

## New Records of Leafhoppers from Sugarcane Crop-Ecosystem in Rayalaseema Region of Andhra Pradesh

S Nagesh, M S V Chalam, S R Koteswara Rao and B Ravindra Reddy  
Department of Entomology, S V Agricultural College, Tirupati, A.P.

### ABSTRACT

Leafhopper fauna associated with sugarcane crop ecosystem of Rayalaseema region were collected, identified and described. The leafhopper fauna viz., *Balclutha saltuella* (Kirschbaum), *Balclutha thea* (Kirschbaum), *Cicadulina bipunctata* (Melichar), *Empoasca defuncta* (Dworakowska), *Empoasca indica* (Datta), *Empoasca prima* (Distant), *Exitianus indicus* (Distant), *Doratulina speciosum* (Distant), *Nephotettix nigropictus* (Stal), *Nephotettix virescens* (Distant) and *Maiestas breviculus* (Dash and Viraktamath) were identified from sugarcane crop ecosystem of Rayalaseema. An illustrated key along with key taxonomic characters was provided for easy identification of the leafhoppers.

**Key words:** Hemiptera, Leafhoppers, Cicadellidae, Sugarcane crop eco-system.

Leafhoppers, an economically important group of Auchenorrhynchan Hemiptera belong to the family Cicadellidae comprising about 2,445 described genera and 22,637 species world wide and 340 genera and 1,350 species in India, respectively (Viraktamath 2005). Leafhoppers are small wedge shaped insects of various forms, colours, sizes and can be readily distinguished from other Auchenorrhyncha by having one or more rows of small spines extending the length of hind tibiae. They are phytophagous and commonly suck sap from leaves, although many species are known to feed on different parts of the plant.

A few groups of leafhopper genera act as vectors and transmit phytopathogenic organisms (viruses, mycoplasmas, spiroplasmas and bacteria) that cause diseases and eventual death of plants. Some of the diseases caused by phytopathogenic organisms vectored by leafhoppers include, little leaf of brinjal, sesamum phyllody, purple top rot of potato, yellow dwarf of rice, rice tungro (Muniyappa and Veeresh 1986), rice transitory yellowing, sandal spike, eastern wheat striate virus and maize streak virus, orange leaf of rice, etc., (Wilson and Claridge 1991).

Since independence efforts were made to improve the yield of crops by introduction of high yielding varieties (HYV) and hybrids and adoption of improved agronomic practices. Many of the HYV's and hybrids are generally susceptible to insect pests. Also, due to changes in agronomic practices some of the minor and / or unknown pests may assume the status of major pests. For example, the rice green leafhoppers and planthoppers which were minor pests prior to the seventies, have now assumed major pest status (Kalode 1983). The accurate identification of a pest species affecting the crop ecosystem is the first

and foremost step for its effective suppression in integrated pest management programme. In this context knowledge on the association between leafhoppers and crop-ecosystems and the occurrence of vector species is of utmost importance. Leafhopper fauna associated with sugarcane crop ecosystems of Rayalaseema region were not studied earlier. In Rayalaseema sugarcane crop occupy an area of 0.18 lakh hectares with a production of 1.67 million tonnes and with a productivity of 92,648 kg ha<sup>-1</sup>. (Department of Agriculture, 2018)

### MATERIAL AND METHODS

Leafhopper specimens were collected from different Agro-climatic zones of Rayalaseema by sweep netting method. About 10-15 to and fro net sweepings were taken each time and Leafhoppers collected were aspirated from the net into a glass tube and killed with a cotton swab wetted with a few drops of ethyl acetate. The killed specimens were transferred to homeopathic vials, labelled, brought to the laboratory and dried in a hot air oven at 45-50°C, for about 5 to 6 hours. For mounting and preparing slides of genitalia, the procedure suggested by Knight (1965) was followed. For describing the different body parts, the terminology suggested by Blocker and Triplehorn (1985) was followed.

