ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

Taxonomy and Ecology of Genus *Euconocephalus* Karny, 1907 (Orthoptera: Tettigonioidea: Conocephalinae) from Pakistan

*** Waheed Ali Panhwar, Riffat Sultana, Muhammad Saeed Wagan, Yawar Saeed Wagan , Santosh Kumar and Faheem Haider Solangi**

Department of Zoology, University of Sindh, Jamshoro, Pakistan

Manuscript Info

Manuscript History:

Received: 24 December 2013
Final Accepted: 15 January 2014
Published Online: February 2014

Key words:
Euconocephalus, Conocephalinae, valuable crops economic loss, distribution

Corresponding Author

Riffat Sultana

Abstract

The grasshopper insects belonging to the genus *Euconocephalus* are of considerable economic importance in Pakistan. They cause constant threat to the valuable crops economic loss to mankind in Pakistan. They are well-known as the "Cone-Headed Grasshoppers". During the present survey a total of 851 specimens of Conocephalinae pertaining to single genus *Euconocephalus* were collected from various localities of Pakistan the material was sorted out into 05 species i-e :*Euconocephalus incertus*, Walker 1869 *E. indicus* (Redtenbacher, 1891) , *E. nasutus* Thunberg, 1815 , *E. mucro* de Haan, 1842 and *E. pallidus*, Redtenbacher, 1891, and *Euconocephalus* sp. Beside this, morphological characters along with ecological account , measurements of different body parts and distribution at district level from Pakistan was provided.

.

1.Introduction

Pakistan is a biologically diverse region mainly due to its rich vegetation and favorable climatic condition which made it trouble-free region for breeding of different insects groups. Amongst insects orders Orthoptera is a relatively well studied insects order throughout the world including Pakistan (Riffat & Wagan 2012). Additionally, Uvarov (1921) declared this group as marker group for biogeographically evaluation of the region. Basically it is divided in to 02 diversify groups i-e Ensifera & Caelifera. There is reasonable taxonomic work has been done on the Caelifera by Karny, 1907; Ragge, 1961; Beier, 1972; Rentz, 1979; Gorochov, 1988, Wagan 1990 & Riffat & Wagan 2007-2010.

But unfortunately, Ensifera of Pakistan is less studied due to lack of extensive surveys and modern identification pattern. Still now 03 sub-families of Tettigonioidea has been described from Pakistan (Riffat *et al*., 2012). At the present the representative of genus *Euconocephalus* Karny, 1907 belonging to sub-family Conocephalinae which are known as the Cone-headed grasshoppers is being studied for the first time from this region. Actually, these are strictly nocturnal insect hide themselves during day time under rolled leaves and cracks occurring in the soil or some time mixed vegetation cover of spring and early summer flowering plants, tall hush and thick grasses along with woody shrubs also protected these insects from predators or collectors. However, for the present study surveys have been carried out during night time when insects were active. Beside this, systematic account along with taxonomic key & photographs were also provided for future researchers in this field.

Material and Methods

Collection of Samples:

The adults of *Euconocephalus* were collected from the different crops such as rice, sugarcane, wheat, maize and forests. However, some specimens were also collected from orchards & grapevine fruits surrounding by other vegetation with the help of traditional insect hand-net having diameter (8.89 cms in width and 50.8 cms in length). The collection was made from various provinces of Pakistan during the year 2013 and material examined from the following districts of Pakistan: **Sindh:** Karachi, Jamshoro, Tharparkar Hyderabad, Khairpur, Benazirabad,

Sakrand Dadu, Badin & Tando Muhammad Khan **Balochistan:** Gwadar , Khuzdar , Jafarabad Kalat Quetta Dali, **Punjab:** Attok , Bahawlnangar, ,Chakwal; Dodual , Sahiwal Jhelum , **Khyber Pakhtunkhwa**: Abbotabad, Batagram , Haripur, Mansehra, Noushera Mardan , Charsadda & Kohat .(See Fig.1)

Killing and preservation of grasshoppers

For killing and preservation of specimens standard entomological methods described by Vickery & Kevan (1983) and Riffat & Wagan (2012) was adopted for all the collected species.

