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Response of the Peach Fruit Fly, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae), to Synthetic Food-Odor Lures and Extent the Effect of pH on Attracting the Fly

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ABSTRACT

The Peach Fruit Fly (PFF), *Bactrocera zonata* is one of the most destructive insect-pest of horticulture in Egypt. Occurrence adults of PFF in the field must be monitored to apply the action plan management of this pest. This study was conducted under field conditions to evaluate the response of PFF adults to some synthetic food-odor lures; Ammonium Acetate (AA), Ammonium Carbonate (AC), Ammonium Di-hydrogen orthophosphate (AD), Di-ammonium hydrogen-orthophosphate (DA) and a mixture of AD and borax. As well as, determining the role of pH degree of the synthetic food-odor lures on attracting of PFF adults. Results indicated that AA was the highest potential attractants in attraction adults of PFF. The borax mixed with AD enhanced the AD attraction potential for PFF compared to attraction of AD alone. The mean number of captured flies of PFF was inversely to tested time, i.e., 0.23±0.02 and 0.16±0.03 capture flies/trap/day in the first and second tested weeks. The overall mean numbers captured flies of PFF was directly proportional to the pH degree ($r = 0.25^{**}$). So, the obtained results showed clearly that the PFF is attracted to the synthetic food-odor lures moderate pH degree or light alkaline.

Key words: Peach fruit flies, *Bactrocera zonata*, synthetic food-odor lures, pH degree

INTRODUCTION

Monitoring the presence and relative abundance of tephritid fruit flies is an important component of area-wide control. Trap captures are used to delimit populations, direct control efforts and measure their effectiveness and influence whether or not vulnerable agriculture commodities can be exported to un-infested states and countries (Simpson, 1993).

The Peach Fruit Fly (PFF), *Bactrocera zonata* (Saunders) is a member of the Family: Tephritidae in the Order: Diptera. The PFF, *B. zonata* poses a threat to commercial fruits in Egypt in recent years and it is considered a major economic pest and a quarantine pest of fruits in Egypt. This pest has become a widespread pest in Egypt, Alexandria (El-Minshawy *et al*., 1999), Kalubia (Hashem *et al*., 2001), El-Boheira (Draz *et al*., 2002), the whole Nile Delta region, Nile Valley, Kharga- and Dakla-Oases, South Sinai and the North Sinai Governorates (EPPO, 2002). The baited traps with solutions of protein or synthetic lures are used worldwide for detecting both sexes of many fruit fly species (Epsky *et al*., 2008). Also, the food baits were attractive for both sexes of each Mediterranean Fruit Fly (MFF), *Ceratitis capitata* and PFF, *B. zonata* (El-Gendy, 2012a). Ammonia compounds are attractant for tephritid fruit flies. Commercial formulations of ammonium acetate and ammonium bicarbonate are available as lures for use in fruit fly traps (Heath *et al*., 2007). Numerous researchers investigated the efficiency of ammonium compounds as attractants to *Bactrocera zonata* (Saunders) and *C. capitata* (Saafan, 2005; Moustafa and Ghanim, 2008). So,

El-Metwally (2012) on olive fruit fly, *Bactrocera oleae* Rossi. As well as BioLure(ammonium acetate, putrescine) for both of *Anastrepha suspensa* (Loew) and *Anastrepha ludens* (Loew) (Thomas *et al.*, 2001).

The primary purpose of this study is to directly evaluate responding the individuals of PFF to synthetic food-odor lures for using it in detection-, delimiting- and monitoring- survey against this pest. As well as, effect of pH degree in attracting of PFF.

MATERIALS AND METHODS

Study location: The study was conducted under field conditions in mangoes (*Mangifera indica* Lindl) orchards with the active field population of PFF, *B. zonata* (Saunders) at two districts of El-Beheira Governorate; Kom-Hamada (12 feddans, contain several varieties, Zebda, Awais and Sadeka, thirty years old) and El-Dalangate (5 feddans, contain Zebda and Awais, twenty five years old) districts.

The study was started from June first until December last during 2012 season at both of Kom-Hamada and El-Dalangate districts.

