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Morphological features of first stage larva (crawler) of *Aonidiella orientalis* (newstead) (Homoptera: Coccoidea: Diaspididae)

Raj Vir Singh Ojha[1], Kamal Singh[2]
[1, 2] Department of Zoology, Raja Balwant Singh College, Agra, Uttar Pradesh, India

Abstract
Authors have studied morphological features of scale insect first stage larva (crawler) of *Aonidiella orientalis*. *Aonidiella orientalis* belongs to subfamily Aspidiotinae, family Diaspididae, super family Coccoidea, Order Homoptera. All the insects of this family are known as armored scales. Armored scales are cosmopolitan found in tropics, subtropics and warmer portions of the temperate zones. It is an important pest of *Mangifera indica, Saraca indica, Musa paradisiaca, Dalbergia sissoo, Psidium guayava, Syzygium cumini, Syzygium jambos, Annona squamosa* and other economical, ornamental and horticultural plants which had been collected in Northern India from the leaves, fruits and twigs. The crawler of *Aonidiella orientalis* (Newstead) body oval and has a pair eyes, a pair six segmented forwardly directed antennae, a pair of each pro, meso and metathoracic legs, two pairs spiracles, pygidium with three pairs of lobes along with dorsal seta, without macro ducts, eight pairs micro ducts pores opening and dorsal anus.

Keywords: crawler (first stage larva) of *Aonidiella orientalis*, morphological features

Introduction
Aonidiella orientalis belongs to subfamily Aspidiotinae, family Diaspididae, super family Coccoidea, Order Homoptera. All the insects of this family are known as armoured scales. Armored scales are cosmopolitan found in tropics, subtropics and warmer portions of the temperate zones.
Lellakova-Duskova (1963) [7] described the morphology, morphosis and life cycle of scale insect *Quadraspidiotus gigas*. Komosinska (1974) [6] studied on the morphology of *Mytilaspis conchiformis*.
Aonidiella orientalis is distributed almost in Southern India, Srivastava (1975) [8] and in Northern India, Dutta (1990) [2], Dutta and Baghel (1991) [3]. Dutta and Singh (2001, 2002) [4, 5] studied on the reproduction behaviour and chemical control of *Aonidiella orientalis* respectively. Chauhan and Ojha (2018) [1] studied morphological study of adult male *Aspidiotus tamarindi* (Green). It prefers only the dorsal surface of the leaves due to the presence of sunlight. It also found on ventral surface of the leaves, fruits and twigs of commercial, ornamental, economical, fruit trees and horticultural plants.

Materials and methods
The morphological studies were carried out in Zoology Department, Raja Balwant Singh College, Agra chiefly taken from different hosts and several localities of Shikohabad, Northern India. Measurement values in millimeters are given frequently together with the description of particular features. All microscopic slides used for measurements were prepared by the method described by Williams and Kosztarab (1972) [9] either from dry material or after a prior fixing in conserving fluid consisting four parts of 95% alcohol and one part of glacial acetic acid.

Observations
Body shape (Fig.1 and 2): Body oval and broadest in thoracic region. Anterior margin is undulated and sclerotized. Dorsal side is feebly convex and ventral side somewhat flat. The average of each length and width of the crawler 0.247mm and 0.147mm respectively. Measurement were yaken of 35 specimens. Colour: Yellowish green. Cuticle: membranous on dorsal side except pygidium. Segmentation OF the body: The body is divided into ovate shape prosoma and abdomen. Prosoma consists head, pro, meso and metathoracic segments. Abdomen divided into five free anterior abdominal segments and three fused posterior segments forming pygidium. The prosoma bears a pair of antennae, a pair of eyes, mouth parts, three pairs legs and two pairs spiracles. Antennae: Both antennae situated on ventral side of the head. Each antenna is six segmented, the fifth segment being the shortest, the sixth one longest and first one broadest. The total length of the antenna 0.682 mm. EYES: One pair well developed laterally situated. Each eye with a black pigment and its diameter 0.0075 mm. MOUTH PARTS: Piercing and sucking type. The stylets by bending form the loop. The length of the loop is 0.1402 mm., labium one segmented, conical shaped.

