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Some Biological Aspects of Black Fly *Aleurolobus marlatti* (Hemiptera: Aleurodidae) on Christ–Thorn in Baghdad

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Abstract

This study aimed to reveal some biological effects of black fly *Aleurolobus marlatti* (Hemiptera: Aleurodidae) on Christ-thorn. The research work was conducted in Baghdad during the period extending from June 2015 to March 2016. The purpose was to count the number of black fly *A. marlatti*'s generations, the appearance period, the overwintering insect and the appearance date. The results showed that the adult appearance began in the last week of March in the field. The generations were marked by insect population that fluctuated between highs and lows. Generations were analyzed both on an annual and monthly basis depending on fluctuations in temperature and relative humidity. The number of insects were noticed in the form of eight peaks representing eight generations per year in central Iraq.

1. Introduction

The Seder plant of small fruit trees is spreading in the tropics and subtropics, in the northern hemisphere and especially in the Indian subcontinent and China (1). It is one of the ideal trees to plant in arid and semi-arid regions, preferably grown in alkaloid soils (2). Seder belongs to the family Rhamnaceae and order Rhamnales, which includes about 58 genus and 600 species between trees and shrubs and climbers and herbs rarely (Al-Junddi et al., 2000). In Iraq, there are four genes comprising 32 species, including the Iraqi species (3) that has economical and

medicinal importance and other benefits, such as the high nutritional value of its fruit. Seder fruit contains high content of carbohydrates (amounting to 17.00g/100g of fresh pulp), total carbohydrates range between 5.40 - 10.50 g / 100 from the core of the fruit. Moreover, the plant also contains fats, proteins, and other metal elements (4,5). Seder trees also serve several other benefits such as the use of leaves, roots, and barks for animal feed and use in medical treatment because of the presence of alkaloids (6). Seder trees found in Iraq are damaged by many pests such as mealy bug kind *Icerya aegyptiaca*,

scale insects, types of Mites (7) fruit fly *Ceratitus capetata*, Naboke fruit fly (8), Naboke worm, and Naboke leaf miner (9). Quaintance which belong to the family Aleuyrodidae, order Hemiptera, is also observed as black fly including *Alurolobus marlattii*. The first epidemic spread on Seder plant in Diyala province was observed in April, 2012. The samples were sent to biological control research unit and after an inquiry was found widespread in most provinces of Iraq (10).

Black flies are small insects ranging in length from 2-3 mm (11). Adult winged insect in both sexes have two pairs of wings covered with powder which is waxy white or brown or black in color. Black flies are generally an important insect group affecting a wide range of plant families all over the world (12). It is one of the dangerous pests since the nymphs and adults feed directly on plant sap, causing significant damage through sucking in the pot cortical leaves and draining the contents of sugars and amino acids (13). They also harm the plant indirectly by secreting honeydew that covers the leaves, fruits and prevents the photosynthesis process, as well as the negative impact of transpiration process, due to the collection and adhesion of dust to prevent the reaching of the sun's rays to the surface cells, leading to yellowish leaves and death (1).

2. Material and Methods

2.1. Study generation number of black fly *A. marlattii* at field

Ten cages of 15 × 30 cm diameter manufactured from water cans were coated by cotton cloth to keep both ends open for the entry of branch of Seder plant (Fig 1). Later, both sides of cans were tied

tightly with the tape and cotton cloth to avoid the entry of parasitoid and predators and for maintenance of optimum environmental conditions (such as temperature and relative humidity for the insect stage development). Branch infected with black fly *A. marlattii* was hooked inside the cage and to release a pair of newly emerging black fly inside the cage. Data was taken every week for a period of a full calendar year and recorded in the tables prepared especially for this purpose.



Figure 1. Calculate the Number of Generations of Black Fly *A. marlattii*

Study a black fly *A. marlattii* overwatering. For the purpose of examining the black fly *A. marlattii* overwatering, the researcher prepared a wooden cage with dimensions 60x60x60 cm, cage base was made of wood and the upper facade remained open, able to plant service, covered with a cloth muslin. The researcher placed five small pots 12x12 cm. It included all potted gesture and one of the young Seder plants with the height of 10 cm. Each plant carried 100 immature stages of all immature insect stages (eggs, instarst, instarnd, instarrd, a pupa) obtained from previous breeding for the purpose of this study. This cage was put in the home garden to simulate field conditions.

Monitoring continued from the hatching of eggs to the development of nymphs to the pupa stage and the emergence of adult. Record the following:

Number of nymphs formed from hatched eggs.

Number of nymphs advanced to pupa stage.

Number of adults emerging daily on the basis of hatching date, evolution and emergence.

