Survey and Abundance of Major Insect Pests on Pomegranate Fruits in Egypt

Abazaid, M.A.A[2].; Shalaby, F.F[1].; Hafez,A.A[1].and Ewaise,M.A[2].
[1]Faculty of Agricultural, Benha University, Egypt.
[2]Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.
Corresponding Author: mohamad_latief@yahoo.com

Abstract

The presented study was carried out to survey and evaluate the abundance of common pomegranate insect pests during 2016 and 2017in Egypt. Four pomegranate varieties in pomegranate orchards were studied. Three insect species were recorded on pomegranate fruit included the pomegranate butterfly, *Virachola livia* (Klug) (Lepidoptera: Lycaenidae), which was the most important followed by *Bactrocera zonata* and *Ceratitis capitata* (Diptera: Tephritidae).

Keywords: pomegranate, survey, *Virachola livia***,** *Bactrocera zonata* & *Ceratitis capitata***,** Egypt.

Introduction

Pomegranate is one of the oldest known edible fruits. For thousands of years, many cultures have believed that pomegranate have beneficialy effects on health, fertility, longevity and rebirth. It has , also, therapeutic activity such as antiparasitic, antimicrobial, antioxidant, anticarcinogenic and antiinflammatory effects. These beneficial effects were attributed to the antioxidative properties of pomegranate phenolic compounds, tannins and anthocyanins **(Arzu *et al.*, 2012).**

The pomegranate tree adapts well to a wide range of climates and soil conditions. For a good yield of high-quality fruits, pomegranate trees need hot dry weather, it is also very suitable in the reclaimed lands **(Mohamed, 2005). (Anonymus, January 2018)** reported that pomegranate was cultivated in about 85415 feddans in Egypt, for the growing season of 2016 producing about 269070 tons of fruits, and exporting of 151138 tons . One of the main reasons for the reduction of pomegranate production is the infestation by different pests particularly the pomegranate fruit butterfly , *Virachola livia* Klug. It is the most destructive and potentially chronic pest that attacks pomegranate making holes and bores in the fruits feeding on the berries, attracting other insects and fungi to attack the fruits . The percentage of infestation by *Virachola* sp. may reach over 50 %**(Balikai *et al.*, 2009).** Infestation by *V. livia* makes the pomegranate fruits unaccepted for consumers, and consequently loses its marketable value. So, many growers in Egypt changed their activity to other crops, because of the virulence of *V. livia* infestations.

Mcadams (2011) reported that grape mealybug, *Pseudoccus maritimus* , black scale, *Saissetia oleae*, the ash whitefly, *Siphoninus phillyreae*, the pomegranate butterfly, *Virachola livia* and the Mediterranean fruit fly, *Ceratits capitata* were the most common pests on pomegranate. Also **(Demiref *et al.*, 2018)** revealed that *C. capitata* is a serious pest on pomegranate fruits in Turkey. Also, the citrus small fruit fly, *Bactrocera dorsalis* was reported as a pest attacking jujube, pear, persimmon and pomegranate **(Yang *et al.*, 2009).**

Elsayed and Bazaid , (2011) observed, that pomegranate fruits are attacked by *Virachola livia*, during the period of pomegranate production (May to October), in Taif , Saudi Arabia.

Cayol *et al.*, (1997) reported that wild population of *C. capitata* was built up on pomegranate cultivations in Tozeur, Tunisia in October 1994. Also, **(Kasap and Aslan, 2016)** found that the highest counts of *C. capitata* adults in traps of pomegranate varieties occurred in October , November and September. While **(El-Shiblawi and Saleh, 2014)** found that the highest intensity of *C. capitata* adult males (45 Males/trap/week), were captured in mid-September, and the best height to put traps on pomegranate trees was at 180 height cm from soil surface .

The aim of this study was to survey the relatively most common pomegranate insect species, as well estimating their population abundance and infestation rates in some pomegranate orchards at Giza Governorate, Egypt.

Materials and Methods

The present study was carried out in pomegranate orchard located in the research farm of Horticulture Research Institute, ARC at Giza Governorate during two successive pomegranate seasons 2016 and 2017, Survey & population dynamics of major pomegranate insect pests, effect of certain weather factors on the population fluctuations of the pests and relative susceptibility of certain pomegranate varieties to infestation by these insect pests were studied.

Experimental area.

Eight trees from each of the four pomegranate varieties; Manfaloty, (the most widespread local variety), H116 (early variety for exportation), H118 (promising variety for export) and wonderful (the most common variety in the reclaimed lands), were determined for studying the relative susceptibility to infestation by the insect pests. The normal agricultural

practices were followed regularly without any insecticidal treatment throughout the period of investigation.

1. Survey and population dynamics of common pomegranate insect pests that infested fruits.

Sampling technique

Inspection of fruit samples was conducted weekly from March, to December in 2016 & 2017. A total of 70 pomegranate fruits of each variety were directly inspected on 8 trees. The inspected fruits were chosen on 5 branches / tree represented the main four directions and the central core of each tree. i.e. (40 branches / 8 trees) / variety. The fruits of the 5 branches / tree were carefully examined for any sign of infestation by insect pests

Also, 20 infested fruits from each variety were collected, transferred to the laboratory and kept in boxes for surveying the major insect pest species which emerged to adults from the fruits during the two successive seasons 2016 and 2017. The emerged insect adults were transferred for identification in the Insect Identification Unit in the Plant Protection Research Institute.

