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Effects of some additives to ammonium acetate and buminal traps on their attraction efficiency to the peach fruit fly under filed conditions

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Abstract
This experiment was carried out in navel orange orchards under field conditions at Kafer - El sheikh and Ismailia governorates in Egypt, to evaluate the efficiency of the food - based traps baited with ammonium acetate at three different concentrations,1 % 2% and 3 % and buminal at a concentration 5% for attracting the peach fruit fly *B. zonata* adults and comparing it with their efficiency after adding to them , yellow color and vanilla essence .The results cleared that, at both governorates efficiency of different concentrations of A. acetate with buminal traps to attract *B. zonata* fly was varied at different times of inspection and the efficiency of all studied treatments was increased after addition of yellow color and vanilla essence. Mean attraction of *B. zonata* females was more obviously higher than that of males with all treatments. The study proved also that the highest mean of attraction of females was recorded with treatments including vanilla essence, while the highest mean of attraction of males was recorded by treatments including yellow color. At Kafer - El-Shiekh governorate the highest mean of attraction for *B. zonata* fly was recorded after 12days of inspection, on the other hand at Ismailia governorate the highest attraction was achieved after 8 days of inspection. Addition of yellow food color and vanilla essence to A. acetate with buminal traps improved their efficiency of attraction to both females and males of the peach fruit fly and this result may be a very important point in the integrated control of this dangerous pest.

Keywords: Additives, ammonium acetate, buminal, attraction, *B. zonata*

Introduction

The tephritide fly, *Bactrocera zonata* is considered one from the most destructive pests for fruits and vegetables in Egypt and all over the world causing great damage to the fruits and consequently great loss in annual production .The attraction , detection and control (by mass trapping) of fruit flies is reached by using food - based traps because immature adult females of fruit flies need protein food for completing their sexual maturation and development of eggs (Epsky *et al*., 2014 and Pinero *et al.*, 2015) [9, 14]. Slowly decomposition of the proteinaceous food bait results in ammonia fumes which is known as the primary attractant source for tephritide fruit flies (El-Metwally *et al*., 2012) [6]. Traps baited with ammonium acetates are used for attraction of fruit flies' males and females (Prokopy1968 and Moore 1969) [11]. To obtain maximum attraction response of both sexes of fruit flies, it is necessary to increase the odors source of ammonia, so synthetic attractant food such as different formulations of ammonium (ammonium acetate) combines with protein material are used as bait in food traps to attract fruit flies. Ammonium compounds and liquid protein are used to attract med fly (IAEA 2003; Moustafa and Ghanim 2008 and El-Metwally 2017) [7, 8, 10, 12]. It is necessary to improve the efficacy of the trap for attracting and catching, this was done by many researchers by adding synthetic compounds for improving baits efficacy (Paiva and Parra 2013 and El-Gendy 2013) [5, 13]. The present study is a trail for this objective by adding some additives to the usual used food-baited traps, so the aim of the present study was to investigate under field conditions : The efficacy of food- based traps baited with ammonium acetates at three different concentration (1%, 2% and 3%) and buminal (the usual used liquid protein) at a concentration 5% for attracting and catching adult flies of *B. zonata* in comparison with their efficacy after adding vanilla essence and yellow food color to them.

Materials and Methods

Materials

- Ammonium acetate and buminal (liquid protein) were obtained from El-Gomhouria Company for Drugs and Chemical.
- Vanilla essence and the yellow food color were obtained from Kamena Company for Food Favors and Colors.
- Pheromone traps (Jackson traps) were used and hanged before performance of the experiment by about one week for detection of *B. zonata* adult flies
- Clear plastic bottles (500 ml volume) with four pores (about 3ml in diameter) in their upper part which allow the entrance of the *B. zonata* adults flies were used.

