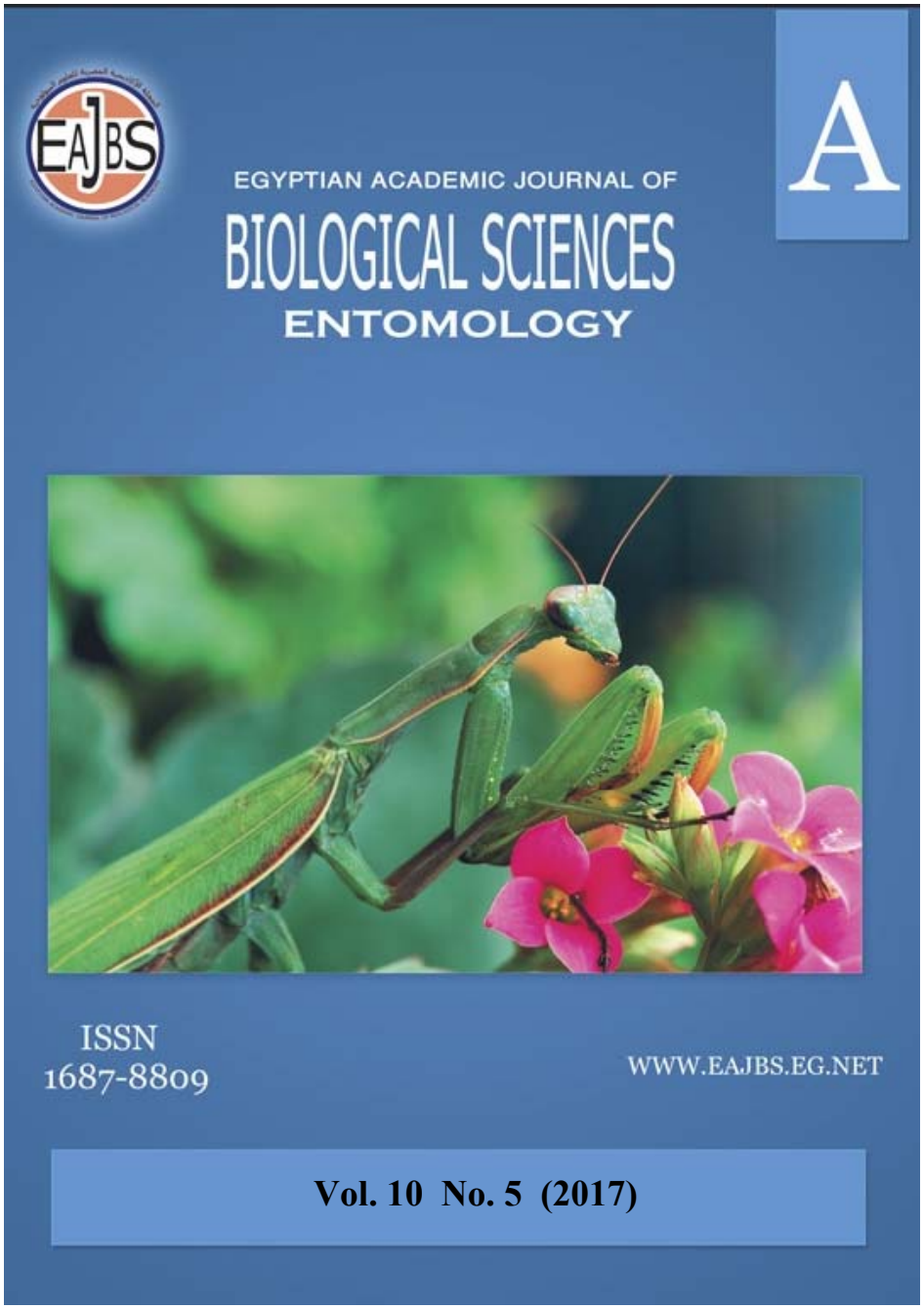

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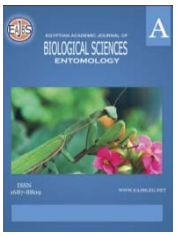

Infestation Level of Mango Varieties with Fruit Flies at Ismalia Governorate, Egypt

