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Note on genus *Maiestas* (Hemiptera: Cicadellidae) with diagnosis of important species

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Abstrac

Maiestas Distant (Hemiptera: Cicadellidae) is an important genera of the grass inhabiting deltocephalus group. These are widely spread and many of its members are serious pests and vectors of diseases of many crops. This group is important as many of them are known as pest and vectors of plant diseases. Despite of huge diversity, less attempts have been made to update it with current classification. This study presented the current status of the genus, redescription of species with photographic illustrations along with ready reckoner keys.

Keywords: Cicadellidae, Deltocephalini, Leafhopper, Maiestas sps

Introduction

The leafhopper family Cicadellidae constitutes one of the largest families in the exopterygotan Hexapoda. Recent estimates of species for the world range between 35,000-45,000 species though little over 22,600 species have been described till now [1]. Many species can cause considerable damage to crops by feeding directly on the plants or by being vectors of plant pathogens [2]. Deltocephalinae is the largest and most economically important of the 40 known subfamilies of the Cicadellidae. It consists of 38 Tribes, 923 genera, 6683 known species [3], of which many are known from Southeast Asia and its adjacent regions [4-6]. Deltocephalines inhabits the grasslands and are abundant and widely distributed in all forest ecosystems like tropical, subtropical and temperate [7]. Deltocephalinae is also an economically important group because it contains numerous vectors of agricultural plant pathogens [2, 8]. Of the leafhopper vectors of the plant diseases, 63 percent of the species belongs to subfamily Deltocephalinae [9].

Deltocephalinae is difficult to define based on a few diagnostic morphological characters, but almost all deltocephalines have some very characteristic structures of the male genitalia, including pygofer with basolateral membranous lateral cleft; valve produced medially and posteriorly; valve articulated with pygofer at a single point; subgenital plates triangular and relatively dorsoventrally flattened; subgenital plate with a dorsolateral fold articulating closely with style; style broadly bilobed basally, with median anterior lobe pronounced; connective Yshaped or with anterior arms closely appressed and without median anterior or ventral lobe [10]. The Deltocephalus group in the Old World, comprises three genera: Deltocephalus Burmeister (also New World), Recilia Edwards and Maiestas Distant. Webb and Viraktamath in 2009 reviewed the group as part of a larger study on Old World Deltocephalini. Zhang and Duan in 2011 revised the group from China. The genus Maiestas Distant was established by Distant in 1917 with M. illustris as its type species. Until now, the genus Maiestas contains 60 species, including 46 from Indian subcontinent [7, 11]. The recent work by Webb and Viraktamath in 2009 re-assess the identities of the Deltocephalus group taxa, resulting in most species of Recilia being transferred to Maiestas. Some leafhoppers of the genus Maiestas are major pests. both adults and nymphs suck sap from plant and transmit the different diseases [12]. The shorter acquisition period 5 hours and incubation period is 6-7 days, symptoms appear after 15-21 days after feeding [12]. Maeistas dorsalis is one of the major pests in rice. It transmits tugro virus, orange leaf virus and rice grassy stunt diseases virus in rice. Some species of Maiestas reported to transmit sugarcane white leaf disease [13].

The genus *Maiestas* received attention because of several changes in classification, therefore developing detailed descriptions with photographic illustrations and molecular based species identification and differentiation will give better understanding of the species as well as identification.

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Materials and methods Materials

The relevant literature was collected from Zoological Records, CAB abstracts, and other sources available at IARI library, which are available online. Following species collected from different places. Maiestas dorsalis (Motschulsky) collected on grasses and paddy fields from Arunachal Pradesh, Chhattisgarh, Delhi, Karnataka, Kerala, and Meghalaya. M. krameri (Rao and Ramakrishnan) collected from Raipur. Following species deposited in the National Pusa Collection were examined, M. fletcheri (pruthi), M. hospes (kirkaldy), M. intermedius (Melichar), M. maculatus (Pruthi), M. pruthii (Metcalf), M. subviridis (Metcalf), M. systenos (Dash and Viraktamath), M. Variabilis (Dash and Viraktamath), M. veinatus (Pruthi), M. Xanthocephalus (Dash and Viraktamath). M. tareni (Dash and Viraktamath). M. albomaculata (Dash and Viraktamath) and M. belonus (Dash and Viraktamath) are examined from insect museum, Department of Entomology, UAS, GKVK.

Methods

Leafhoppers were collected on grasses and paddy fields from 7 different locations from i.e., Indian Agricultural Research Institute, Pusa Campus, New Delhi (28.3285° N, 77.0930° E), Shillong, Meghalaya (25.3543° N, 91.5158° E) National Institute of Biotic stress Management, Raipur, Chhattisgarh (21.2249° N, 81.4931° E), Horticuture College campus, Pasighat, East Siang, Arunachal Pradesh (state) (28.0431° N, 95.1919° E), Shikaripura, Shivamogga, Karnataka (14.1602° N, 75.2054° E), Kerala Agriculture University campus, Vellanikkara, Thrissur, Kerala (10.3300° N, 76.1658° E), University of Agricultural Sciences, Bengaluru, Karnataka (13.4360° N, 75.1960° E). Leafhoppers are collected using sweep net in day time and light trap (Mercury vapor lamp) during night time. Collected leafhoppers were taken in small polythene bag and they were killed by small quantity of 70% alcohol by impregnating in the cotton or small quantity of ethyl acetate and benzene 100%. The collected specimens are processed by sorting and mounting. The sorted specimens were cleaned with a brush and mounted laterally on cards by using gum arabica. The mounted specimens were labelled with details of place, date and author of the collection. The selection of leafhoppers was done based on the hind tibial character (two rows spines on the hind tibia). Then the leafhoppers of the Genus Maiestas were separated using the keys provided by the Viraktamath (2011)

Selection of the characters to study

Terminology is followed after Viraktamath (2011)

I. Head

Crown, Face, Compound eyes, Ocelli, Frontal suture, Subgenal suture, Clypeus.

II. Abdomen

a. Male genitalia: Pygofer, Subgenital plate, style, Connective, Aedeagus.

Dissection and study of genitalia

Male genitalia dissections was carried out as described by Oman in 1949 and Knight in 1965. The abdomen was removed by inserting a sharp pin between the abdomen and thorax and with gentle piercing. The abdomen was treated in 10 % KOH for 2-4 h to remove unsclerotized material by gently prodding the abdomen with the head of a pin. Afterwards, the abdomen will be rinsed thoroughly in water.