Experimental Bioassay

This experiment was carried out under field conditions to evaluate the efficiency of the food - based traps baited with A. acetate at three different concentrations ,1 % 2% and 3 % and buminal at a concentration 5% for attracting the peach fruit fly *B. zonata* adults and comparing it with their efficiency after adding to them , vanilla essence and yellow color(both of them at a concentration 5%) . The experiment was carried out in two orchards of navel orange; each orchard was about 5 feddans in its area in two governorates in Egypt, Kafer - El sheikh and Ismailia during season 2022 starting on 15th November till1st of December. About 350 mills of the attractant solution of each treatment were put in each trap and four replicates were performed for each treatment. All traps were distributed and placed in a shady site of the orange trees and in a completely randomize order at about 1.5 meter above the ground (Ragab and

Youssef, 2021) [16] with a distance between each two adjacent traps was about 30meter. The attractant solutions weren't renewed all over the experimental time. Every four days interval and for a period of 16 successive days all traps were inspected and captured *B. zonata* flies' males, females and total of them were counted and scored as number of flies per trap per four days. At the beginning of the experiment (at 0 time passed) and after each four days (interval time of inspection), pH of the attractant solution for each treatment was measured and recorded to show effect of the changing in PH of the solution with the time passed on the efficiency of the attractant solution.

Statically analysis

Results were analyzed by one-way ANOVA and LSD (least significant difference) at 0.05 probability level by using Cohort Software (2004) [4].

Results and Discussion

Results in Table (1) indicated that the efficiency of different concentrations of A. acetate with buminal traps to attract B. *zonata* fly at Kafer -El-Shiekh governorate was increased after addition of the tested additives (yellow color5% and vanilla essence 5%) and they exhibit different efficiencies in attracting *B. zonata* fly at all the intervals time of the inspection. Data of Table (1) also cleared that after the three intervals time 4,12 and 16 days of inspection ,the highest total attraction(females + males) was recorded by the traps of A.acetate 2% with buminal 5% and vanilla essence and there was no significant difference between yellow color and vanilla essence in total mean of attraction at 4 and 12 days of inspection while after 8 days the most effective treatment was A. acetate 3% with buminal 5% and vanilla essence 5%. Based on the results of Table (1), data of Fig. (1) cleared that the highest mean of attraction at all intervals time of inspection all over 16 days was achieved by A. acetate 2% with buminal 5% and yellow color 5% followed by A. acetate 2% with buminal 5% and vanilla essence 5% followed by A. acetate 3% with buminal 5% and vanilla essence 5%, they recorded 43.94, 42.38 and 41.06 fly /trap /4days, respectively.

Table (1): Mean attracted females, males and total of them of *B. zonata* fly by different concentrations of ammonium acetate with buminal 5%traps alone and with yellow color and vanilla essence along four intervals time of inspection at Kafer -El-Shiekh

Treatments	PH at 0 time	Mean after 4days			PH at 4 days	Mean after 8days			PH at 8 days	Mean after 12days			PH at12 days	Mean after 16days			PH at16 days
		F	M	Total (F+M)		F	M	Total (F+M)		F	M	Total (F+M)		F	M	Total (F+M)	
Aa1%+Bu5%	6.02	8.50 d	0.5d	9.00 A	6.16	16.00 d	1.75 d	17.75 d	7.5	23.50 d	1.25 d	24.75 d	7.14	11.50 d	0.50 d	12.00 D	6.14
Aa1%+Bu5%+Yc5%	6.19	10.25 d	2.75 c	13.00 D	7.09	14.50 d	7.50 b	22.00 c	7.23	24.25 d	6.50 b	30.75 c	7.03	12.25 d	2.50 c	14.75 D	7.60
Aa1%+Bu5%+Ve5%	6.66	14.50 c	1.50 cd	16.00 C	6.5	19.25 c	2.50 d	21.75 c	6.99	30.50 c	2.75 c	33.25 c	7.62	13.50 d	1.50 c	15.00 C	7.45
Aa2%+Bu5%	7.20	11.25 cd	2.50 c	13.75 C	7.17	21.50 b	4.50 c	26.0 c	7.48	36.25 b	3.50 c	39.75 b	7.73	19.50 bc	0.50 d	20.00 B	7.65
Aa2%+Bu5%+Yc5%	7.18	24.50 ab	8.50 a	33.00 A	7.13	34.50 ab	16.5 a	51.00 a	7.34	50.25 a	14.5 a	64.75 a	7.61	20.50 b	6.50 a	27.00 Ab	7.70
Aa2%+Bu5%+Ve5%	7.48	28.50 ab	4.50 b	33.00 A	7.02	37.50 a	2.50 d	40.00 b	7.17	64.50 a	2.25 c	66.75 a	7.64	28.50 a	1.25 d	29.75 A	7.99
Aa3%+Bu5%	7.11	22.25 b	3.75 b	26.00 B	7.24	31.25 ab	3.50 c	34.75 bc	7.66	48.50 ab	2.50 c	51.00 ab	7.32	18.25 c	0.75 d	19.00 C	7.22
Aa3%+Bu5%+Yc5%	6.13	10.25 d	7.75 ab	18.00 Bc	6.15	25.25 b	15.5 a	40.75 b	6.91	38.50 b	12.5 ab	51.00 ab	7.14	18.50 c	5.50 b	21.00 B	7.17
Aa3%+Bu5%+Ve5%	6.32	33.25 a	1.50 cd	34.75 A	6.27	54.50 a	2.50d	57.00 a	7.01	50.50 a	1.75 d	52.25 ab	7.63	20.25 b	0.00 d	20.25 B	7.73
LSD at 5%		4.55	1.53	4.21		7.74	2.41	7.62		9.85	1.35	9.53		4.35	1.11	4.23	

