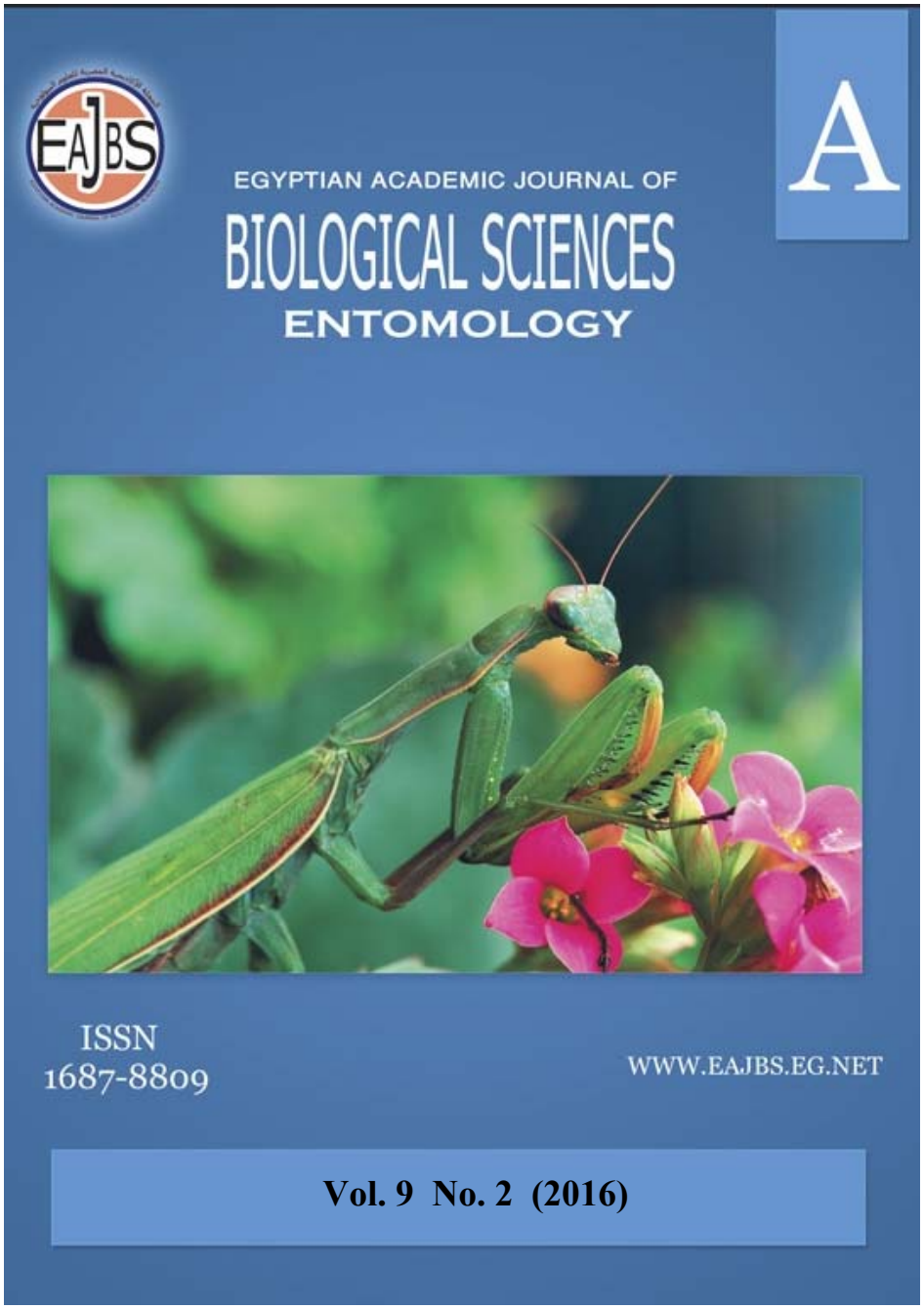

Egyptian Academic Journal of Biological Sciences is the official English language journal of the Egyptian Society for Biological Sciences, Department of Entomology, Faculty of Sciences Ain Shams University.
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www.eajbs.eg.net

