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(Original Article)

Appearance of Pomegranate Butterfly *Deudorix livia* Klug (Lepidoptera: Lycaenidae) on Growth Stages of Different Host Plants and Its Fluctuation on Pomegranate Manfaloty Cultivar in Assiut Governorate, Northern Upper Egypt

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Abstract

Relations between the incidence of mature and immature stages of pomegranate butterfly, *Deudorix* (*Virachola*) *livia* Klug (Lepidoptera: Lycaenidae) and some host plant phenology growth stages was studied. Two host plant species *i,e.*, sweet acacia, *Acacia farnesiana* L., and pomegranate, *Punica granatum* L were selected. Pomegranate butterfly eggs population fluctuation on Manfaloty pomegranate cultivar was encountered during 2020 and 2021 under climatic factors [Maximum (MaxT) and Minimum (MinT) Temp. in Celsius degree (°C), Relative humidity (RH %), and Wind Speed (km/hr)]. Data revealed that the sweet acacia was the most preferred for *D. livia* and appeared as the main host plant during the absence of the targeted stage of other host plants. Eggs and adults were first recorded after 2 and 7 weeks from fruit setting on sweet acacia in 2020 and 2021, respectively. On pomegranates, the previously mentioned stages appeared after 3 weeks of fruit formation in both seasons. October was the most preferred month for eggs deposition in both seasons because eggs averages were highly increased, and this was the damaging time for pomegranate fruits. The populations of eggs showed three peaks in 2020 and two in 2021. The correlation coefficient between the average numbers of eggs and maximum wind speed was negative and highly significant ($r= -0.36776$, $P <0.0001$) in 2020, meanwhile in 2021 still negative with an insignificant effect ($r= -0.10447$, $P= 0.1410$). In conclusion, determining pest peaks are important to establish a control program before peak occurrence or after infestation reaches the economic threshold levels. This will be important to initiate control strategies to prevent this insect pest from laying eggs on pomegranate fruits.

Keywords: *Deudorix livia, Pomegranate, Sweet acacia, plant phenology*

Introduction

Pomegranate Manfaloty cultivar is considered to be one of the most important pomegranate cultivar, that has been successfully planted in Upper Egypt, Assiut Governorate. Its economic importance returns to its high

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antioxidant content, vitamins, and minerals that have anti-inflammatory and preventive benefits against a variety of ailments, such as various malignancies, vascular disorders, and inflammatory issues (Heber *et al.*, 2006; Ozgen *et al.*, 2008; O'Grady *et al.*, 2014 and Ibrahim *et al.*, 2021).

Unfortunately, pomegranate fruits are vulnerable to infestation by a wide range of insect pests and lepidopteran insects are the most serious ones. These pests mainly reduce the quality and marketing of pomegranate fruits (Abd-Ella, 2015). The pomegranate butterfly, *Deudorix* (=*Virachola*) *livia* Klug (Lepidoptera: Lycaenidae), is the major insect pest infesting pomegranate fruits in Egypt. The females start laying eggs on pomegranate fruits at the beginning of fruit setting and continue without interruption during all growth stages (Awadalla, *et. al.*, 1970). The damage caused by caterpillars, which bore holes into the fruits and feed on seeds and pulp. However, the holes made by caterpillars act as a secondary source of infections by pathogens causing rotting of fruits (Balikai *et al*., 2009 and Abazaid *et al*., 2021). This polyphagous pest attacks several different host plants, and the main hosts are pomegranate, sweet acacia, and date palm (Afifa, 2020).

The present work aimed to enrich the knowledge of the phenology of different host plants during their growth stages and the incidence of mature and immature stages (eggs, larvae and pupae) of *D. livia* on different host plants (pomegranate and sweet acacia), and to determine the population fluctuations of *D. livia* egg numbers on fruits of Manfaloty pomegranate cultivar in correlation with ambient weather factors [Maximum temperature (MaxT) and Minimum temperature (MinT) in Celsius degree (°C), Relative humidity (RH %), and Wind Speed (km/hr)]. This study is considered a cornerstone to design Integrated Pest Management (IPM) programs for controlling *D. livia*.

Materials and Methods

Experimental site

The study was conducted in the experimental farm, Faculty of Agriculture, Assiut University, Assiut, Egypt 31° 11' 21.4188" E 27° 10' 48.4824" N during two successive growing seasons (2020 and 2021). A total number of 130 trees (12 years old) of the Manfaloty cultivar in pomegranate field were chosen for the present study. Another host plant such as sweet acacia trees were distributed in clusters around pomegranate plantations.

Plant phenology and pest incidence

Plant phenology of sweet acacia and pomegranate plantations during growth stages was observed weekly during 2020 and 2021 seasons (Plate 1).