The internal structures will be then removed with a hooked pin, before being stored in glycerol vials for study.

Line diagrams and photography

Line diagrams were drawn by using Leica DM500 Compound microscope with drawing tube attachment. The photographs of male, (habitus, lateral, face and thorax) and genitalia structures were at taken with Leica DFC 425C digital camera on the Leica 19205FA stereozoom automontage microscope.

Measurements

Measurements are taken by calibrating the microscope with ocular and stage micrometer and then the above structures have been measured.

Species plate preparation

The photographs and illustrations were processed by using Adobe Photoshop CS3 and plates were prepared with Microsoft publisher documents for each species. All material is deposited in the National Pusa Collection, Division of Entomology, Indian Agricultural Research Institute, New Delhi, India.

Results

Redescription

1. Maiestas albomaculatus (Dash and Viraktamath) [Plate. A]

Deltocephalus albomaculatus Dash and Viraktamath, 1998: 12

Male genitalia: Pygophore 1.5x broader than long, produced into triangular, posterior caudodorsal margin [Plate. A.IX and Fig. 1.e]. Subgenital plate triangular 1.5x longer than broad with long setae on outer margin [Plate. A. VIII and Fig. 1. d]. Apophysis of style short and slightly curved [Plate. A.VII and Fig. 1.c]. Aedeagal shaft in dorsal view with lateral expansion at midlength at the point of junction with connective and serrated outer margin near apex. Dorsal margin of shaft convex laterally with ridge like expansion at the point of junction with connective [Plate. A.V, VI and Fig. 1.a, b].

Measurements (mm): Male: body length: 4.09, body width across eyes: 1.11, vertex length: 0.33, width: 0.54, diameter of ocelli 0.06, distance between compound eye and ocelli 0.03, pronotum: length 0.55, 1.05 width hind margin 0.76, scutellum: 0.36 length, 0.65 width.

Material examined: Holotype, 1♂, INDIA: Delhi: IARI Pusa campus. (28.3285° N, 77.0930° E), 23.x.1991, grasses, Coll. C. A. Viraktamath (UAS, B).

Remarks: *M. albomaculatus* can be easily recognized by brownish ochraceous with chocolate brown markings on head and thorax. Chocolate brown stripes on the forewing. *M. albomaculatus* is closely related to *M. dorsalis*, from which it can be distinguished by aedeagus with serrated outer margin near apex.

2. Maiestas belonus (Dash and Viraktamath) [Plate. B]
Deltocephalus (Recilia) belonus Dash and Viraktamath, 1998:

Male genitalia: Pygophore 1.5x broader than long, produced into triangular posterior caudodorsal margin [Plate. B.IX and Fig. 2.e]. Subgenital plate triangular 1.5x longer than broad

with serialy arranged long setae on outer margin [Plate. B.VIII and Fig. 2.d]. Apophysis of style long and straight [Plate. B.VII and Fig. 1.c]. Aedeagal shaft in dorsal view with slight lateral expansion at midlength at the point of junction with connective and pointed at apex. Dorsal margin of shaft convex laterally with dome shape expansion at the point of junction with connective [Plate. B.VII and Fig. 1.c].

Measurements (mm): Male: body length: 4.09, body width across eyes: 1.11, vertex length: 0.33, width: 0.54, diameter of ocelli 0.06, distance between compound eye and ocelli 0.03, pronotum: length 0.55, 1.05 width with hind margin 0.76. scutellum: 0.36 length, 0.65 width.

Material examined: Holotype, 1♂, INDIA: Maharastra: Khandala. (18.4613° N, 73.2236° E), 6.xi.1991, grasses, Coll. C. A. Viraktamath (UAS, B).

Remarks: *M. belonus* can be easily recognized by dark brownish head, face with regular transvers brown fascie. Forewing with elliptical brown markings. It differs from other species in having much slender and longer apex of shaft.

3. Maiestas dorsalis (Motschulsky) [Plate. C]

Deltocephalus dorsalis Motschulsky, 1859: 114 Deltocephalus fulguralis Matsumura, 1902: 391 Inazuma dorsalis (Motschulsky), Ishihara, 1953: 48 Recilia dorsalis (Motschulsky), Wilson and Claridge, 1991: 92

Deltocephalus (Recilia) dorsalis (Motschulsky), Dash and Viraktamath, 1998: 27

Male genitalia: Pygophore 1.5x broader than long, produced into triangular posterior caudodorsal margin [Plate. C.IX and Fig. 1.e]. Subgenital plate triangular 1.5x longer than broad with long setae on outer margin [Plate. B.VIII and Fig. 2.d]. Apophysis of style long with crenulate margin [Plate. C.VII and Fig. 3.c]. Aedeagal shaft in dorsal view with lateral semicircular expansion at the point of junction with connective. Wider at mid-length, gradually narrowed to an acutely pointed apex. Dorsal margin of shaft is convex in lateral aspect [Plate. C.V, VI and Fig. 3.a, b].

Measurements (mm): Male: body length: 4.09, body width across eyes: 1.11, vertex length: 0.33, width: 0.54, diameter of ocelli 0.06, distance between compound eye and ocelli 0.03, pronotum: length 0.55, 1.05 width with hind margin 0.76, scutellum: 0.36 length, 0.65 width

Remarks: *Maiestas dorsalis* can be easily recognized by the reddish zig-zag pattern on the forewing. Head with pale yellow coloured elliptical spots on either side of the median

frontal suture. Pygophore produced into the triangular posterior caudodorsal margin: Aedeagal shaft, in dorsal view, with lateral semicircular expansion at the point of junction with connective. Wider at midlength, gradually narrowed to an acutely pointed apex. Dorsal margin of shaft is convex in lateral aspect. *M. dorsalis* is closely related to *M. albomaculatus* from which it differs in the shape of aedeagal shaft and in the forewing markings. Molecular characterization has been done by DNA isolaton using cytochrome oxidase – I gene and sequences has been generated.

