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EFFICACY OF CERTAIN PREDATORS IN CONTROLLING APHIDS ON NAVEL ORANGE TREES

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ABSTRACT: The aim of this research was to assess the efficacy of some predators worked as a biocontrol tool against the navel orange aphid species (*Aphis gossypii* (Glover), *Aphis citricola* (van der Goot), *Myzus persicae* (Sulzer), and *Aphis craccivora* Koch.) during a period of two seasons in 2021 and 2022. *Aphis gossypii* and *Aphis citricola* are the two main species of aphid discovered on navel orange plants. In the two seasons of the study, there were three abundance peaks of *Aphis gossypii*. In 2021, the numbers recorded in the third week in April and May, as well as the second week in June were 370, 450 and 454 individuals/40 leaves and recorded 281, 386, and 500 individuals during the first and fourth weeks of April and the fourth week of May in 2022, respectively. Meanwhile, *A. citricola* had two abundance peaks in both seasons: in 2021 (181 and 98 individuals/40 leaves) and in 2022 (245 and 295 individuals/40 leaves). *Coccinella undecimpunctata* L., *Chrysoperla carnea* Steph, *C. septempunctata*, *Metasyrphus corollae* Fand *Cydonia vicina isis* were the most common predators discovered on navel orange trees.. A few number of *Paederus alfierii* (Koch) and true spiders were the most common predators caught in navel orange trees. On navel orange trees, these predators recorded two peaks in two seasons (73 and 77 predators/40 leaves) during the first season, and (83 and 88 predators/40 leaves) during the second season, respectively. Two predators, *C. undecimpunctata* and *C. carnea*, that prey on *A. gossypii* were researched from a biological perspective at 21±1°C and 65± 5% R.H. *C. undecimpunctata* and *C. carnea* took 23.49 ± 1.40 and 25.01 ± 2.63 days, respectively, to develop from egg hatching to adult exclusion. The total consumption rate per *C. undecimpunctata* and *C. carnea* larva fed on *A. gossypii* were 567.50 ± 6.90 and 587.63 ± 9.27 when fed on *A. gossypii*. During their larval stages, *C. undecimpunctata* and *C. carnea* females generally lay around 315.85±5.17 and 321.52±6.19 eggs.

Key words: Aphid, predators, biology, navel orange.

INTRODUCTION

Aphid is one of the most significant piercing-sucking pests of greenhouse and field crops in the world **(Emden and Harrington, 2007)**. The green peach aphid, *Myzus presicae*, is a significant pest of a wide range of plants **(Joe and Jyoti, 2013)**. Plants from more than 40 groups are infected by *Aphis gossypii* and *M. persicae* (**El-Malak *et al*., 2000; Saleh *et al.*, 2017a**). Aphids can cause direct damage to plants by feeding on the sap or unintentional harm by transferring various virus diseases to the host plant (**Murati *et al.*, 2013**).

Many Egyptian researchers are interested in how predators affect *Aphis gossypii* and *Myzus persicae* **(Jabbar *et al.*, 2020; Saleh *et al.*, 2020).** The majority of pest management programmes rely on the application of chemical insecticides that are made as direct contact sprays or dusts that harm the environment. The solution to this problem is biological control, which includes efficient parasitoids and predators **(Mahfouz and Abou El-Ela, 2011; Zawrah *et al.*, 2020)**. Aphid is one of the most economically significant pest groups in agriculture because of its specific feeding and reproduction patterns. In the regions with a

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temperate climate it is considered the most important insect pest, especially when the infestation associated with the transmission of phytopathogenic viruses **(Minks and Harrewijn, 1989; Kamel 2010).** Even though parasitoids and predators are generalists that feed on a variety of prey and hosts, they exhibit a preference or occurrence for a particular species of prey or host **(Venzon *et al*. 2002; Youssif *et al*., 2021).** Predators are one of the most common types of biocontrol factors used to control aphids. These are categorised as Coccinellidae and Chrysopidae, and they consume other small insects during their larval and adult stages in addition to sap-sucking pests like aphids, white flies, jassids, and mites **(Mannan *et al*., 1997; Borges *et al*., 2011; Mohamed *et al*., 2018).** Therefore, the goal of this research is to investigate:

1. Seasonal abundance of aphid species and the predators that prey on them on navel orange plants in 2021 and 2022 seasons.
2. Study some biological aspects of *Coccinella undecimpunctata* and *Chrysoperla carnea* when reared on *A. gossypii*.

