New data on distribution and life cycle of *Comstocaspis perniciosa* Comst. (Hemiptera; Coccomorpha; Diaspididae)

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Introduction

In recent years, an increase abundance and harmfulness of San José scale (*Comstockaspis perniciosa* (Comstock 1881)) has been observed in many European countries, in Poland for the first time from seventy years. *C. perniciosa* is one of such dynamically spreading, alien invasive armored insect species. It is cosmopolitan and polyphagous as well as one of the most important pests of fruit trees and ornamental plants in the world. In a short time, it can lead to the death of plants on which it feeds.

The present paper discussed new data on the distribution of *C. perniciosa* in Poland as well as its life cycle based on the results of studies carried out in the orchards of the Lublin region.

Material and methods

The studies were conducted in the years 2016-2021 in the orchards of Lublin Upland. Samples from the plants infected by scale insects (pieces of twigs about 5 cm length) were collected every seven days from April to October. The collected plant material was examined using binocular microscope with an aim of eliminating the dead specimens. Identification of particular developmental instars was performed on the basis of microscopic slides according to the method by Williams and Kosztarab (1972) and modified by Łagowska (1996).

Results

C. perniciosa is widely distributed in over than 60 countries on various continents, for many years is observed in countries neighboring Poland (Fig. 1). In Poland, the first outbreaks of *C. perniciosa* were detected in the years 1948-49 in several towns near Wadowice. Officially, since the late 1940s, San José scale was not signaled in Poland. The next outbreak starts in 2015 on the Lublin Upland, when few interceptions of San José scale on fruit, notably Malus, have been noted (Fig. 2). The harmfulness of *C. perniciosa* in orchards has been observed in south east of Poland during the next year. Since then, the pest has significantly increased their population. It was observed in many orchards in Mazovia and Sandomierz region (Fig. 3).

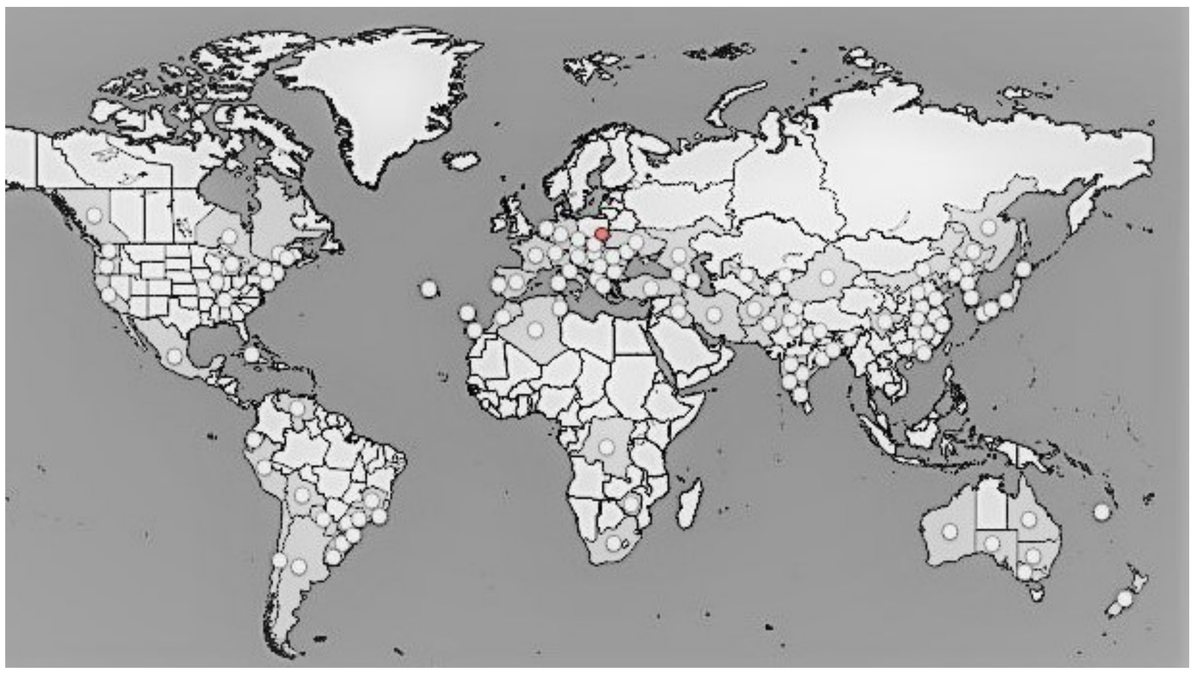

Fig. 1. Distribution of *Comstockaspis perniciosa* (Adopted from https://gd.eppo.int/taxon/QUADPE/distribution and Golan 2020)

Fig. 3. Date of first observation and localities of San José scale in Poland in the years 1948-2021

