COMMON AUCHENORRHYNCHA (Homoptera) IN RICE FIELDS IN SOUTH EAST ASIA

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1981

MINISTRY OF AGRICULTURE
MALAYSIA

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Introduction

Leaf and planthoppers are common insects in rice fields. This paper provides keys to some commonly occurring Auchenorrhyncha in rice fields in South East Asia. The specimens studied were taken from light trap-, sweep net-and suction-samples, from the Philippines, Indonesia, West Malaysia and Sarawak (East Malaysia). It should be emphasised that though taken from rice fields, it is not certain that all species included are necessarily rice feeders. Keys for the separation of the immature stages and sexes (from the third instar onwards) of the families Delphacidae and Cicadellidae are included. These are based on *Nilaparvata lugens* (Stål) and *Nephotettix virescens* (Distant) respectively.

A section on parasitized Auchenorrhyncha has been included, since the host species undergo considerable morphological changes when parasitized by Strepsiptera. This is much less marked when the parasites are either Dryinidae or Pipunculidae.

All drawings were made with the aid of a squared eye piece and binocular microscope.

Glossary of Terminology and List of Abbreviations.

aedaeagus	–	distal portion of median intromittent organ of male used for transference of sperm to female (fig. 8B, F; 14B; 16E; 17D). ae.
anteclypeus	–	triangular sclerite lying below the post-clypeus (Fig. 10B) as in the Delphacidae, or below the frontoclypeus (Fig. 16B) as in the Cicadellidae. an.cl.
apical cells	–	cells at the outer margin of wing (Fig. 9F). ap.
carina	–	elevated ridge or keel (Fig. 7A, B; 8D). c., m.c, l.c.
clavus	–	proximal, posterior portion of forewing (on anal area lying next to scutellum when folded (Fig. 14A). cla.
clypeus	–	median swollen region on face lying ventral to frons which can be divided into post-and anteclypeus, as in the Delphacidae (Fig. 9H), p.cl, an.cl; or into the fronto - and anteclypeus, as in the Cicadellidae (Fig. 16B). fc. an.cl.
corium	–	proximal anterior hardened portion of forewing, (Fig. 14A). co.
face	–	front part of the head between the compound eyes above the probosis to the margin of the vertex (Fig.10B; 16B).
frons	–	Upper anterior portion of head which is usually a distinct sclerite between the epicranium and clypeus, but in the Auchenorrhyncha it is not definitely marked off from the epicranial suture. In the Delphacidae it is the region above the postclypeus to the vertex, and laterally it has the lateral carinae (Fig. 8I). fr. In the Cicadellidae it merges with the clypeus to form the frontoclypeus, which is above the anteclypeus, to the vertex (Fig 16B). fc.
frontoclypeus	–	In the Cicadellidae the frons merges with the clypeus to form the frontoclypeus which is the sclerite above the anteclypeus up to the vertex (Fig. 16B). fc. In the Delphacidae there are two distinct sclerities – postclypeus and frons (Fig. 9D, H). p.cl., fr.
genital plates	–	posterior ventral paired plates in the ninth segment of an adult male Cicadellidae (Fig. 14B). gp. Not present in Delphacidae.
genital valve	–	triangular plate (IX sternum) lying in front of the genital plates in an adult male Cicadellidae (Fig. 14B). gv. Not present in Delphacidae.
gonapophysis	–	median processes of abdominal segment VIII & IX (Scudder, 1961), used for ovipositing. Termed first and second valvulae by some authors, (e.g. Snodgrass, 1963).
gonoplac	–	posterior outgrowth of abdominal segment IX forming part of, or a sheath for, the ovipositor, (Fig. 8C). go.p. Third valvula of some authors, (Snodgrass, 1963)
gonocoxa I	–	sclerotized area which appears laterally to the base of the first gonopophysis and is connected to it, (Scudder, 1961) Fig. 8C, G). lgo. First valvifers of some authors, (e.g. Snodgrass, 1963)
labium	–	probosis, (Fig. 8I; 16B); la.
mesonotum	–	upper surface of second thoracic segment, (Fig. 7A; 16A). me.
parameres	–	paired structures in the ninth abdominal segment lying on either side of the aedeagus, (Fig. 8B; 16D; 17C). pa.

postclypeus	–	posterior or upper part of clypeus in Delphacidae (Fig. 9H). p.cl. In the Cicadellidae it is not a distinct sclerite.
pterostigma	–	conspicuous spot on the costal margin of forewing (Fig. 8H; 9F). pt.
pygofer	–	ninth abdominal segment (Fig. 8E). py.
scutellum	–	triangular part of mesothorax generally placed between the bases of the hemelytra (Fig. 10A; 15A). scu.
sensoria	–	circular pits covered by membrance on antennae or legs (Fig. 2E). se.
subgenital plate	–	posterior ventral plate which is united to the ninth sternum in in nymphs of Cicadellidae (Fig. 12A).s.g.p.
tegmen	–	hard, leathery forewing.
vertex	–	dorsal region of head between the compound eyes (Fig. 7B; 16A). ve.
wing pads	–	encased undeveloped wings of nymphs which show behind the thorax as two flattish structures (Fig. 1C, E; 11 C, D, E). wp.

Section A: Key to the separation of nymphs and adults of three common families of Auchenorrhyncha found in rice fields.

1. Prominent mobile setae along longitudinal keels on hind tibia (Fig. 6B, s). Pit-like sensoria or wart-like outgrowths absent from second antennal segment..... Cicadellidae
– Mobile setae absent from longitudinal keels on hind tibia (Fig. 3A-E; 18D). Pit-like sensoria or wart-like outgrowths present on second antennal segment (Fig. 2A-E,se; 18E)..... 2

2. Prominent mobile spur on post tibia present (Fig. 6A, spu). Pit-like sensoria present on second antennal segment (except instar I) (Fig. 2).....Delphacidae
– Spur absent on post tibia (Fig. 18D). Second antennal segment with wart-like sensilla (Fig. 18E). One or both anal veins granulate (Fig. 18A). Frons lacking median carina; clypeus lacking median and lateral carinae (Fig. 18B).....Meenoplidae

Section B: Family Delphacidae (Araeopidae) (Planthoppers).

