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Research Article

Biological and Ecological Studies of the Ash Whitefly *Siphoninus Phillyreae* (HALIDAY) (Hemiptera: Aleyrodidae) on Citrus

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Abstract

Siphoninus phillyreae (Ash Whitefly) belongs to class Insecta, family Aleyrodidae, and genus Siphoninus. *S. phillyreae* is widely distributed in Middle East, Europe, Central and North Africa. This study aimed to examine the biological and ecological aspects of the whitefly *S. phillyreae*. This study was conducted in the laboratory and field of College of Agriculture, University of Baghdad during spring 2014. The results revealed that eggs with the size 0.29x0.086 mm were laid in partial or complete circular form on both upper and lower surfaces of mature leaves. The eggs had short sub-terminal stalk put into the leaf tissue by female ovipositor. There were four nymphal instars. The first one was yellowish in color, long, elliptical in shape with the dimensions 0.26x0.15 mm, had antennae and long legs. The antennae and legs of nymphal stages (pupa case) larvae were immovable and measured 0.39x0.24 mm, 0.55x0.39 mm, and 0.96x0.78 mm, respectively during different stages of development. The winged adult came out after t-shaped disruption of pupa and its dorsal surface had a yellowish body with pure dusty white wings. Males and females can be differentiated by the size and shape of the abdomen, being 1.5 mm for the females. The laboratory results showed that the life cycle (means developmental time) was completed in 27 days while female longevity extended for 26 days. Fertility check demonstrated that every female laid a maximum of 117.6 eggs while the sex ratio was 3:1 female to male. In Baghdad, the whiteflies are more abundant in the month of April and its generation grows from eggs to larvae. The study confirmed the presence of five to six generations annually in citrus plants in Baghdad.

Keywords: biological aspect, longevity, fertility, sex ratio.

1. Introduction

S. phillyreae (Haliday) is the pest found on different fruits, including citrus, pears, olives (*Olea europaea*), plums, loquat, and ash tree. It also feeds on garden ornamental trees including privet, crepe, pyrus, myrtle, buckthorn, magnolia, and hawthorn. It causes damage to pear and apple in European regions. Most of *S. phillyreae* in California were detected on hand grenade (1) (2, 3). *S. phillyreae* is polyphagous and it feeds on a variety of plant families such as *Punicaceae*, *Oleaceae*, *Leguminosae*, *Lythraceae*, *Magnoliaceae*, *Bignoniaceae*, *Rubiaceae*, European *Rosaceae*, *Rhamnaceae*, *Rutaceae*, and *Pyracantha*. *S. phillyreae* forms sticky and transparent spots known as honeydew. Severe damage leads to dropping and wilting of leaves, reduction in the size of fruit, and sooty growth on the honeydew (4, 5). The first record of this pest was reported in Los Angeles USA in 1988 and then it spread to other countries including Saudi Arabia, Syria, Egypt, Sudan, Libya, Morocco, India, Iran, Israel, Pakistan, Hungary, Cyprus, Romania, England, Spain, Italy, France, Ireland, Ethiopia, Germany, Australia, New South Wales, Switzerland, Victoria and Queens Island. In 2010, it was discovered in Florida (6, 7). The ash whitefly *S. phillyreae* has numerous synonyms listed in Mound and Halsey (3). It was distinguished as *Aleyrodes*

phillyreae by Haliday and named as *Phillyrea latifolia* in Ireland (8, 9). *S. phillyreae* has the ability to become a grave pest in other regions (10).

Some parasites and predators that act as natural enemies of *S. phillyreae* are *Scymnus pallidivestis*, *Menochilus sexmaculatus*, *Clitostethus arcuatus*, *Coccophagus eleaphilus*, *E. partenopea*, *Encarsia inaron*, *E. siphonini*, *E. pseudopartenopea*, *E. galilea*, *E. formosa*, *E. punicae*, *E. siphonini*, and *Eretmocerus corni*.

This is the first research that aims to study the biological and ecological studies of the Ash Whitefly *Siphoninus phillyreae* (HALIDAY) (Hemiptera: Aleyrodidae) on citrus plants in Baghdad.

2. Material and Methods

2.1. Seasonal Occurrence of *S. Phillyreae* Eggs in the Field in Baghdad

Monument of cages were manufactured locally. Plants were grown in polyethylene bags of the size 15x30 cm and open from both sides. The bags were tightly fitted into cages to avoid the entry of parasites and predators. The cages were sealed by taping cloth on their both ends to maintain a favorable environment for the development of insects. The Ash Whitefly was introduced to the injury free branches of the citrus plants grown inside the cage. The readings were calculated every week for the period of 3 years in a table especially designed for this purpose (11, 12).

To confirm the identification of *S. phillyreae*, a slide of pupal cases was prepared and observed under microscope following the procedure suggested by various authors including Martin (11, 13).