Treatments

The first treatment: The potential attractant of four compounds of synthetic food-odor lure at Kom-Hamad district: Ammonium Acetate (AA), Ammonium Carbonate (AC), ammonium dihydrogen orthophosphate (AD) and Di-ammonium hydrogen-orthophosphate (DA), compared with Torula Yeast (TY) were evaluated in two concentrations (Con.); 3 and 5% of each compound of AA, AC, AD and DA while they were 1 and 2% of TY compound using PB Traps (Plastic Bottle Traps). One hundred mililiter of each concentration in the PB Traps was used (according to El-Gendy, 2012a). The PB Traps were hung at the 1.5 to 2 m above the ground in the tree in randomize distribution according to El-Gendy (2012b) one trap every three trees and four replicates of each treatment.

The traps were randomly re-distributed every week to avoid effects of trap position.

The second treatment: Mixed effect of Ammonium Di-hydrogen orthophosphate (AD) and borax on attractiveness of PFF at El-Dalangate district: Borax (Sodium tetraborate decahydrate) with three concentrations; 1, 3 and 5% was blended with each concentration of AD; 1, 3 and 5%, compared with three concentrations of AD; 1, 3 and 5% using PB Traps as above mentioned in the first treatment.

Response of PFF, *B. zonata* to synthetic food-odor lures: The traps were inspected every week and their contents were poured through wire screen sieve (the Attractant solutions were renewed every 2 weeks). The flies were confined in plastic tubes (Eppendolve) marked with a code number and transferred to the laboratory of fruit flies at El-Beheira Governorate. The flies were washed with fresh water and rowed on towel paper, sexing and counting male and female flies. The captured flies of male and female of *B. zonata* were expressed as captured flies/trap/day (CTD).

Effect of pH degree on attractiveness of PFF: To determine the effect of pH degree on attractiveness of PFF, samples about 30 mL of synthetic food-odor lure concentrations; AA, AC, AD, DA and TY were collected after one and two weeks from the tested lures at Kom-Hamada district from PB traps in plastic tubes (Eppendolve) marked with a code number and held in the Ice-box to transfer it to the laboratory of soil analysis at El-Beheira Governorate. The samples of AA,

AC, AD, DA and TY were measured by the Jenway 3505 pH meter. As well as, the captured flies in these tested lures were confined in plastic tubes (Eppendolve) marked with a code number and was transferred to the laboratory of fruit flies at El-Beheira Governorate which were treated as described in the first experiment according to El-Gendy (2012a).

Statistical analysis: The experiments were planned in a completely randomized design. All the obtained data were transferred using logarithmic (n+1) and were statically analyzed to obtain the analysis of variance (ANOVA) and Least Significant Differences (LSDs) using Costat Software (2008).

RESULTS

Response of PFF, *B. zonata* to synthetic food-odor lures under habitat of Kom-Hamada district: Attracting of PFF to synthetic food-odor lures (Ammonium Acetate (AA), Ammonium Carbonate (AC), Ammonium di-hydrogen orthophosphate (AD) and Di-ammonium hydrogen-orthophosphate (DA)) was tested under field conditions and expressed as a mean number of captured flies/trap/day (CTD) as presented in Table 1. The data indicated inequality in attracting of PFF between different tested ammonium compounds, where the AA was the highest potential attraction of the tested synthetic food-odor lures for adults of PFF ($F = 12.51$, $df = 4$, $p = 0.000$) followed by, DA and AC, compared with TY; 0.25, 0.21 and 0.08 CTD for AA, DA and AC, respectively, i.e., AA was 1.19- and 3.13- fold than DA and AC in attraction of PFF.

