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Studies on the Morphology of the Adult Female *Aleurolobus barodensis* Mask (Homoptera: Aleyrodidae)

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Abstract: White-fly, *Aleurolobus barodensis* Mask occurs as sugarcane pest. It is more common species particularly in the north Indian. . It is generally associated with poor crops, particularly ratoons which usually remain neglected. The build-up of the pest population is rapid under water logged conditions and in soils deficient in nitrogen. The present study deals with the detailed morphological description of adult female *Aleurolobus barodensis* Mask.

Keywords: *Aleurolobus barodensis*, Morphology, Shikohabad, Sugarcane, Whitefly

Introduction

Proper crop growth is a pre-requisite for increased yields. Various natural biotic factors such as pest infestation and abiotic factors like weather oppose the growth and development of crops (Takahashi and Mament, 1962; Martin, 2007; Hazarika *et al.*, 2011). The researchers are trying to explore the techniques, which must be proficient, eco-friendly, clean and affordable to reduce the effect of pest infestation on crops. Therefore it is essential to have knowledge of biology of pest. In this study we report the morphology of adult female *Aleurolobus barodensis* Mask belonging to the family Aleyrodidae and commonly known as sugarcane whitefly.

Although it is an important pest of sugarcane but also infests Jwar, Bajra, Maize, Wheat, Barley and other crops in various parts of India such as Punjab, Uttar Pradesh., Madhya Pradesh., Bengal, Bihar etc. Both adult and nymph *Aleurolobus barodensis* Mask suck the sap from under surface of the leaves of the sugarcane plants. The present study would be helpful to understand the biology of pest and also for planning of pest control.

Materials and Methods

The investigation was carried out at Department of Zoology, Narain College Shikohabad, Uttar Pradesh, India. Periodical

observations were done in natural conditions on the plants. The adult female, *Aleurolobus barodensis* Mask was collected from host plants leaves with the help of net. Specimens for microscopy were removed from host plant leaves and preserved in either 70% alcohol or dry preserved or preserved in conserving fluid. Different life stages were prepared with aid of binocular microscope according to the approved standered method (Uygun *et al.*, 1990).

Results

Adult Female, Aleurolobus barodensis Mask

Colour

The colour of the adult female of *Aleurolobus barodensis*, Mask (Fig. 1) was lighter yellow in living condition and become darker yellow after mounting.



Fig. 1: Adult female

Measurement

The range of length of the body of the adult female of *Aleurolobus barodensis* Mask was 1.83 to 2.0 mm (vertex to ovipositor).

Morphology

Head

The range of length of the head of the adult female of *Aleurolobus barodensis* Mask was 0.21 to 0.22 mm and the range of breadth was

0.30 to 0.32 mm. Head bear well developed eyes and antenna on either sides. Eyes were dumbbell shaped and similar to the male. One pair of ocelli were present and each ocelli is located near the upper part of a compound eye. Each antenna is seven segmented (Fig. 2). The range of length of segments first and second is 0.006 to 0.007 mm and 0.024 to 0.026 mm, respectively. Segment third is longest with two sensorial (Fig. 2) and its range of length is 0.065 to 0.066 mm. Segment fourth is sub cylindrical and its range of length is 0.020 to 0.022 mm. A primary apically sensorial is present on the segment fifth (Fig. 2) and its range of length is 0.016 to 0.017 mm. Segment sixth is smaller than segment fifth and its range of length is 0.014 to 0.015 mm, it is also with primary sensorial cone. Segment seventh is elongated and its range of length is 0.049 to 0.050 mm, many concentric microtrachial rings, primary sensorial cone and apical setae are also present on this segment (Fig. 2).

