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## Revision of the Sheesham tree hoppers of the *Gargara flavolineata* DISTANT species subgroup (Homoptera, Membracidae, Centrotinae), with description of three new species from Pakistan

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The members of the Sheesham tree hoppers of the *Gargara flavolineata* DISTANT species subgroup are described, including three new species from different areas of Pakistan, with special reference to their lateral lobes of frontoclypeus and male and female genitalia. A key to the four taxa is given and their cladistic relationships are briefly discussed.

Keywords: *Gargara flavolineata* species subgroup, descriptions, new species, Pakistan.

### INTRODUCTION

MOHAMMAD & AHMAD (1990, 1993a, 1993b) and AHMAD & MOHAMMAD (1994) have described and cladistically analysed the *Gargara majuscula* DISTANT and *G. splendidula* DISTANT species groups (the latter with the *G. citrea* DISTANT, *G. varicolor* STÅL and *G. splendidula* DISTANT species subgroups), comprising three and ten species, respectively, from the Indo-Pakistan subcontinent.

The four members of the *G. flavolineata* DISTANT subgroup of the *flavolineata* group (comprising eleven additional species from various areas of Pakistan) are characterized by having the lateral lobes of frontoclypeus extended for half length of median lobe below lower margin of vertex. In this paper, in addition to DISTANT's species, three new species from Pakistan are described. These *Gargara* species are known to attack Sheesham, *Dalbergia sissoo* (ROXB.), a commercial wood, probably carrying viruses to them (AHMAD, 1972; BADAN, 1986), other leguminous plants of economic importance (NAIR, 1976) and also noxious weeds (HILGENDORF & GOEDEN, 1982).

### METHODS

For the examination of head, thorax, abdomen and their appendages, including male and female genitalial components, a part of the technique of AHMAD (1986) was followed. The genital components were then dissected, examined and illustrated using an eyepiece graticule under a Leitz binocular microscope on graph paper following the procedure of MOHAMMAD & AHMAD (1990). These components were finally placed in a microvial with a drop of glycerine and fixed to the specimens.

The following abbreviations were used for the museums: Museum of Natural History, London (BMNH); Natural History Museum, Department of Zoology, University of Karachi (NHMUK); Natural History Museum, Basel, Switzerland (NHM) and entomological collections of the second author (AHMAD's Coll.).

*Key to the species of the Gargara flavolineata subgroup from the Indo-Pakistan subcontinent*

1. Lateral lobes of frontoclypeus extended for half length of median lobe below lower margins of vertex: *flavolineata* DISTANT group ..... 2
- Lateral lobes of frontoclypeus extended distinctly more than half length of median lobe below lower margins of vertex: *splendidula* DISTANT group
2. Body elongate; subgenital plate very elongate and nearly of uniform width from base to apex; paramere with stem strongly curved ..... 3
- Body small, nearly ovate; subgenital plate comparatively less elongate; paramere with stem straight ..... 4
3. Posterior process passing beyond internal angles of tegmina, straight at base; in female ovipositor elongate, passing beyond tegmina ..... *longispina* sp.n.
- Posterior process not passing beyond internal angles of tegmina, slightly gibbous at base; in female ovipositor short, not extending beyond tegmina ..... *gibbosa* sp.n.
4. Male completely black and female dark brown showing sexual dimorphism; median carina very prominent, especially on posterior process, central area to posterior process without ferruginous spot or marking ..... *neonigrocarinata* sp.n.
- Both sexes black, ferruginous or of same colour, not sexually dimorphic; median carina comparatively less prominent on posterior process, central area to posterior process and sometimes central carinate line to pronotum ferruginous brown or light ochraceous ..... *flavolineata* DISTANT

DESCRIPTIONS

***Gargara flavolineata* DISTANT (Figs 1-7)**

*Gargara flavolineata* DISTANT, 1908: 65; FUNKHOUSER, 1927: 400; 1951: 262; GODING, 1934: 462; METCALF & WADE, 1965: 319; AHMAD *et al.*, 1978: 18; AHMAD, 1979: 18; 1980: 140.