As well as, Highly significant differences ($F = 6.39$, $df = 9$, $p = 0.000$) were recorded between the synthetic food-odor lure concentrations in attraction of PFF, where AA (5%) was the highest

Table 1: Attractability of synthetic food-odor lures to adults of PFF, *B. zonata* using BP traps at Kom-Hamada District through 2012 season

		Mean captured flies/ trap/day (CTD) (±SD)		
Treat.	Conc. (%)	♀	♂	♀♂
AA	3	0.390±0.10	0.05±0.01	0.220±0.05^{ab}
	5	0.420±0.38	0.14±0.11	0.290±0.24^{a}
Mean±SD.		**0.410±0.24**	**0.09±0.11**	**0.250±0.16^{a}**
DA	3	0.330±0.04	0.14±0.02	0.230±0.03^{ab}
	5	0.270±0.08	0.09±0.01	0.180±0.05^{ab}
Mean±SD.		**0.290±0.06**	**0.12±0.02**	**0.210±0.04^{ab}**
AC	3	0.039±0.13	0.00±0.00	0.019±0.09^{cd}
	5	0.200±0.00	0.08±0.01	0.14±0.001^{b}
Mean±SD.		**0.120±0.07**	**0.04±0.01**	**0.08±0.005^{c}**
AD	3	0.000±0.00	0.00±0.00	0.00±0.000^{d}
	5	0.000±0.00	0.00±0.00	0.00±0.000^{d}
Mean±SD.		**0.000±0.00**	**0.00±0.00**	**0.00±0.000^{d}**
TY	1	0.160±0.03	0.09±0.02	0.13±0.010^{bc}
	2	0.320±0.02	0.03±0.01	0.17±0.030^{b}
Mean±SD.		**0.240±0.03**	**0.06±0.02**	**0.15±0.025^{bc}**
Overall mean±SD.		**0.210±0.08^{a}**	**0.06±0.03^{b}**	**0.14±0.060**

Means followed by the same letter(s) are not significantly different according to $LSD^{0.05}$ PFF: Peach fruit fly, Treat: Treatment, Conc.: Concentration, S.E. (±): Standard error, AA: Ammonium acetate, AC: Ammonium carbonate, DA: Di-ammonium hydrogen-orthophosphate, AD: Ammonium di-hydrogen orthophosphate , TY: Torula yeast, ♀: Female, ♂: Male, $LSD^{0.05}$ for Treat = 0.08, $LSD^{0.05}$ for sex = 0.05, $LSD^{0.05}$ for Con. = 0.11, $LSD^{0.05}$ for concentrations of AA = 0.146, $LSD^{0.05}$ for concentrations of DA = 0.13, $LSD^{0.05}$ for concentrations of AC = 0.08, $LSD^{0.05}$ for concentrations of TY = 0.13

attraction for PFF (0.29 CTD), followed by DA (3%), AA (3%), DA (5%), TY (2%), AC (5%), TY (1%) and AC (3%) with values; 0.23, 0.22, 0.18, 0.17, 0.14, 0.13 and 0.019 CTD, respectively. Whereas, the statistical analysis did not reveal any significant differences between concentrations within each of AA, DA, AD and TY in attraction of PFF, Except AC, where a significant difference ($F = 8.96$, $df = 1$, $p = 0.004$) was obtained between concentrations of AC in attraction of PFF.

With regards to attraction of both females and males of PFF for ammonium compounds; the females were significantly higher ($F = 33.50$, $df = 1$, $p = 0.000$) than males in attraction to ammonium compounds, i.e., they were 4.6-, 2.4- and 3- fold than males in attraction for AA, DA and AC compounds, respectively. Either at the level of the concentrations within each of tested synthetic food-odor lure, there weren't significant differences at the tested concentrations (3 and 5%) of AD and AC as well as 1% of TY and 3% of DA in attraction between female and male flies. While, significant differences were obtained between female and male flies of PFF in the attraction within AA concentrations (3 ($F = 11.42$, $df = 1$, $p = 0.001$) and 5% ($F = 8.71$, $df = 1$, $p = 0.005$)), 5% concentration of DA ($F= 4.47$, $df = 1$, $p = 0.04$) and 2% concentration of TY ($F = 10.44$, $df = 1$, $p = 0.002$). With respect to female flies, 5% concentration of both AA and AC was the higher attractant efficiency for PFF than 3% concentration of each them i.e., the attracted females of PFF was 1.07- and 5.13- fold higher at 5 than 3% concentration in attraction percentage of PFF of AA and AC, respectively. While, with respect to male flies, the AA was 2.8- fold higher at 5 than 3% concentration in attraction percentage of PFF males while 3% concentration of AC did not show any impact in attraction of male flies of PFF. In contrast, 3% concentrate of DA was highly attractant efficiency of PFF than 5% concentration. Whereas, AD demonstrated incompetence in attracting neither male nor female flies of PFF at both of 3 and 5% concentrations, when was applied with other tested synthetic food-odor lures.