4. Maiestas fletcheri (Pruthi) [Plate. D]

Cicadula fletcheri Pruthi, 1930: 60 Deltocephalus flectcheri (Pruthi): Ghauri, 1963: 562

Male genitalia: Pygophore produced into tubular blunt edged caudodorsal margin setae crowded on posterior margin [Plate. D.IX and Fig. 1.e]. Subgenital plate 1.2x longer than broad, triangular in shape with lateral margin convex, long setae on outer margin [Plate. D.VIII and Fig. 4.d]. Apophysis of the style curved laterally. Connective and aedeagus equal in length [Plate. D.VII and Fig. 4.c]. Aedeagal shaft in dorsal view, produced into posteriorly directed tubular expansion at point of junction with connective gradually narrowed to apex, in lateral aspect dorsal margin of shaft straight gradually turning to curved apex, ventral posterior margin at shaft end produced tubular expansion [Plate. D.V, VI and Fig. 4.a, b].

Measurements: Male: body length 3.13, 0.89 width across eyes, vertex 0.32 length, 0.49 width. pronotum 0.36 length, 0.87 width with hind margin 0.62, scutellum 0.27 length, 0.51 width, diameter of ocelli 0.07 distance between compound eye and ocelli 0.01.

Material examined: INDIA: Andra Pradesh: Warangal: 2♂, (17.9689° N, 79.5941° E), 12.ix.2011, grasses, Coll. M.S.V. Chalam (NPC).

Remarks: *M. fletcheri* can be easily recognized by following characters, lemon coloured head and thorax, transparent light yellow shiny wings with apical cells opened. Pygophore produced into blunt edged caudo-dorsal margin. *M. fletcheri* closely related to *M. xanthocephalus*, from which it can be distinguished by aedeagal shaft produced into posteriorly directed tubular expansion at point of joint with connective.

5. Maiestas hospes (Kirkaldy) [Plate. E]

Deltocephalus hospes kirkaldy, 1904:177 Deltocephalus (Recilia) hospes: knight, 1975: 202

Male genitalia: Pygophore produced into straight blunt edged margin on dorsal side, few setae on the posterior margin [Plate. A. IX and Fig. 1. e]. Subgenital plate 1.51x longer than broad, with lateral end base produced tubular shape, few setae at the blunt edge of distal region [Plate. E.VIII and Fig. 5.d]. Apophysis is style curved laterally and produced into sharp tube [Plate. E.VIII and Fig. 5.c]. Aedeagal connective is slightly longer than aedeagus. Aedeagus produced into small lateral expansion at the point of junction with connective gradually narrowed at apex, in lateral aspect the dorsal margin is curved and sharp at the apex ventral posterior margin produced to two tubular expansion [Plate. E.V, VI and Fig. 5.a, b].

Measurements (mm): Male: body length: 3.95, width across eyes: 1.04, vertex length: 0.35, width: 0.63, diameter of ocelli 0.11, distance between compound eye and ocelli 0.02, pronotum: length 0.46, 0.08 width with hind margin 0.85. scutellum: 0.43 length, 0.64 width.

Material examined: INDIA: Andra Pradesh: Warangal: 2♂ (17.9689° N, 79.5941° E), 12.ix.2011, grasses, Coll. M.S.V.chalam (NPC).

Remarks: *M. hospes* is closely related to *M. intermedius* but differs in the structure of apex of the aedeagus and sternal apodemes and subgenital plates.

6. *Maiestas intermedius* (Melichar) [Plate. F] *Deltocephalus intermedius* Melichar, 1903: 205

Male genitalia: Pygophore 0.8x wider the length, produced into blunt edged posterior caudo- dorsal margin [Plate. A. IX and Fig. 1. e]. Subgenital plate triangular with the dorsal base elongated and small setae along the outer margin, 2x longer than broad [Plate. F.VIII and Fig. 6.d]. Apophysis of style small stout curved dorsaly [Plate. F.VII and Fig. 6.c]. Aedeagal shaft in dorsal view curved and wider at the base, gradually narrowed medially broader at the end and acutely pointed at apex. Dorsal margin of shaft is straight up to midlength and curved at apex in lateral aspect [Plate. F.V, VI and Fig. 6.a, b].

Measurements (mm): Male: body length: 3.53, body width across eyes: 1.04, vertex length: 0.51, width: 0.56, diameter of ocelli: 0.06, distance between compound eye and ocelli: 0.01, pronotum: length 0.40, 0.95 width with hind margin 0.73, scutellum: 0.42 length, 0.64 width.

Material examined: INDIA: Andhra Pradesh: Kammavaripalem: 1 ♂ (15°31'69"N 79°90'68"E), 22.ix.2002, grasses, Coll. M.S.V. Challum (NPC).

Remarks: *M. intermedius* recognized by three prominent white spots on the vertex, ocelli black with black rim. Yellow translucent wings with closed apical cells. Aedeagal shaft in dorsal view curved and wider at the base, gradually narrowed medially broader at the end and acutely pointed at apex. *M. intermedius* closely related to *M. hospes* from which it differs in colouration, shape of style and its apophysis.

7. Maiestas krameri (Rao and Ramakrishnan) [Plate. G] Recilia krameri Rao and Ramakrishnan 1988: 133

Male genitalia: Pygophore 0.5x broader than long, produced into triangular posterior caudo-dorsal margin [Plate. G. IX and Fig. 1. e]. Subgenital plate broader triangular in shape, 1.5x longer than broader and few long setae on distal margin [Plate. G.VIII and Fig. 7.d]. Apophysis of style long with crenulate inner margin [Plate. G.VII and Fig. 7.c]. Aedeagal shaft with lateral basal expansion and pointed apex dorsal view connective same length of aedeagal shaft, lateral aspect of aedeagal shaft same width along and acutely pointed at apex [Plate. G.V, VI and Fig. 7.a, b].

Measurements (mm): Male: body length: 3.39, body width across eyes: 0.96, vertex length: 0.31, width: 0.53, diameter of ocelli 0.06 distance between compound eye and ocelli 0.02. pronotum: length 0.40, 0.90 width with hind margin 0.70.

scutellum: 0.36 length, 0.59 width.

Material examined: INDIA: Chhattisgarh: NIBSM, Raipur: $4 \, \mathring{\Diamond}, 2 \, \mathring{\Diamond}$ (21.1797° N, 81.7787° E) Coll. P.R.Shashank (NPC).

Remarks: *M. krameri* closely related to *M. variabilis* from which it differs in having uniformly curved aedeagus. DNA barcode have been generated using cytochrome oxidase – I gene and submitted to NCBI. This is the first time DNA barcodes have been generated for this species.

