



Significance of Male Supra-Anal Plate and Cerci in the Classification of Indian Acrididae (Orthoptera: Acridoidea)

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ABSTRACT: A comparative study of male supra-anal plate and cerci was carried out in ninety-eight species of grasshoppers representing fifty-seven genera belonging to the family Acrididae. Its taxonomic significance is described. Male supra-anal plate and cerci are considered as external part of male genitalia of Acrididae. Taxonomic significance of internal genitalia such as epiphallus and aedeagus was already known for identification and classification in various families and subfamilies of Acridoidea. However the significance of male supra-anal plate and cerci has not been shown. The aim of this study was an attempt to discover their significance for the identification of grasshopper genera and species. In the study, a comparative investigation of male supra-anal and cerci was undertaken in ninety-eight species of grasshoppers representing fifty-seven genera belonging to the family Acrididae. The study revealed that the shape and size of male supra-anal plate and cerci have significant value in separating various genera and species of Acrididae. Shape of male supra-anal plate and cerci is considered as generic character while the shape of apex of supra-anal plate and cerci is suggested to be a specific character of genera *i.e.* *Oxya*, *Dibolocatantops*, *Xenocatantops*, *Anacridium*, *Heteracris*, *Eucoptacra*, *Schistocerca*, *Choroedocus*, *Acorypha*, *Truxalis*, *Acrida*, *Phlaeoba*, *Orthochtha*, *Aulacobothrus*, *Acrotylus*, *Chloebora*, *Ceracris*, *Aiolopus*, *Oedaleus*, *Heteropternis*, *Bryodema*, *Morphacris*, *Gastrimargus*, *Sphingonotus* *Orchilidia* and *Hieroglyphus*.

Keywords: Significance, Supra-anal plate, Cerci, Classification, Acrididae

INTRODUCTION

Supra-anal plate of male is eleventh tergite known as epiproct. It is triangular in its simplest form lying above the paraproct. Paraprocts are present under the epiproct in half-concealed form. Paraproct represents the eleventh sternite. Cerci are tubular or plate-like appendages arising from the membrane between the joints of epiproct and paraproct. Cerci are sensory in nature. Supra-anal plate and cerci together are used to hold the female abdomen during the course of copulation. A cercus consists of two sclerotised components; the main body and a small lobe which is usually concealed under the supra-anal plate provided

with dense patch of hairs called brustia, possibly sensory (Jannone, 1939). Cerci also function as sense organs, the supra-anal plate is usually triangular and cercus is conical but differs greatly in shape and size. Dirsh (1965) gave brief description of male supra-anal plate and cerci in African genera of Acridoidea. Uvarov (1966) illustrated supra-anal plate and cerci in some species of Acridoidea. Usmani and Ajaili (1994) have shown taxonomic significance of male supra-anal plate in some species of Libyan grasshoppers. Usmani & Khan (2012) have evaluated taxonomic significance of supra anal plate in fifteen Indian species representing fifteen genera of Acridoidea. Kumar *et al.* (2014) made a

comparative study of male supra anal plate and cerci in twelve species representing six genera under four tribes belonging to the family Pyrgomorphidae.

Keeping in view the taxonomic importance of male supra-anal plate and cerci, the present study is an attempt to compare these structures in ninety-eight species representing fifty-one genera of the family Acrididae. The characters i.e., shape of supra-anal plate, cerci and their apices are considered as generic and specific characters respectively.

MATERIALS AND METHODS

For the study of male supra-anal plate and cerci, the apical part of male body was cut off and boiled in 10% KOH solution till the material became transparent. Thus, washed thoroughly in water for complete removal of KOH. It was then dissected with the help of fine needles under stereoscopic microscope in order to take out the supra-anal plate and cerci. The normal process of dehydration was followed and cleaning was done in clove oil. The supra-anal plate and cerci were mounted in Canada balsam on a cavity slide. Drawings were done with the help of Camera lucida.

OBSERVATIONS AND RESULTS

Subfamily Acridinae

1. *Truxalis exemia* Eichwald, 1830 (Fig. 1 A)

Supra anal plate elongate-angular, slightly longer than wide, apex triangularly rounded, cercus narrow, compressed, two and a half times as long as wide, with obtuse apex.

2. *Truxalis nasuta* (Linnaeus, 1758) (Fig. 1 B)

Supra-anal plate elongate-angular, almost as long as wide, sculptured at lateral margins, apex obtusely conical, cercus narrow, compressed, three and a half times as long as wide, with rounded apex.

3. *Acrida exaltata* (Walker, 1859) (Fig. 1 C)

Supra anal plate broadly-angular, slightly longer than wide, lateral margins incurved medially, apex obtusely conical; cercus uniformly broad, less than three times as long as wide, apex broadly rounded.

4. *Acrida turrita* (Linnaeus, 1758) (Fig. 1 D)

Supra-anal plate wide, flattened, wider than long, sculptured laterally, lateral margins slightly incurved apically, apex obtusely-flattened; cercus long, of uniform width, shorter than supra-anal plate, three times as long as wide, apex obtusely-conical.

5. *Acrida gigantea* (Herbst, 1786) (Fig. 1 E)

Supra-anal plate wide, flattened, as long as wide, lateral margins slightly incurved medially, apex obtusely conical; cercus short, shorter than supra-anal plate, slightly less than three times as long as wide, longer than wide, apex obtusely rounded.

6. *Neophaeoba walayarensis* Usmani & Shafee, 1983 (Fig. 1 F)

Supra anal plate broadly triangular, slightly wider than long, apex broadly rounded, cercus broad at base, gradually narrowing apically and downcurved, two and a half times as long as wide, with obtuse apex.

7. *Phlaeoba infumata* Brunner von Wattenwyl, 1893 (Fig. 1 G)

Supra anal plate broadly triangular, curved apically, slightly longer than wide, apex rounded; cercus broad at base, narrowing apically, two and a half times as long as wide, apex obtusely rounded.

8. *Phlaeoba panteli* Bolivar, 1902 (Fig. 1 H)

Supra-anal plate triangular, longer than wide, apex rounded; cercus broad at base, narrowing apically, shorter than supra-anal plate, two and a half times as long as wide, apex rounded.

9. *Phlaeoba tenebrosa* (Walker, 1871) (Fig. 1 I)

Supra-anal plate elongate-angular, longer than wide, apex broadly rounded; cercus conical, narrowing apically, shorter than supra-anal plate, two times as long as wide, apex obtuse.

10. *Phlaeoba angustidorsis* Bolivar, 1902 (Fig. 1 J)

Supra-anal plate elongate narrow, two times as long as wide, apex rounded, cercus elongate, narrowing apically, shorter than supra-anal plate, two and a half times as long as wide, apex rounded.

11. *Phlaeoba antennata antennata* Brunner, 1893 (Fig. 1 K)

Supra-anal plate elongate-angular, as long as wide, lateral margins slightly curved, apex broadly rounded; cercus conical, narrowing apically, shorter than supra-anal plate, slightly less than two times as long as wide, apex obtuse.

12. *Orthochtha indica* Uvarov, 1942 (Fig. 1 L)

Supra anal plate broadly triangular, slightly longer than wide, apex broadly rounded; cercus broad, narrowing apically, two and a half times as long as wide, apex obtuse.

13. *Orthochtha ramchandreae* Popov, 1981 (Fig. 1 M)

Supra-anal plate elongate-angular, as long as wide, lateral margin curved apically, apex obtusely conical; cercus narrow-conical, shorter than supra-

anal plate, slightly more than two times as long as wide, slightly incurved with obtuse apex.

14. *Orthochtha schmidti* Popov & Fishpool, 1992 (Fig.1 N)

Supra-anal plate elongate-angular, lateral margins curved apically, longer than wide, apex obtusely rounded; cercus narrow-conical, shorter than supra-anal plate, two times as long as wide,

slightly incurved with obtuse apex.