3. Results and discussion

3.1. Count the number of generations of black fly *A. marlatti* detected in different environmental conditions

The results in table (1) (fig.2) explain that there are eight generations of black fly *A. marlatti* by the first batch eggs of the insect. The first generation started hatching in May, when females put the first fertilized batch eggs on Seder leaves in the cages, when temperatures were 39-25.6⁰C and relative humidity was 20%. The second generation put the first batch eggs at the beginning of June, when temperatures were 43-25.4⁰C and relative humidity was 21%.

The first batch continued the development of third generation eggs on the third of July. To complement generation members for development at temperatures 46.33-28⁰C and relative humidity 21.39%, beginning in August, put the first egg batch of fourth generation which developed when temperatures were 44.24-25.98⁰C and relative humidity was 24.96%. Then the end generation was complete with the

first batch of the fifth generation on the first of September to complement its life cycle within a temperature range of 21.90- 42⁰C and relative humidity of 28.16%.

The first egg batch of sixth generation put after the end of last generation on the third of October when the temperatures were 31.74-17.56⁰C and relative humidity was 45%. Then this generation continued up to the nineteenth of November, until the beginning of the seventh generation, which evolved its members to the pupa stage at the end of January when temperatures were 9-19.21⁰C and relative humidity was 78.8%. Pupa entered in overwintering in December when temperatures were 6.4-16.7⁰C and relative humidity was 67%. In February, the temperatures were 9.4 -29.7⁰C and relative humidity was 65% and remained so up to the twenty-fifth of March.

The adult emergence date when temperatures were 9.4-29.34⁰C and relative humidity was 45.28% as the eighth and last generation began to put the first batch eggs on the twenty eighth of March until the tenth of May when temperatures were 16.29-29.3⁰C and relative humidity was 42.53%.

Existing literature suggest that *Aleurocanthus woglumi* Ashby or a citrus blackfly was first discovered in 1976 in Fort Lauderdale. Parasites *Amitus hesperidum* and *Encarsia opulenta* have been reported to control citrus blackflies. Another facultative hyperparasite *Encarsia smithi* (Silvestri) showed intermediate dominance in the control of citrus blackflies.

Table 1. Implementation of the First Batch Egg Dates of Black Fly *A. Marlatti* in Locally Made Cages to Calculate the Number of Generations in the College Of Agriculture for One Year

The Date	The first egg hatches	Generation period
01/05/2015	37	31
02/06/2015	36.4	30
03/07/2015	39.6	28
01/08/2015	36	30
01/09/2015	37.2	31
03/10/2015	30.8	45
19/11/2015	24	43
01/01/2016	0	31
01/02/2016	0	28
01/03/2016	0	25
28/03/2016	29.6	44

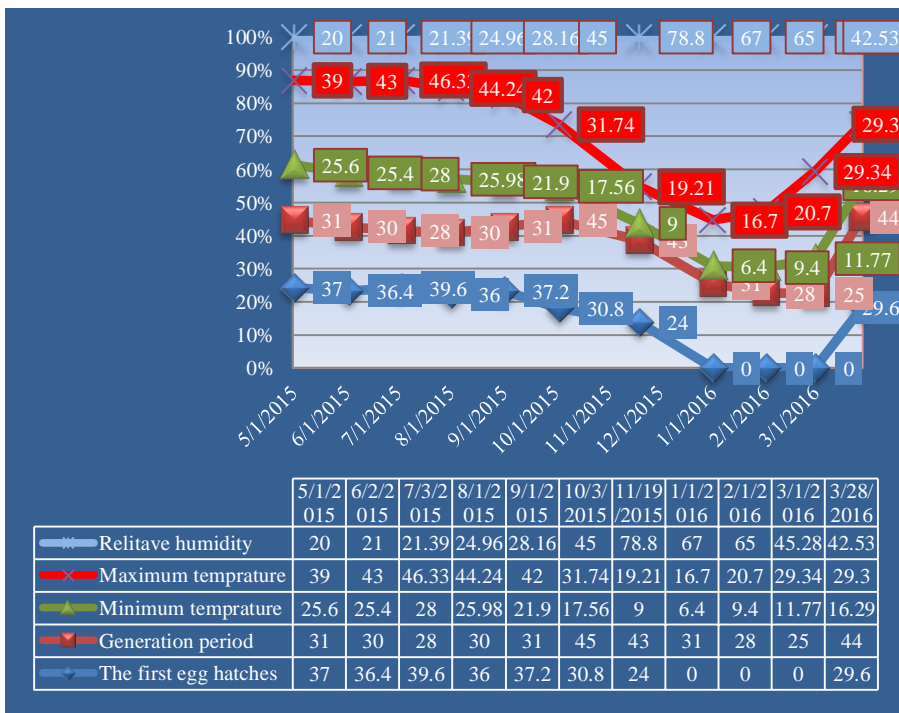


Figure 2. The first batch eggs dates of blackfly *A. marlatti* in cages made locally to calculate the number of generations in the College of Agriculture for one year in the minimum and maximum temperatures and relative humidity