2- Percentage of infestation

To determine the rate of infestation with *V. livia*, weekly samples of 70 fruits on the 5 branches / tree of the four pomegranate varieties under study were inspected directly on trees in the field and numbers of the *V. livia* eggs were counted. On the other hand, to determine the rate of infestation with *Bactrocera zonata* Saunders and *Ceratitis capitata* Wiedemann , weekly samples of 70 fruits on the 5 branches / tree / variety were inspected directly in the field and the infested fruits (Fig.4) were counted . The percentages of infested fruits were calculated according the following formula.

Percentage of infested fruits (infestation incidence) = $\frac{\text{No. of infested fruits}}{\text{No. of examined fruits}} \times 100$

3. Effect of certain weather factors on the population fluctuations of major pomegranate insect pests

The seasonal fluctuations of the pomegranate insect pests, in relation to two main weather factors [temperature (°C) and relative humidity (R.H %)] were estimated. The weather factors were obtained from the Central Lab. for Agricultural Climate at A.R.C.

The simple correlation coefficient values were calculated, between each of the above mentioned factors on one hand and the weekly numbers of pomegranate insect species on the other hand.

Results and Discussion

Data showed that there were 3 major insect pest species, the most destructive and potentially chronic pests that attacks pomegranate fruits causing high loss, included one lepidopteran, *Virachola livia* Klug (Lycaenidae) and two dipteran Tephritidae , *Bactrocera zonata* Saunders and *Ceratitis capitata* Wiedemann (Table 1).

Table 1. Survey of major pomegranate fruit insect pest species in the two successive seasons 2016, 2017.

No.	Scientific name	Family	* Infested part on tree
A.	**Major Pests**		
*	**Order: Lepidoptera**		
1	*Virachola livia* Klug	Lycaenidae	Fruit
*	**Order: Diptera**		
2	*Bactrocera zonata* Saunders		
3	*Ceratitis capitata* Wiedemann	Tephritidae	Fruit

2- Population fluctuation of *V. livia* eggs

(A) (B)

(C) (D)

Fig. 1 (A & B): *Virachola livia* eggs on pomegranate fruits.
(C & D): Butterflies of *Virachola livia* on fruits of pomegranate.

Table 2. Weekly counts of *Virachola livia* eggs on 70 fruits of 4 pomegranate varieties during 2016 season

Date of inspection	No. of *V. livia* eggs			
	Manfaloty	H116	Wonderfull	H118
May,19	0	1	1	1
26	0	0	0	0
June,2	8	7	9	8
9	0	0	0	0
16	9	5	10	10
23	0	0	0	0
30	0	0	0	0
July,7	0	0	0	0
14	0	0	0	0
21	0	2	3	1
28	0	0	0	0
August, 4	0	0	0	0
11	0	0	0	0
18	0	0	0	0
25	0	0	0	0
September, 1	1	0	0	4
8	0	0	0	0
15	0	0	0	0
22	0	0	0	0
29	1	2	1	1
Oct, 6	0	0	0	0
13	0	0	0	0
20	0	0	0	3
27	55	13	9	14
November, 3	51	8	46	38
10	69	9	21	13
17	40	0	20	4
24	24	8	21	4
December,1	22	2	17	9
8	12	1	10	3
15	14	3	11	1
22	4	0	3	0
29	7	0	3	0

Mean Variety	Manfaloty	H116	Wonderfull	H118	2016
	1.92 ± 0.39^{A}	0.37 ± 0.10^{C}	1.12 ± 0.20^{B}	0.69 ± 0.16^{BC}	1.03 ± 0.12
Mean Direction	North	East	South	West	Center
	0.72 ± 0.16^{B}	0.95 ± 0.21^{B}	2.11 ± 0.47^{A}	0.99 ± 0.22^{B}	0.36 ± 0.13^{B}
LSD for		Variety = 0.54	Direction = 0.60	Date = 1.55	