Means with the same letters in the same column aren't significantly different.

F: females M: males Aa: Ammonium acetate Bu: Buminal Yc: Yellow food color Ve: Vanilla essence

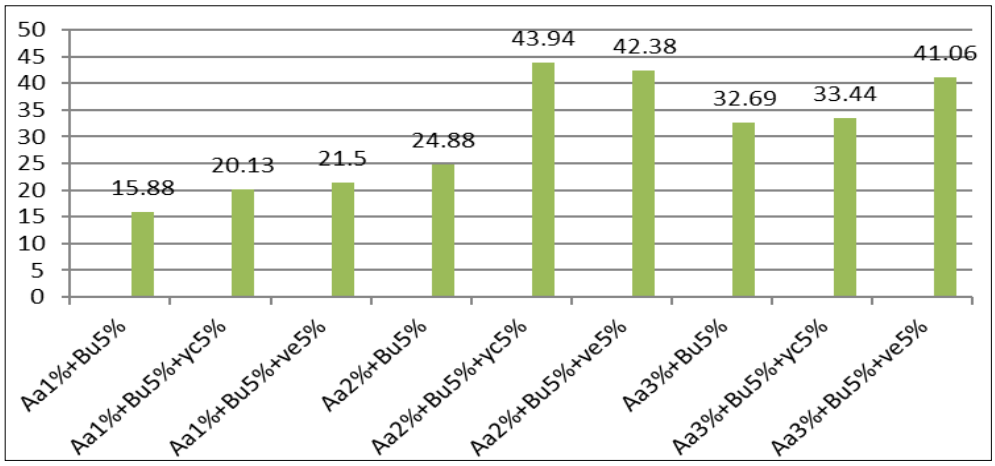

Fig (1): Mean number of attractions of *B. zonata* fly by different concentrations of ammonium acetate with buminal 5%traps alone and with yellow color and vanilla essence all over all intervals time of inspection (16 days) at Kafer -El-Shiekh governorate

The obtained results of Table(1) also indicated that, in all treatments,mean attraction of *B. zonata* females was more obviously higher than that of males as shown in Fig. (2), it was cleared from the data of the figure that, the highest attraction of females 39.75 fly /trap /4days was collected by A. acetate 2% with buminal 5% and vanilla essence 5%, at the same time the highest attraction of males 11.5 fly /trap/4days was collected by A. acetate 2% with buminal 5% and yellow color 5% .

