Düzce University Faculty of Forestry Journal of Forestry
Düzce Üniversitesi Orman Fakültesi Ormancılık Dergisi
22 (1), 2026, 170-177.
https://doi.org/10.58816/duzceod.1911709
ISSN: 2148-7871 e-ISSN: 2148-7855
https://dergipark.org.tr/en/pub/duzceod
Research Article

Investigation of the Basic Biological Characteristics of *Pochazia shantungensis* Chu & Lu, 1977, in Yalova Province, Türkiye

Gürsel Çetin[1*], Pınar Hephızlı Göksel[1], Kibar Ak[2], Erdem Hızal[3]

[1] General Directorate of Agricultural Research and Policies (TAGEM), Atatürk Horticultural Central Research Institute, Department of Plant Health, 77100, Yalova, Türkiye
ror.org/0174skq71

[2] Ondokuz Mayıs University, Hemp Research Institute, 55200, Samsun, Türkiye
ror.org/028k5qw24

[3] İstanbul University-Cerrahpaşa, Faculty of Forestry, Forest Engineering İstanbul, Türkiye
ror.org/01dzn5f42

*Corresponding author:
gurselcetin77@gmail.com

Received: 17.03.2026
Revision: 16.05.2026
Accepted: 18.05.2026
Online: 18.06.2026

Abstract: *Pochazia shantungensis* Chu & Lu, 1977 (Hemiptera: Ricaniidae) is an invasive insect species that poses a significant threat to agricultural crops and forest flora. Initially identified in İstanbul, Türkiye, in 2019, the species has since spread to a large part of the Eastern Marmara region. Detailed data on its biology and specific behaviors throughout its life cycle are important for developing sustainable management and control strategies. Therefore, a study was conducted in Yalova between 2020 and 2022 to obtain biological and morphological findings that could contribute to control practices against the pest in question. The main life stages of the insect—including egg, nymph, and adult—as well as its overall lifespan, life cycle, and number of generations were determined in 250–400 mm rectangular porous tulle bags under natural environmental conditions. The bags were placed on the annual shoots of the privet plant when the insect was in its egg stage. The findings revealed that the insect overwinters in the egg stage on host-plant shoots and undergoes five distinct nymphal instars before reaching adulthood; adults produce two generations per year. The lifespans of the first and second generations were recorded as 94 days (average temperature 18.95°C, relative humidity 70.5%) and 76 days (average temperature 22.8°C, relative humidity 70.9%), respectively. Additional findings on egg-laying behaviors were obtained during the study.

Keywords: *Pochazia shantungensis, Ricaniidae, Biology, Biological parameter, Privet*

I. INTRODUCTION

Due to global warming and the resulting climate change, as well as the negative impacts of increased international trade and human mobility, invasive insect species have been rapidly spreading worldwide. Whereas many of these insect species are neutral in their natural ecosystems, their introduction to foreign environments often leads to significant ecological disruption (Shrestha, 2019). In most cases, invasive species can cause populations of native organisms to decline or disappear by competing with local species for resources such as food and shelter. In the absence of natural predators, they can disrupt ecosystem dynamics. *Pochazia shantungensis* Chou & Chin-Sheng, 1977 (Hemiptera: Ricaniidae), first identified in South Korea by Choi et al. (2011) and originally native to China, exemplifies the above-mentioned situation. This insect was initially recorded in the province of İstanbul, Türkiye, in 2019 (Hızal et al., 2019). It was also observed in outdoor ornamental plants in Yalova Province in 2018. Initially, attempts were undertaken to eradicate it, but these efforts were unsuccessful. Because of this process, no records have been published from Yalova. The Asian pest was initially detected in İstanbul and Yalova in Türkiye and then multiplied and spread to the neighbouring provinces of Kocaeli and Bursa (Çetin et al., 2026). *P. shantungensis* is known to have a wide range of host plants, with records indicating 138 plant species across 62 families in South Korea (Kim et al., 2015). In Yalova Province, nineteen distinct plant species have been identified as host plants. These include several economically important fruit crop species, such as olive (*Olea europaea*), apple (*Malus domestica*), quince (*Cydonia oblonga*), persimmon (*Diospyros kaki*), grape (*Vitis vinifera)*, blackberry (*Rubus fruticosus*), aronia (*Aronia melanocarpa*), and jujube (*Ziziphus jujuba*). Among these, the outdoor ornamental plant Japanese privet (*Ligustrum japonicum*) has been recognized as the most preferred host (Çetin et al., 2026). Another study conducted in İstanbul, focusing primarily on forest plants, identified fifty-seven host species (Hızal et al., 2023). Similar to other species in the Ricaniidae family, this insect causes harm through injuries to plant shoots during oviposition, sap consumption by nymphs and adults, and honeydew production on plants resulting from feeding. Mould growth in honeydew, caused by saprophytic fungi, harms plants by hindering photosynthesis and respiration. Thus, secondary damage occurs. In addition to harming plant products, the pest may cause severe public nuisances in urban and residential areas by forming dense populations (Ak et al., 2015; Çetin et al., 2026). Understanding the biology and behaviour of a species is crucial for effective pest management strategies. This study aimed to create a principal database to guide control measures by determining the biological characteristics and egg-laying behaviour of *P. shantungensis* in Yalova Province.

