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GENUS *BEMISIA* (HOMOPTERA: ALEYRODIDAE) WITH A NEW RECORD FROM PUNJAB, PAKISTAN

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The whitefly genus *Bemisia* was studied from the Punjab, Province of Pakistan. A total of 6 species viz., *B. afer, B. elongata, B. giffardi, B. grossa, B. leakii and B. tabaci* were identified from the pupal cases mounted on slides. Of these, one species, *B. elongata*, is new to science, two species, viz., *B. grossa* and *B. leakii*, are new records for Pakistan. Pupae of *B. giffardi* and *B. elongata* are elongately elliptical, but remaining species are elliptical or oval. The new species is illustrated and described in detail. This species differs in size, margin is irregularly crenulated, submargin not differentiated from dorsum, transverse moulting suture is broadly bow-shaped and caudal furrow is equal to vasiform orifice. This genus is severely infesting *Acacia nilotica, Cassia fistula, Dalbergia sissoo, Echinochloa colona, Gossypium hirsutum, Grewia asiatica* and *Vigna radiate* in Punjab. A key for the identification of Pakistani species of this genus is also given.
Key words: Whitefly genus *Bemisia elongata* new species Punjab Pakistan.

INTRODUCTION

The minute whitish insects belonging to the family Aleyrodidae are popularly known as whiteflies. Their wings are covered with waxy powder and are usually white, but in a few species, they are mottled or banded. They are cosmopolitan insects, but most abundant in the tropical and subtropical countries of the world. Whiteflies pass through four larval instars; the last quiescent instar is called pseudopupa. It is of considerable taxonomic value. As the adults of most of the species do not differ in morphological characters and cannot be distinguished from one another, their identification is based on the pupae which distinctly differ in various species.

Genus *Bemisia* was erected by (Quaintance and Baker, 1914) with type species of *Aleurodes inconspicua*, which is now a synonym of *Bemisia tabaci*. Later (Mound and Halsey, 1978) in their systematic catalogue of family Aleyrodidae listed 37 species under this genus. Recently (Martin and Mound, 2007) in a check list of whiteflies of the world have reported 41 species belonging to this genus. Some other workers have reported 39 species that are genetically and morphologically differ from each other (Qin *et al*., 2016). It is represented by 8 species so far in India (Jesudasan and David, 1991). This genus is poorly investigated in Pakistan with only three valid species reported by (Qureshi, 1980; Mukhtar, 1997).

Economically, whiteflies species are serious pests of different crops and cause heavy economic losses in Pakistan. For example, *Bemisia tabaci* and its biotypes specially biotype B and Q are major threat to tomato *Solanum lycopersicum* and ranks as one of the world's 100 most invasive pests (Ramos *et al*., 2018). All American varieties of cotton were failed completely during 1919, 1926, 1921, 1923, 1927 and partially in 1993-94 by whitefly transmitted Gemini virus, which caused a loss of 7.1 million bales of cotton (Mahmood, 1999). During September, 1996, the cotton whitefly appeared in an epidemic form and resulted in complete or partial failure of the crop at different places in Bahawalpur region (Aheer *et al*., 1999; Yonas *et al*., 2019). This genus is polyphagous in nature feed on different crops, trees, vegetables, ornamental plants (Puri *et al.,* 1995). *Bemisia tabaci*, is also polyphagous and has been observed feeding on 540 host plants belonging to 77 families (Basu, 1995). Furthermore, this group of species is also vector of more than 200 plant viruses (Polston *et al*., 2014).

This paper deals with 6 species viz., *B. afer, B. elongata, B. giffardi, B. grossa, B. leakii and B. tabaci* of which one is new to science and two are new records for Pakistan.

MATERIALS AND METHODS

The leaves of different plants having pupal cases on them were detached and brought to the laboratory in paper envelopes after writing the name of locality, host plant and date of collection on them. The pupal cases were removed from the leaves with a fine needle and preserved in 75 per cent alcohol in vials.

For identification of these specimens, the permanent slides were prepared according to (Martin, 1987) with little modifications, as given below.

1. The pupal cases were punctured from the ventral surface with a minute pin and gently heated to the boiling point in 10 per cent KOH in a glass tube for 10 minutes to remove their inner body contents.
2. Then they were treated with glacial acetic acid to neutralize the alkali.
3. The pupal cases were thereafter treated with chloral phenol and heated for a few minutes to remove the wax coating present on them.
4. After this, the specimens were treated with 95 and 100 per cent alcohol each for 5 minutes to remove the excessive stain.
5. Finally, the pupal cases were then mounted in Hoyer's medium on microscope slides, which were dried at room temperature for 24 hours.

