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Predatory Efficiency of *Eupoedes Corollae* (Fabricius)(Diptera: Syrphidae) to Different Densities of *Aphis Gossypii* and *Aphis Nerii*

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Abstract

Predatory efficiency of Eupoedes corollae predator's larvae toward densities of 25, 50, 75, 100 insect of Aphis gossypii and of Aphis nerii, a study was carried out of the laboratory in growth chamber with a temperature of 24±1 C◦ and 70 ± 10 % RH and photoperiod 12: 12 hours. The results showed that the predator E. corollae larvae consumption in different percentage according to the prey's species and the number provided, and that 50 density of cotton aphid was the best in the daily and total consumption of E.corollae predator, in addition to the relatively low development period of predator larvae at the same density. The average of consumption of the predator's larvae instars was proportional to the different densities of the aphids 25, 50.75 and 100 insect, as it reached to (84.64, 143.16, 170.9 and 217.93) of cotton aphid and (56.23, 110.67, 124.78 and 148.16) insects of oleander aphid , respectively. The average of aphid is estimated at 154.2 and 110.2 insect, respectively, for the two species with significant differences between them.

Keywords. Predatory efficiency, Eupoedes corollae, Aphis gossypii, Aphis nerii.

1-Introduction

Diptera have 150,000 species of 158 families, spread worldwide except Antarctica [1,2]. The family syrphid is called hoverflies or flower flies [3]. Species of flower flies are spread in most countries of the world and include 207 species and more than 6,100 species [4,5]. The species differ in shape and behavior, such as those that feed on leaves or bulbs and fungi, some species live in wet wood, mud, dung, or polluted water and decaying plants. While other species are rearing on degradable animal materials, the majority individuals of this family's larvae usually prey and feed on aphids, psyllid, white flies, mealybug, cicada and scale insects [6]. Flowerflies species have many important characteristics such as specialization in prey species, their high capacity to exploit natural resources and distribute eggs over large areas [7], their ability to prey to higher numbers of aphids than they need to develop [8]. The aphid is a major pest in the agricultural ecosystem [9] and, to the extent that the aphid are more harmful, it lives in colonies that

include the stages of nymphs and adults, and is characterized by short life cycles and parthenogenesis reproduction most days of the year. In addition to its many generations, it may reach 60 generations a year [10,11]. The predatory ability of flower flies varies according to their stages and the stages and species of prey. Murdoch [12] proposed the concept of the developmental response in his analysis of predation reactions, which relate to predator development and its role in predation. Due to the lack of studies on flower flies predators in Iraq, the study aimed to establish the predatory efficiency *E. corollae* and can be employed the predator in biological control, and in integrated management programs of different aphid species**.**

2-Materials and Methods

2.1 Breeding of Flower Fly Predator E.corollae

In January 2021, adult flower flies were collected from fields belonging to the Faculty of Agricultural Engineering (Jadriya), in a direct sweeping net and then placed in transparent plastic tubes 3 cm in diameter and 6 cm in height. It was brought to the laboratory as a nucleus to prepare the laboratory colony necessary to provide the study with the numbers required by the predator to carry out the tests, after confirming the morphological diagnosis of the predator isolated the females and males, they were placed in a cage prepared for this purpose made of wood dimensions (40 x 40 x 40 cm). The top surface and sides were tightly covered with white boring cloth to prevent the escape of adult, supplied with food consisting of 10 – 20 pollen grains, 7-10 grams of sugar and distiled water [13], the cage also provided some flowers of acacia trees for adaptation and feeding on its back and the sugar solution was provided by immersing a small piece of saturated cotton in a transparent plastic dish with a diameter of 9 cm and a height of 1.5 cm [14].

The cucumber planted on 1 February 2021 in the Department of Plant Protection, Ministry of Agriculture, in the plastic house with an area of 300 m^2 with central ventilation and the front door was sealed, and after the plants grew to a height of about 10 cm, they were infested with a cotton aphid after being diagnosed. After acquiring various stages of the aphid it was taken sufficient numbers to conduct various experiments in the study to feed predator larvae in growth chamber at a temperature of 24± 1 C° and relative humidity of 70-10% and photoperiod 12: 12 hours [15]. The *Aphis nerii* was obtained from the oleander planted in the surroundings of the College of Agriculture's ancient site/Abu Gharib. I took the predator larvae one day from the study cages, and each was placed in a clear plastic dish with a diameter of 9 cm and a height of 1.5 cm, each of which was prepared daily with the intensities 25, 50, 75 and 100 insects of cotton aphid and oleander aphid , with 5 replicates per treatment and each replicate 10 larvae per species It was fixed with a tight rubber band, and the dishes were placed in the growth chamber at a temperature of 24± 1 C° and relative humidity of 70-10% and photoperiod 12: 12 hours , and is the number of aphids consumed daily by the predator's larvae and each of its instar, as calculated the duration of the instar, the rate of numbers consumed per instar, and the percentage of consumption in each treatment. The predatory efficiency values were from calculated the following equation [16,17]:

$$\text{Daily Predatory efficiency} = \frac{\text{Number of aphids consumed by the larvae instar}}{\text{Duration of the instar}}$$

$$\text{Percent of numbers consumed} = \frac{\text{whole instar} - \text{consuming number}}{\text{total number consumed by all instar}} \times 100$$

2.2 Statistical Analysis

The experiment was designed in full Random Design (CRD) using a variance analysis table to compare average results using the least-probability LSD test at 0.05, and the software used SAS, Ver. 9.1 [18], in results analysis.