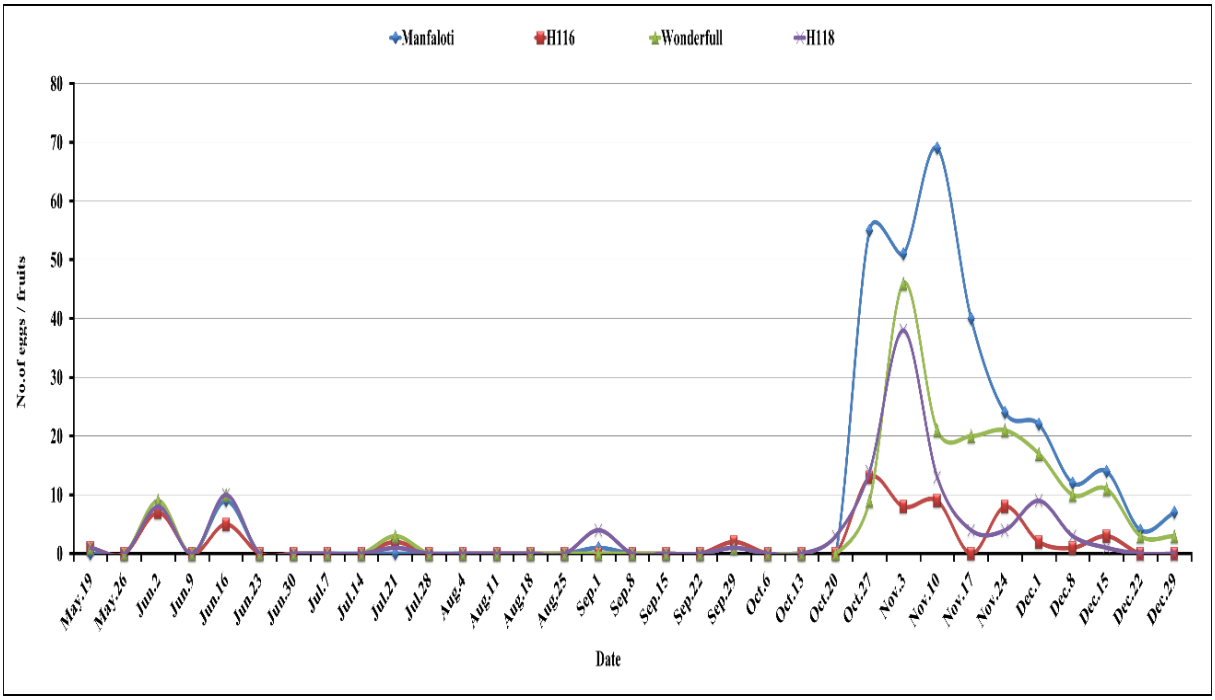

Fig. 2 Weekly counts of *Virachola livia* eggs on 70 fruits of 4 pomegranate varieties during 2016 season.

In the first season 2016, data presented in table (2) and illustrated in Fig. (2) show that the female moths of *V. livia* started egg laying on pomegranate fruits on the third week of May. Number of eggs /70 fruits started to fluctuated till it reached the first peak in the 3rd week of June (9 eggs in Manfaloty, 5 eggs in H116, 10 eggs in Wonderfull and 10 eggs in H118), then the eggs disappeared until the 2nd week of July. On July, 21st the eggs began to appear again in very low numbers on fruits (2 eggs in H116, 3 eggs in Wonderfull and only one egg in H118 fruits) then the eggs disappeared again during August , September until October, 20th, after that the number of deposited eggs increased gradually to reach the first peak of abundance in the 1st week of November when reached 51 eggs in Manfaloty, 8 eggs in H116, 46 eggs in Wonderfull and 38 eggs in H118.

The number of eggs on Manfaloty during the 3rd week of June. was (9 eggs) as 1st peak , then recorded the 2nd peak in the second week of November (51 eggs).

On H116 variety, *V. livia* eggs began to appear on May,29th. The 1st peak of eggs was recorded during the 1st week of June (7eggs) , while the 2nd peak abundant was estimated in the last week of Oct.(13eggs).

On Wonderfull fruits the 1st peak of eggs was observed during the 3rd week of June (10 eggs) , then the eggs disappeared until the mid of July. (3 eggs) and disappeared again until the last week of September, where recorded (1egg). On the other hand, the highest peak recorded in the 1st week in November, (46 eggs).

While, on fruits of variety H118 , the eggs began to appear on May, 19th after which the eggs then disappeared. The number of eggs was observed during the 3rd week of June (10 eggs) as 1st peak , then recorded the highest and 2nd peak in the 1st week of November (38 eggs), the 3rd peak abundant in the 1st week of December (9 eggs).

From the above mentioned data it could be observed that fruits of Manfaloty variety received the highest infestation by the *V. livia* butterfly females for deposition of eggs during the first season , which recorded the highest seasonal mean number of eggs (1.92 egg), followed by the Wonderfull (1.12 egg) and H118 recorded (0.69 egg) while the lowest seasonal mean number of eggs (0.37 egg) was estimated on H116 variety.

The correspondent mean of population density of eggs recorded on fruits of the pomegranate tree in experimental area at the five directions (north, east, south, west and center) recorded 0.72, 0.95, 2.11, 0.99 and 0.36 eggs /fruits , respectively. Thus indicating that the south direction of the trees received the highest infestation with *V. livia* while, the north direction was the lowest preferred for deposition of eggs.

During the subsequent season (2017), data presented in Table (2) and illustrated in Figs. (3) show that the female moths of *V. livia* started laying of eggs on pomegranate fruits on the second week of May.

Table 3. Weekly counts of *Virachola livia* eggs on 70 fruits of 4 pomegranate during 2017 season .

Date of inspection	No. of *V. livia* eggs			
	Manfaloty	H116	Wonderfull	H118
May,11	1	1	2	1
18	0	0	1	0
25	0	0	0	0
Junee,1	9	7	7	7
8	4	7	6	6
15	0	0	0	0
22	0	0	0	0
29	0	0	0	0
Julyy,6	0	0	0	0
13	0	2	0	0
20	3	2	3	0
27	0	0	0	0
August,3	0	0	0	0
10	1	0	0	0
17	0	0	0	0
24	0	0	0	0
31	0	0	0	0
September,7	0	0	0	0
14	0	2	3	0
21	0	0	0	0
28	2	6	0	2
Oct,5	7	0	0	2
12	7	2	3	0
19	5	0	3	0
26	23	24	13	22
November,2	28	22	37	34
9	27	18	22	25
16	22	12	19	15
23	11	9	18	5
30	7	11	10	13
December,7	7	4	6	6
14	4	3	2	3
21	1	2	0	1
28	0	0	1	4