### RESULTS AND DISCUSSION

In present study eleven leafhopper species were collected, identified and described from sugarcane crop ecosystem of Rayalaseema region. The collected leafhopper fauna includes *Balclutha saltuella* (Kirschbaum), *Balclutha thea* (Kirschbaum), *Cicadulina bipunctata* (Melichar), *Empoasca*

*defecta* (Dworakowska), *Empoascanara indica* (Datta), *Empoascanara prima* (Distant), *Exitianus indicus* (Distant), *Doratulina speciosum* (Distant), *Nephotettix nigropictus* (Stal), *Nephotettix virescens* (Distant) and *Maiestas breviculus* (Dash and Viraktamath).

An illustrated key has been prepared to aid rapid and accurate identification of the common species of leafhoppers found associated with sugarcane crop eco-system of Rayalaseema. For those species which were not studied during the present study, literature or a Taxonomist working on the leafhoppers were consulted.

1. Vertex with a single black spot / two black spots / conspicuous black band. ... 2  
Vertex without spots / conspicuous band ..... 4
2. Vertex with a black band between the compound eyes. Fore wings with four apical and three anteapical cells. Pygofer with two conspicuous spines, upper spine is longer than the lower spine, aedeagus simple and curved, apex notched (Figs. 1a-c) ..... *Exitianus indicus* (Distant)  
Vertex with one large black spot / with a pair of black spots ..... 3
3. Yellowish orange coloured insects; dorsal side of the abdomen is black in colour. Vertex with a pair of round black spots; Pygofer with a curved bifid process. A robust sub apical spine is seen on pygofer; Aedeagus short and 'C' shaped (Figs. 2a-b) ..... *Cicadulina bipunctata* (Melichar)  
Vertex with a large single central black spot which is irregularly margined. Pygofer lobe with curved dorsal process. Subgenital plates wider at middle, narrow towards apex. Aedeagus abruptly narrowed towards apex (Figs. 3a-b) ..... *Empoascanara indica* (Datta)
4. Medium to large sized insects; yellowish green to green in colour; width of the vertex more than half the width of the pronotum ..... 5  
Small to medium sized insects; width of the vertex less than half the width of the pronotum ..... 10
5. Aedeagus without any process, articulated to connective with a membranous joint. Aedeagal shaft may be symmetrical / asymmetrical but definitely curved dorsad ..... 6  
Aedeagus with processes ..... 7
6. Aedeagal shaft without any processes, articulated in side view. Aedeagal appendages longer, convergent apically with distinct transverse ledges in terminal half (Figs. 4a-c) ..... *Empoascanara defecta* (Dworakowska)

Dorsal pygofer process almost triangular in profile. Aedeagus with a single dorsally curved shaft; gonopore subapical. Aedeagus bent in the form of 'C' Connective short, arms of the connective widely separated at their base. Subgenital plates sclerotized at their margins (Figs. 5a-c).

..... *Empoascanara prima* (Distant)

7. Green coloured insects with black patch / black stripe on fore wing ..... 8  
Brown coloured insects ..... 9
  8. Medium to large sized insects with green coloured fore wings. Fore wings with a black patch, which does not reach the claval region. Aedeagus with a pair of lateral apophysis, dorsal surface elongated, sclerotised with four pairs of spines laterally (Figs. 6a-b) ..... *Nephotettix virescens* (Dworakowska)  
Medium to large sized insects with green coloured fore wing. Anterior margin of pronotum and inner margin of Clavus of fore wing with a black stripe. Aedeagus with a pair of lateral apophyses; dorsal surface elongated; sclerotized with eight pairs of spines laterally and directed towards apex and gonopore apical. (Figs. 7a-c) ..... *Nephotettix nigropictus* (Stal)
  9. Vertex posteriorly sulcate; forewings does not have a black spot. Connective arms 'U' shaped with a bifid stem. Aedeagus very long, wider at base the abruptly narrowed and with a pointed apex; apex extends up to the arms of the connective (Figs. 8a-c) ..... *Doratulina speciosum* (Distant)  
Pronotum with three longitudinal brown stripes on either side of median line. Veins of fore wing margined by brown areas. Aedeagus short, heel at the base of the shaft well developed, ventral margin strongly sinuated, dorsal margin straight, apex of aedeagus blunt and gonopore subapical (Figs. 9a-c) ..... *Maiestas breviculus* (Dash and Viraktamath)
  10. Cream to pale yellowish brown coloured insects. Aedeagus elongate simple and narrow, gonopore apical (Figs. 10a-b) ..... *Balclutha saltuella* (Kirschbaum)  
Green coloured insects. Aedeagus simple, filamentous, curved distad and aedeagus shaft evenly curved (Figs. 11a-c) ..... *Balclutha thea* (Kirschbaum)
- Empoascanara indica* (Datta)**  
Vertex, pronotum and scutellum yellow. Vertex with a large central black spot. Abdomen black and fore wings pale grey, transparent without any markings. Pygofer lobe more or less triangular in shape, broader at base and narrowed towards apex, with its dorsomesal processes curved, rounded at base and gradually

