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**Biological Control of the Pomegranate Whitefly, *Siphoninus phillyreae*  
(Homoptera:Aleyrodidae:Aleyrodinae) by Using the Bioagent,  
*Clitostethus arcuatus* (Coleoptera:Coccinellidae)**

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**Abstract:** This research was carried out to study the biological control of this pest by mass rearing, releasing and evaluation of the most important predator *Clitostethus arcuatus* (Rossi) (Coleoptera:Coccinellidae). About 480 000 were released in different locations in Egypt on apple (*Pyrus malus* L.) olive (*Olea europaea*), Pear (*Pyrus communis*), pomegranate (*Punica granatum*) and infested by *S. phillyreae*. The results indicated that the population of whitefly species was decreased after releasing *C. arcuatus* in all locations in Egypt. Also, the population of *C. arcuatus* was increased in all experiments after releasing. During the present research *C. arcuatus* was established on olive in Fayum and on pomegranate in Assuit for the first time.

**Key words:** Pomegranate whitefly, *Siphoninus phillyreae*, predators, *Clitostethus arcuatus*

### Introduction

The pomegranate whitefly, *Siphoninus phillyreae* (Haliday) (Homoptera:Aleyrodidae:Aleyrodinae) attacking 60 host economic plant species, including, apple, pear, citrus, olive and pomegranate. It distributed in Palaearctic region. It causes severe damage to pear and apple in Europe. Heavy infestations caused leaf wilt, early leaf drop and smaller fruit (Bellows *et al.*, 1990). In Egypt, the host plants, distribution, natural enemies and biological control studied by Abd-Rabou (1997, 1998, 1999, 2001, 2002, 2003) and Abd-Rabou and Abousetta (1998). The role of the biological control of *Clitostethus arcuatus* (Rossi) (Coleoptera:Coccinellidae) in controlling *S. phillyreae* studied by Bellows *et al.* (1992). This species recorded for the first time in Egypt as a predator of *Dialeurodes citri* (Ashm.) by Mesbah *et al.* (1999) and its role in controlling *D. citri* studied by Metwally *et al.* (1999). The aim of this work is to study the biological control of this pest by mass rearing, releasing and evaluation of the most important predator *C. arcuatus*.

### Materials and Methods

*C. arcuatus* was successfully mass reared on *S. phillyreae*, which reared on *Punica granatum*. In 2004 and 2005 about 480 000 were released in Assuit, Fayum, Minufiya and Sharqia on apple (*Pyrus malus* L.) olive (*Olea europaea*), Pear (*Pyrus communis*) and pomegranate (*Punica granatum*) infested by *S. phillyreae*. Predators were released as adults by fixing the tubes containing these adults to the tree.

During 2004-2005, biweekly releases were made of 50 adults per tree of apple (100 trees), pomegranate (100 trees, olive (100 trees) and pear (100 trees), 240 000 adults for each year. Releases were begun from June to October. The evaluation of releases was assessed monthly during 2004 and 2005 by counting the stages of whiteflies present and larvae and pupa adult of *S. phillyreae* present on a total of 100 leaves from each plant in each site.

Statistical analysis of the obtained data was followed using ANOVA procedures in SAS. Mean separation was conducted using Duncan Multiple range test in SAS.

## Results

### *On Apple*

The highest population of *S. phillyreae* on apple in Sharqia was 87, 290 individuals/100 leaf while the predator *C. arcuatus* was 140, 354 individuals/100 leaf in October during 2004 and 2005, respectively after releases while in comparison to 1601, 1900 individuals/100 leaf and the predator was 120, 145 individuals/100 leaves (Table 1 and 2).

### *On Olive*

The highest population of *S. phillyreae* on olive in Fayum was 804, 680 individuals/100 leaves while the predator *C. arcuatus* was 23, 70 individuals/100 leaves in October during 2004, 2005, respectively after releases while in comparison to 1109, 945 individuals/100 leaf during 2004, 2005, respectively and the predator *C. arcuatus* was not found in the control experiment during 2004 while in 2005 the predator *C. arcuatus* was 22 (Table 3 and 4). This coccinellid established on *S. phillyreae* in this area for the first time.

### *On Pear*

The population of *S. phillyreae* on pear in Minufiya was 198, 243 individuals/100 leaf while the predator *C. arcuatus* was 102, 170 individuals/100 leaves during October after releases while in comparison to 1126, 1148 individuals/100 leaf and the predator *C. arcuatus* was 75, 102 individuals/100 leaves in the control experiment during 2004, 2005, respectively (Table 5 and 6).

### *On Pomegranate*

The population of *S. phillyreae* on pomegranate in Assuit was 756, 541 individuals/100 leaf while the predator *C. arcuatus* was 78, 75 individuals/100 leaves during October after releases while in comparison to 5964, 6280 individuals/100 leaves during 2004, 2005, respectively and the predator *C. arcuatus* not found in the control experiment during 2004 while in 2005 the predator *C. arcuatus* was 55. This coccinellid established on *S. phillyreae* in this area for the first time (Table 7 and 8).