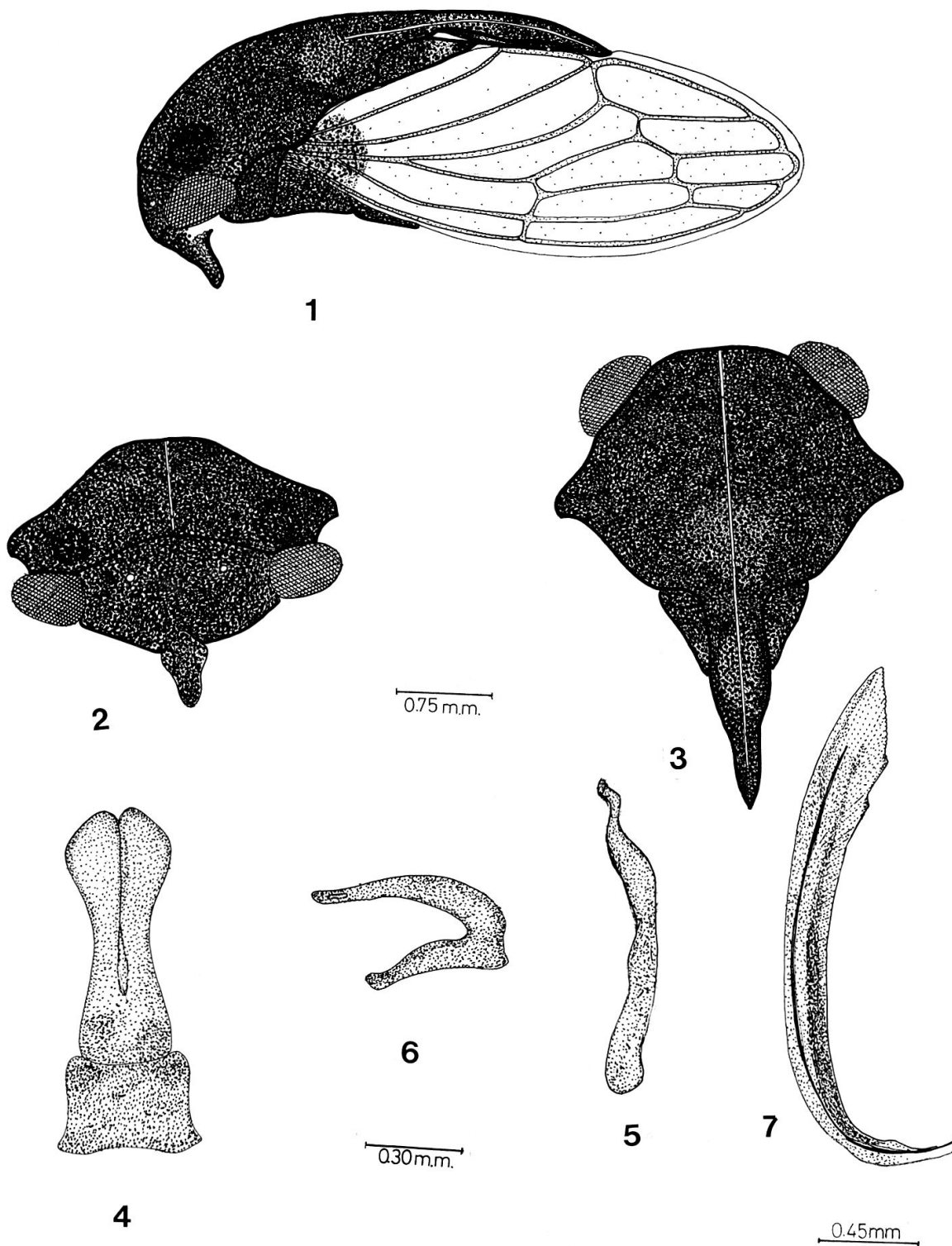
Male: Generally black.

Head (Fig. 2): Not projected, black; vertex not projected in between ocelli, upper margin shallowly arcuate, lower margin subround, strongly recurved; eyes ferruginous; ocelli pale; frontoclypeus broader towards apex with tip truncate and recurved, lateral lobes prominent, extending for half length below lower margin of vertex.

Thorax and appendages (Figs 1, 3): Pronotum usually black; humeral angles sinuate, slightly raised with tip acute; scutellum dark ferruginous; posterior process with central area and sometimes median carina ferruginous brown, not sexually dimorphic, median carina comparatively less prominent medially; tegmina hyaline, opaque, veins very light, especially apically not so prominent; legs with femur dark ferruginous, tibia and tarsi light ochraceous.

Measurements: Total length from front of head to tip of tegmina 3.2-4.1 mm; width between humeral angles 1.6-1.9 mm.

Male genitalia: Subgenital plate (Fig. 4) comparatively less elongate, much depressed a little before apex, apices truncate, lateral margins deeply concave and smooth, basal angles round; paramere (Fig. 5) almost straight, parameral head remarkably small and round with inner lateral process not prominent and subacute,



Figs 1-7. *Gargara flavolineata* DISTANT – 1. Entire male, lateral view; 2. Head, anterior view; 3. Pronotum, dorsal view; 4. Male subgenital plate, ventral view; 5. Paramere, inner view; 6. Aedeagus, lateral view; 7. Second gonapophyses, ventral view.

distal portion or neck narrower, smooth, outer lateral margin long, almost straight, inner lateral margin slightly truncate, proximal portion with outer lateral margin very slightly apically round then straight, inner lateral margin slightly concave; aedeagus (Fig. 6) with transverse and curved arms, almost equal in length, transverse arm almost of uniform width, apex slightly depressed and tip subacute.