Citation: *Egypt. Acad. J. Biolog. Sci. (A. Entomology) Vol.9 (2)pp. 97-105(2016)*

Egypt. Acad. J. Biolog. Sci., 9(2): 97– 105 (2016)

Egyptian Academic Journal of Biological Sciences
A. Entomology

ISSN 1687- 8809
www.eajbs.eg.net

Population Fluctuation of the Peach Fruit Fly, *Bactrocera zonata* (Saunders) (Diptera, tephritidae) on Different Mango Varieties in Ismailia Governorate, Egypt.

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ARTICLE INFO
Article History
Received:5/5/2016
Accepted:10/6/2015

Keywords:
population fluctuation, the peach fruit fly, *Bactrocera zonata,* Ismailia governoratem Egypt.

ABSTRACT

The population fluctuation of the peach fruit fly, *Bactrocera zonata* on some mango varieties (early mature "Hendy & Founs"; medium mature "Zebdia & Awyesy" and late mature "Fagrklan & Kent") were studied throughout two successive seasons 2013/2014 at Abosoyr district, Ismailia. *B. zonata* has (two peaks) on med of July &August and (one peak) at end of July in early mature mango variety during the two successive seasons, respectively. In medium mature mango variety there were three one peak at the beginning of August and two peaks at late of August and September during the two successive seasons, respectively. Meanwhile, in case of late-mature mango varieties only one peak at the beginning and end of October were recorded in the two successive seasons, respectively.

Statistical analysis of variance in 2013 /2014 season showed combined effect of the weather factors to the ripping stage of the fruit revealed EV were high significant as (88.09 and 78.64%), (86.06 and 86.30%) and (80.19 and 81.90%) on *B. zonata* population in the three tested varieties (early, moderate and late varieties) compared with the three weather factors separately. In addition, the simple correlation during the second seasons between the maximum temperature and CTD of *B. zonata* was positive significant in early variety. While the medium-mature mango varieties, was significant between the maximum temperature and CTD number of *B. zonata* in medium mature mango variety during the two successive seasons , while the minimum temperatures and CTD number of *B. zonata* were significant and high significant during the two successive seasons, respectively. On the other hand, the simple correlation during the two seasons between relative humidity all tested mango varieties was insignificant and However late mango variety were insignificant between the maximum and minimum temperatures and CTD number of *B. zonata* .

From here we can say that both physiological and biological factors of fruits flies as well as the maturity states of the three varieties of mangoes play an integral role in environmental factor with presence of the in the pests in Ismailia governorate

INTRODUCTION

Mangoes (*Mangifera indica* L.), is one of the most delicious tropical fruits having an outstanding flavor with a range of varieties as a member of the family Anacardiaceae. The total cultivated area of mango trees in Egypt reached 284036 Feddans (FAO, 2013). Mangoes have a good nutritional value having great variations in the form, size, color and quality of the fruits.

The fruit flies (Family : Tephritidae) are important group of insect pests of horticulture production throughout the world .Over 1500 fly species occur world wide of which 50 species are regarded as major pests and another 30 species are of minor economic importance .Different species of Family Tephritidae have been accidentally introduced into Egypt.

Dacine fruit flies are very economically important group of Diptera. There are approximately 700 known species of Dacine fruit flies, and the rate of discovery of new species suggests that there is over thousand species in total (Fletcher, 1987, Robison and Hooper, 1989). Four hundred species belonging to genus *Bactrocera* widely distributed in tropical Asia, South Pacific and Australia regions, but very few species of such genus were recorded in Africa (Drew and Hancock, 1994).

The peach fruit fly, *Bactrocera zonata* (Saunder) (Diptera: Tephritidae) is a new fruit pest attack wide range of fruit species in Egypt including mango, guava, peach, apricot, apple, citrus as well as some vegetable crops (Joomaye & Price, 2000 and White, 2000). This species has become widely spread in the country as well as C. *capitata*. Although, Efflatoun (1924) recorded *B. zonata* for first time in Egypt with few numbers. This new pest attracted the attentions of many authors in Egypt, *i.e.* Hashem *et al.* (2001), Afia (2007) and Amin (2008).