3-Results and Discussion

3.1 The Effect of the Population Densities of the Cotton Aphid A. Gossypii and the Oleander Aphid A. Nerii on the Consumption and Development Period of the First Larvae Instar of the Predator E. Corollae

The results of the table (1) showed that there are no significant differences in the daily consumption average when the first instar is feeding on a cotton aphid and the oleander aphid reached to 22.10 and 21.96 insects respectively. While there were significant differences in the total consumption average and the duration of the larvae when it was feed on the two species aphids, which reached to 66.1, 50 and 2.8 and 2.5 days respectively. The difference in the daily average of consumption of the first larvae instar according to the prey specie. When the predator was fed at different densities of the cotton aphid, it was found that the daily consumption average was inversely proportional to the prey density, where the daily consumption average was 14.10, 12.90, and 16.36 insects, respectively, for the densities of 25, 50 and 100, without any significant difference, while the predator was fed at different densities of the oleander aphid the daily consumption average was 20.70, 27.40, 29.70 and 31.60 insects, respectively, for the densities 25, 50 , 75 and 100 without any significant differencesl. The results also showed that the highest total consumption during the larvae instar was 90.20 and 68.30 insects, respectively, at 75 density of the oleander aphid and cotton aphid . The lowest total consumption average when the predator feeds on a cotton aphid at a density of 50 insect was 31.50 insects . the highest instar duration was 2.96 days, for the densities 25 insects of cotton aphid and the lowest was 2.00 days, at a density of 100 insects for the oleander aphid ,with significant differences.

Table 1. Number of the daily and total prey consumed and duration of the first larvae instar of predator *E. corollae* at different densities of *A. gossypii* and *A. nerii* in growth chamber.

Density	Prey specie	Daily consumption	Total consumption	% consumption	instar duration (Day)
25	*A. gossypii*	14.10	41.10	5.40	2.96

50		12.90	31.50	5.30	2.63
75		23.30	68.30	4.20	2.47
100		16.36	54.30	4.60	2.93
average		21.96	66.10	5.00	2.80
25	*A. nerii*	20.70	64.90	6.20	2.80
50		27.40	56.60	5.50	2.50
75		29.70	90.20	5.00	2.73
100		31.60	57.70	4.30	2.00
average		22.10	50.00	5.30	2.50

	Daily consumption = 6.20
	Total consumption = 12.70
	Consumption % = .1.52
L.S.D. 5 %	Instar duration = 0.28
	prey species x density daily consumption=12.40
	prey species x density Total consumption = 25.30
	prey species x density to consume %= 4.80
	prey species x density of the larvae instar duration = 0.60

Effect of Population Densities of A. Gossypii and A. Nerii on the Consumption and Duration of the Second Larvae Instar of the Predator E. Corollae

The results of the statistical analysis in Table (2) showed that there were no significant differences in the daily consumption average of the second larvae instar of the predator *E. corollae* on the cotton aphid and the oleander aphid reached 43.17 and 40.18 insects respectively, while there were significant differences in the total consumption average of 114.13 and 82.10 insects respectively. With a similar consumption average of 8.4 and 8.3% respectively, the results indicated that there was significant difference in the average duration of the second instar of the predator reaching 2.80 and 2.30 days respectively.

The highest daily consumption at 100 and 75 density was 73.21 and 64.00 insect, with a total consumption average of 137.30 and 137.30 respectively, of the oleander aphid, and the lowest daily consumption average of the predator at 25 and 50 density of the cotton aphid at 21.53 and 22.82 insect, respectively. The highest average of total predator consumption of a oleander aphid at 25 density was 153.50 and the lowest average was 47.50 cotton aphid at 50 insect density, In the same context, the highest instar duration was 3.20 days at the density of 25 cotton aphid, and the least 2.00 days at the density of

100 oleander aphid and with significant differences.

Table 2. Number of daily and total prey consumed and duration of the second larvae instar of predator *E. corollae* at different intensities of *A. gossypii* and *A.nerii* in growth chamber.