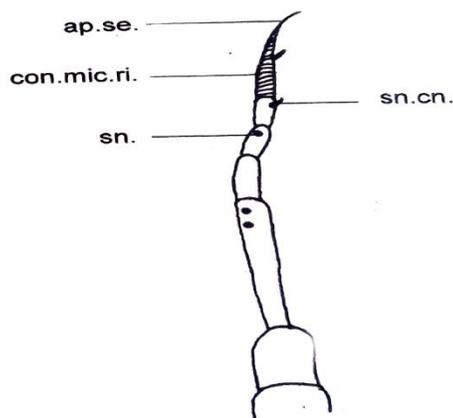


Fig. 2: Antenna of female *Aleurolobus barodensis*. con.mic.ri (concentric microlateral ring), sn. (sensorial), sn.cn. (sensorial cone)

Thorax

The range of length of the thorax of the adult female of *Aleurolobus barodensis*, Mask was 0.81 to 0.89 mm and breadth was 0.42 to 0.44

mm. The thorax of the adult female was three segmented. First segment was smaller than the second one and the third one was larger than first and second thoracic segment.

Wing

The second and third thoracic segment bear two pairs of white powderly fore- and hind-wings. The range of length of each fore-wing was 1.62 to 1.66 mm and breadth was 0.61 to 0.64 mm in widest area, however, the range of length of each hind-wing was 1.39 to 1.42 mm and breadth was 0.41 to 0.42 mm in widest area. The wing venation of both pairs is reduced. There were three main veins costa-subcostal, radial and cubital (Fig. 3). Costa-subcostal vein was unbranched, located near the margin of the wing. Radial was main branch of the wing and not reaching up to the margin. Cubital vein was also not touching the margin of the wing (Fig. 3).

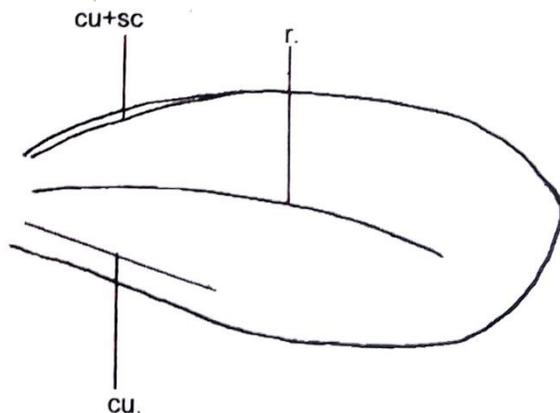


Fig. 3: Wing of female *Aleurolobus barodensis*. cu (cubital), cu+sc (cubital+subcosta)

Leg

Each thoracic segment bears a pair of six jointed walking legs. Each leg consists of coxa, trochanter, femur, tibia and two segmented tarsus.

Fore Leg--Each foreleg consist of a short coxa. The range of length is 0.05 to 0.057 mm.

Trochanter was the second part of the leg and its shape was roughly triangular, its range of length is 0.03 to 0.04 mm. Femur is long and spiny; its range of length is 0.28 to 0.30 mm. Tibia is longest, its range of length is 0.52 to 0.55 mm, the spines are found in rows and with 9 to 10 setae (Fig. 4). The tarsus is two segmented, 2 to 4 setae present on proximal tarsus and 1 to 3 setae present on distal tarsus. The distal tarsus is ending with 2 claws and a paronychium.

Middle Leg -- The range of length of coxa is 0.05 to 0.60 mm. The trochanter is roughly triangular and the range of length is 0.28 to 0.30 mm. The femur is with long stout spine and its range of length is 0.22 to 0.28 mm. The tibia is the longest segment of the mid leg, it was spiny and 5 to 6 setae on the upper part and 3 to 4 setae on lower part of the tibia (Fig. 4), its range of length is 0.53 to 0.55 mm. The tarsus is two segmented. The range of length of proximal tarsus is 0.12 to 0.122 mm and with 2 to 3 setae. Distal tarsus is smaller and its range of length is 0.08 to 0.09 mm, and with 1 to 2 setae present. The ending of distal tarsus is with two claws and a paronychium.