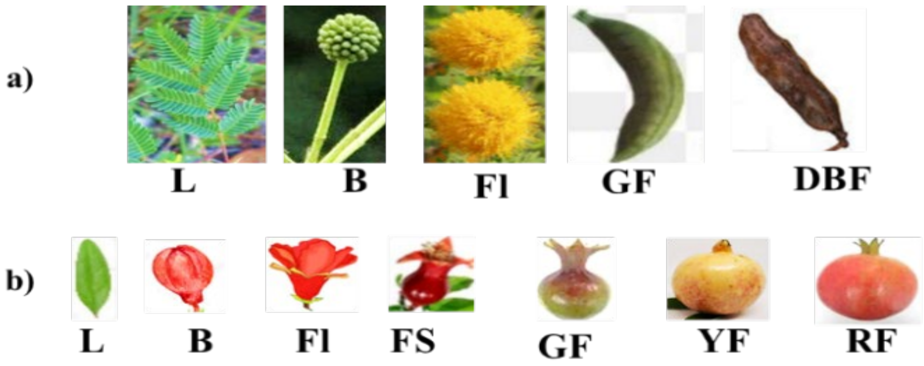


Plate 1. Plant stages of sweet acacia and pomegranate plantations. a) Sweet acacia, b) Pomegranate: *L* = Leaves, *B* = Buds, *Fl* = Flowers, *FS* = Fruit Setting, *GF* = Green Fruits, *DBF* = Dry Brown Fruits, *YF* = Yellow Fruits, and *RF* = Red fruit.

The incidence of immature stages (eggs, larvae, and pupae) and mature stage of *D. livia* was weekly monitored from sweet acacia, *Acacia farnesiana* L., (Fabales: Fabaceae) and pomegranate, *Punica granatum* L., (Myrtales: Punicaceae), (Plate 2).

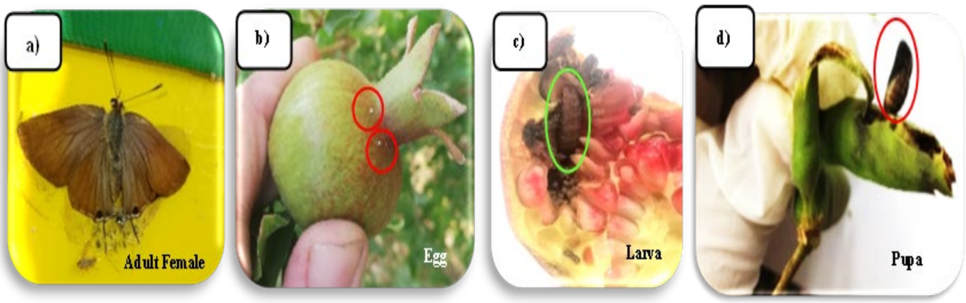


Plate 2: The mature and immature stages of the pomegranate butterfly. (a, Adults; b, eggs; c, larvae; and d, pupae) were collected from infested fruits by sticky trap and infested fruit of Pomegranates, and sweet acacia pods.

Monitoring the population of *D. livia* via eggs numbers

Five sites of pomegranate corresponding to the cardinal directions (North, South, East, West, and Center) were selected for collecting samples. Weekly samples of pomegranate butterfly eggs were counted from the fruits of 5 branches/ ten trees/direction during the 2020 and 2021 growing seasons. The collected eggs were transferred to the laboratory for counting and identification.

Weather Factors

The climatic factors considered in the study were the maximum temperature (MaxT) and minimum temperature (MinT) in Celsius degree (°C), relative humidity (RH %), and maximum and minimum wind speed in (km/hr)]. The previous metrological data were obtained from Weather Underground

(https://www.wunderground.com/).

Data Analysis

Data were statistically analyzed by SAS 9.1 (2008) software program to calculate ANOVA, Correlation Coefficient (r-value), and Coefficient of Determination (R^2 value).

Results and Discussion

Phenology of host plants and incidence of *D. livia* during 2020 and 2021 seasons

Sweet acacia

The appearance of eggs and adults of *D. livia* (Table 1 and 2) were observed for the first time on 2 of February and 14 of April in 2020 (after two weeks from fruit setting) and 2021 (after seven weeks from fruit setting), respectively. The larvae were counted on 9 of February and 21 of April in 2020 (three weeks after fruit setting) and 2021 (eight weeks after fruit setting), respectively during the two successive growing seasons. The pupae appeared on 18 of February and 28 of April, respectively during 2020 and 2021.

Pomegranate

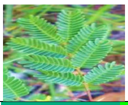
The eggs and adults of *D. livia* (Tables 3 and 4) were observed for the first time on 21 and 8 of May during 2020 and 2021, respectively, when the plant phenology reached three weeks after fruit setting in both growing seasons. Afterward, the eggs hatched into larvae on 28 and 15 of May in 2020 and 2021, respectively for both growing seasons. However, pupae in both growing seasons were recorded on 24 and 13 of Jun during 2020 and 2021, respectively.

The obtained results proved that sweet acacia was the main host plant of the pomegranate butterfly. Also, it is considered the main source of infestation during the absence of a suitable targeted plant stage for the rest of the other hosts of pomegranate and date fruit. Various authors like to concur with this finding including Ksentini *et al* (2011), who reported that the common English name attributed to this species 'Pomegranate butterfly' was probably chosen due to the economic importance of pomegranate although this plant is only a secondary host. The primary host plant for *D. livia* is sweet acacia (pod).