In light of the foregoing note, the presence of eighth generation of black fly on Seder leaves in Baghdad, with continued generation for October and December of 2015 to more than forty days as a result of low temperatures (17.56 -31.74^oC and 9-19.21^oC respectively), as well as in March and April and at the beginning of June (16.29-29.3C^o), compared with May, June, July, August and September as minimum temperature did not fall 21-39^oC respectively. Major decrease in temperatures happened in January, February, and up to twenty-fifth of March, which led the pupa stage to the entry in overwintering phase a last generation for 2016. The citrus black fly *Aleurocanthus woglumi* has 5-4 generations in Florida (14). (Vulic and Beltran, 1977 found that the wooly white fly *A. floccosus* has 7-6 generations in Spain, while it has 4-6 generations in Italy and Greece (15). The white fly *A. takahshi* has been reported to have 8-10 generations in a year in southeast China.

3.2. The Diapause

The results in Table 2 revealed that the insect black fly *A. marlatti* spends winter by eggs stage, instarrd pupa on Seder leaves, the adults stopped for insect emergence during the first half of November and the first week of December, minimum temperatures were 13.2^oC, 7.9^oC, and 24.4 C^o while the maximum was 18.5^oC and relative humidity was 66% and 71%, respectively (Fig. 3). The insect continued egg stage, instarrd and a pupa throughout the winter period during December, January and February until the last week of March 2016, with 5% hatching percentage in mid-April and the diapause period of 156-161 day (Fig.4), when the average

minimum temperature was 16.78^oC and the average maximum temperature was 31.35 C^o, while relative humidity was 36.75%.

Eggs continued hatching and reached the highest hatching percentage during the second half of April, reaching 35% and the hatching period of 156-166 days, when the average minimum temperature was 17.10^oC and the maximum was 31^oC, while relative humidity was 33.1%. At the end of April, the hatching rate was 12% and the diapause period was of 156 -176 days when minimum temperature was 16^oC and the maximum was 31.1^oC, while relative humidity was 24.0%.

The total hatching rate reached 52% and that the percentage of non-hatching was 48% which can be attributed to exposure to harsh environmental conditions, the larval nymphs did not develop to instarnd and instarrd but perished soon, as falling maximum and minimum temperatures claimed the lives mid-November, while instarrd evolved into pupa after the diapause period that continued for 161-166 days and began in the first half of November when evolution was 10% (Fig. 5), minimum temperature was 16.7^oC and the maximum was 31.2^oC, while relative humidity was 39.5% .

While evolution of nymphs increased to pupa for up to 69%, overwintering duration was 161-171 days when the minimum temperature was 16.68^oC and the maximum was 31.35^oC, while relative humidity was 36.75%. The lowest percentage of evolution was 6% at the end of the April. It lasted with an overwintering period of 161-186 days, when minimum temperature was 16^oC and the maximum temperature was 31.1^oC,

while relative humidity was 24.0%.The total development percentage amounted to 85% while the evolution failure rate was 15% which has been attributed to the harsh environmental conditions and natural enemies, especially exoparasites such as *Encarsia* spp and *Eertmocerus* spp.

The adults began to emerge during the last week of March by the emergence percentage of 11%. The overwintering period was 110-115 days (Fig. 6) when minimum temperature was 11.63°C and the maximum temperature was 25.6°C, while relative humidity was 42.93%. The adult continued to appear and reached the highest emergence percentage during the first half of April, reaching 67% with the overwintering duration of 110-120 days, when average minimum temperature was 16.7°C and the maximum was 31.2°C, while relative humidity was 39.3%. During the second half of the same month, the low percentage of appearance reaching 13% with the overwintering period of 110-135 days was recorded, when average minimum temperature was 17.1°C and the maximum was 31°C, while relative humidity was 36.13%.

The results revealed that the total emergence percentage was 91% and the failure rate from pupa overwintering to adult amounted to 9% which can be attributed to the impact of harsh environmental conditions and decrease temperatures in the winter or to the vital natural enemies of this insect, especially pathogenic fungi as a result of exposure to rain. The adult insect emergence during

this time period may be due to the necessary photoperiods to break down the insect overwintering phase in the insect, as well as the appropriate environmental conditions for the insect development period. The study concludes that the first date of adult emergence from overwintering phase is during the last week of March, which informs us to take timing control programs. This study corroborates with the study published by Dowell and Fitzpatrick, (1978) that showed that the white fly *A. takahashi* spends its overwintering period in nymph and pupa stage (16), the white citrus fly *D. citri* spends its overwintering period instarnd to pupa in the citrus orchards situated at Florida, US. As mentioned by Cherry et al. (1979), the critical degree of evolution of whiteflies is relatively low as compared to the black fly (17). Uygun et al. (1990) noted the survival rate of the wooly fly *A. floccosus*, when field conditions amounted to 27% in summer and 40.9% in winter, while it was for the species *D. citri* 50.4% summer and 23.7% in winter (18).