Mean Variety	Manfaloty	H116	Wonderfull	H118	2017
	0.99 ± 0.17^{A}	0.79 ± 0.13^{A}	0.92 ± 0.16^{A}	0.86 ± 0.15^{A}	0.89±0.08
Mean Direction	North	East	South	West	Center
	0.89 ± 0.16^{ABC}	0.76 ± 0.16^{BC}	1.3 ± 0.20^{A}	0.99 ± 0.20^{AB}	0.52 ± 0.12^{C}
LSD for		Variety = N.S	Direction = 0.32	Date = 0.84	

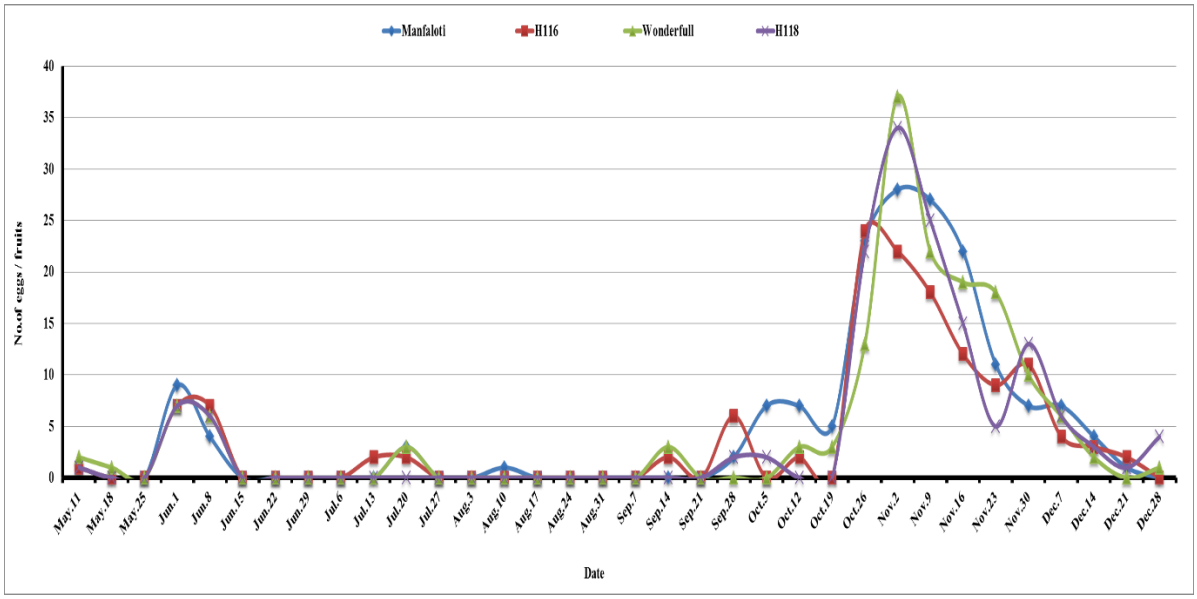

Fig. 3 Weekly counts of *Virachola livia* eggs on 70 fruits of 4 pomegranate during 2017 season .

Number of eggs fluctuated till it reached the 1st peak in the 1st week of June. (9 eggs in Manfaloty, 7 eggs in H116, 7 eggs in Wonderfull and 7 eggs in H118), then decreased at the beginning of the 2nd week of June. No other eggs were observed on pomegranate peels during most of the subsequent weeks and appeared again few weeks later until the 4th week of September when the number of eggs started to increase gradually until reached the highest peak in the 1st week of November. (28 eggs in Manfaloty, 22 eggs in H116, 37 eggs in Wonderfull and 34 eggs in H118).

Eggs of *V. livia* on Manfaloty fruits began to detect on the 2nd week of May and recorded the 1st peak during the 1st week of June. (9 eggs), the highest number of eggs /fruits was detected on November, 2nd 2017 (28 eggs).

The highest number of egg counts on fruits of the varieties H116, H118 and Wonderfull reached (240 eggs) on October 26th , (37 eggs) and (34 eggs) on November , 2nd 2017 for these varieties, respectively (Table (3) and Fig (3)

Finally it can be concluded that , through out 2017 season ,the highest mean number of *V. livia* eggs (0.99 eggs) was recorded on Manfaloty fruits followed by Wonderfull which recorded (0.92eggs), H118 recorded (0.86 eggs) and finally H116 recorded (0.89 eggs).

Comparing the overall seasonal mean counts of *V. livia* eggs on the five directions of pomegranate trees, it is clear that the highest eggs count was detected on fruits of the south direction (1.3 egg / fruit), being significantly higher than those counted on the north (0.89 egg / fruit), east (0.76 egg / fruit) and center of trees (0.52 egg / **fruit**), and non-significantly higher than that counted on fruits of the west direction (0.99 egg / fruit). On the other hand, the differences between counts of eggs on the north, east and west directions were , no significantly, different. While the lowest count (0.52 egg/fruit) was that recorded from the center of trees, being, significantly, lower than those recorded from the remaining directions.

