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# BIODIVERSITY OF PLANTHOPPER FAUNA (DELPHACIDAE: HEMIPTERA) ASSOCIATED WITH RICE AND SUGARCANE CROP-ECOSYSTEMS IN SOUTH INDIA.*

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**ABSTRACT:** The biodiversity of planthoppers of the family Delphacidae (Fulgoroidea : Hemiptera) associated with graminaceous crops, Rice (*Oryza sativa* L) and Sugarcane (*Saccharam officinarum* L) from five states of South India *viz.*, Andhra Pradesh, Tamilnadu, Karnataka, Maharastra and Kerala was studied and 23 planthoppers species of 17 genera were identified. The biodiversity of these delphacids associated with rice and sugarcane ecosystems in different states are discussed. The species *viz., Coronacella sinhalana* (Kirkaldy); *Euidella* sp.; *Harmalia* sp.; *Latistria* sp. *Opiconsiva* sp.; *Perkinsiella sinensis* Kirkaldy; *Perkinsiella* sp.; *Stenocranus* sp.; *Toya bridwelli* (Muir); *Toya propinqua* (Fieber), *Toya* sp. and *Tropidocephala* sp. are recorded for the first time in India. As per the checklist prepared, 47 delphacids are reported so far from India including these 12 species reported for the first time from India. The planthoppers viz., *Nilaparvata lugens*(Stal), *Sogatella furcifera*(Horvath), *S.Kolophon*(Kirkaldy), *Cemus* sp., *Sardia* sp. and *Tagosodes pusanus*(Distant) are distributed in all the states of South India. Among these planthoppers, *Nilaparvata lugens* population is dominant in rice ecosystems of Karnataka and Kerala, whereas *Sogatella furcifera* population is dominant in Andhra Pradesh, Maharastra and Tamilnadu. These two species are the major pests in all rice growing tracts of South India and the remaining species are not at pest status and may be casual visitors from the weeds of a particular crop ecosystem or from neighbouring crops. In sugarcane ecosystems, *Sogatella furcifera(Stal), S. kolophon(Horvath), Perkinsiella sinensis* Kirkaldy, *Peregrinus maidis*(Ashmead), *Tagosodes pusanus(Distant)* and *Toya propinqua* (Fieber) are present in all the states of South India except Kerala, where the sugarcane growing area is very less and none of them are at pest status. The computerized Key for the identification of South Indian Delphacidae associated with rice and sugarcane ecosystems is developed which is very much useful to the Entomologists to identify the planthoppers in a particular crop-ecosystem in case of pest outbreaks.

**Key words:** Fulgoroidea, Delphacidae, Planthoppers, Rice, Sugarcane

## INTRODUCTION

Planthoppers belong to the superfamily Fulgoroidea of Auchenorrhynchous- Hemiptera comprising of 20 families and the economically important planthoppers are found in the family Delphacidae. The Delphacidae is the largest family of planthoppers and there are about 1835 species which includes 55 species recorded as pests of 25 plants. Delphacids also serve as insect vectors transmitting various plant diseases which include 9 virus vectors of rice, 3 of sugarcane, 1 of taro, 2 of coconut palms, 7 of maize and 9 of cereals (Wilson and O'Brien, 1987). Delphacid's are small, elongate, subcylindrical or laterally or dorso ventrally flattened, generally bear the antennae beneath the compound eyes; usually have tegulae; a Y-shaped vein in the clavus of forewing and hind tibia bear mobile apical spur at the apex. They are phytophagous and more commonly feed on plants by sucking the sap and there by devitalizing the plants.

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## MATERIALS AND METHODS

The palnthoppers were collected from the rice and sugarcane crop-ecosystems from five different states of South India *viz.*, Andhra Pradesh, Tamilnadu, Karnataka, Maharastra and Kerala by following sweeping method with the help of an insect collection net. About 10 – 15 to and fro net sweepings were done each time and the planthoppers collected were aspirated, killed with ethyl acetate swab, transferred to homeopathic vials labeled and dried in an oven at 45 – 50 $^{0}$C for 5 – 6 hours. For mounting and preparing the slides of genitalia, the procedure suggested by Knight (1965) for leafhoppers and the terminology advocated by O'Brein and Wilson (1985) are followed to describe the different body parts of a planthopper.

## RESULTS AND DISCUSSION

A total of 23 planthopper species belonging to 17 genera were identified and biodiversity of all these planthoppers associated with Rice and Sugarcane crop-ecosystems in South India is provided in table -1. The species *viz., Coronacella sinhalana* (Kirkaldy); *Euidella* sp.; *Harmalia* sp.; *Latistria* sp. *Opiconsiva* sp.; *Perkinsiella sinensis* Kirkaldy; *Perkinsiella* sp.; *Stenocranus* sp.; *Toya birdwelli* (Muir); *Toya propinqua* (Fieber); *Toya* sp. and *Tropidocepahla* sp. were recorded for the first time in India.