Results of the present study indicated that sweet acacia plantations harbored *D. livia* eggs early before pomegranate fruit setting. For that acacia can be considered a source of infestation for pomegranate fruit. This finding agrees with other authors such as Mkaouar *et al*. (2016), who reported that the absence of sweet acacia green pods on the trees from July; enhance the butterfly migrates to the pomegranate as an alternative host.

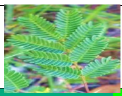
In conclusion, the above-mentioned results regarding the presence date of *D. livia* on the alternative host plant, sweet acacia, help researchers to prognosticate its arrival to the pomegranate and date fruits that gives up a better chance to control this pest on its alternative host plant and to build a better-integrated management strategy to overcome the losses of the pomegranate fruit.

Table 1: Sweet Acacia phenology and stages of *Deudorix livia* in the Experimental Farm of the Faculty of Agriculture, Assiut university, Assiut, Northern Upper Egypt during the 2020 growing season

Date		Plant Stages					Insect Stages			
							Adults	Eggs	Larvae	Pupae
Jan.	5						0	0	0	0
	12						0	0	0	0
	19						0	0	0	0
	27						0	0	0	0
Feb.	2						1	1	0	0
	9						1	1	1	0
	18						1	1	1	0
	26						1	1	1	1
Mar.	7						1	1	1	1
	14						0	0	1	1
	22						0	0	1	0
	29						0	0	1	0
Apr.	9						0	0	1	1
	15						1	0	1	1
	22						1	0	1	1
	30						1	0	1	1
May	7						1	0	1	1
	14						1	0	1	1
	21						1	1	1	1
	28						1	1	1	1
Jun.	2						1	1	1	1
	10						0	0	0	0
	17						0	0	0	0
	24						0	0	0	0
Jul.	1						0	0	0	0
	8						0	0	0	0
	15						0	0	0	0
	22						0	0	0	0
	29						0	0	0	0
Aug.	5						0	0	0	0
	13						0	0	0	0
	20						0	0	0	0
	26						0	0	0	0
Sept.	3						0	0	0	0
	13						0	0	0	0
	20						0	0	0	0
	27						0	0	0	0
Oct.	3						0	0	0	0
	10						0	0	0	0
	17						0	0	0	0
	24						0	0	0	0
	31						0	0	0	0
Nov.	7						0	0	0	0
	14						0	0	0	0
	21						0	0	0	0
	28						1	1	1	0
Dec.	5						1	1	1	0
	13						1	0	1	0
	22						1	0	1	1
	29						1	0	0	1

0. The absence of the stage; 1. The presence of the stage.

Table 2. Sweet Acacia phenology and stages of *Deudorix livia* in the Experimental Farm of Faculty of Agriculture, Assiut University, Assiut, Northern Upper Egypt during the 2021 growing season

Date		Plant Stages					Insect Stages			
							Adults	Eggs	Larvae	Pupae
Jan.	5						0	0	0	0
	12						0	0	0	0
	21						0	0	0	0
	27						0	0	0	0
Feb.	4						0	0	0	0
	9						0	0	0	0
	16						0	0	0	0
	24						0	0	0	0
Mar.	7						0	0	0	0
	15						0	0	0	0
	21						0	0	0	0
	28						0	0	0	0
Apr.	6						0	0	0	0
	14						1	1	0	0
	21						1	1	1	0
	28						1	1	1	1
May	8						1	1	1	1
	15						1	1	1	1
	22						0	0	1	1
	29						0	0	1	1
Jun.	5						0	0	0	0
	13						0	0	0	0
	21						0	0	0	0
	28						0	0	0	0
Jul.	8						0	0	0	0
	17						0	0	0	0
	24						0	0	0	0
	31						0	0	0	0
Aug.	9						0	0	0	0
	14						0	0	0	0
	21						0	0	0	0
	28						0	0	0	0
Sept.	5						0	0	0	0
	12						0	0	0	0
	19						0	0	0	0
	26						0	0	0	0
Oct.	2						0	0	0	0
	9						0	0	0	0
	16						0	0	0	0
	23						0	0	0	0
Nov.	9						0	0	0	0
	13						0	0	0	0
	20						0	0	0	0
	26						0	0	0	0
Dec.	4						0	0	0	0
	11						0	0	0	0
	18						0	0	0	0
	25						0	0	0	0
	31						0	0	0	0

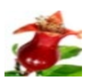
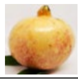
0. The absence of the stage; 1. The presence of the stage.