Female genitalia: Second gonapophyses (Fig. 7) elongate, apically dentate, moderately prominent and of uniform width, margin with 2 prominent teeth.

Material examined: Lectotype ♂, with labels: "Type", "DISTANT Coll."; "1911-383", "Ranchi"; "Irvine", "*Gargara*", "*flavolineata*", "type DIST", in BMNH. Other specimens: 300 ♂♂ and 500 ♀♀, Pakistan: Sind; Karachi, Malir, Karachi University Campus, Thatta, Panoo Aquil, Kotri, Hala, Mianiforest, Tandojam, Kundcoat, Jacobabad, Mirpurkhas, Khairpur, Pipri; Punjab; Rawalpindi, National Park, Islamabad, Lahore, Ravi, Wah, Sargodha, Texila, Hazroo, Chonia, Wakilwala, Multan, C.D. Nursery, Murree; N.W.F.P.; Peshawar, Turbella dam, Saidusharif, Swat, Haripur, Hazara, Sarhad; Baluchistan; Turbat, Ziarat, on *Delbergia sissoo* (ROXB.), Wild grass, *Sesbania sesbans* (L.) MERRIL, *Withenia somnifera*, (L.) DUNAL., *Amaranthus viridis* (L.), *Rumex hastatus* D. DON., *Indigofera* spp., *Medicago sativa* L., 9, 17, 18.6., 3, 9, 12, 17, 26, 30, 7., 1, 2, 11, 19, 20, 29.8., 20.9., 3.10., 15, 19, 20, 25.11.1968; 18.1., 21, 22, 27.3., 26.4., 11, 20.6., 28.7., 22.10.1969; 7, 22.6., 4.7., 9.9.1970; 3, 15, 16.6.1971; 7, 22.6., 4.7., 3, 9.9.1972; 16.5., 3.6.1973; 15.6., 3.7.1974; 14.1.1975; 14.4., 19, 20.8., 19.11.1976; 5, 2., 26.6., 9.7.1977; 5.5., 23.6., 12.7., 15.11.1978; 2.5., 3.7.1979, leg. I. AHMAD, M. SALEEM, N. YASMEEN, M. ASLAM, H. REHMAN, S. MOIZUDDIN, A.A. KHAN, A. KHAN, M. RAHIM, Q.A. ABBASI, F. AHMAD and N.A. RANA, in NHMUK and NHM.

General variations: In some specimens head and anterior portion of metopidium are black and pronotum ferruginous; sometimes head and pronotum are pale ochraceous with median carinae having palish spots or areas; tip of the posterior process light ochraceous, dark ferruginous or black; in some specimens the ferruginous areas on the posterior pronotal process are large or obscure; ocelli are sometimes white in colour; tegmina sometimes have a dark fuscous apical region.