MATERIALS AND METHODS

Seasonal Abundance of Aphid Species and Their Predators on Navel Orange Trees

Five feddans of land were cultivated in Kafer Saqr Sangha village district, Sharkia Governorate, during the two study seasons 2021 and 2022. A weekly sample size of 40 leaves was randomly selected from four trees that were being grown for navel orange trees. No chemicals were employed for control; only standard agricultural procedures were used. Four identical orange trees of the same age, size, and form were randomly selected from each orange tree and designated for the current study. Ten leaves of varied sizes were chosen from the tree's various locations, including its periphery, inner zone, lower, and middle strata, producing a sample of forty infected leaves. After being put in paper bags, the samples were taken to the lab. Adult and nymph aphids were counted separately. The majority of the time, predators were counted immediately, albeit in a few instances, laboratory rearing was necessary from immature to adult stages.

Biological Studies

Developmental periods of *C. undecimpunctata* and *C. carnea* stages

Durations of larval and pupal stages and larval feeding capacity

For this experiment, 30 eggs were taken from the lab colonies. In a Petri dish (12 cm in diameter), moistened filter paper was used for preserving eggs. The eggs were monitored daily until they hatched. Until pupation, the newly hatched larvae were carefully moved into additional Petri dishes (12 cm in diameter). Each stock culture's adult *C. undecimpunctata* was transferred to a single, large Petri dish (200 mm in diameter by 9 mm in height) with filter paper on the bottom and kept in cohort for mating. Each mating pair was carefully relocated to a different Petri dish (100×9 mm). Aphid nymphs were added to each Petri dish for the *C. undecimpunctata* pair and provided daily with new aphid nymphs. Until egg laying, each pair received one type of aphid per treatment group. The eggs were gently relocated to a new Petri dish Aphid nymphs were added to each Petri dish for the *C. undecimpunctata* pair, who received daily additions of aphid nymphs to each Petri dish. Until egg laying, each pair received one type of aphid per treatment group. The eggs were gently relocated to a new Petri dish (100 × 9 mm) each day until they hatched. To gauge the length of time *C. undecimpunctata* takes to develop, the incubation period of eggs deposited by females was calculated. In Petri dishes (100 × 9 mm), newly hatched larvae were transferred individually. On the same species of aphid that fed their parental culture, twenty larvae from each culture were grown as duplicates. Every day, a known quantity of aphid nymphs were added to each Petri dish. Aphid nymphs in their first and second instars were fed on the first larval instar of the predator. From the second instar until the adults, all stages of aphid were fed to the larvae. Larvae in each treatment were monitored daily for growth, survival, and feeding capacity, and dead ones were removed.

Longevity and fecundity of *C. undecimpunctata* adults

Adults from each treatment group were separated by sex and placed singly in a Petri

dish(100 × 9 mm). Each adult was fed the same quantity of aphids as their larvae and in the same manner. Adult males and females from each treatment group were transported to a single Petri dish (200 × 9 mm) and fed aphid nymphs while remaining in cohort for mating. Each treatment included ten successfully mated pairs that were carefully transferred to ten Petri dishes (100 × 9 mm) and fed aphids on a daily basis. After seven days, each mated couple was separated. The adults were continuously fed aphids until they died. All throughout a female or male's lifespan, the amount of ingested preys was recorded daily. Between the day of emergence and oviposition, the pre-ovipositional stage was taken into account. Daily counts of the eggs laid by each female during the ovipositional stages were done, and the total number of eggs laid by each female was determined. The post-ovipositional period was determined from the end of the ovipositional period till death.

Longevity and fecundity of *C. carnea* adult

Male and female adults were kept in a glass chimney cage. Each chimney cage was placed inside a 9 cm Petri dish. The bottoms of the Petri dishes were lined with filter paper, and the upper open end of the glass chimney was wrapped in black muslin cloth and secured with a rubber band. Adult diets are distributed using tiny paper strips inside the glass chimney. Each strip contains water, dry yeast, and hony bees (6+3+1) at three spots drilled was given to adults as food to build pits for storing diet drops. The diets were administered every 24 hours. A piece of cotton soaked in distilled water was placed on top of the muslin cloth to maintain the moisture in the glass chimneys. Every day, muslin cloth and eggs deposited on the chimney's walls were gathered.

Statistical Analysis

The average consumption per larval stage and the predators' developing period were compared using a one-way analysis of variance (ANOVA). Dancan's Multiple Rang Test was used to distinguish the means (**Cochrot Software 2004**).