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ABSTRACT

The infestation level with the peach fruit fly (PFF), *Bacterocera zonata* and the Mediterranean fruit fly (MFF), *Ceratitis capitata* on different mango varieties (early mature "Hendy & Founs", moderate mature "Zebdia & Awyesy" and late mature varieties "Fagrklan & Kent") were studied at Abosoyr district, Ismailia governorate, during two successive seasons (2014 and 2015). Results indicated that the percent of infestation with *B. zonata* in early mango varieties "Hendy & Founs" and moderate mango varieties "Zebdia & Awyesy" was high, while it was low in late mango varieties "Fagrklan & Kent" during the two successive seasons. Total numbers of natural fallen fruits in early mango varieties "Hendy & Founs" were more than the other varieties (moderate and late mature varieties) during the two successive seasons (2014 & 2015). Also, the average numbers of infested fallen fruits in early mango varieties "Hendy & Founs" were more than that of the other varieties (moderate and late mature varieties) during the two successive seasons (2014 & 2015). The percentage of infestation descendingly arranged according to different reasons such as susceptibility of variety to infestation as follows: early mature, moderate mature and late mature varieties during the two successive seasons, respectively. The percentages of infestation with *B. zonata* were (95.8 & 93.0), (90.3 & 88.1) and (85.6 &76%). While, that recorded by *C. capitata* were (4.2 & 7.0), (9.7 & 11.9) and (14.4 & 23.2%) for the three tested varieties (early, moderate and late varieties) during the two successive seasons, respectively. Statistical analysis showed significant and high significant differences between the percentages of infestation by *B. zonata* and *C. capitata* of the three tested varieties (early, moderate and late varieties) during the two successive seasons. The weather factors (max. and min. temperatures as well as relative humidity) affected % infestation of fallen fruits of mango trees with *B. zonata* and *C. capitata* during the two successive seasons (2014 & 2015). During first season, fruit infestation was positively significant with min. temp. and relative humidity for early and moderate varieties. While, during the second season, infestation of early varieties was positively significant for max. temp. But, it was significantly negative for relative humidity. Infestation of moderate mango variety positively and significantly correlated with max. temp. Therefore, the late mango varieties were insignificantly affected with weather factors during the two successive seasons.

INTRODUCTION

Mango (*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). Mango have a good nutritional value having great variations in the form, size, color, and quality of the fruits.

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. 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 Mediterranean fruit fly or Medfly, *Ceratitis capitata* (Wiedemann), originates in the Mediterranean region of Europe and North Africa. It attacks more than 260 different fruits, vegetables, and nuts. Host preferences vary in different regions. An extensive host list is provided by Weems (1981). The peach fruit fly, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae) is a new fruit insect pest which attacks wide range of fruit species in Egypt including mango, guava, peach, apricot, apple, citrus as well as some vegetable crops (Joomaye & Price, 2000; White, 2000). This species has widely spread in the country as well as *C. capitata*. 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). It was recorded on more than 50 cultivated and wild plant species, mainly those with fleshy fruits (EPPO, 2005). *B. zonata* has become a widespread pest in Egypt (EPPO, 2002). According to EPPO (2005) and Ghanim (2009), *B. zonata* could out compete other Tephritid fruit fly species such as *Ceratitis capitata*.

The aim of this work is to study infestation level of different mango varieties with *B. zonata* and *C. capitata* under field conditions at Ismailia governorate throughout the two successive seasons of 2014 and 2015.

MATERIALS AND METHODS

Fruit Infestation with Both *B. zonata* and *C. capitata* on Mango Varieties at Ismailia Governorate:

Location and varieties Mango fruit infestation with both *B. zonata* (PFF) and *C. capitata* (MFF) were recorded during two successive seasons (2014 and 2015) on six species of mango varieties divided to three categories; early mature "Hendy & Founs", moderate mature "Zebdia & Awyesy" and late mature varieties "Fagrklane & Kent" collected from three orchards at Abosoyr district, in Ismailia governorate. Three mango trees (more than 25 years old) of each variety as replicates were chosen.

Fruit Samples:

The fruit infestation with MFF and PFF in each of the different mango varieties was estimated. Three trees (representing every mango variety) were selected. Total number of fruits on every selected tree was recorded. Samples of fallen fruits for each variety were weekly collected in a cloth bag, transferred to Plant Protection

Research Institute (PPRI) at Giza governorate, weighed, and individually incubated in plastic jar (15cm Radius ×25cm highest) for 5 days. Fruits produced pupae were considered infested furnished with sterilized sand for pupation. Formed pupae were collected, counted and reserved in a clean plastic tube until emergence. The emerged flies were identified to MFF and PFF. Also, the percentages of infestation in each fruit varieties with the two flies (MFF & PFF) were estimated according to the total number of fruits as well as number of fallen fruits.

