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**Description of the immature stages of *Ceroplastes japonicus* Green
(Homoptera Coccoidea)**

Abstract - The three immature female stages, previously undescribed, of *Ceroplastes japonicus* Green, are described and illustrated. The main morphological characters useful to identify the adult female are also provided together with an identification key of the four female stages. The morphological characters useful for separating the stages are discussed. Besides, a comparison with the morphology of the immature stages of *Ceroplastes floridensis* Comstock is reported.

Riassunto - Descrizione degli stadi giovanili di *Ceroplastes japonicus* Green (Homoptera Coccoidea).

I tre stadi giovanili, non ancora descritti, di *Ceroplastes japonicus* Green, specie orientale attualmente presente in vaste zone dell'Italia centro-settentrionale, vengono descritti e illustrati. Sono riportati anche i principali caratteri morfologici utili per l'identificazione della femmina adulta. Viene presentata una chiave di identificazione dei quattro stadi di sviluppo della specie e sono discussi i caratteri morfologici validi per separarli. Segue un breve commento sulla possibilità di individuare, in base alla sola morfologia delle forme giovanili, *C. japonicus* dall'affine *C. floridensis* Comstock.

Key words: *Ceroplastes japonicus*, immature stages, description, identification key.

Ceroplastes japonicus Green is an oriental species first detected in Italy in 1984 (Kozar et al., 1984). At the moment it is widespread in many Italian regions, both in northern Italy and in central and southern Italy, mainly in the urban environments (Longo, 1985; Camporese, 1991). In Italy, female stages only have been detected on the host plants (Camporese, 1991). In order to study the biology and the population dynamics of this species in Italy, it was necessary to identify the immature stages and the adult female. In fact, the external characters cannot help to distinguish the developmental stages of the

Ceroplastes species (Amitai, 1969) and the use of wax cover characters to separate them may lead to mistakes. Therefore, we considered the description of the immature stages, previously undescribed, as the starting point from which to study the biology of this species in Italy.

Descriptions and illustrations of the adult female of *C. japonicus* are available in the works of Borchsenius (1957), De Lotto (1969), Tang (1991), Pellizzari e Camporese (1994), nevertheless we believe it useful to include a brief description and the illustration of the adult female in this paper also, in order to have a complete view of the morphology of this species.

MATERIALS AND METHODS

Descriptions and measurements are based on 25 specimens of each immature stage, collected after the moult on different host plants (*Acer* sp., *Citrus trifoliata*, *Hedera elix*, *Ilex aquifolium*, *Laurus nobilis*, *Liquidambar styraciflua*, *Salix babylonica*) in the town of Padua (Italy). For the description of the adult female only we studied specimens collected in different Italian towns.

Measurements are given in millimeters and are presented in the text as the average, followed by the range in brackets. To prepare slide mounts we followed the method proposed by Kozarzhevskaya (1968). With regard to terminology, we adopted the terms used by coccid taxonomists which are well explained by Gimpel et al. (1974) for the genus *Ceroplastes*.

The material is preserved in the collection of the Institute of Agricultural Entomology (IEAP), University of Padua, Italy.

KEY TO THE STAGES OF *CEROPLASTES JAPONICUS*

1. Three stigmatic setae in each stigmatic cleft 2
 More than three stigmatic setae in each stigmatic cleft 3
2. 3-4 quinquelocular disc pores in the stigmatic furrow. Stigmatic setae of the same size. Claw digitules similar in shape *first instar*
 4-8 quinquelocular disc pores in the stigmatic furrow. Medial stigmatic seta distinctly longer than other two. Claw digitules different in shape *second instar female*
3. Multilocular pores absent; tubular ducts absent; stigmatic setae 10-23 laterad of each stigmatic cleft. The stigmatic setae of the anterior group are separated by the stigmatic setae of the posterior group by 3-5 marginal bristle-shaped setae *third instar female*

Multilocular pores present; tubular ducts present; the stigmatic setae of anterior and posterior group form a continuous row of 90-148 setae along the body margin
 *adult female*

MORPHOLOGY

First instar (fig. 1)