narrowed towards apex; microsetae scattered all over the apical half. Styles long, outer margin bilobed in middle, inner margin straight, apical extension broadened at apex, cephalic end of styles shorter than caudal part which is gradually narrowed. Connective more or less 'Y' shaped, arms longer than stem, joined by a membrane at base. Aedeagus with its shaft simple, tubular, without any processes, broader at base, abruptly narrowed towards apex and gonopore subapical.

***Empoascanara defecta* (Dworakowska)**

Stramineous in colour. Fore wings hyaline with four apical cells, the second being quadrangular in shape. Pygofer lobe broad and long in the lateral view. Styles elongated, broad at apex and narrowed towards the base. Connective very short. Aedeagus very short, curved, appendages arising from aedeagus are longer and convergent apically with distinct transverse ledges in the apical portion.

***Empoascanara prima* (Distant)**

Light yellow to yellowish orange in colour. Pronotum with conspicuous pit like structures. Pygofer lobe rounded or angulated with a well defined sclerotised lobe like structure. Subgenital plates slightly sclerotised apically, lateral margins produced into a strong notch with micro setae. Connective loosely attached to aedeagus, inverted 'Y' shaped in structure with arms widely separated. Aedeagus 'C' shaped with a strong curvature towards the lateral side.

***Exitianus indicus* (Distant)**

Yellowish brown body with a black band between compound eyes. Forewings elongate, subhyaline with four apical and three antepical cells and appendix wider. Pygofer with two conspicuous dark brown or black spines along the apical margin, upper spine is longer than lower spine and is wider and short. Styles with a sharp apophysis and distinct preapical lobe. Aedeagus simple, curved having an articulation between shaft and base, apex notched. Gonopore large and subapical.

***Cicadulina bipunctata* (Melichar)**

Vertex with a pair of round black spots on the anterior margin. Vertex, pronotum and scutellum are yellowish orange in colour and the dorsum of abdomen is black in colour. Pygofer with an elongate dorsal process which is bifid, with curved, short and robust ventral subapical spine. Connective 'Y' shaped, arms close together, approximately equal in length to the stem. Aedeagal shaft cylindrical, 'C' shaped and curved dorsally with a pair of processes basally.

***Nephotettix virescens* (Distant)**

Yellowish green in colour. Fore wings with a black patch which does not reach the claval region, apical third black in males. Subgenital plates broader at base and gradually narrowed to an acute apex with submarginal macrosetae. Styles robust, highly sclerotised with longer apophyses, apex blunt. Aedeagus with a pair of lateral paraphyses, dorsal surface elongate, sclerotized with five pairs of spines laterally and directed towards apex.

***Nephotettix nigropictus* (Stal)**

Yellowish green in colour. Vertex with a black submarginal transverse band. Anterior margin of pronotum and inner margin of clavus of tegmina with a black stripe. Pygofer broader basally, gradually narrowed and apex with few black spines. Styles robust, sclerotized with longer apophyses. Aedeagus with a pair of lateral apophyses; dorsal surface elongate, sclerotized with eight pairs of spines laterally and directed towards apex.

***Doratulina speciosum* (Distant)**

Brownish yellow. Connective arms 'U' shaped and stem bifid at apex. Style with narrow, slender apophysis with bluntly pointed apex. Aedeagus very long, wider at base, then abruptly narrowed, deeply bent dorsocephalad and the shaft with distinct sinuation, in the middle and with a pointed apex which extends upto connective arms.