The statistical analysis of the obtained data (Table 2) revealed that the CTD of PFF was directly proportional to the concentrations of the tested synthetic food-odor lures except DA compound and this was in parallel with correlation analysis, which revealed a positive significant correlation ($r = 0.29^{**}$) between concentrations of AC, as well as a positive insignificant correlation between concentrations for both AA ($r = 0.09$ ns) and TY ($r = 0.07$ ns) in attraction of PFF. In contrary, a negative insignificant correlation ($r = -0.07$ ns) was obtained between concentrations of DA and CTD of PFF.

Generally, the overall mean attraction adults of PFF showed that the attractancy of PFF to the synthetic food-odor solutions was primary dependent on treatments (lures) then their concentrations, according to the estimated values of determination coefficient (R2); 0.07 and 0.005 for both of treatments and their concentrations [Treat: R^2: 0.072, b: -0.32, a: 0.92, p: 0.000***] [Con: R^2: 0.005, b: -0.042, a: 0.62, p: 0.000***], respectively.

Table 2: Correlation coefficients between weekly mean numbers trapped of PFF, *B. zonata* and the synthetic food-odor lures concentrations through 2012 season

	Coefficients		
Treat	r	SE (±)	p
AA	0.09	0.10	0.40^{ns}
DA	-0.07	0.11	0.47^{ns}
AC	0.29	0.09	0.003**
TY	0.07	0.10	0.50^{ns}

PFF: Peach fruit fly, Treat: Treatment, r: Correlation, S.E. (±): Standard error, P: p-value, AA: Ammonium acetate, AC: Ammonium carbonate, DA: Di-ammonium hydrogen-orthophosphate, AD: Ammonium di-hydrogen orthophosphate and TY: Torula yeast

Mixture effect of Ammonium Di-hydrogen orthophosphate and Borax on attracting of PFF: The obtained data in Table 3 indicated that the ammonium di-hydrogen orthophosphate (AD) could attracting fewer numbers of adults of PFF when it was tested without any other synthetic food-odor lures and its attraction potential for PFF enhanced with addition of borax, i.e., 0.62 CTD, compared with 0.31 CTD for AD alone. These results were in the same trend with the statistical analysis, where the solution of AD and borax was a highly significant difference ($F = 22.15$, $df = 1$, $p = 0.000$) than AD in attraction of PFF. On the other hand, the solution of AD plus borax was the higher significant ($F = 45.72$, $df = 1$, $p = 0.000$) in attraction female (0.82 CTD) than male flies (0.42 CTD) at the total mean of capture flies of PFF, i.e., females were 1.95- fold than male flies of PFF. While, AD was the higher significant ($F = 11.87$, $df = 1$, $p = 0.001$) in attraction of male (0.49 CTD) than female flies (0.13 CTD) i.e., males were 3.77-fold higher than female flies of PFF.

With regards to effect of borax concentrations, the presented results showed inequality in attracting of PFF, whereas no significant differences ($F = 0.59$, $df = 8$, $p = 0.74$) were obtained between different concentrations of borax at different concentrations of AD as well as between different concentrations of borax within each concentration of AD ($F = 0.43$, $df = 2$, $p = 0.65$), also between concentrations of AD in attraction of PFF ($F = 0.24$, $df = 2$, $p = 0.78$). Results of correlation analysis (Table 4) indicated that there wasn't a significant correlation between borax concentrations within each concentration of AD mixture as well as between concentrations of AD

Table 3: Attractability of Ammonium Di-hydrogen orthophosphate mixed with Borax to adults of PFF, *B. zonata* using BP traps at El-Dalangate District through 2012 season