Identification & Drawing lines of the samples

Identification of specimens was carried out under the Stereoscopic Dissecting Binocular Microscope with the help of keys and description available in literature while some of the specimens have been confirmed by Dr. David Rentz an Adjunct Professor at the James Cook University and an Honorary Fellow of the California Academy of Sciences, Australia. The diagrams were all drawn with the help of "Ocular Square Reticule" fitted in one Ocular of Binocular dissecting microscope. All the measurements are given in millimeter and were made with scale, divider, and ocular square graph

RESULTS & DISCUSSION

Systematic Account

Genus *Euconocephalus* Karny, 1907

Euconocephalus Karny**,** 1907, p.39 (as subgenus of Concephalus).

Type species: Locusta acuminata Fabricus (=Concephalus nasutus Thunberg, Euconocephalus indicus (Redtenbacher) Conocephalus indicus Redtenbacher, 1891, p408

Diagnosis:

Fastigium of the vertex extending beyond the base of the antennae, not pointed or elongate, fastigium separated from the frons by a notch, the tubercle at the base of fastigium small. Eyes spherical not oval, head not pronouncedly elongate, rounded Pronotum with side keels deep rather than long, hind invagination of the pronotum marked in most species. Fore tibiae with spines ventrally, knees armed. Wings long not brachypterous, male stridulatory rib characteristic for each species. Hind femora with spines ventrally, knees armed. Ovipositor long and straight.

Key to the species of *Euconocephalus* occurring in the Pakistan

1. Fastigium separated frons by notch pronotum with side keels (Plate.i,e) ----------**2**
-- Fastigium short, Pronotum elongated with or without keels (Plate.ii,a) ----------**3**
2. Cerci in male thick (Plate.i, h) Ovipositor long and straight (Plate.i,g) ----------***E.incertus***
-- Fastigium short and blunt and extending beyond the antennal segment ----------**4**
3. Cerci in male thick at the basal half and pointed at apex (Plate. ii ,f) ----------***E.pallidus***
-- Fastigium long finely pointed cerci thick at the basal and thin at the middle (Plate.iii, d)---------- ***E.mucro***
4. Hind femora and fore tibia with numerous ventral spines (Plate.iv,a)---------- ***E.nasutus***
--- Hind femur with seven minute external and 14 internal spines while fore tibia having six internal & six external spines (Plate.v ,a)----------***E.indicus***

***Euconocephalus incertus*, Walker 1869**

Conocephalus incertus Walker, F. 1869
Ecuconocephalus breviceps (Redtenbacher, 1891)
Ecuconocephalus chagosensis (Bolívar, 1912)
Euconocephalus incertus Uvarov. 1922. Jour. Bombay Nat. Hist. Soc. 28(3):735
Euconocephalus incertus Karny. 1926. Treubia 9(1-3):252

(Plate.i, a-h)

Diagnostic features:

Body medium to large slender in shape, green or yellowish-brown in color(Plate.i, a-d); head cone shaped pointed fastigium extending beyond the antennal sockets; eyes spherical; fastigium separated from frons by a notch; pronotum with side keels (Plate. i, e, f), tegmen and wings fully developed; wings transparent with green veins; stridulatory organ exposed on the left tegmina, hind femora surpassing beyond the end of abdomen; hind femora and fore tibiae with ventral spines. Cerci in male thick at the basal half and slightly pointed at apex (Plate. i, h).Cerci in female thick at basal half and thin at the apex. Ovipositor long and straight (Plate. i, g).

