1.29	1.51	1.39	3.09	4.65	3.68
	4P/300 cm^3/water	0.42	1.05	0.69	3.88	5.62	4.68	7.79	1.51	4.89	1.95	1.72	1.81
Total		100	100	100	100	100	100	100	100	100	100	100	100

*** P= pellet (5 gm torula yeast/ borax)**

The highest percentage relative attractancy of males, females and total adults during October belonged to di-ammonium phosphate 2%, which recording 16.78, 15.56 and 16.25% of the total catch, respectively.

On the other hand, during December di-ammonium phosphate 1% recorded the highest relative attractancy for males , females and total adults with 18.44, 15.73 and 17.19% of the total catch, respectively. In January

2012 the highest relative attractancy of males , females and total adults were recorded by ammonium acetate 1%, Buminal 2.5% and ammonium acetate 4%, with 18.8, 30.03 and 16.78 % of the total catch, respectively Table (5).

Concerning the mean of three months, the highest percentage of males, and total adults were recorded by diammonium phosphate 2% with 13.89 and 13.32%, while the highest percentage of females were recorded by diammonium phosphate 3%, with 14.33% of the total catch Table (5).

DISCUSSION

Efficient lures for *B. oleae* is an essential requirement for integrated olive fruit fly management. In order to find more efficient attractants for this pest, our trails were conducted. Field trials showed that different ammonium compounds and certain food attractants varied significantly in their attraction of OFF. Obtained data indicated that the ammonium acetate and diammonium phosphate were the preferable attractants for *B. oleae*. Pheromonic and McPhail traps are necessary to be operated and activated for accurate measurements of the olive fruit fly population and timing the control (Mazomenos *et al.* (2002). The results of our experiments confirm the finding of Thomas *et al*. (2008) who mentioned that ammonium acetate that releasing acetic acid along with the ammonia was better for attracting flies than ammonium bicarbonate, which releases carbon dioxide along with the ammonia. Katsoyannos *et al.* (2007) mentioned that during summers seasons, Nulure, ammonium bicarbonate, ammonium phosphate and ammonium acetate captured 2-3 times more male than female of *B. oleae* and different doses of ammonium bicarbonate seem to influence on the sex ratio of the captured flies. Mazomenos *et al.* 2002 reported that, there is no significant difference between the number of olive fruit fly *B. oleae* males and females caught by McPhail traps (baited with 3% solution of ammonium carbonate) in spring and autumn, whilst in summer significant more females were caught. In Egypt, Moustafa and Ghanim, (2008) and Abd El-Karim *et al.* (2008), found that ammonium acetate and ammonium carbonate attracted the highest numbers of *C. capitata* and *B. zonata* at all tested concentrations comparing with other ammonium compounds. Such differences of response could be interpreted when considering the effect roles of climatic factors (the variation of environmental conditions), fruiting period and difference in response among species, *Anastrepha spp*. was attracted to liquid lures in the dry season than in wet season (Heath *et al.* 2007). Similarly, Yee *et al*. (2005) reported that ammonium carbonate was a superior lure for apple maggot fly, *Rhagoletis pomonella* (Walsh) than fruit volatiles in the relatively dry climate of the western U.S. but not in the eastern U.S. Our results varied among trials, perhaps in part because of the different environmental conditions. The lower dosages of ammonium acetate and ammonium bicarbonate had significantly greater captures, thus, demonstrating that release rate of ammonia from the formulations is critical. Very high dosages of ammonia may actually be repellent as has been shown in flight tunnel bioassays (Kendra *et al.,* 2005). Our results was in agreement with Moustafa (2009), who reported that, Prolure 2% caught *C. capitata* and *B. zonata* more than Prolure 5%, but disagree with Prolure which caught *C. capitata* and *B. zonata*

more than Buminal, this differences may be attributed to variance in climatic factors , fruiting period and difference in response among species.

Beside detecting and monitoring the adult fruit flies, implementation of attractants for control are the two objectives of using the attractants for fly control (Navarro-Llopis *et al.,* 2008). Therefore, the tested compounds especially local ammonium acetate and diammonium phosphate can be used in monitoring populations of fruit fly and in mass trapping as a part of integrated control program of olive fruit fly. Future researches should be conducted to investigate effect of climatic factors, particularly, temperature and relative humidity on efficiency of attractants.

REFERENCES

Abd El-Kareim, A. I.; L. M. Shanab; M. E. El-Naggar, and N. M. Ghanim (2008). Response of peach fruit fly, *Bactrocera zonata* (Saunders) (Diptera : Tephritidae) to some ammonium compounds as olfactory stimulants. J. Agric. Sci. Mansoura Univ., 33(12): 8965-8973.