15. *Odontomelus manipurensis* Meinodas & Shafee, 1990 (Fig. 1 O)

Supra-anal plate broadly angular, curved apically, as long as wide, apex broadly rounded; cercus broad basally, narrowing apically, shorter than supra-anal plate, two and a half times as long as wide, apex obtusely rounded.

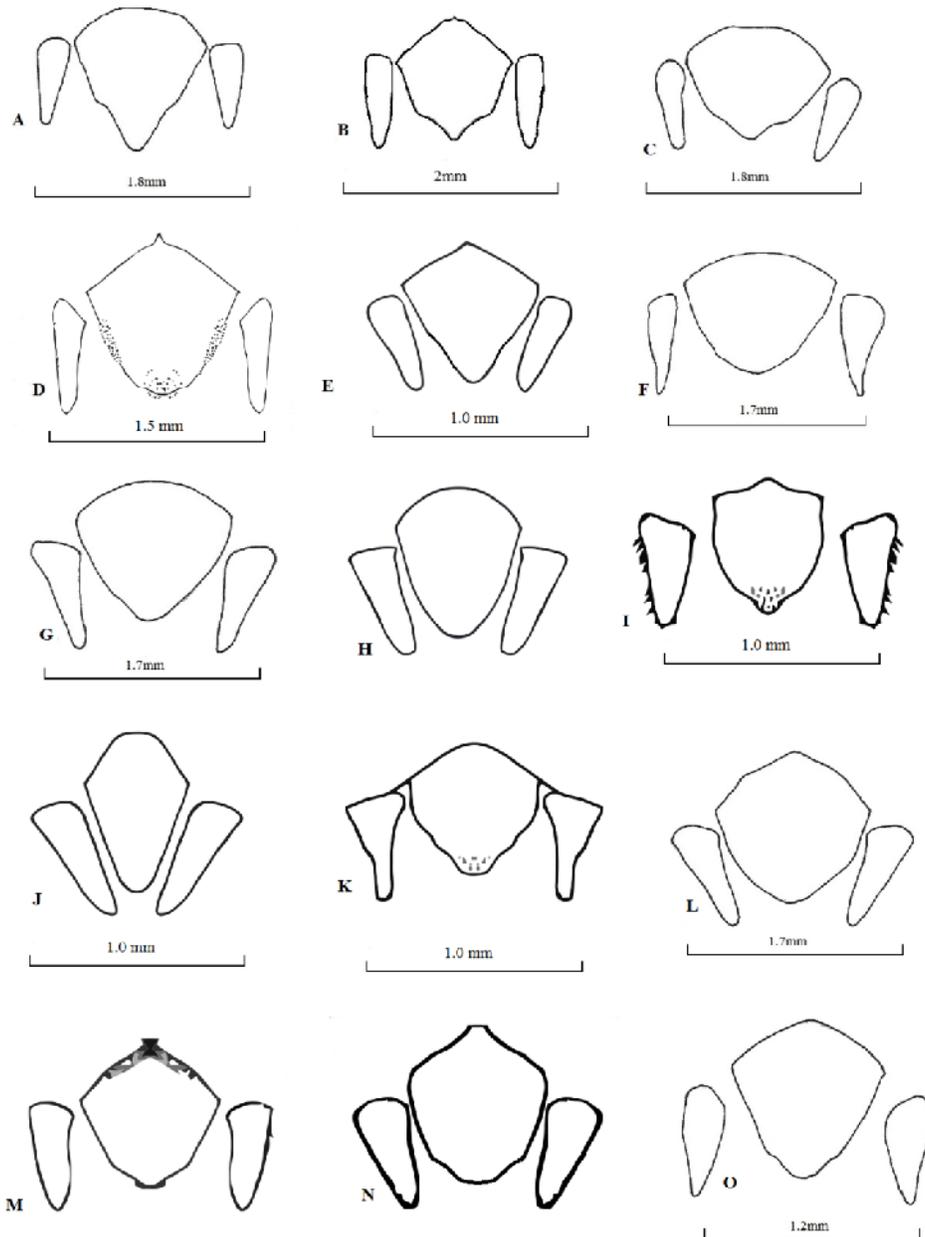


Fig. 1. A-O Supra Anal Plate (Male); A. *Truxalis exemia*, B. *Truxalis nasuta*, C. *Acrida exaltata*, D. *Acrida turrita*, E. *Acrida gigantea*, F. *Neopflaeoba walayarensis*, G. *Phlaeoba infumata*, H. *Phlaeoba panteli*, I. *Phlaeoba tenebrosa*, J. *Phlaeoba angustidorsis* K. *Phlaeoba antennata antennata*, L. *Orthochtha indica*, M. *Orthochtha ramchandreae*, N. *Orthochtha schmidti*, O. *Odontomelus manipurensis*.

Subfamily Gomphocerinae

16. *Chorthippus indus* (Uvarov, 1942) (Fig. 2 A)

Supra-anal plate elongate-angular; curved apically, slightly longer than wide, apex rounded; cercus elongate, narrow-conical, shorter than supra-anal plate, almost three times as long as wide, with obtuse apex.

17. *Dhimbana dawsoni* Henry, 1940 (Fig. 2 B)

Supra-anal plate elongate angular, wider than long, apex obtusely rounded; cercus narrow conical, much shorter than supra-anal plate, one and a half times as long as wide, apex subacute and slightly incurved.

18. *Aulacobothrus strictus* Bolívar, 1902 (Fig. 2 C)

Supra anal plate angular, short, wider than long, lateral margins curved apically, apex broadly rounded; Cercus slightly broad at base, narrow apically, shorter than supra-anal plate, two and a half times as long as wide, apex rounded, acutely conical.

19. *Aulacobothrus taeniatus* Bolivar, 1902 (Fig. 2 D)

Supra-anal plate elongate angular with triangular projection apically, lateral margins curved medially and apically, wider than long, apex obtusely conical; Cercus conical, shorter than supra-anal plate, slightly less than three times as long as wide, apex obtuse.

20. *Aulacobothrus socius* Bolívar, 1902 (Fig. 2 E)

Supra anal plate angular, short, as long as wide, lateral margins curved apically, apex obtusely rounded; Cercus slightly broad at base, narrow apically, shorter than supra-anal plate, slightly more than two times as long as wide, apex rounded, acutely conical.

21. *Aulacobothrus luteipes luteipes* (Walker, 1871) (Fig. 2 F)

Supra anal plate angular, as long as wide, lateral margins slightly curved apically, apex acutely rounded; Cercus elongate, uniformly broad at base, narrow apically, shorter than supra-anal plate, two and a half times as long as wide, apex rounded, acutely conical.

22. *Aulacobothrus luteipes infernus* Bolivar, 1902 (Fig. 2 G)

Supra-anal plate elongate angular with triangular projection apically, lateral margins curved apically, as long as wide, apex obtusely conical; Cercus conical, slightly shorter than supra-anal plate, three times as long as wide, apex obtuse.

23. *Cruciotacris decisa* (Walker, 1817) (Fig. 2 H)

Supra anal plate short, slightly wider than long, lateral margins curved medially and apically, apex obtusely rounded; Cercus slightly broad at base, narrow apically, shorter than supra-anal plate, slightly more than twice as long as wide, apex obtusely rounded.

24. *Leva indica* (Boliver, 1902) (Fig. 2 I)

Supra anal plate broad, short, slightly wider than long, lateral margins curved medially and apically, apex acutely rounded; Cercus uniformly broad, shorter than supra-anal plate, two and a half times as long as wide, apex rounded.

25. *Leva soluta* Bolivar, 1914 (Fig. 2 J)

Supra-anal plate elongate angular with triangular projection apically, lateral margins curved apically, longer than wide, apex obtusely conical; Cercus conical, shorter than supra-anal plate, more than two times as long as wide, apex obtuse.

26. *Stenhippus mundus* (Walker, 1871) (Fig. 2 K)

Supra-anal plate elongate angular with triangular projection apically, lateral margins curved apically, slightly wider than long, apex obtusely conical; Cercus conical, shorter than supra-anal plate, two times as long as wide, apex obtuse.