Table 3. Pomegranate phenology and stages of *Deudorix livia* in the Experimental Farm of Faculty of Agriculture, Assiut University, Assiut, Northern Upper Egypt during the2020 growing season

Date		Plant Stages							Insect Stages			
									Adults	Eggs	Larvae	Pupae
Jan.	5								0	0	0	0
	12								0	0	0	0
	19								0	0	0	0
	27								0	0	0	0
Feb.	2								0	0	0	0
	9								0	0	0	0
	18								0	0	0	0
	26								0	0	0	0
Mar.	7								0	0	0	0
	14								0	0	0	0
	22								0	0	0	0
	29								0	0	0	0
Apr.	9								0	0	0	0
	15								0	0	0	0
	22								0	0	0	0
	30								0	0	0	0
May	7								0	0	0	0
	14								0	0	0	0
	21								1	1	0	0
	28								1	1	1	0
Jun.	2								1	1	1	0
	10								1	1	1	0
	17								1	1	1	0
	24								1	1	1	1
Jul.	1								1	1	1	1
	8								0	0	1	1
	15								0	0	1	1
	22								0	0	1	1
	29								0	0	1	1
Aug.	5								0	0	1	1
	13								1	1	1	1
	20								1	1	1	0
	26								0	0	1	0
Sept.	3								1	1	1	1
	13								1	1	1	1
	20								1	1	0	0
	27								1	1	1	0
Oct.	3								1	1	1	0
	10								1	1	1	1
	17								1	1	1	1
	24								1	1	1	1
	31								1	1	1	1
Nov.	7								1	1	1	1
	14								1	1	1	1
	21								0	0	1	1
	28								1	1	1	1
Dec.	5								1	1	1	1
	15								1	1	1	1
	22								1	1	1	1
	29								1	1	1	1

0: The absence of the stage; 1 The presence of the stage.

Table 4. Pomegranate phenology and stages of *Deudorix livia* in the Experimental Farm of Faculty of Agriculture, Assiut University, Assiut, Northern Upper Egypt the 2021 growing season

Date		Plant Stages							Insect Stages			
									Adults	Eggs	Larvae	Pupae
Jan.	5								0	0	0	0
	12								0	0	0	0
	21								0	0	0	0
	27								0	0	0	0
Feb.	4								0	0	0	0
	9								0	0	0	0
	16								0	0	0	0
	24								0	0	0	0
Mar.	7								0	0	0	0
	15								0	0	0	0
	21								0	0	0	0
	28								0	0	0	0
Apr.	6								0	0	0	0
	14								0	0	0	0
	21								0	0	0	0
	28								0	0	0	0
May	8								1	1	0	0
	15								1	1	1	0
	22								1	1	1	0
	29								1	1	1	0
Jun.	5								1	1	1	0
	13								1	1	1	1
	21								1	1	1	1
	28								0	0	1	1
Jul.	8								0	0	1	1
	17								0	0	1	0
	24								0	0	1	1
	31								0	0	1	1
Aug.	9								0	0	0	1
	14								0	0	0	1
	21								0	0	0	1
	28								0	0	0	1
Sept.	5								0	0	0	1
	12								0	0	0	1
	19								1	1	0	1
	26								1	1	1	0
Oct.	2								1	1	1	1
	9								1	1	1	1
	16								1	1	1	0
	23								1	1	1	0
Nov.	9								1	1	1	1
	13								1	1	1	1
	20								1	1	1	1
	26								1	1	1	1
Dec.	4								0	0	1	1
	11								0	0	1	1
	18								0	0	0	1
	25								0	0	0	1
	31								0	0	0	1

0: The absence of the stage; 1.The presence of the stage.

Population fluctuation of *D. livia* eggs on Manfaloty pomegranate cultivar during the growing seasons

Population dynamics during the first season of 2020

The average number of laid eggs (Table 5 and Fig. 1) during 2020 indicated that the females started laying eggs on 21 of May with an average of (5.04 eggs/5 branches/ ten trees/ direction), and sharply increased to record its 1st peak with average numbers of (29.2 eggs/5 branches/ ten trees/ direction) on 24 of June, when the selected climatic factors were 38.14 °C (Max.T), 23.71°C (Min.T), 28.14 (Max. WS Km/hr), 10.71(Min. WS Km/hr), and 35.47 (RH %) with total means of egg averages in June 18.75±12.2. Then, the averages fluctuated gradually from the previous peak in June till the end of October.

In November, the average of egg numbers scored two outbreaks (total average mean was 50.8±43.0). On the 7 of November, the 2nd general peak occurred with the highest averages of eggs numbers during the season (84 eggs/5 branches/ ten trees/ direction), when the prevalent weather factors were 28.86°C (Max.T), 16.86 °C (Min.T), 26.43 (Max. WS Km/hr), 11.86 (Min. WS Km/hr), and 55.09 (RH %). The 3rd general peak (the second one in November) was registered on 28 of November (45.00 04 eggs/5 branches/ ten trees/ direction) under the following metrological data 22.43°C (Max.T), 10.14°C (Min.T), 22.57 (Max. WS Km/hr), 3.71 (Min. WS Km/hr), and 53.59 (RH %).

Population dynamics in the second season 2021

Laying eggs was observed 2 weeks earlier than the first season. The first observed laid eggs was recorded on the 8 of May (Table 6 and Fig. 2). Then, the average of eggs increased gradually until scoring the first outbreak on the 5 of June by an average number of 25.60 (eggs/5 branches/ ten trees/ direction); when the climatic factors were 37.00 °C (Max.T), 23.00 °C (Min.T), 27.43 (Max. WS Km/hr), 9.57 (Min. WS Km/hr), 29.06 (RH %) and the total averages of means were 15.85± 8.66. Afterward, the number of eggs fluctuated normally from the past outbreak to record the second peak with the highest mean during this season in the 16 of October with an average number of 95 (eggs/5 branches/ ten trees/ direction) under prevalent weather factors 35.71 (Max.T °C), 19.57 (Min.T °C), 22.00 (Max. WS Km/hr), 5.14 (Min. WS Km/hr), 41.44 (RH %) and the total averages of means for this month was 79.10± 16.83.