## DIAGNOSIS OF THE SPECIES

The family Delphacidae is characterised by the presence of a movable apical spur on hind tibia. This character helps in distinguishing delphacids from other related families like Cixiidae, Menopolidae, Lophopidae, Tropiduchidae *etc.* The most important external diagnostic features for these planthopper species are provided here under.

1. ***Nilaparvata lugens*** **(Stal) :**

*Nilaparvata lugens* (Stal). Okada,1977: 3; Wilson and Claridge, 1991: 49
Synonyms: *Delfax lugens* Stal., *Liburnia greeni* Motschulsky, *Nilaparvata greeni* Distant, *Kalpa aculeata* Distant, *Delphax oryzae* Matsumura, *Delphax ordovix* Kirkaldy, *Delphax parysatis* Kirkaldy, *Dicranotropis anderida* Kirkaldy, *Hikona formosana* Matsumura.

Length/ width : Macropterous male 3.7- 4.15 / 0.9 – 1.0 mm; Macropterous female 4.45 – 4.60 / 1.25 – 1.35 mm; Brachypterous male 2.1 – 2.15 / 0.75 – 0.80 mm; Brachypterous female 2.1 – 2.4 / 0.85 – 1.05 mm. Yellowish brown or dark brown in colour with eyes slightly bluish. One or more lateral spines present on the basal segment of hind tarsus.Tegmina with a pterostigma.

2. ***Sogatella furcifera*** **(Horvath) :**

*Sogatella furcifera* (Horvath). Asche and Wilson,1990: 9; Wilson and Claridge, 1991 :56
Synonyms: *Delphax furcifera* Horvath, *Sogata distincta* Distant, *Sogata pallescens* Distant, *Sogata kyusyuensis* Matsumura and Ishihara, *Sogata tandojamensis* Qadri and Mirza

Length/ width : Macropterous male 3.2- 3.60 / 0.80 – 0.90 mm; Macropterous female 3.40 – 3.85 / 0.80 – 1.05 mm. The body is black dorsally, creamy white ventrally with a distinct yellowish white longitudinal band in both males and females and hence the name white backed planthopper. Face with frons, clypeus and genae dark brown. Tegmina with a pterostigma.

**3. *Sogatella kolophon* (Kirkaldy) :**

*Sogatella kolophon* (Kirkaldy). Asche and Wilson, 1990 :16; Wilson and Claridge , 1991: 58

Synonyms: Delphax kolophon Kirkaldy, Opiconsiva insularis Distant, Opiconsiva derelicta Distant, Sogatella kolophon atlantica Fennah, Sogatella kolophon insularis Fennah, Sogata meridiana Beamer, Sogatella kolophon meridiana Fennah, Opiconsiva balteata Distant, Sogatella belateata Fennah, Sogatella deralicta Fennah, Sogatella chenchea Kuoh, Delphacodes eleganteissima Fennah, Sogatella nebris Fennah.

Length/ width : Macropterous male 2.70- 3.00 / 0.60 – 0.70 mm; Macropterous female 3.00 – 3.90 / 0.75 – 1.00 mm; Vertex and pronotum light yellowish to pale stramineous in colour. Face with frons, clypeus and genae entirely pale yellowish brown in colour. Tegmina without a pterostigma.

**4. *Sogatella vibix* (Haupt) :**

*Sogatella vibix* (Haupt). Asche and Wilson,1990 : 22; Wilson and Claridge , 1991: 62

Synonyms: *Liburnia vibix* Haupt, *Sogatella suezensis* Linnavuori, *Sogatella catoptron* Fennah, *Sogatella diachenhea* Kuoh, *Delphacodes dogensis* Ishihara, *Delphacodes longifurcifera* Esaki and Ishihara, *Delphacodes panicicola* Ishihara, *Sogatella longiurcifera* Fennah, *Sogatella pancicola* Fennah, *Liburnia matsumurana* Metcalf, *Sogatella matsumurana* Nast, *Sogatella parakolophon* Linnavuori.

Length/ width : Macropterous male 2.75 - 3.35 / 0.65-0.85 mm; Vertex yellowish white, blackish, beyond mid lateral carina. Face with frons and clypeus pale yellowish brown in colour, but genae dark brown in colour. Tegmina without pterostigma.