Amin, A. A. and M. M. El-Metwally (2011). Field evaluation of some attractants for mediterranean and peach fruit flies in Egypt. Assiut J. of Agric. Sci. 42(5): 165-178.

Bjeliš, M. (2009). Control of olive fruit fly, *Bactrocera oleae* Rossi (Diptera, Tephritidae) by mass trapping and bait sprays methods in Dalmatia. Zbornik predavanj in referatov 9. slovenskega posvetovanja o varstvu rastlin z mednarodno udeležbo 397 Nova Gorica, 4.–5. marec 397-401.

Bjeliš, M.; V.Pelicarić and I.T. Masten (2003). Olive fruit fly – *Bactrocera oleae* Gmelin (Diptera, Tephritidae) in Croatia; damage in new milenium and advanced methods of control. Abstracts of 1st European Meeting of the IOBC/WPRS Study Group «Integrated Control in Olives», MAICh, Chania, Grčka, May 29-31, 2003., pp. 5 (summary).

Broumas, T.; G. Haniotakis; C. Liaropoulos; T. Tomazou and N. Ragoussis. (2002). The efficacy of an improved form of the mass-trapping method, for the control of the olive fruit fly, *Bactrocera oleae* (Gmelin) (Dipt., Tephritidae): pilot-scale feasibility studies. J. Appl. Entomol. 126: 217-223.

Costa, C. (1998). Olive fly. Pp. 89 – 90 In: Olive Production in South Africa: a Handbook for olive growers. Agricultural Research Council – Infruitec. ABC Press.

Costat, Software (1990). Microcomputer program analysis Version 4.2, CoHort Sofware, Berkeley, CA.

Ghanim, N. M. (2009). Studies on the peach fruit fly, *Bactrocera zonata* (Saunders)(Tephritidae, Diptera). Ph. D. Thesis, Fac. Agric. Mansoura Univ.

Hanafy, A. H.; A. I. Awad, and M. Abo-Sheasha (2001). Field evaluation of different compounds for attracting adults of peach fruit fly *Bactrocera zonata* (Saunders) and Mediterranean fruit fly, *Ceratitus capitata* (Wied.) in guava orchards. J. Agric. Sci. Mansoura Univ., 26 (7): 4537-4546.

Heath, R. R.; A.C. Espada; P.E. Kendra and A. D. Epsky (2007). Quantification of ammonia release from fruit fly (Diptera: Tephritidae) attractants using infrared spectroscopy. J. Econ. Entomol. 100(2): 580-585

Katsoyannos, B.I.; N.T. Papadopoulos and R. R. Heath (2007). Field evaluation of trap types and lures for *Bactrocera oleae* (diptera: tephritidae). experiments conducted in Chios, Greece. Proceedings of development of improved attractants and their integration into fruit fly sit management programmes. IAEA, Vienna,33-41.

Kendra, P. E., W. S. Montgomery, D. M. Mateo, H. Puche, N. D. Epsky and R. R. Heath. (2005). Effect of age on EAG response and attraction of female *Anastrepha suspensa* (Diptera: Tephritidae) to ammonia and carbon dioxide. Environ. Entomol. 34: 584-590.

Kheder, B.S.; W. Salleh; N. Awadi; M. Fezzani; F. Jrad (2011). Efficiency of different traps and baits used in mass trapping of Mediterranean fruit fly, *Ceratitis capitata* Wied. (Diptera: Tephritidae). IOBC/WPRS Bulletin. 62: 215-220.

Mazomenos, B. E.; A. Pantazi-Mazomenou and D. Stefanou (2002). Attract and kill of the olive fruit fly *Bactrocera oleae* in Greece as a part of an integrated control system. Bulletin OILB/SROP.. 25: 9, 137-146.

Moustafa, S. A (2009). Response of the Mediterranean fruit fly, *Ceratitis capitata* (Wied.) and peach fruit fly*, Bactrocera zonata* (Saund.) to some food attractants. Egypt. Acad. J. biolog. Sci., 2 (2): 111-118.

Moustafa, S. A. and N. M. Ghanim (2008). Some ammonium compounds as olfactory stimulants for Mediterranean fruit fly, *Ceratitis capitata* Wiedemann (Diptera: Tephritidae). J. Agric. Sci. Mansoura Univ., 33 (12): 8965-8973

Navarro-Llopis, V; F. Alearo; J. Dominguez; J. Sanchis and J. Primo (2008). Evaluation of traps and lures for mass trapping of Mediterranean fruit fly in citrus groves. J. Econ. Entomol. 101(1): 126-131.