27. *Orchilidia geniculata* (Bolivar, 1913) (Fig. 2 L)

Supra-anal plate elongate angular, as long as wide, sculptures laterally, apex rounded; Cercus elongate, narrow-conical, narrowing apically, as long as supra-anal plate, four times as long as wide, with obtuse apex.

28. *Ochridia gracilis* (Krauss, 1902) (Fig. 2 M)

Supra-anal plate elongate-angular, slightly longer than wide, sculptured laterally, apex acutely pointed; Cercus narrow-conical, elongate, slightly shorter than supra-anal plate, three and a half times as long as wide, with subacute apex.

29. *Dociopterus (Dociopterus) apicalis* (Walker, 1871) (Fig. 2 N)

Supra-anal plate slightly longer than wide, lateral margin diverging posteriorly, apex broadly rounded. Cercus straight, uniformly broad, shorter than supra-anal plate, two and a half times as long as wide, apex acutely rounded.

30. *Leionotacris bolivari* (Uvarov, 1921) (Fig. 2 O)

Supra-anal plate elongate angular with triangular projection apically, as long as wide, apex obtusely rounded; cercus conical, shorter than supra-anal plate, slightly more than twice as long as wide, apex obtuse.

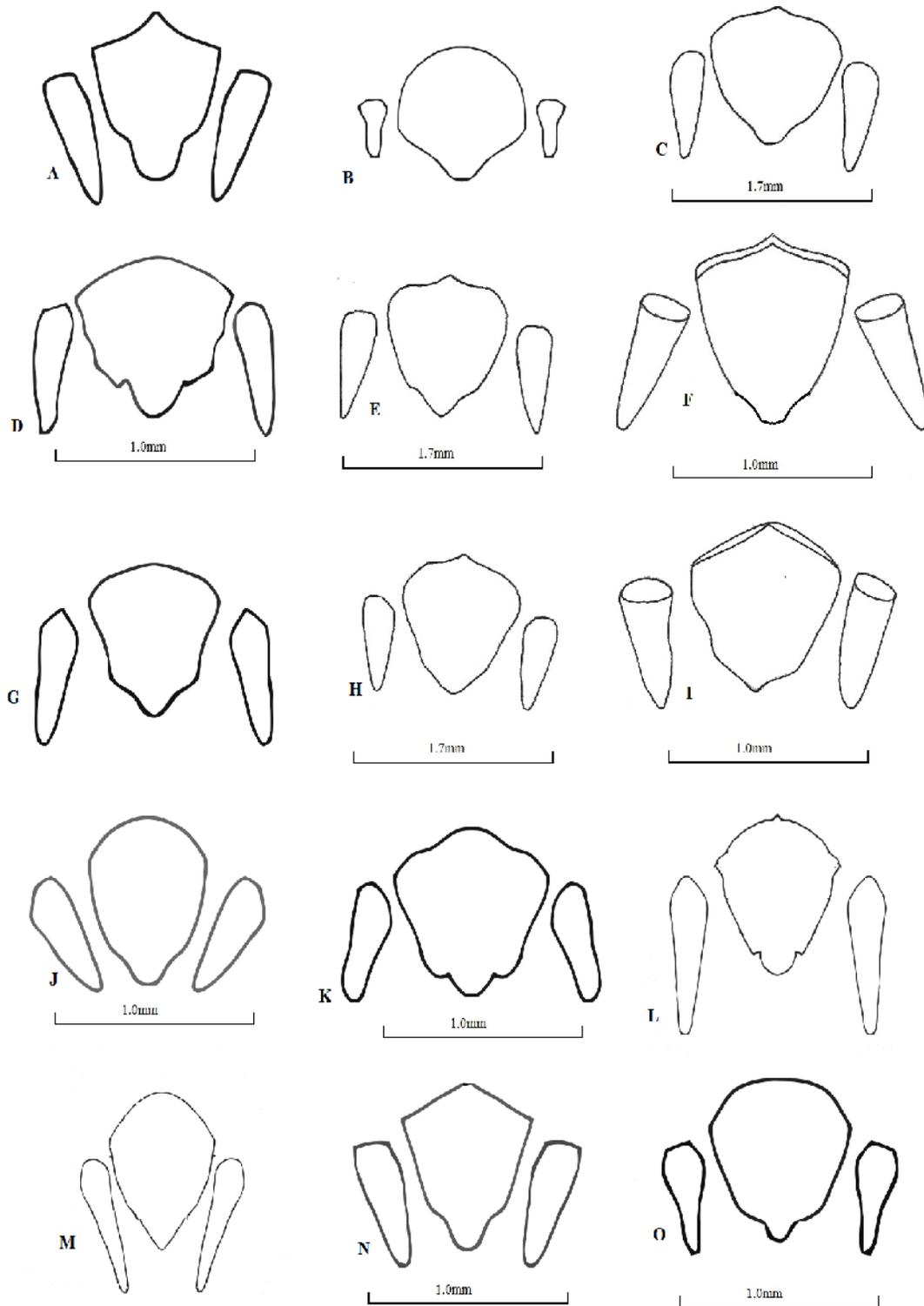


Fig. 2. A-O Supra Anal Plate (Male); A. *Chorthippus indus*, B. *Dhimbana dawsoni*, C. *Aulacobothrus strictus*, D. *Aulacobothrus taeniatus*, E. *Aulacobothrus socius*, F. *Aulacobothrus luteipes luteipes*, G. *Aulacobothrus luteipes infernus*, H. *Cruciotacris decisa*, I. *Leva indica*, J. *Leva soluta*, K. *Stenohippus mundus*, L. *Orchridia geniculata*, M. *Ochrilidia gracilis*, N. *Dociostaurus (Dociostaurus) apicalis*, O. *Leionotacris bolivari*.

Subfamily Oxyinae

31. *Oxya fuscovittata* (Marschall, 1836) (Fig. 3 A)

Supra-anal plate triangular, wider than long, trapezoid, lateral tubercles prominent, posterior lobe slightly less developed, apex bluntly rounded; Cercus broad, longer than supra-anal plate, strongly compressed, slightly more than two times as long as wide, apex bifid.

32. *Oxya japonica japonica* (Thunberg, 1815) (PL.3 Fig. B)

Supra-anal plate rounded triangular, with very well developed basal folds, wider than long, sculptured laterally, apex acutely rounded; Cercus conical, slightly shorter than supra-anal plate, slightly more than two times as long than wide, apex subacute or truncated.

33. *Oxya hyla hyla* Serville, 1831 (Fig. 3 C)

Supra-anal plate trapezoid, as long as wide, with triangular apical projection, at base of this projection, on dorsal surface, on either side there is a small tubercle; Cercus conical or compressed laterally, slightly shorter than supra-anal plate, three times as long as wide, with subacute or truncated apex.

34. *Oxya chinensis* (Thunberg, 1815) (Fig. 3 D)

Supra-anal plate broad, wider than long, lateral margins diverging apically, apex rounded; cercus long and slender, slightly narrowing apically, shorter than the supra-anal plate, two and a half times as long as wide, apex rounded.

35. *Oxya nitidula* (Walker, 1870) (Fig. 3 E)

Supra-anal plate broad, rectangular, as long as wide, lateral margins diverging apically, apex rounded; Cercus long and slender, slightly narrowing apically, slightly longer than the supra-anal plate, two and a half times as long as wide, apex pointed.

36. *Oxya velox* (Fabricius, 1787) (Fig. 3 F)

Supra-anal plate with rounded triangular posterior projection, wider than long; apex obtusely rounded; Cercus conical, shorter than supra-anal plate, three times as long as wide with subacute apex.

37. *Gesonula punctifrons* (Stål, 1861) (Fig. 3 G)

Supra-anal plate triangular, oval, the groove of which tubular in shape, almost as long as wide, large anterior process diverged, tip more or less rounded. Posterior process with notch like structure, below of which bilobed structure present. The upper lobe connected with membrane; Cerci simple, spine like and incurved, shorter than supra-anal plate, three times as long as wide.