Cite as: Çetin, G. Hephızlı Göksel, P., Ak, K, & Hızal, E. (2026). Investigation of the basic biological characteristics of *Pochazia shantungensis* Chu & Lu, 1977, in Yalova province, Türkiye. *Düzce University Faculty of Forestry Journal of Forestry, 22*(1), 170-177. https://www.doi.org/10.58816/duzceod.1911709

II. MATERIAL METHOD

A. Material

The study materials included the privet, *Ligustrum japonicum* (Lamiales: Oleaceae); jujube, *Ziziphus jujube* (Rosales: Rhamnaceae); blackberry, *Rubus fruticosus* (Rosales: Rosaceae); various developmental stages of *P. shantungensis*; tulle bags; a stereo-binocular microscope; an insect aspirator; raffia; transparent polyethylene bags; Eppendorf tubes; petri dishes; soft-tipped brushes; tissue paper; culture dishes; and a range of consumables and chemicals required for preparatory procedures. The study area is located within the approximately 150-hectare recreational area of the Atatürk Horticultural Research Institute, situated at 40°39'3.68" north latitude and 29°16'51.49" east longitude. Its elevation above sea level is approximately 2 m.

B. Method

B.1. Determination of Number of Generation and Duration of Biological Stages

In March 2020, twenty distinct egg masses—one from each of the twenty privet plants located at least 10 metres apart—were identified and marked with coloured ribbons (Figure 1a). When colour changes were observed in the overwintering eggs and the first red spots appeared, indicating hatching, in the second week of April, eggs were enclosed in perforated tulle bags (250 × 400 mm), and nymph emergence was monitored daily (Figure 1b). After all first-stage nymphs had emerged and completed development, the developmental stages and lifespans of second-, third-, fourth-, and fifth-stage nymphs were evaluated based on their moulting intervals (Figure 1c). After the adults had fully emerged, they were released into their natural habitat. The adults' active periods and the locations and dates of egg-laying were determined by daily inspection of the privet shoots. The second-generation studies were conducted in the third week of July on twenty egg masses laid on the same plants, using the same method as the first-generation studies.

Figure 1. a) The overwintered egg mass, b) a tulle bag containing an egg mass in which to observe the biological stages, c) the final nymph stage of *Pochazia shantungensis* and the subsequent emergence of the adult.

B.2. Determining Egg-Laying Behaviour

The study of egg-laying behavior was conducted on privet, the pest's preferred host plant, between 2020 and 2022. A total of 100 shoots—10 from each of 10 privet plants—were examined. The heights of egg masses on plant shoots, measured from the ground with a tape measure, were recorded. Egg masses were categorized into four height ranges (0-0.5 m, 0.6-1 m, 1.1-1.5 m, and 1.6-2 m), and their frequencies were presented as percentages. The lengths of egg masses on the shoots at different heights were measured with a ruler. For this purpose, 10 plants with egg masses were selected; one egg mass per plant (from a single shoot) was assessed, totaling 10 egg masses. The arithmetic mean of the egg masses in the four classifications listed above was computed.

B.3. Measurements of Length and Width for the Biological Stages of Pochazia shantungensis

The dimensions of images of the biological stages were measured using an Olympus SZX7 stereo binocular microscope. Measurements were made on 10 individuals at each egg, larval and adult stage.

B.4. Meteorological Data

Meteorological data were provided by the Yalova Provincial Meteorological Directorate.

III. RESULTS AND DISCUSSION

A. *Number of Generation and Duration of Biological Stages*

The results of the 2020 study, conducted under natural conditions in the province of Yalova to determine the number of generations and the duration of biological stages of *P. shantungensis,* are presented in Tables 1 and 3. Meteorological data relating to the study have been provided in Tables 2 and 4.

Table 1*.* Duration of biological stages of the first generation of *Pochazia shantungensis* in the ecological conditions in Yalova Province in 2020.