2.2. Biology and Ecology

Whitefly was cultured on the tree of citrus plants for oviposition, whereas the rearing period trials were done according to protocol defined by Kanmiya and Snobe (2002) (14). Plants were grown in the pot and stored in the cage. Readings were recorded in specially designed tables every week for the period of one year. The plants were kept in airtight places from spring to autumn and in a non-heated plastic house in winters.

Pupae whiteflies were collected in July and kept in petri dishes until the emergence of adults. The adults were later introduced to citrus plants. Laboratory conditions to maintain cultures were optimized as 30±2°C, 14/10L/D, 60% RH in an airtight place.

Developmental and immature stages of *S. phillyreae* were studied in the ecological cabinets. A citrus plant was placed in the cabinet for *S. phillyreae*. The eggs of adult Whiteflies were observed on the leaves of the plant. Eggs from ovipositor were marked and the number of instars and nymphs were recorded on a daily basis until the emergence of the adult.

3. Results

Winged adult females laid eggs on the underside of leaves (Figure 1). The hatched nymphs from the eggs fed on tree sap until they become pupa. The undersides of leaves were the sites for pupation and completion of life cycle (from egg to adult). We observed that eggs of *S. phillyreae* were pale yellowish and were covered by a very thin layer of white wax. The eggs were long, oval and almost pointed at the front, with a very short stalk. The eggs were 0.28-0.30 mm long and 0.084-0.088 mm wide (Table 1).

Table 1. Dimensions of *S. Phillyreae* Stages

Stage	Length/mm	Range	Width/mm	Range
Eggs	0.29± 0.011	0.28- 0.30	0.086± 0.002	0.084- 0.088
instar st nymph	0.26± 0.02	0.24- 0.28	0.15± 0.01	0.14 - 0.16
instar nd nymph	0.39± 0.06	0.33 - 0.45	0.24 ± 0.03	0.21- 0.27
instar rd nymph	0.55± 0.06	0.49 - 0.61	0.39± 0.06	0.33 - 0.45
Pupae	0.96± 0.09	0.87 - 0.105	0.78± 0.02	0.76 - 0.80
Adult	1.5± 0.091	1.41- 0.59	—————	—————

The ovipositing females form a fine waxy powder in the form of circular spots on the host plant. Development time and hatching took 8-9 days and the adults had yellowish body with pure white wings. The body length was 0.59-1.41 mm including the wings. Females were usually larger than the males (Figure 1).

**Figure 1.** Adult ash whiteflies, *S. phillyreae* (Haliday).

The illustrations of Haliday have shown that adult Ash Whitefly exists either as white powder of wax or as a pale whitish whitefly similar to other whitefly species (15). Development time to adulthood was 24-30 days. The longevity of females was from 25 to 27 days and the survival time was 8 to 9.5 days in males (Table 2).

Table 2. Some Adult Biological Aspects for *S. Phillyreae* on *Citrus* Sp at 25C°

Days	Longevity		Number of egg/female	%Hatching	Sex ration	
	♀	♂			♀	♂
Range	25-27	8-9.5	115-119	75-93	24- 31	69 -76
Mean	26	8.8	117.6	87.2	27.4	72.6

S. phillyreae was found on the leaves (especially the undersides) of host plants. Colonies of *S. phillyreae* were detected as small white adults flying near the host plants or nymphs on the

underside of the leaves. The ovipositing females also leave a fine waxy powder arranged in circular spots on the host plant (Figure 2). Five to six generations have been observed on the citrus plant in Baghdad, annually (Figure 3).

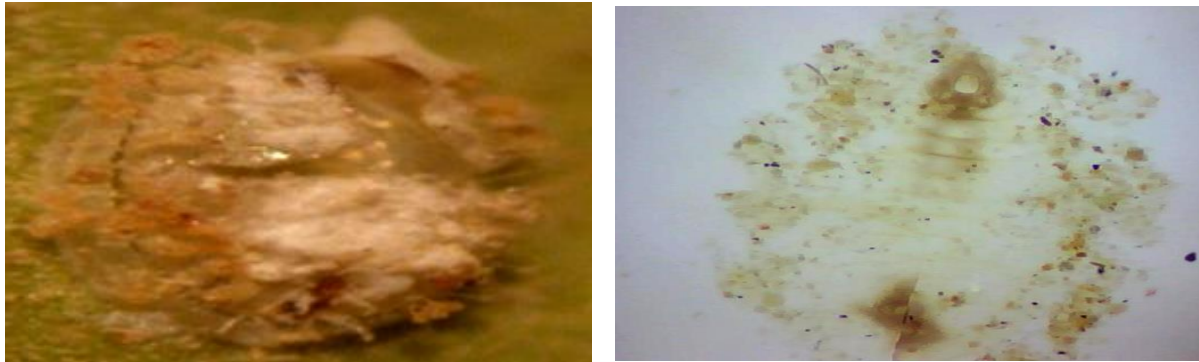


Figure 2. Stages of Pupal of , *S. phillyreae* (Haliday), evidencing glassy, wax drops.