In similar studies, **(Wisam and Mazen, 2002)** compared the susceptibility of the most commonly planted pomegranate varieties (Khdari and Hlawi) to pomegranate butterfly, *V. livia*. The authors estimated that population trend of the butterfly during the season. Butterfly infestation in the field during 1998 was 31.8 and 13.1% for Khdari and Hlawi, respectively. During 1999, Khdari fruit infestation was 48%. Ovipositions were observed after fruit set from late-June to September 1999. The eggs were usually oviposited on the fruit and on the skin around the floral apex. The same authors suggested that *V. livia* developed 2-3 generations on the pomegranate fruit during the season. Also, **Ksentini *et al.*, (2011)** found that the rates of *V. livia* infestation were shown to vary among nine pomegranate varieties; whereas the Klaii, Mezzi and Garoussi varieties were the highest susceptible, while Gabsi, Jbeli, Andolsi, Tounsi, Zaghweni and Zehri were more tolerant to this lycaenidae. The authors considered that may be attributed to female preference.

3. Effect of certain weather factors on the population of *V. livia* eggs.

The pomegranate fruit butterfly, *V. livia* is the most destructive and potentially chronic pest that attacks pomegranate making holes and borers in the fruits , and consequently pomegranate fruits become unaccepted for consumers and loses its marketable value. *V. livia* eggs were usually oviposited on the fruit and on the skin around the floral apex. This exeperiment aimed to study the effect of some weather factors on the population trend of the butterfly eggs during the two seasons 2016 & 2017. In the first season , 2016 data presented in table (4) show that there are

Table 4. Number of *V. livia* eggs on pomegranate fruits and correlation coefficient values in relation to weather factors in the first season 2016

Date of inspection	No. of *V. livia* eggs				*Mean	**Mean
	Manfaloty	H116	Wonderfull	H118	Tem.˚C	R.H.%
May.	**0**	**1**	**1**	**1**	**26.04**	**42.57**
Correlation coefficient *	**----**	**0.99****	**0.99****	**0.99****		
Correlation coefficient **	**----**	**-0.92****	**-0.92****	**-0.92****		
June.	**17**	**12**	**19**	**18**	**29.27**	**45.63**
Correlation coefficient *	**-0.81****	**-0.92****	**-0.82****	**-0.78****		
Correlation coefficient **	**-0.24**	**-0.25**	**-0.24**	**-0.23**		
July.	**0**	**2**	**3**	**1**	**29.11**	**56.25**
Correlation coefficient *	**----**	**0.17**	**0.17**	**0.17**		
Correlation coefficient **	**----**	**-0.64***	**-0.64***	**-0.64***		
August.	**0**	**0**	**0**	**0**	**29.35**	**57.57**
Correlation coefficient *	**----**	**----**	**----**	**----**		
Correlation coefficient **	**----**	**----**	**----**	**----**		
September.	**2**	**2**	**1**	**5**	**28.02**	**55.89**
Correlation coefficient *	**-0.61***	**-0.99****	**-0.99****	**0.00**		
Correlation coefficient **	**-0.07**	**-0.66***	**-0.66***	**0.41**		
Oct.	**55**	**13**	**9**	**17**	**25.12**	**62.11**
Correlation coefficient *	**-0.73****	**-0.73****	**-0.73****	**-0.86****		
Correlation coefficient **	**0.41**	**0.41**	**0.41**	**0.56***		
November.	**184**	**25**	**108**	**59**	**21.20**	**61.07**
Correlation coefficient *	**0.73****	**0.07**	**0.72****	**0.82****		
Correlation coefficient **	**0.69**	**-0.45**	**0.15**	**0.27**		
December.	**59**	**6**	**44**	**13**	**15.43**	**58.89**
Correlation coefficient *	**0.94****	**0.66***	**0.98****	**0.93****		
Correlation coefficient **	**0.08**	**0.03**	**0.24**	**0.19**		

*= significant **= highly significant

Data presented in Table (4) indicated a positive correlation between the number of *V. livia* eggs and the mean temperature in the pomegranate varieties during May, while this correlation was negative with relative humidity. During June, a negative correlation between number of eggs and mean temperature and mean relative humidity in the four varieties. During July, there was a positive correlation between the number of eggs and the mean temperature while this correlation was negative with relative humidity. In September, a negative correlation between the number of eggs and the mean temperature and relative humidity while this correlation was positive with relative humidity in H118. In October, there was a negative correlation between the number of eggs and the mean temperature while this correlation was positive with relative humidity. During November, a positive correlation between the number of eggs and the mean temperature and relative humidity while this correlation was negative with relative humidity in H116. Also in December, a positive correlation between the number of eggs and the mean temperature and relative humidity.

Data presented in Table (5) indicated a positive correlation between the number of *V. livia* eggs and the mean temperature in the pomegranate varieties during May, while this correlation was negative with relative humidity. During June, a positive correlation between number of eggs and mean temperature and mean relative humidity in the four varieties. During July, there was a positive correlation between the number of eggs and the mean temperature and relative humidity in different pomegranate varieties while this correlation was negative with relative humidity in H116 variety. During August, there was a positive correlation between the number of eggs and the mean temperature and relative humidity in Manfaloty variety. In September, a negative correlation between the number of *V. livia* eggs and the mean temperature while this correlation was positive in Wonderfull variety, while this correlation was positive with relative humidity in H118 & Manfaloty varieties, and a negative correlation in

Wonderfull & H116 varieties. In October, there was a negative correlation between the number of eggs and the mean temperature and relative humidity. During November, there was a positive correlation between the number of eggs and the mean temperature while this correlation was negative with relative humidity. Also in December, a positive correlation between the number of *V. livia* eggs and the mean temperature and relative humidity, while this correlation was negative between the number of eggs and the mean temperature in Wonderfull & H118 varieties. In this respect, **Abd-Ella (2015)** found that the change in temperature and relative humidity may affect the susceptibility of pomegranate fruits to the infestation by *V. livia.*