The aim of this work is to study population dynamics of *B. zonata* on mango trees for six different varieties under field conditions in Ismailia Governorate throughout the two successive seasons of 2013 and 2014.

MATERIALS AND METHODS

Seasonal abundance of the peach fruit fly, *B. zonata* as well as relationship between the population activity and the prevailing climatic factors were studied for two successive seasons (2013 and 2014) Abundance was based on trap catches in six mango varieties cultivated in the same orchards' (35 feddans early mature (Hendy & Founs) , 35 feddans medium-mature (Zebdia & Awyesy) and 35 feddans late-mature (Fegryklan & Kent) at Abosoyr district, Ismailia governorate. The trees of those different varieties were about 15-20 years old.

Fifteen Nadal traps mounted with 4 ml mixture of methyl eugenol (male sex attractant) 90% + sumithion 50% (Fenitrothion insectiside) at a ratio of 8:2 were randomly distributed in a mango orchards cultivated with three different varieties.

Five trap replicates were used for each variety for 19 week ,(early mango was second week of may till second week of September, medium mango was second week of June till third week of October and late mango variety was mid of August until fourth week of December) . Traps were hung at a shaded side of the tree at about 1.5-2 meters height and supplied with the above mixture every 4-6 weeks. Traps were inspected weekly during the two successive seasons (2013 / 2014) and trap catches were transferred to be captured per trap per day (CTD) in the three different mango varieties from May to December.

Statistical analysis:

To estimate relationship between population of *B. zonata* and prevailing climatic factors, day-maximum temperature (D. Max. T.), day minimum temperature (D.Min.T.) and daily mean relative humidity (D.M. R.H.) of Ismailia governorate were obtained from the Central Laboratory for Agriculture Meteorology, Agriculture Research Center, and Ministry of Agriculture. The daily records of each weather factor were calculated as weekly means presenting the previous one to sampling date. Weather factors were considered over 19 weeks for each crop (i.e early, mid and

late). This period included the ripping stage for each crop. Ripping of the fruits during this period was presented as plant age(X). These ripping stages were considered as biotic factor affecting the trapping of the flies. This variable was considered as non linear relation (polynomial of the fourth degree, $Y= a+b_1 X+b_2X^2+b_3X^3 + b_4X^4$). This was included in the multiple regression analysis. The results obtained of the total numbers of peach fruit fly and the population infestation percentages were statistically analyzed by using ANOVA Mean separation was conducted using L.S.D. in SAS program (SAS Institute, 1988).

RESULTS AND DISCUSSION

First season 2013:

Obtained results are illustrated in Fig. (1) Indicated that adults of *B. zonata* began to invade early-mature varieties on mid-May with few numbers of CTD was 0.249flies. These few numbers coinciding with the beginning of the ripping period and emigration of flies from intercropped hosts such as Valencia orange which are planted in large areas, then they increased gradually to show the highest peak on July 18th with mean numbers of CTD was 16.602 flies this increment may be due to the favorable weather conditions specially mean of maximum, minimum temperature and ripping stage which were 37.9 and 23.1°C, respectively, as well as relative humidity of 62.2%.This period coinciding with the fruit full ripping stage of early mango variety (Hendy).