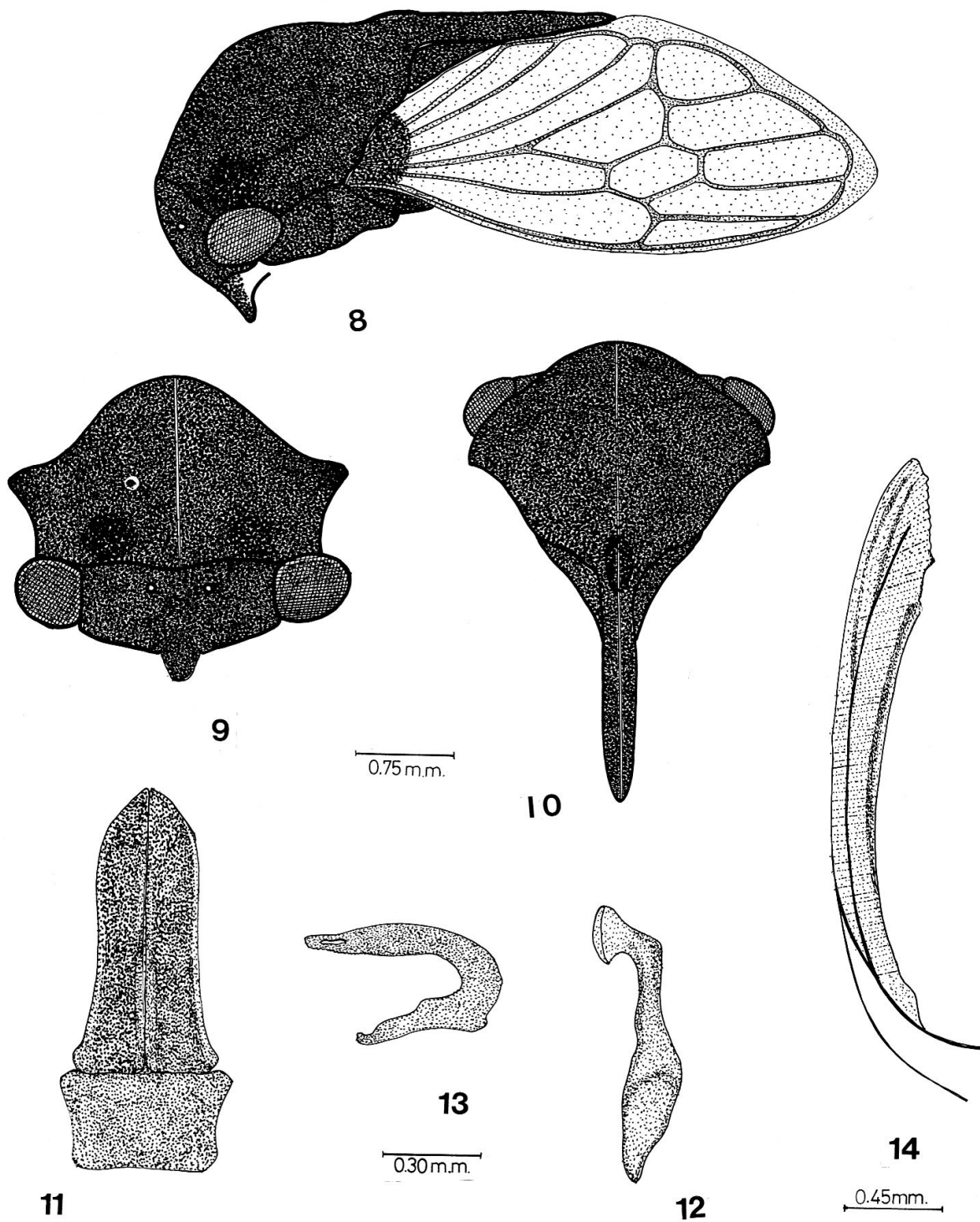
Comparative note: This species is closely related to *G. neonigrocarinata* sp.n. in having smaller, almost ovate body but could be easily separated from it by having central area of posterior process and median carina ferruginous, as compared to uniformly black posterior process in male and ferruginous in female in *G. neonigrocarinata*.

### *Gargara gibbosa* sp.n. (Figs. 8-14)

Male: Generally black.

Head (Fig. 9): Not projected, black; vertex not projected in between ocelli; upper margin very shallowly arcuate, lower margin obliquely round and recurved; eyes dark ochraceous; ocelli pale; frontoclypeus as broad as long, medially broad with tip broadly round and recurved; lateral lobes of frontoclypeus extended for half length of frontoclypeus below lower margin of vertex.

Thorax and appendages (Figs 8, 10): Pronotum black; humeral angles sinuate with tip acute; scutellum usually entirely black; posterior process usually black, not passing clavus, slightly gibbous at base; tegmina pale ochraceous, with dark ochraceous markings, veins dark brown, apically light ochraceous, legs with femur and tibia dark ferruginous red, tarsi light ferruginous.



Figs 8-14. *Gargara gibbosa* sp.n. – 8. Entire lateral view; 9. Head, anterior view; 10. Pronotum, dorsal view; 11. Male subgenital plate, ventral view; 12. Paramere, inner view; 13. Aedeagus, lateral view; 14. Second gonapophyses, ventral view.



Measurements: Total length from front of head to tip of tegmina 3.6-3.8 mm; width between humeral angles 1.6-1.7 mm.

Male genitalia: Subgenital plate (Fig. 11) much elongate, outer lateral margins slightly sinuate and medially depressed, apex subround, basal angles very prominent and subround, tips acute; paramere (Fig. 12) curved, head somewhat fan-like, outer lateral process acute, apically blunt, apex smooth and sharp, distal portion or neck narrow and more curved, outer lateral margin deeply sinuate, inner margin deeply curved, basal or proximal portion swollen, outer margin slightly convex, inner lateral margin partly concave, partly straight; aedeagus (Fig. 13) much curved at base, transverse and curved arms unequal, former flattened with apex depressed and tip subacute.

Female genitalia: Second gonapophyses (Fig. 14) much elongate, outer lateral margin apically with prominent but scattered serrations and with 2 unequal teeth.

Material examined: Holotype ♂, Pakistan: Baluchistan; Ziarat, on wild grass; 31.7.1975, leg. M. ASLAM, in NHMUK. Paratypes: 6 ♂♂, 1 ♀, same data as above, in NHMUK, NHM and in AHMAD's Coll.

Comparative note: This species is closely related to *G. longispina* in that the head is not projected and the body and the subgenital plate are very elongate, but could be separated from it by having a short posterior process not passing beyond the clavus and slightly gibbous at base as compared to a long posterior process passing beyond the clavus and is straight at base in *G. longispina*.

