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A study on the life history of *Diaspidiotus ostreaeformis* in Poland

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Abstract

This paper presents the results of a study on the biology of *Diaspidiotus ostreaeformis* (Curtis) (Hemiptera Diaspididae) conducted in Poland during 2019. The observations revealed that population of *D. ostreaeformis* in the area of study is biparental and that it develops one generation a year. Second instar nymph overwinters.

Key words: *Diaspidiotus ostreaeformis*, developmental stages, egg-laying, life-cycle.

Introduction

Diaspidiotus ostreaeformis (Curtis) (Hemiptera Diaspididae), the European fruit scale (or pear oyster scale), is a Palearctic species widely distributed in nearly all parts of the world (Kosztarab and Kozár, 1988; Kozár, 1990). It is a highly polyphagous species that has been recorded on host plants from 19 families and 40 genera (Garcia Morales *et al*., 2016). The European fruit scale lives almost exclusively on deciduous trees and shrubs, mainly on the bark, but it was also recorded on fruits (Schmutterer, 1952; Brookes and Hudson, 1969; Kosztarab, 1996).

It is a pest especially of Rosaceae, and is often found on apple, plum, cherry and other fruit trees (Kozár, 1990). It is also frequently found on Betulaceae and Salicaceae. Heavy infestations can kill the branches of the host trees.

The life cycle of *D. ostreaeformis* has been investigated in a few European countries: in Southern Germany (Franconia) by Schmutterer (1952), in England by Boratyński (1953) and in Ukraine by Tereznikova (1969). According to these observations in Europe *D. ostreaeformis* is univoltine, biparental and overwinters as a second instar nymph.

In Poland, the life cycle of *D. ostreaeformis* has never been studied in detail.

Materials and methods

The observations on the biology of *D. ostreaeformis* were performed between the beginning of March and the end of October 2019. Specimens of *D. ostreaeformis* were collected from *Betula pendula* Roth in various areas of Warsaw.

Each month was divided into three ten-day periods (decades): I - from the 1st to the 10th day of the month, II - from the 11th to the 20th day of the month and III - from the 21st to the end of the month. *D. ostreaeformis* samples were collected at least once in each period. Pieces of infested bark were cut from the trees and in laboratory, all living specimens were collected under a stereomicroscope and then preserved in 70% ethanol.

The specimens were preliminary soaked in 10% KOH for 24 hours, then mounted in glycerin and examined with an Olympus microscope at a higher magnification in order to identify the scale stage. The identification of nymphal sex was based on the description of *D. ostreaeformis* male and female nymphal instars by Podsiadło (2017; 2019).

The present study was preceded by occasional observations of the biology of *D. ostreaeformis* that had been performed in the years 2008, 2009, 2017 and 2018.

The reported mean monthly air temperatures in Warsaw during 2019 are from the Bulletin of the National Hydrological and Meteorological Service (Institute of Meteorology and Water Management, Warsaw) and are given in figure 1. Deviations from the respective long-term (1971-2000) means are also reported.

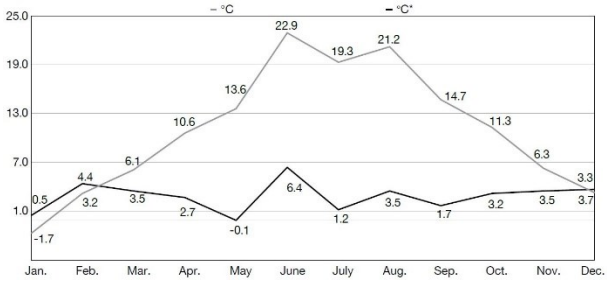

Figure 1. Mean monthly air temperatures (°C) in Warsaw in 2019 (from the Bulletin of the National Hydrological and Meteorological Service published by the Institute of Meteorology and Water Management in Warsaw, 2019). * deviations from the respective long-term (1971-2000) means.

Results

Figure 2 presents the number of specimens of *D. ostreaeformis* that were examined and shows that *D. ostreaeformis* overwintered in the 2nd nymphal instar.