The influence of prevalent weather factors on averages of egg numbers of *D. livia* during the growing seasons

The analysis of data for both seasons 2020 and 2021(Table 5) revealed that the monthly maximum average number of eggs encountered was recorded in October for both seasons (56.4± 26.5 and 79.1±16.83 eggs in 2020 and 2021; respectively). The Correlation Coefficient (r) values between the average number of eggs and ambient weather factors were insignificant except for maximum wind speed in 2020 which was -0.36776^{**} and the relative humidity in both seasons were 0.23540** and 0.30525** in 2020 and 2021, respectively (Table 5 and 6). Weather factors clearly affected the average numbers of *D. livia* eggs, since R^2 was68% and 20.31% in 2020 and 2021; respectively. However, the maximum R^2 value was presented by the maximum wind speed (R^2= 29%) in the 2020 season (Table 5) and (R^2= 16.92) for relative humidity in the 2021 season (Table 6).

By discussing the above-mentioned results, increased egg numbers of *D. livia* in October during the two seasons proved that egg deposition during this period can be led to identify the favourable time for damaging pomegranate fruits. This finding agrees with Elsayed and Bazaid (2011) who reported that pomegranate fruits are highly attacked by *V. livia* during field observations of the production season of pomegranate (from May to October) in Saudi Arabia. Therefore, increasing the population in this period might be led to a great economic loss in pomegranate fields. In this regard, safe control strategies should be directed before the occurrence of peaks or after the infestation reached its economic threshold of damage to prevent its reproduction and laying eggs.

The total number of *D. livia* eggs encountered on pomegranate fruits in 2020 was (3816 eggs) higher than in 2021 (2902 eggs). The statistical analysis of the differences between both seasons was highly significant (F = 26.11**; P <0.0001). However, the populations of eggs fluctuated with three peaks during 2020 more than in 2021 (two peaks), (Fig. 1 A and 2 A).

The maximum, and minimum wind speed and relative humidity were highly significant (F = 9.72**, 129.58**, and 92.09**; P <0.0001), respectively. However, the r-value between egg average numbers and maximum wind speed was negatively and highly significant in 2020, but in 2021 was negatively and insignificant. This difference is one reason for the differentiation in the total number of *D. livia* eggs counted during the two seasons. On the other hand, the coefficient of determination (R2) for all weather factors was 68% and 20.31% in 2020 and 2021, respectively during the growing seasons. These results of means indicate that other unknown and non-considered factors have an impact. Therefore, our findings need to further study in the future. The different effects of the ambient climatic factors on *D. livia* egg numbers explain the differences in fluctuation dynamics encounter between the two seasons. This finding agrees with the reported results by Van Den Bosch *et al.* (1982), who stated that the population changes in size, that is, in the number of individuals it contains according to whether environmental (biotic and abiotic) circumstances favor the production of more or fewer individuals than the number dying in each interval of time. The migration of individuals into or out of the local population affects population size.

Table 5. The average numbers of *D. livia* eggs on Manfaloty pomegranate cultivar fruits per week, ambient weather factors, coefficient of determination, and correlation coefficient values during the 2020 growing season