***Maiestas breviculus* (Dash and Viraktamath)**

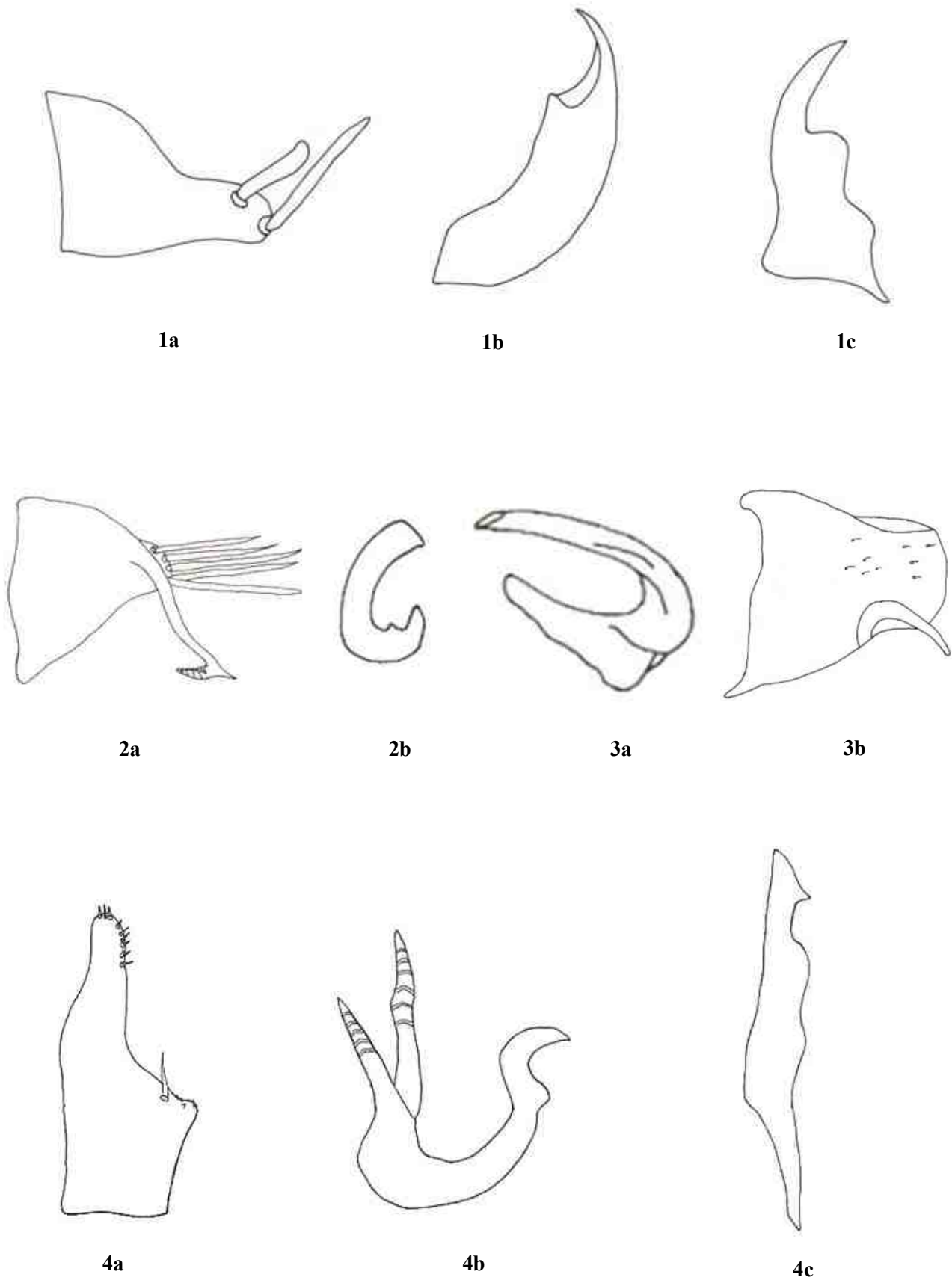
Ochraceous with tinges of yellow and black shades. Fore wings with brown fuscous markings denoting the margins of cells. Abdominal sternal apodemes hook like. Subgenital plates wider basally, lateral margins convex, armed with marginal macro setae. Apophysis of style with a blunt tip and is thumb like. Connective longer than aedeagus and is completely fused with it. Aedeagus short with a pronounced heel on the lateral margin. Tip of the aedeagus subacute in lateral margin.