Table 5. Number of *V. livia* eggs on pomegranate fruits and correlation coefficient values in relation to weather factors in the second season 2017

Date of inspection	No. of *V. livia* eggs				*Mean Tem.˚C	**Mean R.H.%
	Manfaloty	H116	Wonderfull	H118		
May.	**1**	**1**	**3**	**1**	**28.35**	**34.11**
Correlation coefficient *	**0.50***	**0.50***	**0.83****	**0.50**		
Correlation coefficient **	**-0.52**	**-0.52**	**-0.47**	**-0.52**		
June.29	**13**	**14**	**13**	**13**	**30.90**	**39.69**
Correlation coefficient *	**0.33**	**0.68***	**0.62***	**0.62***		
Correlation coefficient **	**-0.72****	**-0.95****	**-0.91****	**-0.91****		
July.	**3**	**4**	**3**	**0**	**32.34**	**46.39**
Correlation coefficient *	**0.71****	**0.15**	**0.71****	**---**		
Correlation coefficient **	**0.39**	**-0.41**	**0.39**	**---**		
August.	**1**	**0**	**0**	**0**	**31.45**	**48.74**
Correlation coefficient *	**0.90****	**---**	**---**	**---**		
Correlation coefficient **	**0.84****	**---**	**---**	**---**		
September.	**2**	**8**	**3**	**2**	**29.25**	**49.54**
Correlation coefficient *	**-0.98****	**-0.86 ****	**0.52***	**-0.98****		
Correlation coefficient **	**0.22**	**-0.07**	**-0.87****	**0.22**		
Oct.	**42**	**26**	**19**	**24**	**25.83**	**49.32**
Correlation coefficient *	**-0.50***	**-0.58***	**-0.73****	**-0.52***		
Correlation coefficient **	**-0.26**	**-0.21**	**-0.10**	**-0.17**		
November.	**95**	**72**	**106**	**92**	**20.93**	**56.20**
Correlation coefficient *	**0.81****	**0.63***	**0.81****	**0.64***		
Correlation coefficient **	**-0.81****	**-0.83****	**-0.96****	**-0.82****		
December.	**12**	**9**	**9**	**14**	**18.27**	**61.85**
Correlation coefficient *	**0.31**	**0.64***	**-0.03**	**-0.49**		
Correlation coefficient **	**0.41**	**0.04**	**0.71****	**0.96****		

*= significant **= highly significant

Table 6. infestation intensity of lepidopteran insect pests emerged from 20 infested fruits of pomegranate varieties during two seasons 2016 & 2017.

	lepidopteran insect pests	Manfaloty		H-116		Wonderfull		H-118	
		2016	2017	2016	2017	2016	2017	2016	2017
1.	***Virachola livia* Klug**	0.95^{aD}	1.05^{aC}	1.15^{aB}	1.3^{aB}	1.35^{aA}	1.45^{aA}	1.05^{aC}	1^{aC}
2.	***Anagasta kuehniella* Zeller**	0.05^{bcA}	0.05^{bC}	0.1^{bA}	0.05^{bC}	0.05^{bA}	0.1^{bA}	0.05^{bcA}	0.15^{bB}
3.	***Ephestia kuehniella* Zeller**	0.05^{bcA}	0.05^{bA}	0.05^{bcA}	0.1^{bA}	0.05^{bA}	0.1^{bA}	0.1^{bA}	0.05^{bcA}
4.	***Ephestia figulella* Gregon**	0^{cA}	0.05^{bA}	0.05^{bcA}	0^{bA}	0.05^{bA}	0^{bA}	0^{cA}	0.05^{bcA}
5.	***Tegostoma baphialis* Taudinger**	0.05^{bcA}	0^{bA}	0^{cA}	0^{bA}	0^{bA}	0^{bA}	0^{cA}	0^{cA}
6.	***Euchromius ramburiellus* Duponchel**	0^{cA}	0^{bA}	0.05^{bcA}	0^{bA}	0^{bA}	0.05^{bA}	0^{cA}	0^{cA}
7.	***Cydia pomonella* Linnaeus**	0^{cA}	0^{bA}	0.05^{bcA}	0^{bA}	0^{bA}	0^{bA}	0^{cA}	0^{cA}
8.	***Ectomyelois ceratoniae* Zeller**	0.1^{bA}	0.05^{bA}_{B}	0.1^{bA}	0^{bB}	0.05^{bA}	0.1^{bA}	0.05^{bcA}	0.05^{bcA}_{B}

a, b & c: There is non significant difference (P>0.05) between any two means, within the same column have the same superscript letter.

A, B & C: There is non significant difference (P>0.05) between any two means for the same attribute, within the same row have the same superscript letter.

Data presented in Table (6) show that there are 8 adult species of lepidopteran insects that emerged from the pomegranate fruits in 2016 and 2017 seasons. The highest mean number of *V. livia* emerged butterflies was recorded on Wonderfull variety (1.35 individuals) then H116 and H118 (1.15 and 1.05 individuals,respectively) and finally Manfaloty by (0.95 individuals) in 2016, and in 2017 recorded (1.45 individuals) in Wonderfull then H116, Manfaloty and H-118 (1.30,1.05and1.0 individuals respectively).