Table: I

Showing measurement of various body parts of *E. incertus*

Body Parameters	Male (n=15)			Female (n=15)		
	Mean± SD	LSD	Min-Max	Mean± S D	LSD	Min-Max
Length of pronotum	10.02±0.18	A	9.7-10.3	8.11±0.23	A	7.8-8.5
Length of tegmina	47.06±0.28	B	46.6-47.5	48.02±0.25	B	47.6-48.5
Length of femur	25.99±0.26	C	25.7-26.3	26.94±0.31	C	25.5-27.5
Length of ovipositor	------	---	---	25.96±0.21	D	25.5-26.3
Total body length	34.05±0.28	D	33.5-34.5	32.96±0.27	E	32.5-33.5

Note: *The letter indicate a significant difference (P<0.01) according to LSD test

Remarks:

This is widely distributed species occurring all over the country. During present study, it has been collected mostly from grasslands with scattered bushy vegetation along with tree of *Accacia nilotica* this host plant is being reported for the first time. Beside this, local movement within the habitat by flight, walking, and jumping of insects was observed in field. Collection of its in large numbers has confirmed that this is widespread species of Pakistan.

***Euconocephalus pallidus* Redtenbacher, 1891**

Conocephalus pallidus Redtenbacher. 1891. Verh. der Zoologisch-Botanischen Gesellsch. Wien 41:383, 414
Conocephalus pallidus Brunner von Wattenwyl. 1893. Ann. Mus. Civ. Stor. Nat. Genova 2 13(33):180
Conocephalus pallidus Bolívar, I. 1900[1899]. Ann. Soc. ent. Fr. 68:776
Euconocephalus pallidus Karny. 1912. Genera Insectorum 139:35
Euconocephalus pallidus Karny. 1926. Treubia 9(1-3):253

(Plate.ii ,a-f)

Diagnostic features:

Body medium to large sized slightly cylindrical green (Plate. ii, a, d); antennae brown in color; fastigium short; pronotum with or without keels (Plate. ii ,b, c); pronotum elongate; wings and tegmen fully developed; (a narrow black line on the extreme anterior margin of the tegmen is present) fore tibiae with ventral spinulose; Stridulatory organ present on left tegmen relatively slender shaped; cerci thick at the basal half and pointed at apex (Plate. ii, f). Ovipositor long slightly straight tapers to apex (Plate. ii, e).

Table: II

Showing measurement of various body parts of E. pallidus

Body Parameters	Male (n=15)			Female (n=15)		
	Mean±SD	LSD	Min-Max	Mean±SD	LSD	Min-Max
Length of pronotum	7.97±0.27	A	7.5-8.4	7.36±0.17	A	7.1-7.7
Length of tegmina	47.08±0.3	B	46.5-47.5	43.5±44.3	B	43.5-44.3
Length of femur	22.99±0.27	C	22.5-23.5	23.04±0.30	C	22.5-23.5
Length of ovipositor	------	---	---	23.03±0.31	D	22.5-22.6
Total body length	34.02±0.23	D	33.7-34.5	28.06±0.35	E	27.5-28.8

Note: *The letter indicate a significant difference (P<0.01) according to LSD test

Remarks:

This species like *E.incertus* occur in tall and lush vegetation of scattered grasses along with long pine trees near the roadside. Earlier, this species was collected from Calcutta, India, Ceylon Burma, Tonkin, Penang and Singapore, Java and Philippines (Hebard, 1920). Careful comparison of our specimens from Tan (2011) showed that our specimens' smaller in size it might be due to geographically variation of the region or might be due to less collection

of Tan (2011). He reported 07 males from Singapore. At the present, we have collected such large numbers from different district of Pakistan. It is widely distributed species, but less in population as compared to *E. incertus*.