Statistical Analysis:

To estimate relationship between the percentage of infestation of fallen fruits and fruits on trees with *C. capitata* and *B. zonata* and prevailing climatic factors, data of day-maximum temperature (D.Max.T.), day minimum temperature (D.Min.T.), and daily mean relative humidity (D.M.R.H.) at Ismailia governorate were obtained from the Central Laboratory for Agriculture Meteorology, Agriculture Research Center. The daily records of each weather factor were calculated as means of weeks coinciding the sampling date. Weather factors were considered over 15 weeks for each crop (i.e early, mid and late). This period included the fallen fruits for each crop. The obtained results were statistically analyzed using ANOVA and L.S.D. The simple correlation (r) and regression coefficient value (b) were adopted to clarify the change in infestation due to change in each of weather factors and the mean values compared to the least significant differences according to SAS program (SAS Institute, 1988).

RESULTS AND DISCUSSION

Level of Mango Fruits Infestation with Fruit Flies during Two Years:

Data in Table (1) indicate the level of infestation of different Mango varieties with both *B. zonata* and *C. capitata* during the two successive seasons of 2014 and 2015. The average number of fallen fruits/tree was the highest (102 and 55 fruits) for early varieties during 2014 and 2015 seasons, respectively. While, it was the lowest (17 and 10 fruits) for late varieties. The average number of infested fallen fruits was 96, 44, & 14 and 50, 28, & 8 for early, moderate, and late varieties during the first and second seasons, respectively. The percentages of infestation were (92.1 and 88.4%), (87.1 and 81.0%), and (77.0 and 70.2%) during the successive seasons for early, moderate, and late varieties, respectively. The infestation level differently varied according to mango variety, where the early varieties recorded the highest level of infestation, whereas the late varieties recorded the lowest one. The degree of infestation was more in the first season than that of the second one. The recovery of fruit was assessed as average number of pupae/kg of fruits which 279.0, 177.9 & 69.9 and 185.9, 96.6 & 36.6 for the three tested varieties during 2014 and 2015 seasons, respectively. Also, the average numbers of emerged flies were (255.3, 162.8), (153.0 , 80.4) and (57.9 , 28.3) flies during the two seasons of investigation the percentage of emergence 90.2,86.6, 83.5,80.2 and 79.6,72.9% for early, moderate and late varieties, respectively. The emerged flies were sorted showing higher average number of peach fruit fly 246.8, 139.3& 49.9 and 152.0 , 71.4 & 22.8 than that of 8.5, 13.8 & 8.7 and 10.8 , 9.0 & 5.5 flies of Mediterranean fruit fly for early, moderate and late varieties during 2014 and 2015 seasons, respectively. The level of infestation with *B.zonata* was significantly higher than that of *C. capitata*, where the percentages of emerged flies of the two species were 95.8, 90.3 & 85.6% (for *B*

.*zonata*) and 4.2, 9.7 & 14.4% (for *C. capitata*) during the first season on the three tested varieties . The same trend was obtained during the second season.

From the previous results the percentages of infestation of fallen fruits are very important in case re-infestation of the mango fruits in the three varieties (early, moderate, and late), therefore, these fallen fruits should be collected to prevent fruits' re-infestation.

There was no big differences in the percentages of infestation of fallen fruits between the three varieties (early, moderate and late varieties) in the 1st season (2014) and 2nd season (2015), respectively (Table 1). Statistical analysis in Table (1) shows significant differences of the percentages of infestation by PFF between the three tested varieties (early, moderate, and late varieties) (F = 215.0 and L.S.D. 0.05 = 1.15) and (F = 64.37 and L.S.D. 0.05 = 3.4539) in the two season. On the other hand, statistical analysis shows high significant differences of the percentages of infestation by MFF between the three tested varieties (early, moderate and late varieties) (F = 339.69 and L.S.D. 0.05 = 0.9135) and (F = 564.74 and L.S.D. 0.05 = 1.1522) during 2014 and 2015, respectively.