Also few mean counts of *Anagasta kuehniella ,Ephestia kuehniella, Ephestia figulella., Tegostoma baphialis, Euchromius ramburiellus, Cydia pomonella, Ectomyelois ceratoniae,* emerged from the fruits in the two seasons.

A. kuehniella recorded the highest mean adults on H-118 variety (0.15) in 2017, while only (0.1) from H-118 in 2016 and on Wonderfull & H-116 varieties recorded also (0.1) in 2017.

The emerged adults of *Ephestia figulella* recorded the same number of (0.05) on Wonderfull and H-116 varieties in 2016 and in Manfaloty and H-118 in 2017 . *Tegostoma baphialis* was recorded just in 2016 season on Manfaloty (0.05 emerged adults) while *Euchromius ramburiellus* recorded (0.05 on Wonderfull in 2017 and H-116 in 2016.

Cydia pomonella recorded just in H-116 (0.05) in 2016n season and the percentage of *E.ceratoniae* emerged adults recorded on Manfaloty & H-116 varieties (0.1) in 2016 in 2017 was in Wonderfull(0.1).

It is means that, it can be categorized these insect pests according to the rate of infestation and number of adults emerged from infested pomegranate fruits to:

1-Major insect pests (*V. livia*)

2- Secondary insect pests (*A. kuehniella ,E. kuehniella, E. figulella., T. baphialis, E. ramburiellus, C. pomonella, E. ceratoniae*).

4. Rate of damage by *Bactrocera zonata* & *Ceratitis capitata* attacking fruits of different pomegranate varieties .

This part of study aimed to measure the rate of infestation on different pomegranate varieties.

(A)

(B)

Fig: 4 (A& B): Signs of infestation by the peach and Mediterranean fruit fly *Bactrocera zonata & Ceratitis capitata* on pomegranate fruits.

Table (7 A&B): Cumulative rates of infestation caused by *Bactrocera zonata* & *Ceratitis capitata* during 2016 & 2017 seasons.

Table (7 A):2016

Date Of inspect.	varieties							
	Manfaloty		H116		Wonderfull		H118	
	No. of infested fruits	% of infestation	No. of infested fruits	% of infestation	No. of infested fruits	% of infestation	No. of infested fruits	% of infestation
August,18	0	0.0	11	15.7	0	0	0	0
25	8	11.4	12	32.9	6	8.6	5	7.1
September , 1	5	18.6	10	47.1	4	14.3	9	20.0
8	5	25.7	6	55.7	7	24.3	7	30.0
15	8	37.1	7	65.7	6	32.9	8	41.4
22	10	51.4	3	70.0	10	47.1	6	50.0
29	2	54.3	1	71.4	3	51.4	1	51.4
Oct,6	3	58.6	1	72.9	1	52.9	0	51.4
13	0	58.6	0	72.9	0	52.9	0	51.4
20	0	58.6	0	72.9	0	52.9	0	51.4
27	2	61.4	0	72.9	0	52.9	0	51.4
Total	**43**	**61.4**	**51**	**72.9**	37	**52.9**	36	**51.4**

Table (7 B):2017

Date Of inspect.	varieties							
	Manfaloty		H116		Wonderfull		H118	
	No. of infested fruits	% of infestation	No. of infested fruits	% of infestation	No. of infested fruits	% of infestation	No. of infested fruits	% of infestation
August, 17	2	2.9	4	5.7	2	2.9	0	0
24	4	8.6	10	20.0	6	11.5	6	8.6
31	5	15.8	8	31.4	7	21.5	7	18.6
September,7	4	21.5	9	44.3	9	34.3	8	30.0
14	11	37.2	12	61.4	14	54.3	6	38.6
21	10	51.5	5	68.6	7	64.3	11	54.3
28	2	54.3	2	71.4	2	67.2	10	68.6
Oct,5	4	60.0	2	74.3	0	67.2	0	68.6
12	2	62.9	0	74.3	0	67.2	0	68.6
19	1	64.3	0	74.3	0	67.2	2	71.4
26	0	64.3	1	75.7	0	67.2	0	71.4
Total	**45**	**64.3**	**53**	**75.7**	**47**	**67.2**	**50**	**71.4**

In 2016 season , damage to pomegranate fruits started on August,18th on H116 variety with a rate of 15.7 % infestation , while on Manfaloty , Wonderfull and H118 was on August 25th with a rate of 11.4, 8.6 and 7.1 % infestation , respectively . The number of damaged fruits increased successively until reached a noticeable increase (12 fruits /tree) on 25th August showed 32.9 % as cumulative percentage of infestation. Also, data revealed that the highest rate of infestation 72.9% was recorded on fruits of H116 variety, followed by the Manfaloty, Wonderfull and H118, respectively.

In 2017 season, damage to pomegranate fruits started on August,17th on Manfaloty, H116 and Wonderfull variety with a rate of 2.9, 5.7and 2.9 % infestation, respectively while on H118 was on August 24th with a rate of 8.6 % infestation. The number of damaged fruits increased successively until reached a noticeable increase (12 & 14 fruits /tree) on 14th September on H116 and Wonderfull varieties showed 61.4 & 54.3 % as cumulative percentage of infestation, respectively.