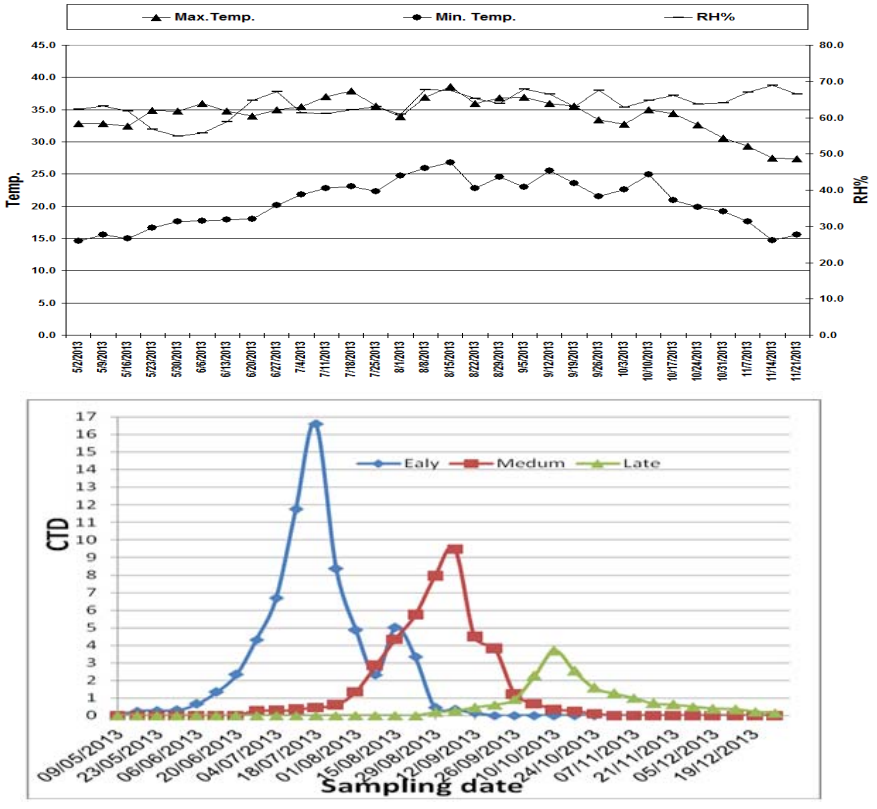

Fig. 1: CTD of attracted males the peach fruit fly, *Bactrocera zonata* (Saunders) on different mango varieties with corresponding means of main weather factors in Abosoyr, Ismailia Governorate during 2013 season.

The population density of the flies was gradually decreased with end of handy variety harvesting. Afterwards population increased gradually to form the second peak by CTD was 5.007 flies during mid of August. This increment may be attributed to the presence riped fruits from Founs variety and worm weather where when means of the maximum and minimum temperature were 38.6 and 26.8°C, and the relative humidity was 67.5% . After that, the population decreased gradually till end of September, 2013, which coinciding with the end of Founs variety harvesting.

Results in figure. 1 showed seasonal fluctuation of *B. zonata* followed the same trend on moderate - mature mango varieties, the population density began with few numbers and recorded 0.292flies on the 27th of June. Afterwards population density gradually increased and recorded only one peak of seasonal abundance on 5th of September, which represented by CTD was 9.471flies where the maximum and minimum temperature means were 36.9°C and 23.0°C, respectively, and relative humidity was 68.0%.This period was coinciding with improvement of weather factors as well as full ripping stage of moderate-mature mango variety (Zebdia & Awyesy). The population began to decrease gradually till late October with the end of moderate-mature mango varieties harvesting.

On the other hand, in late-mature mango varieties, the first incidence was occurred on the late of ultimate week of August with relatively high numbers of CTD was 0.199 flies, probably due to emigration flies from early intercropped such as early and moderate-mature mango varieties. Then, the population gradually increased to make the lowest peak of mango varieties at all in 2013 on October 10th with CTD was3.686 flies at maximum and minimum temperature 34.9 and 24.9°C respectively, as well relative humidity of 64.74% , after that the population decreased until the late of December ,with the end of late-mature mango varieties harvesting.

Second season (2014):

Data illustrated in Fig. (2) Revealed that the population density of PFF was less active and started lately on early-mature varieties with relativity low numbers CTD, was 0.143flies on 15th May, 2014. These low numbers in this locality were coinciding with lowest persistence of PFF population resulting from immigrated flies from intercropped such as Valencia orange which was harvested earlier. Then the mean population density increased gradually throughout successive inspections and recorded the only one peak of seasonal abundance, represented by CTD was 9.96 flies on 24th July. This increase may be due to the improvement of weather conditions, especially the maximum and minimum temperature which recorded 36.6 and 21.6°C, respectively, and the relative humidity of 62.3%, as well as early-mature varieties fruits (Hendy & Founs) were on full ripping stage. The population gradually decreased to completely disappear with the end of early-mature varieties harvesting.