Inspection Date	Avg. Egg No. ()	Temp. (°C)		WS (Km/hr)		RH (%)
		Max.	Min.	Max.	Min.	
Apr. 9	0.00	27.86	14.43	31.29	9.57	41.47
15	0.00	27.57	13.71	29.57	11.71	42.21
22	0.00	32.14	16.57	31.29	7.14	40.21
30	0.00	32.29	17.57	26.43	6.86	38.44
Mean±SD	**0.0±0.0**	**29.97**	**15.57**	**29.64**	**8.82**	**40.59**
May-07	0.00	32.43	17.00	27.57	10.86	37.87
14	0.00	37.14	19.43	24.57	6.57	36.31
21	5.40	40.86	25.43	24.00	3.43	31.73
28	10.60	30.14	17.86	29.43	14.43	42.24
Mean±SD	**4.0±7.5**	**35.14**	**19.93**	**26.39**	**8.82**	**37.04**
Jun. 2	9.60	37.00	21.00	27.43	11.57	34.71
10	17.00	39.86	23.29	25.57	9.00	32.33
17	19.20	37.29	23.29	29.71	13.71	35.97
24	29.20	38.14	23.71	28.14	10.71	35.47
Mean±SD	**18.75±12.2**	**38.07**	**22.82**	**27.71**	**11.25**	**34.62**
Jul. 1	26.00	38.43	23.14	26.43	8.29	33.70
8	0.00	38.57	24.86	26.71	7.86	34.76
15	0.00	37.43	23.29	27.86	9.29	39.04
22	0.00	38.00	24.00	28.00	11.57	38.14
Mean±SD	**6.5±11.9**	**38.11**	**23.82**	**27.25**	**9.25**	**36.41**
Aug. 5	0.00	40.57	25.14	27.57	5.71	33.14
13	9.80	38.57	24.71	29.00	7.14	40.91
20	14.80	36.43	24.00	28.14	8.57	41.81
27	0.00	36.43	20.00	28.00	8.29	42.97
Mean±SD	**6.15±8.2**	**38.00**	**23.46**	**28.18**	**7.43**	**39.71**
Sept. 3	28.20	36.29	24.40	23.43	7.43	38.67
13	28.20	38.43	20.57	25.86	9.86	42.01
20	26.20	35.71	23.86	28.86	11.43	46.41
27	27.40	38.14	23.86	28.57	6.86	39.54
Mean±SD	**27.5±11.5**	**37.14**	**23.17**	**26.68**	**8.89**	**41.66**
Oct. 3	40.80	38.14	23.86	28.57	6.86	39.54
10	46.20	36.86	22.57	24.29	10.14	42.29
17	67.20	33.71	21.00	25.29	12.14	49.60
24	71.40	35.00	19.86	23.57	7.14	45.59
Mean±SD	**56.4±26.5**	**35.93**	**21.82**	**25.43**	**9.07**	**44.25**
Nov. 7	84.00	28.86	16.86	26.43	11.86	55.09
14	74.20	24.57	14.57	22.57	4.14	51.54
21	0.00	23.14	12.43	25.57	8.00	64.76
28	45.00	22.43	10.14	22.57	3.71	53.59
Mean±SD	**50.8±43.0**	**24.75**	**13.50**	**24.29**	**6.93**	**56.24**
Dec. 5	31.60	22.57	11.00	17.43	2.43	49.77
15	29.80	22.57	10.43	23.86	10.29	50.33
22	16.40	21.29	9.00	24.14	9.14	65.66
29	5.00	20.86	7.86	21.71	5.43	68.76
Mean±SD	**20.7±18.5**	**21.82**	**9.57**	**21.79**	**6.82**	**58.63**
R^2 (%)		**6**	**2**	**29**	**3**	**28**
Correlation Coefficient		**-0.10790 ^{ns}**	**-0.01715 ^{ns}**	**-0.36776****	**-0.00861 ^{ns}**	**0.23540****

() = Avg. egg no. based on 5 branches/ ten trees / direction weekly.

***= significant at 0.05 level of probability, **= highly significant at 0.01 level of probability, and ns= Insignificant.**

Table 6. The average numbers of *D. livia* eggs on Manfaloty pomegranate cultivar fruits per week, ambient weather factors, coefficient of determination, and correlation coefficient values during the 2021 growing season

Date	Avg. Egg No. ()	Temp. (°C)		Wind Speed (km/hr)		RH (%)
		Max.	Min.	Max.	Min.	
Mar.7	0.00	28.57	11.43	22.86	8.86	41.29
15	0.00	22.43	8.71	25.00	4.86	48.16
21	0.00	30.29	13.86	32.71	12.57	32.57
28	0.00	22.43	8.71	24.00	11.00	51.20
Mean± SD	**0.00± 0.00**	**25.93**	**10.68**	**26.14**	**9.32**	**43.30**
Apr. 6	0.00	30.43	13.29	26.00	7.71	32.81
14	0.00	29.14	10.57	25.14	9.14	41.37
21	0.00	36.57	21.86	26.29	8.86	30.64
28	0.00	36.57	18.43	25.71	7.57	35.90
Mean± SD	**0.00± 0.00**	**33.18**	**16.04**	**25.79**	**8.32**	**35.18**
May 8	1.20	41.29	24.00	26.29	7.14	22.69
15	2.00	37.43	20.86	26.00	8.14	30.33
22	7.80	35.43	20.14	28.86	12.57	38.01
29	11.60	35.71	19.86	27.86	12.00	34.01
Mean± SD	**5.65±4.94**	**37.47**	**21.22**	**27.25**	**9.96**	**31.26**
Jun. 5	25.60	37.00	23.00	27.43	9.57	29.06
13	19.80	34.57	22.00	33.00	10.71	33.10
21	12.20	37.86	23.43	26.86	7.29	28.11
28	5.80	40.00	25.29	30.43	6.29	29.54
Mean± SD	**15.85± 8.66**	**37.36**	**23.43**	**29.43**	**8.46**	**29.95**
Jul. 8	0.00	38.00	24.00	25.86	8.57	32.73
17	0.00	38.86	25.29	22.86	1.43	27.57
24	0.00	37.86	23.43	26.86	7.29	28.11
31	0.00	37.71	24.43	29.43	2.86	31.29
Mean± SD	**0.00± 0.00**	**38.11**	**24.29**	**26.25**	**5.04**	**29.93**
Aug. 9	0.00	39.00	25.43	28.14	1.43	31.01
14	0.00	39.00	25.43	28.14	1.43	31.01
21	0.00	37.14	23.57	29.71	3.57	33.44
28	0.00	38.29	24.00	29.14	1.29	32.57
Mean± SD	**0.00± 0.00**	**38.36**	**24.61**	**28.79**	**1.93**	**32.01**
Sept. 5	0.00	36.14	23.14	32.00	3.29	41.89
12	0.00	35.57	21.71	26.29	5.57	40.44
19	5.80	35.57	22.14	27.14	12.14	37.39
26	18.80	32.00	19.29	28.71	8.71	45.34
Mean± SD	**6.15± 8.87**	**34.82**	**21.57**	**28.54**	**7.43**	**41.26**
Oct. 2	56.00	32.00	19.29	28.71	8.71	45.34
9	87.00	30.86	15.14	27.00	7.57	52.07
16	95.00	35.71	19.57	22.00	5.14	41.44
23	78.40	30.57	17.57	28.29	10.57	47.79
Mean± SD	**79.10± 16.83**	**32.29**	**17.89**	**26.50**	**8.00**	**46.66**
Nov. 6	63.00	30.43	17.43	22.43	3.14	48.76
13	55.80	29.57	14.43	16.43	1.43	54.34
20	26.60	26.71	14.29	19.57	0.86	61.29
26	8.00	25.71	11.00	17.00	3.43	52.34
Mean± SD	**38.35± 25.63**	**28.11**	**14.29**	**18.86**	**2.21**	**54.18**
Dec. 4	0.00	27.00	12.00	19.43	1.86	47.93
11	0.00	21.57	9.43	19.71	0.00	49.46
18	0.00	20.00	9.00	17.86	0.86	59.09
25	0.00	17.14	4.57	22.57	2.00	58.87
Mean± SD	**0.00± 0.00**	**21.43**	**8.75**	**19.89**	**1.18**	**53.84**
R^2 (%)		**0.51**	**0.24**	**2.10**	**0.54**	**16.92**
Correlation Coefficient		**-0.02266^{ns}**	**-0.00184^{ns}**	**-0.10447^{ns}**	**0.11018^{ns}**	**0.30525^{**}**