Con. (%)		Mean captured flies/trap/day (CTD) (±SD)		
Lure	Borax	♀	♂	♀♂
1	1	0.84±0.57	0.39±0.33	0.62±0.51[a]
	2	0.93±0.54	0.47±0.34	0.70±0.50[a]
	3	0.77±0.54	0.44±0.35	0.60±0.44[a]
Mean±SD		**0.85±0.54[a]**	**0.43±0.34[b]**	**0.64±0.49**
3	1	0.77±0.40	0.34±0.36	0.55±0.43[a]
	2	0.98±0.60	0.39±0.41	0.68±0.58[a]
	3	0.83±0.58	0.65±0.40	0.74±0.49[a]
Mean±SD		**0.86±0.52[a]**	**0.50±0.40[b]**	**0.66±0.50**
5	1	0.77±0.39	0.38±0.28	0.58±0.39[a]
	2	0.76±0.50	0.41±0.29	0.59±0.47[a]
	3	0.72±0.45	0.29±0.24	0.51±0.42[a]
Mean±SD		**0.75±0.44[a]**	**0.36±0.27[b]**	**0.56±0.42**
Total Mean±SD		**0.82±0.50[a]**	**0.42±0.34[b]**	**0.62±0.16[a]**
1	0	0.15±0.10	0.56±0.22	0.35±0.16[a]
3	0	0.13±0.09	0.49±0.27	0.31±0.18[a]
5	0	0.10±0.07	0.44±0.24	0.27±0.16[a]
Mean±SD		**0.13±0.08[b]**	**0.49±0.24[a]**	**0.31±0.16[b]**
Overall Mean±SD		**0.65±0.36[a]**	**0.44±0.42[b]**	**0.14±0.28**

Means followed by the same letter(s) are not significantly different according to $LSD^{0.05}$. PFF: Peach fruit fly, Conc.: Concentration, S.E. (±): Standard error, ♀: Female, ♂: Male, $LSD^{0.05}$ for sex at mixture of borax and concentration of lure 1 = 0.21, $LSD^{0.05}$ for sex at mixture of borax and concentration of lure 2 = 0.22, $LSD^{0.05}$ for sex at mixture of borax and concentration of lure 3 = 0.18, $LSD^{0.05}$ for sex at concentrations of AD = 0.25, $LSD^{0.05}$ for borax concentrations at lure 1 = 0.29, $LSD^{0.05}$ for borax concentrations at lure 2 = 0.30, $LSD^{0.05}$ for borax concentrations at lure 3 = 0.25, $LSD^{0.05}$ for concentrations of AD alone = 0.28

and CTD of PFF; a non-significant negative correlation (r) was obtained between borax concentrations within each concentration of AD mixture and CTD of PFF; -0.012 and -0.05 at both AD concentration 1 and 5%, respectively. While, a non-significant positive correlation (r = 0.15 ns) was obtained at concentration 3%. On the other hand, a non-significant negative correlation (r = -0.08 ns) was obtained between concentrations of AD and CTD of PFF.

Effect of pH degree on attractiveness of PFF: Results in Table 5 and 6 showed that the pH degree of the synthetic food-odor lures varied from treatment to another with highly significant differences (F = 714.84, df = 4, p = 0.0000***). As well as, in the first tested week the pH varied not only from treatment to another but also from concentration to another within each treatment, where the highest mean value of pH degree in the first week was obtained in DA (8.36), followed by AC (7.31), AA (7.11) and AD (5.31), compared with TY (8.54). Similar results were obtained in the second tested week with a small reduction in the percent of pH degree; 7.88, 7.2, 7.13 and 5.30 for DA, AC, AA, AD, respectively, compared with TY (8.58). These results were corresponding with the statistical analysis (p = 0.05), which revealed significant differences (F = 707.0, df = 4, p = 0.0000***), (F = 245.27, df = 4, p = 0.0000***) between treatments in pH degree in the 1st and the 2nd tested weeks, respectively. Whereas, there were no significant differences (F = 1.76, df = 2, p = 0.1744 ns) between tested time periods in pH degree and this was in the same direction with the obtained correlation value (r = -0.13 ns) of the tested time periods and pH degree. On the other hand, the obtained data showed that the overall mean numbers of captured flies of PFF (CTD) was inversely to tested time periods; 0.23 CTD in the first tested week which descending to 0.16 CTD in the second ones. However, no significant difference (F = 1.33, df = 1, p = 0.25 ns) was obtained between tested times of the synthetic food-odor lures in CTD of PFF as well as a non-significant negative correlation (r = -0.11 ns) was obtained between CTD of PFF and tested time periods of synthetic food-odor lures. It is demonstrated that the pH degree of the tested synthetic food-odor lures was relatively stable along tested period. Thus, the tested synthetic food-odor lures can be retention along two week period in the traps.

