

ECOLOGICAL AND BIOLOGICAL STUDIES ON THE PREDATOR *Clitostethus arcuatus* (ROSSI) (COLEOPTERA: COCCINELLIDAE) AS A PREDATOR OF POMEGRANATE WHITEFLY, *Siphoninus phillyreae* (HOLIDAY) (HOMOPTERA: ALERODIDAE)

Awadalla, S. S.¹; Hala A. El-Syrafy¹; M. E. El-Naggar² and Amany A. Khalifa²

¹ Economic Entomology Dept, Faculty of Agriculture, Mansoura Univ.

² Plant Protection Res. Institute, Agric. Research Center, Dokki, Giza

ABSTRACT

The present work was carried out to study the population abundance, biology and efficiency of the coccinellid predator *Clitostethus arcuatus* (Rossi) when fed on pomegranate-whitefly, *Siphoninus phillyreae* (Haliday) at Kafr El-Sheikh region during two successive seasons 2006 and 2007. *S. phillyreae* and its related predator *C. arcuatus* appeared together during May to June. The period from August through October considerable of the pest and its related predator *C. arcuatus*. Duration of the first, second, third, fourth larval instars and prepupae of the predator averaged were 1.2, 2.2, 2.6, 2.8 and 1.1 days, respectively. The total larval period, pupal stage at total developmental period averaged 3.6, 9.9 and 17.8 days, respectively. Adults, male and female averaged 69.2 and 103.1 days, respectively. *C. arcuatus* larval consumed an average total number of 319.8 eggs. The adults male and female consumed an average number of 4237.6 and 5486.6 of *S. phillyreae* eggs, respectively.

Keywords: *Clitostethus arcuatus*, *Siphoninus phillyreae*, population, abundance, biology, efficiency.

INTRODUCTION

Clitostethus arcuatus (Rossi), a predator of aleyrodids and other insects and mites is one of several coccinellids predator to feed on whiteflies (Gerling, 1990). Its was widely distribution in the Mediterranean and surrounding areas, and France; the Italian peninsula (Priore, 1969, Loi, 1978); Sicily (Liotta, 1981); Greece (Mentzelos, 1967); Turkey (Soylu, 1980 and Ulu, 1985); Germany (Bathon and Bietrizik, 1986); the southern and western of former USSR (Agekyan, 1977). Its distribution in northern Africa was also considered (Agekyan, 1977). It feed on whiteflies eggs, nymphs and adults (Priore, 1969, Bathon and Pietrizik, 1986), with predation apparently primarily on the eggs and nymphs when all stages are present (Priore, 1969).

In the Summer 1989, *C. arcuatus* (Rossi) was imported from Israel to California as a part of a broader program to introduce natural enemies against *S. phillyreae*.

C. arcuatus was first recorded in Egypt as a predator of *Dialeurodes citri* (Mesbah, *et al.*, 1998). It was the most dominating predatory species attacking citrus whitefly *D. citri* immatures in citrus trees at Kafr El-Sheikh

Governorate (northern Egypt). It constituted 41.9% of the total number of predators found associated with the pest on citrus trees (Mesbah, 1999).

C. arcuatus was also observed predating on the pomegranate whitefly *S. phillyreae* immature stages mainly eggs and rarely on the adults (Mesbah, 2000). The population dynamics of *S. phillyreae* was decreased after releasing of *C. arcuatus* on apple, Olive, pear and pomegranate trees in different locations in Egypt (Abd-Rabou, 2006). *C. arcuatus* was correlated with the dominate *S. phillyreae* on pomegranate trees as well as the predator and the pest were appeared together on the pomegranate trees by the first week of August (Mesbah, 2008).

This work aimed to give more light on the biology and feeding capacity of *C. arcuatus* predator when fed on *S. phillyreae* immature stages.

MATERIALS AND METHODS

This study was carried on pomegranate trees growing at the experimental farm, Faculty of Agriculture, Kafr El-Sheikh University, in 2006 and 2007 seasons.

Samples from the predator adults were collected from the pomegranate trees using the sweep net. A pomegranate sprig having ample amounts of the pomegranate whitefly *S. phillyreae* eggs was introduced into a glass vial (2 x 4 cm) filled with water to keep the sprig fresh. The vial was placed into a jar (9 x 25 cm). *C. arcuatus* adults were released on the pomegranate sprig to feed on the host eggs, and to oviposit on the sprig leaves. To avoid the cannibalism, pomegranate sprig having the predator's eggs were always been substituted by new ones, having *S. phillyreae* eggs (Tawfik, et al., 1962 and Mesbah, 2001). The sprig carrying the predatory eggs were put into Petri dishes until hatching.