Sampling of *D. ostreaeformis* started in March, when the whole population consisted mainly of 2nd instar nymphs of both sexes.

The moulting of the 2nd instar males into prepupae began at the end of the first decade of April. The prepupae were recorded until the first decade of May. The prepupae started to moult into pupae at the end of the second decade of April. Pupae were observed until the second decade of May. Swarming of adult males started in early May and went on until May 20th.

The moult of the 2nd instar females into adult females began in late April.

During May and the early June, the adult females remained immature. Egg-laying began in the middle of June and lasted until the middle of September (figure 2). From the second half of June and during July, egg-laying proceeded intensively; afterwards, only single adult females laid eggs (figure 2). The egg phase lasted some hours, and was followed by the hatching of the crawlers. They wandered for some hours before settling and then produced the protective cover. The 1st instar nymphs began to moult by late July onwards. In October the whole population consisted mainly of 2nd instar males and females. The 1st instar lasted about 40 days. As single adult females laid eggs until mid-September, rare 1st instar nymphs were present until the end of October (figure 2). Possibly they may have moulted with a delay in late autumn or died during the winter. The 2nd instar nymphs continued to grow and, in the autumn, entered the winter diapause.

There was a high nymphal mortality during the development. The highest mortality rate was observed among the 1st instar nymphs, the lowest one - among the young 2nd instar nymphs collected between July and October 2019.

Discussion

It is confirmed that *D. ostreaeformis* is a bisexual species and that only one generation a year occurs. It overwinters in the 2nd nymphal instar. Adult males were observed in the first two decades of May, whereas pre-reproductive females from late April to late June. The first egg-laying females were noticed in mid-June (figure 3). Egg-laying period extended from mid-June until mid-September. These observations suggest that the preoviposition period lasts at least one month or more and that an adult female lays eggs for about one month before dying. Most of the adult females laid eggs in June and July, but a few females matured later and they laid eggs in August and September.

Because of the prolonged period of egg-laying by each female and the short egg phase, it was impossible counting the number of eggs laid by each female. According to Schmutterer (1952) in Franconia, one female lays from 72 to 203 eggs, while according to Tereznikova (1969) in Ukraine, one female lays from 20 to 80 eggs.

The present study, carried out in 2019 enabled to establish the time of the appearance of each life stage and to estimate their duration.

It is worth noting that it was extremely hot in Poland in 2019. The mean air temperatures in spring and summer were almost always higher than normal (figure 1) and this could have accelerated the development of *D. ostreaeformis*. Nevertheless, accidental observations on the development of *D. ostreaeformis* that had been performed in previous years enabled to conclude that the main scheme of its life cycle remained the same.