***Euconocephalus mucro* de Haan, 1842**
(*Conocephalus) mucro* Haan. 1842.
Eucoocephalus sobrinus (Bolívar, 1884)
Euconocephalus mucro Karny. 1926. Treubia 9(1-3):249

(Plate.iii, a-d)
Diagnostic features:
Pronotum larger than the head; pronotum (Plate.iii, b-c) broader distally, compressed ventrally; fastigium with horizontal elongated dark marks on lateral side; Body slender shaped with silky brown coloration (Plate.iii, a); antennae dark brown in color. Fastigium long fairly pointed and extending beyond the antennal sockets; tegmen and wings fully developed. Costal margin of tegmen pale throughout, latter a series of slight darkening is apparent. Left stridulatory file crescent-shaped, relatively broad. Cerci thick at the basal half and thin at middle (Plate.iii, d).

Table .III

Showing measurement of various body parts of *Euconocephalus mucro*

	Male (n= 07)		
Body Parameters	**Mean±SD**	**LSD**	**Min-Max**
Length of head	**4.71±0.14**	**A**	**4.55-4.9**
Length of pronotum	**8.25±0.41**	**B**	**8.05-9.0**
Distance b/w comp eyes	**2.13±0.24**	**C**	**1.75-2.40**
Length of tegmina	**33.65±0.65**	**D**	**33.1-34.5**
Length of femur	**23.6±0.11**	**E**	**22-25**
Length of tibia	**19.6±0.13**	**F**	**18-21**
Total body length	**31.4±0.23**	**G**	**29-35**

Note: *The letter indicate a significant difference (P<0.01) according to LSD test

Remarks:
This species is mostly collected from mixed vegetation cover of spring and early summer flowering plants along with tall grasses and low wood shrubs. Unlike *E. nasutus* it is also very interesting to note that their only male has came in collection. Although, many other trips at different dates were made to same localities but unfortunately we did not find the female of this species. It might be due to less survival of female after oviposition or may be another reason. Nevertheless, it is to be hoped that more extensive survey of different localities at different timing of the year will certainly, resolved this problem**.**

***Euconocephalus nasutus* Thunberg, 1815**
Conocephalus nasutus Thunberg. 1815. Mem. Acad. Imp. Sci. St. Peterburg 5:273
Conocephaloides nasutus Kirby, W.F. 1906. A Synonymic Catalogue of Orthoptera (Orthoptera Saltatoria, (*Locustidae vel Acridiidae*) 2:250
Euconocephalus Hebard. 1922. Proc. Acad. Nat. Sci. Philad. 74:240
Euconocephalus nasutus Vickery, D.K.M. Kevan & Stanford English. 1999. Micronesica 32(1):56 [264]

(Plate.iv ,a-d)
Diagnostic features:
Body slendrical in shape medium to large size, greenish in color (Plate.iv,a); antennae pale brown in color;Pronotum with lateral white band (Plate.iv,b,c) ;fastigium short and blunt; fastigium extending beyond the antennal sockets; tegmen fully developed; wings with transparent cells,bright green veins;hind femora and fore tibiae with ventral spines. Cerci of female pointed at apex and thin at apex. Ovipositor long straight (Plate.iv, d).

Table: IV

Showing measurement of various body parts of Euconocephalus nasutus

Body Parameters	Female (n= 13)		
	Mean ± SD	LSD	Min-Max
Length of head	5.3±0.88	A	4.55-6.3
Length of pronotum	8.05±0.29	B	8.05-8.9
Distance between comp: eyes	2.57±0.41	C	2.1-3.0
Length of tegmina	46±0.31	D	43-48
Length of femur	24±0.21	E	22-26
Length of tibia	21.4±0.16	F	19.3-23
Length of ovipositor	24.2±0.37	G	19.5-25
Total body length	32.8±0.14	H	31-34.5

Note: *The letter indicate a significant difference (P<0.01) according to LSD test

Remarks:

This species treated as *acuminatus* (Fabricius) by Redtenbacher and Karny but latter study of Fabricius has confirmed it exact status. During the present study, it was found that majority of them showing the pale costal margins throughout the tegmina these observation generally agreed with description given by Hebard (1920) with exception of fewer having slight darkening apparent at the costal margins of tegmina. Earlier, Hebard (1920) reported 2♀♀ and single ♂ in brown and green coloration from Philippine Island. At the present, we have collected 13 ♀♀ from different district of Pakistan. However, unluckily, we failed to collect single male individual from any locality. Present study suggests that it might be due to cannibalistic behavior of female after mating but latter detailed research in aspect of biology will proved this fact.