(a) Key to the separation of nymphal instars based on *Nilaparvata lugens.*

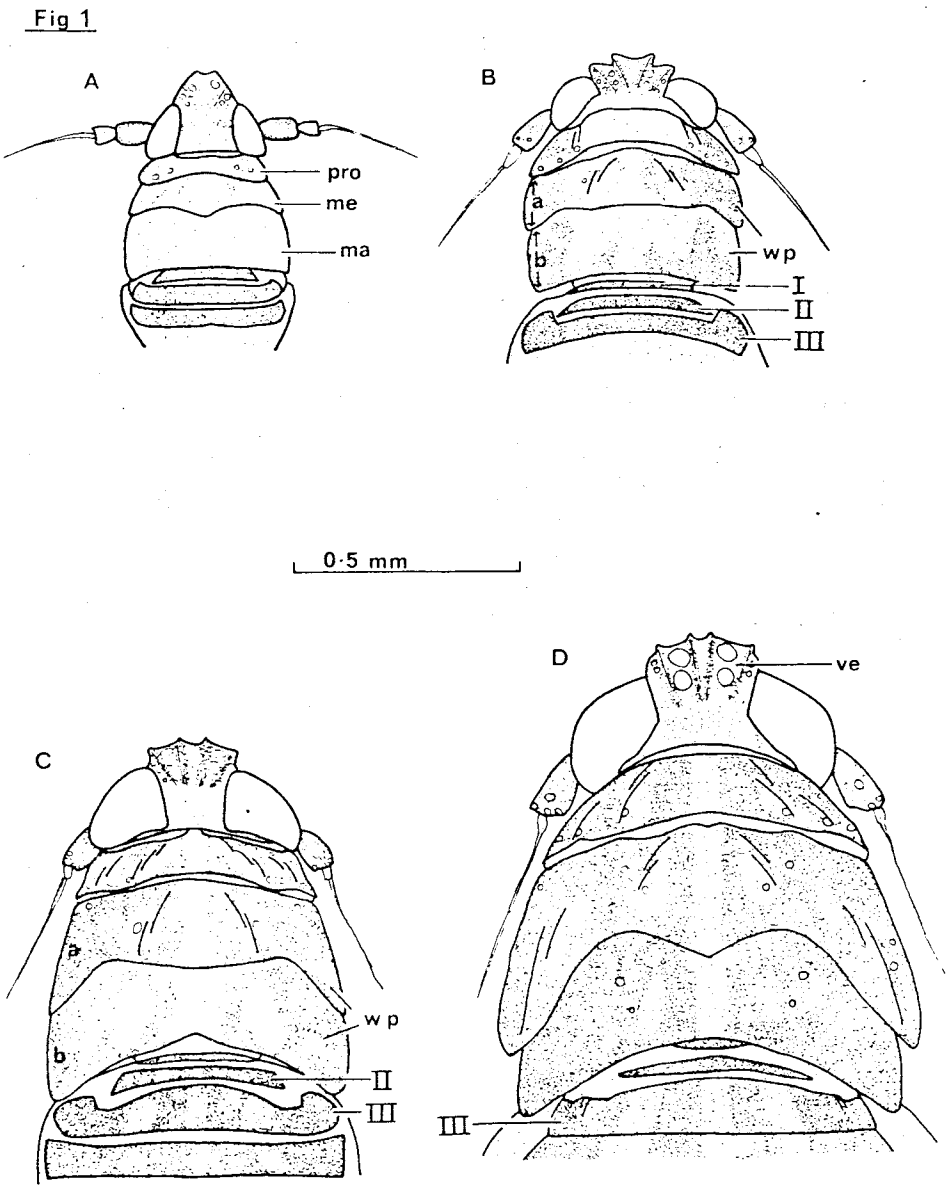
1. Sensoria absent on second abdominal segment (Fig 2A). Vertex only slightly wider than long (including eyes) (Fig. 1A).....Instar I
– Sensoria present on second antennal segment (Fig. 2B-E) Vertex twice, or more than twice as wide as long (including eyes) (Fig. 1B-E)..... 2

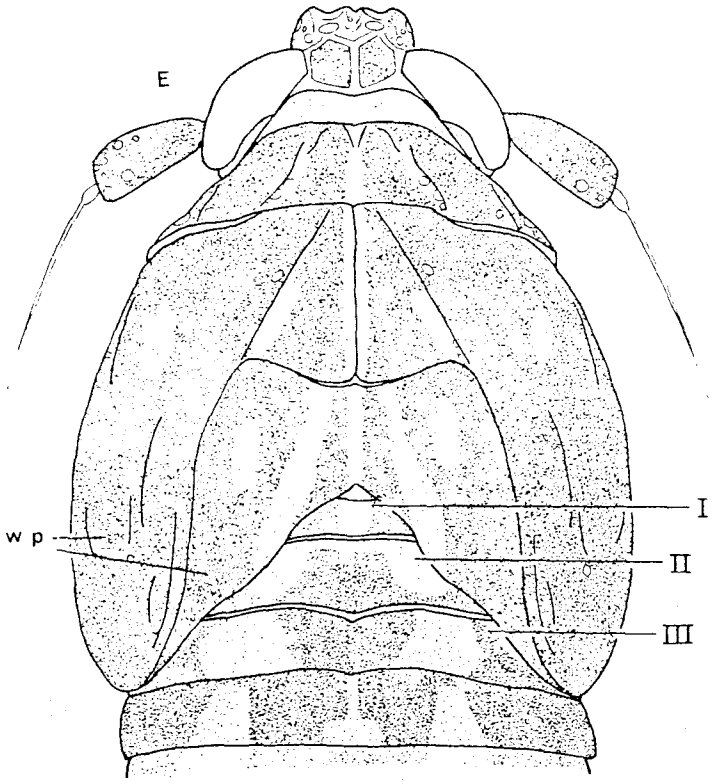
2. Two sensoria on second antennal segment (fig. 2B). Lateral margin of mesothoracic wing pads (Fig. 1B,a) of equal length to that of metathoracic ones (Fig. 1B,b).....Instar II
– More than two sensoria on second antennal segment (Fig. 2C-E) Lateral margin of mesothoracic wing pads (Fig. 1C, D, E,a) longer than metathoracic ones (Fig. 1C, D, E,b)..... 3

3. Metathoracic wing pads extending beyond second abdominal segment (Fig 1C). Lateral margin of mesothoracic wing pads (Fig. 1C,a) slightly longer than metathoracic ones (Fig. 1C,b). Four sensoria on second antennal segment (Fig. 2C). Spur on tibia with more than four spines Fig 3C) .....Instar III
– 3a. Faint cleft on ventral posterior margin of abdominal segment IX (Fig. 4A, cl).....Instar III ♂
– 3b. Paired outgrowths on posterior margin of sternum VIII and sternum IX (Fig. 5 1, 2).....Instar III ♀
– Distal tip of wing pads extending to or beyond third abdominal segment (Fig. 1D & E). Lateral margin of mesothoracic wing pads much longer than metathoracic ones. More than four sensoria on second antennal segment (Fig 2D & E)..... 4

4. Distal tip of mesothoracic wing pads not extending as far down as the distal tip of metathoracic ones (Fig. 1D). Six sensoria on second antennal segment (Fig. 2D). Vestiges of third tarsal segment visible (Fig 3D).....
.....Instar IV
- 4a Swollen cleft on ventral posterior margin of abdominal segment IX (Fig. 4B.....
.....Instar IV ♂
- 4b. A pair of outgrowths on posterior margin of sternum VIII and two pairs on sternum IX (Fig. 5B). The first pair covers the second and third pairs.....Instar IV ♀
– Distal tip of mesothoracic wing pads extending as far down as distal tip of metathoracic ones (Fig. 1E), and are about level with the fourth abdominal segment. Ten sensoria on second antennal segment (Fig. 2E). Third tarsal segment clearly formed (Fig. 3E) .....Instar V
-4c. Prominent cleft on ventral posterior margin of abdominal segment IX (Fig 4C) .....Instar V ♂
-4d. First pair of outgrowths on sternum VIII prominent. Tip of second and third pairs on sternum IX visible behind the first pair (Fig. 5C 1, 2, 3).....Instar V ♀