Table (1):Average infestation percentages of the fruit fly, *Ceratitis capitata* and the fly, *Bacterocera zonata* on mango fruits varieties at Ismailia Governorate during 2014 and 2015 seasons.

Year	Variety	Average N. of natural fallen fruits/tree	Average N. of infested fallen fruits/tree	%Infest. fallen fruits	Ave N. of pupae/ kg fruits	Ave No. of emerged flies	Emergence %	Average No. of adult PFF	Avenge No. of adult MFF	% PFF	% MFF
2014	Early	102	96	92.1	279.0	255.3	90.2	246.8	8.5	95.8[a]	4.2
	Moderate	50	44	87.1	177.9	153.0	83.5	139.3	13.8	90.3[b]	9.7
	Late	17	14	77.0	69.9	57.9	79.6	49.9	8.0	85.6[c]	14.4
	F value	-	-	-	-	-	-	-	-	215.0**	339.69***
	$LSD_{0.05}$	-	-	-	-	-	-	-	-	1.15	0.9135
2015	Early	55	50	88.4	185.9	162.8	86.6	152.0	10.8	93.0	7.0
	Moderate	33	28	81.0	96.6	80.4	80.2	71.4	9.0	88.1	11.9
	Late	10	8	70.2	36.6	28.3	72.9	22.8	5.5	76.8	23.2
	F value	-	-	-	-	-	-	-	-	64.37**	564.74***
	$LSD_{0.05}$	-	-	-	-	-	-	-	-	3.4539	1.1522

The results illustrated in Figures (1&2) show that the percentage of infested fallen fruits on trees in early variety increased during beginning of August 2014 and 3rd July 2015 (98.3 and 97.9%) decreased before and after this time, respectively, while in case moderate variety reached (95.3 and 95.1%) on late and mid-August during two season, respectively. Whereas in late variety reached 87.2 and 92.9% during mid-October and last September during 2014 and 2015, respectively. The test host plants exhibited variable infestation predispositions. Antibiosis phenomenon as one of the host plant resistance factors could be responsible for these variations. In this approach, the relation between the number of mature fruits available on trees and *C. capitata* infestation was studied by Eskafi and Kolbem (1990). Also, Tsitsipis (1992) reported that host fruit had an important role in the development of fruit flies. Bodenheimer (1951) found that the percentage of infestation on apricot was 100% in May. The early maturing plum was only slightly infested (3%) in July, whereas 30%

of the later varieties. Also, Saafan *et al.*, (2005) found that *C. capitata* was very low compared to *B. zonata* in apricot orchards in Fayoum Governorate during 2002-2004. Amin (2008) found that the infestation rate of both fruit flies were recorded in July and the highest percentage of infestation was recorded in August, and all emerged flies of collected fruits were belonging to *B. zonata.*