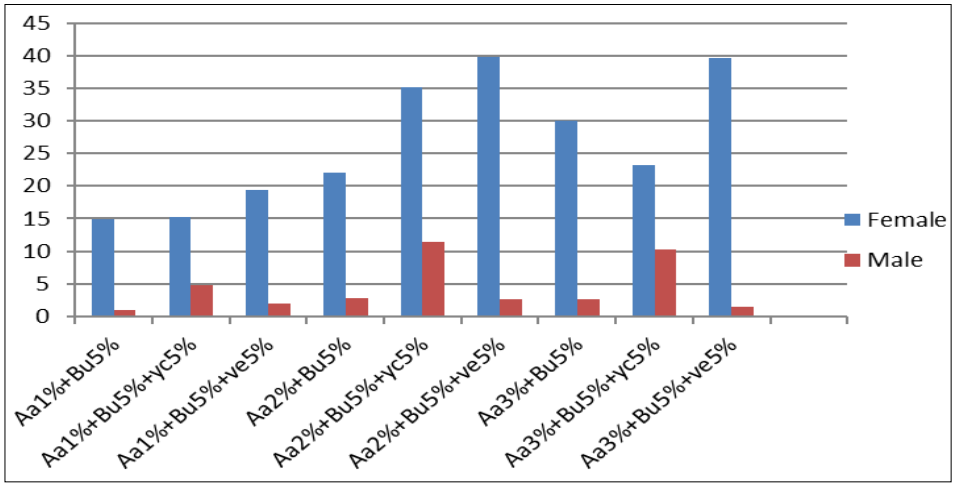

Fig. (2): Mean number of attracted females and males of *B. zonata* fly by different concentrations of ammonium acetate with buminal 5%traps alone and with yellow color and vanilla essence at Kafer -El-Shiekh governorate

Table (2): Mean attracted females and males and total of them of *B. zonata* fly by different concentration of ammonium acetate with buminal 5% traps alone and with yellow color and vanilla essence along four intervals time of inspection at Ismailia governorate.

Treatments	PH at 0 time	Mean after 4days			PH at 4 days	Mean after 8days			PH at 8 days	Mean after 12days			PH at12 days	Mean after 16days			PH at16 days
		F	M	Total (F+M)		F	M	Total (F+M)		F	M	Total (F+M)		F	M	Total (F+M)	
Aa1%+B%	5.30	11.75 d	0.0 d	11.75 d	6.10	12.50 d	0.0 d	12.50 d	6.4	22.50 c	1.25 D	23.75 d	7.01	4.50 C	1.50 c	6.0 D	7.28
Aa1%+Bu5%+Yc5%	6.06	13.50 c	3.75 b	17.25 c	6.31	13.25 d	6.75 b	20.00 d	6.62	12.25 d	7.25 B	19.50 d	6.22	3.75 D	5.50 ab	9.25 B	6.20
Aa1%+Bu5%+Ve5%	6.55	14.25 b	0.50 d	14.75 c	6.84	28.50 c	0.75 d	29.25 c	7.14	32.25 b	1.25 D	33.50 c	7.25	11.50 Bc	0.50 d	12.0 B	7.34
Aa2%+Bu5%	7.17	10.50 d	1.25 c	11.75 d	7.45	46.50 b	2.75 c	49.25 b	7.21	30.50 bc	3.50 C	34.00 c	7.33	3.75 D	1.50 c	5.25 D	7.45
Aa2%+Bu5%+Yc5%	6.91	14.75 b	10.50 a	25.25 ab	7.12	50.50 ab	15.50 ab	66.00 ab	7.44	48.50 ab	14.25 A	62.75 a	7.66	21.50 B	7.50 a	29.0 Ab	7.46
Aa2%+Bu5%+Ve5%	6.33	24.50 a	2.75 c	27.25 a	6.77	69.50 a	2.25 c	71.75 a	7.61	56.50 a	1.50 C	58.00 ab	8.26	30.50 A	0.0 d	30.5 A	7.76
Aa3%+Bu5%	6.81	20.25 ab	1.75 c	22.00 b	7.48	26.50 c	2.25 c	28.75 c	7.73	45.50 ab	1.50 C	47.00 b	7.50	6.50 C	0.50 d	7.0 C	7.43
Aa3%+Bu5%+Yc5%	6.36	12.50 c	9.50 ab	22.00 b	7.28	28.50 c	17.50 a	46.00 b	7.76	22.50 c	10.50 ab	33.00 c	7.61	0.75 D	4.25 b	5.0 D	7.23
Aa3%+Bu5%+Ve5%	6.97	25.50 a	0.0 d	25.50 ab	7.10	52.50 ab	0.50 d	53.00 b	7.54	39.50 B	0.25 D	39.75 b	8.20	7.75 C	0.50 d	8.25 C	7.70
LSD at 5%		4.23	1.34	4.13		8.91	2.30	8.52		7.76	1.25	7.71		2.35	1.39	2.62	

Means with the same letters in the same column aren't significantly different

F: females M: males Aa: Ammonium acetate Bu: Buminal Yc: Yellow food color Ve: Vanilla essence

The results of Table (2) indicated that at Ismailia governorate the efficiency of A. acetate with buminal traps for attracting *B. zonata* fly also increased after addition of the tested additives compared to the individual treatments. The highest mean of total attraction (females +males) of *B. zonata* fly was recorded by A. acetate 2% with buminal 5% and vanilla essence at the three intervals time 4,8 and 16 days of inspection while it was recorded by A. acetate 2% with buminal 5% and yellow color after 12 days of inspection.