***Balclutha saltuella* (Kirschbaum)**

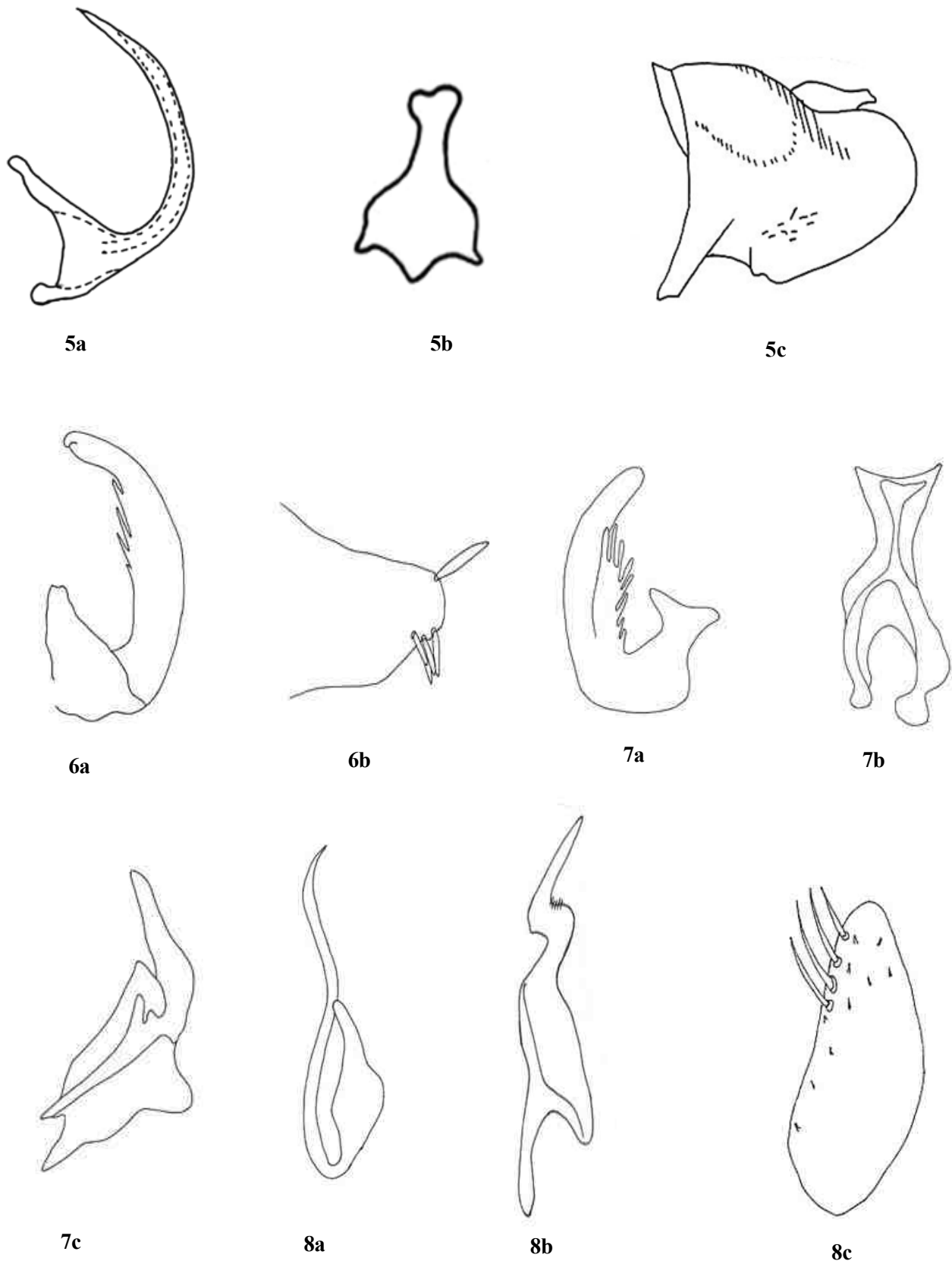
Cream to pale yellowish brown. Head wider than pronotum. Subgenital plates very short with fingers like apex. Connective with arms as long as stem. Aedeagus elongate simple, shaft narrow.