RESULTS AND DISCUSSION

Survey of Aphid Species and Their Predators on Navel Orange Trees

Aphis gossypii (Glover), *A. citricola* (van der Goot), *Myzus persicae* (Sulzer), and *A. craccivora* Koch were discovered infesting navel orange leaves. **Güncan *et al.* (2008)** found five aphid species that infest navel orange trees: *A. spiraecola, A. craccivora, T. aurantii, M. persicae,* and *A. gossypii*. The results are consistent with those of **Kalaitzaki *et al.* (2019), Youssif (2015), Lebbal and Laamari (2016),** and **Ali (2009)**. According to them, many insects were attacking navel orange trees. Aphids, specifically *A. nerii* (Boyer), *A. gossypii, A. citricola, M. persicae, A. craccivora,* and *Macrosiphum euphorbiae* (Thomas). **Mohsen (2019)** also discovered two aphid species that infest navel orange trees: *A. gossypii* and *A. citricola*. **Youssif *et al.* (2021)** discovered four aphid species *M. persicae, A. gossypii, A. citricola,* and *A. craccivora*.

Insect Predators Associated with Aphid Species on Navel Orange Trees

On navel orange trees, the following insect predators were seen surviving with aphid species: Coccinellids (Coleoptera, Coccinellidae) include *Coccinella septumpunctata* L., *C. undecimpunctata* L., and *Cydonia vicinia isis* Muls.*Chrysoperla carnea* Steph (Neuroptera: Chrysopidae) is a chysopid. *Metasyrphus corollae* F. (Diptera, Syrphidae) is a species of syrphid.*Paederus alfierii* (Koch), a staphylinid (Coleoptera) insect.

Michelena and Sanchis (1997) reported that first appearance of chrysopids was when aphid populations peaked in orange orchards, although predators such as *C. carnea* and *C. septempunctata* appeared later. The citrus aphid infestation on navel orange trees was associated with *C. undecimpunctata, C. carnea, A. aphidimyza,* and *S. corollae,* according to **Güncan *et al.* (2008)**.

Population density of aphid species infesting navel orange trees

According to Table 1, the aphid infestation in 2021 and 2022 was dominated by the aphid species *A. gossypii*, which accounted for 69.38

Table 1. Total numbers of aphid species and their associated predators on navel orange trees

Year season	2021			2022		
Variable	Total No.		%	Total No.		%
Insect pests:						
A. gossypii	3799		69.38	3783		66.94
A. citrocola	933		17.04	1454		25.73
A. craccivora	590		10.77	352		6.23
M. persicae	154		2.81	62		1.10
Total	5476		100	5651		100
Insect predators:						
C.undecimpunctata	264		37.50	285		37.45
Chrysoperla carne	163		23.15	232		30.49
C.septempnctata	88		12.50	80		10.51
***Cydonia vicina isis*.**	60		8.52	55		7.23
Metasyrphus corollae	94		13.35	76		9.99
P. alfierii	26		3.69	21		2.76
True spider	9		1.29	12		1.57
Total	704		100	761		100

and 66.94% of all aphids. Other aphid species included *A. citricola* (17.04 and 25.73%), *A. craccivora* (10.77 and 6.23%), and *M. persicae* (2.81 and 1.10%). Hemiptera (4.06%), Neuroptera (24.46%), Diptera (26.44%), and Coleoptera (45.04%) had the largest relative populations of insects in Egypt during the seasons of 2020 and 2021**(Youssif *et al.*, 2021)**. *Orius* sp. was a hemipterous species. *C. carnea. M. corollae, Paragus aegyptius* Macq., and *P. alfierii* (Koch) (Staphylinidae) were examples of dipterous predators. Coleopterous predators include *C. undecimpunctata, C. septempunctata, C. vicina nilotica* Muls., and *C. vicina isis* .

Population density of predators associated aphid species on navel orange trees

During two seasons in 2021 and 2022, *C. undecimpunctata* was the most prevalent and represented by (37.50 and 37.45%), followed by *C. carnea* (23.15 and 30.49%), *C. septempunctata* (12.50 and 10.51%), *M. corollae* and *C. vicinia isis* (8.52 and 7.23%), *P. alfierii* (3.69 and 2.76%), and a few true spiders (1.29 and 1.57%) during two seasons in 2021 and 2022.