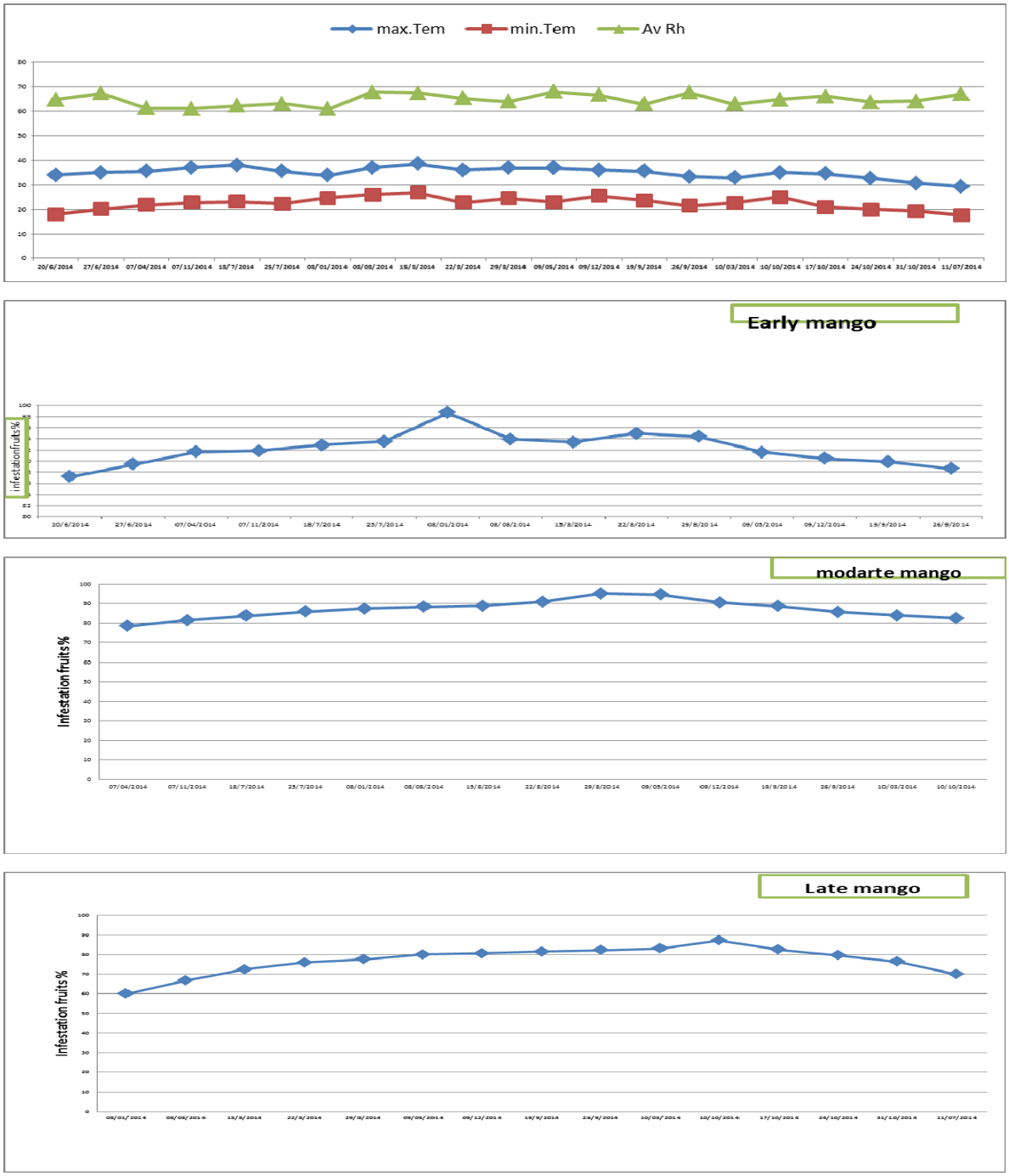

Fig. (1): Percentage of infestation of fallen fruits recorded on different stages of mango fruits with corresponding means of main weather factors at Ismailia governorate during 2014 season.