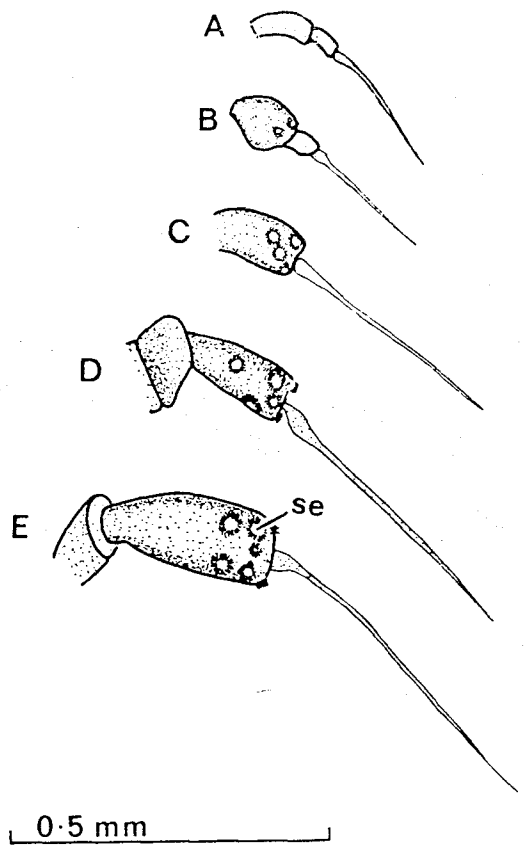
Figure1. Head and thorax of *Nilaparvata lugens* (dorsal view):–





A.	Instar I
B.	" II
C.	" III
D.	" IV
E.	" V
a	length of mesonotum (at sides)
b	length of metanotum (at sides)
ma	metanotum
me	mesonotum
pro	pronotum
ve	vertex
wp	wing pads
I	first abdominal segment
II	second abdominal segment
III	third abdominal segment

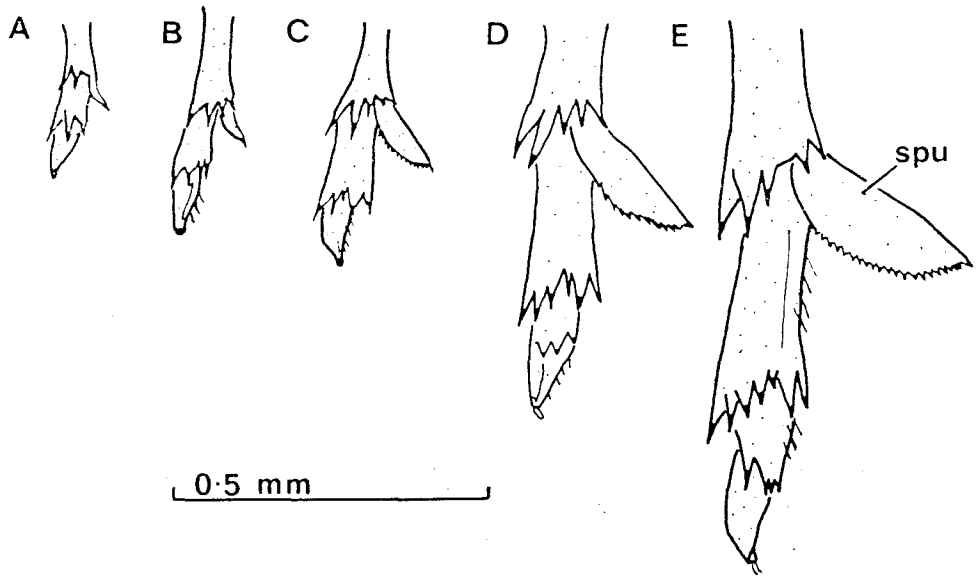
Figure 2. Antennae of *Nilaparvata lugens*:–



A. Instar I
B. Instar II
C. Instar III
D. Instar IV
E. Instar V
se sensoria

Figure 3. Hind tarsus of *Nilaparvata lugens*:–

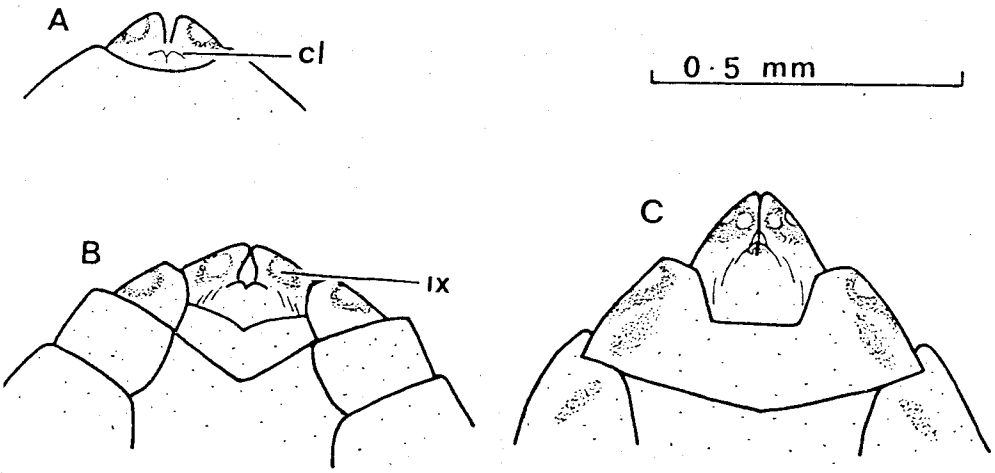
Fig 3



A.	Instar I
B.	Instar II
C.	Instar III
D.	Instar IV
E.	Instar V
spu	spur

Figure 4. Last two abdominal segments of male *Nilaparvata lugens* (ventral view)

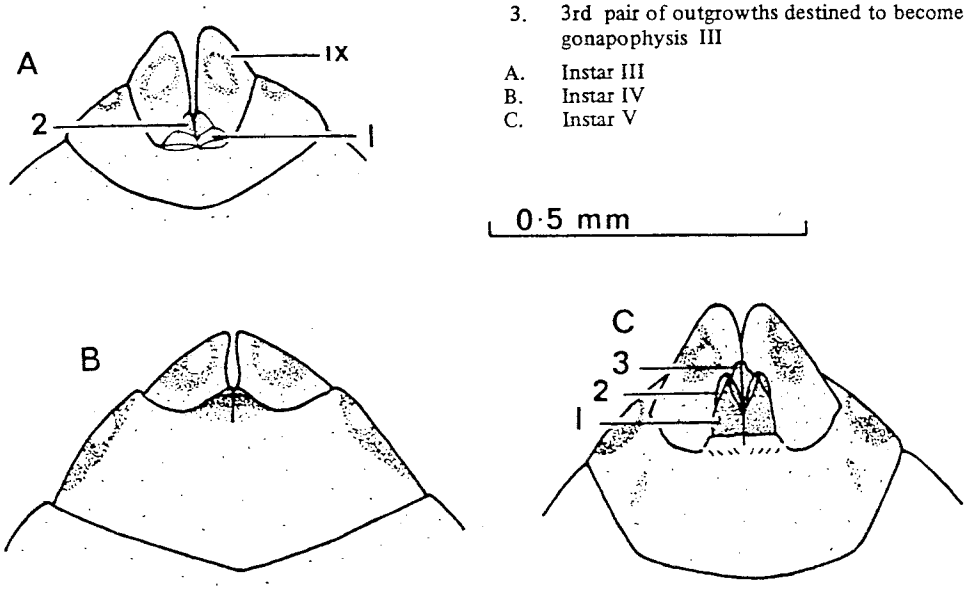
Fig 4



A. Instar III
B. Instar IV
C. Instar V
cl cleft
IX ninth abdominal segment

Figure 5. Last two abdominal segments of female *Nilaparvata lugens* (ventral view)