Hind Leg -- Coxa, trochanter and femur of the hind leg are similar to mid leg. The range of length of coxa, trochanter and femur is 0.06 to 0.08 mm, 0.04 to 0.06 mm and 0.30 to 0.32 mm, respectively. The hind tibia with a row of 11 to 12 setae (Fig. 4) and its range of length is 0.54 to 0.56 mm; the spines are present in row around the tibia. The tarsus is two segmented. The range of length of proximal tarsus is 0.13 to 0.15 mm and with 4 to 6 setae. The range of length of distal tarsus is 0.08 to 0.10 mm and with 3 to 4 setae. The distal tarsus ending is present with a pair of claws and a paronychium like that of mid leg.

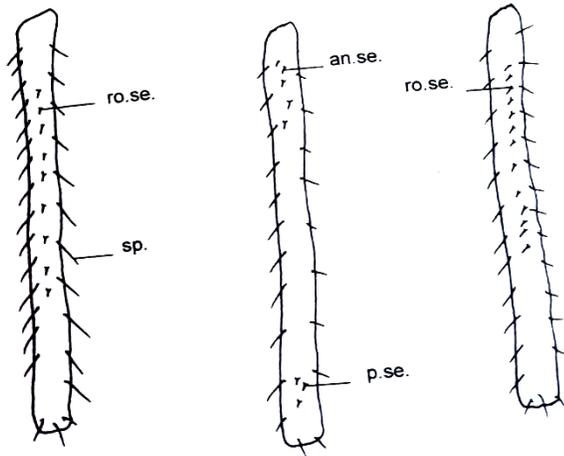


Fig. 4: Fore, mid, hind leg tibia. psc (posterior setae), ro.se (row of setae), sp (spine), an.se (anterior setae)

Abdomen

The range of length of the abdomen of the adult female of *Aleurolobus barodensis* Mask was 0.58 to 0.60 mm and the range of breadth of the abdomen was 0.16 to 0.18 mm. The second and third abdominal segment is equal in size and shape.

Wax Plates

Two pairs of wax plates were present on the mid sternum of second and third abdominal segment. Each with one minute seta on outer margin and two setae on inner margin are present on each abdominal wax plate (Fig. 5). Both wax plates are similar in size and distribution of setae.

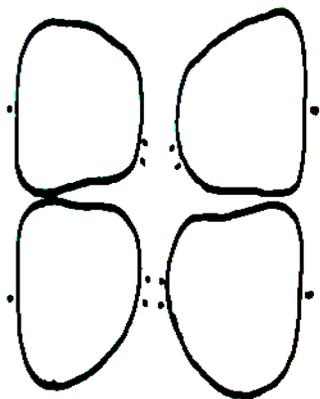


Fig. 5: Wax plates

Genitalia

Vasiform orifice located on the eight abdominal segment of the adult female, and its shape was roughly triangular narrower posteriorly. Operculum is sub-circular in shape. Ligula is exposed. 8 to 10 pairs setae on gonopophysis (3 to 4 pairs centrally and 4 to 6 pairs laterally) (Fig. 6). The cement gland is tapering and it is situated between central gonopophysis.

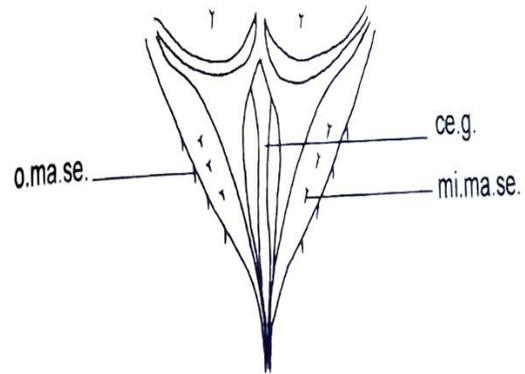


Fig. 6: Genitalia. ce.g. (cement gland), mi.ma.se. (middle marginal setae), o.ma.se. (outer marginal setae)