Two experiments were carried out under laboratory conditions (27.5 ± 2.5 °C and 65–70% R.H). The first experiment was conducted to study the duration of immature stages and larval efficiency. The second one, to study the longevity and feeding capacity of the adults.

In the first experiment newly laid eggs (0-24 h. old) of the predator, *C. arcuatus* (n = 10) were placed individually on pomegranate leaves in Petri dishes. Newly hatching larvae were provided with access number of *S. phillyreae* eggs in Petri-dishes (n = 10). Adults were provided daily with a new food and maintained until the death of all individuals. Survivorship rate was estimated in both experiments by calculating the proportion of alive predators (Mesbah, 2001).

RESULTS AND DISCUSSION

Population abundance of *S. phillyreae* immature stages and its related predator *C. arcuatus*:

Data illustrated in Fig. (1) showed that the coccinellid predator. *C. arcuatus* was appeared by the second week of June (10 individuals/100 stroks) coincided with the first peak of *S. phillyreae* pupae (70 pupae/40 leaves). The first peak of *C. arcuatus* was recorded on July 15 (18

individuals/100 strokes) coincided with the first one of *S. phillyreae* eggs (47 eggs/40 leaves) and second peak of the pest pupae (108 pupae/40 leaves), the highest peak of the *C. arcuatus* was detected in the end of August 2006 related with the highest peak of *S. phillyreae* eggs (438 eggs/40 leaves) and third peak of pupae 240 pupae/40 leaves.

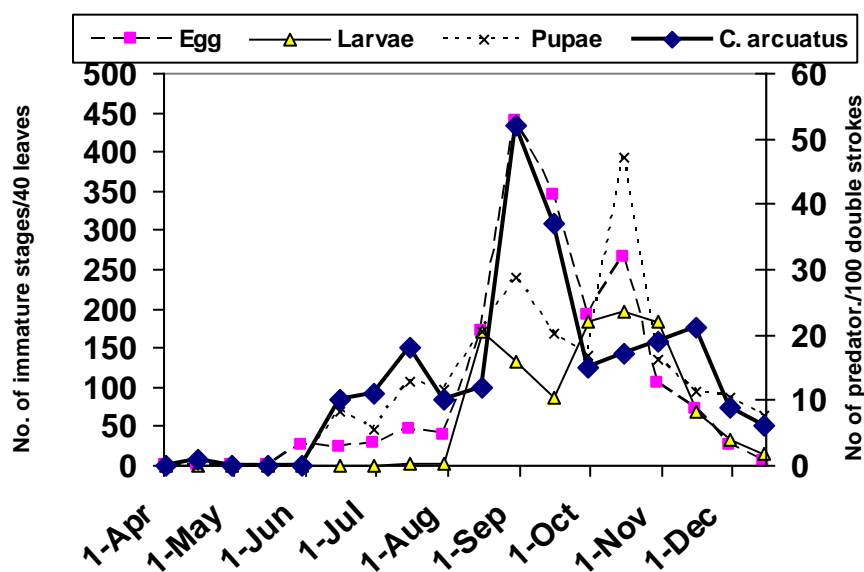


Fig. (1): Population abundance of pomegranate whitefly *S. phillyreae* immature stages and related predator, *C. arcuatus* adults on pomegranate trees during 2006 season.

In the second season (2007) data illustrated in Fig. (2) indicated that the *S. phillyreae* eggs and *C. arcuatus* were appeared together on 15 June and increased to reach the highest peak on 30th August and represented with 41 individuals/100 strokes and 438 eggs and 353 larvae/40 leaves of *S. phillyreae*. The second peak of the predator was observed on 15 October (36 indi./100 strokes) coincided with peaks of *S. phillyreae* eggs, larvae and pupae 303, 168 and 286, individuals/40 larvae respectively. The present results are agreement with those of Loi (1978), Bathon and Pietrizk (1986) and Gerling (1990) who recorded that *C. arcuatus* was the considerable predator of aleyrodids. In Egypt Mesbah *et al.* (1998) were recorded *C. arcuatus* for the first time as a predator of *Dialeurodes citri*. Also Mesbah (2001) and (2008) recorded that *C. arcuatus* was highly correlated with the dominant whitefly, *S. phillyreae* immatures on pomegranate trees.