With respect to effect of pH degree on attractiveness PFF, the obtained results indicated that the AA (5%) with pH degree equal to 6.98 and 6.85 in the first and second tested weeks was the most effective treatment concentration, followed by the other treatments with the greatest pH degree (Alkaline pH). In contrary, the AD (1 and 5%) with an average pH degree equal to 5.31 and 5.30 (Acidic pH) in the first and second tested weeks didn't attract any flies along tested time periods. Statistically, the obtained results indicated that there were no significant differences

Table 4: Correlation coefficients between weekly mean numbers trapped of PFF, *B. zonata* and mixing borax with Ammonium Di-hydrogen orthophosphate concentrations as well as ammonium di-hydrogen orthophosphate concentrations alone

	Factor		Coefficients		
	Con	Borax	r	SE (±)	p-value
AD	1	+	-0.012	0.11	0.91^{ns}
	3	+	0.15	0.11	0.20^{ns}
	5	+	-0.05	0.11	0.58^{ns}
AD	CTD		-0.08	0.11	0.49^{ns}

PFF: Peach fruit fly, Conc.: Concentration, r: Correlation, S.E. (±): Standard error, AD: Ammonium di-hydrogen orthophosphate, CTD: Mean captured flies/trap/day

Table 5: The pH degree of synthetic food-odor lures and response of PFF adult's, *B. zonata*, expressed as mean numbers captured per trap per day

			Mean captured flies/trap/day (CTD) (±SD)							
		Zero time	1st week				2nd week			
Treat	Con. (%)	pH	pH	♀	♂	♀♂	pH	♀	♂	♀♂
AA	3	7.42±0.01	7.23±0.09	0.48±0.10	0.10±0.00	0.29±0.23	7.42±0.24	0.41±0.30	0.00±10.0	0.21±0.05
	5	7.62±0.62	6.98±0.03	0.69±0.20	0.30±0.34	0.50±0.22	6.85±0.03	0.61±0.41	0.48±0.00	0.41±0.20
Mean±SD		7.52±0.08	7.11±0.14	0.58±0.28	0.20±0.02	0.39±0.33	7.13±0.35	0.51±0.33	0.10±0.05	0.37±0.21
AD	3	5.20±0.15	5.41±0.01	0.00±0.00	0.00±0.00	0.00±0.00	5.38±0.03	0.00±0.00	0.00±0.00	0.00±0.00
	5	5.23±0.00	5.22±0.00	0.00±0.00	0.00±0.00	0.00±0.00	5.21±0.01	0.00±0.00	0.00±0.00	0.00±0.00
Mean±SD		5.21±0.10	5.31±0.05	0.00±0.00	0.00±0.00	0.00±0.00	5.30±0.04	0.00±0.00	0.00±0.00	0.00±0.00
AC	3	8.25±0.02	7.26±0.01	0.47±0.34	0.26±0.10	0.37±0.26	7.19±0.10	0.33±0.23	0.10±0.01	0.21±0.06
	5	8.26±0.02	7.34±0.02	0.26±0.21	0.20±0.00	0.23±0.21	7.22±0.06	0.25±0.10	0.00±0.00	0.13±0.02
Mean±SD		8.25±0.01	7.31±0.41	0.36±0.28	0.23±0.01	0.30±0.25	7.21±0.04	0.29±0.10	0.05±0.10	0.17±0.14
DA	3	8.72±0.02	8.28±0.01	0.00±0.00	0.00±0.00	0.00±0.00	7.51±0.32	0.00±0.00	0.00±0.00	0.00±0.00
	5	8.75±0.01	8.43±0.01	0.50±0.10	0.31±0.00	0.41±0.12	8.24±0.29	0.10±0.45	0.00±0.10	0.05±0.02
Mean±SD		8.74±0.02	8.36±0.07	0.25±0.01	0.15±0.00	0.20±0.86	7.88±0.47	0.05±0.12	0.00±0.00	0.03±0.01
TY	1	8.13±1.04	8.45±0.08	0.31±0.20	0.33±0.10	0.33±0.13	8.53±0.04	0.58±0.05	0.10±0.00	0.34±0.04
	2	8.75±0.02	8.64±0.01	0.20±0.31	0.20±0.00	0.20±0.43	8.63±0.01	0.55±0.10	0.00±0.00	0.28±0.11
Mean±SD		8.38±0.80	8.54±0.11	0.26±0.20	0.25±0.01	0.26±0.48	8.58±0.05	0.56±0.16	0.05±0.00	0.30±0.14
Overall Mean±SD		7.62±1.23[a]	7.33±1.16[a]	0.29±0.12	0.17±0.01	0.23±0.02[a]	7.22±1.13[a]	0.28±0.13	0.04±0.01	0.16±0.03[a]