Density	Prey species	Daily consumption	Total consumption	% Consumption	instar duration
25	*A. gossypii*	21.53	69.10	9.10	3.20
50		22.82	47.50	7.50	2.40
75		32.30	96.70	10.00	2.70
100		31.80	57.40	7.00	2.40
average		43.17	114.13	8.40	2.80
25	*A. nerii*	54.89	153.50	9.40	2.90
50		32.90	86.00	5.80	2.20
75		64.00	137.30	7.70	2.40
100		73.21	137.30	10.20	2.00
average		40.18	82.10	8.30	2.30
	Daily consumption = 4.60				
	Total consumption = 19.60				
	% Consumption = 2.30				
L.S.D	Instar duration = 0.39				
	prey specie x density daily consumption=9.30				
% 5	prey specie x density total consumption = 39.24				
	prey specie x density for consumption %= 4.70				
	prey specie x density of the larvae instar duration = 0.80				

Effect of the Population Densities of A.Gossypii and A.Nerii on the Consumption and Development Period of the Third Larvae Instar of the Predator E.Corollae

Statistical analysis of the results in Table (3) indicate a variation in the daily and total consumption average according to the prey species ,.the third instar exceed on the cotton aphid consumption more than oleander aphid reached (50.00 , 45.70) and (282.50 , 198.30) insects and the consumption average was 20.10 and 20 00. %, respectively. It was also found that the growth period of the third instar was 5.60 and 3.90 days respectively when the predator consumed a cotton aphid and oleander aphid with a significant difference between them.

The highest daily consumption of the third instar that found at the density of 75 and 100 insects of the cotton aphid and

oleander aphid , were 42.43 and 76.20 insects, respectively, and the lowest at the density of 50 insect, was reached 18.70 and 49.50 insect, respectively. The highest total consumption average was 264.50 at 75 density, and the least was 89.70 at 50 density of the cotton aphid with a significant difference, while, this instar recorded the highest total consumption of 294.30 at 25 density, and the lowest reached 231.80 at 50 density of the oleander aphid and at a relatively close consumption average between densities.

This instar took the highest development duration at 75 insect density of 6.30 days and the lowest at 50 insect density of 3.70 days of the cotton aphid with a clear significant difference, also in case of consumption of the oleander aphid the highest duration of this instar was at 75 density of 5.90 days and the lowest at 100 density was 3.60 days.

Table 3. Number of daily and total prey consumed and duration of the third larvae instar of the predator *E. corollae* at different intensities of *A. gossypii* and *A. nerii* in growth chamber.

Density	**Prey species**	**Daily consumption**	**Total consumption**	**% Consumption**	**instar duration**
25	*A. gossypii*	22.70	144.80	18.80	5.70
50		18.70	89.70	20.50	3.70
75		42.43	264.50	19.13	6.30
100		38.60	219.57	21.60	3.90
average		50.00	282.50	20.10	5.60
25	*A. nerii*	62.70	294.30	17.70	4.70
50		49.50	231.80	22.10	4.30
75		72.30	426.40	20.60	5.90
100		76.20	251.97	19.60	3.60
average		45.70	198.30	20,00.	3.90
L.S.D 5 %	Daily consumption = 3.30 Total consumption = 40.20 % Consumption = 3.52 instar duration = 0.91 prey specie x density daily consumption=6.50				

prey specie x density total consumption= 80.50

prey specie x density for consumption %= 7.04

prey specie x density of the instar duration=1.80

Therefore, the predator *E. corollae consumes* its prey by a varying percentage in the larvae instars , and according to the prey species, it consumes the number it needs to grow and develop, and the two species of aphid are a major prey of the predators *E.corollae* and thus allow it to optimal grow, develop and reproduction [19,20]. In addition, this predator a specialized on the aphid insects .

It was revealed from results that the developmental period of *E. corollae* varied significantly with respect to instars. Results demonstrated that the body size of syrphid larvae increased gradually at different instar levels with the increase in the predation average on *A. pomi*, [21]. In addition, the density of 50 cotton aphid was optimal for the daily and total consumption of predator, *E. corollae* that the development time of predator larvae at the same density was relatively low. The quantity and quality of the prey available is one of the basic prop for the design and success of the breeding predators, and mass production.

In similar studies, showed a significant difference in the probability of 0.1 between the stages of the predator *E. Corollae* in the daily and total consumption of *A. Pomi* , the daily consumption average reaching to 6.68, 27.85 and 59.27 insects respectively, to the first, second, and third instar of the predator, third instar has consumed 66.09% of the total consumption of the larvae's stage was 392.20 insects [21].

In China, breeding successfully the predator *E.corollae* on four species of *(Macrosiphum avenae, R. padi, Acyrthosipum dirhodum , A.pisum*), which completed its development periods were 11, 10.2, 10.1 and 10.6 days respectively, and the predator did not complete its growth on *B.brassicae* [22]. The highest daily consumption of the predator *E. corollae* for its three instars when feed on green peach aphid was 10.4, 55.7 and 166.7 insect, respectively [23]. The effects of prey species on survival rate and development time differed: *A. pisum* was better food for *E. balteatus*, while the larval performance of *E. corollae* was enhanced by *A. craccivora* [24].

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