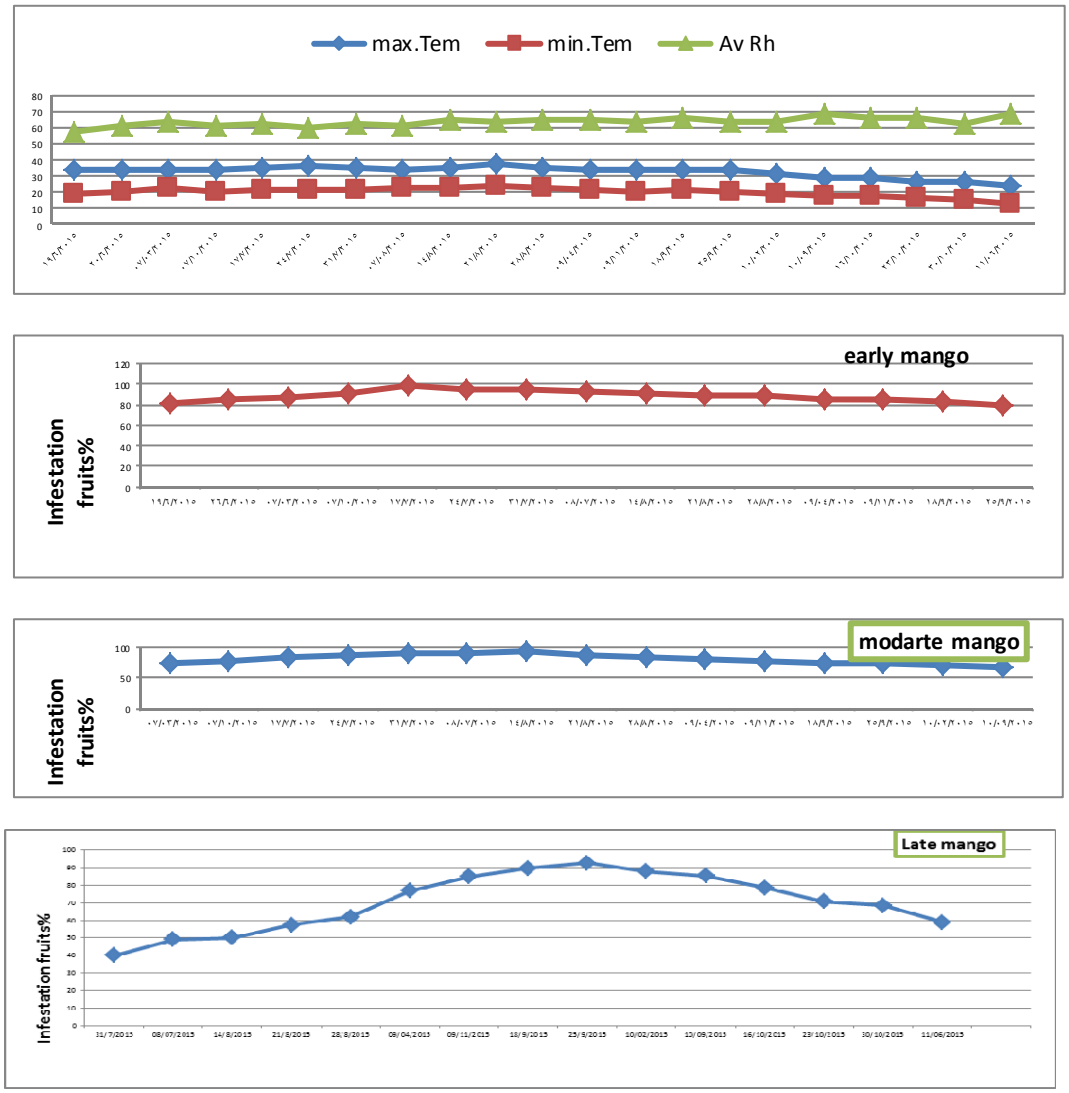

Fig. (2): Percentage of infestation of fallen fruits recorded on different stages of mango fruits with corresponding means of main weather factors at Ismailia governorate during 2015 season.

Effect of Weather Factors:

Results presented in Table (2) show the effect of weather factors (max., min. temperature, and relative humidity) on %infestation of fallen fruits of mango trees with *B. zonata* and *C. capitate* during two successive seasons (2014 & 2015).

In early mango, data in Table (2) show that the simple and correlation between %infestation of fallen fruits of mango and max., min. temperature and relative humidity were positive significant with min. temperature (r = 0.611) and positive and negative no significant with max . temp and relative humidity, in early mango, while in moderate mango, varieties were positive significant with relative humidity (r = 0.553) and no significant positive with max., min. temperature, respectively. In late mango, the max. and min. temperatures and relative humidity were no significant during 2014 season. During 2015, results presented in Table (2) show that the simple and correlation between %infestation of fallen fruits of mango and max., min. temperature, and relative humidity in early mango were positive and

negative significant with max. temperature and relative humidity were (r= 0.557 and r=-0141), respectively. While moderate mango , the max. temperature was positive significant (r=0.558), while min. temperature and relative humidity were no significant. In late mango, the max. and min. temperature and relative humidity were no significant during 2015 season.

Table 2 : Simple correlation and regression values between weather factors and %infestation of fallen fruits and %infestation of fruits on mango trees after infestation with the fruit fly, *Ceratitis capitata* and the peach fly, *Bacterocera zonata* on different stages of mango fruits during 2014 and 2015 seasons.