Seasonal abundance of aphid species infesting navel orange trees

Population of *Aphis gossypii*

According to data in Table 2, an aphid infestation in season 2021 started in the third week of March (8 individuals/40 leaves), increased quickly, and peaked in the third week of April, May, and June (370, 450, and 454 individuals/40 leaves, respectively). *A. gossypii* appeared on navel orange trees in the first week of March during the 2022 season (35.0 individuals/40 leaves), and there were three activity peaks in the first and fourth weeks of April and May (281, 386, and 500 individuals/ 40 leaves) (Table 3). *A. gossypii* was present in 3799.0 and 3783.0 individuals/40 leaves on average over the two seasons of 2021 and 2022, respectively.

Table 2. Seasonal abundance of aphid species and their associated predators on navel orange trees during 2021 season

Sample date	Aphid species					Predators								Predator Prey ratio	Mean	
	A. gossypii	*A. citrocola*	*A. craccivora*	*M. persicae*	Total	*C. undecimpunctata*	*C. carnea*	*C. septempunctata*	*C.vicina isis*	*M. corllae*	*P. alfierii*	True spider	Total predators		Temp.	RH%
March. 3rd	8	7	0	0	15	0	0	0	0	0	0	0	0	0015	17.07	56.02
4th	29	13	0	0	42	0	0	0	0	0	0	0	0	0.42	18.01	54.36
April 1st	44	35	0	0	79	0	0	0	0	0	0	0	0	0.79	23.8	57.71
2nd	89	63	0	0	152	7	11	0	0	0	0	0	19	1: 8	21.02	49.49
3rd	370	149	0	0	519	15	8	3	1	5	0	0	33	1: 15.73	20.71	40.61
4th	204	181	0	0	335	22	13	8	2	8	0	0	55	1 : 6.09	21.2	54.82
May, 1st	296	126	19	13	454	29	18	12	4	5	2	0	73	1 : 6.22	25.31	62.12
2nd	335	91	37	28	491	20	12	8	7	9	3	2	59	1 : 8.05	28.8	60.39
3rd	450	54	87	41	632	32	16	10	5	5	4	1	75	1 : 8.43	27.8	56.41
4th	308	98	49	32	487	24	10	8	7	13	2	0	62	1 : 5.48	29.06	58.95
June, 1st	296	49	92	16	453	28	19	11	5	5	3	3	77	1 : 5.96	30.13	53. 25
2nd	454	26	57	8	545	27	14	9	8	9	2	1	68	1 : 8.015	30.39	62.14
3rd	303	14	64	10	391	19	11	7	6	3	3	0	47	1 : 8.32	31.1	61.38
4th	278	18	101	6	403	16	13	8	4	12	4	2	60	1 :6.72	28.5	58.59
July,1st	156	9	40	0	205	11	8	4	5	9	2	0	37	1 : 5.42	30.43	62.08
2nd	97	0	29	0	126	9	7	0	3	7	1	0	26	1 : 4.5	31.5	61.27
3rd	49	0	15	0	64	5	3	0	2	4	0	0	13	1 : 4.92	31.13	63.10
4th	33	0	0	0	33	0	0	0	1	0	0	0	0	0.33	30.8	61.08
Total	3799	933	590	154	5476	264	163	88	60	94	26	9	704			
Mean	211.06 ±34.50	51.83 ±12.73	32.78 ±8.28	8.56 ± 3.02	304.22 ±49.45	14.67 ±2.61	9.06 ±1.57	4.89 ±1.06	3.33 ±1.21	5.22 ±0.9	1.44 ±0.35	0.50 ±0.22	39.11 ±6.73			

Population of *A. citricola*

Aphid infection in the 2021 season began during the third week of March (7.0 individuals / 40 leaves), increased significantly, and reached two peaks of activity during the fourth weeks of April and May (181 and 98 individuals/40 leaves, respectively). *A. citricola* also had two peaks in the season of 2022, which were discovered in the second week of April and the first week of May (245 and 295 individuals / 40 leaves, respectively). *A. citricola* generally averaged 933.0 and 1454.0 individuals/40 leaves across the two seasons, respectively.

Population of *A. craccivora*

According to the information in Table 2 for the 2021 growing season, aphid infestation began in the first week of May (19.0 individuals/ 40 leaves) and quickly increased to reach two peaks of activity in the third and fourth weeks of May and June, respectively, with 87 and 101 individuals/40 leaves.

A. craccivora also had one peak in the season of 2022, which was discovered in the third week of May (98 individuals/40 leaves). *A. craccivora* generally averaged 590.0 and 352.0 individuals/40 leaves across the two seasons of 2021 and 2022, respectively.