Discussion

The colour of the body of the adult male of *Bemisia tabaci* (Gennadius) was pale yellow (Patel and Srivastava, 1989). Similar observations were reported by Tahiliani (1977), Bhardwaj and Kushwaha (1984) and Pimpale and Summanwar (1984). Colour of the body of the adult male of *Singhiella melanolepis* (Chen and Ko, 2007) was reported as yellowish to brown when alive, with a light dusting of wax, yellowish when mounted, except extreme tip of rostrum and thorax, however, the colour of the body of the adult male of *Udamoselis estrellamarinae* (Enderlein) was very dark, with little apparent waxy bloom covering the cuticle (Martin,

2007). In this study the colour of the body of the adult male *Aleurolobus barodensis* Mask was noticed as light yellow in living condition. After mounting the body became yellowish brown with darker head and abdominal first to sixth segment.

Patel and Srivastava (1989) reported the range of length of the body of the adult male *Bemisia tabaci* (Gennadius) ranging from 0.875 to 1.025 mm and f breadth 0.375 to 0.450 mm. Uygun *et al.* (1990) noted average length of the body of the adult male *Parabemisia myricae* (Kuwana) and *Dialeurodes citri* (Ashmead) to be 0.98 mm and 1.62 mm, respectively. Chen and Ko (2006) reported the average length of the body of the adult male *Lipaleyrodes emiliae* as 0.79 mm from vertex to clasper. Chen and Ko (2007) described the average length of the body of the adult male *Singhiella melanolepis* as 1.5 mm included vertex to clasper. In this study the range of length of the body of the adult male *Aleurolobus barodensis* Mask is 1.0 to 1.4 mm included vertex to clasper.

The upper and lower compound eyes jointed by a single ommatidium in *Lipaleyrodes emiliae* and *Bemisia tabaci* (Gennadius) (Chen and Ko, 2006). In *Singhiella melanolepis* (Chen and Ko, 2007) dorsal and ventral parts connected by two ommatidia like that of *Aleurolobus barodensis* Mask. In *Singhiella melanolepis* (Chen and Ko, 2007) the ventral part of the compound eye is about 50% larger than the dorsal part, whereas in *Aleurolobus barodensis* Mask the ventral part is somewhat smaller than the ventral part.

Antenna of the female is longer than male in *Agrostaleyrodes arcanus* (Ko *et al.*, 2001) *Lipaleyrodes emiliae* (Chen and Ko, 2006) and *Singhiella melanolepis* (Chen and Ko, 2007). In

Aleurolobus barodensis, Mask the antenna of the female is smaller than male. The antenna is seven segmented. The segment third of the antenna of *Agrostaleyrodes arcanus* (Ko *et al.*, 2001) is longest and two and half times longer than the first in male. In *Lipaleyrodes emiliae* (Chen and Ko, 2006) the segment third of the antenna is roughly seven times than the first in male, however, in the male antenna of *Singhiella melanolepis* (Chen and Ko, 2007) the segment first is less than half as long. In *Aleurolobus barodensis*, Mask the segment third is longer in both male and female. Besides this the antennal structure, segmental size, distribution of sensorial, presence of sensorial cone, structure of the seven segments and the distribution of the marginal setae and concentric microtracheal rings included structure of seven antennal segment varies in *Agrostaleyrodes arcanus* (Ko *et al.*, 2001), *Bemisia*, *Rhachisphora* and *Aleurotracheus* (Calvert *et al.*, 2001) *Lipaleyrodes emiliae* (Chen and Ko, 2006) and *Singhiella melanolepis* (Chen and Ko, 2007). In this way the length of each segment of antenna is very characteristic in different species of whiteflies and may be used for identification of male and female as well as for identification of different species of whiteflies.

There is no indication of size dimorphism in *Dialeurodicus caballeroi* (Martin, 2007) with female fore-wings even slightly longer and broader than in most males. In female *Lipaleyrodes emiliae* (Chen and Ko, 2006) both pairs of the wing are longer than the male. In both male or female of this species wing venation reduced to costal-subcostal veins and radial veins like that of *Singhiella melanolepis* (Chen and Ko, 2007) wings were with a patch of maculation in middle and near distal end. However, in *Aleurolobus barodensis*

Mask both pairs of the wings of female are longer than the male and the wing venation in both pairs is different in male and female as female with costal-subcostal, radial and cubical and male with costal-sub costal and radial vein.