**5. *Cemus* sp. :**

*Cemus Fennah,1964;* Wilson and Claridge 1991: 70
Type species : *Cemus leviculus* Fennah

Length/ width : Macropterous male 3.50 - 4.05 / 0.90 – 1.10 mm; Macropterous female 3.75 – 4.55 / 1.00 – 1.20 mm; Vertex, pronotum reddish-black with carinae cream colour. Vertex very short and broad between eyes. Tegmina with characteristic black dots along veins, fuscous streaks apically with a distinct pterostigma. Frons with conspicuous raised pits on either side of the median carina.

**6. *Coronacella sinhalana* (Kirkaldy) :**

*Coronacella sinhalana* (Kirkaldy) Wilson and Claridge 1991:73.
Synonyms: *Liburnia frontalis* Melichar, *Delphacodes sinhalana* Kirkaldy, *Kelisia kirkaldyi* Muir

Length/ width : Macropterous male 2.95- 3.15 / 0.65 – 0.75 mm; Macropterous female 3.20 – 3.25 / 0.75 – 0.80 mm; A characteristic cream coloured band is present on pronotum. The outer carinae of frons and tip of the scutellum are cream coloured.This species superficially resembles *Laodelphaux striatellus*. However, in *C. sinhalana* the central carina of the face is black, and the first antennal segment dark pigmented. Head nearly as broad as pronotum. Tegmina with pterostigma.

**7. *Euidella* sp. :**

Euidella Puton, 1886 Hemiptera Fauna Paleartiqua 3 ed. : 72.

Length/ width : Macropteryous male 3.90 - 4.20 / 0.75 – 0.95 mm; Vertex slightly produced in front of eyes. Legs fairly long and slender, hind basal tarsi distinctly longer than the other two segments together. Tegmina with pterostigma.

**8. *Harmalia* sp.:**
*Harmalia Fennah, 1969;* Wilson and Claridge 199: 66
Synonyms: *Sogata thoracica* Distant

Length/ width : Macropterous male 3.05- 3.10 / 0.70 mm; Body is light brown in colour. Vertex very short, broad and excavated between eyes. Tegmina more or less uniformly pale brown without pterostigma.

**9. *Latistria* sp.**

*Latistria* Huang et al.,1980: 166; Vertex, pronotum and scutellum are green in colour. Pterostigma is present on tegmina.

**10. *Opiconsiva* sp.**

*Opiconsiva* Distant, 1917 (17):301; Wilson and Claridge 1991:73
Synonyms: *Opiconsiva fuscovaria* Distant

Length/ width : Macropterous male 2.55- 3.00 / 0.50 – 0.65 mm; Macropterous female 2.70 / 0.70 mm; Stramineous in colour. Head is shorter than the pronotum. Mesonotum and scutellum are shiny black in colour. Pterostigma is present.

**11. *Peregrinus maidis* (Ashmead) :**

*Peregrinus maidis* (Ashmead). Wilson and Claridge, 1991: 70.
Synonyms: *Delphax maides* Ashmead,

Length/ width : Macropterous male 3.60- 4.0 / 0.65 – 0.75 mm; Macropterous female 4.0 – 4.30 / 0.75 – 0.85 mm; Head narrower than pronotum. Vertex short and broad. Vertex, pronotum and mesonotum with longitudinal orange or pale cream coloured band. Hind tibial spur with numerous minute teeth. Pterostigma is present.

**12. *Perkinsiella sinensis* Kirkaldy :**

*Perkinsiella sinensis* Kirkaldy, 1903(36) : 179.

Length / width : Macropterous male 3.60- 5.0 / 0.70 – 1.0 mm; Macropterous female 3.75 – 4.35 / 0.70 – 0.85 mm; Brownish black in colour with vertex, pronotum and scutellum are yellowish . Vertex is broader and more or less equal to its length. Wings are brownish in colour, veins granulate and pterostigma present.

**13. *Perkinsiella* sp. :**

*Perkinsiella* Kirkaldy, 1903 (36):179.

Length/ width : Macropterous male 3.90 – 5.0 / 0.75 – 0.85 mm; Macropterous female 4.65 – 5.15 / 0.90 – 0.95 mm; This species much darker than the above species. Vertex, pronotum and scutellum are yellowish. Wings are brownish, veins granulate and pterostigma present.

**14. *Purohita* sp. :**

*Purohita* Distant, 1906:470.

Length/ width : Macropterous male 3.75 / 0.60 mm; Stramineous in colour .Head narrower than pronotum, vertex very narrow, excavated with lateral carinae distinctly raised. Antennae inserted in a groove underneath the eyes, flattened, first segment is very long and broad, second segment is half of the length of the first, thickened but much narrower and hairy. Tegmina longer than the abdomen thickened and granulate. Pterostigma present but not distinct.