***Euconocephalus indicus* (Redtenbacher, 1891)**

Conocephalus indicus Redtenbacher, 1891,

(Plate.v, a-e)

Diagnostic features:

Fastigium short, as long as broad, surpassing the antennal sockets(Plate.v,c,d); apex of the fastigial vertex blunt, rounded; ventral notch clearly open, ventral tubercle small. Antennae not annulated (Plate.v,a). Pronotum converging towards the posterior margin from the dorsal aspect, side keels deep and not markedly elongate (Plate.v,b). Prosternum armed with a pair of spines. Anterior lobes of meso and mestasternum rounded and the posterior lobes are angulated. Forewings longs, surpassing hind knees with the tips rounded. Radius sector two arises beyond the middle of the wing. Cubito-anal area of forewing not distinctly broadened or rounded.

All legs are long and slender.post femora armed both externally and internally on the ventral aspect. Legs with the following number of spines on ventral margins: profemur no external and two indistinct internal, meso femur four minute external and no internal, post femur seven minute external and 14 minute internal, protiba with six external and six internal,mesotibia with six external and six internal, post-tibia 25 small external and 25 small internal. All tibiae with two ventro-apical spurs and post-tibia with an apical spur on dorsal its margin. Post-femur smooth. Post-tibia with the following number of spines on dorsal margins,28 small external and 25 small internal. Ovipositor longer than the body and straight (Plate.v, e). The tibial tympana closed on both sides.

Table: V

Showing measurement of various body parts of *E. indicus*

Body Parameters	Male (n=15)			Female (n=15)		
	Mean± SD	LSD	Min-Max	Mean± SD	LSD	Min-Max
Length of pronotum	6.64±0.01	A	6.62-6.65	8.34±0.12	A	8.1-8.8
Length of tegmina	42.71±0.28	B	42-43	45.54±0.30	B	45-46
Length of femur	21.58±0.26	C	21-22	24.54±0.30	C	24-25
Length of tibia	18.7±0.47	D	18-19	19.48±0.31	D	19-20
Length of ovipositor	---	---	---	22.52±0.32	E	22-23
Total body length	30.66±0.27	E	30-31	32.52±0.27	F	32-33

Note: *The letter indicate a significant difference (P<0.01) according to LSD test

Remarks:

This species was collected from irregular grazed mountain grassland along with some herbaceous plantation mostly *Helianthus annus, Echinochloa colonum, Acacia nilotica* and *Acacia parkensonia* was cultivated here.

Earlier Redtenbacher (1891) reported a single male of this species from Malaya. Hebard (1920) reported some specimens of this species from Himalaya Mountain, China, Burma, Penang, Borneo, Java, Sumatra, and Peak Downs Australia. Similarly, Bailey (1979) also reported a single male from the Himalayas. Recently, we have reported a large number of male & female of this species from different districts of Pakistan it has confirmed its roomy occurrences all over the country.

Fig.1 showing the percentage of collection of *Euconocephalus* species from different provinces of Pakistan