***Balclutha thea* (Kirschbaum)**

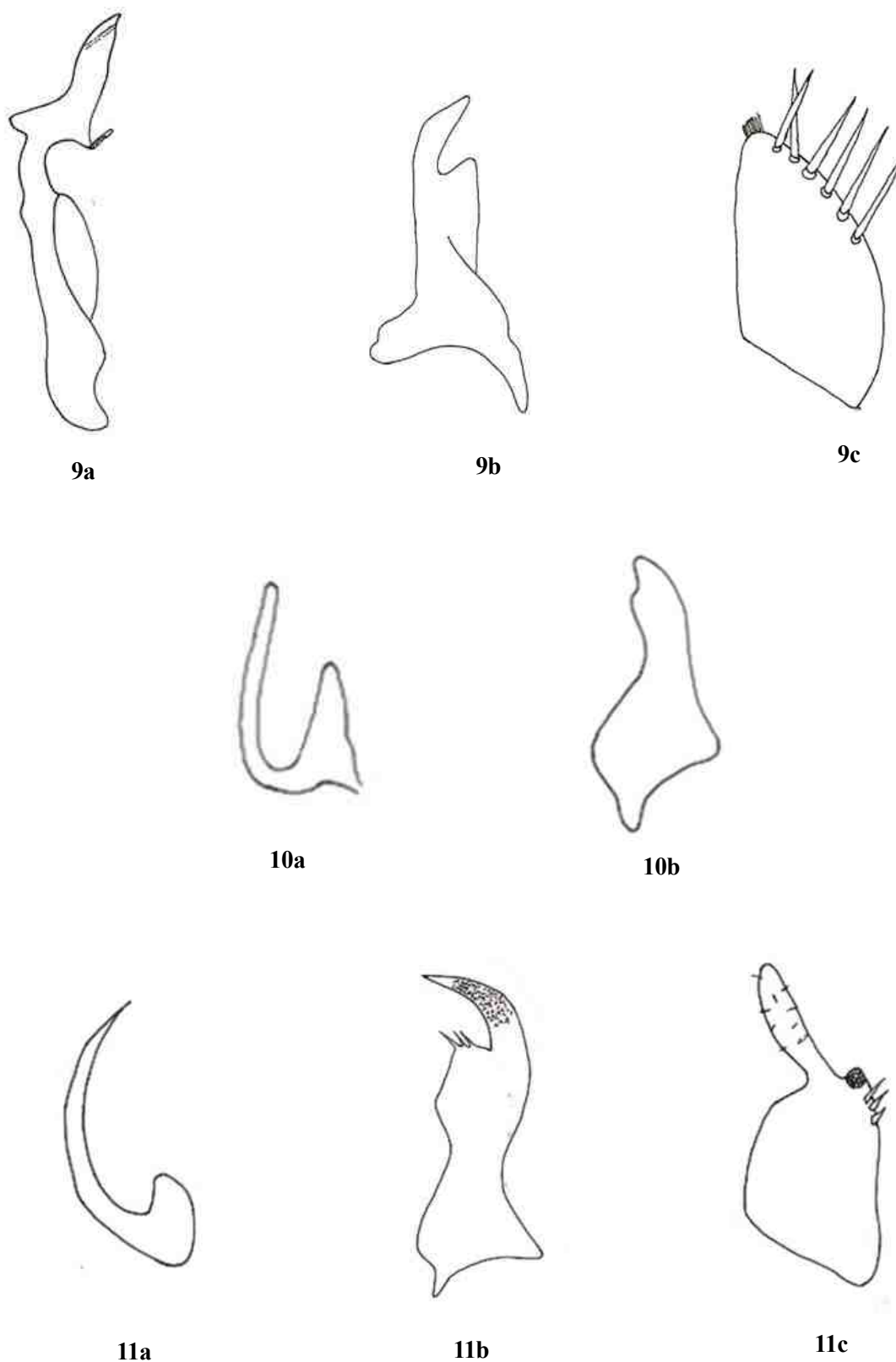
Green in colour, sometimes with darker green spots on vertex posteriorly and pronotum anteriorly. Subgenital plates with pronounced tooth laterally at midlength. Connective 'Y' shaped, stem very much



Figs. 1a-c. *Exitianus indicus* (Distant): 1a. Pygofer lobe, lateral view; 1b. Aedeagus, lateral view; 1c. Style. 2a-b. *Cicadulina bipunctata* (Melichar): 2a. Pygofer, lateral view; 2b. Aedeagus, lateral view. Figs. 3a-b. *Empoasca indica* (Datta): 3a. Aedeagus, lateral view; 3b. Pygofer. Figs. 4a-c. *Empoasca defecta* (Dworakowska): 4a. Subgenital plate; 4b. Aedeagus, lateral view; 4c. Style.