() = Avg. egg no. based on ten 5 branches/trees/direction weekly

***= significant at 0.05 level of probability, **= highly significant at 0.01 level of probability, and ns= Insignificant**

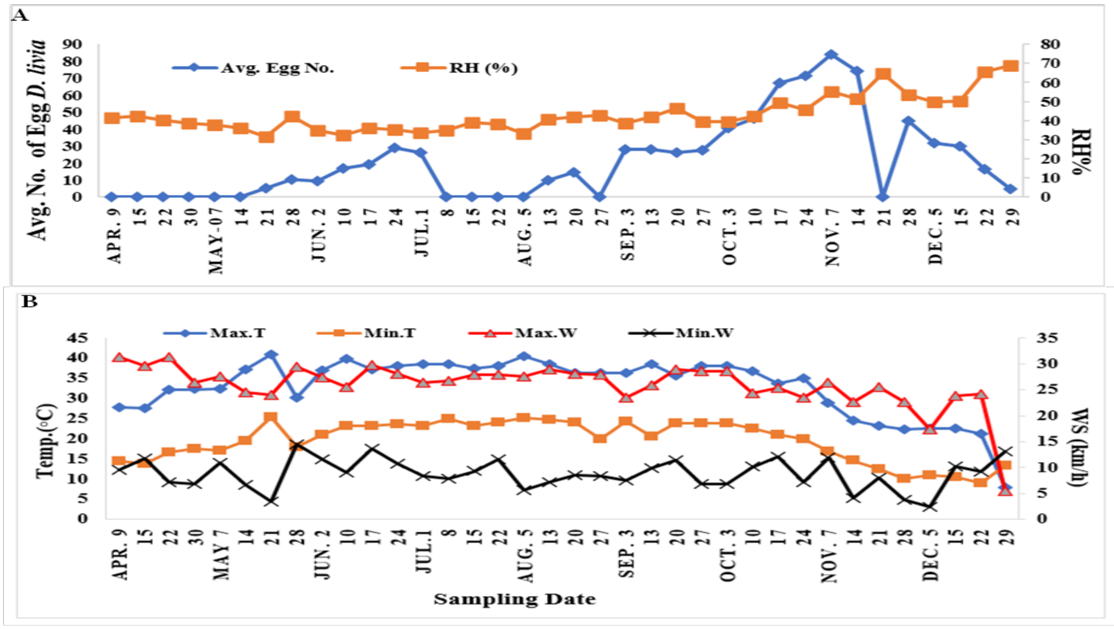


Fig.1. The average number of *Deudorix livia* eggs counted under ambient weather factors during the 2020 growing season: A) Average of egg number and relative humidity (%), B) Maximum & minimum temperature (°C), and maximum &minimum wind speed (km/hr)