Quilici, S.; A. Franck; P.F. Duyck; P. Rousse; F. Fabre; P. Ryckewaert; I. Rioux; V. Litrico; A. Chaboud; C. Simiand (2007). Development of improved attractants and their integration into fruit fly sit management programmes: Proceedings of a final Research Coordination Meeting organized by the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture, Vienna, 5-7 May 2005 .

Ragoussis, N. (2002). Eco-Trap: efficient tool for the control of the olive fruit fly *Bactrocera oleae* in the Mediterranean area. Bulletin OILB/SROP. 25: 9, 195-201.

Saafan, M. H. (2005). Field evaluation of some attractants for attracting the adults of Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) and peach fruit fly, *Bactrocera zonata* (Saunders) in citrus orchards. Egypt. J. Agric. Res.,83 (3): 1141-1156.

Thomas, D. B. and D. C. Robacker (2006). Trapping for Mexican Fruit Fly (Diptera: Tephritidae) with Torula Yeast and Propylene Glycol. Subtropical Plant Science 58:23-25

Thomas, D. B.; N. D. Epsky; P. E. Kendra; R. A. Heath; C. A. Serra and D. G. Hall (2008): Ammonia Formulations and Capture of (Diptera: Tephritidae) J. Entomo. Sci. 43(1): 76-85.

YEE, W. L.; P. J. Landolt and T. J. Yarnell (2005). Attraction of *Rhagoletis pomonella* (Diptera:Tephritidae) and nontarget flies to traps baited with ammonium carbonate and fruit volatile lures in Washington and Oregon. J. Agric. Urban Entomol. 22: 133-149.

إستجابة ذبابة ثمار الزيتون لبعض مركبات الأمونيوم وبعض الجاذبات الغذائية تحت الظروف الحقلية فى بساتين الزيتون

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تعتبر ذبابة ثمار الزيتون من أخطر الآفات التي تهاجم ثمار الزيتون والتي تؤثر عليها كما ونوعا. وقد قيمت استجابة الحشرة الكاملة لذبابة ثمارالزيتون لبعض مركبات الأمونيوم والجاذبات الغذائية تحت الظروف الحقلية من خلال تجربتين بمنطقة أجا بمحافظة الدقهلية خلال الفترة من يوليو 2011 حتى يناير 2012 ، في التجربة الأولى قيمت كفاءة ستة مركبات أمونيوم محليه الانتاج (خلات الامونيوم، ثنائي فوسفات الأمونيوم ثنائي القاعده، كلوريد الأمونيوم، كربونات الأمونيوم، هيدروكسيد الأمونيوم، بيكربونات الأمونيوم) وذلك بأربع تركيزات (1، 2، 3، 4%) لكل منها وذلك خلال أشهر يوليو وسبتمبر وأكتوبر 2011. وأظهرت النتائج تفوق خلات الامونيوم 4،3% معنويا على باقي مركبات الأمونيوم المختبره حيث بلغ عدد الأفراد التي تم إصطيادها 8.25 ، 8.00 فرد/مصيده/ 14 يوم.

وفي التجربه الثانيه قيمت كفاءة خلات الامونيوم و ثنائي فوسفات الأمونيوم ثنائي القاعده بالتركيزات نفسها السابقة مقارنةً بجاذبات غذائية مستورده شملت البومينال والبرولور و الكونسرف والتي تم إستخدامها بثلاثة تركيزات هي 2.5 و 5 و 10% بالإضافة إلى أقراص خميرة التوريولا والتى تم إستخدامها بثلاث تركيزات بمعدل 2 و 3 و 4 قرص خميره لكل 300سم^3 ماء وذلك خلال أشهر أكتوبر وديسمبر 2011 ويناير 2012. وأظهرت النتائج التفوق المعنوي لثنائي فوسفات الأمونيوم ثنائي القاعده 2 و3 و1 % والبومينال 2.5% معنويا على باقي المركبات المختبرة حيث بلغ عدد الأفراد التي تم إصطيادها 19.58 و18.58 و17.08 و16.50 فرد/مصيده/ 14 يوم.

وقد أوضحت نتائج التجربتين التباين المعنوي لاستجابة ذبابة ثمار الزيتون للمركبات المختبرة باختلاف التركيزات المستخدمة ودرجات الحرارة.

وتوصي النتائج بأدراج ثنائي فوسفات الأمونيوم ثنائي القاعده و خلات الامونيوم فى دراسات رصد التعداد والإستخدام المكثف للمصائد وذلك فى إطار برنامج المكافحة المتكاملة لذبابة ثمار الزيتون وذلك لتفوقها المعنوي على جذب إناث ذبابة ثمار الزيتون على باقي المركبات المختبره وأنها مركبات محلية الإنتاج والأقل تكلفه مقارنةً بتكاليف الجاذبات الغذائية المستوردة.

قام بتحكيم البحث

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