### *Gargara longispina* sp.n. (Figs 15-21)

Male: Generally black.

Head (Fig. 16): Not projected, usually black; vertex not projected in between ocelli, upper margin shallowly arcuate, lower margin subtruncate and recurved; eyes ochraceous; ocelli pale; frontoclypeus broader towards apex, tip broadly subround and slightly recurved; lateral lobes not so prominent, extending at least  $\frac{1}{2}$  length of frontoclypeus below lower margin of vertex.

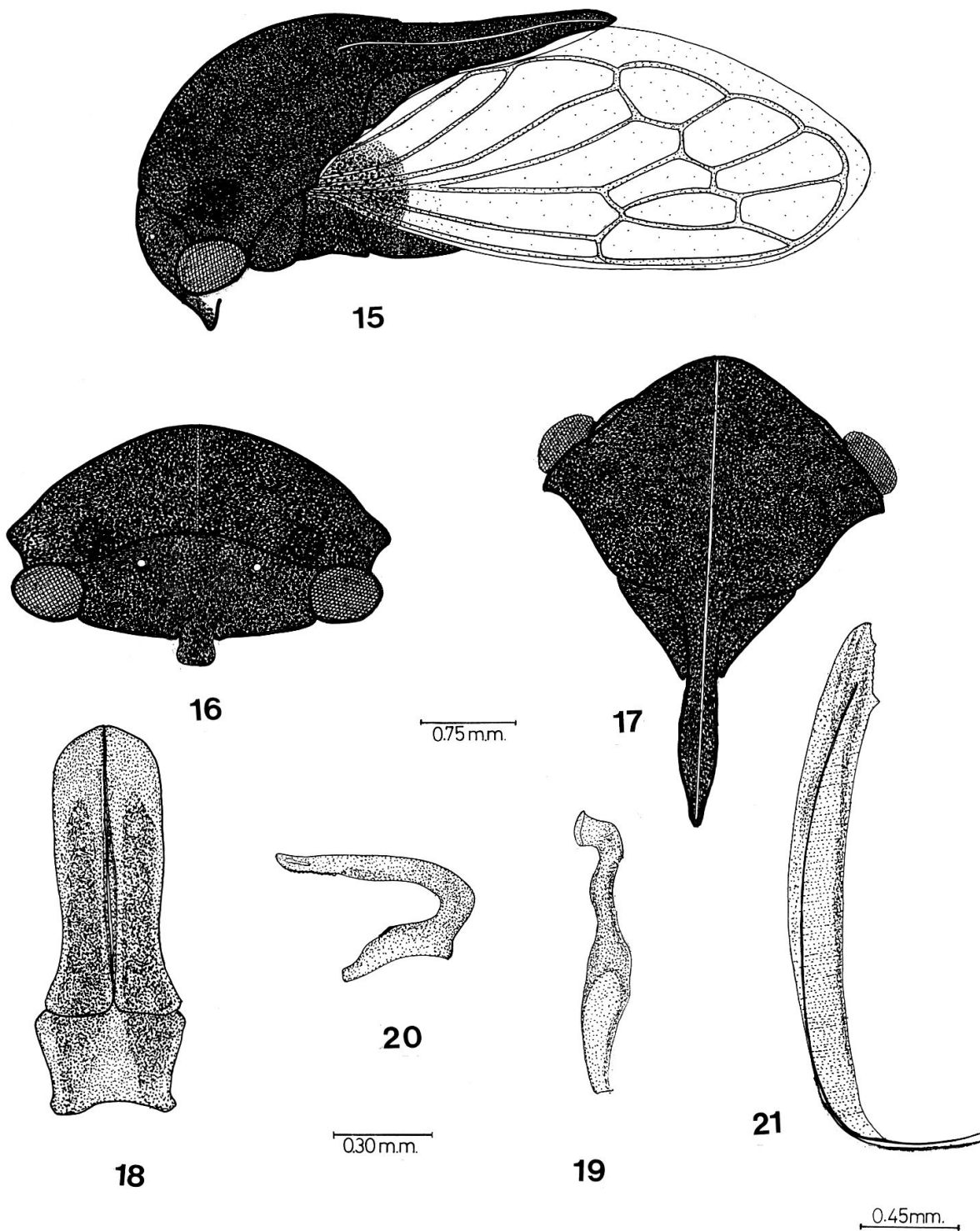
Thorax and appendages (Figs 15, 17): Pronotum black; humeral angles prominent, triangular; posterior process passing beyond clavus and straight at base; scutellum black; tegmina pale, bronzy with veins dark brown; legs with femur blackish brown, tibia and tarsi light ochraceous, in case of female ovipositor elongate extended outside tegmina.