- 1948-49: near Wadowice
- 2015: Lublin Upland near Opole Lubelskie (numerous localities incl: Kamień, Łaziska, Kępa Piotrawińska, Piotrawin, Kamionka, Kamień, Józefów, Wojciechów, Wilków)
- 2016 r: near Nowy Sącz
- 2018: Sandomierz Lowland
- 2020: Mazovian Lowland (incl: Świesielice, Wola Solecka, Wólka Solecka, Wólka Folicka, Kowale, Solec nad Wisłą, Boiska)

Fig. 2. Apple fruit infested with San José scale (Fot. K. Golan)

Life cycle

San José scale individuals overwinters as first instar-nymphs under a black scale (black cap stage) usually, however different stages may entered hibernation. In the early spring, overwintering first instar-nymphs start their activity during the first decade of April, molt and the second-instar hidden under wax cover, lead a sedentary lifestyle. Sexual dimorphism becoming apparent after the first nymphal moult. The adult female appears after the next moult and the cover develops, incorporating the nymphal exuviae. Few days later usually the adult males are observed. They live for only a few days and die soon after mating. The development of female has three stages and two molting (first - and second-instar nymph and the adult), adults appear already after the second molting, while the male has five stages and four moltings (first- and second-instar nymph, the prepupa, pupa and adult) (Fig. 4).

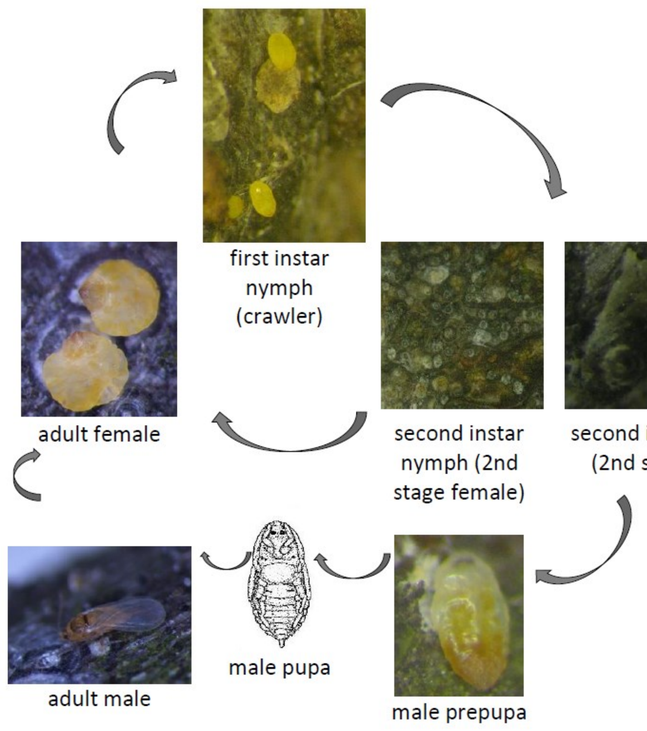

Fig. 4. Scheme of the life cycle of *Comstockaspis perniciosa*

Observations conducted in 2016-2021 in the Lublin Upland have shown the occurrence of two complete generations during the year (Tab.1). Theses generations overlap so all stages of the pest occur at the same time during the summer. The first generation of crawlers appears between early and mid-June and the second in the end of July and during August. Adults appear for the first time during May, the next generation at the end of July and begining of August the last in late August and early September. Our study also showed if warmer temperatures continue into the fall, a third generation of San José scale can begin on September (Tab.1).

Tab. 1. First incidence dates of successive developmental life stages of *Comstockaspis perniciosa* in Lublin Upland (2016-2021)

Year	First instar nymph	Second instar nymph	Adult male	Adult female	First instar nymph	Second instar nymph	Adult male	Adult female	First instar nymph	Second instar nymph	Adult male	Adult female	First instar nymph
2016-2018	to 1st decade of April	1st decade of April	2nd decade of May	2 nd decade of May	June 4th	1st/3rd decade of July	1st decade of August	1st decade of August	2nd decade of August	x	x	x	x
2019	to 1st decade of April	1st decade of April	May 20th	May 19th	June 6th	1st decade of July	August 7th	August 7th	August 20th	x	x	x	x
2020	to 2nd decade of May	April 21st	May 6th	May 20th	June 18th	begining of July	July 16th	August 6th	July 23th.	September 9th	September 11th	September 11th	Semtember 26th
2021	to 2nd decade of April	2nd decade of April	May 20th	May 27th	June 17th	July of 12th	July 20th	July 20th	July 28th	August 8th	August 20th	August 20th	September 2nd

Conclusions

C. perniciosa established very well outdoors in orchards of south east Poland. Since 2016 it was observed in many new localities in Lublin Upland, Mazovia and Sanomierz region. San José scale adapts very well to temperate climate conditions. Results of our studies in the orchards of the Lublin region have shown at least two complete generations *C. perniciosa.* Diifferences in appearance of particular life stages were observed depend of the year of observation.