Means followed by the same letter(s) are not significantly different according to $LSD^{0.05}$, PFF: Peach fruit fly, Treat: Treatment, Conc: Concentration. AA: Ammonium acetate, AC: Ammonium carbonate, DA: Di- ammonium hydrogen-orthophosphate, AD: Ammonium di-hydrogen orthophosphate, TY: Torula yeast, F: Female, M: Male, $LSD^{0.05}$ for CTD = 0.118, $LSD^{0.05}$ for pH along time = 0.436, $LSD^{0.05}$ for treat pH = 0.18, $LSD^{0.05}$ for Treat pH in 1st week = 0.088, $LSD^{0.05}$ for Treat pH in 2nd week = 0.22

Table 6: Correlation coefficients of PH degree of the synthetic food-odor lures and some tested factors as well as between mean numbers trapped of PFF, *B. zonata* and tested time

		Coefficients		
Factor		r	SE (±)	p
pH	T	-0.13	0.074	0.07^{ns}
	CTD	0.25	0.089	0.06**
	Sex	0.00	0.090	0.10^{ns}
CTD	T	-0.11	0.074	0.07^{ns}

PFF: Peach fruit fly, r: Correlation, S.E. (±): Standard error, P: p-value T: Time, CTD: Captured flies/trap/day

(F = 1.45, df = 48, p = 0.07 ns) between CTD of PFF and pH degree. However, the overall mean numbers captured of PFF adults was directly proportional to pH degree, where a positive significant correlation (r = 0.25**) was obtained between overall mean numbers of captured flies (CTD) and pH degree of the synthetic food-odor lures. However, no correlation was obtained between sex and the pH degree (r = 0.00). The pH degree of the synthetic food-odor lures has an effect on the variance in population density about 6.2% of total variance of population density of PFF, according to the estimated value of determination coefficient [pH: R^2: 0.062, b: 0.072, a: -0.32, p: 0.006**]. In accordance with this study, it suggested also that the attractancy of PFF to the synthetic food-odor solutions was basically dependent on the pH degree of treatments.

Generally, it is clearly that the PFF is attracted to the synthetic food-odor lure moderate pH degree or light alkaline.

DISCUSSION

The presented data indicated inequality in attracting of PFF among different tested synthetic food-odor lures; Ammonium Acetate (AA), Ammonium Carbonate (AC), Ammonium di-hydrogen orthophosphate (AD) and Diammonium hydrogen-orthophosphate (DA), where AA was the highest attractiveness tested synthetic food-odor lure for adults of PFF and this agrees with Ghanim (2009), who indicated that ammonium acetate attracted the highest numbers of *B. zonata* at all tested concentrations, while ammonium carbonate, ammonium hydroxide, diammonium phosphate and ammonium tartrate ranked the second group and recorded the moderate level of attractiveness with significantly different from ammonium acetate. So, Liburd *et al.* (1998, 2001) mentioned that ammonium acetate is an attractant for both male and female *Rhagoletis* flies and El-Metwally (2012) indicated that the ammonium acetate (at 3 and 4%) recorded the highest efficiency, followed by ammonium acetate (at 1%) and diammonium phosphate (at 3%) with the same efficiency (4.16 flyl/trap/14days), while ammonium bicarbonate at the tested concentration 4, 3 and 2% recorded the lowest efficiency, followed by ammonium carbonate for *B. oleae*.