38. *Pseudoxya diminuta* (Walker, 1871) (Fig. 3 H)

Supra-anal plate broad, slightly broader than long, lateral margins strongly diverging apically, apex rounded; Cercus elongate, narrowing apically, three times as long as wide, apex acutely rounded.

39. *Lemba motinagar* Ingrisch et al., 2004 (Fig. 3 I)

Supra-anal plate broad, as long as wide, lateral margins slightly diverging apically, apex rounded; Cercus broad basally and gradually narrowing apically, twice as long as wide, apex conical.

Subfamily Hemacridinae

40. *Hieroglyphus banian* (Fabricius, 1789) (Fig. 3 J)

Supra-anal plate longer than wide, apex acute-angular; Cercus elongate, uniformly broad, as long as supra-anal plate, slightly more than four times as long as wide, apex bifurcate.

41. *Hieroglyphus nigrorepletus* Bolívar, 1912 (Fig. 3 K)

Supra-anal plate longer than wide, apex obtuse-angular; Cercus elongate, broad basally, narrowing apically, longer than supra-anal plate, curved inward, slightly more than three times as long as wide, apex truncate.

42. *Hieroglyphus oryzivorus* Carl, 1916 (Fig. 3 L)

Supra-anal plate slightly longer than wide, apex acute-angular or trilobate, cercus of the medium size, shorter than supra-anal plate, two and a half times or four times longer than wide, apex appendiculate.

43. *Hieroglyphus perpolita* (Uvarov, 1933) (Fig. 3 M)

Supra-anal plate angular, broad at base, wider than long, apex obtuse, cercus simple, thick, slightly longer than supra-anal plate, almost three times as long as wide, longer than supra-anal plate, slightly down-curved, with subacute apex.

Subfamily Cyrtacanthacridinae

44. *Anacridium flavescens* (Fabricius, 1793) (Fig. 3 N)

Supra-anal plate broad, slightly trilobate, with annulate apex, sculptured marginally, lateral margins curved medially; cercus elongate, broad at base, narrow and strongly curved apically, about four and a half times as long as wide, incurved with obtuse apex.

45. *Anacridium aegyptium* (Linnaeus, 1764) (Fig. 3 O)

Supra-anal plate broad, slightly trilobate, with annulate apex, sculptured marginally, lateral margins curved medially; cercus elongate narrow, about one and a half times as long as wide, incurved with obtuse apex.

46. *Cyrtacanthacris tatarica* (Linnaeus, 1758)
(Fig. 3 P)

Supra-anal plate slightly trilobate with angular apical lobes, longer than wide, apex obtusely conical; cercus conical, compressed, shorter than supra-anal plate, more than two times as long as wide, apex acute and slightly down curved.

47. *Schistocerca gregaria* (Forskål, 1775) (Fig. 3 Q)

Supra-anal plate elongate-angular, longer than wide, apex attenuate; cercus strongly compressed, shorter than supra-anal plate, more than three times as long as wide, apex almost truncate and slightly incurved.

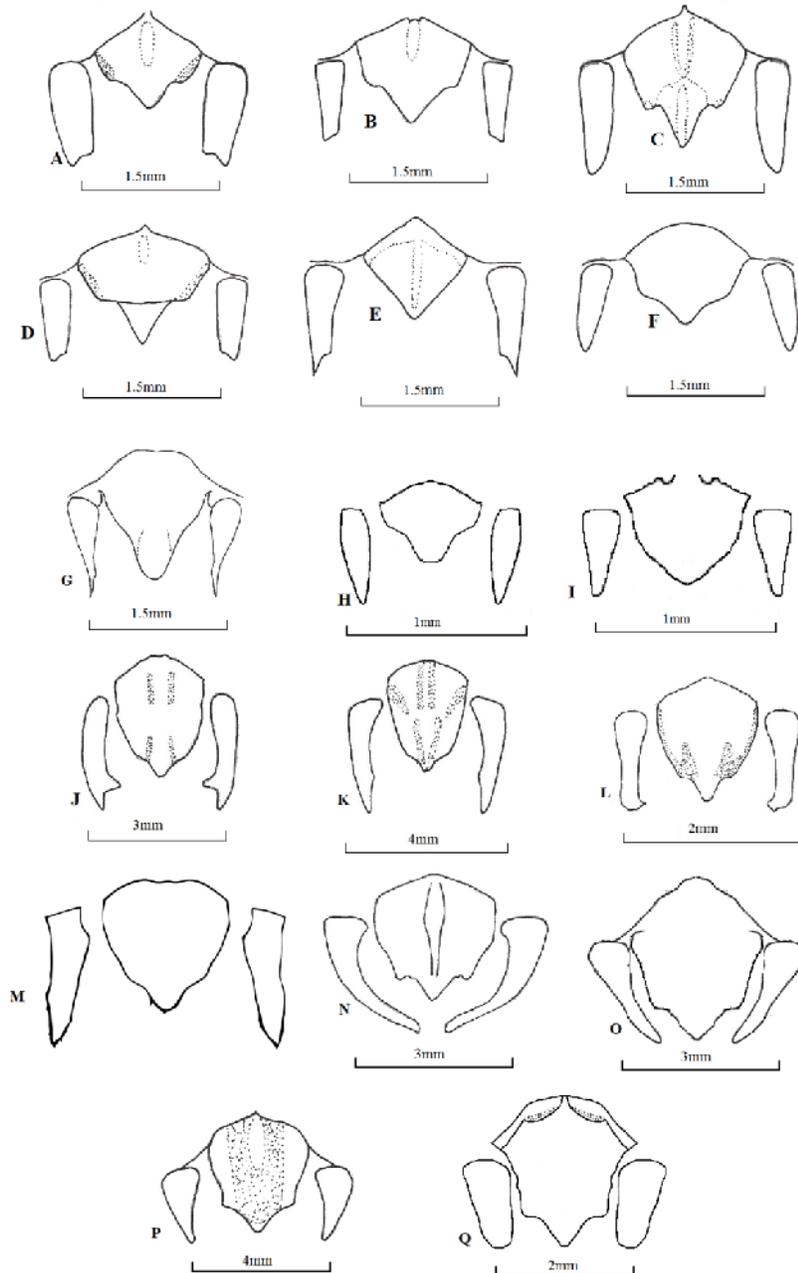


Fig. 3. A-Q Supra Anal Plate (Male); A. *Oxya fuscovittata*, B. *Oxya japonica japonica*, C. *Oxya hyla hyla*, D. *Oxya chinensis*, E. *Oxya nitidula*, F. *Oxya velox*, G. *Gesonula punctifrons*, H. *Pseudoxya diminuta*, I. *Lemba motinagar*, J. *Hieroglyphus banian*, K. *Hieroglyphus nigrorepletus*, L. *Hieroglyphus oryzivorus*, M. *Hieroglyphus perpolita*, N. *Anacridium flavescens*, O. *Anacridium aegyptium*, P. *Cyrtacanthacris tartaric*, Q. *Schistocerca gregaria*.

Subfamily Calliptaminae

48. *Acorypha glaucopsis* (Walker, 1870) (Fig. 4 A)

Supra-anal plate elongate, acutely angular, longer than wide, apex slightly attenuate; cercus robust, incurved, much longer than supra-anal plate, four and a half times as long as wide, apex bilobate.

49. *Acorypha insignis* (Walker, 1870) (Fig. 4 B)

Supra-anal plate short, acutely angular, as long as wide, apex slightly attenuate; cercus robust, incurved, much longer than supra-anal plate, of uniform width, four times as long as wide, apex bilobate.

Subfamily Spathosterninae

50. *Spathosternum prasiniferum* (Walker, 1871) (Fig. 4 C)

Supra-anal plate broadly triangular, as long as wide, curved apically, apex obtusely conical; Cerci uniformly broad, of medium size, shorter than supra-anal plate, three times as long as wide, apex narrowing apically with acutely conical apex.