Replication (N=20)*	Incubation duration of the egg stage	Emergence date of first stage nymphs	Emergence date of second stage nymphs	Emergence date of third stage nymphs	Emergence date of fourth stage nymphs	Emergence date of fifth stage nymphs	Emergence date of adult
1.	14 .04	28. 04	07. 05	16. 05	27. 05	09. 06	24. 06
2.	14. 04	02. 05	10. 05	19. 05	29. 05	11 .06	24. 06
3.	14. 04	01. 05	10. 05	18. 05	28. 05	10. 06	24 .06
4.	14. 04	30. 04	09. 05	18. 05	29. 05	11. 06	24. 06
5.	14. 04	02. 05	10. 05	19. 05	30. 05	11. 06	25. 06
6.	14. 04	04. 05	12. 05	21. 05	31. 05	13. 06	27. 06
7.	14. 04	01. 05	10. 05	18. 05	29. 05	11. 06	25. 06
8.	14. 04	03. 05	12. 05	21. 05	01. 06	14. 06	29. 06
9.	14. 04	04. 05	12. 05	20. 05	31. 05	13. 06	29. 06
10.	14. 04	29. 04	07. 05	17. 05	29. 05	12. 06	28. 06
11.	14. 04	05. 05	14. 05	22. 05	02. 06	15. 06	30. 06
12.	14. 04	02. 05	11. 05	21. 05	01. 06	14. 06	30. 06
13.	14. 04	02. 05	12. 05	22. 05	03. 06	16. 06	02. 07
14.	14. 04	03. 05	12. 05	20. 05	31. 05	12. 06	29. 06
15.	14. 04	04. 05	14. 05	23. 05	06. 06	19. 06	05. 07
16.	14. 04	29. 04	09. 05	18. 05	30. 05	11. 06	27. 06
17.	14. 04	05. 05	15. 05	25. 05	05. 06	18. 06	29. 06
18.	14. 04	03. 05	13. 05	21. 05	05. 06	18. 06	29. 06
19.	14. 04	06. 05	15. 05	26. 05	08. 06	23. 06	08. 07
20.	14. 04	02. 05	11. 05	19. 05	30. 05	12. 06	29. 06
Mean number of days and SE**	18±0. 5005	9±0. 1817	9±0. 1983	11±0. 5959	13±0. 2052	15 ±0. 7251	

* Egg mass, **Standard error

As shown in Table 1, the average incubation period for 20 egg clusters overwintering on the annual shoots of privet plants and showing signs of revival with colour changes from the second week of April onwards is 18 days. This incubation phase took place on seven distinct dates, spanning April 14 to April 27 and April 14 to May 5. The earliest nymph emergence occurred on April 28 in the first of 20 egg masses; the latest occurred on May 6 in the 19th egg mass. Emergence from the other egg masses occurred between these dates. The average duration of emergence for first-stage nymphs was 9 days. The emergence of nymphs occurred as follows: second-stage nymphs, May 7–15; third-stage nymphs, May 16–26; fourth-stage nymphs, May 27–June 8; and fifth-stage nymphs, June 9–23, 2020. The emergence of the second, third, fourth, and fifth nymph stages was completed on May 15 and 25, May 26 and June 7, June 8 and 22, and June 23 and July 7, respectively. The average lifespans for the second, third, fourth, and fifth nymph stages were 9 days, 11 days, 13 days, and 15 days, respectively. Adult emergence in the first and nineteenth egg masses occurred on June 24 and July 8, 2020, respectively. Adult emergence was completed on July 9 and 22, 2020. The first-generation adult emergence lasted a mean of 15±0.2087 days. In natural outdoor conditions, the adults started laying eggs on annual shoots as of July 16, 2020. Consequently, the egg-to-egg developmental cycle of the first generation lasted 94 days, with an average temperature of 18.95°C and an average humidity of 70.5% (Table 2).

Table 2. Meteorological data from Yalova Province regarding the biological stages of the first generation of *Pochazia shantungensis i*n 2020.

Duration of the first generation (days)	Average temperature (°C)	Minimum temperature (°C)	Maximum temperature (°C)	Relative humidity (%)	Average rainfall (mm)	Rainfall (days)
14-30 April	12.8	7.5	17.7	65.9	2.4	2
01-31 May	17.1	12.7	21.30	72.00	68.3	10
01-30 June	22.0	17.7	26.00	71.10	115.2	7
1-16 July	23.9	20.1	28.70	72.90	2.3	2
Total: 94	18.95	14.5	23.4	70.5	2.0	21

Table 3. Duration of biological stages of the second generation of *Pochazia shantungensis* in the ecological conditions in Yalova Province in 2020.