In moderate-mature varieties the population density was nearly different than in 2013 season. Traps showed remarkable increase in population especially at the begging of infestation with relatively low numbers of CTD was 0264 flies on 26st of June, and then the population increased gradually forming two peaks. The 1st peak was in late August with CTD was 6.482 flies at maximum and minimum was 37.7, 23.3°C and relative humidity of 63.5%. This period was coinciding with improvement of weather conditions as well as full ripping stage of moderate-mature mango variety (Zebdia). Then the population density gradually decreased with end of Zebdia variety harvesting. Afterwards population increased gradually to form second peak by CTD was 4.241flies during mid-September. This increment may be attributed to the availability of fruit ripping stage of Awyesy variety and worm weather during the summer season where means of the maximum and minimum

temperature were 34.3and of 21.3°C, and the relative humidity was of 65.4%.After that, the population decreased gradually to reach CTD values 0.143flies on late October with the end of moderate-mature mango varieties harvesting.

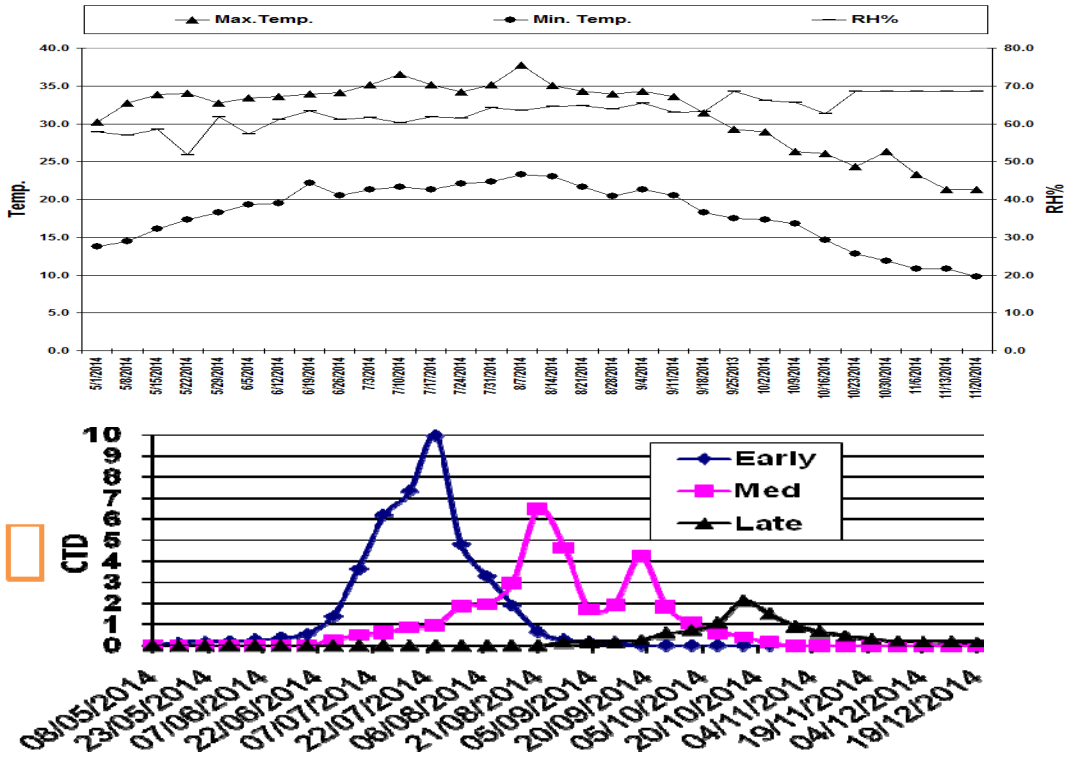

Fig. 2: CTD of attracted males the peach fruit fly, *Bactrocera zonata* (Saunders) on different mango varieties with corresponding means of main weather factors in Abosoyr, Ismailia Governorate during 2014 season.