Body oval in shape, average length 0.375 mm (0,355-0,395). 6-segmented antennae, average length 0,097 (0,088-0,104). One pair of interantennal setae. Legs well developed, without tibio-tarsal scleroses. Tarsal digitules present; one of them is distinctly thicker than the other and longer than the tarsus itself. This digitule originates in the middle of the tarsus. Claw with two digitules, similar in shape, but one of them appears somewhat thicker than the other. Three stigmatic setae, conical, with blunt point, equal in shape and size, in each stigmatic cleft. Marginal bristle-shaped setae distributed along the body margin as follows: 6 setae between the eye-spots, 11 setae from the eye-spot to the anal lobe; one seta only on the anal lobe and this seta is distinctly longer than the other marginal setae. 3-4 quinquelocular disc pores in each stigmatic furrow. Some minute cruciform pores in ventral submargin. Anal plates triangular with rounded angles and with three dorsal setae. The medial seta on apex is very long and strong.

MATERIAL EXAMINED: *Citrus trifoliata*, 25.VI.1989, IEAP n.125/2, 10 specimens; *Laurus nobilis*, 25.VI.1989, IEAP n.125/3, 10 specimens; *Ilex aquifolium*, 26.VI.1989, IEAP n. 125/4.

Second instar female (fig. 2)

Body oval in shape, average length 0.848 mm (0,68-0,96). 6-segmented antennae, average length 0,118 (0,105-0,135). Two pairs of interantennal setae, the mesal setae longer than the others. Legs well developed, without tibio-tarsal scleroses and with two tarsal digitules. Claw digitules of different shapes: one broad with expanded apex, the other slender with knobbed apex.

Margin: three conical stigmatic setae with blunt point in each stigmatic cleft; the medial seta noticeably larger than the other two. Marginal bristle-shaped setae along the body margin: 6 setae between the eye-spots, 2 setae between the eye-spot and the anterior stigmatic cleft, 2 setae between anterior and posterior stigmatic cleft, 8 setae from posterior stigmatic cleft to anal lobe. The two setae on the anal lobe are distinctly longer than the others.

Dorsum: membranous, clear areas not defined. Simple minute dorsal pores, scattered. Anal plates triangular with rounded angles and with three dorsal and one ventral setae.

Venter: 4-8 quinelocular disc pores distributed in a row in the stigmatic furrow. Cruciform pores scattered along the submargin. Small submarginal setae along the body submargin.

MATERIAL EXAMINED: *Citrus trifoliata*, 8.VIII.1989, IEAP n. 126, 10 specimens; *Acer* sp., 23.VII.1990, IEAP n. 127/2, 10 specimens; *Salix babylonica*, 23.VII.1990, IEAP n. 127/3, 5 specimens.