**15. *Sardia* sp. :**

*Sardia* Melicher, 1903 : 96; Wilson and Claridge, 1991: 72.
Synonyms: *Sardia rostrata* Melicher

Length/ width : Macropterous male 3.40 – 3.65 / 0.60 – 0.70 mm; Macropterous female 3.75 – 4.40 / 0.65 – 0.95 mm; The over all coloration of vertex, thorax, tegmina dark brown with black fuscous markings. Vertex narrow, elongated and produced anteroirly between larger compound eyes. Tegmina dark brown with pterostigma and fuscus apically.

**16. *Stenocranus* sp. :**

*Stenocranus* Fieber, 1866(16):519.
Synonyms: *Stenocranus minutus* Oshanin,

Length/ width : Macropterous male 4.20 – 4.50 / 0.70 – 0.75 mm; Macropterous female 4.70 – 4.90 / 0.70 – 0.75 mm; Stramineous in colour, vertex elongated. Head is narrower than pronotum and vertex slightly produced between the eyes.Lateral carina on vertex and frons are prominently raised with black stripe. Tegmina stramineous in colour, veins darker without pterostigma.

**17. *Tagosodes pusanus* (Distant) :**

*Tagosodes pusanus* (Distant). Wilson and Claridge, 1991 : 63. comb. n.
Synonyms: *Sogata pusana* Distant, *Kelisia fieberi* Muir, *Unkana formosella* Matsumura, *Sogata striatus* Quadri and Mirza, *Himeunka chibana* Tran and Kuoh, *Sogatodes assimilis* Yang

Length/ width : Macropteryous male 2.75 – 3.25 / 0.60 – 0.65 mm; Macropteryous female 3.10 – 3.35 / 0.60 – 0.70 mm; It resembles *S.furcifera* but can be distinguished by the pattern of the dark markings of the tegmina and male genitalia .Tegmina with pterostigma and fuscus apically.

**18. *Terthron albovittatum* (Matsumura) :**

*Terthron albovittatum* (Matsumura). Wilson and Claridge, 1991: 69
Synonyms: *Dicranotropis albovittata* Matsumura, *Delphacodes albovittata* (Matsumura), *Liburnia albovittata* (Matsumura), *Sogata albovittata* (Matsumura)

Length/ width : Macropterous male 2.65 / 0.70 – 0.76 mm; Dark brown with cream colour dorsal median stripe extending from vertex to apex of mesonotum. Frons, clypeus, genae dark brown in colour with cream coloured lateral and median carinae. Tegmina without pterostigma.

**19. *Toya bridwelli* (Muir):**

Ochraceous in colour, Head slightly narrower than pronotum.

**20. *Toya propinqua* (Fieber) :**

*Toya propinqua* (Fieber). Wilson and Claridge .1991: 76
Synonym: *Delphax propinqua* Fieber

Length/ width: Macropterous male 2.60 – 3.05 / 0.60 – 0.65 mm; Macropterous female 2.70 – 3.05 / 0.60 – 0.75 mm; Stramineous in colour, Head slightly narrower than pronotum, tegmina light stramineous in colour, veins darker without pterostigma or if present not so distinct.

**21. *Toya sp.:***

Toya *Distant, 1906 (3): 42.*
Synonym: *Toya attenuata* Distant

This species externally similar to the remaining two species but it can be distinguished by shape of the aedeagus which is broader basally and slightly curved with sub apical teeth like projections. The shape of the diaphragm is as shown in figure.

**22. *Tropidocephala serendiba* (Distant) :**

*Orchesma serendiba* Melicher,1903 :95.
Synonym: *Orchesma serendiba* Melicher, *Orchesma signata* Distant

Length/ width : Macropterous male 3.75 – 4.20 / 0.75 – 0.85 mm; Macropterous female 3.80 – 4.0 / 0.70 – 0.85 mm; The median and lateral carinae on vertex , pronotum and mesonotum are very much prominent. Vertex slightly produced between the eyes anteriorly with raised lateral carinae. Median carinae cream colour bordered with black, frons tricarinate, raised and pinkish in colour. Tegmina longer than abdomen, veins granulate with black coloured maculae near clavus and pterostigma is present.

**23. *Tropidocephala* sp. :**

*Tropidocephala* Stal,1853(10):266.

Length/ width : Macropterous male 2.85 – 3.10/ 0.55 – 0.60 mm; Macropterous female 3.25 / 0.60 mm; Chocolate brown in colour. Vertex, pronotum and scutellum are cream coloured with a green tinge on pronotum. Claval margin of tegmina are cream coloured with pterostigma.