Measurements: Total length from front of head to tip of tegmina 3.8-4.6 mm, width between humeral angles 1.6-1.9 mm.

Male genitalia: Subgenital plate (Fig. 18) much elongate, nearly of uniform width from base to apex, outer lateral and inner margins almost straight, apex round, basal angles prominent and acute; paramere (Fig. 19) funnel-shaped, stem more strongly curved and neck comparatively narrower, proximal portion with outer margin very slightly convex, inner margin sinuate; aedeagus (Fig. 20) with transverse and curved arms unequal, curved arm nearly  $\frac{1}{2}$  length of transverse arm, latter medially slightly flattened with tip much depressed and slightly recurved or raised.

Female genitalia: Second gonapophyses (Fig. 21) much elongate, outer lateral margin apically with strongly prominent serrations and with a prominent tooth.

Sexual dimorphism: Females sometimes differ from males in colour of pronotum with disc reddish brown, lateral margins of pronotum and posterior process black and apex of posterior process also black.



Figs 15-21. *Gargara longispina* sp.n. – 15. Entire lateral view; 16. Head, anterior view; 17. Pronotum, dorsal view; 18. Male subgenital plate, ventral view; 19. Parameres, inner view; 20. Aedeagus, lateral view; 21. Second gonapophyses, ventral view.



Material examined: Holotype ♂, Pakistan: Baluchistan; Ziarat, wild bush; 31.7.1975, leg. M. SHADAB, in NHMUK. Paratypes: 2 ♂♂, 3 ♀♀, same data as Holotype, leg. M. ASLAM, in NHMUK and in NHM. Other specimens: 3 ♀♀, with same data as above, in NHMUK, NHM and in AHMAD's Coll.

Comparative note: This species is related to its closest ally *G. gibbosa* in having an elongate body, the subgenital plate very elongate and of uniform width from base to apex and the paramere with a stem strongly curved, but could be easily separated from it by having a posterior process passing beyond the clavus and straight at base and the ovipositor extending beyond tegmina as compared to a short posterior process not passing beyond clavus and gibbous at base and a short ovipositor not extended beyond tegmina in *G. gibbosa*.

***Gargara neonigrocarinata* sp.n. (Figs 22-28)**

Male: Black, body small, ovate.

Head (Fig. 23): Not projected, black (male) or reddish brown (female); vertex normal, not projected in between ocelli, upper margin shallowly arcuate, lower margin obliquely straight, strongly recurved; eyes dark brown; ocelli dark ferruginous; frontoclypeus with apex much broader, tip subround, latter strongly recurved; lateral lobes less prominent, partly fused, extended 1/2 length of frontoclypeus below lower margin of vertex.

Thorax and appendages (Figs 22, 24): Pronotum black; humeral angles comparatively small and acute; posterior process black, median carina throughout length prominent, apex passing beyond clavus; scutellum black; tegmina pale, bronzy with veins dark brown; legs with femur dark brownish black, tibia and tarsi pale.

Measurements: Total length from front of head to tip of tegmina 3.5-4.0 mm, width between humeral angles 1.7-1.9 mm.