Population of *M. persicae*

The data from Tables 2 for the 2021 growing season revealed that aphid infestation began in the first week of May (13.0 individuals/40 leaves) and quickly increased to reach a peak of activity by (41 individuals/40 leaves) in the third week of May. Additionally, *M. persicae* had one peak in the season of 2022, which was discovered in the second week of May (19 individuals / 40 leaves). In overall, there were 154.0 and 62.0 *M. persicae* individuals per 40 leaves in 2021 and 2022 seasons, respectively.

According to **Ali (2009)**, the aphid population density peaked in Egypt during the third week of June. The months of May and July had the highest aphid population densities on navel orange plants. **(Lebbal and Laamari 2016)**. The aphid infestation on navel orange trees reportedly started in the third week of May. **(Kalaitzaki *et al.*, 2019)**. The fourth week of June marked the population's high, and by the end of August, it had started to decline. *A. gossypii* populations peaked in Egypt across two distinct seasons in the final week of April and the beginning of May.

Seasonal abundance of predators associated with aphid species infesting navel orange trees

Coccinella undecimpunctata

The second week of April saw the onset of *C. undecimpunctata* on potato plants (7 individuals / 40 leaves), according to the data in Table 2. There were two activity peaks in the 2021 season, which occurred in the first and third weeks of May (29 and 32 individuals/40 leaves, respectively). In the second season of 2022, *C. undecimpunctata* was more common started in the third week of February (2 individuals/40 leaves), then increased and reached three peaks of activity in the fourth week of April, the second and fourth weeks of May. (Table 3).

Chrysoperla carnea

Tables 2 and 3 cleared that during the two seasons of 2021 and 2022. *C. carnea* occurred on navel orange trees in the second week of April and the third week of March by 11 and 8 individuals/40 leaves. Three activity peaks were noted during the first season, with the highest levels occurring in the first week of May and June and the fourth week of June with 18, 19 and 13 individuals/40 leaves, respectively. Also in 2022, two peaks (29 and 24 individuals/40 leaves, respectively) were observed in the fourth weeks of April and May.

Coccinella septumpunctata

Tables 2 and 3 showed that during two seasons, *C. septumpunctata* individuals first appeared in the second and third week of April by (3 individuals / 40 leaves). Two peaks of activity (12 and 11 individuals/40 leaves), respectively, were recorded in the first week of May and June during the 2021 season (Table 2). *C. septumpunctata* also showed two peaks in the 2022 season, which were identified in the third fourth and week of April and the third week of May (Table 3).

Table 3. Seasonal abundance of aphid species and their associated predators on navel orange trees during 2022 season

sample date	Aphid species					Predators								Predator Prey ratio	Mean	
	A. gossypii	*A. citrocola*	*A. craccivora*	*M. persicae*	Total	*C. undecimpunctata*	*C. carnea*	*C. septempunctata*	*C.vicina isis*	*M. corllae*	*P. alfierii*	True spider	Total predators		Temp.	RH%
March. 1st	35	0	0	0	35	0	0	0	0	0	0	0	0	0.35	18.85	57.82
2nd	57	0	0	0	57	0	0	0	0	0	0	0	0	0.57	16.67	53.56
3rd	76	29	0	0	105	2	8	0	0	0	0	0	10	1 : 10.5	18.48	52.2
4th	119	76	0	0	195	7	12	0	0	0	0	0	19	1 : 10.26	17.28	55.6
April 1st	281	109	0	0	390	11	15	0	0	0	0	0	26	1 : 15	21.02	58.4
2nd	178	245	0	0	423	17	19	3	0	4	0	0	43	1 : 9.84	20.71	47.49
3rd	231	172	24	0	427	20	24	5	2	6	0	0	57	1 : 7.49	22.2	49.62
4th	386	203	27	13	629	31	29	10	5	8	0	0	83	1 : 7.94	25.1	67.9
May, 1st	250	295	35	10	590	29	25	8	7	5	2	0	76	1 : 10.45	28.3	56.6
2nd	395	84	69	19	567	31	17	11	5	9	5	2	80	1 : 7.09	29.06	56.41
3rd	311	68	98	12	489	27	13	14	10	7	3	3	77	1 : 6.35	25.5	59.7
4th	500	62	31	5	598	39	24	9	7	5	4	0	88	1 : 6.97	30.7	59.5
June, 1st	298	49	22	3	371	21	18	10	9	8	2	1	69	1 : 4.7	28.92	58.3
2nd	237	26	19	0	282	17	13	6	4	7	1	3	51	1 : 5.65	30.13	63.3
3rd	189	12	14	0	215	23	10	4	3	10	2	1	53	1 : 5.19	30.4	60.5
4th	134	17	9	0	160	7	5	0	2	6	0	2	22	1 : 7.27	28.9	60.7
July, 1st	67	8	4	0	79	3	0	0	1	1	2	0	7	1 : 4.29	30.39	56.6
2nd	39	0	0	0	39	0	0	0	0	0	0	0	0	0.39	30.25	61.9
3rd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30.9	59.5
Total	3783	1454	352.0	62.0	5651	285	232	80.0	55	76.0	21	12	761			
Mean	199.11 ±32.17	76.53 ±20.49	18.53 ±6.04	3.26 ±1.33	294.42 ±49.69	13.95 ±2.79	12.21 ±2.19	4.21 ±4.36	2.89 ±0.77	4.0± 0.84	1.11 ±0.36	0.63 ±0.24	40.05 ±7.49			