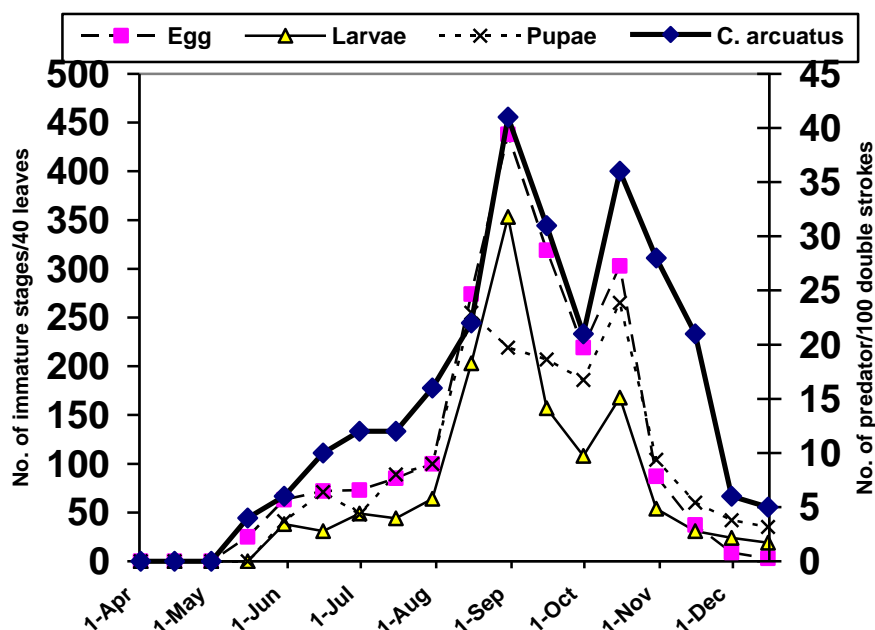


Fig. (2): Population abundance of pomegranate whitefly, *S. phillyreae* immature stages and related predator, *C. arcuatus* adults on pomegranate trees during 2007 season.

Predator Biology:

Duration of immature stages:

Egg stage:

As data shown in Table (1) the incubation period of the *C. arcuatus* eggs ranged between 3-5 days with an average of 3.6 days. The percentage of eggs hatch ability reached 100%.

Larval stage:

Larva molts 3 times, the average duration of the four larval instars of *C. arcuatus* when fed on pomegranate whitefly *S. phillyreae* eggs were 1.2, 2.2, 2.6, 2.8 and 1.1 days of the first, second, third, four in star and prepupae, respectively. Survival rate of larval stage was 92%.

Pupal stage:

The pupal duration ranged between 4-6 with an average 4.3 days. Survival rate of pupal stage was 100%. The total development period ranged between 15-24 days on average 17.8 days.

These result are in line with those of Agekyan (1977) who reported that the total development time ranged between 23-25 days at 24-27 C⁰. Loi (1978) reported the respective period of 3-8, 8-24 and 3-8 days, for eggs, larva and pupal stage. In both cases the predator was prying on *Dialeurodes citri*. Bellows et al. (1992) reported that the maximum development period of the predator was at 28.2 C⁰ while the minimum was at 21.1 C⁰ pomegranate

whitefly was used as prey. Mesbah in (2000) found that total development period averaged 16.79 days when fed on pomegranate whitefly eggs on (14-23 C⁰). On the other hand Mesbah (2003) found that the total larval period, pupal stage and total development period averaged 11.83, 6.44 and 22.57 days respectively when fed the *C. arcuatus* on *Bemisia tabaci* eggs on 14-23 C⁰.

Table (1): Life cycle and longevity of the predators *Clitostethus arcuatus* (Rossi) under laboratory conditions (27.5 ± 2.5 C⁰ and 65 – 70% R.H)

Stage	Duration (days)		Mean	Mean numbers of eggs/Female
	Minimum	Maximum		
Eggs stage	3	5	3.6	-
Larval stage				
1 st instar	1	2	1.2	
2 nd instar	2	3	2.2	
3 rd instar	2	3	2.6	
4 th instar	2	3	2.8	
Prepupae	1	2	1.1	
Larval period	8	13	9.9	
Pupal stage	4	6	4.3	
Total development period	15	24	17.8	
Adult longevity				
Male	65	71	59.2	
Female	94	114	103.2	
Pre Oviposition	8	13	9.4	
Oviposition	76	93	85.4	127.2
Post-Oviposition	6	9	8.2	

Adult longivity:

Mean longevity of adult male ranged 65-71 days with on average 69.2 days. Meanwhile the adult female ranged 94-114 days with an average 103.2 days, while the pre-oviposition period ranged 8-13 days with an average 9.4 days, the oviposition period ranged 76-93 days with an average 85.4 days and the post oviposition period ranged between 6-9 days with an average 8.2 days (Table 1) this results are in agreement with those of Bathan and Pietrizk (1986) who recorded a longevity of 150 days at 22-24 C⁰, when fed on eggs of *Aleyrodes proletella*. Bellowes, *et al.* (1992) reported that the timed mean longevity of Female (98.9 days) was recorded at 21.1 C⁰. Data also agremented with those of Mesbah (2000) who recorded longevity of adults (male and female) averaged of 94.33 and 97.00 days when fed on *S. phillyreae* eggs on 18-22 C⁰. In contrast, the obtained data do not agree with those of Mesbah (2003) who found the mean longevity of adults male ranged between 176-214 days with an average of 192 days, while the adult female ranged 176-236 days with an average 207.00 days when the predator fed on *Bemisia tabaci* eggs (14-23 C⁰).

Predator efficiency:

C. arcuatus larvae consumed an average of 29.6, 85.0, 101.0 and 104.0 eggs of *S. phillyreae* during the 1st, 2nd, 3rd and 4th instars, respectively Table (2). The total consumption number ranged 148-521 eggs with on average 319.8 eggs during its development period. In this regard, Liotta (1981) and Bathon and Pietrzik (1986) recorded that *C. arcuatus* larva consumed during the course of its development not more than 300 and 544 eggs of *D. citri* and *A. prolella*, respectively. The present data also agreement with these of Mesbah (2000) who found the *C. arcuatus* larvae consumed on average 325 eggs of *S. phillyreae* during its development period. The present data in contrast with these of Mesbah (2001) who recorded that predator larva consumed an average total number of 987.5 eggs of *B. tabaci* during its development period. As for *C. arcuatus* adult male was consumed on average 4237.6 of *S. phillyreae* eggs, while the adult female consumed an average 5486.6 eggs during its longevity.

Table (2): Number of *Siphoninus phillyreae* eggs consumed by *Clitostethus arcuatus* (Rossi) larvae and adult under the laboratory conditions (25.5 ± 2.5 C^o and 70-81% R.H).

Stage	Range	Mean ± S.D.	Mean/day
Larval stage			
1 st instar	14-44	29.60	24.66
2 nd instar	59-112	85.00	36.84
3 rd instar	60-124	101.00	45.90
4 th instar	91-123	104.00	47.27
Total	148-523	319.80	44.41
Adult			
Male	3720-4344	4237.6	61.23
Femol	4913-6112	5486.6	53.16

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دراسات ايكولوجية وبيولوجية على المفترس *Clitostethus arcuatus*
(Rossi) كمفترس لحشرة ذبابة الرمان البيضاء *Siphoninus phillyreae*

سمير صالح عوض الله¹ ، هالة احمد الصيرفي¹، محمود السيد النجار² و
أمانى عبد الحكيم خليفة²

1. قسم الحشرات الاقتصادية- كلية الزراعة- جامعة المنصورة
2. معهد بحوث وقاية النباتات- مركز البحوث الزراعية- الدقى- الجيزة

تم في هذا البحث دراسة الوفرة العددية وكذلك البيولوجي والكفاءة الإفتراضية للمفترس *Clitostethus arcuatus* من مجموعة أبو العيد وذلك بتغذيته على بيض ذبابة الرمان البيضاء وفي منطقة كفر الشيخ خلال موسمي 2006 ، 2007 وأوضحت الدراسة أن ذبابة الرمان البيضاء وذلك المفترس يظهرها معا خلال مايو ويونيو وتعتبر الفترة من أغسطس وحتى أكتوبر أهم فترة - تواجد ذبابة الرمان وكذلك المفترس المرتبط بها. ويستغرق العمر اليرقى الأول والثاني والثالث والرابع وكذلك فترة ما قبل العذراء لهذا المفترس بمتوسط 1.2 ، 2.2 ، 2.6 ، 2.8 ، 1.1 يوم على التوالي وبينما طور اليرقة وطور العذراء والفترة الكلية للتطور تستغرق 3.6 ، 9.9 ، 17.8 يوم على التوالي. وبالنسبة للحشرة الكاملة للمفترس فإن الذكر يستغرق في المتوسط 69.2 يوما بينما الأنثى تستغرق في المتوسط 13.1 يوما وتستهلك اليرقة خلال عمرها اليرقة متوسط 319.8 بيض. بينما الحشرة الكاملة الذكر يستهلك 4237.6 بيضة والأنثى 5486.6 بيضة من بيض ذبابة الرمان البيضاء.

قام بتحكيم البحث

كلية الزراعة - جامعة المنصورة
كلية الزراعة - جامعة الأزهر

أ.د / عادل حسن عبد السلام
أ.د / حمدى احمد محمد