On the other hand, in late-mature varieties the population density recorded one peak as obtained in 2013 seasons with few exceptions in population numbers. The infestation increased gradually to record the activity peak in the 16th October with CTD was 2.145 flies, where maximum temperature was 28.9°C and minimum temperature was 17.3°C as well as relative humidity was 66.2%, after that the population decreased to disappear completely on the late of December with the end of late-mature mango varieties harvesting.

These data agree with those obtained by Grewal and Kapoor (1987) and Khan and Khan (1987) who mentioned that *B. zonata* occurred from March to August (especially during the July-August summer monsoon) in pakistan also (Rana *et al.* 1992) mentioned that the activity of adult *B. zonata* males in Haryana India reached a peak from (July /August), which coincided with the maturity of guava fruits. Ishtiaq *et al*., (1999) in India observed a peak population of *B. zonata* for winter crop in September while ,negligibly in December. Mohammed (2003) In Egypt indicated that *B. zonata* adults were active all over the year except the period of cold weather and was also affected by availability of host fruit and weather factors changes .In addition, Khalid and Mishkatullah (2007) In pakistan monitored that *B. zonata* infected the fruits with low population level from November to February then increased from March to August. The population recorded one peak in July and August, while minimum level decline was observed in October depending on the host fruit maturity and prevailing temperature.

Results presented in Table (1) show that 1- Effect the weather factors: the

simple correlation between18 factors of different temperatures, relative humanity and CTD number. 5factors of 18 was positively significant, in Early mango variety between maximum temperature and CTD was (r=0.459)during second year.

Table 1: Simple correlation and regression values between the weather factors and the ripping stage of the fruit in relation with capture males trap daily(CTD) of the peach fruit fly, *Bactrocera zonata* (Saunders) on different mango varieties in Abosoyr, Ismailia Governorate during 2013/ 2014 season.

Crop	Year	Variable	Simple correlation		Partial regression				
			r	P	b	P	F	P	EV %
Early	2013	Temp. max.	0.455	0.050	1.049	0.302	1.47	0.2618	22.76
		Temp. min.	0.360	0.129	0.222	0.66			
		RH %	0.051	0.833	0.198	0.544			
		Plant (Age1-Age4)	-	-	-	-	8.07	0.0014	69.75
		Combined effect	-	-	-	-	11.62	0.003	88.09
	2014	Temp. max.	0.459	0.047	0.459	0.520			
		Temp. min.	0.421	0.072	0.361	0.436	1.63	0.2225	24.53
		RH %	0.171	0.418	-0.211	0.4948			
		Plant (Age1-ge4)	-	-	-	-	1.63	0.2225	24.53
		Combined effect	-	-	-	-	5.79	0.0053	78.64
Med	2013	Temp. max.	0.492	0.032	0.504	0.255	3.16	0.0558	38.7
		Temp. min.	0.458	0.048	0.321	0.332			
		RH %	0.392	0.096	0.383	0.137			
		Plant (Age1-Age4)	-	-	-	-	11.92	0.0002	77.3
		Combined effect	-	-	-	-	9.69	0.0006	86.06
	2014	Temp. max.	0.556	0.013	0.340	0.257	9.25	0.0010	64.92
		Temp. min.	0.662	0.002	0.297	0.433			
		RH %	0.219	0.365	0.402	0.010			
		Plant (Age1-ge4)	-	-	-	-	8.86	0.4333	55.71
		Combined effect	-	-	-	-	9.90	0.0006	86.30
Late	2013	Temp. max.	0.326	0.171	0.172	0.351	1.61	0.2297	24.32
		Temp. min.	0.387	0.101	0.235	0.279			
		RH %	-0.409	0.081	0.109	0441			
		Plant (Age1-Age4)	-	-	-	-	7.26	0.0022	67.47
		Combined effect	-	-	-	-	6.36	0.0036	80.19
	2014	Temp. max.	0.037	0.878	-0.112	0.307	0.45	0.7190	8.31
		Temp. min.	0.092	0.705	0.131	0.339			
		RH %	-0.121	0.618	-0.033	0.729			
		Plant (Age1-Age4)	-	-	-	-	9.38	0.0007	72.84
		Combined effect	-	-	-	-	7.11	0.0023	81.90