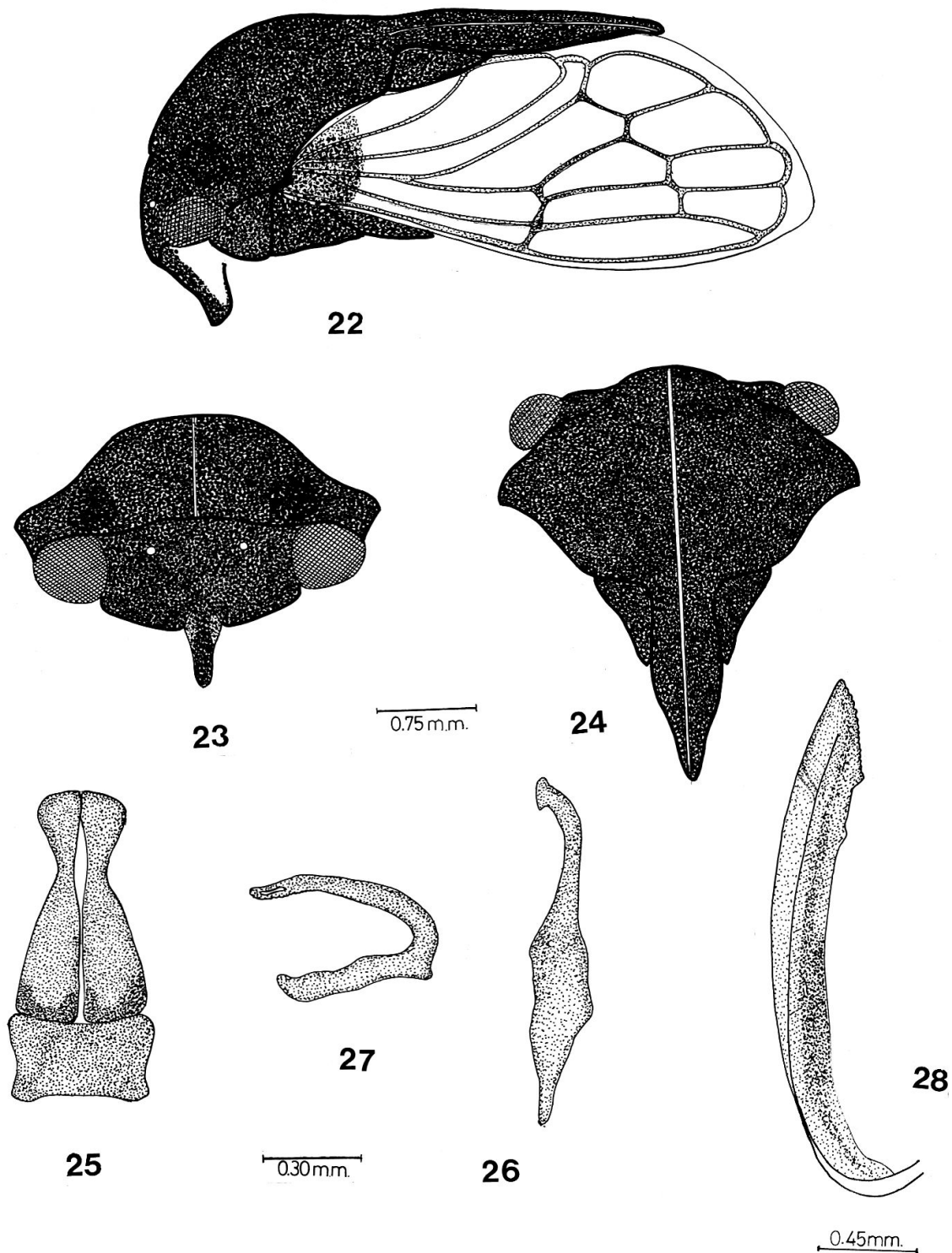
Male genitalia: Subgenital plate (Fig. 25) comparatively less elongate, apically broad and truncate, constriction a little before apex forming a lobe-like structure, lateral margins a little before apex sinuate, then straight, basal angles less prominent and round; paramere (Fig. 26) straight, with stem long and head slightly flattened, distal portion much curved, proximal portion longer than distal portion, with inner lateral margin continuously sinuate; aedeagus (Fig. 27) with transverse arm slightly longer than curved arm, former with apex much depressed, tip subacute.

Female genitalia: Second gonapophyses (Fig. 28) of moderate length, outer apical portion with minute uniform dentation or serration, 2 teeth very prominent and comparatively closer to each other.

Sexual dimorphism: Females differ from males by having dark brown or ferruginous colour.

Material examined: Holotype ♂, Pakistan: Baluchistan; Turbat, on *Dalbergia sissoo* (ROXB.), 26.4.1969, leg. I. AHMAD, in NHMUK. Paratypes: 3 ♂♂, 2 ♀♀, Baluchistan; Turbat; NWFP; Haripur, Mardan, Hazroo, on *Dalbergia sissoo* (ROXB.), *Sesbania sesbans* L. MERRILL., *Medicago sativa* L. and wild bush, 3.7., 7.8.1968, 24.6., 19.9.1969, leg. I. AHMAD and F. AHMED, in NHMUK, NHM and in AHMAD's Coll. Other specimens: 15 ♂♂, 20 ♀♀, with same data as above, in NHMUK, NHM and in AHMAD's Coll.

Comparative note: This species is closely related to *G. flavolineata* DISTANT in having a small, ovate body, the subgenital plate less elongate and the paramere with stem straight, but could easily be separated from it by the male being comple-



Figs 22-28. *Gargara neonigrocarinata* sp.n. – 22. Entire lateral view; 23. Head, anterior view; 24. Pronotum, dorsal view; 25. Male subgenital plate, ventral view; 26. Paramere, inner view; 27. Aedeagus, lateral view; 28. Second gonapophyses, ventral view.

tely black, the female dark ferruginous and the median carina on the posterior process more percurrent as compared to ferruginous or black male and female, and the median carina comparatively less prominent in *G. flavolineata*.

#### CLADISTIC RELATIONSHIPS

AHMAD & MOHAMMAD (1994) have already cladistically analysed the *G. splendidula* group, which is characterized by lateral lobes of frontoclypeus distinctly extending more than half the length of the median lobe below the inferior margin of vertex, showing an outgroup relationship with the present *G. flavolineata* group, characterized by lateral lobes of frontoclypeus extending distinctly more than one-third but not more than half length of median lobe below the inferior margin of vertex.