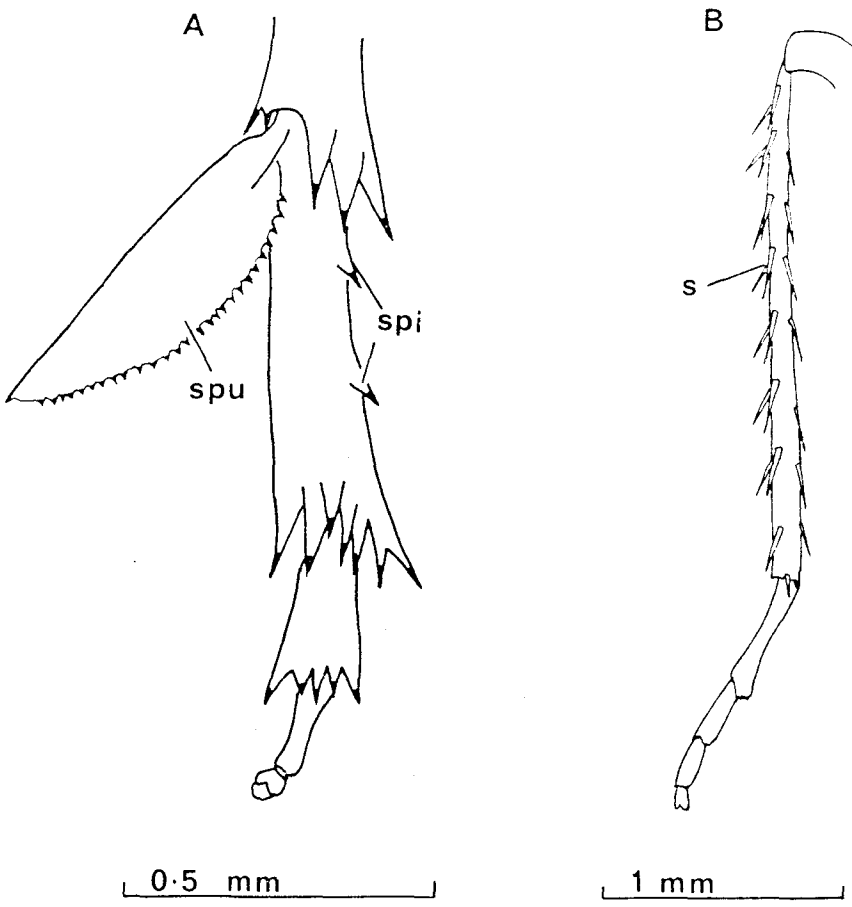
Fig 5



1. 1st pair of outgrowths destined to become gonapophysis I
2. 2nd pair of outgrowths destined to become gonapophysis II
3. 3rd pair of outgrowths destined to become gonapophysis III

A. Instar III
B. Instar IV
C. Instar V

Fig 6



A. Hind tarsus of *Nilaparvata lugens*.
B. Hind leg of *Nephotettix nigropictus*.

s setae
spi spine
spu spur

(b) *Key for the separation of adults of three common genera.*

Nilaparvata, Sogatella and *Laodelphax* are the three commonest genera of Delphacidae found in rice fields in South East Asia, the first two being generally more abundant than the latter.

1. Prominent fixed spines on basal segment of post tarsus (Fig. 6A, spi)..... .....*Nilaparvata* (Distant)
   No prominent spines on basal segment of post tarsus..... 2
2. Prominent whitish-yellow areas on vertex, pro and mesonotum. This may appear as a "streak" in some species (Fig. 7A; 9C. G)...*Sogatella* Fennah
   Male and female pale brown with black mesonotum, except for apex (Fig. 10A); or female with mesonotum pale brown and dark brown markings outside lateral carinae (Fig. 10D). Genae black (Fig. 10B).....*Laodelphax* Fennah

(c) *Key to the separation of two common species of* **Nilaparvata** *and descriptions.*

Of the fourteen described species of this genus in Asia the most abundant ones are *N. lugens* and *N. bakeri.* The following key separates the two from each other, and other brown delphacid species.

1. Median carina intercepted by excavation on frons (Fig. 8I, mc). Posterior margin of male pygofer with central process ventrally (Fig. 8E, pr). Parameres bifurcated apically.....*Nilaparvata bakeri* (Muir)
   Median carina not intercepted on frons (Fig. 8D, mc). Posterior margin of male pygofer with no central process ventrally (Fig. 8B). Parameres not bifurcated apically (Fig. 8B,pa).....*Nilaparvata lugens* (Stål)

Nilaparvata lugens (Stål), Ofvers K. Vetensk Akad. Forh 11: *246. (Delphax).*

Macropterous male 2.5 mm; female 2.9–3.1 mm
Bachypterous male 2–3 mm; female 2.8–3.4 mm
N.lugens is a widely spread species in East and South East Asia.

Yellowish-brown to dark brown in colour. Carinae on vertex faint; median carina on frons distinct. Parameres not bifurcated and ends in a spine-like process; aedeagus slender and upturned (Fig. 8B, ae). Inner margin of first gonocoxa in female rounded at base (Fig. 8C, lgo).

Transmits the "grassy" and "ragged stunt" virus diseases of the rice plant in India, Indonesia, Malaysia, Philippines, SriLanka, Taiwan and Thailand. Besides this by direct feeding *N. lugens* causes complete drying of the rice plants – a condition referred to as "hopper burn". As the species name suggests the male makes a 'wailing' noise during courtship.

Distribution: South China (Fennah, 1956 a), Fiji (Fennah, 1950), Micronesia (Fennah, 1956 b); Sri Lanka (Fennah, 1963); New Guinea (Fennah, 1965); New Caledonia (Fennah, 1969); Cambodia, Sarawak, Thailand, Vietnam, India, (Mochida, 1977; Okada, 1977); Indonesia, West Malaysia, Japan (Ishihara, 1949).