In Medium mango varieties the simple correlation between different temperatures and CTD were (r=0.492and r=0.458) during first year respectively., while the simple correlation between maximum and minimum temperatures and CTD number were significant and high significant (r=0.556 and r=0.662) during second seasons respectively. The combined effect of three weather factors and CTD number were not significant in 5 of 6 cases. The percentage of explained variance was 64.92%, in medium mango variety. The variance ratio value was high significant (9.25). 2- Effect the plant stage, results of statistical analysis during 2013 season add the effect weather factors to the ripping stage of the fruit revealed EV as 69.75%, 77.3% and 67.47 % at Early, Moderate and Late mango, respectively. These values were high significant, while the second year the EV was 72.84 % at Late mango variety, These value was high significant . 3- Effect the combine effect , the result revealed that the statistical analysis during 2013 and 2014 seasons revealed that the combine effect of three weather factors and the ripping stage of the fruit were responsible, The percentages of explained variance were(88.09%, 78.64%), (86.06 and 86.30%) and (80.19and 81.90%) at Early, Moderate and Late mango, respectively. These values were high significant.

From the abovementioned discussion it could be stated that the changes population densities of *B. zonata* at the three mango varieties in Ismailia Governorate were mostly related to the simultaneous effects of the all factors selected (three weather factors, CTD and the ripping stage of the fruit) than the single effect of each factor separately. The percentages of explained variance were highly significant during two seasons at the three mango varieties. The remaining unexplained variance were assumed to be due to the influence of other inconsiderable factors (biological, environ-mental, blooming and fruiting stages of the hosts and ripping stage of the fruit).

These data are in agreement with those obtained by Manrakhan and Price (2000) In India stated that fruit availability and temperature had significant effects on *B. zonata* populations on mango production. Amin (2008) In Egypt found that the weather factors were apparent during periods of critical temperature, particularly during winter months in which population of *B. zonata* reduced to its minimal numbers. Also during summer months, the peach fruit fly was found to be adversely by such temperature increasing over optimal range (30°C). Monira *et al.* (2016). In Egypt studied plant age and some weather factors on *Aphis gossypii* population on four some vegetables, they found the effect weather factors are firstly affect the plant growth which makes the plant more palatable for infestation, so plant phenology as plant age took over the effect weather factors mathematically.

However **Afia (2007)** found that the weather factors were not the main driver for the population dynamics of fruit flies in different corps at three governorates and for sure, weather factors are main players (with other environmental and agricultural procedures) in providing appropriate stage of host for fruit flies (*ie* mature or near mature fruits) but it might not be the main controller for fruit flies population dynamics. Thus, the availability of alternate fruit host and appropriate host stage for infestation are limiting factors for pest abundance.

Results in Table (2) summarizes the results obtained of seasonal fluctuation of *B. zonata* on six mango varieties represented by total numbers of males / season captured by Nadel traps baited with ME at Abosoyr district, Ismailia governorate during two successive seasons.

Table 2: Total numbers of peach fruit fly and the population percentages in three mango orchards of differently-mature varieties in Abosoyer, Ismailia governorate during 2013 and 2014 seasons.

Variety	Total No of *B.Z* in 1st season	% Population on 1st season	Total No of *B.Z* in 2nd season	% Population on 2nd season
Early mango	69.27 [a]	52.728 [a]	41.652 [a]	49.0 [a]
Moderate mango	44. 409 [b]	33. 804 [b]	33.238 [b]	39.10 [b]
Late mango	17.693 [c]	13.468 [c]	10.113 [c]	11.90 [c]
Total No.	131.372	100	85.003	100
F value	155.74***	34.29***	167.41***	41.77***
LSD at 0.05	14.17	7.54	6.17	4.95