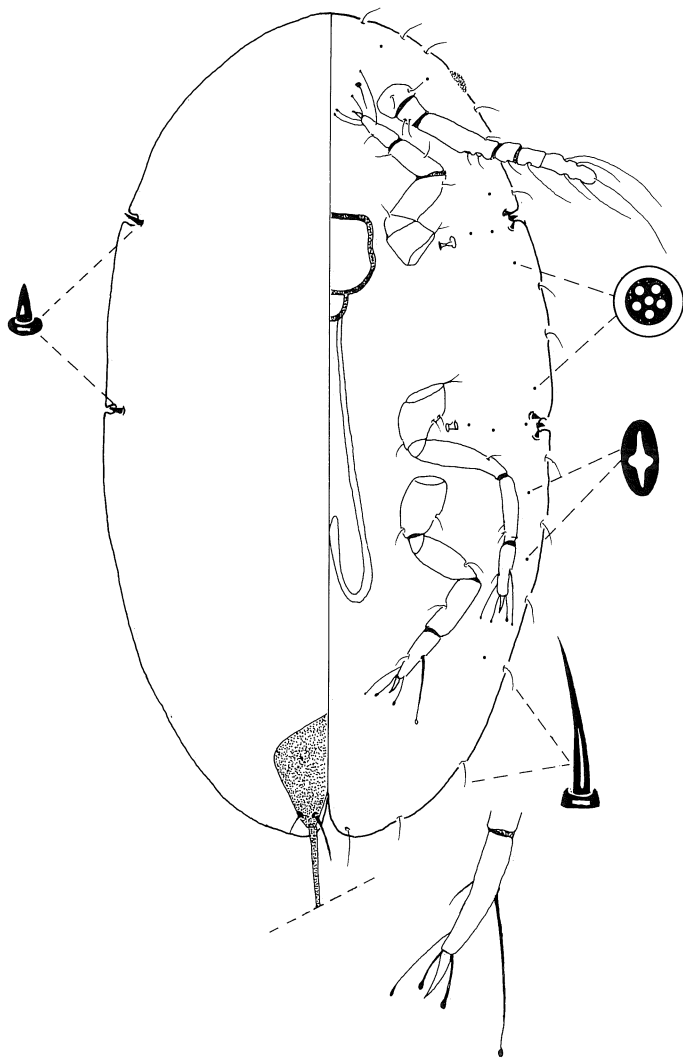


Fig. 1 - *Ceroplastes japonicus* Green: first instar.

Third instar female (fig. 3)

Body oval in shape, average length 1.31 mm (0,94-1,66). 6-segmented antennae 0,164 mm long (0,15-0,185). Two pairs of interantennal setae, the mesal pair distinctly longer than the other. Legs well developed, without tibio-tarsal scleroses and with two tarsal digitules. Claw digitules different in shape: one broad with expanded apex, the other slender with knobbed apex.

Margin: stigmatic setae lanceolate, 2-3 larger setae on dorsal side, the others

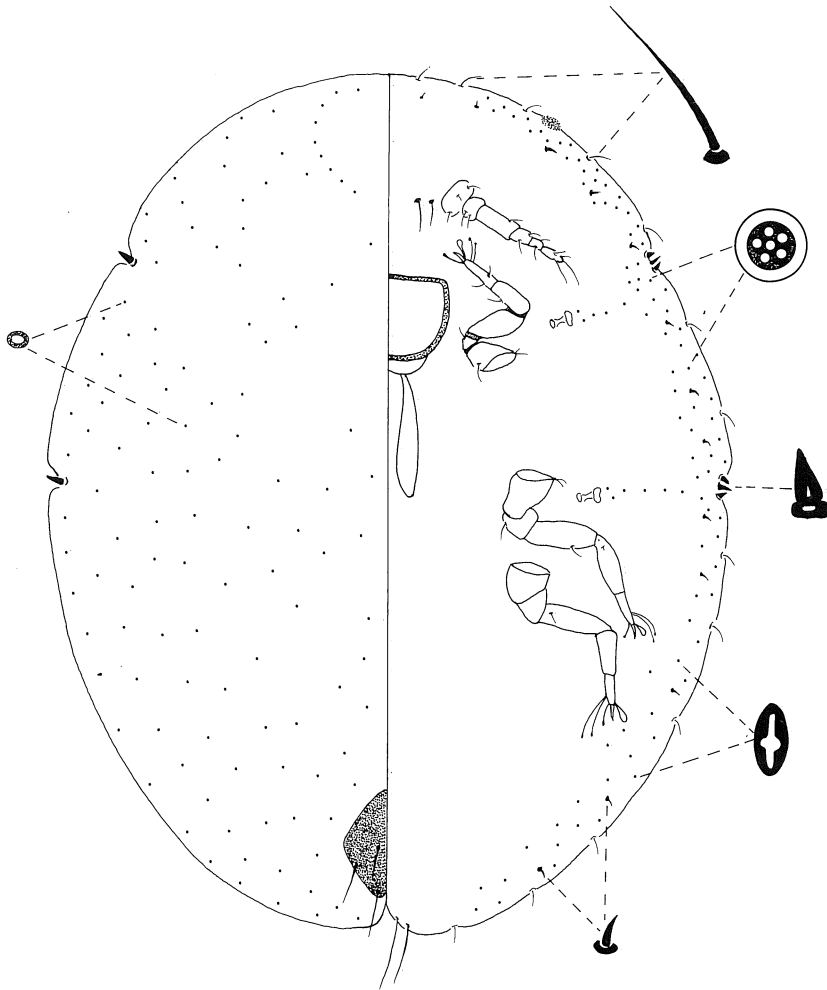


Fig. 2 - *Ceroplastes japonicus* Green: second instar female.

distributed in a marginal row laterad of anterior and posterior stigmatic cleft. There are 16 (12-21) stigmatic setae in the anterior group and 16 (10-20) setae in the posterior group; 3-5 marginal bristle-shaped setae are distributed between anterior and posterior group of stigmatic setae. Other marginal bristle-shaped setae are distributed along the body margin: the last 3-4 setae on the anal lobe are distinctly longer than the others.