Based on the above mentioned results in Table (2), data of Fig. (3) showed that, all over four intervals time of the inspection 4,8,12 and 16 days, the highest mean of attraction was achieved by A. acetate 2% with buminal 5% and vanilla essence followed by A. acetate 2% with buminal 5% and yellow color 5% followed by A. acetate 3% with buminal 5% and vanilla essence 5% they recorded 46.875, 45.75 and 31.625 fly /trap /4days respectively.

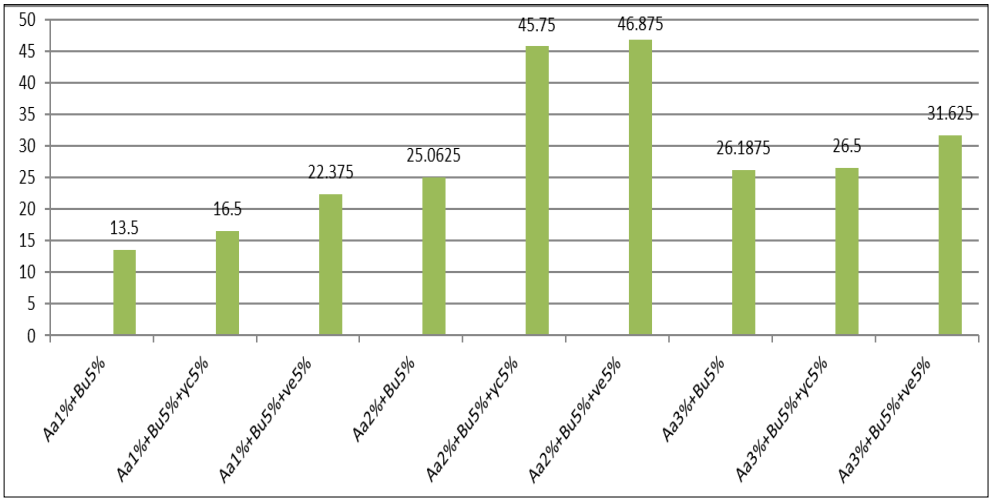

Fig (3): Mean number of attracted *B. zonata* fly by different concentrations of ammonium acetate with buminal 5% traps alone and with yellow color and vanilla essence all over four intervals time of inspection (16 days) at Ismailia governorate.

Results of Table (2) cleared also that, mean number of attractions of *B. zonata* females was higher than that of males as indicated in Fig. (4), the results of the figure cleared that, the highest female's attraction was scored by A. acetate 2% with buminal 5% and vanilla essence followed by, A. acetate 2% with buminal 5% and yellow color 5% followed by A. acetate 3% with buminal 5% and vanilla essence.

The above mentioned results of the two tables of both governorates proved that, addition of yellow color and vanilla essence to ammonium acetate and buminal traps leads do increment in mean attraction of *B. zonata* fly compared to individual treatments, these results agree with Chajro *et al*.,(2019) [3] who used different food additives, lemon essence and vanilla essence in methyl eugenol traps to improve their attraction and they found that,the highest mean attraction were achieved by traps with vanilla essence. The results showed also that, the highest attraction of females was recorded with treatments including vanilla essence, this may be due to immature *B. zonata* fly females need nutrition to reach sexual maturity, this agree with (Epsky *et al*., 2014 and Pinero *et al*., 2015) [9, 14] who reported that, immature adult females of fruit flies need protein food for completing their sexual maturation and development of eggs. On the other hand the highest attraction of males was recorded by treatments including yellow color this finding run in full agreement with Ali *et al*., (2020) [2] who evaluated the influence of color on the attractiveness of Jackson trap, local trap and McPhail trap, they reported that, the highest attraction and catching for the flies were achieved by yellow traps followed by white traps then green traps.