Table 1: Number of populations of *Siphoninus phillyreae* and its predator, *Clitostethus arcuatus* on apple during 2004 in treatment and control experiment

Month	Treatment		Control	
	<i>Siphoninus phillyreae</i>	<i>Clitostethus arcuatus</i>	<i>Siphoninus phillyreae</i>	<i>Clitostethus arcuatus</i>
June	40	30	910	20
July	56	70	1203	50
August	60	86	1400	70
September	66	123	1542	95
October	87	140	1601	120

Table 2: Number of populations of *Siphoninus phillyreae* and its predator, *Clitostethus arcuatus* on apple during 2005 in treatment and control experiment

Month	Treatment		Control	
	<i>Siphoninus phillyreae</i>	<i>Clitostethus arcuatus</i>	<i>Siphoninus phillyreae</i>	<i>Clitostethus arcuatus</i>
June	151	50	1011	41
July	198	120	1352	44
August	210	213	1579	64
September	274	312	1754	102
October	290	354	1900	145

Table 3: Number of populations of *Siphoninus phillyreae* and its predator, *Clitostethus arcuatus* on olive during 2004 in treatment and control experiment

Month	Treatment		Control
	<i>Siphoninus phillyreae</i>	<i>Clitostethus arcuatus</i>	<i>Siphoninus phillyreae</i>
June	420	4	600
July	456	12	761
August	642	16	912
September	741	19	1001
October	804	23	1109

Table 4: Number of populations of *Siphoninus phillyreae* and its predator, *Clitostethus arcuatus* on olive during 2005 in treatment and control experiment

Month	Treatment		Control	
	<i>Siphoninus phillyreae</i>	<i>Clitostethus arcuatus</i>	<i>Siphoninus phillyreae</i>	<i>Clitostethus arcuatus</i>
June	490	15	550	5
July	510	30	643	11
August	560	45	710	18
September	601	63	812	20
October	680	70	945	22

Table 5: Number of populations of *Siphoninus phillyreae* and its predator, *Clitostethus arcuatus* on pear during 2004 in treatment and control experiment

Month	Treatment		Control	
	<i>Siphoninus phillyreae</i>	<i>Clitostethus arcuatus</i>	<i>Siphoninus phillyreae</i>	<i>Clitostethus arcuatus</i>
June	110	10	830	9
July	142	25	910	16
August	165	47	988	22
September	177	76	1024	34
October	198	102	1126	75

Table 6: Number of populations of *Siphoninus phillyreae* and its predator, *Clitostethus arcuatus* on pear during 2005 in treatment and control experiment

Month	Treatment		Control	
	<i>Siphoninus phillyreae</i>	<i>Clitostethus arcuatus</i>	<i>Siphoninus phillyreae</i>	<i>Clitostethus arcuatus</i>
June	124	21	912	12
July	150	30	996	23
August	176	71	1001	56
September	199	124	1090	89
October	243	170	1148	102

Table 7: Number of populations of *Siphoninus phillyreae* and its predator, *Clitostethus arcuatus* on pomegranate during 2004 in treatment and control experiment

Month	Treatment		Control
	<i>Siphoninus phillyreae</i>	<i>Clitostethus arcuatus</i>	<i>Siphoninus phillyreae</i>
June	320	17	1900
July	450	23	2640
August	541	41	3591
September	610	55	4326
October	756	78	5964

Table 8: Number of populations of *Siphoninus phillyreae* and its predator, *Clitostethus arcuatus* on pomegranate during 2005 in treatment and control experiment

Month	Treatment		Control	
	<i>Siphoninus phillyreae</i>	<i>Clitostethus arcuatus</i>	<i>Siphoninus phillyreae</i>	<i>Clitostethus arcuatus</i>
June	240	31	2070	18
July	387	36	2941	22
August	423	47	3890	34
September	497	67	4870	40
October	541	75	6280	55

This result indicated that the population of whitefly species on different host plants in different locations in Egypt was decreased significantly in all experiments after releasing of *C. arcuatus* ( $p < 0.01$ ) and ( $p < 0.05$ ). The population of *C. arcuatus* on different host plants in different locations increased significantly during all experiments ( $p < 0.01$  and  $p < 0.05$ ).

## Discussion

Coccinellids have been widely used in biological control for over a century and the methods for using these predators have remained virtually unchanged. The causes for the relatively low rates of establishment of coccinellids in importation biological control have not been examined for most species. Augmentative releases of several coccinellid species are well documented and effective (Obrycki and Kring, 1998).

Several small lady beetles including *Clitostethus arcuatus* (on ash whitefly) and scale predators such as *Scymnus* or *Chilocorus* species and the Asian multicolored lady beetle, *Harmonia axyridis*, feed on whiteflies.

In the Mediterranean, *C. arcuatus* plays an important role as predators of the whiteflies, *Aleyrodes proletella* (L.), *Dialeurodes citri* (Ashmead), *S. phillyreae* in France, Italy, USA (California: introduced) and of *Trialeurodes ricini* (Misra). This coccinellid beetle for the control of ash whitefly in California (Bellows *et al.*, 1990).

The results indicated that the highest population of *S. phillyreae* on apple in Sharqia, on olive in Fayum, on pear in Minufiya and on pomegranate in Assuit was decreased after releasing the predator *C. arcuatus*. Also, the population of *C. arcuatus* was increased in all experiments after releasing. During the present work *C. arcuatus* was established on olive in Fayum and on pomegranate in Assuit for the first time. Evaluations of augmentative releases of coccinellids have focused on immediate reductions of target pest densities (Hagen and Van den Bosch, 1968; Abd-Rabou, 2000). The effective role of *C. arcuatus* on different species of whiteflies including *S. phillyreae* was observed by Bellows *et al.* (1992) Ageryan (1977) Bathon and Pietrzik (1986) Liotta (1981) and Loi (1978). The present research agrees with the findings of the aforementioned authors and confirmed the effective role of *C. arcuatus* after rearing and releasing in different locations in Egypt.

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