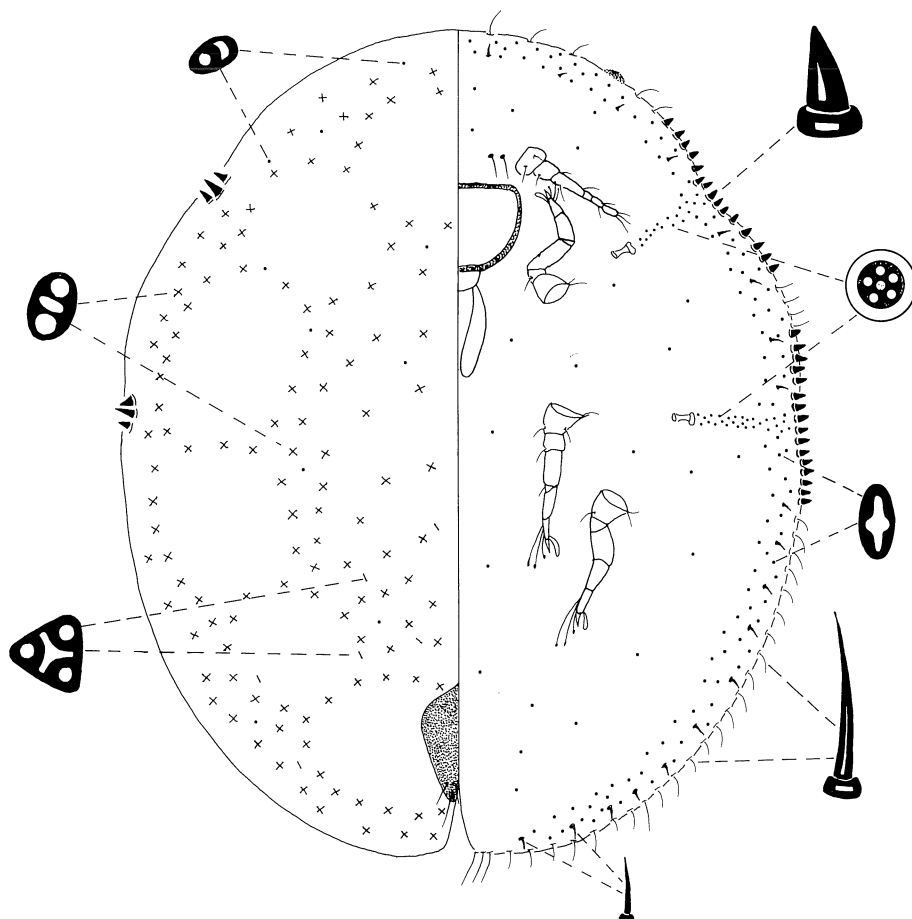


Fig. 3 - *Ceroplastes japonicus* Green: third instar female.

Dorsum: membranous with clear areas well defined. Dorsal pores oval trilocular numerous and scattered. Some triangular trilocular pores may be present. Bilocular pores scattered, less numerous than trilocular pores. Anal

plates triangular with rounded angles, with three dorsal and one ventral setae.

Venter: quinquelocular disc pores in the stigmatic furrow 14 (8-15) in the anterior band and 15 (9-19) in the posterior band. Cruciform pores mainly distributed in the submargins.

MATERIAL EXAMINED: *Citrus trifoliata*, 30.VIII.1989, IEAP n. 134/3, 10 specimens; *Liquidambar styraciflua*, 8.VIII.1990, IEAP n. 128, 10 specimens; *Acer* sp., 8.VIII.1990, IEAP n.130/2, 5 specimens.

Adult female (fig. 4)

A detailed description of the adult female may be found in the work of Pellizzari & Camporese (1994). Therefore, only the main morphological characters are reported here.

Mounted female oval in shape. 6-segmented antennae. Legs well developed, without tibio-tarsal scleroses. Claw without denticle. Claw digitules of the same shape, broad, with expanded apices.