Replication (N=20)*	Incubation duration of the egg stage	Emergence date of first stage nymphs	Emergence date of second stage nymphs	Emergence date of third stage nymphs	Emergence date of fourth stage nymphs	Emergence date of fifth stage nymphs	Emergence date of adult
1.	16. 7	05. 8	13. 8	20. 8	27. 8	03. 9	11. 9
2.	20. 7	06. 8	14. 8	21. 8	28. 8	05. 9	13. 9
3.	17. 7	05. 8	13. 8	20. 8	27. 8	04. 9	12. 9
4.	20. 7	08. 8	16. 8	24. 8	31. 8	07. 9	15. 9
5.	20. 7	05. 8	13. 8	20. 8	27. 8	03. 9	10. 9
6.	20. 7	09. 8	17. 8	25. 8	01. 9	08. 9	16. 9
7.	22. 7	06. 8	13. 8	20. 8	27. 8	03. 9	11. 9
8.	22. 7	06. 8	15. 8	23. 8	30. 8	06. 9	14. 9
9.	22. 7	10. 8	18. 8	25. 8	01. 9	08. 9	16. 9
10.	23. 7	11. 8	19. 8	26. 8	02. 9	10. 9	18. 9
11.	23. 7	07. 8	16. 8	24. 8	01. 9	08. 9	16. 9
12.	23. 7	12. 8	19. 8	26. 8	02. 9	10. 9	17. 9
13.	21. 7	07. 8	14. 8	21. 8	28. 8	04. 9	12. 9
14.	22. 7	06. 8	15. 8	22. 8	29. 8	05. 9	12. 9
15.	23. 7	07. 8	15. 8	22. 8	29. 8	05. 9	13. 9
16.	22. 7	08. 8	16. 8	23. 8	30. 8	06. 9	14. 9
17.	22. 7	09. 8	17. 8	24. 8	01. 9	08. 9	15. 9
18.	2.2 7	12. 8	19. 8	26. 8	02. 9	09. 9	16. 9
19.	22. 7	07. 8	15. 8	22. 8	29. 8	05. 9	13. 9
20.	22. 7	11. 8	19. 8	26. 8	02. 9	09. 9	17. 9
Mean number of days and SE**	16±0.8864	8 ±0.1352	7±0.0918	7±0.0688	7±0.0993	8 ±0.0993	

* Egg mass, **Standard error

According to Table 3, the incubation period for eggs laid by first-generation adult females from June 16 to June 23 was a mean of 16 days. This incubation phase took place over seven distinct dates, spanning from July 16 to August 04 and July 23 to 11 August. The earliest nymph emergence occurred on August 05, in the first, third and twelfth egg masses among a total of 20 egg masses, while the latest emergence was observed in the 19th egg mass on August 12, 2020, and was completed in the twentieth egg mass on August 17, 2020. Therefore, the first nymph stage lasted an average of eight days. The emergence of subsequent nymphs occurred as follows: second-stage nymphs, August 13–19; third-stage nymphs, August 20–26; fourth-stage nymphs, August 27–September 02; and finally, fifth-stage nymphs between September 3 and 10, 2020. The emergence of the second, third, fourth, and fifth nymph stages was completed on August 19 and 25, August 26 and September 01, September 02 and 09, and September 10 and 17, respectively. The average lifespans for the second, third, fourth, and fifth nymph stages were seven days, seven days, seven days, and eight days, respectively. Adult emergence occurred on September 11 and September 18, 2020, in the first and tenth egg masses, respectively. Adult emergence was completed between September 19 and 26, 2020. The second-generation adult emergences lasted a mean of 8±0.20390 days. In the natural environmental conditions, adult egg-laying occurred on October 4, 2020. Consequently, the egg-to-egg cycle for the second generation lasted 76 days, with an average temperature of 22.8°C and a humidity of 70.9% (Table 4). Second-generation adults were monitored in their natural environment up to November 2, 2020, under an average temperature of 15°C and a relative humidity of 78%. During the second generation's lifespan, average temperature and humidity increased, while the number of rainy days and total rainfall decreased (Table 4).

Table 4. Meteorological data from Yalova Province regarding the biological stages of the second generation of *Pochazia shantungensis* in 2020.

Duration of the second generation (days)	Average temperature (°C)	Minimum temperature (°C)	Maximum temperature (°C)	Relative humidity (%)	Average rainfall (mm)	Rainfall (days)
16 -31 July	24.3	19.1	29.3	70.8	0	0
01-31 August	24.4	19.2	29.2	70.8	0	0
01-30 September	23.1	19.1	27.3	73.6	29.3	7
01-04 October	19.4	14.0	24.6	68.3	0.8	1
Total: 76 days	22.8	17.9	27.6	70.9	0.4	8
05-31 October*	18.9	15.2	23.4	78.6	8.4	10.5
02 November*	11.6	8.6	16.3	77.5	7.8	1
Mean	15,25	11,9	19,9	78	8.1	6

*The presence of adults in nature

B. Findings Related to the Egg-Laying Behaviour of Pochazia shantungensis

Pochazia shantungensis was observed to overwinter in the egg phase within the annual shoots of its host plant (Figure 2a). The study indicated that adults use their ovipositors to deposit eggs in masses, burying them 1-2 mm beneath the host-plant shoots. These egg masses were subsequently found to be densely covered with white or camel-coloured waxy filaments (Figure 2b). Egg masses are generally laid on shoots in 1-4 masses per shoot (Figure 2b). The eggs within each mass were arranged in two patterns: parallel and cross, with the number of eggs per mass varying from 24 to 50 depending on the host plant (Figure 2).