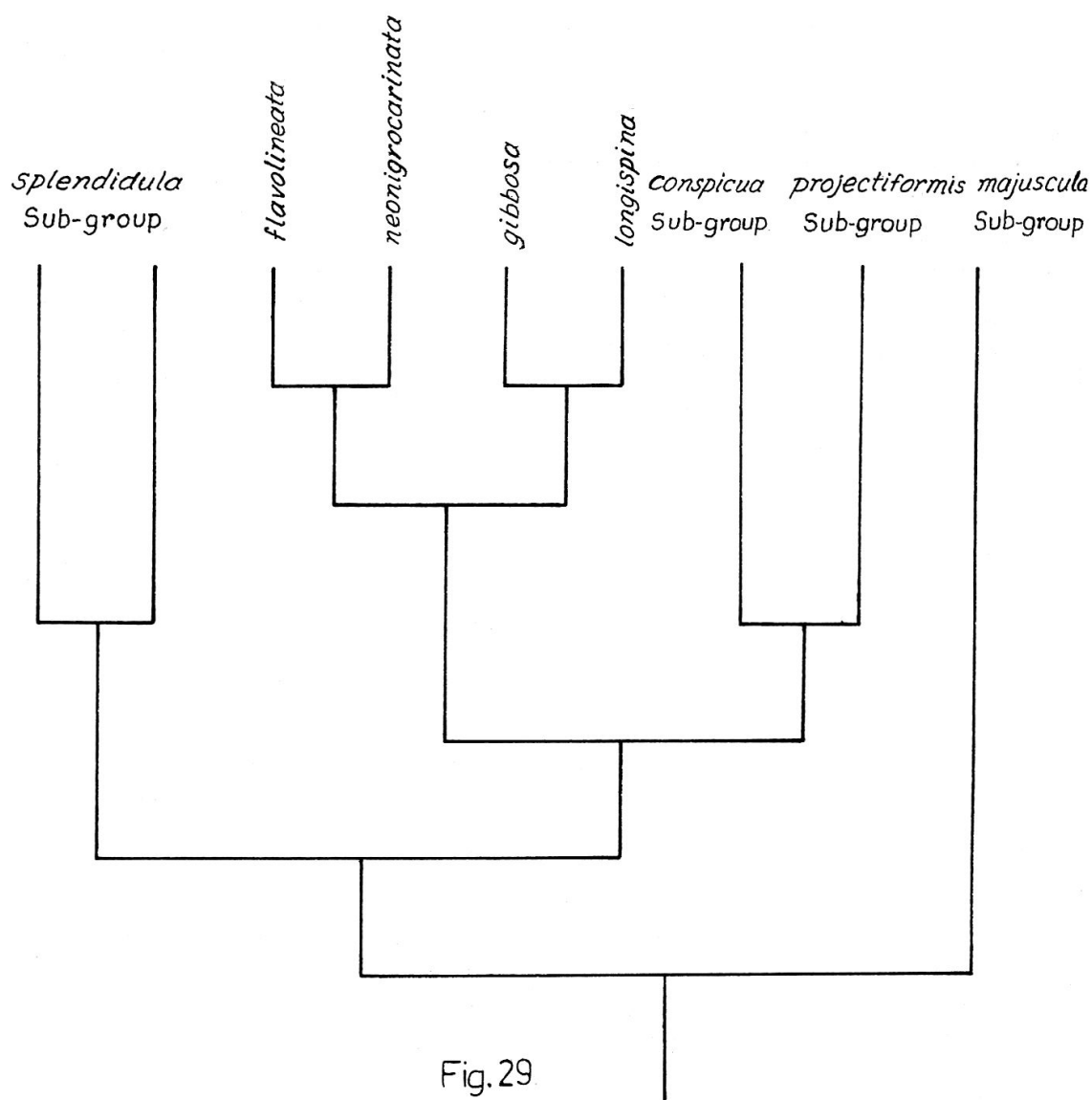


Fig. 29

Fig 29. Cladogram showing the relationships of the included taxa.

The four species of the *G. flavolineata* subgroup described here (Fig. 29) appear to show outgroup relationships to the other eleven species also belonging to the *flavolineata* group (having a distinctly projected head, to be reported on separately). Among the present subgroup (with markedly elongate subgenital plates and second gonapophyses as their synapomorphies and the projection of the head secondarily lost), *G. flavolineata* and *G. neonigrocarinata* on the one hand and *G. gibbosa* and *G. longispina* on the other hand appear to be most closely related and to represent sister groups, showing an outgroup relationship with one another. The former sister group could be defined by the synapomorphy of a depression or constriction in their subgenital plates before apices, the latter by their strongly curved parameral stem. AHMAD (1987) has already discussed plesiomorphies of male genital characters in different tree hopper's genera including *Gargara* AMYOT & SERVILLE.

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