Figs. 5a-c. *Empoascanara prima* (Osborn): 5a. Aedeagus; 5b. Connective; 5c. Pygofer. Figs. 6a-b. *Nephotettix virescens* (Distant): 6a. Aedeagus, lateral view (with four spines); 6b. Pygofer lobe, lateral view (with five spines). Figs. 7a-c. *Nephotettix nigropictus* (Stal): 7a. Aedeagus, lateral view; 7b. Connective; 7c. Style. Figs. 8a-c. *Doratulina speciosum* (Distant): 8a. Aedeagus, lateral view; 8b. Style; 8c. Subgenital plate.



Figs. 9a-c. *Maiestas breviculus* (Dash and Viraktamath): 9a. Fused connective and aedeagus, lateral view; 9b. Style; 9c. Subgenital plate. Figs. 10a-b. *Balclutha saltuella* (Kirschbaum): 10a. Style; 10b. Aedeagus, lateral view. Figs. 11a-c. *Balclutha thea* (Kirschbaum): 11a. Aedeagus in lateral view; 11b. Style; 11c. Subgenital plate.

**Table 1. Morphometric details of leafhopper fauna identified from sugarcane crop ecosystem of Rayalaseema region (in – millimetres) (average of 10 specimens)**

S. No.	Leafhopper species	Total body length	Width of the body	Length of the head	Inter-ocular distance	Length of the pronotum	Length of the scutellum	Length of the wing	Width of the wing	Length of the male genitalia	Length of the aedeagus
1	<i>E. indicus</i>	3.45	1.24	0.28	0.53	0.38	0.33	2.42	0.65	0.3	0.18
2	<i>N. nigropictus</i>	3.32	1.05	0.21	0.47	0.37	0.41	2.7	0.74	0.56	0.36
3	<i>N. viriscens</i>	3.23	1.02	0.25	0.4	0.39	0.38	2.54	0.74	0.56	0.29
4	<i>M. breviculus</i>	2.55	0.99	0.32	0.31	0.3	0.24	1.94	0.61	0.29	0.3
5	<i>E. defecta</i>	1.86	0.5	0.13	0.24	0.22	0.21	1.48	0.31	0.15	0.11
6	<i>E. indica</i>	1.71	0.45	0.12	0.31	0.37	0.14	1.99	0.33	0.27	0.15
7	<i>E. prima</i>	1.59	0.49	0.12	0.27	0.15	0.2	1.21	0.32	0.19	0.11
8	<i>B. saltuella</i>	1.97	0.47	0.07	0.26	0.25	0.11	1.68	0.32	0.16	0.09
9	<i>B. thea</i>	2.37	0.47	0.12	0.31	0.37	0.14	1.99	0.33	0.27	0.15
10	<i>C. bipunctata</i>	2.08	0.59	0.16	0.26	0.24	0.18	1.62	0.34	0.27	0.13
11	<i>D. speciosum</i>	2.37	0.75	0.34	0.25	0.28	0.23	1.74	0.59	0.27	0.39

longer than arms. Apophyses of style well developed with sharp ending and strongly arched. Aedeagus simple, filamentous, curved distad and aedeagal shaft evenly curved.

This is the first study of leafhopper fauna associated with sugarcane crop ecosystem in Rayalaseema region of Andhra Pradesh. Bindra (1973) studied the host range, description and biology of 61 leafhoppers and stressed the need for identification of leafhopper species occurring in different crop ecosystems for the benefit of farmers, economic

entomologists and extension workers. Virakatamath (1983) emphasized the need of keys for leafhopper fauna of Karnataka and provided a key for identification economically important leafhoppers. Ahmed (1987) reported 33 Typhlocybinae leafhoppers, their host association, and associated yield loss in graminaceous crop ecosystems in Pakistan. Wilson and Claridge (1991) published a comprehensive account of leafhoppers in major rice growing areas of the world and keys for identification of leafhoppers along with colour photographs. Rao *et al.*, (2000) reported 26

leafhoppers belonging to 12 genera associated with rice and sugarcane crop ecosystems along with keys for distinguishing these leafhoppers from Telangana (erstwhile Andhra Pradesh). Giridhar *et al.*, (2008) studied leafhopper fauna associated with sugarcane ecosystems of South India and reported 22 leafhopper species. Shashank (2009) reported 20 leafhopper species associated with rice crop ecosystems of coastal and central Karnataka.