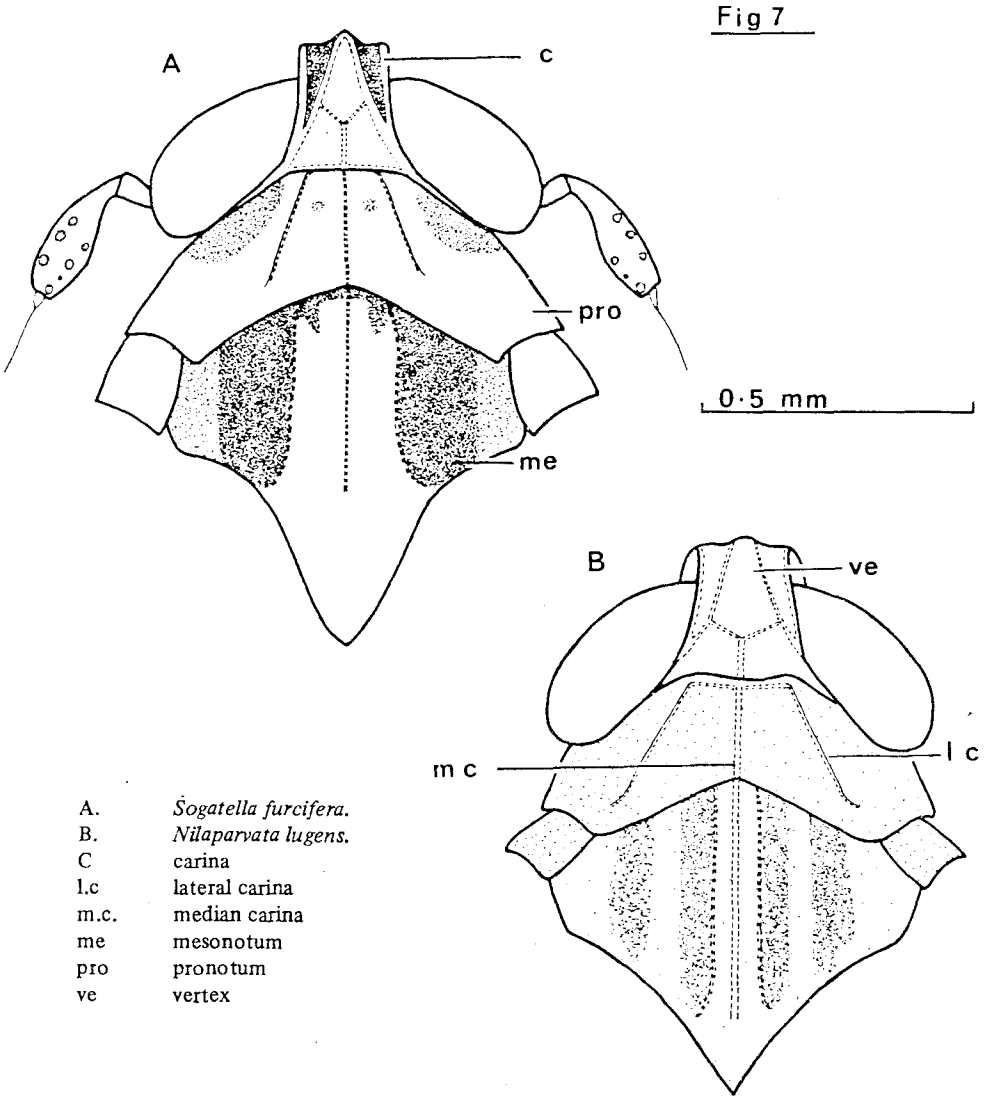
N. bakeri (Muir), 1917. Proc. Haw. Ent. Soc *3*(4) 314-5; 336-7 *(Delphacodes)*

Macropterous male 2.5-3 mm; female 3.5 mm.
Brachypterous male 2.7-2.8 mm; female 3-3.2 mm.

Larger and darker than *N.lugens*. Apical cells on the anterior region in macropterous forewing are darkened (Fig. 8H,pt). The central process on male pygofer ventrally has spines (Fig. 8E, pr). Parameres bifurcated apically; aedeagus with beak-like structure apically, and laterally has sharp spines (Fig. 8F) - the whole structure looks like the mane of a lion. At its base, the first gonocoxa has a short process on its inner margin (Fig. 8G,1go).

Distribution:– South China, (Fennah, 1956 a); Sri Lanka, (Fennah, 1975); Formosa, Indonesia, Korea, Taiwan, Thailand, (Mochida, 1977; Okada, 1977); West Malaysia (personal observation - new record), Japan, Philippines (Ishihara, 1949).

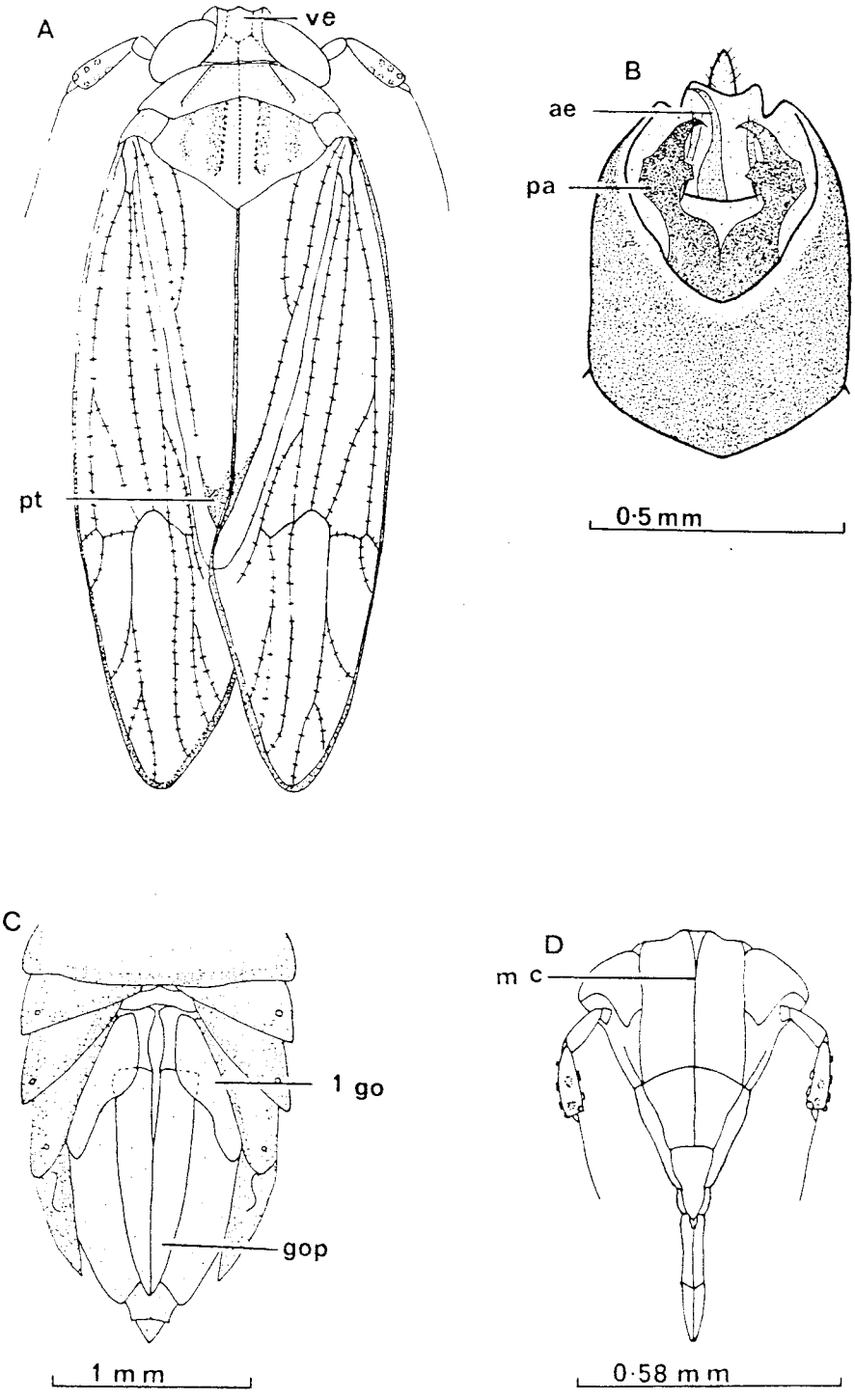
Figure 7. Head, pro and mesothorax (dorsal view).