Takahashi and Mament (1962) erected the genus *Lipaleyrodes* which is mainly characterized by the submarginal area being distinctly defined by dorsal margin with wax plates in large clusters arranged in a row, and abdominal segment seventh being extremely reduced medially, with only seven segments discernible.

Ko *et al.* (2001) noted vasiform orifice 40 to 50 mm long, clasper curved at distal end and armed with a number of spines, 150 to 170 mm long, aedeagus not bifurcate, elongated, 160 to 175 mm long, sub-cylindrical, tapering on distal part and swollen at base in the male of *Agrostaleyrodes arcanus*. Chen and Ko (2006) described aedeagus not bifurcate, 77 mm length, 11 mm breadth, shorter than clasper. In the male of *Lipaleyrodes emiliae* Chen and Ko (2006) reported clasper 88 mm long and seven setae in mid region. Chen and Ko (2007) presented vasiform orifice oval, wider than long, ligula 0.002 mm, capsule with 5 to 6 pairs of dorsal setae, lateral most setae distinctly thinner and shorter than more medial pairs, most medial pair thinner than thick middle pair, clasper 0.01 mm, with 5 pairs of dorsal setae and four and three pairs of setae present on inner and outer surfaces, respectively. Chen and Ko (2007) recorded small rounded tooth on medial surface subapically, aedeagus 0.1 mm, curved up apically and forked at end in the male of *Singhiella melanolepis*. In *Aleurolobus barodensis*, Mask vasiform orifice triangular

narrower posteriorly, operculum is subcircular in shape, the range of length is 0.03 to 0.04 mm, ligula is exposed and setose, three pairs of setae are present on genital plate, clasper gradually thinner and folded inwardly, the range of length is 0.15 mm to 0.04 mm and 13 to 16 pairs of setae present on clasper (3 to 4 pairs on outer margin, 4 to 6 pairs on centre and 4 to 5 pairs on inner margin), aedeagus is elongated structure (0.15 to 0.17 mm), the aedeagus is sub-cylindrical tapering on distal part and folded ventrally in the male.

Guimares (1996) described lateral ovipositor and cement gland structure of seven species-- *Aleurothrixus floccosus* (Maskell), *Aleyrodes prolella* (Linnaeus), *Bemisia tabaci* (Gennadius), *Dialeurodes citri* (Ashmead), *Parabemisia myricae* (Kuwana), *Siphoninus phillyreal* (Haliday) and *Trialeurodes vaporariorum* (Westwood). In the female of *Agrostaleyrodes arcanus* (Ko *et al.*, 2001) vasiform orifice was 60 to 70 mm long, central gonopophysis with a pair of setae, four pairs on each lateral gonopophysis, caudal portion not strongly curved, with small teeth, ligula clothed with spinules, setae absent, female cement gland situated between central gonopophysis and external reproductive organs, not sinuous, 100 to 120 mm long, without a transverse constriction, caudal region tapering to efferent duct. In the female of *Lipaleyrodes emiliae* (Chen and Ko, 2007) nine pairs of setae were present on gonopophysis, two pairs centrally and seven pairs laterally, bulb-like vasiform orifice of cement gland trapezoidal, extremely curved not mottled, full length 36mm, while, in the female of *Singhiella melanolepis* Chen and Ko (2007) reported vasiform orifice with ligula 0.03 mm long, genitalia with lateral ovipositor

and 0.095 mm long with four setae, middle ovipositor 74 to 84 mm long with two setae, cement gland slightly segmented. In female of *Aleurolobus barodensis* Mask vasiform orifice is triangular narrower posteriorly, 8 to 9 pairs setae on gonopophysis (3 to 4 pairs centrally and 4 to 6 pairs laterally), operculum is sub-circular, ligula exposed and cement gland tapering.

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