Subfamily Catantopinae

51. *Pachyacris violascens* (Walker, 1870) (Fig. 4 D)

Supra-anal plate as long as wide, apex rounded or trilobate, cercus of the medium size, slightly longer than supra-anal plate, broad at base, narrowing apically, more than three times as long as wide, apex pointed or acute.

52. *Diabolocatantops innotabilis* (Walker, 1870) (Fig. 4 E)

Supra-anal plate elongate angular, lateral margins curved apically, longer than wide, apex obtusely conical; cercus conical, shorter than supra-anal plate, more than four times as long as wide, apex bilaterally flattened, upcurved and weakly bifurcated with upper lobe rounded and lower lobe obtuse.

53. *Diabolocatantops pinguis* (Stål, 1861) (Fig. 4 F)

Supra-anal plate elongate angular with triangular projection apically, lateral margins curved medially, longer than wide, apex obtusely conical; cercus conical, shorter than supra-anal plate, more than four times as long as wide, apex bilaterally flattened, upcurved and weakly bifurcated with both lobe rounded.

54. *Eupreponotus inflatus* Uvarov, 1921 (Fig. 4 G)

Supra-anal plate elongate angular with triangular projection apically, lateral margins curved apically, slightly longer than wide, apex obtusely conical; cercus conical, slightly incurved, as long as supra-

anal plate, three times as long as wide, apex acute and down curved.

55. *Apalniacris shillong* Ingrisch, Willemse & Shishodia, 2004 (Fig. 4 H)

Supra-anal plate almost rectangular, slightly wider than long, apex short and pointed; Cerci modified, elongate, of uniform width, as long as supra-anal plate, two and half times as long as wide, apex slightly truncated.

56. *Xenocatantops karnyi* (Kirby, 1910) (Fig. 4 I)

Supra-anal plate elongate angular, lateral margins curved apically, longer than wide, apex obtusely conical; cercus broad at base, narrowing apically, strongly curved, slightly longer than supra-anal plate, three and a half times as long as wide, apex conical.

57. *Xenocatantops brachycerus* (Willemse, 1932) (Fig. 4 J)

Supra-anal plate longer than wide, apex obtuse-angular or trilobate, cercus of the medium size, slightly shorter than supra-anal plate, more than three times longer than wide, apex appendiculate.

58. *Xenocatantops humilis* (Serville, 1838) (Fig. 4 K)

Supra-anal plate elongate angular, lateral margins curved medially, longer than wide, apex obtusely conical; cercus conical, longer than supra-anal plate, more than five times as long as wide, apex obtuse.

59. *Stenocatantops splendens* (Thunberg, 1815) (Fig. 4 L)

Supra-anal plate elongate angular, lateral margins curved medially and apically, longer than wide, apex obtusely conical; Cercus conical, weakly compressed laterally, shorter than supra-anal plate, slightly less than four times as long as wide, gradually narrowing towards the rounded apex, slightly in and upwards.

60. *Catantops erubescens* (Walker, 1870) (Fig. 4 M)

Supra-anal plate elongate angular, lateral margins curved medially, slightly longer than wide, apex obtusely conical; Cercus conical, shorter than supra-anal plate, slightly more than four times as long as wide, apex flattened, incurved and rounded.

61. *Navasia insularis* Kirby, 1914 (Fig. 4 N)

Supra-anal plate long and triangular, slightly longer than wide, apex obtusely conical; Cercus broad at base, slightly curved outward apically, as long as supra-anal plate, more than four times as long as wide, apex acute.

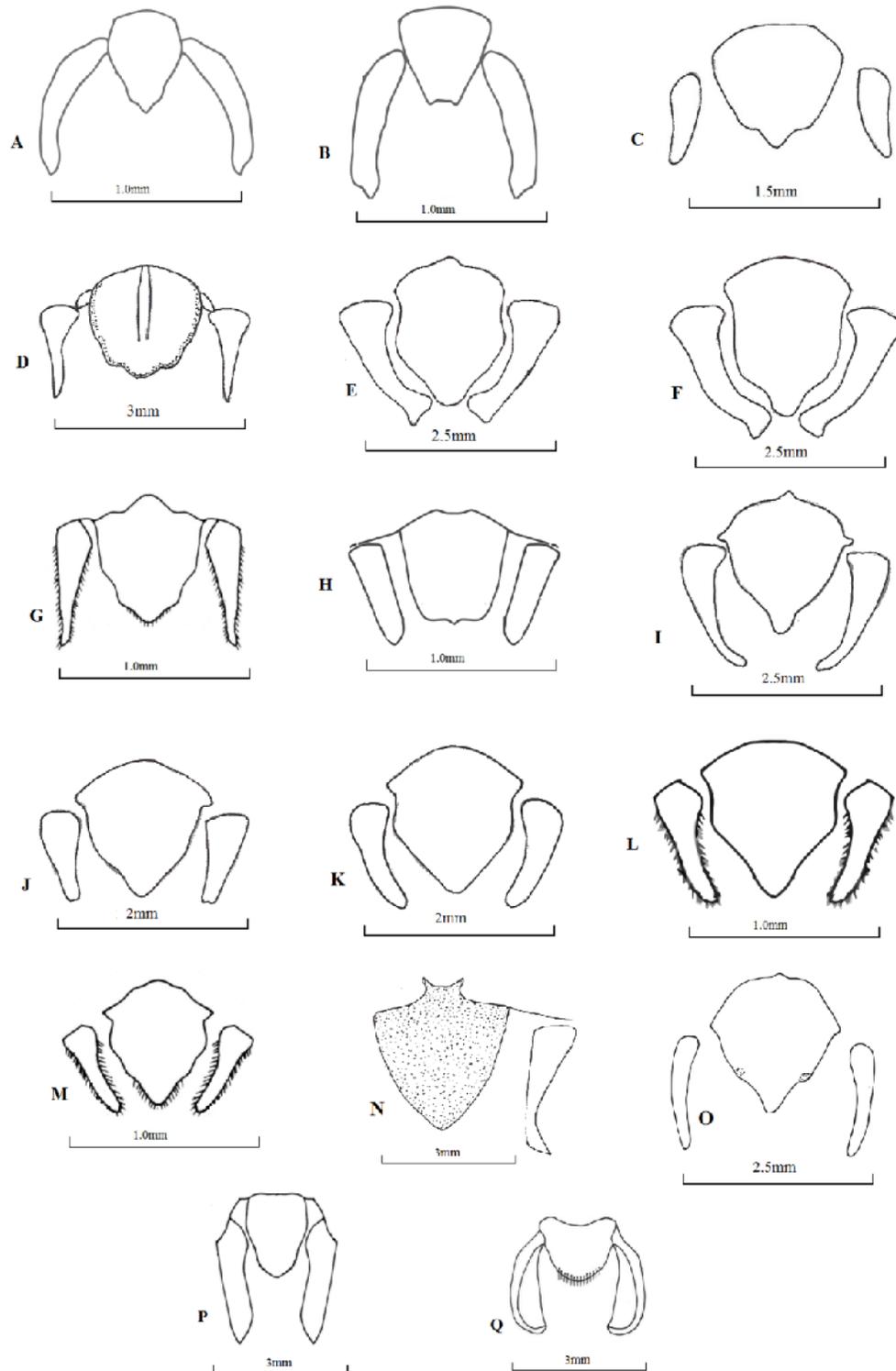


Fig. 4. A-Q Supra Anal Plate (Male); A. *Acorypha glaucopsis*, B. *Acorypha insignis*, C. *Spathosternum prasiniferum*, D. *Pachyacris violascens*, E. *Diabolocatantops innotabilis*, F. *Diabolocatantops pinguis*, G. *Eupreponotus inflatus*, H. *Apalniacris shillong* I. *Xenocatantops karnyi*, J. *Xenocatantops brachycerus*, K. *Xenocatantops humilis*, L. *Stenocatantops splendens*, M. *Catantops erubescens*, N. *Navasia insularis*, O. *Oxyrrhepes obtusa*, P. *Choroedocus illustris*, Q. *Choroedocus robustus*.