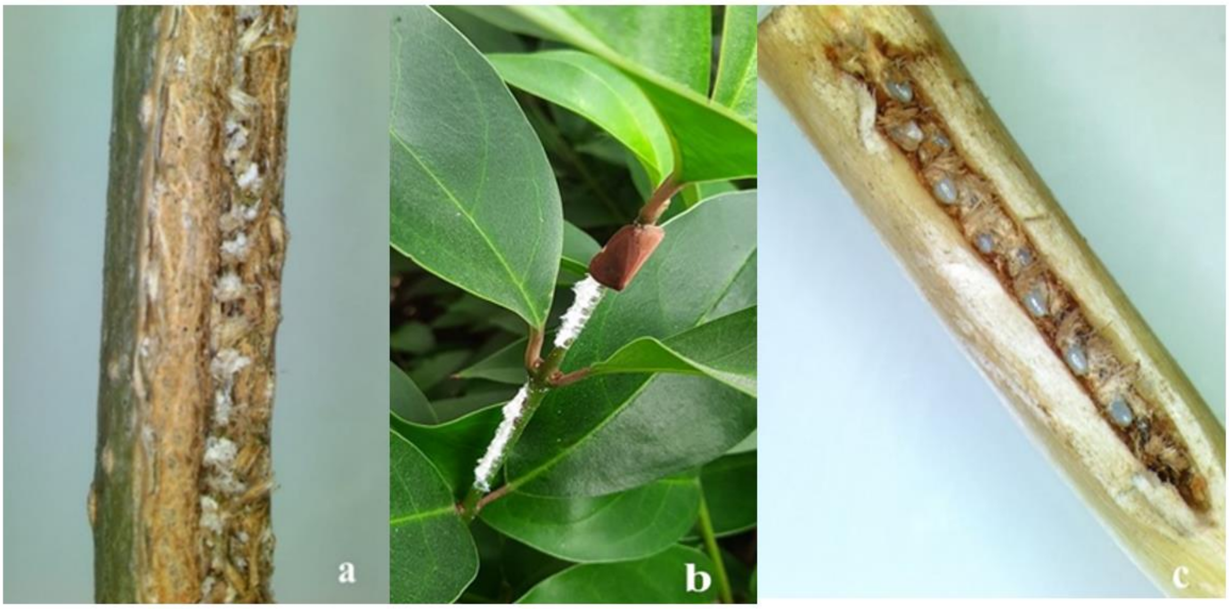

Figure 2. *a) Egg mass, b) two egg masses covered with hairs on a plant shoot, c) egg masses including two rows buried inside the shoots.*

This harmful insect has been observed to lay its eggs in masses of one to four masses per shoot, usually on sun-exposed parts of the host plant, about 2 m above the ground (Table 5). In this study, the mean length of egg masses on privet shoots, the host plant of *P. shantungensis,* was 13 mm. The sample size consisted of 10 masses (N=10), and the mean length ($\bar{x}$) and standard error were calculated as 13.33±0.088 mm; the observed lengths ranged from 11 mm to 15 mm.

Table 5. *The ratios of the height from the ground and the number of egg masses belonging to Pochazia shantungensis on the shoots of the privet (Ligustrum japonicum).*

Year	Height above the ground (m)				The number of eggs masses per shoot (%)			
	0 - 0.5 (%)	0.6 - 1 (%)	1.1 - 1.5 (%)	1.6 - 2 (%)	One mass	Two mass	Three mass	Four Mass
2020	6	12	30	52	45	40	10	5
2021	4	10	32	54	46	38	12	4
2022	4	12	38	46	58	34	7	1

As indicated in Table 5, the percentages of eggs deposited by *P. shantungensis* on the annual shoots of its host plants varied among years. The distribution ranged between 2020 and 2022 as follows: 0 - 0.5 m, 0.6 - 1 m, 1 - 1.5 m, and 1.6 - 2 m at rates of 4 - 6%, 10 - 12%, 30 - 38%, and 46 - 54%, respectively. In terms of group numbers, eggs were laid in the following proportions during the years 2020, 2021, and 2022: one mass accounted for 45–58%, two masses for 34–40%, three masses for 7–12%, and four masses for 1–5%.

C. Results of Measurements of Length and Width for the Biological Stages of Pochazia shantungensis

Measurements of the dimensions of the biological stages of *P. shantungensis* were presented in Table 6.