The planthoppers *viz., Nilaparvata lugens, Sogatella furcifera, S.kolophon, Cemus sp., Sardia sp.,* and *Tagosodes pusanus,* are distributed in all the states *viz.,* Andhra Pradesh, Karnataka, Maharastra, Tamilnadu and Kerala. A detailed look in to the planthopper fauna of Rice in the entire south India yielded that species belonging to two genera *viz., Nilaparvata* and *Sogatella* were predominantly found in rice-ecosystems. Among these planthoppers, *N.lugens* population is dominant in rice ecosystems of Karnataka and Kerala, whereas *Sogatella furcifera* population is dominant in Andhra Pradesh, Maharastra and Tamilnadu. These two species are the major pests in all the rice growing tracts of South India. Other species belonging to Genus *Sogatella viz., kolophon and vibix* were found in a minor proportion. In sugarcane ecosystems, *Sogatella furcifera, S.kolophon, Perkinsiella sinensis, Peregrinus maidis, Tagosodes pusanus* and *Toya propinqua* are reported in South India. The remaining species reported in the present studies are not at pest status and may be casual visitors from the weeds of a particular crop ecosystem or from neighbouring crops.

Wilson and Claridge (1991) reported 25 delphacids on rice in major rice growing areas in the world. Wilson and O'Brien (1987) reported 22 delphacids on rice and 16 on sugarcane. Okada (1977) reported 20 species of delphacids on rice as pests in Japan. Gunathilagaraj (1999), Ishihara and Lowe (1969), Kalode (1983), Misra (1980) reported 9 delphacids *viz., Nilaparvata lugens* (Stal), *N.bakeri* (Muir), *Sogatella furcifera* (Horvath), *S.vibix* (Haupt), *Laodelphax striatellus* (Fallen), *Euidellana celadon* Fennah, *Sardia rostrata* Melichar, *Tagosodes pusanus* (Distant) and *Unkanodes sapporonus* (Matsumura) associated with rice from India. Lakshminarayana *et al.* (2005) reported seven delphacid-planthopper species Viz., *Sogatella kolophon* (Kirkaldy), *Sogatella vibix* (Haupt), *Tagasodes pusanus* (Distant), *Tethron albovittatum* (Matsumura), *Toya propinqua* (Fieber), *Harmalia anacharsis* (Fennah), and *Cemus* sp. associated with different rice ecosystems

for the first time from Andhra Pradesh. In the present investigations, 23 species are identified and 12 species are reported for the first time in India. The total number of planthopper species in India is 47.

**Table 1- Biodiversity of planthopper fauna (Delphacidae : Hemiptera) of Rice and Sugarcane crop-ecosystems in South India**

| S. No. | Name of the Species | Distribution | Associated Crop-ecosystems |
|---|---|---|---|
| 1 | *Nilaparvata lugens* (Stal) | Andhra Pradesh, Karnataka, Kerala | Rice |
| | | Maharastra and Tamilnadu | Rice and Sugarcane |
| 2. | *Sogatella furcifera* (Horvath) | Kerala | Rice |
| | | Andhra Pradesh, Karnataka, Maharastra and Tamilnadu | Rice and Sugarcane |
| 3. | *S. kolophon* (Kirkaldy) | Kerala | Rice |
| | | Andhra Pradesh, Karnataka, Maharastra and Tamilnadu | Rice and Sugarcane |
| 4. | *S. vibix* (Haupt) | Andhra Pradesh, Maharastra and Tamilnadu | Rice |
| | | Karnataka | Rice and Sugarcane |
| 5. | *Cemus* sp. | Andhra Pradesh and Kerala | Rice |
| | | Karnataka, Maharastra and Tamilnadu | Rice and Sugarcane |
| 6. | *Coronacella sinhalana* (Kirkaldy) | Karnataka | Rice |
| 7. | *Euidella* sp. | Karnataka and Maharastra | Rice |
| 8. | *Harmalia* sp. | Andhra Pradesh and Karnataka | Rice |
| | | Tamilnadu | Rice and Sugarcane |
| 9. | *Latistria* sp. | Karnataka | Rice |
| 10. | *Opiconsiva* Sp. | Karnataka and Maharastra | Rice |
| | | Tamilnadu | Rice and Sugarcane |
| 11. | *Perigrinus maidis* (Ashmead) | Andhra Pradesh | Sugarcane |
| | | Karnataka and Maharastra | Rice and Sugarcane |
| 12. | *Perkinsiella sinensis* Kirkaldy | Andhra Pradesh and Maharastra | Rice and Sugarcane |
| | | Tamilnadu | Sugarcane |
| 13. | *Perkinsiella* sp. | Tamilnadu | Rice |
| 14 | *Purohita* sp. | Maharastra | Sugarcane |
| 15. | *Sardia* sp. | Maharastra, Andhra Pradesh, Karnataka and Kerala | Rice |
| | | Tamilnadu | Rice and Sugarcane |
| 16 | *Stenocranus* sp. | Tamilnadu | Sugarcane |
| 17. | *Tagosodes pusans* (Distant) | Andhra Pradesh, Karnataka, Maharastra and Tamilnadu | Rice and Sugarcane |
| | | Kerala | Rice |
| 18. | *Tethron albovittatum* (Matsumura) | Andhra Pradesh | Rice |
| 19. | *Toya bridwelli* (Muir) | Tamilnadu | Rice |
| 20. | *Toya propinqua* (Fieber) | Maharastra, Andhra Pradesh, Karnataka and Tamilnadu | Rice and Sugarcane |
| 21. | *Toya* sp. | Tamilnadu | Rice |
| 22. | *Tropidocephala serendiba* (Melichar) | Karnataka and Tamilnadu | Sugarcane |
| 23. | *Tropidocephala* sp. | Karnataka and Tamilnadu | Sugarcane |
| | | Maharastra | Rice and Sugarcane |