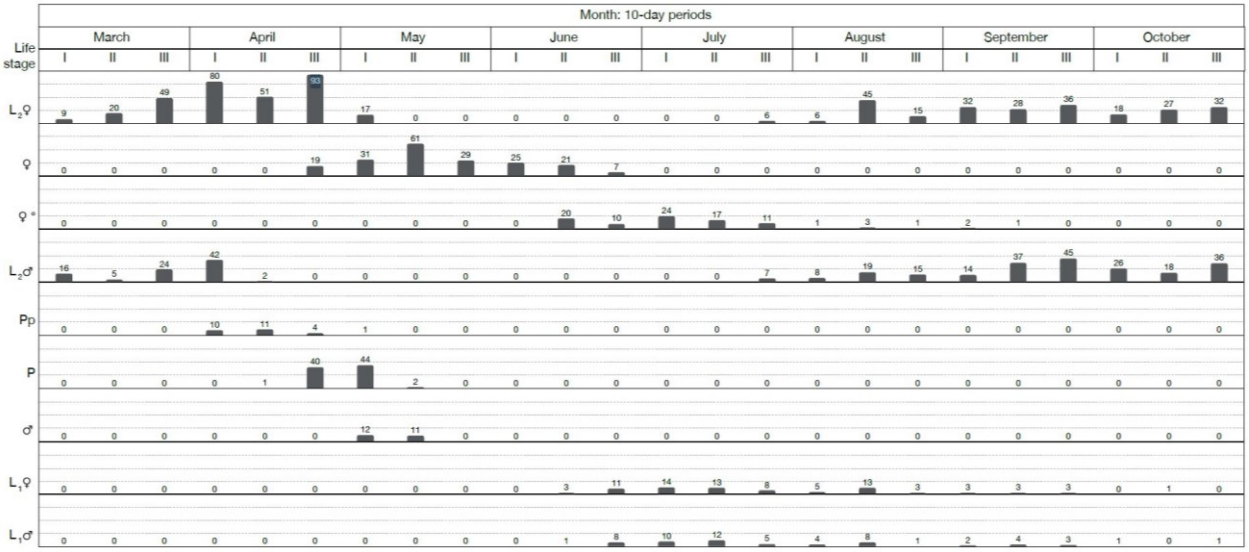

Figure 2. Number of specimens of *D. ostreaeformis* collected on *B. pendula* in Warsaw from March to October 2019. L_2♀ - second instar female, ♀ - pre-reproductive female, ♀° - reproductive female, L_2♂ - second instar male, Pp - prepupa, P - pupa, ♂ - male, L_1♀ - first instar female, L_1♂ - first instar male.

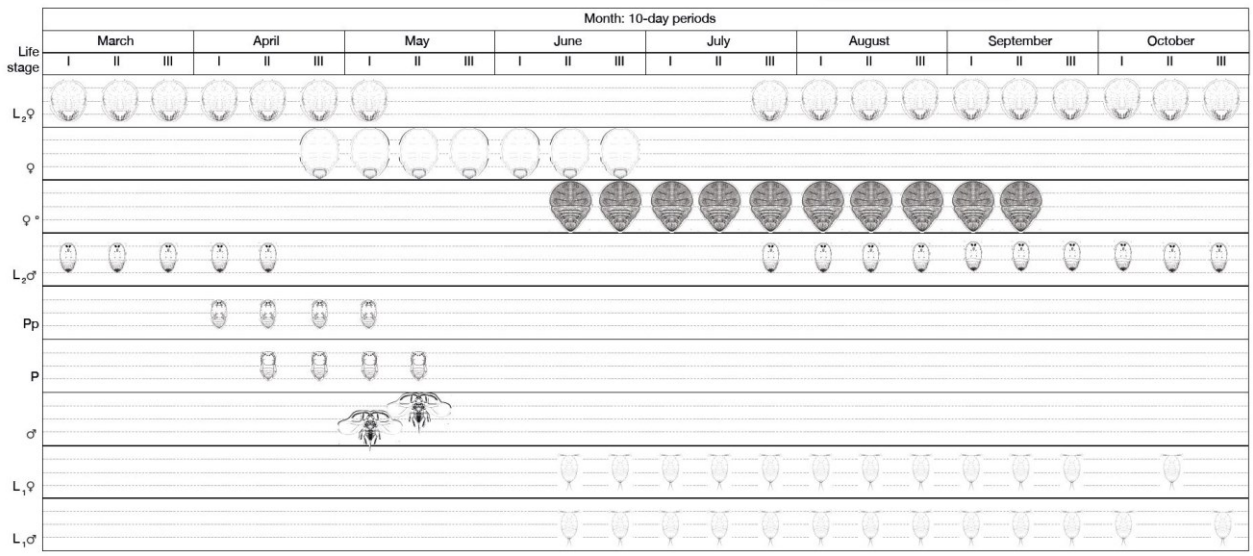

Figure 3. Life cycle of *D. ostreaeformis* collected on *B. pendula* in Warsaw between March and October 2019. L_2♀ - second instar female, ♀ - pre-reproductive female, ♀° - reproductive female, L_2♂ - second instar male, Pp - prepupa, P - pupa, ♂ - male, L_1♀ - first instar female, L_1♂ - first instar male.

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