Metasyrphus corollae

M. corollae individuals first appeared during the 2021 season in the third week of April (5 individuals/40 leaves), followed by two peaks of activity (13 and 12 individuals/40 leaves, respectively) in the fourth week of May and June (Table 2). Two activity peaks were seen in the second week of May and the third week of June, respectively, in the 2022 season, which started in the second week of April (4 individuals/40 leaves) (Table3).

Cydonia vicinia isis

In both seasons, the third week of April saw the emergence of *C. vicinia isis* (1 and 2 individuals/40 leaves), and in the season of 2021, there were two peaks in activity (7 and 8 individuals/40 leaves, respectively). During the 2022 season, the third week of May saw a high in activity (10 individuals/40 leaves) (Table 3).

During the first season of 2021, two peaks of activity in the number of predators on navel orange trees (73 and 77 predators/40 leaves) were observed in the fourth weeks of May and June. Additionally, two peaks were discovered in the fourth week of April and May in the 2022 season (correspondingly, 83 and 88 predators/40 leaves).

According to Al-**Allan *et al.* (2004),** coccinellids are of great importance and frequently play a large natural role in managing and/or reducing the numbers of their potential prey, primarily aphid species. **Boraei *et al.* (2005)** discovered that chrysopid and coccinellid beetles were among the most common predators in the majority of Egyptian field crops. According to **Youssif *et al.* (2021)**, the highest monthly total of 148 predators and 1845 aphids was reported in May, while the lowest monthly total of 58 predators and 858 aphids was recorded in April.

Biology of *C. undecimpunctata* on *A. gosspii* under Laboratory Condition

Developmental time and feeding capacity

Data presented in Table 4 cleared that *C. undecimpunctata* incubation period was 3.69±0.53 days. *C. undecimpunctata* consumed *A. gossypii* larvae as followed; first larval instar: 2.67 ± 0.45 days; daily consumption: 18.48±1.43 individuals; second larval instar: 2.49±0.61 days; daily consumption: 38.63± 3.96 individuals third larval instar: 2.97±0.39 days; daily consumption: 56.35 ±5.10 individuals, and fourth larval instar: 4.89 ± 0.73; daily consumption: 52.07± 4.15 individuals. The time of development was found to be 13.02±1.12 days (Table 4). The total average consumption rate per *C. undecimpunctata* larva was 567.5 ± 6.90 individuals of the same prey. The feeding capacity percentages for each of this predator of fourth larval instars were 8.69, 16.95, 29.49, and 44.87%, respectively. pupa takes 6.78 ± 1.09 days for development. When fed *A. gossypii*, the overall developmental time from egg hatching to adult eclosion for *C. undecimpunctata* was 23.49± 1.40 days (Table 4).

Longevity and fecundity of adult stage

After rearing on *A. gossypii*, the female's average pre-ovipositional period was 5.81 ±0.64 days. During this time period, the predator female consumed 309.92± 5.32 individuals with a daily rate of 53.34 individuals. Females had an average ovipositional period of 34.01 ± 2.15. *C. undecimpunctata* female consumed during the oviposition period 2303.85 ±26.75 individuals with a daily rate of 67.74 individuals (Table 4). On *A. gossypii*, the average number of deposited eggs per predator female was 315.85 eggs, with a daily rate of 7.06 eggs. The predator female consumed 215.40± 4.91 individuals during the post-oviposition period, with a daily rate of 43.60 individuals fed on *A. gossypii* (Table 3). A mated female fed *A. gossypii* had a feeding capacity of 2829.17±30.75 individuals throughout lifespan, whereas a male fed *A. gossypii* had a feeding capacity of 2064.63 ± 27.19 (Table 5).