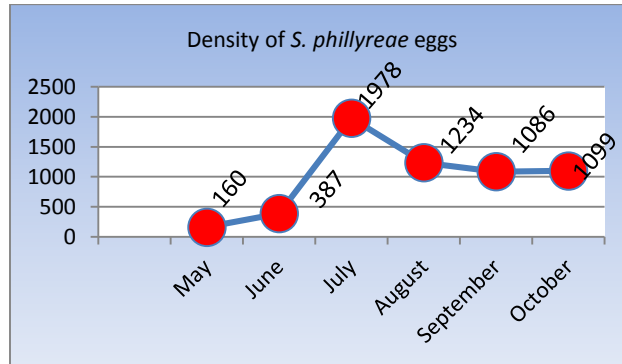


Figure 3. Seasonal occurrence of *S. phillyreae* eggs in the field.

The first-instar nymphs of *S. phillyreae* were yellowish in color and elliptical in shape, 0.241-0.28 mm long and 0.14-0.16 mm wide. The antennae and legs were well developed. Development time to first-instar nymph was 2-3 days (Table 3). The second-instar nymphs were similar to the first-instar nymphs in color and shape. They were 0.33-0.45mm long and 0.21-0.271mm wide. Reduction in the size of antennae and legs was observed. Development time to second-instar nymphs took 2-4 days. The third-instar nymphs were whitish-yellow and oval in shape, 0.49-0.61 mm long and 0.33-0.45 mm wide. Development time to third-instar nymphs was 3-4 days. The fourth-instar nymphs were white, with a median longitudinal brown stripe. They were oval in shape, 0.87-0.105 mm long and 0.76-0.80 mm wide. Development time to pupa stage was 9-10 days. The pupal case of whitefly appeared as greater or lesser amounts of white wax with two longitudinal patches of white wax. The longitudinal white wax was in the form of tufts.

Table 3. Developmental period for *S. phillyreae* on *Citrus* sp at 25C°

Days	Total Egg	1 st Instar Nymph	2 nd Instar Nymph	3 rd Instar Nymph	Pupae	Total
Range	8-9	2-3	2-4	3-4	9-10	24-30
Mean	8.6	2.8	3	3.4	9.2	27

4. Discussion

Contrary to the findings of our study, Stocks and Hodges (2010) found that the pupa was 0.81 to 1.01 mm long, 0.551 to 0.71 mm wide and was black tan in color. Development time of pupa was 9-10 days (6, 16, 17).

Paine et al. (2015) observed that the life-time of *S. phillyreae* depended on temperature. Sex ratio of this insect was 72.6:27.4 female to male, respectively. Temperature was also reported to effect female fecundity with a maximum number of 141 eggs per female at 25°C. Hatching percentage was 87.2% (4). Leddy et al. (1995) studied the duration of development, fertility, sex, longevity, and survival at 25°C as well as critical temperatures above and below 10°C and 30°C. It was observed that sex ratio was 1:1 and temperature did not affect female longevity. The study further reported significantly longer longevity in females as compared to males. Every female laid 181 eggs on average. The maximum time for copulation was 67 minutes while the average pre-oviposition and premating lasted for 1.8 days and 3.8 days, respectively (3). While in Egypt, Mound and Halsey reported about two to three generations annually (18). In Sicily, three spring-summer generations have been recorded on pear. In California, according to Sorensen et al. (1990), *S. phillyreae* have more cycles per year with a potential generation time of 25 days (7).

Gould et al. (1995), while studying the life history of parasitoid, reported that development time to adulthood was between 55-60 days at 15°C (59°F) to 15 days at 30°C (86°F). The average female longevity was 19 days and the average egg count was approximately 150. Pre-adult survival was recorded as 59% at 25°C (77°F) and male to female sex ratio was 1:3. Female oviposition took place preferably in fourth-instar nymphs (19).

Ash whitefly accidentally entered into Egypt and led to the study of efficacy of various bio-control agents in infested pomegranate orchards. Simmons et al. (2002) reared the predator *Clitostethus arcuatus* and released seven parasitoids wasps. The study reported that high control levels were attributable to aphelinid wasp *Encarsia inaron* (1).

5. Conclusion

To conclude, we observed an annual five to six generations in citrus plants in Baghdad. The average size of eggs was measured to be 0.29x0.086 mm and the eggs were laid on upper and lower side of mature leaves in either partial or completely circular form. The size of abdomen was the differentiating parameter between males and females. The Ash White completed its life cycle in 27 days and the average number of eggs laid by a female was 117.6.

Competing Interest

None

Funding Interest

None

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