RESULTS AND DISCUSSION

In Pakistan, very little work has been done on the identification of whiteflies, which are economically an important group of insects. It is evident from the fact that after excluding the synonymised species only two valid species of whiteflies *B. afer* Priesner & Hoosny and *B. tabaci* (Gennadius) were identified from Pakistan under this genus. Both these species are widely distributed throughout the country. In this paper, four additional species *B. elongata*, *B. giffardi*, *B. grossa*, and *B. leakii* are added to the *Bemisia* genus from Pakistan. Three species *B. giffardi*, *B. grossa*, and *B. leakii* are new records for country, but *B. elongata* is new to science. New species differs from other species of this genus in having its body elongate. Furthermore, this species greatly differs from other closely related genera i. e., *Bemisiella*, *Metabemisia* and *Parabemisia*. These whiteflies species are infesting *Acacia nilotica* (Kikar), *Cassia fistula* (Amaltas), *Dalbergia sissoo* (Sheesham), *Echinochloa colona* (Jungle rice grass), *Ficus glomerata* (Peepal),*Gossypium hirsutum* (Kapas), *Grewia asiatica* (Bariu' an)and *Vigna radiate* (Mungbean). All these species are first time from Pakistan identified from original photographs of pseudopupe. This information will act an additional tool for identification of whiteflies species attacking different plants in Pakistan for their effective control.

Key to the Pakistani species of *Bemisia*

1. Pupal case elongately elliptical ……..…… 2
   - Pupal case not elongately elliptical ……..…… 3
2. Dorsum with a pair of sublateral, parallel and longitudinal folds running from cephalic setae to the sides of vasiform orifice; submarginal area without a row of pores ……..……..… *giffardi* (Kotinsky)
   - Dorsum without the above mentioned folds; submarginal area with a row of pores ……..…….....*elongata* sp. nov.
3. Transverse moulting suture reaching margin ……..……. *grossa* Singh
   - Transverse moulting suture not reaching margin ……..…….…… 4
4. Operculum filling about one-third of vasiform orifice; abdominal segments mostly without tubercles ……..……..… *leakii* (Peal)
   - Operculum filling less than half of vasiform orifice; abdominal segments with tubercles ……...…… 5
5. Thoracic tracheal fold absent; caudal setae very small, less than half length of vasiform orifice ……..*afer* (Priesner & Hosny)
   - Thoracic tracheal fold present; caudal setae stout and long, equal to the length of vasiform orifice ……..…… *tabaci* (Gennadius)

***Bemisia afer* (Priesner & Hosny)**

Dialeurodoides afer (Priesner and Hosny, 1934).

Bemisia afer (Habib and Farag, 1970).

Specimens of this species collected from Pakistan conform to the description of (David and Subramaniam, 1976; Qureshi, 1978).

Material examined: 14 mounted pupal cases on *Rosa indica*, Rahim Yar Khan, 9-6-2019, M.Tayyib; 13 mounted pupal cases on *Grewia asiatica*, Faisalabad, 12-8-2018, M.Tayyib; 3 mounted pupal cases on *Pyrus communis*, Muree, 19-8-2018, M.Tayyib; 12 mounted pupal cases on *Acacia nilotica*, Multan, 23-9-2018, M.Tayyib; 12 mounted pupal cases on *Vigna radiata*, Sialkot, 30-9-2018, M.Tayyib.

Bemisia elongatasp.nov.

Pupal case: large, elongate, elliptical, pale white, broadest at metathorax, slightly depressed in or concave at the two anterior thoracic segments, with length 0.9 to 1.1mm and width 0.52 to 0.67mm.

Margin:Crenulate, with 15-16 crenulations in 0.1mm. Anterior and posterior marginal setae 15-16 µm and 20-24 µm respectively.

Submargin: Not differentiated from dorsum. A row of light-coloured pores in this area. A pair of caudal setae (106µm).

Dorsal surface: A pair of dorsal disk spines (120-130µm) present. Three pairs of submedian setae, i.e., a cephalic pair (15-16µm), 1st abdominal pair (15µm) and 8th abdominal pair (26µm), are discernible. Transverse moulting suture broadly bow-shaped, runs lateroventral and ends in the submedian area. A median row of tubercles on 1st six abdominal segments, a submedian row of 5 tubercles on 2nd to 6th abdominal segments, and also a pair on each of the pro- and meso-thorax.