Margin: stigmatic setae lanceolate with pointed apices, distributed in two rows: a row with 3-4 larger setae extending on dorsum, the others distributed along margin. These setae form a continuous row of 111 (97-148) setae along the body margin. A few marginal bristle-shaped setae (2-7) usually mingled with stigmatic setae (rarely contiguous) may help to distinguish between the anterior and posterior group of stigmatic setae. Marginal bristle shaped setae distributed along the body margin except where stigmatic setae are present. The last 3-4 setae on anal lobe are distinctly longer than the others.

Dorsum: membranous in young female, with 1 cephalic and 6 lateral clear areas. Dorsal pores scattered, mostly oval trilocular and triangular trilocular; the oval trilocular predominant over other kinds of pores. Some quadrilocular pores present in medio dorsal region. Irregular bilocular pores mainly distributed in submargins. Minute oval pores with filamentous duct distributed in the submargins (these pores are somewhat difficult to detect). Anal plates with 3-4 dorsal and 1 ventral setae. Pre-opercular pores 10 (6-14) just above the anal plates.

Venter: tubular ducts with enlarged inner filament form a submarginal band of 2-3 elements distributed from the eye spot to about the level of the caudal process. Cruciform pores in a submarginal band between the body margin and the band of tubular ducts. Quinquelocular pores in the stigmatic furrows form an irregular band. There are 41 (29-66) quinquelocular disc pores in the anterior band and 50 (24-72) in the posterior band. Multilocular disc pores numerous around the vulva and on sixth abdominal segment. Several multilocular disc pores arranged in a single row in the remaining abdominal segments. Groups of 2-7 multilocular pores near the base of the coxae and near the stigmatic atrium.

MATERIAL EXAMINED: Padova, *Citrus trifoliata*, 30.XI.1989, IEAP n. 133, 5 specimens; Padova, *Hedera elix*, 16.IX.1991, IEAP n. 400, 5 specimens; Riccione, *Hedera elix*, 25.II.1992, IEAP n. 429, 5 specimens; Roma, *Laurus nobilis*, 29.III.1992, IEAP n. 427, 5 specimens; Capri, *Hedera elix*, 23.X.1992, IEAP n. 446, 5 specimens.

DISCUSSION

The morphological characters of significance in distinguishing the four developmental stages of *C. japonicus* will be discussed here.

The first instar differs from the second one in having three equal stigmatic setae in the stigmatic cleft, a lower number of quinquelocular disc pores in the stigmatic furrow and one seta only instead of two on the anal lobe. First and second instar may also be spotted by observing the claw digitules: they are similar in shape in the first instar, but clearly different (one broad and one slender) in the second female instar. Besides, the first instar has one thick tarsal digitule, longer than the tarsus itself and arising in the middle of the same, while in the second female instar the two tarsal digitules are equal in size and shape. One pair of interantennal setae only is present in the first instar, but the second instar has two pairs of interantennal setae.

Second and third female instars are easy to distinguish, mostly due to the different number of stigmatic setae: they are only three in the second female instar and 16 (10-21) in the third instar. On the contrary there is no difference in the shape of claw digitules (one broad and one slender in both the instars) nor in the number of interantennal setae (two pairs). Dorsal trilocular and bilocular pores are present only in the third female instar.

The adult female differs from the third female instar in possessing a uninterrupted row of stigmatic setae on the body margin. Moreover, it has multilocular disc pores, tubular ducts and caudal process.

The immature female stages of *C. japonicus* appear very similar to the immature stages of *C. floridensis* Comstock, described by Amitai (1969) and Ezzat & Fayez (1983). In fact, the adult females of the two species are also morphologically similar. If we compare the morphology of the first and second instar of *C. floridensis* (according to the descriptions of the above reported authors) with the same instars of *C. japonicus*, it is not possible to detect any valid differential character. The third instars of the two species may be separated on the grounds of the different number of stigmatic setae: 7-12 in *C. floridensis*, but 16 (10-21) in *C. japonicus*. The number of quinquelocular disc pores in the stigmatic furrows is also lower in *C. floridensis* (9-12) in comparison with *C. japonicus* (8-19, average: 14). In spite of these differences,

we believe that only the study of the adult females may lead to a correct identification of the two species.

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