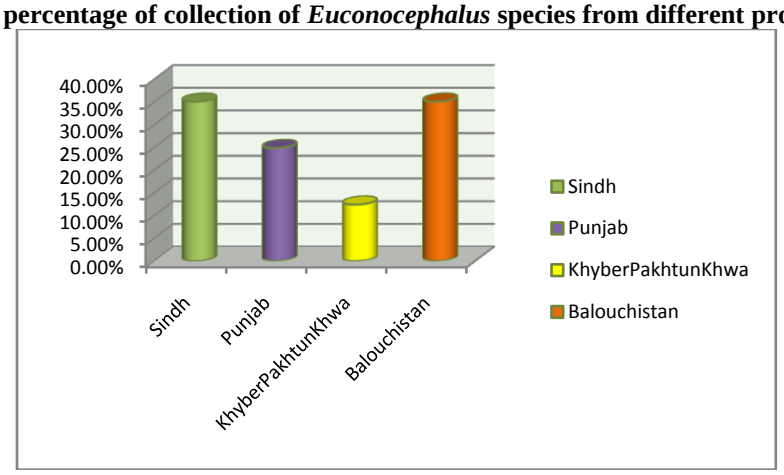


Plate:i. *Euconocephalus incertus* a-h male & female, a adult Female DV, b same but LV, c adult male DV, d same but LV, e Pronotum LV, f same but DV, f Ovipositor LV, h Cerci male

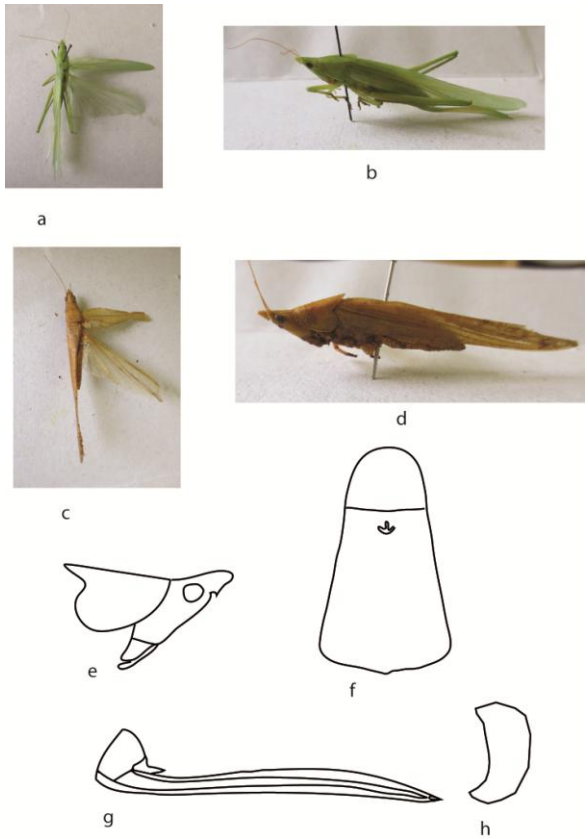


Plate:ii. *Euconocephalus pallidus* a-f male & female, a adult Female LV, b Pronotum DV, c same but LV, d adult male LV, e Ovipositor LV, f Cerci

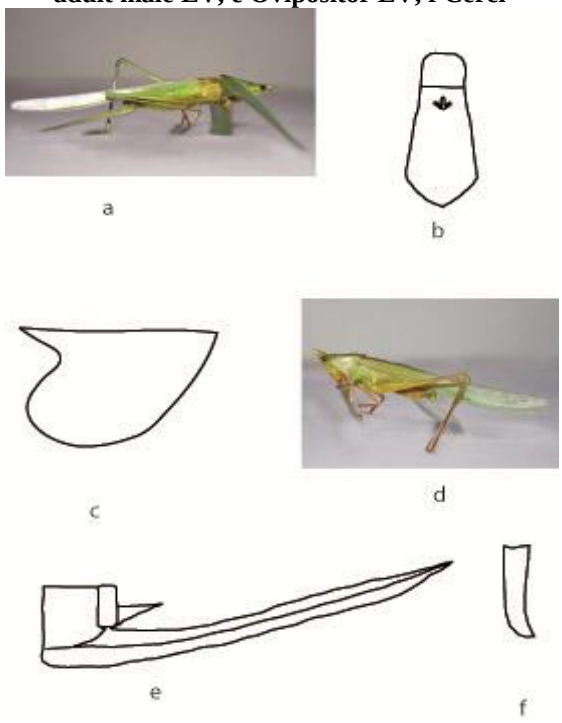


Plate: iii. *Euconocephalus mucro* a-d male, a adult LV, b Pronotum DV, c, Pronotum LV, d Cercus