Table 6. *Measurement results related to the sizes of the biological stages of Pochazia shantungensis (x̄±SE).*

Biological Stages	Number of individual (N)	Width (mm)	Length (mm)	Wingspan (mm)
Egg	10	0,58±0.0224	1.38±0.0144	
First Instar Nymph	10	0.83±0.1155	1.23±0.0126	
Second Instar Nymph	10	1.31±0.2122	1.70±0.3245	
Third Instar Nymph	10	1.72±0.0234	2.50±0.0244	
Fourth Instar Nymph	10	2.65±0.0156	3.51±0.2368	
Fifth Instar Nymph	10	3.77±0.0145	4.60±0.0194	
Adult Male	10	4.60±0.2228	8.60±0.2228	24.03±0.030
Adult Female	10	3.50±0.2228	9.40±0.0517	29.07±0.010

The study indicates that the eggs of *P. shantungensis* are approximately *0.6 mm* wide and 1.4 mm long. The width and length of the first to fifth instar nymphs are approximately as follows: 0.8 mm and 1.2 mm for the first stage; 1.3 mm and 1.7 mm for the second stage; 1.7 mm and 2.5 mm for the third stage; 2.7 mm and 3.5 mm for the fourth stage; and 3.8 mm and 4.6 mm for the fifth stage. The dimensions of the fan-shaped projections extending from the dorsal posterior part of the fifth-instar nymphs' bodies were calculated to have an average width of approximately 8.4 mm (N=10, x̄=8.38±0.0270) and an average length of 4.4 mm (N=10, x̄=4.38±0.2278). Adult males and females have recorded wingspans of approximately 24 mm and 29 mm, respectively. Body length, measured from the top of the head to the genital organ in males and to the ovipositor in females, was 8.6 mm in males and 9.4 mm in females (Table 6).

The results of the study revealed that this pest overwintered in the egg stage under the climatic conditions of Yalova Province. In nature, the incubation period for eggs during the first generation typically lasts from the second week of April to the first week of May. First-stage nymphs emerge between the last week of April and the first week of May. Fifth-stage nymphs, marking the final nymph phase, are observed from the second to the fourth week of June. The emergence of adult individuals occurs between the third week of June and the second week of July. The study conducted by Kang et al. (2013) examined the development durations of overwintering eggs of *Ricania* sp., a species similar to *P. shantungensis*, under seven constant temperatures (10–34°C) with 4°C intervals and a photoperiod of 14 hours light and 10 hours dark. According to their findings, the times taken for overwintering eggs to develop into the first nymphal stage were recorded as 107.1, 54.5, 33.9, 25.3, 20.0, 25.1, and 16.7 days at 10, 14, 18, 22, 26, 30, and 34°C, respectively. They observed that developmental duration decreased with rising temperatures. The first occurrence of nymphs in the field typically ranged from May 19 to May 22. In another study by Choi et al. (2016), laboratory experiments were conducted under conditions with relative humidity varying between 40 and 70% and a photoperiod of 14 hours light and 10 hours dark. They examined the hatching durations of *P. shantungensis* eggs at 15, 18, 21, 24, 27, and 30°C. The hatching durations were 51.2, 31.3, 24.8, 19.4, 17.1, and 19.4 days. Their findings also indicated a reduction in hatching duration over the years studied; between 2011 and 2014, the hatching period decreased by nine days. In this study, which was conducted entirely under natural conditions, the egg incubation period was found to be 18 days for the first generation and 16 days for the second generation. Throughout the process, temperature and relative humidity were recorded, with ranges of approximately 15-24°C and 67-78%, respectively. The first nymphs were observed in nature between April 28 and May 6. Choi et al. (2016) conducted a study under laboratory conditions with relative humidity ranging from 40% to 70% and a photoperiod of 14 hours of light and 10 hours of darkness. These researchers found that at temperatures of 18°C, 21°C, 24°C, and 27°C, the total development times for the five nymphal stages were 82.8, 58.0, 45.8, and 39.6 days, respectively. In contrast, in our study conducted under natural conditions, the development time for first-generation nymphs was 57 days at an average temperature of 19.5°C and 70% relative humidity, while for the second generation, this period was 37 days at an average temperature of 24°C and 72% relative humidity.

In addition, the species undergoes five nymphal stages, resulting in two generations per year, with the first and second generations completing their development in 94 and 76 days, respectively. Similar findings have been reported from İstanbul, Türkiye. Under current climatic conditions, it has been observed that the pest produces two generations and overwinters in the egg stage (Hızal et al., 2023). Conversely, it has been reported that this pest produces one generation in South Korea and two generations in the People's Republic of China and overwinters as eggs in the annual shoots of its host plants (Baek et al., 2019; Baek, 2019). In Yalova in 2020, first-generation nymphs emerged in the last week of April and the first week of May, whereas adults were recorded in the last week of June and the first week of July. The first-stage nymphs of the second generation appeared in the first and second weeks of August, whereas adults appeared in the second and third weeks. In a study conducted in İstanbul, the districts of Kadıköy and Sarıyer were examined in 2019 and 2020. In both years, the first-stage nymph of the first generation emerged in the second and third weeks of May. The emergence of adults was identified in the fourth week of June in Kadıköy and in the first and second weeks of July in Sarıyer (Hızal et al., 2023). According to the same researchers, in these locations in 2019 and 2020, the second-generation, first-instar nymphs emerged in Kadıköy and Sarıyer, respectively, during the first and fourth weeks of July, and the first and second weeks of August. Meanwhile, adult emergences occurred during the first, second, and fourth weeks of September and the first week of October.