Variable			Simple correlation "r"	Simple regression "b"	Probability "P"
Early mango 2014	%infestation of fallen fruits	Max. Temp	0.270045	0.1395	0.330358
		Min. Temp.	0.611401	0.4814	0.015445
		R.H. %	-0.32917	0.3027	0.230904
Moderate mango 2014	%infestation of fallen fruits	Max. Temp	0.280209	0.098	0.311754
		Min. Temp.	0.373359	0.1265	0.170453
		R.H. %	0.553362	0.3055	0.032366
Late mango 2014	%infestation of fallen fruits	Max. Temp	0.019857	0.007	0.944002
		Min. Temp.	-0.127391	0.0473	0.650959
		R.H. %	0.099568	0.0299	0.724051
Early mango 2015	%infestation of fallen fruits	Max. Temp	0.557108	0.1218	0.030974
		Min. Temp.	0.419631	0.0896	0.119439
		R.H. %	-0.14116	0.0548	0.037432
Moderate mango 2015	%infestation of fallen fruits	Max. Temp	0.557108	0.122	0.03097
		Min. Temp.	0.419631	0.0896	0.1194
		R.H. %	-0.14116	0.0548	0.6158
Late mango 2015	%infestation of fallen fruits	Max. Temp	-0.17376	0.0421	0.535696
		Min. Temp.	-0.1974	0.0376	0.480616
		R.H. %	0.298306	0.0378	0.280172

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ARABIC SUMMARY

مستوى الإصابة بذباب الفاكهة فى أصناف المانجو المختلفة

بمحافظة الإسماعيلية ـ مصر

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

تم دراسة مستوى الإصابة بكل من ذبابة الخوخ وذبابة الفاكهه فى أصناف المانجو المختلفة وهي المانجو المبكرة "هندي وفونس" وأصناف المانجو متوسطة النضج "زبدية وعويسي" وصنفي المانجو متأخرة النضج "فجركلان وكنت" خلال موسمي 2014 و2015 في محافظة الإسماعيلية. أثبتت النتائج أن صنفي المانجو المبكرة "فونس وهندي" أكثر الأصناف مهاجمة بذبابة ثمار الخوخ خلال موسمي 2014 و2015 في حين كان صنفي المانجو متوسطة النضج "زبدية وعويسي" كانت الإصابة متوسطة بينما كانت قليلة لحد ما بالنسبة صنفي المانجو متأخرة النضج "فجركلان وكنت" كانت مستوى الإصابة بذبابة الفاكهة كانت قليلة خلال موسمي الدراسة وكانت الاكثر إصابة بذبابة الفاكهة لصنفي المانجو متأخرة النضج "فجركلان وكنت". أثبتت النتائج أن متوسط التساقط الطبيعي لثمار المانجو كان أكثر في صنفي المانجو المبكرة عن صنفي المانجو متوسطة النضج وصنفي المانجو متأخرة النضج. علي الجانب الآخر، وجد أن متوسط نسبة إلاصابة الثمار المتساقطة طبيعيا بذبابه الخوخ كان أكثر في صنفي المانجوالمبكر(95.8&93%) وعنها فى صنفى المانجو متوسطة النضج(90.3.&88.1%) و متأخرة النضج(85.60&76.8 %) اما بالنسبة لذبابة الفاكهة كانت النسبة الاصابة فى صنف مانجوالمبكر(4.2&7.0%) وعنها فى صنفى المانجو متوسطة النضج(9.7& 11.9%) و متأخرة النضج(14.4&23.2%) على التوالى خلال العامين يمكن ترتيب متوسط إصابة الثمار المتواجدة علي الأشجار كالتالي: صنفي المانجو المبكرة ثم صنفي المانجو متوسطة النضج ثم صنفي المانجو متأخرة النضج ،علي التوالى .

أثبت التحليل الإحصائي وجود اختلافات عاليه معنوية بين نسبة الإصابة بنوعي ذبابه الخوخ بين الأصناف المبكرة والمتوسطة والمتأخرة النضج. كذلك وجد علاقة بين الظروف المناخية ونسبة إصابة الثمار المتساقطة طبيعيا بذباب الثمار كانت فى السنة الاولى كانت موجبه ومعنوية لدرجة الحرارة الصغرى والرطوبة النسبية بالنسبه لمانجو المبكر النضج والمانجو متوسط النضج على التوالى. أما السنة الثانية فكانت تاثيرها موجبة ومعنوية لدرجة الحرارة العظمى وبينما الرطوبة كانت سالبه معنوية لصنف المبكر النضج وبالنسبة لصنف المتوسط النضج كانت تاثير موجبة ومعنوية لدرجة الحرارة العظمى اما لصنف المتاخر النضج ليس للعوامل الجوية اى تاثير على نسبه الاصابة بالثمار المتساقطة خلال موسمي 2014 و2015.