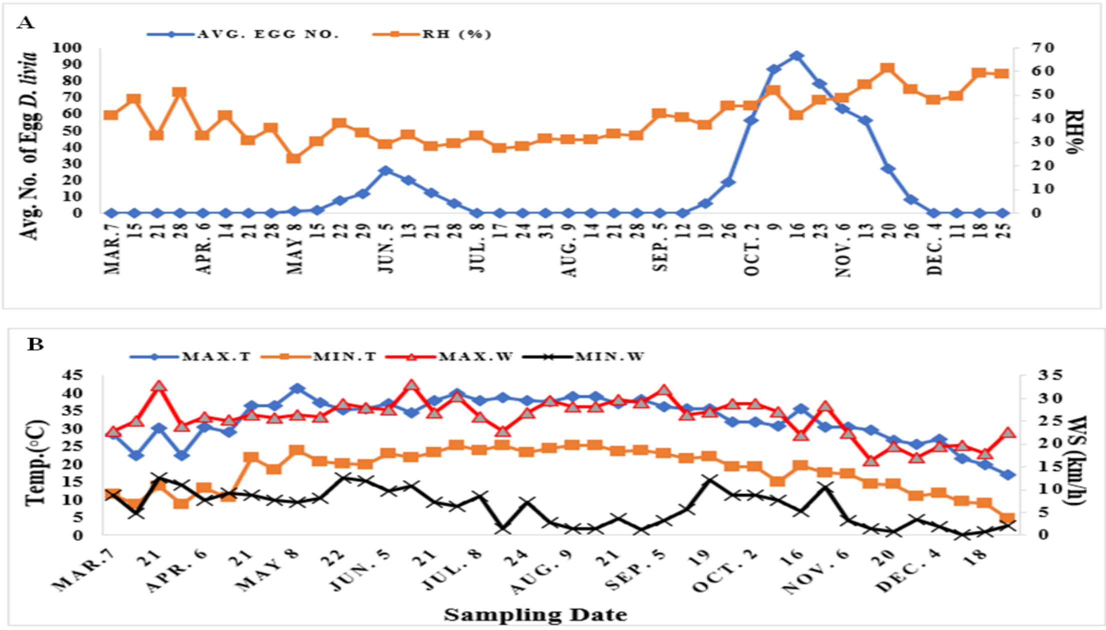


Fig.2. The average number of *Deudorix livia* eggs counted under ambient weather factors during the 2021 growing season: A) Average of egg number and relative humidity (%), B) Maximum & minimum temperature (°C) and maximum & minimum wind speed (km/hr)

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تواجد أبـي دقيـق الرمـان *Deudorix livia* Klug (Lepidoptera: Lycaenidae) اثنـاء مراحل النمو المختلفة لعوائله النباتية وتذبذب أعداده على صنف الرمان المنفلوطي في محافظـة أسيوط، شمال صعيد مصر

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الملخص

تمـت الدراسـة الحاليـة علـى تواجـد الاطـوار الكاملـة وغيـر الكاملـة لأبـي الـدقيق الرمان *Deudorix livia* Klug., التابع لرتبة حرشفية الاجنحة وعلاقه تواجده بمراحل نمو بعض عوائله النباتية مثل الفتنة والرمان. تم دراسة تذبذبات تعداد بيض أبو دقيق الرمـان علـى صـنف الرمان المنفلوطي خـلال موسـمين متتـاليين 2020 و2021 وتحـت تـأثير بعـض العوامـل المناخيـة (درجة الحرارة العظمي والصغرى، الرطوبة النسبية، وكذلك سرعة الرياح القصوى والصغرى).

أشارت النتائج إلى أن أشجار الفتنة هي العائل النباتي الرئيسي لأبي دقيق الرمـان. كمـا أنهـا تعتبر المصدر الرئيسي للإصابة في حالة غياب الطـور النبـاتي المناسـب للإصـابة بالحشـرة علـى عوائله النباتية الاخرى. التسجيل الأول لأعداد البـيض والحشـرات الكاملـة بعـد أسـبوعين وسـبعة أسابيع من تكوين الثمار وذلك خلال عامي 2020 و2021م على التوالي.

التذبذب في تعداد البيض بلغ ذروته وسجل ثلاثة قمم في عام 2020م، بينما في عام 2021 م سجل عدد اثنين قمة. وكان شهر أكتوبر الأفضل لوضع البيض خـلال موسـمي الدراسـة وذلـك تـم تسجيل أعلي معدلات لوضع البيض بهذا الشهر وقد تزامن ذلك مع وقت الضرر لثمار الرمان فـي تلك الفترة.

وجد أن قيمة معامل الارتباط بين متوسط تعداد البيض والسرعة القصوى للريح كانت سالبة ومعنوية جداً ($r= -0.36776, P= <.0001$) في عام 2020 م بينما في عـام 2021 م كانـت سـالبة وغير معنوية($r= -0.10447, P= 0.1410$) .

وفى الخلاصة فإن الفائدة من تحديد أقصى تعداد لهذه الآفة يعتبر من الأهمية بمكان لتأسيس برنـامج مكافحـة مناسـب قبـل وصـول تعـداد الحشـرة الـى اقصـى ذروة أو عنـدما تصـل الإصـابة بالحشرة الـى الحـد الاقتصـادي الحـرج للضـرر. وهـذا البحـث يمثـل اهميـة لتوجيـه اسـتراتيجيات المكافحة لمنع مثل هذه الافه من وضع البيض علي ثمار الرمان.