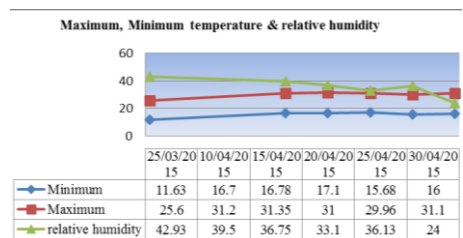


Figure 3. Maximum and minimum temperatures and relative humidity to study the diapause period

Table 2. Stages Diapause Period of Blackfly *A. marlatti* According to the Hatching, Development and Emergence

Insect stages	Diapaus period/day	Minimum temperatur	Maximum temperatur	Relative humidity	date of hatching, emergence & developm	Hatching , Developed & emergence percentage%
Eggs	156-161	16.78 °C	31.35 °C	36.75%	15/4/2016	5 %Hatching eggs
	156-166	17.10 °C	31 °C	33.1%	20/4/2016	35 %Hatching eggs
	156-176	16.0 °C	31.1 °C	24.0%	30/4/2016	12 %Hatching eggs
	Total					52%
Instar st	Didn't develop and dead					
Instar nd	Didn't develop and dead					
Instar rd	161-166	16.7 °C	31.2 °C	39.5%	10/4/2016	10%Developed to pupa
	161-171	16.78 °C	31.35 °C	36.75%	15/4/2016	69% Developed to pupa
	161 -186	16.0 °C	31.1 °C	24.0%	30/4/2016	6% Developed to pupa
	Total					85%
Pupa	110- 115	11.63 °C	25.60 °C	42.93%	25/3/2016	11 %Adult emergence
	110-120	16.7 °C	31.2 °C	39.5 %	10/4/2016	67 %Adult emergence
	110-135	15.68 °C	29.96 °C	36.13 %	25/4/2016	13 %Adult emergence
	Total					91%

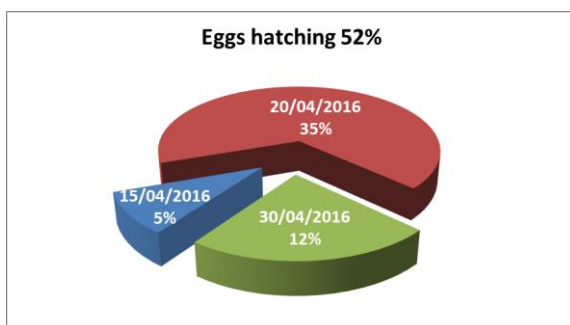


Figure 4. The eggs hatching percentage after the overwintering stage with the egg hatching date that shows the highest rate is 35% on 20/4/2016, the lowest is 5% on 15/4/2016

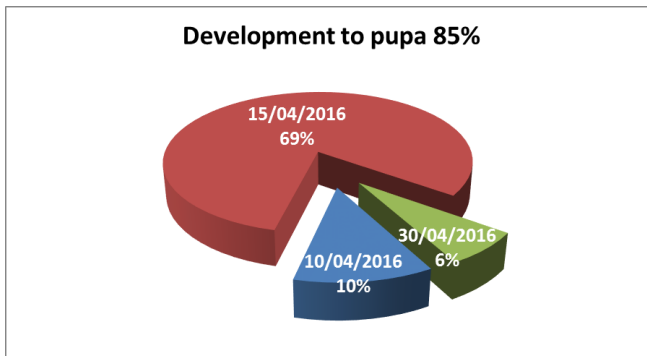


Figure 5. The development percentage from instar to pupal stage with the development date that shows that the highest rate is 69% on 15/4/2016, the lowest is 6% on 30/4/2016

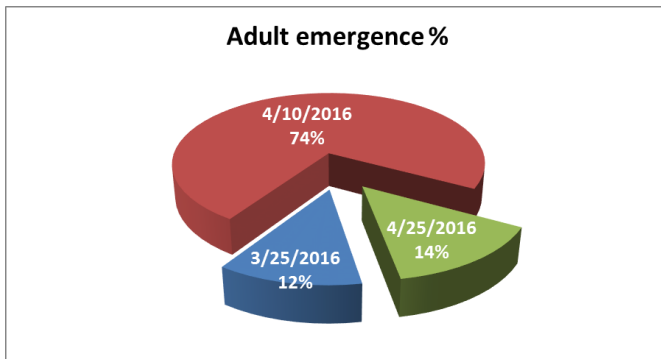


Figure 6. Adults emerging percentage from pupal overwintering stage with the emerging date that shows that the highest rate is 74% on 10/4/2016, the lowest is 12% on 25/3/2016

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