## KEY TO THE PLANTHOPPER SPECIES

The key for distinguishing these species along with illustrations is given as under. The key is based on male specimens only, because the male genetalia usually provides authentic identification features in planthoppers. The key has been prepared to aid rapid and accurate identification of the common species of planthopper species in rice and sugarcane ecosystems of South India. However, there will be occasions the species which are not studied here may come across and for those species consult the literature or a Systematist who has been working on planthoppers.

1. Hind basal tarsal segment with one or more lateral spines. Aedeagus slender, broader medially, tapering apically and apex upturned (Figs. 1 & 2)..... ***Nilaparvata lugens*** **(Stal)**

— Hind basal tarsal segment without lateral spines ..... 2

2 (1) Vertex and mesonotum with a distinct pale yellow or orange or white stripe extending from head.....3

— Vertex and mesonotum without a distinct pale yellow or orange or white stripe extending from head .....11

3 (2) Aedeagus twisted with two or three rows of small teeth (Figs. 3, 6, 8 and 17) ..... 4

— Aedeagus not twisted without two or three rows of small teeth..... .....7

4 (3) Aedeagus with 3 rows of small teeth; genital styles are sclerotised (Figs. 17 & 18) ..... ***Latistria*** **sp.**

— Aedeagus with 2 rows of small teeth and tapering to apex; genital styles are not sclerotised (Figs.3, 4, 5, 6, 7 and 8) .....5

5 (4) Tegmina with pterostigma; face with frons, clypeus, genae dark brown; genital styles dilated at base, apex relatively small and almost equally bifurcated (Fig. 4) ..... .....***Sogatella furcifera*** **(Horvath)**

— Tegmina without pterostigma; face with frons, clypeus, genae not entirely dark brown; genital styles are not as above.....6

6 (5) Face with frons, clypeus, genae entirely pale yellowish brown in colour; genital styles flattened bifurcated with inner process very short and outer process long and gradually tapering to apex (Fig. 5).....***Sogatella kolophon*** **(Kirkaldy)**

— Face with frons, clypeus pale yellowish brown but genae dark brown in colour ; genital styles have the outer process of apical bifurcation dilating from the base of middle then tapering to apex with dorsal margin forming a blunt angle (Fig. 7) .....***Sogatella vibix*** **(Haupt)**

7 (3) Aedeagus tubular with a few small teeth like projections subapically.....8

— Aedeagus not tubular and not as above .. .....9

8 (7) Aedeagus tubular and deeply curved; tegmina without pterostigma (Fig. 34) ..... ..... .....***Te. hron albovittatum*** **(Matsumura)**

— Aedeagus basally wider, gradually narrowed; tegmina with pterostigma (Fig. 33) ..... .....***Tagosodes pusanus*** **(Distant)**

9 (7) Aedaegus whip like, slender and elongated with four unequal processes subapically (Fig. 21).....***Peregrinus maidis*** **(Ashmead)**

— Aedaegus not as above ..... 10

10 (9) Anal tube process short not longer than its length; aedeagus with a small subapical spine and a pair of process medially (Figs. 22, 23, 24 and 25) ..... ***Perkinsiella sinensis*** **Kirkaldy**

— Anal tube process longer than its length; aedeagus elongated, curved with a pair unequal processes apically (Figs. 26 and 27) ..... ***Perkinsiella*** **sp.**

11 (2) Vertex narrow , elongated between larger eyes; tegmina dark brown in colour with pterostigma. Aedeagus more or less straight tubular with sub apical serration and gonopore apical (Fig. 30.)..... ***Sardia*** **sp.**