Fig 1: Microphotograph of the first larva (crawler) of *Aonidiella orientalis* (Newstead).

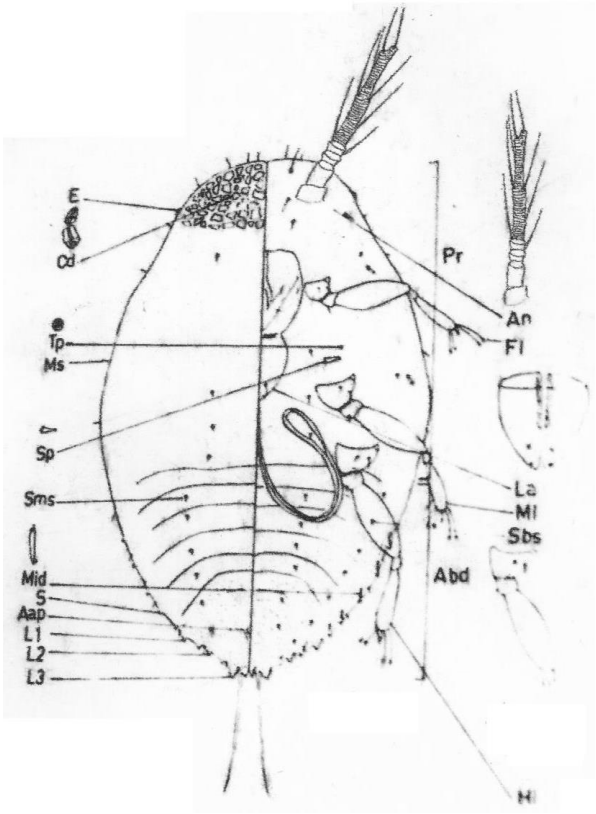

Fig 2: Photograph of a diagram showing left dorsal and right ventral side along with magnified views of various parts of the body of first larva (crawler) *Aonidiella orientalis* (Newstead)

Legs: The legs of first larva of *Aonidiella orientalis* (Newstead) are three pairs and well developed. All the three pairs of legs similar cosmopolitan like that of the insects in general. The first pair is shortest and the third pair one is longest. There is a comparative long gap in between first and second than that of the second and third pairs of the legs. Each leg consists of coxa, trochanter, femur, tibia and tarsus like that of a typical insect. The average length of various parts of the three pairs of the legs are given separately in the table.

Table 2: Showing average length of various parts of the anterior, middle and posterior pairs of the legs (in mm.) of crawler of *Aonidiella orientalis* (Newstead).

Leg Part	Length of anterior leg	Length of middle leg	Length of posterior leg	Measurement No.
Coxa	0.0072 (0.0060 – 0.0090)	0.0085 (0.0062 – 0.0100)	0.0087 (0.00677 – 0.0092)	10
Trochanter	0.0052 (0.0040 – 0.0062)	0.0060 (0.0055 – 0.0062)	0.0062 (0.0055 – 0.0070)	10
Femur	0.0252 (0.0212 – 0.0280)	0.0265 (0.0262 – 0.0272)	0.0250 (0.0232 – 0.0260)	10
Tibia	0.0042 (0.0035 – 0.0052)	0.0050 (0.0045 – 0.0052)	0.0057 (0.0045 – 0.0062)	10
Tarsus	0.0170 (0.01625 – 0.01850)	0.0182 (0.01675 – 0.0190)	0.0207 (0.0185 – 0.0210)	10
Total	0.0575(0.0510 – 0.0625)	0.0625(0.0585 – 0.0640)	0.0675(0.08645 – 0.0690)	10

The coxa is provided with one long and one short setae, and is connected with trochanter. The setae and sensilla on the trochanter are three. The trochanter is followed by femur which is without setae. The femur is followed by tibia which is very small and without setae, and is followed by one segmented long tarsus which is covered by two long and three short setae. The tarsus bears a claw which is simple arch like.