8. Maietas maculatus (Pruthi) [Plate. H]

Cicadula maculata Pruthi, 1930: 80-81

Recilia maculata (Pruthi): Rao and Ramakrishnan, 1989:10

Male genitalia: Pygophore 1.6x broader than long, produced into triangular posterior caudo- dorsal margin [Plate. H. IX and Fig. 8. e]. Subgenital plate triangular in shape with long setae on outer margin, 2x longer than broad with long stout setae on outer margin [Plate. H.VIII and Fig. 8.d]. Apophysis of style long with broader base [Plate. H.VIII and Fig. 8.c]. Aedeagal shaft in dorsal view with lateral acutely pointed expansion at the point of junction with connective, wider at mid-length, gradually slightly narrowed apex, lateral aspect of aedeagal shaft wider at base, dorsal margin of shaft is convex with inwardely curved hook at apex, aedeagus boat shaped in ventral view [Plate. H.V, VI and Fig. 8.a, b].

Measurements (mm): Male:ody length: 3.40, body width across eyes: 0.88, vertex length: 0.23, width: 0.48, diameter of ocelli 0.03 distance between compound eye and ocelli 0.03, pronotum: length 0.38, 0.82 width with hind margin 0.69. scutellum: 0.42 length, 0.53 width.

Material examined: INDIA: Arunachal Pradesh: Roing: Kebali: 1 ♂ (28°11'56"N 95°48'48"E), 10.ix.2014, grasses, Coll. Yeshwanth, H.M. (UAS, B).

Remarks: *M. maculatus* easily recognized by three black spots on vertex and two on scutellum. It closely related to *M. systenos* from which it can be distinguished by inwardly curved aedeagal shaft in lateral view.

9. Maiestas pruthii (Metcalf) [Plate. I]

Deltocephalus notatus, 1936: 128 Deltocephalus pruthii Metcalf, 1967: 1173

Male Genitalia: Pygophore 0.6x broader than long, produced into blunt edged circular posterior caudo-dorsal margin [Plate. I. IX and Fig. 9. e]. Subgenital plate triangular with few long setae on outer margin, 1.6x longer than broader [Plate. I.VIII and Fig. 9.d]. Style base broader, apophysis small stout process without crenulate margin [Plate. I.VII and Fig. 9.c]. Aedeagal shaft in dorsal view with lateral acute pointed expansion at the point of junction with connective, wider at mid-length, gradually narrowed to an acutely pointed unforked round apex. Dorsal margin of shaft is convex in lateral aspect with pointed apex [Plate. I.V, VI and Fig. 9.a, b].

Measurements (mm): Male: body length: 2.99, body width across eyes: 0.86, vertex length: 0.31, width: 0.45, diameter of ocelli 0.05 distance between compound eye and ocelli 0.16, pronotum: length 0.32, 0,81 width with hind margin 0.64, scutellum: 0.32 length, 0.5 width.

Material examined: INDIA: Andra Pradesh: Guvval cheruvu: 2♂ (13°5′N 79°2′E), 24.x.2008, grasses, Coll. Kalleshwara swamy (UASB).

Remarks: *M. pruthii* can be easily recognized by reticulate wing pattern, pygophore longer than broader, broader aedeagal shaft than connective and lateral expansion at the base. *M. pruthii* closely related to *M. dorsalis* except in ventral expansion of aedeagal shaft and reticulate wing venation.

10. Maiestas subviridis (Metcalf) [Plate. J]

Stirellus subviridis Metcalf, 1946: 125 Deltocephalus subviridis (Metcalf): Wilson and Claridge, 1991: 97

Male genitalia: Pygophore 0.6x broader than long, produced into triangular posterior caudodorsal margin [Plate. J. IX and Fig. 10. e]. Subgenital plate, broader, triangular in shape, 1.2x longer than broad and few setae on distal margin [Plate. J.VIII and Fig. 10.d]. Apophysis of style broader in midlength with crenulate inner margin [Plate. J.VII and Fig. 10.c]. Aedeagal shaft in dorsal view broader at base with lateral expansion at the point of junction with connective, gradually slightly narrowed apex, connective same length of aedeagal shaft, lateral aspect of aedeagal shaft curved dorsally with acute apex [Plate. J.V, VI and Fig. 10.a, b].

Measurements (mm): Male: body length: 3.37, body width across eyes: 0.96, vertex length: 0.33, width: 0.48. diameter of ocelli 0.03 distance between compound eye and ocelli 0.03, pronotum: length 0.39, 0.86 width with hind margin 0.67, scutellum: 0.32 length, 0.51 width.

Material examined: INDIA: Andra Pradesh: Valluvady: 1 ♂ (11°43'13"N 76°18'17"E), 4.iii.2000, Green gram, Coll. P.S. Jacob (NPC).

Remaks: *M. subviridis* can be identified by faint discontinuous dark round spot on anterior middle region of vertex. Broader triangular subgenital plate. Aedeagal shaft in dorsal view broader at base with lateral expansion at the point of junction with connective, gradually slightly narrowed apex, connective same length of aedeagal shaft. *M. subviridis* closely related to *M. tareni* externally.

11. Maiestas systenos (Dash and Viraktamath) [Plate. K] Deltocephalus (Recilia) systenos Dash and viraktamath, 1998: 28

Male genitalia: Pygophore 1.7x broader than long, produced into triangular posterior caudo- dorsal margin [Plate. K. IX and Fig. 11. e]. Subgenital plate triangular in shape with long setae on outer margin, 1.1x longer than broader [Plate. K.VIII and Fig. 11.d]. Base of apophysis of style with crenulate margin, sharp at the apex [Plate. K.VII and Fig. 11.c]. Aedeagal shaft in dorsal view with lateral backwardly directed expansion at the point of junction with a connective wider at mid-length, gradually narrowed to an acutely pointed apex dorsal margin of shaft is convex in lateral aspect [Plate. K.V, VI and Fig. 11.a, b].

Measurements (mm): Male: body length: 4.04, body width across eyes: 1.13, vertex length: 0.44, width: 0.61, diameter of ocelli 0.07, distance between compound eye and ocelli 0.02,

pronotum: length 0.50, 1.04 width with hind margin 0.77. scutellum: 0.43 length, 0.64 width.