It was noted that the nymphs of *Orosanga japonica* (Hemiptera: Ricaniidae), a species from the same family as this harmful pest and found in the Eastern Black Sea region of Türkiye, start appearing from mid-May, similar to the species *P. shantungensis*; it undergoes five nymph stages (Ak et al., 2015). According to these researchers, adults of this pest emerge in early July and begin laying eggs on host plants in early August. They overwinter in the egg stage and produce one generation per year.

Studies of the biological stages of *P. shantungensis* under environmental conditions in İstanbul and Yalova have demonstrated that meteorological factors, such as temperature, humidity, and precipitation, can significantly influence its presence in the ecosystem. Additionally, host plants on which they feed play a role in this process. Although the results are relatively similar, this study highlights that the biological phases can occur at different times. Host plants and their phenological stages can affect the timing and behaviour of this pest's egg-laying.

According to the findings of Kim et al. (2016), it was determined that female adult individuals of this pest deposit their eggs at different rates on the lower, middle, and upper parts of blueberry plant shoots; these rates were 56.6-60.2%, 23.8-28%, and 11.7-19.7%, respectively. The eggs were laid in clusters, with one cluster on 50.9% of the shoots, two clusters on 20.5%, three clusters on 14.6%, and four clusters on 14%. The length of double-rowed egg clusters laid on host plants varied among host species. As noted by Choi et al. (2011), egg clusters on apple and plum plants were approximately 12 mm long and consisted of 15 to 19 eggs. In contrast, in this study, egg clusters of 8 mm in length were found on jujube and blackberry plants, while the average length was determined to be 13 mm (N=10, $\bar{x}$, SE=13.33±0.088 mm).

Although researchers have obtained varying measurements of the sizes of the biological stages of this pest, the differences among these findings have been small. According to Shen et al. (2007), the eggs are either white or milky white and turn brownish red as they get closer to hatching, measuring 1.29 to 1.34 mm in length and 0.54 to 0.63 mm in width. The same researchers reported that adult males had body lengths of 7.0–8.4 mm and wingspans of 23.0–25.4 mm, whereas adult females had body lengths of 8.2–9.0 mm and wingspans of 27.0–30.0 mm. According to other researchers (Hızal et al., 2023), the body length of male individuals of this pest was found to range between 7.8 and 9.6 mm, while the body length of adult females ranged from 8.1 to 10.8 mm. The study concluded that differences in size measurements across biological stages can be influenced by factors such as climatic conditions, pest location, host plant species consumed, and timing of measurements.

IV. CONCLUSION

Pochazia shantungensis has been identified as overwintering in the egg stage on the annual shoots of its host plant, and it subsequently undergoes five nymphal instars before maturing into an adult. In the study, adults were found to deposit their eggs in clusters of two egg rows, cover them with fine white filaments, and place them using their ovipositor approximately 1-2 mm beneath the host shoot's bark. Eggs are deposited on shoots in one to four masses, with each mass containing between 24 and 50 eggs. In Yalova, the pest developed two generations: the first lasted 94 days at an average temperature of 18.95°C and average relative humidity of 70.5%, while the second lasted 76 days at an average temperature of 22.8°C and average relative humidity of 70.9%. Given that *Orosanga japonica*, another ricaniid species prevalent in the Black Sea region, produces only one generation per year, whereas *P. shantungensis* produces two, *it was* concluded that *P. shantungensis* could pose a greater threat to the habitat. Controlling harmful insects relies on understanding the duration of their egg, nymph, and adult stages under natural conditions, as well as the number of generations. This study has identified the key biological criteria for the management and control of this species.

DECLARATIONS

Acknowledgements: We would like to thank the General Directorate for Agricultural Research and Policy of the Ministry of Agriculture and Forestry for the financial support to the project.

Author Contributions: Conceptualization, G.Ç., P.H.G, K.A, E.H; Data curation, P.H.G; K.A; E.H; Formal analysis, G.Ç., P.H.G, K.A, E.H; Funding procurement, G.Ç., Investigation, G.Ç. and P.H.G; Methodology, G.Ç., P.H.G, K.A, E.H.; Project execution, G.Ç and P.H.G.; Resources G.Ç., P.H.G, K.A, E.H; Writing, G.Ç., Supervision, K.A and E.H., Validation, K. A. and E.H; Visualization: G.Ç and P.H.G., Writing – original draft: G.Ç.; Writing – review & editing, K.A. and E.H. All authors have read and approved the final version of the article.

This study is based on a section of the final report of the project of TAGEM/BSAD/G/21/A2/P1/2828 funded by the General Directorate of Agricultural Research and Policy of the Ministry of Agriculture and Forestry.