— Vertex short and not so elongated ..... 12

12 (11) Anal tube processes absent (Figs. 39 and 42) ..... 13

— Anal tube processes present (Figs. 9 and 11)..... 14

13 (12) Anal style is elongated and longer than the anal segment; genital style with sclerotised serrated processes. Aedeagus broader basally and gradually narrowed towards apex and aedeagal process sickle shaped, arises from base of the aedeagus. (Fig. 39, 40 and 41) ..... ***Tropidocephala serendiba*** **( Melichar)**

— Anal style not longer than the anal segment; genital style with two unequal sclerotised processes. Aedeagus broader basally gradually narrowed towards apex with an aedeagal process arising basally (Fig. 42, 43 and 44)..... ***Tropidocephala*** **sp.**

14 (12) Frons with conspicuous raised pits on either side of median carina; tegmina granulate along the veins and fuscus apically. Aedeagus elongated, curved with a pair of processes apically. (Figs. 9 & 10.).. ..... ***Cemus*** **sp.**

— Frons without conspicuous raised pits on either side of median carina; tegmina not granulate ..... 15

15 (14) Vertex and mesonotum dark brown with a characteristic cream coloured band on pronotum. Aedeagus is tubular with small teeth near apex (Figs. 11 & 12.) ..... ..... ..... ..... ..... ***Coronacella sinhalana*** **(Kirkaldy)**

— Vertex and mesonotum dark brown without a characteristic cream coloured band on pronotum ..... 16

16 (15) Aedeagus flattened, curved with a pair of long unequal subapical processes ; genital style L-shaped (Figs. 13 and 14) ..... ***Euidella*** **sp.**

— Aedeagus and genital styles are not as above ..... 17

17 (16) Antennae flattened, first segment is very long and broader than the remaining segments; posteroventral margin of pygofer 4 lobed and anal tube process very long, curved and directed ventrally (Figs. 28 & 29.)..... ***Purohita*** **sp.**

— Antennae and pygofer are not as above ..... 18

18 (17) Anal segment processes are fused throughout the length with distal bifurcation or single anal tube process with distal bifurcation (Figs. 31 & 32). Aedeagus with a process which is basally wider and abruptly narrowed apically. ..... ***Stenocranus*** **sp.**

— Anal segment process is not as above ..... 19

19 (18) Aedeagus tubular with dorsal basal extensions; diaphragm cone shaped and sclerotised (Figs. 19 and 20) ..... ***Opiconsiva*** **sp.**

— Aedeagus tubular without dorsal basal extensions; diaphragm not as above..... 20

20 (19 ) Aedeagus tubular with uniform width throughout and without any teeth; genital style bifurcated distally (Figs. 15 and 16)..... ***Harmalia* sp.**

— Aedeagus tubular but not with uniform width and with a few teeth like projections (Figs. 35, 36 and 37).....21

21 (20) Aedeagus bulged with a row of small teeth ascending from ventro dorsal to apex on both sides (Fig. 35)..... ***Toya bridwelli* (Muir)**

— Aedeagus not so bulged and teeth not as above (Figs. 36 and 37)..... .....22

22 (21) Diaphragm Y-shaped; aedeagus tubular slightly narrower apically with a few teeth subapically (Fig. 36) ..... ***Toya propinqua* (Fieber)**

— Diaphragm not as above; aedeagus broader basally and slightly curved and narrowed apically with subapical teeth (Figs. 37 and 38) ..... ***Toya* sp.**

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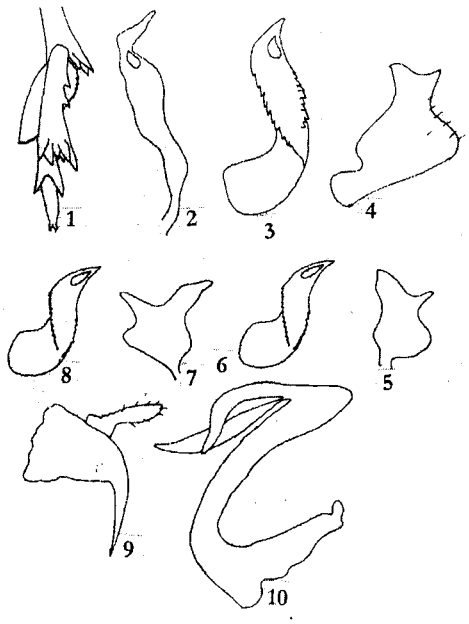
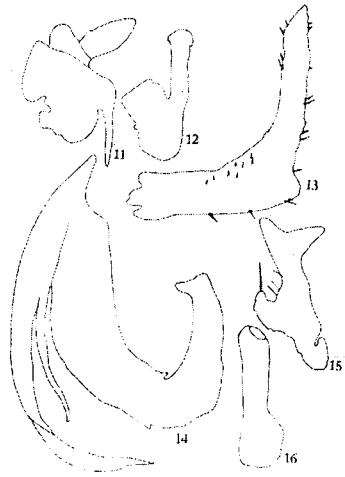
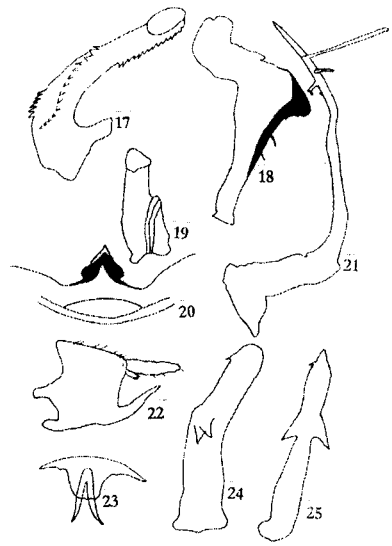