Material examined: INDIA: Andhra Pradesh: Warangal: 1♂ (17.9689° N, 79.5941° E), 21.IX.2002, grasses, Coll. M.S.V.Chalam (NPC).

Remarks: *M. systenos* closely related to *M. maculatus* which it differs with black markings on vertex, straight stouter apophysis of style and acutely pointed aedeagal shaft.

12. *Maiestas tareni* (**Dash and Viraktamath**) [**Plate. L**] *Deltocephalus* (*Recilia*) *albomaculatus* Dash and Viraktamath, 1995: 74

Male genitalia: Pygophore 1.7x broader than long, produced into triangular posterior caudodorsal margin [Plate. L. IX and Fig. 12. e]. Subgenital plate long triangular in shape with long setae on outer margin, 1.1x longer than broader [Plate. L.VIII and Fig. 12.d]. Apophysis of style broad from base to apex, sharp at the apex [Plate. L.VII and Fig. 12.c]. Aedeagal shaft in dorsal view with long lateral finger like expansion at the point of junction with connective, wider at mid-length, gradually narrowed to an acutely pointed apex, dorsal margin of shaft is convex in lateral aspect [Plate.L.V, VI and Fig. 12.a, b].

Measurements (mm): Male: body length: 4.04, body width across eyes: 1.13, vertex length: 0.44, width: 0.61, diameter of ocelli 0.07, distance between compound eye and ocelli 0.02, pronotum: length 0.50, 1.04 width with hind margin 0.77, scutellum: 0.43 length, 0.64 width.

Material examined: INDIA: Andhra Pradesh: Warangal: 1♂ (17.9689° N, 79.5941° E), 21.IX.2002, grasses, Coll. M.S.V.Chalam (NPC).

Remarks: *M. tareni* can be easily recognized by oblong spots on the forewings and finger like expansion of the aedeagus at base. *M. tareni* closely related to *M. subviridis* externally. It differs from *M. subviridis* in having stouter and serrated apophysis of style and finger like expansion of the aedeagus at base.

13. *Maiestas variabilis* (**Dash and Viraktamath**) [**Plate. M**] *Deltocephalus* (*Recilia*) *variabilis* Dash and viraktamath, 1998: 15-16.

Male genitalia: Pygophore 1.3x broader than long, produced into triangular posterior caudodorsal margin [Plate. M. IX and Fig. 13.e]. Subgenital plate triangular with dorsal margin extended laterally and basally at base, 1.6x longer than broader and long setae on distal margin [Plate. M.VIII and Fig. 13.d]. Apophysis of style small sharp and curved dorsally with broader base. Aedeagal shaft in dorsal view broader at base with lateral expansion at the point of junction with connective, gradually slightly narrowed apex, slender connective. Lateral aspect of aedeagal shaft with wider base, dorsal margin of shaft straight and produced into curved apex [Plate. M.V, VI and Fig. 13.a, b].

Measurements (mm): Male: body length: 3.75, body width across eyes: 1.60. Vertex length: 0.32, width: 0.52. Diameter of ocelli 0.07 distance between compound eye and ocelli 0.04. Pronotum: length 0.42, 0.94 width with hind margin 0.72. Scutellum: 0.42 length, 0.66 width.

Material examined: INDIA: Andhra Pradesh: R.nagar: 1♂, (11°43'13"N 76°18'17"E), 16.iii.2002, paddy, Coll. M.S.V.Chalam (NPC).

Remarks: *M. variabilis* easily recognized by shape of apophysis of style and constriction of aedeagal shaft in dorsal aspect. It closely related to *M. krameri* from which it differs by the ventrally curved apex of aedeagal shaft.

14. Maiestas veinatus (Pruthi) [Plate. N]

Thamnotettix veinatus Pruthi, 1930: 63 Deltocephalus veinatus (Pruthi): Ghauri, 1936: 563 Recilia veinatu (Recilia) transversus Singh, 1969: 355

Male genitalia: Pygophore 1.1x broader than long, produced into blunt edged posterior caudo-dorsal margin [Plate. N. IX and Fig. 14.e]. Subgenital plate triangular with long setae on dorsal distal margin, 1.8x longer than broader [Plate. N.VIII and Fig. 14.d]. Apophysis of style small and acutely produced [Plate. N.VII and Fig. 14.c]. Aedeagal shaft in dorsal view broader at base gradually narrowed to apex, connective is narrow and longer than aedeagal shaft, lateral aspect of aedeagal shaft wider base with process and rounded apex [Plate. N.V, VI and Fig. 14.a, b].

Measurements (mm): Male: body length: 3.30, body width across eyes: 1.03, vertex length: 0.35, width: 0.60, diameter of ocelli 0.06 distance between compound eye and ocelli 0.04, pronotum: length 0.43, 0.86 width with hind margin 0.49, scutellum: 0.42 length, 0.59 width.

Material examined: INDIA: Andhra Pradesh: Warangal: 5♂ (18°0'19"N 79°35'17"E), 25.xii.2002, grasses, Coll. M.S.V. Challum (NPC).

Remarks: *M. veinatus* share the shape of aedeagal shaft with *M. subviridis* but differs from it in having rounded apex of shaft in lateral aspect. The lateral margins of subgenital plates are straight for most of their length.

15. Maiestas xanthocephalus (Dash and Viraktamath) [Plate. O]

Deltocephalus (*Recilia*) xanthocephalus Dash and Viraktamath, 1998: 19.

Male genitalia: Pygophore is 1.3x longer than broader, produced into triangular posterior caudodorsal margin setate crowded on the posterior setae crowded on the posterior margin [Plate. A. IX and Fig. 1. e]. Subgenital plate 1.4x longer than broader, triangular in shape with lateral margin convex, long setae on the dorsal and outer margin [Plate. O.VIII and Fig. 15.d]. Apophysis of the style slender, curved laterally with bluntly pointed apex. Connective is 1.5x longer than aedeagus [Plate. O.VII and Fig. 15.c]. Aedeagal shaft slightly curved dorsally at the point of junction with connective, gradually narrowed to acutely pointed apex, dorsal margin of shaft convex in lateral aspect with acute pointed end [Plate. O.V, VI and Fig. 15.a, b].