Conflict of Interest: The authors declare that there is no conflict of interest.

Supporting Institution: This study was funded by the General Directorate of Agricultural Research and Policy of the Ministry of Agriculture and Forestry.

Ethical Approval: The study does not require ethics committee approval.

Plagiarism Statement: This article has been reviewed for plagiarism and no cases of plagiarism have been found.

Use of AI Tools: The authors declare that the QuillBot program (https://quillbot.com/grammar-check) was used for grammar check in the preparation of this article.

REFERENCES

Ak, K., Güçlü, Ş., Eken, C., & Sekban, R. (2015). *Ricania simulans* (Walker, 1851) (Hemiptera: Ricaniidae) a new pest for Turkey. *Turkish Journal of Entomology*, *39*(2), 179-186. https://doi.org/10.16970/ted.94434

Baek, S. (2019). *Spatio-temporal dynamics of Ricania shantungensis (Hemiptera: Ricaniidae) in Korea*. [Doctoral dissertation, Seoul National University]. https://hdl.handle.net/10371/162084

Baek, S., Koh, S. H., & Lee, J. H. (2019). Occurrence model of first instars of *Ricania shantungensis* (Hemiptera: Ricaniidae). *Journal of Asia-Pacific Entomology*, *22*(4), 1040–1045. https://doi.org/10.1016/j.aspen.2019.08.010

Choi, Y. S., Hwang, I. S., Kang, T. J., Lim, J. R., & Choe, K. R. (2011). Oviposition characteristics of *Ricania* sp. (Homoptera: Ricaniidae), a new fruit pest. *Korean Journal of Applied Entomology, 50*(4), 367-372.

Choi, D. S., Ko, S. J., Ma, K. C., Kim, H. J., Lee, J. H., Kim, D. I. (2016). Effect of temperature on hatchability of overwintering eggs and nymphal Development of *Pochazia shantungensis* (Hemiptera: Ricaniidae). *Korean Journal of Applied Entomology, 55*(4), 453-457. https://doi.org/10.5656/KSAE.2016.11.0.029

Chou, I., & Chin-Sheng, L. (1977). On the Chinese Ricaniidae with descriptions of eight new species. *Acta Entomology Sinica*, *20*(3), 314-322.

Çetin, G., Hephızlı Göksel, P., Ak, K., & Hızal, E. (2026). Determining host preferences, population density, and geographical distribution of *Pochazia shantungensis* (Chu & Lu, 1977) (Hemiptera: Ricaniidae) in the Eastern Marmara Region. *Plant Protection Bulletin, 65*(4), 57-68.

Hızal, E., Öztemiz, S., & Gjonov, I. (2019). *Ricania shantungensis* Chou & Lu 1977 (Hemiptera: Fulgoromorpha: Ricaniidae) a new invasive insect species in European Turkey. *Fresenius Environmental Bulletin, 28*(12A), 9816-9920. https://doi.org/10.5281/zenodo.3547678

Hızal, E., Öztemiz, S., & Gjonov, I. (2023). Phenology and host preferences of the invasive *Pochazia shantungensis* (Chou & Lu, 1977) (Hemiptera: Ricanidae), a risk for agriculture and forest areas in the West-Palaearctic Region. *Acta Zoologica Bulgarica, 75*(2), 251-258.

Kang, T. J., Kim, S. J., Kim, D. H., Yang, C. Y., Ahn, S. J., Lee, S. C., & Kim H. H. (2013). Hatchability and temperature-dependent development of overwintered eggs of *Ricania* sp. (Hemiptera: Ricaniidae). *Korean Journal Applied Entomology*, *52*(4), 431–436.

Kim, D. E., Lee, H., Kim, M. J., & Lee, D. H. (2015). Predicting the potential habitat, host plants, and geographical distribution of *Pochazia shantungensis* (Hemiptera: Ricaniidae) in Korea. *Korean Journal Applied Entomology*, *54*(3), 179-189. https://doi.org/10.5656/KSAE.2015.06.0.011

Kim, D. H., Kim, H. H., Yang, C. Y., Kang, T. J., Yoon, J. B., & Seo, M. H. (2016). Characteristic of oviposition and effect of density suppression by yellow-coloured sticky trap on *Pochazia shantungensis* (Hemiptera: Ricaniidae) in blueberry. *Korean Journal of Pesticide Science, 20*(4), 281-285.

Shen, Q., Wang, J. Y., Liu, J. D., Chen, Y. F., Fan, X. H., & Zhu, Y. Q. (2007). Bionomios and control of *Pochazia shantungensis. Chinese Bulletin of Entomology*, *44*, 116-119.

Shrestha, S. (2019). Effects of climate change in agricultural insect pest. *Acta Scientific Agriculture, 3*(12), 74-80. https://doi.org/10.31080/ASAG.2019.03.0727