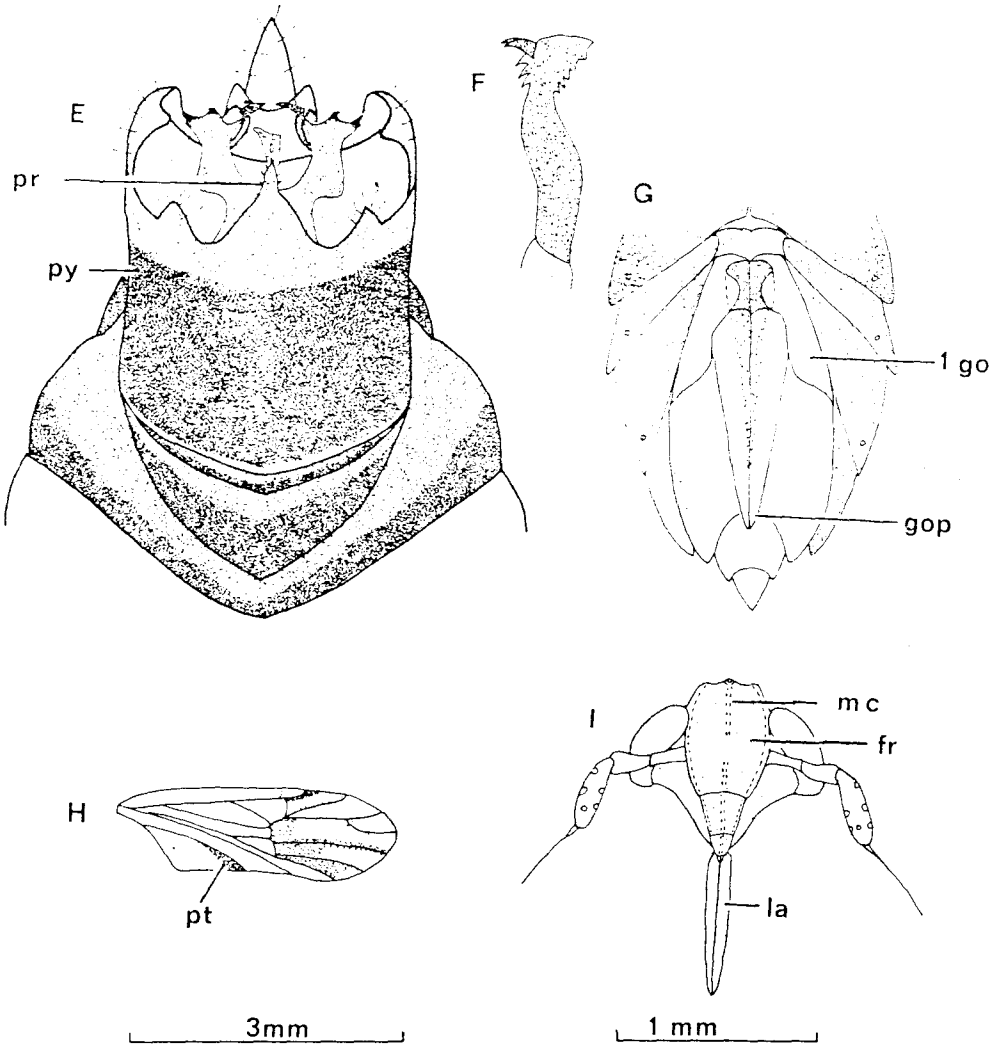


A. *Sogatella furcifera.*
B. *Nilaparvata lugens.*
C carina
l.c lateral carina
m.c. median carina
me mesonotum
pro pronotum
ve vertex

Figure 8. *Nilaparvata*

Fig 8





A. Dorsal view of *N. lugens.*
B. Ventral view of last abdominal segment of adult male *N. lugens.*
C. Ventral view of last few abdominal segments of adult female *N. lugens.*
D. Front view of face *N. lugens*
E. Ventral view of last abdominal segment of adult male *N. bakeri.*
F. Aedeagus of *N. bakeri.*
G. Ventral view of last abdominal segment of adult female *N. bakeri.*
H. Forewing of *N. bakeri.*
I. Front view of face of *N. bakeri.*

ae	aedeagus
fr	frons
lgo	1st gonocoxa
gop	gonoplac
la	labium
m.c.	median carina
pa	parameres
pr	process
pt	pterostigma
py	pygofer
ve	vertex

(d) *Key to the separation of three common species of* **Sogatella** *and descriptions.*

Fennah (1963) gives a key to eighteen species of *Sogatella* found in Asia and Africa. The three commonest found in rice fields in South East Asia are *S. furcifera, S. pusana* and *S. longifurcifera.* These may be separated from each other and from other described species as follows:–

1. Pronotum and mesonotum whitish-yellow medially and dark brown laterally (Fig. 9C). Forewings and apical cells crescently fuscous (Fig. 9F). Parameres straight and apically ends in two divergent processes (Fig. 9E, pa)..... .....*Sogatella pusana* (Distant)

– Pronotum whitish-yellow throughout except area underneath eyes where they are dark brown or pale yellow (Fig. 9A, G). Mesonotum whitish-yellow medially with outsides of lateral carinae dark brown or pale brown (Fig. 9A, G). Forewings not crescently fuscous. Parameres either divergent apically or broad at base (Fig 9B, I) 2

2. Mesonotum whitish-yellow medially with outer-sides of lateral carinae pale brown (Fig. 9G). Forewing with no pterostigma. Genae distinctly brown-black (Fig. 9H). Parameres not broad basally and divergent apically with a large blunt-ended spine in the inner margin (Fig. 9I,pa)..... .....*Sogatella longifurcifera* (Esaki & Ishihara)

– Mesonotum whitish-yellow medially with outer-sides of lateral carinae dark brown (Fig. 7A; 9A). Forewing with black pterostigma (Fig. 9A,pt). Parameres broad basally and bifurcated apically with no large spine (Fig. 9B,pa)..... .....*Sogatella furcifera* (Horváth)

Sogatella furcifera (Horváth), 1899. Termeszetr. Füz *22: 372. (Delphax)*

Macropterous male 2.5 mm; female 3mm.

The prominent whitish-yellow area on the vertex, pro and mesonotum dorsally is a generic character. The common name "white-backed hopper" is often used for *S. furcifera.* This can be misleading in identification as there are several species within this genus with variations of this character.

In. *S. furcifera* the sides of the mediolateral carinae on the vertex are dark brown; frons, clypeus, genae are dark brown; pronotum whitish-yellow thorughout except underneath the eyes where they are dark brown. The mesonotum is whitish-yellow medially and dark brown laterally; the latter portion forms a crescent shape posteriorly on the mesonotum thereby interrupting the 'white streak' which extends from the vertex (Fig. 7A; 9A). Vertex is slightly longer than broad (Fig 9A). Apical veins on wings brownish Parameres broad basally and bifurcated apically (Fig. 9B).

Distribution: South China (Fennah, 1956 a); Micronesia, Japan (Fennah, 1956 b), 1971); Australia (Fennah, 1965); Cambodia, Bangladesh, Burma, Fiji, India, Indonesia, Japan, Korea, West Malaysia, Mongolia, Maritime Territory, New Hebrides, Pakistan, Philippines, Sabah, Solomon Islands, Sarawak, Sri Lanka, Taiwan, Vietnam, (Okada, 1977).

Fennah (1963) notes that there are two subspecies *S. furcifera distincta* (Distant) from Sri Lanka and *S. furcifera pallencens* (Distant) from India.

Sogatella pusana (Distant), 1912. Ann. Mag. Nat. Hist. 9(8):191. (*Sogata*).

Macropterous male 1.8-2 mm; female 2.4 mm.