Measurements (mm): Male: body length 3.86, 1.10 width across eyes, vertex 0.34 length, 0.60 width, pronotum 0.15 length, 1.03 width with hind margin 0.77, scutellum 0.43 length, 0.64 width, diameter of ocelli 0.11 distance between compound eye and ocelli 0.02.

Remarks: *M. xanthocephalus* is closely related to *M. fletcheri* (Pruthi) from which it differs in having more slender, strongly curved aedeagus and slender elongate sternal apodemes at the base of apodeme.

Discussion

The genus Maiestas Distant previously referred by various synonyms as followed: Togacephalus by Matsumara in 1940 with type species Deltocephalus distinctus, by original designation. Later it was treated as subgenus of Recilia by lee, et al in 1979 and Day and Flectcher in 1994. Then it was synonymized with Recilia by Dash and Viraktamath in 1998; *Inazuma* by Ishihara in 1953 with type species *Deltocephalus* dorsalis Motschulsky, by original designation. Later it was synonymized with Recilia by Nielson in 1968 and Dash and Viraktamath in 1998. Then it was treated as a subgenus of Recilia by Lee in 1979, Kwon and Lee (1979) and Day and Fletcher (1994): Inemadara by Ishihara in 1953 with type species Deltocephalus oryzae Matsumura, by original designation. Later it was synonymised with Recilia by Nast in 1972 and Dash and Viraktamath in 1998 and with Recilia (Togacephalus) by Kwon and Lee in 1979; Insulanus by Linnavuori in 1960 (as subgenus of *Deltocephalus*) with type species Stirellus subviridis Metcalf, by original designation. Later it was Synonymized with Recilia by both Knight in 1975 and Linnavuori in 1975. Then it was treated as a subgenus of Recilia by Day and Fletcher in 1994.

From 1859 till now many species are described by various workers. Despite the huge diversity exists among the Maiestas of India, no specific efforts so far have been made for its collection, characterization and documentation. The task of routine species identification has several limitations, which includes incorrect identification due to phenotypic and genetic variability in the characters use for species recognition and presence of morphologically cryptic taxa in some ecosystems. Therefore, this study would be of such kind specifically focusing on integrative characterization and documentation of species of *Maiestas* leafhopper from India. This study would help to correctly document the diversity and estimate the existence of *Maiestas* in India and will also help to identify the existence of cryptic species among this group. The data and information generated from this study would also be helpful for revision and taxonomical updating higher level classification. Characters selected for description are colouration, spots, length and width of habitus, face, crown, pronotun, scutellum, compound eyes, ocelli, and variation in

Colours variations is reported in all species, where Maiestas albomaculatus Brownish ochraceous with chocolate brown markings. Anterior half of vertex chocolate brown with white spots, posterior half with a few white spots. Maiestas belonus can be easily recognized by dark brownish head, Face with regular transvers brown fascie from its closely related species. M. jogensis Reddish zig-zag pattern on the forewing. Head with pale yellow coloured elliptical spots on either side of the median frontal suture in M. dorsalis and lemon yellow in M. flectheri. M. hopes can easily distinguish by head and thorax with faint yellow, a small light spot on either side of the dark median line on the vertex. Face with irregular transvers brown fascie in M. intermedius. Greenish black species, head and thorax greyish yellow, vertex anterior region blackish yellow, posterior greenish yellow M. krameri, vertex with three large black spots in M. maculatus and fine dark coronal suture on vertex in M. pruthii compare to M. subviridis which has faint discontinuous dark round spot on anterior middle region of vertex. Anterior margin of vertex black with three white prominent spot in *M. systenos* and *M. tareni* with dark abdomen. Face without any marking in *M. variabilis*, vertex dorsum with two dark spot on either side of dark coronal suture in *M. veinatus* and vertex anterior region with black convex semicircular markings with edges attached to ocelii margin in *M. xanthocephalus*.

All the species studied here, were showing prominent differences in the male genitalia structure. M. albomaculatus is distinguished from closely related M. dorsalis by aedeagus with serrated outer margin near apex. M. belonus is differs from other the species in having much slender and longer apex of shaft. M. fletcheri (Pruthi) can be easily distinguish from its closely related M. xanthocephalus by aedeagal shaft produced into posteriorly directed tubular expansion at point of joint with connective. M. hospes is closely related to M. intermedius but differs in the structure of apex of aedeagus and sternal apodemes and subgenital plates and M. krameri closely related to M. variabilis from which it differs in having uniformly curved aedeagal shaft. M. maculatus easily recognized by three black spots on vertex and two on scutellum, aedeagal shaft inwardly curved in lateral view from M. systenos. M. pruthii can be easily recognized by reticulate wing pattern, pygophore longer than broader, broader aedeagal shaft than connective and lateral expansion at base. This is closely related to M. subviridis except in ventral expansion of aedeagal shaft and reticulate wing venation. M. tareni can be easily recognized by oblong spots on the forewings and finger like expansion of the aedeagus at base. M. tareni closely related to M. subviridis externally. It differs from subviridis in having stouter and serrated apophysis of style. M. veinatus share the shape of aedeagal shaft with M. subviridis and M. bispinosus but differs from them in having rounded apex of shaft in lateral aspect. The lateral margins of subgenital plates are straight for most of their length. M. xanthocephalus is closely related to M. fletcheri (Pruthi) from which it differs in having more slender, strongly curved aedeagus and slender elongate sternal apodemes at the base of apodeme. DNA barcodes was developed, on the species of Maiestas which has difficulty/ambiguities in identification. M. dorsalis and M. krameri was subjected to the molecular characterization (DNA extraction, PCR amplification and sequencing). The molecular characterization was done using mitochondrial genes (Mt COI). The morphological and molecular characterization data was integrated accordingly so that the species identity confirmed and established.

Conclusion

Members of the genus *Maiestas* Distant are widely distributed and many are reported as potential pests from India and other countries. Dispite their wide diversity and economic importance less work has been done on taxonomy of this group. After the revision of Deltocephalini tribe in 2009 there is no concise work has been done for identification of the species. So this study provides validity of names, in depth photography as well as illustrations which will be utilized as readyreckoner material for identification of species. Morphological and molecular characterization data was integrated accordingly so that the species identity is confirmed.