62. *Oxyrrhepes obtusa* (Haan, 1842) (Fig. 4 O)
Supra-anal plate long and triangular, lateral margins curved medially, longer than wide, apex obtusely conical; Cercus conical and slightly curved, shorter than supra-anal plate, more than four times as long as wide, apex conical.

63. *Choroedocus illustris* (Walker, 1870) (Fig. 4 P)

Supra-anal plate elongate angular, lateral margins curved apically, longer than wide, apex obtusely conical; Cercus very large, flattened and compressed, slightly incurved, much longer than supra-anal plate, more than three times as long as wide, apex obtusely rounded.

64. *Choroedocus robustus* (Serville, 1838) (Fig. 4 Q)

Supra-anal plate broadly angular, impressed, as long as wide, much shorter than cerci; Cercus very large, elongate-narrow, flattened and compressed, strongly incurved, much longer than supra-anal plate, three times as long as wide, apex pointed.

Subfamily Oedipodinae

65. *Oedipoda miniata miniata* (Pallas, 1771) (Fig. 5 A)

Supra-anal plate elongate-angular, as long as wide, lateral margins curved apically, apex obtuse-angular; Cercus elongate-conical, incurved, slightly more than two times as long as wide, broad basally, tubular apically with obtusely-rounded apex.

66. *Aiolopus simulatrix* (Walker, 1870) (Fig. 5 B)

Supra-anal plate elongate-angular, longer than wide, finely sculptured, lateral margins curved medially, apex elongately conical; Cercus elongate-conical, almost the same length as supra-anal plate, slightly more than two times as long as wide, with obtuse apex.

67. *Aiolopus thalassinus thalassinus* (Fabricius, 1781) (Fig. 5 C)

Supra-anal plate elongate-angular, much longer than wide, sculptured in middle, lateral margins slightly curved medially, apex obtusely rounded; Cercus narrow-conical, shorter than supra-anal plate, two and a half times as long as wide, with obtuse apex.

68. *Aiolopus thalassinus tamulus* (Fabricius, 1798) (Fig. 5 D)

Supra-anal plate elongate-angular, sculptured in middle, lateral margins curved medially, diverging posteriorly, as long as wide, apex obtusely conical; Cercus narrow-conical, as long as supra-anal plate, two times as long as wide with obtuse apex.

69. *Ceracris nigricornis* Walker, 1870 (Fig. 5 E)
Supra-anal plate elongate angular, lateral margins curved medially and apically, slightly longer than wide, apex obtusely conical; Cercus conical, shorter than supra-anal plate, slightly less than three times as long as wide, apex obtuse.

70. *Ceracris deflorata* (Brunner, 1893) (Fig. 5 F)
Supra-anal plate broadly angular, lateral margins slightly curved medially, slightly longer than wide, apex narrowly rounded; Cercus broad basally, narrowing apically, longer than supra-anal plate, two times as long as wide, apex rounded.

71. *Heteropternis respondens* (Walker, 1859) (Fig. 5 G)

Supra anal plate angular, wider than long, lateral margins slightly curved medially and apically, Cercus broad at base, narrow-conical apically, slightly shorter than supra-anal plate, three times as long as wide, with obtuse apex.

72. *Dittopternis venusta* (Walker, 1870) (Fig. 5 H)

Supra anal plate triangular, slightly wider than long, lateral margins curved medially and apically; Cercus broad at base, narrowing apically, shorter than supra-anal plate, three times as long as wide, conical with obtuse apex.

73. *Acrotylus humbertianus* Saussure, 1884 (Fig. 5 I)

Supra anal plate angular, slightly wider than long, lateral margins curved medially and apically, Cercus straight, slightly curved in the middle, slightly shorter than supra-anal plate, two and a half times as long as wide, apex obtusely rounded.

74. *Acrotylus insubricus* (Scopoli, 1786) (Fig. 5 J)

Supra anal plate elongate-angular, slightly longer than wide, apex obtuse, lateral margins curved medially; Cercus broad, slightly shorter than supra-anal plate, slightly more than two times as long as wide, apex obtusely conical.

75. *Gastrimargus africanus* (Thunberg, 1815) (Fig. 5 K)

Supra anal plate elongate-angular, as long as wide, slightly curved medially and apically; Cercus elongate, shorter than supra-anal plate, three and a half times as long as wide, uniformly narrow with conical apex.

76. *Gastrimargus africanus sulphureus* Bey-Bienko, 1951 (Fig. 5 L)

Supra-anal plate elongate angular, lateral margins curved apically, slightly longer than wide, apex obtusely conical; Cercus conical, slightly shorter than supra-anal plate, two and a half times as long as wide, apex obtuse.