Vasiform orifice: Triangular, with sides straight, inner wall ridged, length 100-110µm and width 70-80µm; operculum subcordate, filling less than half of orifice, with length 50µm

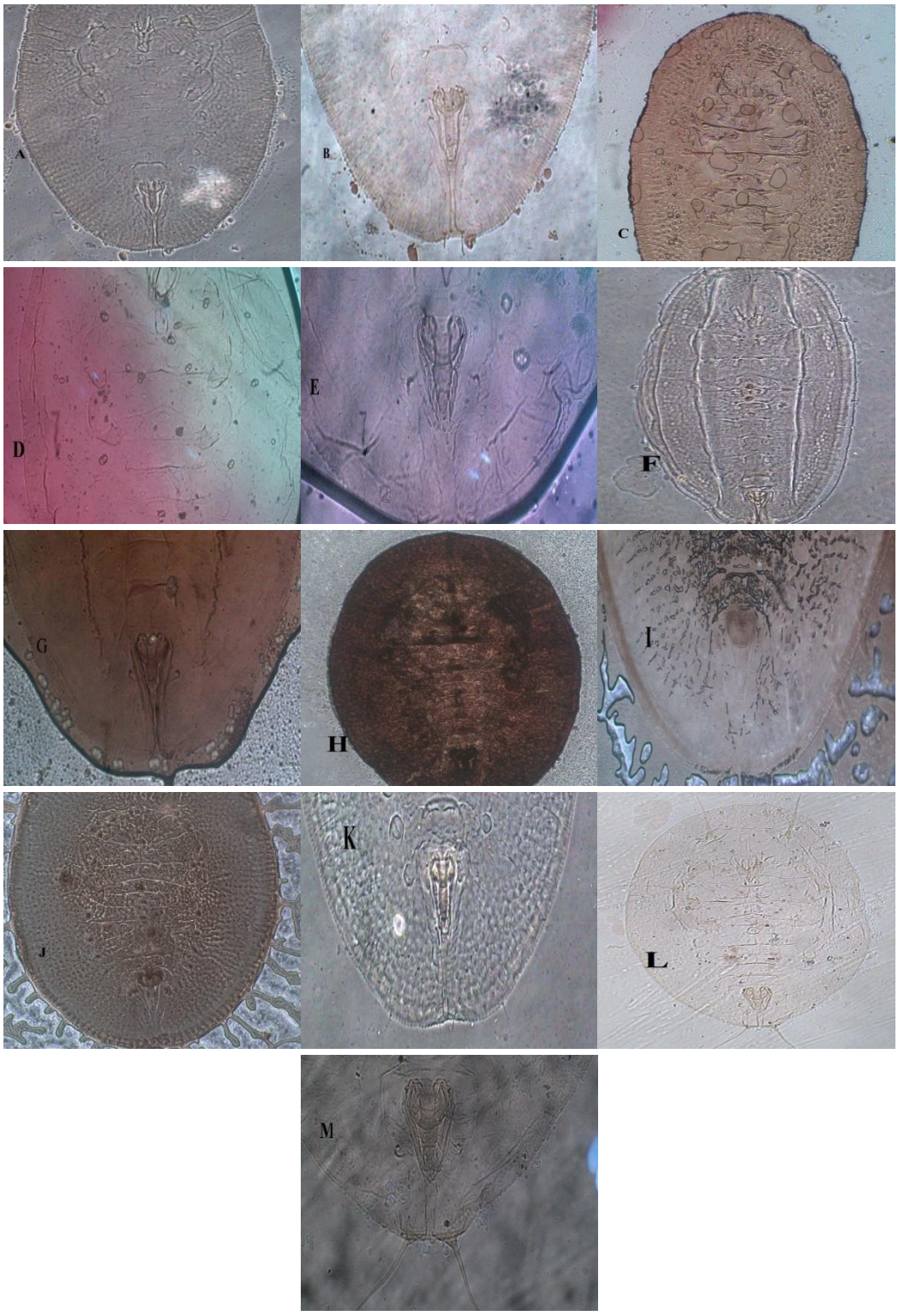

Figure ***B. afer*: A. Pupal case B. Vasiform orifice; *B. elongata* sp.nov.C. Pupal case D. Transverse moulting suture E. Vasiform orifice; *B. giffardi* F. Pupal case G. Vasiform orifice; *B. grossa.* H. Pupal case I. Vasiform orifice; *B. leakii* J. Pupal case K. Vasiform orifice; *B. tabaci* L. Pupal case M. Vasiform orifice.**

and width 30µm; lingula exposed, setose, with a pair of setae at the end, measuring 32µm long and 12µm wide; caudal furrow well-defined, slightly shorter than orifice.