## CONCLUSION

The leafhoppers viz., *Balclutha saltuella*, *Balclutha thea*, *Cicadulina bipunctata*, *Empoasca defuncta*, *Empoasca indica*, *Empoasca prima*, *Exitianus indicus*, *Doratulina speciosum*, *Nephotettix nigropictus*, *Nephotettix virescens* and *Maiestas breviculus* were identified from sugarcane crop ecosystem of Rayalaseema. Correct and quick identification of leafhopper species associated with sugarcane crop ecosystems helps in timely management of these leafhoppers if they attain pest status in future.

## LITERATURE CITED

- Ahmed M 1987** Host associations and losses to growth and yield to some vegetable plants caused by Typhlocybinae leafhoppers (Cicadellidae) in Pakistan. *Proceedings of 2<sup>nd</sup> International Workshop on leafhoppers and plant hoppers of economic importance*, 28<sup>th</sup> July-1<sup>st</sup> August 1986, Eds Wilson M R and Nault L R, CIE, provo, Utah, USA. 243-250.
- Andhra Pradesh agricultural officers association, Department of Agriculture. 2018. *Plant doctors dairy*. 4-7.
- Bindra O S 1973** Cicadellid vectors of plant pathogens. *Final report of the PL-480 Project No.A7-ENT-22 Grant No.FG-IM-300 completed on October 13, 1971*. Department of Entomology, Punjab Agricultural University, Ludhiana, India. 1-56.
- Blocker H D and Triplehorn B W 1985** *External morphology of leafhoppers. In, the leafhoppers and planthoppers (eds Nault, L.R and Rodriguez, J.G)*. John Wiley and Sons, New York. 4-60.
- Giridhar V, Rao V R S and Prasad K V H 2008** Leafhopper fauna (Hemiptera: Cicadellidae) associated with sugarcane ecosystem of south India. *Current Biotica*. 2 (3): 287-299.
- Knight W J 1965** Techniques for use in the identification of leafhoppers (Homoptera: Cicadellidae). *Entomologist's Gazette*. 16(4): 129-136.
- Kalode M B 1983** Leafhopper and Planthopper pests of rice in India. *Proceedings of the 1<sup>st</sup> international workshop on Biotaxonomy, Classification and Biology of Leafhoppers and Planthoppers (Auchenorrhyncha) of economic importance*, London. 4-7 October 1982. 225-245.
- Muniyappa V and Veeresh G K 1986** Arthropod vectors of virus and mycoplasma diseases of plants in India. *Colemania*. 2: 19-38.
- Rao V R S, Singh J P and Sudhakar T R 2000** Leafhoppers fauna associated with rice and sugarcane crop ecosystems of Telangana region in Andhra Pradesh. *Indian Journal of Entomology*. 62 (1): 43-52.
- Shashank P R 2009** Taxonomic studies on leafhopper and planthopper fauna associated with rice ecosystem and their management. *M.Sc. (Ag.) thesis*. Acharya N G Ranga Agricultural University, Lam, Guntur.
- Viraktamath C A 1983** Genera to be revised on a priority basis. In *proceedings of the first international workshop on leafhoppers and plant hoppers of economic importance*, W J Knight, N C Pant, T S Robertson and Wilson M R (Eds.). Common Wealth Institute of Entomology, London. 471-492.
- Viraktamath C A 2005** key to the subfamilies and tribes of leafhoppers (Hemiptera: Cicadellidae) of the Indian subcontinent. *Bionotes*. 7(1): 20-24.
- Wilson M R and Claridge M F 1991** Handbook for identification of leafhopper and palnthoppers of rice. *CAB International, Wallingford. Oxon, U.K.* 142.