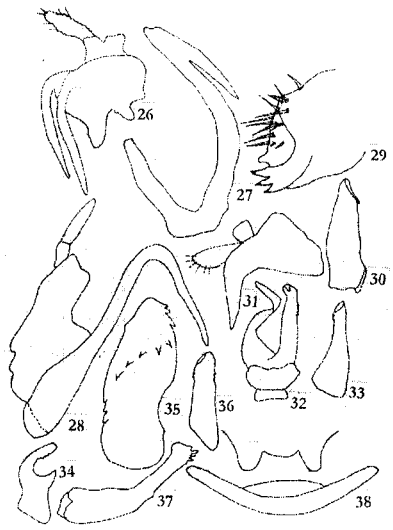

**Figs. 1-10:** *Nilaparvata lugens (Stal)* :1. Hind leg – tibia and Tarsus; 2. Aedeagus, lateral view; *Sogatella furcifera* (Horvath): 3. Aedeagus, lateral view; 4. Style *S. kolophon* (Kirkaldy) : 5. Style, 6.Aedeagus, lateral view; *S. vibix* (Haupt) : 7. Style, 8. Aedeagus, lateral view; *Cemus* sp. : 9. Anal Tube; 10. Aedeagus, lateral view



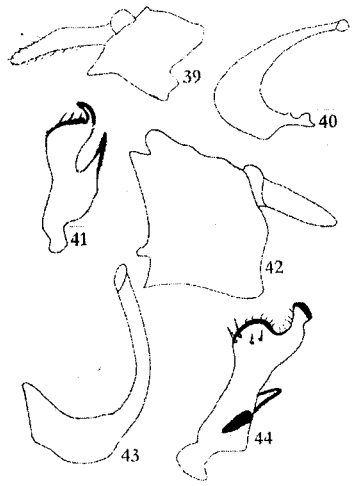

**Figs. 11-16 :** *Coronacella sinhalana* (Kirkaldy): 11.Anal Tube; 12. Aedeagus, lateral view *Euidella* sp. : 13. Style; 14. Aedeagus, lateral view;*Harmalia* sp. : 15. Style; 16. Aedeagus, lateral view




**Figs. 17- 25 :** *Latistria* sp. :17. Aedeagus, lateral view; 18. Style; *Opiconsiva* sp. : 19. Aedeagus, lateral view; 20. Diaphragm; *Perigrinus maidis* (Ashmead) **:** 21. Aedeagus, lateral view; *Perkinsiella sinensis* Kirkaldy : 22 & 23. Anal Tube (Different Orientations); 24 & 25. Aedeagus (Different Orientations)




**Figs. 26 – 38 :** *Perkinsiella* sp. :26. Anal Tube; 27. Aedeagus, lateral view; *Purohita* sp. 28. : Anal tube, lateral view; 29. Pygofer lobe; *Sardia* sp. :30. Aedeagus, lateral view; *Stenocranus* sp. : 31. Anal Tube; 32. Aedeagus, lateral view; *Tagosodes pusans* (Distant) : 33. Aedeagus, lateral view; *Tethron albovittatum* (Matsumura) : 34. Aedeagus, lateral view; *Toya bridwelli* (Muir) : 35. Aedeagus, lateral view; *Toya propinqua* (Fieber) : 36. Aedeagus, lateral view; *Toya* sp. : 37. Aedeagus, lateral view; 38. Diaphragm




**Figs.39 - 44 :** *Tropidocephala serendiba* (Melichar) : 39. Anal Tube; 40. Aedeagus, lateral view; 41. Style. *Tropidocephala* sp. : 42. Anal Tube; 43. Aedeagus, lateral view; 44. Style.