Ventral surface*:* Thoracic tracheal fold not differentiated; posterior abdominal spiracles present.

Material examined:

Holotype: One mounted pupal case on *Morus alba*, Faisalabad, 23-6-2019, M. Tayyib; 4 mounted pupal case on *Echinochloa colona*, Multan, 30-6-2019, M. Tayyib.

Paratypes: 6 mounted pupal cases on *Echinochloa colona*, Sialkot, 30-6-2019, M. Tayyib; 2 mounted pupal cases on *Echinochloa colona*, Faisalabad, 7-7-2019, M. Tayyib.

Repository: Paratypes were deposited in the Insect Museum, Department of Entomology, University of Agriculture, Faisalabad, Pakistan.

Distinguishing characters*:* It differs from other species of this genus in having its body elongate. In this respect it comes close to *B. giffardi*, from which it differs in the absence of lateral folds present in the submedian area of dorsal surface.

Name: This species has been named after the shape of its pupae, which is very elongate.

***Bemisia giffardi* (Kotinsky):** *Aleyrodes giffardi* (Kotinsky, 1907). *Bemisia giffardi* (Quaintance and Baker, 1914).

Specimens of this species collected from Pakistan are similar to the description of (Singh,1931; David and Subramaniam 1976).Material examined: 9 mounted pupal cases on *Citrus sp*, Lahore, 4-2-2018, M.Tayyib; 12 mounted pupal cases on *Ficus glomerata*, Faisalabad, 11-2-2018, M.Tayyib; 5 mounted pupal cases on unknown host, Lahore, 25-2-2018, M.Tayyib.

***Bemisia grossa* Singh:** *Bemisia grossa* (Singh, 1931).

It has been recorded for the first time from Pakistan. Specimens of this species from the Punjab tally with the description of (Singh, 1931). Material examined: 2 mounted pupal cases on *Acacia nilotica*, Lahore, 2-12-2018, M.Tayyib; 4 mounted pupal cases on *Acacia nilotica*, Multan, 6-1-2019, M.Tayyib; 1 mounted pupal cases on *Acacia nilotica*, Rahim Yar Khan, 17-3-2019, M.Tayyib; 5 mounted pupal cases on *Acacia nilotica*, Rawalpindi, 14-4-2019, M.Tayyib.

***Bemisia leakii* (Peal):** *Aleurodes leakii* (Peal, 1903). *Bemisia leakii* (Quaintance and Baker, 1914).

This species presents a new record in Pakistan. Its specimens collected from the Punjab tally with the description of (Singh, 1931) of this species.Material examined: 2 mounted pupal cases on *Citrus sp*, Lahore, 21-4-2019, M.Tayyib; 3 mounted pupal cases on *Citrus sp*, Faisalabad, 21-4-2019, M.Tayyib; 6 mounted pupal cases on *Dalbergia sissoo*, Faisalabad, 27-10-2019, M.Tayyib; 1 mounted pupal cases on *Dalbergia sissoo*, Multan, 20-10-2019, M.Tayyib.

***Bemisia tabaci* (Gennadius):** *Aleurodes tabaci* (Gennadius, 1889). *Bemisia tabaci* (Takahashi, 1936).

Its specimens collected from the Punjab tally with the description of (Qureshi, 1978; Martin, 1987) of this species. Material examined: 22 mounted pupal cases on *Syzigium jambolanum*, Multan, 14-9-2019, M.Tayyib; 15 mounted pupal cases on *Gossypium hirsutum*, Lodhran, 15-9-2019, M.Tayyib; 45 mounted pupal cases on *Cucurbita spp*, Bahawalpur, 15-9-2019, M.Tayyib; 21 mounted pupal cases on *Rosa chinensis*, Multan, 24-11-2019, M.Tayyib; 5 mounted pupal cases on *Gossypium hirsutum*, Multan, 11-8-2019, M.Tayyib; 43 mounted pupal cases on *Gossypium hirsutum*, Faisalabad, 11-7-2019, M.Tayyib.

Conclusion:The purpose of the present work was to prepare a key for the identification of whitefly species from Pakistan with their original photographs, information of location and host plants of each species. This research will help in correct identification of species of *Bemisia* genus from Pakistan which will assist for their management and action that is to be taken against this pest. Whiteflies have received more attention throughout the cotton belt of Pakistan due to their appearance in large number on cotton crop. Six species viz., *B. afer, B. elongata, B. giffardi, B. grossa, B. leakii and B. tabaci* were collected and identified from Punjab, Pakistan. *B. tabaci* is distributed throughout the cotton belt of Punjab and transmits Gemini virus.

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