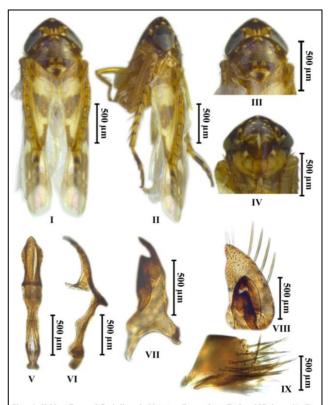


Plate. A. Habitus, Face and Genitalia male *Maiestas albomaculatus* (Dash and Viraktamath). (I), (II). Habitus dorsal and lateral view; (III). Head and Thorax; (IV). Face; (V), (VI). Aedeagus dorsal and lateral; (VII). Style; (VIII). Subgenital Plate; (IX). Pygophore.

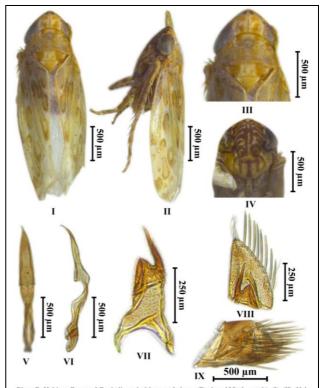
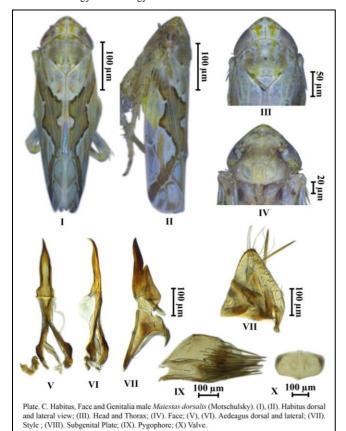
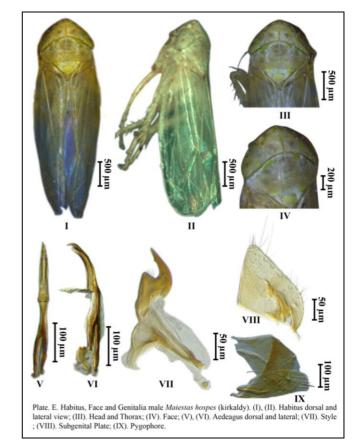
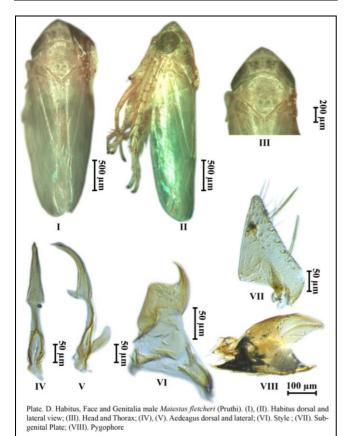
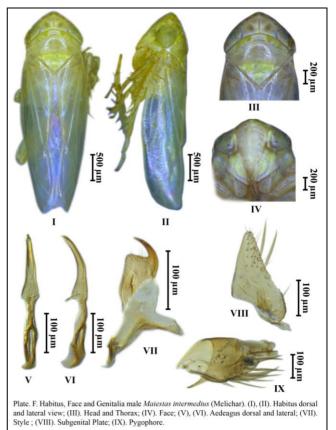


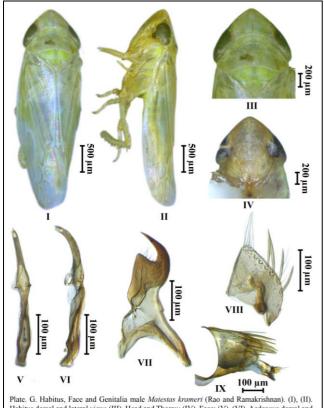
Plate. B. Habitus, Face and Genitalia male *Maiestas belonus* (Dash and Viraktamath). (I), (II). Habitus dorsal and lateral view; (III). Head and Thorax; (IV). Face; (V), (VI). Aedeagus dorsal and lateral; (VII). Style; (VIII). Subgenital Plate; (IX). Pygophore.











Plate, G. Habitus, Face and Genitalia male *Maiestas krameri* (Rao and Ramakrishnan). (I), (II). Habitus dorsal and lateral view; (III). Head and Thorax; (IV). Face; (V), (VI). Aedeagus dorsal and lateral; (VII). Style; (VIII). Subgenital Plate; (IX). Pygophore.

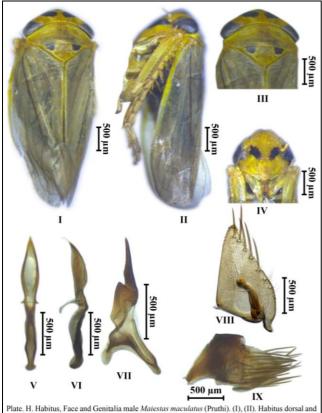


Plate. H. Habitus, Face and Genitalia male *Maiestas maculatus* (Pruthi). (I), (II). Habitus dorsal and lateral view; (III). Head and Thorax; (IV). Face; (V), (VI). Aedeagus dorsal and lateral; (VII). Style; (VIII). Subgenital Plate; (IX). Pygophore.

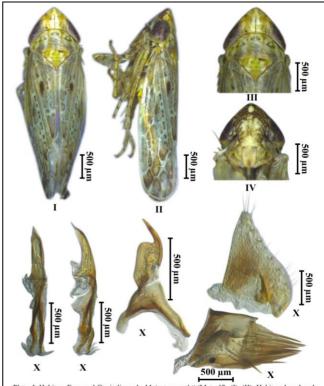


Plate. I. Habitus, Face and Genitalia male *Maiestas pruthii* (Metcalf). (I), (II). Habitus dorsal and lateral view; (III). Head and Thorax; (IV). Face; (V), (VI). Aedeagus dorsal and lateral; (VII). Style; (VIII). Subgenital Plate; (IX). Pygophore.