Vertex yellow except at sides of mediolateral carinae (Fig. 9C); frons dark brown; clypeus pale brown, gena brown (Fig. 9D). Pronotum whitish-yellow medially with a pair of dark impressions (Fig. 9C) and dark brown laterally with paler posterior margin. Mesonotum whitish-yellow medially and dark brown laterally. This whitish-yellow area medially on the vertex, pro and mesonotum is distinct and appears as a white 'streak' dorsally. Wings with apical cells crescently fuscous near veins, apical veins black-brown (Okada, 1977), (Fig. 9F). Parameres divergent apically with two prominent processes (Fig. 9E).

Distribution: Indonesia, Philippines, Taiwan, (Fennah, 1956); Sri Lanka (Fennah, 1956, 1975); Western Micronesia (Fennah, 1956), 1971); West Malaysia (personal observation – new record).

Sogatella longifurcifera (Esaki & Ishihara), 1947. Mushi; 17: 41 (*Delphacodes*).

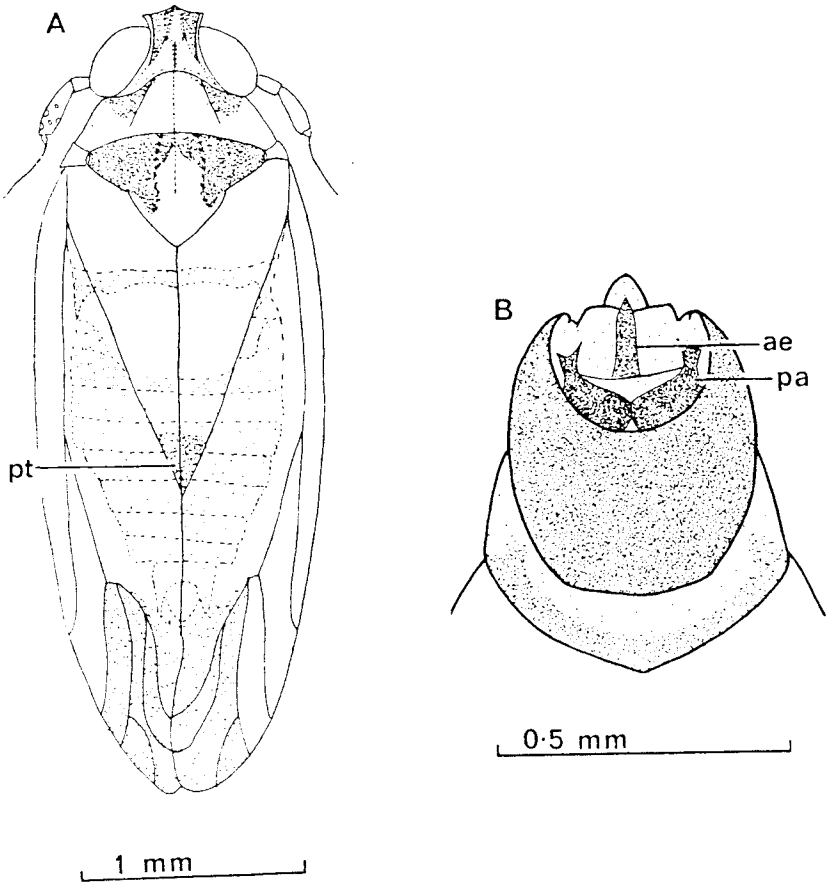
Macropterous male 1.8mm; female 2mm

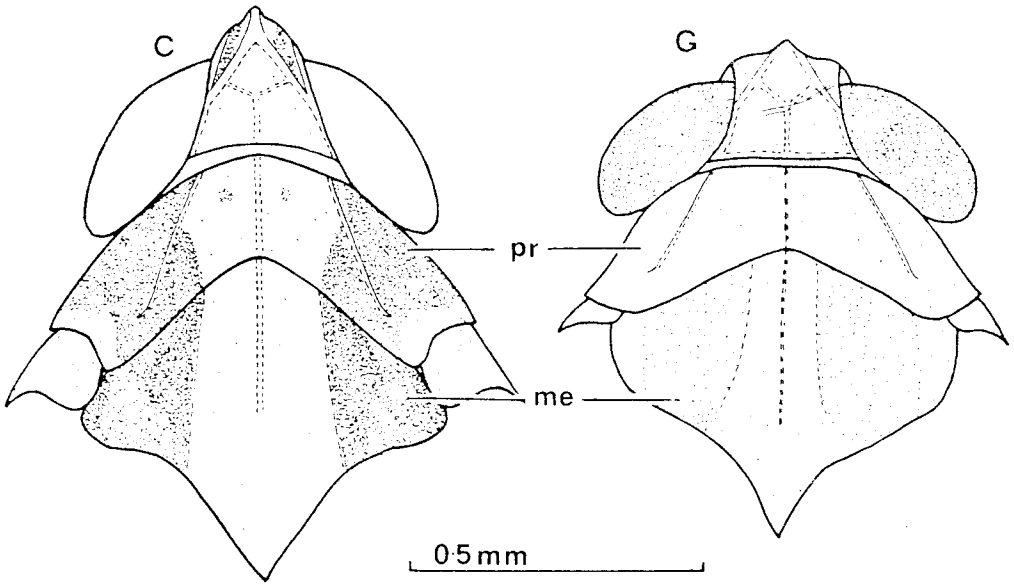
Vertex, antennae, clypeus, rostrum pale brown. Flagellum dark brown. Genae characteristically brownish-black and this is prominent with pale-yellowish-brown lateral carinae face (Fig. 9H). Pronotum whitish-yellow; mesonotum whitish-yellow medially with pale brown markings on outer parts of lateral carinae (Fig. 9G). This also gives a whitish-yellow 'streak' effect dorsally but is paler than that in *S. pusana*. Vertex longer than broad. Frons three times as long as the greatest width. Forewings are pale with pale brown veins. Prominent horse-shoe process lying behind the parameres (Fig. 9J). Male genitalia as in Fig. 9I; parameres are divergent apically with a large blunt-ended spine in the inner margin.

Distribution: Taiwan (Fennah, 1963); Australia (Fennah, 1965; Tonga Islands (Fennah, 1967); New Caledonia (Fennah, 1969); Maritime Territory (Fennah, 1968); Japan (Fennah, 1971); West Malaysia (personnal observation – new record).