This is in line with the findings of the **Saleh and Ali (2012)** study, which found that when *C. carnea* larvae were reared on *A. gossypii* individuals, the total consumption rate per larvae was 623.18 ± 41.80 The typical rate of aphid ingestion per *C. carnea* larva also varied greatly. There was a considerable disparity in female longevity.

When *C. carnea* was reared on *A. gossypii*, **Saleh *et al.* (2017b)** reported that the entire developmental period from egg hatching to adult eclosion was 23.81.36 days.

Table 4. Duration period of *C. undecimpunctata* reared on *A. gossypii* under laboratory condition

A: Larval stage	Duration in days	Daily average consumption	Average of total consumption	% of feeding capacity
Incubation period (Eggs)	3.69 ± 0.53			
1st instar	2.67 ±0.45±	18.48± 1.43	49.34 ± 2.03	8.69
2nd instar	2.49 ±0.61	38.63 ± 3.96	96.18 ± 2.94	16.95
3rd instar	2.97± 0.39	56.35 ± 5.10	167.35 ± 3.81	29.49
4th instar	4.89±0.73	52.07± 4.15	254.63 ± 5.12	44.87
Total	13.02 ± 1.12		567.50 ± 6.90	100
Pupal stage	6.78±1.09			
Total of immature stages	23.49±1.40			

Biology of *C. carnea* on *A. gossypii* under Laboratory Condition

Developmental time and feeding capacity

As given in Table 6, the incubation period of *C. carnea* was 3.38 ± 0.47 days. During larval instars, *C. carnea* fed on *A. gossypii* at 21 ± 1°C and 65 ± 5.0 R.H%. The first larval instar lasted 3.84±0.81 days and consumed 21.52 individuals per day. The second larval instar lasted 4.56 ± 0.92 days and consumed 34.25 ± 2.39 individuals per day. The third larval instar lasted 6.25 ± 1.03 days and consumed 55.81 ± 3.52 people per day. Data in Table 6 showed that the total developmental time is 65±1.65 days.

On *A. gossypii*, the overall average consumption rate per *C. carnea* larva was 587.63±9.27. Each of the three larval instars of this predator has a feeding capacity percentage of 14.06, 26.58 and 59.36%, respectively. The total developmental time for *C. carnea* from egg hatching to adult exclusion was 25.01± 2.63 days for *C. carnea* when fed on *A. gossypii* (Table 6).

Such findings supported by those of **Saleh and Ali (2012)** who reported that the mean rate of consumption was 623.18 ± 41.80 cotton aphid individuals per *C. carnea* larva. They also mentioned that there were large variations in the usual rate of aphid consumption per *C. carnea* larva. And that there was significant difference between the longevity of females and males.

After rearing *C.carnea* on *A. gossypii*, **Saleh *et al.* (2017b)** indicated that the entire developmental time from egg hatching to adult eclosion was 23.8 ±1.36 days. The overall rate of prey consumed by each *C. carnea* larva was 367.31 ± 50.28.

Longevity and fecundity of adult stage

After feeding on *A. gossypii*, the female's average pre-ovipositional period was 5.89 ±0.76 days. Females had an average ovipositional period of 30.46 ±1.24 days. And the number of deposited eggs per predator female averaged 321.52 eggs, with a daily rate of 10.56 eggs per day. When larva fed on *A. gossypii*, the post-oviposition period of females lasted 5.53 ±0.65 days (Table 7).

On *A. gossypii*, the average number of eggs laid by a predator female per day was 10.56 eggs per day, or 321.52 eggs overall. The predator female's post-oviposition time lasted 5.53± 0.65 days (Table 6). A mated female that fed on *A. gossypii* lived an average of 41.88. ± 1.24 days. Male longevity was 11.37 days (Table 7).

According to **Saleh *et al.* (2017b)**, the average number of eggs laid on *A. gossypii* feeding by *C. carnea* female was 316±21.88 eggs. These findings are in harmony with those of **Saleh and Ali (2012)**, who reported that when *C. carnea* females fed on *A. gossypii* throughout larval instars, the average number of deposited eggs per *C. carnea* female was 327.73± 31.19 According to statistical evidence, aphid species have a significant impact on female fecundity.