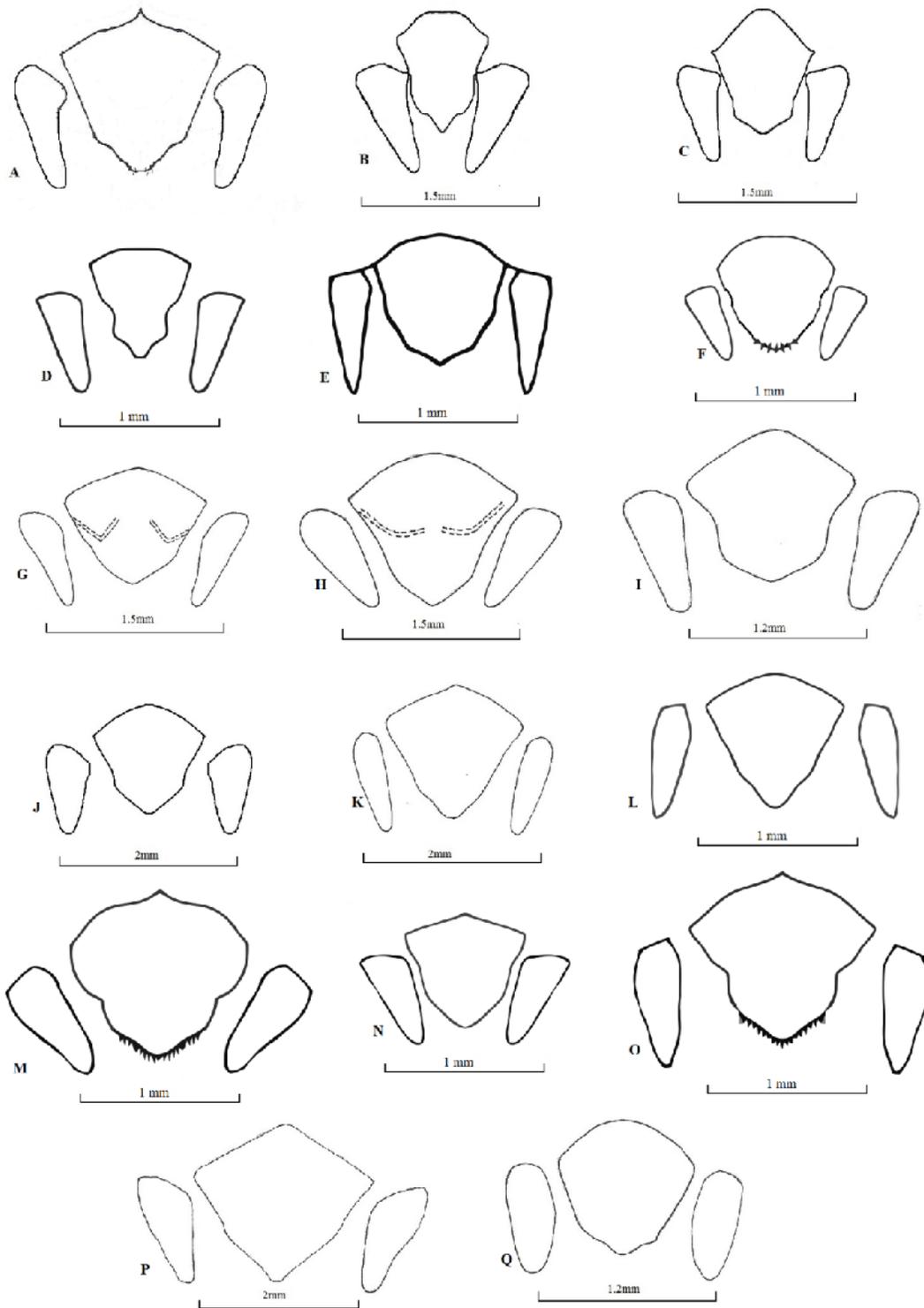


Fig. 5. A-Q Supra Anal Plate (Male); A. *Oedipoda miniata miniata*, B. *Aiolopus simulatrix*, C. *Aiolopus thalassinus thalassinus*, D. *Aiolopus thalassinus tumulus*, E. *Ceracris nigricornis*, F. *Ceracris deflorata*, G. *Heteropternis respondens*, H. *Dittopternis venusta*, I. *Acrotylus humberianus*, J. *Acrotylus insubricus*, K. *Gastrimargus africanus*, L. *Gastrimargus africanus sulphureus*, M. *Chloeobora grossa*, N. *Chloeobora marschalli*, O. *Chloeobora crassa*, P. *Locusta migratoria*, Q. *Trilophidia annulata*.

77. *Chloebora grossa* Saussure, 1884 (Fig. 5 M)

Supra anal plate angular, wider than long, lateral margins curved medially and apically, apex obtusely-rounded; Cercus broad at base, narrowing apically, shorter than supra-anal plate, two times as long as wide, with obtuse apex.

78. *Chloebora marschalli* (Henry, 1933) (Fig. 5 N)

Supra-anal plate elongate angular, lateral margins incurved medially, slightly wider than long, apex obtusely conical; Cercus narrow conical, slightly shorter than supra-anal plate, two times as long as wide, apex obtuse.

79. *Chloebora crassa* (Walker, 1870) (Fig. 5 O)
Supra-anal plate elongate-angular; curved medially and apically, as long as wide, apex obtusely rounded; Cercus narrow conical, broad basally, narrowing apically, more than three times as long as wide, with obtuse apex

80. *Locusta migratoria* (Linnaeus, 1758) (Fig. 5 P)

Supra-anal plate elongate angular, lateral margins incurved medially, slightly longer than wide, apex obtusely conical; Cercus narrow conical, shorter than supra-anal plate, more than two times as long as wide, apex obtuse.

81. *Trilophidia annulata* (Thunberg, 1815) (Fig. 5 Q)

Supra anal plate rounded-triangular, as long as wide, curved apically, apex rounded; Cercus uniformly broad, slightly shorter than supra-anal plate, three times as long as broad, apex broadly rounded.

82. *Oedaleus abruptus* (Thunberg, 1815) (Fig. 6 A)

Supra anal plate angular, longer than wide, curved medially and apically, apex obtusely rounded; Cercus elongate-conical, slightly shorter than supra-anal plate, almost three times as long as wide, with obtuse apex.

83. *Oedaleus senegalensis* (Krauss, 1877) (Fig. 6 B)

Supra anal plate angular, slightly longer than wide, curved medially and apically, apex acutely rounded; Cercus uniformly broad, slightly shorter than supra-anal plate, two and a half times as long as wide, with broadly rounded apex.

84. *Sphingonotus rubescens* (Walker, 1870) (Fig. 6 C)

Supra-anal broad, obtuse-angular, as long as wide, finely sculptured dorsally, lateral margin incurved medially and apically forming an obtuse-angular apex; Cercus elongated, broad basally,

narrowing apically, slightly incurved, two and a half times as long as wide, apex obtuse-conical (Fig. 6 C).

85. *Sphingonotus savignyi* Saussure, 1884 (Fig. 6 D)

Supra anal plate angular, slightly longer than wide, curved medially and apically, apex acutely rounded; Cercus uniformly broad, shorter than supra-anal plate, three times as long as wide, curved medially, with truncated apex.

86. *Morphacris fasciata* (Thunberg, 1815) (Fig. 6 E)

Supra-anal plate angular, as long as wide, curved medially and apically apex acutely rounded; Cercus elongate, slightly incurved, slightly shorter than supra-anal plate, two and a half times as long as wide, with rounded apex.

87. *Bryodema luctuosa inda* Saussure, 1884 (Fig. 6 F)

Supra-anal plate triangularly shield-like, lateral margins curved medially and apically, much wider than long, apex obtusely conical; Cercus conical, shorter than supra-anal plate, two times as long as wide, apex rounded.

88. *Scintharista notabilis* (Walker, 1870) (Fig. 6 G)

Supra-anal plate angular, longer than wide, lateral margins curved medially, apex obtusely rounded; Cercus broad basally, curved, narrowing apically, shorter than supra-anal plate, three times as long as wide with obtuse apex.

Subfamily Eyprepocneminae

89. *Eyprepocnemis alacris* (Serville, 1838) (Fig. 6 H)

Supra-anal plate elongate angular, longer than wide, apex attenuate; Cercus narrow and conical, longer than supra-anal plate, more than three times as long as wide, apex acute, incurved and slightly down curved.

90. *Tylotropidius varicornis* (Walker, 1870) (Fig. 6 I)

Supra-anal plate elongate-angular, longer than wide, apex slightly attenuate; Cercus long and conical, slightly compressed, slightly shorter than supra-anal plate, slightly less than three times as long as wide, apex subacute.

91. *Heteracris nobilis* (Brancsik, 1893) (Fig. 6 J)

Supra-anal plate broadly triangular, longer than wide, apex obtusely conical, Cercus moderately broad, strongly compressed, slightly longer than supra-anal plate, more than three times as long as wide, apex rounded, incurved and down curved.