References

Abd-Ella,A.A. (2015). Efficacy of emamectin benzoate, pyridalyl and methoxyfenozide on pomegranate butterfly, *Virachola livia* (Klug) (Lepidoptera: Lycanidae) in cultivated and reclaimed lands. Journal of Phytopathology and Pest Management 2(3): 32-42, 2015.

Anonymous, Jan(2018). Agricultural statistics summer and nilli crops, Arab Republic of Egypt, Ministry of Agricultural and Land Reclamation, Economic Affairs Sector, January 2018 ,315-316.

Arzu,A.B.; Ozcan.T, and Ersan,Y.L.(2012). The Therapeutic Potential of Pomegranate and Its Products for Prevention of Cancer. Chapter · April

2012 in book Cancer Prevention – From Mechanisms to Translational Benefits. DOI: 10.5772/30464.

Balikai,R.A.; Kotikal,Y.K. and Prasanna, P.M.(2009). Status of pomegranate pests and their management strategies in India .II International Symposium on pomegranate and Minor-including Mediterranean –Fruits :ISPMMF2009. 10.17660/ActaHortic.2011.890.81.

Cayol, J. P.; Buyckx, E. J.; Loussaief, F.; Zarai, M.; Boukhari, M. and Arfaoui, T. (1997). Control of Mediterranean fruit fly with Vienna-43/44 TSL sterile males in Tunisian oases. Bulletin OILB/SROP; 1997. 20(8):219-232.

Demiref, N.; Yildirim, A. E. and Kilic, G. (2018). Effectiveness of various attractants for Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae) on pomegranate fruits in Turkey. Fresenius Environmental Bulletin; 2018. 27(5):3191-3198.

Elsayed, G. and Bazaid, S. A. (2011). Field investigation of pomegranate fruit worms in Taif and laboratory evaluation of *Bacillus thuringiensis* against *Ectomyelois ceratoniae*. Archives of Phytopathology and Plant Protection; 2011. 44(1):28-36.

El-Shiblawi, L. M. A. and Saleh, H. E. A. M. (2014). Study the seasonal presences of Mediterranean fly *Ceratitis capitata* (Wied) and assess certain types of traps and height in the pomegranatum orchards. Diyala Agricultural Sciences Journal; 2014. 6(2):Ar107-Ar115.

Kasap, A. and Aslan, M. M. (2016). The monitoring the population and detection of the loss ratio of the Mediterranean fruit fly (*Ceratitis capitata* Wied.) (Diptera: Tephritidae) by pheromone traps in pomegranate and persimmon varieties. Kahramanmaras Sutcu Imam Universitesi Doga Bilimleri Dergisi; 2016. 19(1):43-50.

Ksentini, I.; Jardak, T.and Zeghal, N. (2011). First report on *Virachola livia* Klug. (Lepidoptera: Lycaenidae) and its effects on different pomegranate varieties in Tunisia. Bulletin OEPP/EPPO Bulletin; 2011. 41(2):178-182.

Mcadams, P.C.(2011). Willingness-to-pay For Pomegranates: Impact of Product and Health Features Using No Hypothetical Procedures. M.Sc. Thesis, Department of Agricultural Economics at Texas A&M University.453pp.

Mohamed.A.S.A.(2005). Studies on biology, ecology and control of the key insect pests infestation pomegranate in Assiut Governorate. M.Sc. Thesis, Department of Plant protection. Fac.of.,Agriculture.,Assiut ,University , Egypt.

Wisam,O. and Mazen,A. (2002). Bionomics and control of pomegranate butterfly *Virachola (Deudorix) livia* (Klug) (Lepidoptera: Lycanidae) in Northern Jordan. Dirasat. Agricultural Sciences; 2002. 29(1):1-12. 16 ref.

Yang,Z.X.; Cai,P. and Wang,L. (2009). The occurrence and damage to the fruit trees of citrus small fruit fly in Sizhou area, Jiangsu province. South China Fruits; 2009. (2):38-39.

حصر وتعداد الآفات الحشرية الشائعة علي ثمار الرمان في مصر

محمد عبداللطيف عبدالله ابازيد[2] وفوزي فائق شلبي[1] وعادل عبدالحميد حافظ[1] ومحمد عرفة عويس[2]

1 كلية الزراعة بمشتهر جامعة بنها – مصر.

2 معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقي – جيزة –مصر.

يعد محصول الرمان احد المحاصيل الهامة والواعدة في مصر وذلك لأهميته الغذائية و التصديرية وملائمته للزراعة في الاراضي المستصلحة. في هذه الدراسة تم القاء الضوء علي أهم الافات الحشرية التي تصيب ثمار الرمان ودراسة تعدادات كلا من ابي دقيق الرمان وذبابة فاكهة البحر المتوسط وذبابة الخوخ كأهم هذه الآفات التي تسبب ضررا بالغا في المحصول وقد تم رصد معدل وضع بيض ابي دقيق الرمان علي الثمار وحساسية الاصابة في اربع اصناف من الرمان كذلك دراسة تاثير الظروف الجوية علي تعداد هذه الافة علي اربع(H118 – Wonderfull اصناف محل الدراسة وذلك خلال موسمين 2016 و 2017 وايضا تم رصد نسبة الاصابة بكلا من ذبابة الخوخ والفاكهة للثمار علي الاربع اصناف محل الدراسة وكذلك معرفة الحشرات الاخري من حرشفية الاجنحة التي تصيب الثمار .