Based on the obtained results in Tables (1 and 2),data of Fig. (5) showed the effect of time of inspection passed on mean number of attracted *B. zonata* flies at both governorates .The figure cleared that, at Kafer -El-Shiekh governorate the highest mean of attraction for *B. zonata* fly 46.03 fly/ trap/ 4days achieved by traps of A. acetate with buminal and the tested additives was recorded at the third interval time of inspection (after12 days) while at Ismailia governorate the highest attraction 41.83 fly /trap/4days was achieved at the second interval time of inspection(after 8 days) as shown in Fig. (5), this may be due to differences in weather factor and consequently differences in times of fruits ripping in addition to differences in the presence of available hosts in the experimental site. These results come in full agreement with Tiboni *et al*. (2008) [17] and El-Metwally *et al*., (2017) [7, 8] who reported that, weather factors and the presence of available hosts may be responsible for the catch of the insects.

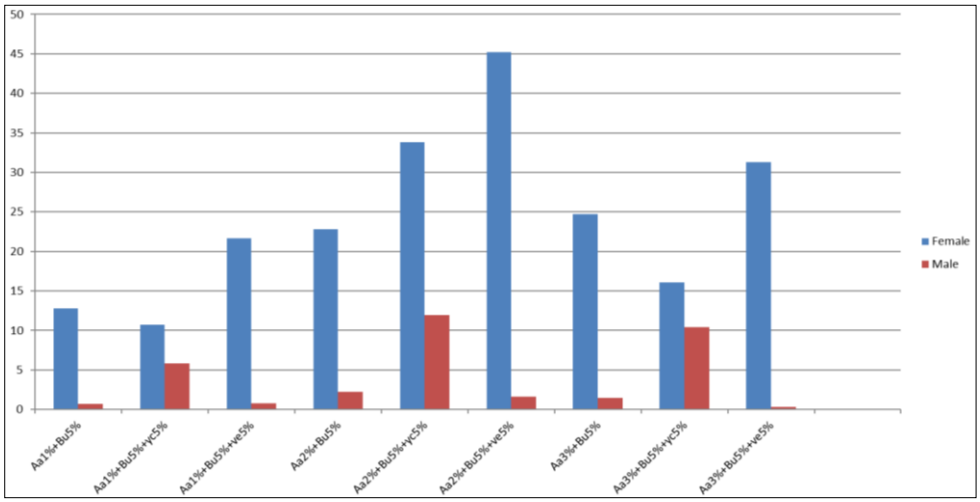

Fig. (4): Mean number of attracted females and males of *B. zonata* fly by different concentrations of ammonium acetate with buminal 5%traps alone and with yellow color and vanilla essence at Ismailia governorate.

The results of Table (1 and 2) cleared that, there was no relation between PH of the tested compounds and the attracted flies.

Based on the obtained results, it could be concluded that, efficiency of ammonium acetate and buminal traps to attract both males and females of *B. zonata* fly was improved after addition of vanilla essence and yellow food color and this may be useful in the control of this serious pest.

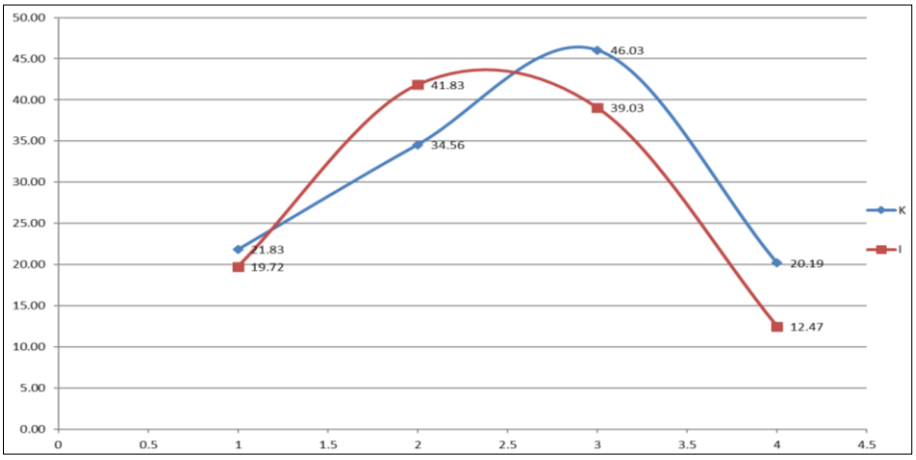

Fig (5): Mean number of *B. zonata* flies attracted at different intervals time of inspection at Kafer-El sheikh and Ismalia governorates

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