Table 5. Longevity, food consumption and fecundity of *C. undecimpunctata* reared on the *A. gossypii* under laboratory condition

Adult stage	Period in days Daily	average consumption	Average of total consumption	No. of eggs	
				Daily	Total
A : Female	5.81±0.64	53.34±2.76	309.92±5.32	**7.06**	**315.85**
Pre-oviposition				**±**	**±**
Oviposition	34.01±2.15	67.74±2.94	2303.85 ±26.75	**0.89**	**5.17**
Post-oviposition	4.94±0.63	43.60±1.96	215.40±4.91		
Longevity	44.76±3.15	63.21±2.83	2829.17±30.75		
B : Male Longevity	35.58±2.94	58.01±3.45	2064.63±27.19		

Table 6. Duration period of *C. carnea* reared on *A. gossypii* under laboratory condition

A: Larval stage	Duration in days	Daily average consumption	Average of total consumption	% of feeding capacity
Incubation period	3.38 ± 0.47			
1st instar	3.84 ±0.81	21.52± 1.41	82.64 ± 4.60	14.06
2nd instar	4.56 ±0.92	34.25 ± 2.39	156.17 ± 5.82	26.58
3rd instar	6.25± 1.03	55.81 ± 3.52	348.82 ± 6.07	59.36
Total	14.65 ± 1.65		587.63 ± 9.27	100
Pupal stage	6.98±1.13			
Total of immature stages	25.01±2.63			

Table 7. Longevity, food consumption and fecundity of *C. carnea* adult reared on the *A. gossypii* under laboratory condition

Adult stage	Period in days Daily	No. of eggs	
		Daily	Total
A : Female	**5.89±0.76**	**10.56**	**321.52**
Pre-oviposition		**±**	**±**
Oviposition	**30.46±1.13**	**1.46**	**6.19**
Post-oviposition	**5.53±0.62**		
Longevity	**41.88±1.24**		
B : Male Longevity	**11.37±0.93**		

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فـاعليـــة بعـض المفتـرســـــات فـي مكـافحـــة المـــن علـــى أشـــجار بـرتقـــال أبوســـرة

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أجريت تجارب خلال موسمي 2021و 2022 لتقييم فاعلية بعض المفترسات كعنصر من عناصر المكافحة البيولوجية لأنواع حشرة المن التى تصيب أشجار البرتقال بسره وكان اكثر أنواع المن تواجدا . *A. gossypii* and *A. citricola* أوضحت النتائج وجود ثلاث قمم لمن القطن *A. gossypii* خلال موسمي الدراسة في الأسبوع الثالث من إبريل ومايو والأسبوع الثاني من يونيو (370 و450 و454 فرد من / 40 ورقة) خلال موسم 2021، بينما كانت (281 و386 و500 فرد من/40 ورقة) خلال موسم 2022. أظهرت النتائج أن لمن *A. citricola* قمتين نشاط (181 و98 فرد من / 40 ورقة) خلال موسم 2021، بينما كانت (245 و295 فرد من / 40 ورقة) خلال موسم 2022. تم حصر المفترسات الشائعة على أشجار البرتقال بسره وهي أبو العيد ذو أحدي عشر نقطة وأسد المن وأبو العيد ذو سبعة نقاط وأبو العيد الأسود وحشرة السيرفس وأفراد قليلة من الحشرة الرواغة والعناكب الحقيقة وكان مفترس أبو العيد ذو أحدي عشر نقطة وأسد المن أكثرهم تواجدا. أوضحت النتائج أن للمفترسات قمتين نشاط خلال موسمي الدراسة (73 و77 مفترس/40 ورقة) خلال موسم الدراسة الأول، بينما كانت (83 و88 مفترس/40 ورقة) خلال موسم الثاني. أجريت دراسة معملية لدراسة بعض الخصائص البيولوجية لمفترس أبو العيد ذو أحدي عشر نقطة وأسد المن عند درجة حرارة ثابته (21± 1 ورطوبة نسبية 65± 5 %) أوضحت النتائج أن فترة النمو من فقس البيض حتى خروج الحشرة الكاملة 23.49 ± 1.40 و25.01 ± 2.63 يوما عند تربيته على من القطن *A. gossypii*. وكان متوسط عدد البيض الي تضعه أنثي أبو العيد ذو أحدي عشر نقطة وأسد المن 315.85 ± 5.17 و321.52 ± 6.19 بيضة عند تغذيتها في طور اليرقة على من القطن، على التوالي.

الكلمات الإسترشادية: المن، المفترسات، بيولوجى، برتقال أبوسرة.

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