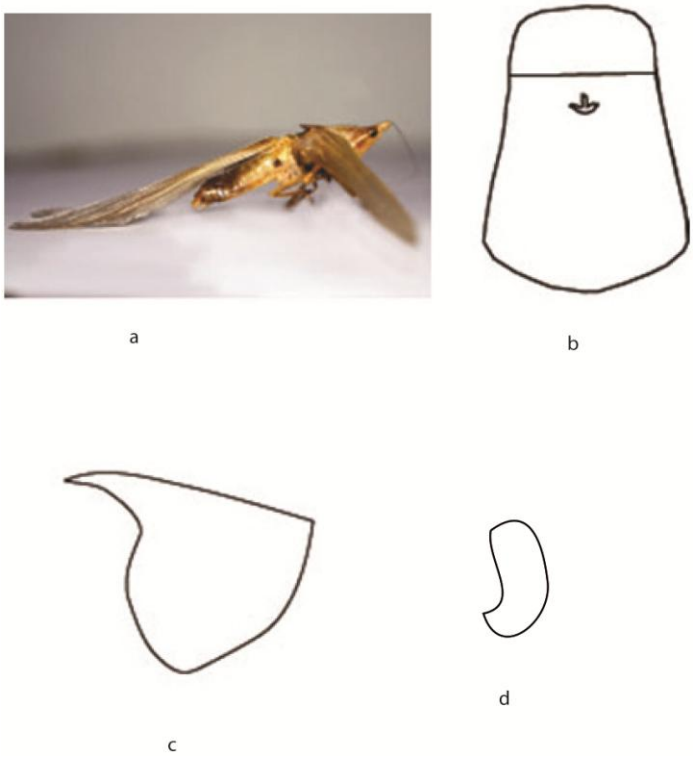


Plate:iv. *Euconocephalus nasutus* a-d female , a adult LV, b Pronotum DV, c same but LV , d Ovipositor LV

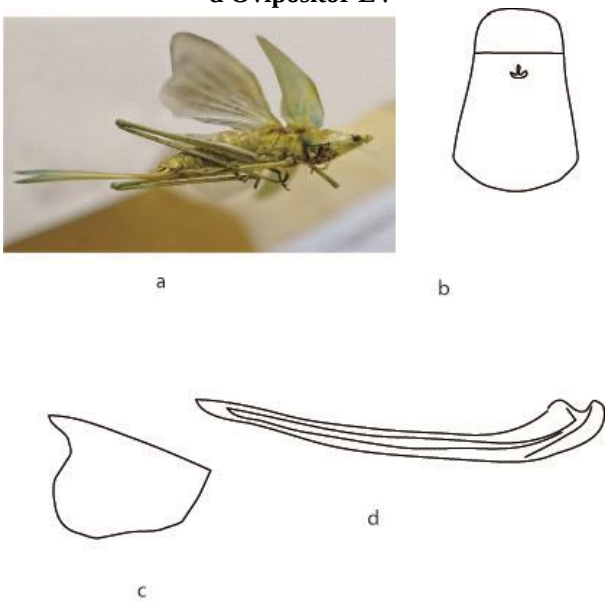
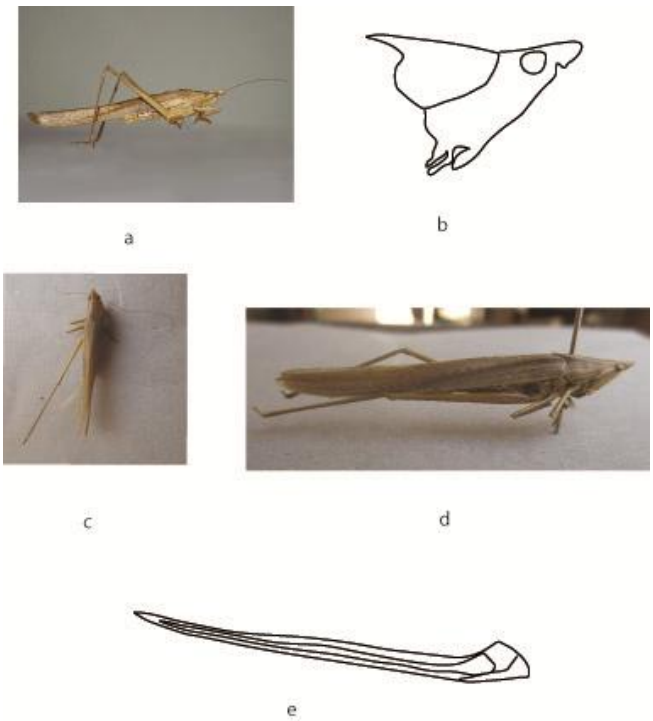