Spiracles: Two pairs spiracles present on ventral side in the first larva. The length of each anterior and posterior spiracle is 0.0075mm. and 0.0092mm. respectively. The anterior spiracle is situated below a trilocular pore its diameter 0.00275mm. Suh pore is not present above the posterior spiracle. Tubular Glandular Ducts of The Body: There are three types of glandular ducts: One pair cephalic ducts which situated below the anterior margin of the head. The length of the each cephalic duct is 0.0956mm. Three pairs microducts whose broad openings situated on ventro-lateral sides. The length of each microduct is o.001075mm. Eight pairs microducts whose openings situated on epices of abdominal glandular spines, otherwise they are similar to that of other microducts. Abdominal Glandular Spines: Glandular spines are eight pairs. The first pair situated on the first abdominal segments on ventro-lateral side while the rest of the pairs situated laterally. Pygidium: The pygidium fairly well sclerotized and consisting of posterior part of VI, VII and VIII segments. The pygidium consists of three pairs lobes (L_1, L_2 and L_3) which fairly well sclerotized with quite long apophyses directed towards ventral side. The L_1 is largest with rounded apex and two nearly equal outer and inner notches. L_2 smaller than L_1 with rounded apex and with outer deep and minute notches. L_3 strongly reduced and monodentate. ANUS: The anus located at the antero-posterior axis on dorsal side of the pygidium. SETAE: The setae are distributed on dorsal as well as on ventral sides of the body. Dorsally each right and left side bear two longitudinal rows of setae marginal and sub median one. The ventral setae present in three rows: marginal, sub marginal and sub median.

Results and discussion

The first stage larva (crawler) of *Mytilaspis conchiformis* (Komosinska, 1974) [6] is oval in shape, feebly convex dorsally and ventral side is somewhat flat like that of our species *Aonidiella orientalis* (Newstead) but in former species the crawler is pale pink to dark pink in colour, and in later the colour of the crawler is yellowish. The crawler of *Quadraspidiotus gigas* (Lellakova-Duskova, 1963) [7] is oval like that of *Aulacaspis tegalensis* (Williams, 1970) [9] but in former species the egg is flat and in later it is much flattened dorsoventrally. The crawler of *Aonidiella orientalis* (Newstead) has a pair of eyes, a pair of six segmented forwardly directed antenna, a pair of each pro, meso and metathoracic legs, two pairs of spiracles, pygidium with three pairs of lobes along with dorsal seta, without macroducts, eight pairs microducts pores opening and dorsal anus. The crawler of *Quadraspidiotus gigas* (Lellakova-Duskova, 1963) [7] has a pair of eyes, five segmented forwardly directed antennae, a pair of each pro, meso and metathoracic legs, two pairs of spiracles, pygidium with four deep notches each with one seta, a pair of great lobe, with macroducts opening and twenty microducts opening and dorsal anus. *Mytilaspis conchiformis* (Komosinka, 1974) has a pair of eyes, six segmented backwardly directed antennae, a pair of each pro, meso and metathoracic legs, two pairs of spiracles, pygidium with three pairs of lobes along with dorsal without macroducts, with eight pairs microducts pore opening and dorsal anus.

Abbreviations

Aap, Anal aperture ; Abd, Abdomen ; An, Antenna ; Cd, Cephalic duct ; E, Eyes ; Fl, Fore leg ; Hl, Hind leg ; La, Labium ; $L_{1, 2, 3}$ Lobes ; Mid, Microduct ; Ml, Middle leg ; Ms Marginal seta ; Pr, Prosoma ; S, Spine ; Smas, Submarginal seta ; Smes, Submedian seta ; Sp, Spiracale ; Tp, Trilocular pore ;

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