These results revealed that population density of *B. zonata* at different varieties was more abundant during the first season than the second where (131.372) and (85.003) males /season, were recorded, respectively. The total numbers of males' early-mature mango was the highest numbers 69.27and 41.652 males /seasons representing 52.728 and 49.0% of total captured males, during the first and second seasons, respectively. Moderate and late mature mango varieties came in the second and third place in this order with totals of males (44.409 &33.328) and (17.693 &10.113) representing (33.804 and 39.10%) and (13.468 &11.90%) during the first and second seasons, respectively. Statistical analysis of variance showed high

significant differences in the total No. of captured flies among mango varieties classified according to time of maturation (F = 155.74 and 167.41) and (34.29 and41.77) and L.S.D. at 0.05 = 14.17and 6.17) (7.54and 4.95) throughout the both seasons.

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ARABIC SUMMERY

تذبذب تعداد بذبابة ثمار الخوخ علي أصناف المانجو المختلفة في محافظة الإسماعيلية

سهام محمد المهدي – يسري اسماعيل عافية
معهد بحوث وقاية النباتات - مركز البحوث الزراعية- الدقي – الجيزة – 12618 مصر

تم دراسة التوزيع الموسمى لذبابة الخوخ علي مجموعة أصناف من المانجو "هندي و فونس" كأصناف مبكرة النضج وأصناف "زبدية و عويسي" متوسطة النضج والأصناف "فجركلان و كنت" متأخرة النضج لمدة عامين متتالين (2014/2013) فى مركز ابو صوير بمحافظة الأسماعلية . خلال موسمى الدراسة تم رصد قمتين نشاط لذبابة الخوخ في منتصف يوليووأغسطس وقمة نشاط واحدة فى نهاية يوليوعلى صنفي المانجو المبكرة على التوالى ، على العكس تم رصد قمة نشاط واحدة فى بداية أغسطس وقمتين نشاط أواخر أغسطس وسبتمبرللأصناف المتوسطة النضج على التوالى ، علي الجانب الآخر، وفى حالة صنفي المانجو متأخرة النضج كان للحشرة قمة نشاط واحدة فى كلا العامين في بداية ونهاية أكتوبر على التوالى.

أثبت التحليل الإحصائي لموسم الدراسة ان هناك تاثير عالية المعنوية بين تعداد الذباب وفترة نضج الثمار والعوامل الجوية الثلاثة بين الأصناف المبكرة والمتوسطة و المتأخرة النضج (88.09&78.64%) و(86.06&30.86%)و(80.19&81.90%) على التوالى .

كذلك كان الإرتباط البسيط خلال العام الثانى بين تعداد الذباب ودرجات الحرارة العظمي معنويا فى الأصناف المبكرة واما بالنسبة المتوسطة النضج بينما كان هناك إرتباط معنوي بين التعدادالذباب ودرجات الحرا رة العظمى خلال العامين ودرجة الحرارة الصغرى فى الاصناف المتوسطة النضج كانت معنوية وعالية المعنوية خلال العامين على التالى اما الرطوبة النسبية للأصناف المبكرة والمتوسطة والمتاخرة النضج هناك ارتباط غير معتوى بين تعداد الذباب ودرجات الحرارة بينما يوجد أرتباط غير معنويا لتعداد الذباب ودرجتى الحرارة العظمى و الصغرى للأصناف المتاخرة النضج فى كلا العامين.

بدراسة تذبذب التعداد أثبتت الدراسة أن صنفي المانجو المبكرة أكثر الأصناف مهاجمة بذبابة ثمار الخوخ في حين كان صنفي المانجو متوسطة النضج كانت الإصابة متوسطة بينما كانت قليلة لحد ما لصنفي المانجو متأخرة النضج وأن تعداد ذبابة الخوخ فى السنة الأولى أعلى بكثير من السنة الثانية.

من هنا يمكن القول أن كلا العوامل الفسيولوجية والبيولوجية لذبابة الخوخ وكذا العوامل الزراعية لأصناف المانجو الثلاثة تلعب دورا مكملا للظرروف البيئية فى تواجد الأفة فى مركز ابوصويرفى محافظة الأسماعلية