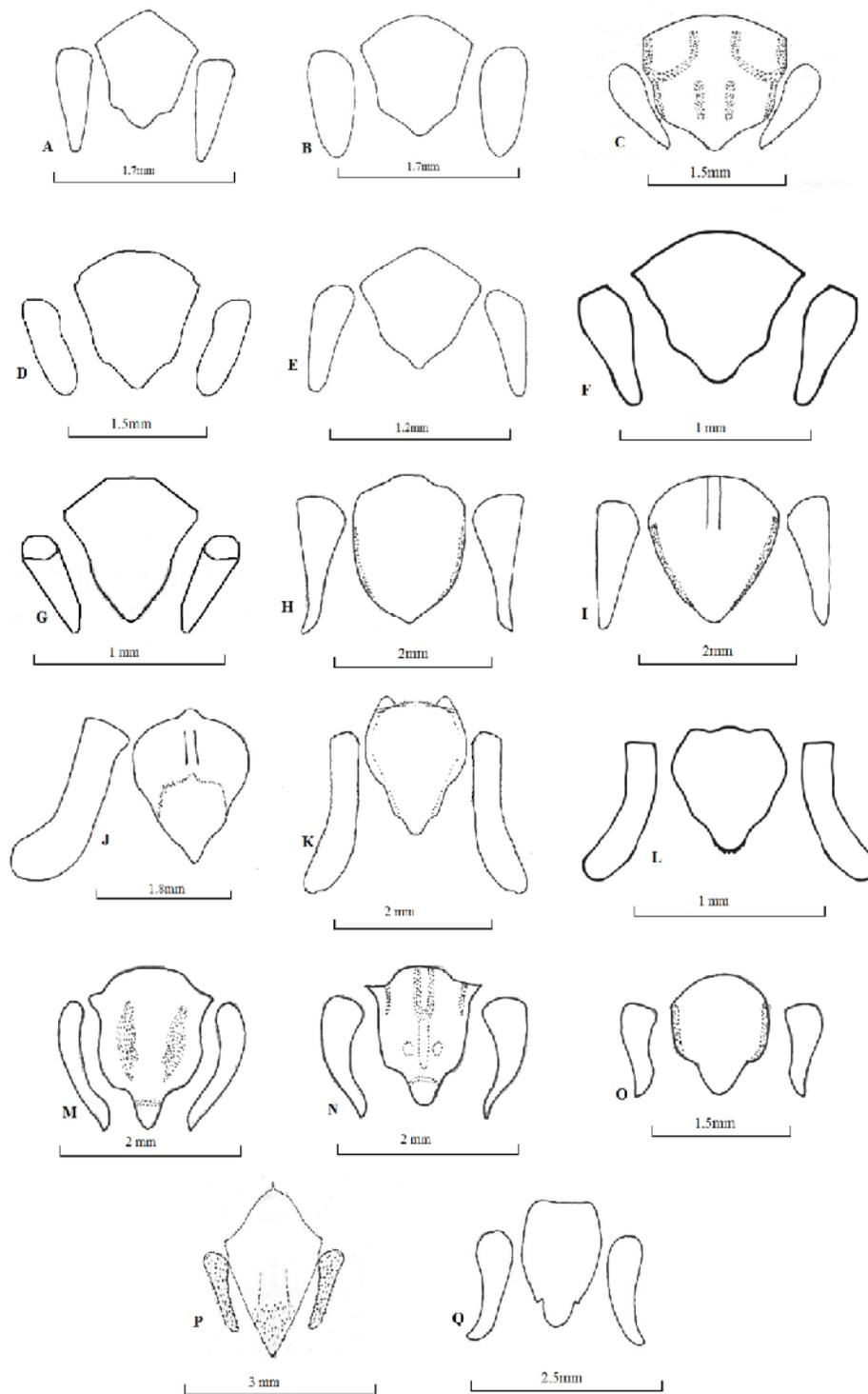


Fig. 6. A-Q Supra Anal Plate (Male); A. *Oedaleus abruptus*, B. *Oedaleus senegalensis*, C. *Sphingonotus rubescens*, D. *Sphingonotus savignyi*, E. *Morphacris fasciata*, F. *Bryodema luctuosa inda*, G. *Scintharista notabilis*, H. *Eyrepocnemis alacris*, I. *Tylotropidius varicornis*, J. *Heteracris nobilis*, K. *Heteracris littoralis*, L. *Heteracris pulcher*, M. *Eucoptacra binghami*, N. *Eucoptacra praemorsa*, O. *Epistaurus aberrans*, P. *Tropidopola longicornis longicornis*, Q. *Tristria pulvinata*.

92. *Heteracis littoralis* (Rambur, 1838) (Fig. 6 K)

Supra-anal plate broadly triangular, longer than wide, apex obtusely conical; Cercus moderately broad, strongly compressed, longer than supra-anal plate, more than four times as long as wide, apex rounded, incurved and down curved.

93. *Heteracris pulcher* (Bolivar, 1902) (Fig. 6 L)

Supra-anal plate broadly triangular, wider than long, lateral margins curved medially, apex obtusely rounded; Cercus moderately broad, strongly compressed, longer than supra-anal plate, four times as long as wide, apex rounded, incurved and down curved.

Subfamily Coptacridinae

94. *Eucoptacra binghami* Uvarov, 1921 (Fig. 6 M)

Supra-anal plate elongate-angular, longer than wide, apex triangularly rounded; Cercus moderately broad and conical, compressed laterally, decurved, shorter than supra-anal plate, more than four times as long as wide, apex slightly truncated;

95. *Eucoptacra praemorsa* (Stål, 1861) (Fig. 6 N)

Supra-anal plate elongate-angular, longer than wide, with apex triangularly rounded; Cercus broad at base and narrowing apically, laterally compressed, decurved, as long as supra-anal plate, three times as long as wide, apex acute and outcurved.

96. *Epistaurus aberrans* Brunner von Wattenwyl, 1893 (Fig. 6 O)

Supra-anal plate elongate, slightly less than two times as long as wide, lateral margin straight apically, diverging apically, forming bluntly rounded apex; Cercus elongate, uniformly broad, narrowing apically, apex blunt and excurved, slightly less than three times as long as wide.

Subfamily Tropidopolinae

97. *Tropidopola longicornis longicornis* (Fieber, 1853) (Fig. 6 P)

Supra-anal plate elongate-angular, much longer than wide, apex acutely conical; Cercus moderately broad, much shorter than supra-anal plate, two and a half times as long as wide, apex truncated, widened and compressed.

98. *Tristria pulvinata* (Uvarov, 1921) (Fig. 6 Q)

Supra-anal plate oblong, distinctly longer than wide, apex obtusely rounded; Cercus subconical in basal two-thirds, apical third compressed, shorter than supra-anal plate, three times as long as wide, down curved with acute apex.

CONCLUSION

Earlier studies on the systematic of Acridoidea were exclusively based on conventional characters like color, size, texture, number of antennal segments etc. The recent trends in Acridid systematic is mainly based on genitalic characters. Insect male external genitalia present rich structural details, which are remarkably uniform within a species, presenting only a small range of variation. Involvement of sexual features, including sexual behaviour, has been referred to as sexual selection. While Natural Selection leads to taxonomic diversity, sexual selection operates within the limits of a population or a species (Verma, 2012).

Uvarov (1966) described the morphology of genitalic structures and their importance in the classification of Acridoidea. However no attempt has been made to study the significance of male supra-anal plate and cerci at generic and specific level. In the present study, five specimens of each species were examined in order to study the male supra-anal plate and cerci, which represent the external genitalia of male copulatory organs, and exist in some groups very stable and reliable.

Comparative study of male supra-anal plate and cerci in ninety-eight species from the family Acrididae revealed morphology of supra-anal plate and cerci and the shape of their apices can be considered as diagnostic characters of various genera and species. Supra-anal plate broadly triangular, cercus large and wide in *Heteracris*; supra-anal plate slightly trilobite, lateral margin curved apically, cercus narrow, incurved in *Anacridium*, *Heiroglyphus* and *Eucoptacra*; supra-anal plate elongate-angular, cercus wide, strongly compressed in *Schistocerca*; supra-anal plate elongate-angular, lateral margins incurved medially, cercus broad in *Acrotylus*, *Chloebora*; supra-anal plate elongate-angular, lateral margin curved apically, and apically, cercus conical in *Aiolopus*, *Ceracris*; supra-anal plate angular, cercus narrow-conical in *Oedaleus*, *Gastrimargus*, *Heteropternis*, *Dittopternis* and *Locusta*; supra-anal plate angular, curved medially and apically, cercus curved medially in *Sphingonotus*, *Morphacris* and *Bryodema*; supra-anal plate elongate-angular, lateral margin curved apically, cercus elongate, narrow-conical in *Ochrilidia*, *Aulacobothrus* and *Xenocatantops*; supra-anal plate elongate-angular, slightly curved apically, cercus narrow, compressed in *Truxalis* and *Acrida*; supra-anal plate angular, cercus broad, curved medially with obtuse apex in *Phlaeoba*; supra-anal plate angular, slightly curved apically, cercus

curved medially, conical in *Orthochtha*; supra-anal plate triangular, cercus wide, compressed, truncated apically in *Oxya*; supra-anal plate short, triangular, cercus elongate, wide, compressed, truncated at apex in *Acorypha* and *Choroedocus*; These findings together with other generic characters may help in the identification of the different genera of Acrididae.

Shape and ratio of length and width of supra-anal plate are suggested as generic character while ratio of length and width of cerci and shape of their apices are suggested as specific characters in separating various species of the genera *Oxya*, *Dibolocatantops*, *Xenocatantops*, *Anacridium*, *Heteracris*, *Choroedocus*, *Acorypha*, *Eucoptacra*, *Truxalis*, *Acrida*, *Aulacobothrus*, *Orthochtha*, *Acrotylus*, *Aiolopus*, *Phlaeoba*, *Morphacris*, *Oedaleus*, *Sphingonotus*, *Gastrimargus*, *Orchilidia*, and *Hieroglyphus*.

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