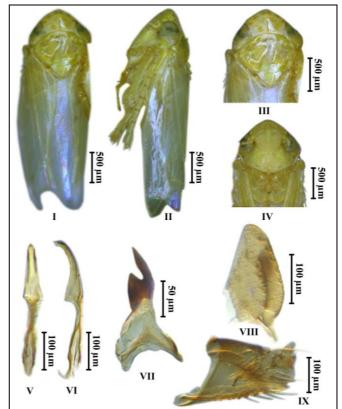
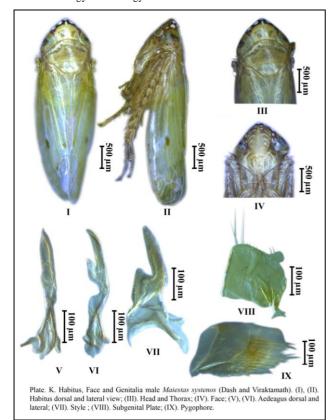
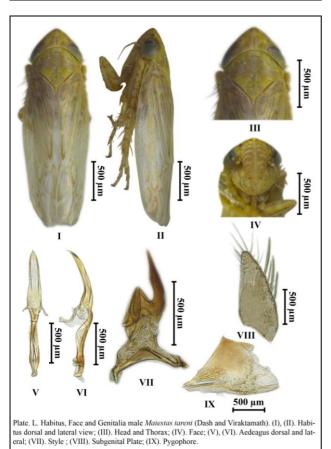


Plate. J. Habitus, Face and Genitalia male *Maiestas subviridis* (Metcalf). (I), (II). Habitus dorsal and lateral view; (III). Head and Thorax; (IV). Face; (V), (VI). Aedeagus dorsal and lateral; (VII). Style; (VIII). Subgenital Plate; (IX). Pygophore.





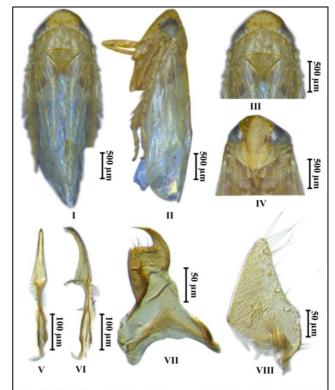


Plate. M. Habitus, Face and Genitalia male *Maiestas variabilis* (Dash and Viraktamath). (I), (II). Habitus dorsal and lateral view; (III). Head and Thorax; (IV). Face; (V), (VI). Aedeagus dorsal and lateral; (VII). Style; (VIII). Subgenital Plate; (IX). Pygophore.

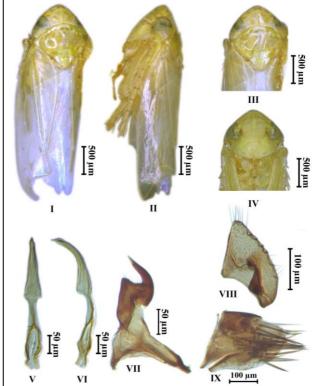
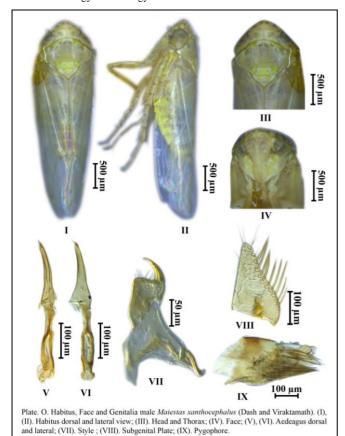


Plate. N. Habitus, Face and Genitalia male *Maiestas veinatus* (Pruthi). (I), (II). Habitus dorsal and lateral view; (III). Head and Thorax; (IV). Face; (V), (VI). Aedeagus dorsal and lateral; (VII). Style; (VIII). Subgenital Plate; (IX). Pygophore.



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References

- Dietrich CH. Phylogeny of the leafhopper subfamily Evacanthinae with a review of Neotropical species and notes on related groups (Hemiptera: Membracoidea: Cicadellidae). Systematic Entomology. 2004; 29:455-487.
- 2. Nielson MW. The leafhopper vectors of phytopathogenic viruses (Homoptera: Cicadellidae). Taxonomy, biology and virus transmission. United States Department of Agriculture Technical Bulletin. 1968; 1382:1-386.
- 3. Zahniser JN, Dietrich CH. A review of the tribes of Deltocephalinae (Hemiptera: Auchenorrhyncha: Cicadellidae). European Journal of Taxonomy. 2013; 45:1-211.
- Oman PW, Knight WJ, Nielson MW. Leafhoppers (Cicadellidae): a bibliography, generic check-list and index to the world literature, 1956–1985. CAB International Institute of Entomology; BPCC Exeter, 1990.
- Dietrich CH, Rakitov RA. Some remarkable new deltocephaline leafhoppers (Hemiptera: Cicadellidae: Deltocephalinae) from the Amazonian rainforest canopy. Journal of New York Entomological Society. 2002; 110:1-48.

- 6. Zahniser JN, Dietrich CH. Phylogeny of the leafhopper subfamily Deltocephalinae (Insecta: Auchenorrhyncha: Cicadellidae) and related subfamilies based on morphology. Systematics and Biodiversity. 2008; 6:1-24.
- 7. Webb MD, Viraktamath CA. Annotated check-list, generic key and new species of Old World Deltocephalini leaf-hoppers with nomenclatorial changes in the Deltocephalus group and other Deltocephalinae (Hemiptera: Auchenorrhyncha: Cicadellidae). Zootaxa. 2009; 2163:1-64.
- 8. Weintraub, Phyllis G, LeAnn Beanland. Insect vectors of phytoplasmas. Annual Review of Entomology. 2006; 51:91-111.
- 9. Nielson MW. Taxonomic relationships of leafhopper vectors of plant pathogens. Leafhopper Vectors and Plant Disease Agents. In: Maramarosch, K. and Harris, K. edition. Academic Press, New York, 1979, 3-27.
- Zahniser JN, Dietrich CH. Phylogeny of the leafhopper subfamily Deltocephalinae (Hemiptera: Cicadellidae) based on molecular and morphological data with a revised family-group classification. Systematic Entomology. 2010; 35:489-511.
- 11. Zhang YL, Duan YN. Review of the Deltocephalus group of leafhoppers (Hemiptera: Cicadellidae: Deltocephalinae). Zootaxa. 2011; 2870:1-47.
- 12. Mathur KC, Chaturvedi DP. Biology of leaf and planthoppers, the vectors of Rice virus diseases in India. Proceedings of Indian National Science Academy. 1980; B:46: 797-812.
- 13. Hanboonsong F, Ritthison W. Transmission of Sugarcane White Leaf Phytoplasma by Yamatotettix flavovittatus, a New Leafhopper Vector. Journal of Economic Entomology. 2006; 99(5):1531-1537.