With regards to attraction both females and males of PFF; the females were significantly higher than males in attraction to tested ammonium compounds and these results are similar to some extent with the results of Ghanim (2009), who mentioned that all of the tested ammonium compounds (except ammonium tartrate) attracted females more than males with no significant difference and El-Gendy (2012a) revealed a significant difference in attraction to protein derivatives was obtained between female and male flies of both Mediterranean Fruit Fly (MFF), *Ceratitis capitata* and PFF. While, El-Metwally (2012) mentioned that there were no significant differences between males and females of *B. oleae* captured by all tested ammonium compounds except, numbers of females recorded by ammonium hydroxide during September which was higher than males. The Statistical analysis did not show any significant differences between tested concentrations of AA, DA, AD and TY in attraction of PFF, while a significant difference was obtained between concentrations of AC in attraction of PFF. These results were in contrast with Ghanim (2009) who, showed that there was no significant difference between the efficiency of ammonium carbonate, ammonium hydroxide at 1 and 4% concentrations.

It is clearly that the pH degree in the tested synthetic food-odor lures was relatively stable along tested period and this was in agreements with Ghanim (2009) who, showed that the regression analysis of the attraction of ammonium acetate, ammonium hydroxide, di-ammonium phosphate and ammonium tartrate or its concentrations for PFF adults over 15 days was not affected by the time, on the contrary ammonium carbonate and ammonium citrate (at 4% concentration) significantly increased by the time. So, El-Gendy (2012a) on MFF and PFF showed a non-significant difference in pH degree of food baits between tested periods.

The presented results demonstrated that the attractancy of PFF to the tested synthetic food-odor lures was found to be basically dependent on treatments then concentrations and their pH degree and this result resemble to the results of Bateman and Morton (1981) who, mentioned that the attractancies of ammonium bicarbonate solutions for the Queensland fruit fly was found to be strongly dependent on concentration and pH. The results indicated that the attraction potential of AD for PFF was enhanced with addition of borax, compared with AD alone, this may be indicate

the role of borax in increasing the pH degree. This result may be in harmony with Heath *et al.* (2009), who mentioned that the NuLure (Acid hydrolysate of corn and has an acidic pH) is captured more flies of *Amastrepha* and *Bactrocera* sp., with addition of borax. Addition of borax makes the solution more alkaline and increase in alkalinity results in increase of ammonia release from the bait solution and this is a very dynamic system, with resultant pH affected by factors such as the amount of borax added. On the other hand, the AD mixed with borax was higher significant in attraction female than male flies of PFF while AD was higher significant in attraction of male than female flies of PFF and this may be due to pH degree of the solution. This result agrees with Epsky *et al.* (1993) on Caribbean fruit fly, *Anastrepha suspensa* (Loew), who mentioned that the addition of 1-10% borax to 10% NuLure solution increased bait pH and this increase was directly correlated with increase in number of female flies trapped in two-choice laboratory bioassays and in field trials conducted in three locations in south Florid. So, Heath *et al.* (1994) found that the addition of 1-10% borax to 10% NuLure solution increased bait pH which corresponded directly with increase in number of female *C. capitata* trapped in field trials.

CONCLUSION

The obtained results, revealed inequality in attracting of PFF between different tested ammonium compounds, where the AA was the highest potential attraction of the tested synthetic food-odor lures for adults of PFF, so the CTD of PFF was directly proportional to concentrations of the tested synthetic food-odors (except DA compound) as well as the pH degree of treatments. The present study revealed that mixing borax with AD enhanced the AD attraction potential for PFF. So, it is demonstrated that the pH degree of the tested synthetic food-odor lures was relatively stable along tested period.

The results suggest that the synthetic food-odor lures can be used in female-targeted trapping systems for PFF, especially AA 3, 5% or DA 3%. On the other hand, AD 1% can be used for attraction PFF without any lure located in the same area or AD 2% mixed with borax 3% which, they can be used for a two week period. So that,the pH degree of the used synthetic food-odor lures is moderate or light alkaline.

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