Figure 9 *Sogatella*

Fig 9

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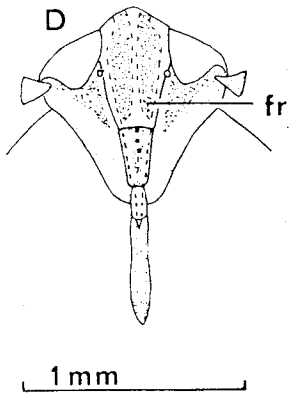
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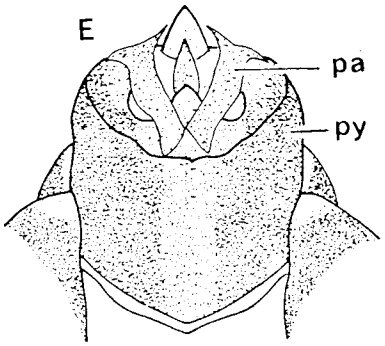
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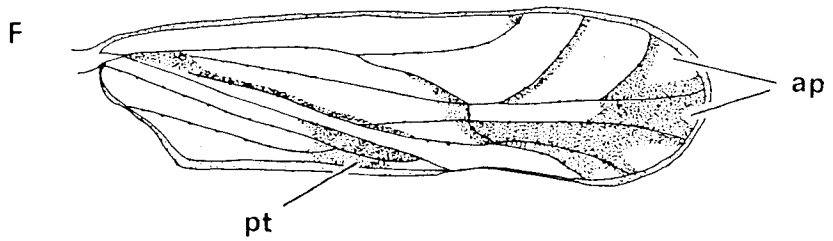
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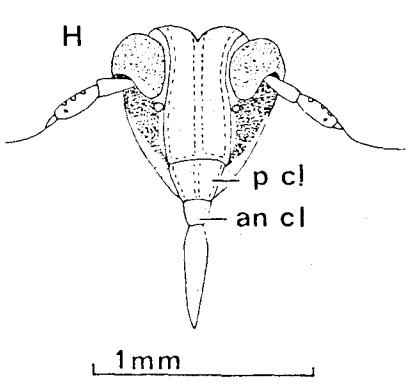
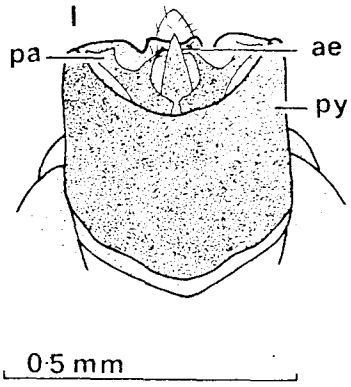
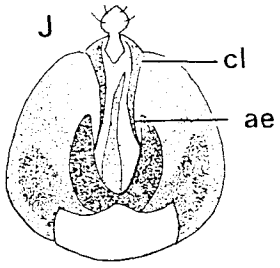






A. Dorsal view of adult *S. furcifera.*
B. Ventral view of last abdominal segment of adult male *S. furcifera.*
C. Head, pro and meso thorax of adult *S. pusana.*
D. Front view of face of adult *S. pusana.*
E. Ventral view of last abdominal segment of male *S. pusana*
F. Forewing of adult *S. pusana*
G. Head, pro and mesothorax of adult *S. longifurcifera*
H. Front view of face of adult *S. longifurcifera.*
I. Last abdominal segment of adult *S. longifurcifera.*
J. Ventral view of pygofer with parameres removed of *S. longifurcifera.*

ae	aedeagus
ap	apical cells
an.cl	anteclypus
cl	claspers
fr	frons
me	mesonotum
pa	parameres
p.cl	postclypeus
pr	process
pt	pterostigma
py	pygofer

(e) *Laodelphax striatellus* (Fallén), 1826. Han. Svc. Licad. *(Delphocodes).*

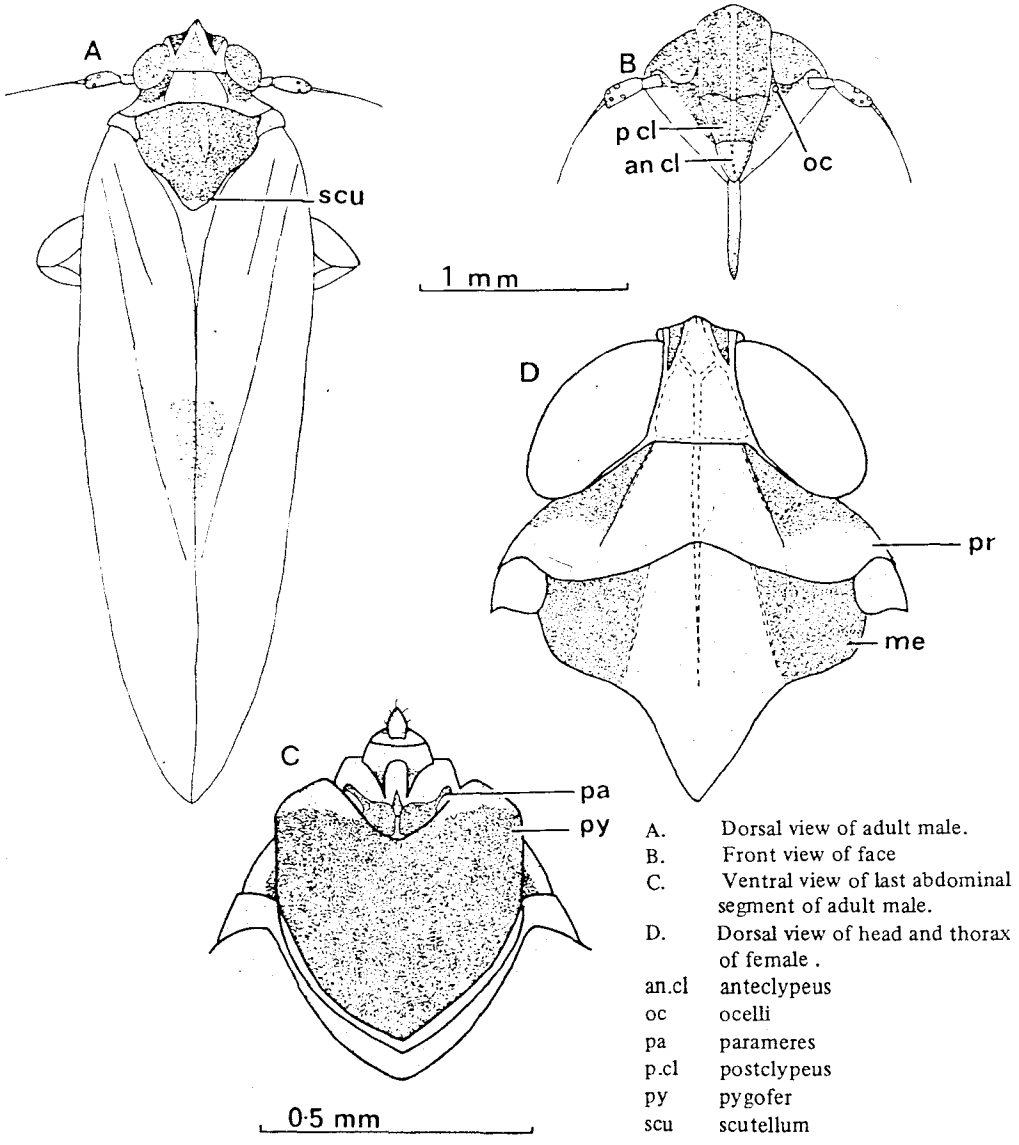
Brachypterous male 3mm; female 3.5 mm.
Macropterous male 4mm; female 4.5 mm.

Vertex brown, with portion between lateral and mediolateral carinae black. pronotum whitish except areas beneath eyes and outside lateral carinae which are black (Fig. 10A). Mesonotum in males and some females black with white tipped scutellum, (Fig. 10A). Other females with light brown scutellum and conspicuous large black or brown markings outside lateral carinae (Fig. 10B). Forewing subhyaline with light brown tint especially on clavus. Veins light brown. Pterostigma dark brown. Male genitalia as in figure 10C; parameres simple and clubbed shaped.

It transmits the rice black streaked and stripe viruses, (Iida, 1967).

Distribution: Northern Philippines, Japan (Nasu, 1967); Formosa, Micronesia (Fennah, 1971); Palaeartic Region.

Fig 10. *Laodelphax striatellus*



A. Dorsal view of adult male.
B. Front view of face
C. Ventral view of last abdominal segment of adult male.
D. Dorsal view of head and thorax of female .
an.cl anteclypeus
oc ocelli
pa parameres
p.cl postclypeus
py pygofer
scu scutellum

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