Plate:v. *Euconocephalus indicus* a-e male & female, a adult male LV, b Pronotum LV, c adult female DV, d same but LV, e Ovipositor LV



Acknowledgements

This study was supported by Pakistan Science Foundation Islamabad under Research Project No PSF/S-SU/BIO (423). We are also grateful to Dr. Karim Vahed Professor of Entomology, Biological Sciences University of Derby, UK for providing concerned literature.

References

Baily,W.J. (1979). A review of Australian Copiphorini (Orthoptera:Tettigoniidae: Conocephalinae).Aust.Jur. Zool. 27(6):1015-1049

Beier, M.(1972). Saltatoria (Grillen und Heuschreeken). In J.G.Helmcke,D.Starck & H.Wermuth (Eds) Handbucb der Zoologie.IV.Band Arthropoda- 2.Halfte: Insecta (Zweite Auflage). 2 Teil: Spezielles (pp.1- 217). Berlin: Walter de Gruyter

Gorochov, A.V.(1988). The classification and phylogeny of grasshoppers (Gryllidae - Orthoptera, Tettigonioidea).In The Cretaceous Biocoenotic Crisis and the Evolution of Insects, ed. by A. Pomerenko, Moscow, Hayka. Pp. 145-190

Haan, W.(1842). Bijdragen tot de Kennis der Orthoptera. Verhand, nat. Gesch.Nederl. overz.Bezitt. in Indie.Zoologie: 45-248.

Hebard, M. (1920). New species and genera of Melanopli found within the United States Part III (Orthoptera: Acrdidae) Transactions of the American Entomological Society 46: 355-403.

Karny, H.(1907). Die Orthopterenfauna des Kustengebietes von Osterreich-Ungarn- Berlin.entomol.Ztscher., LII: 17-52

Ragge, D.R.(1961). A revision of the genus *Ducetia Stal* (Orthoptera, Tettigoniidae) Bull. Brit. Mus. nat. Hist (Ent.) 10:171-208

Rentz, D.C.F.(1979). Comments on the classification of the Orthopterean family Tettigoniidae, with a key to subfamilies and description of two new Sub- families. Aust. J. Zool. 27:991-1013

Retdenbacher, J.(1891). Monographie der Conocephaliden. Verh.zool.bot.Ges.Wien 41:315-362, p1.3-4

Riffat, S and Wagan, M.S. (2007). Life history and economic importance of *Hieroglyphus nigrorepletus* Bolivar(Hemiacridinae: Acrididae:Orthoptera) from Pakistan. J. Entomol. 4(5): 379-386.

Riffat, S and Wagan, M.S.(2007). The effect of food plants on growth, fecundity and survivability of grasshopper *Hieroglyphus nigrorepletus* I.Bolivar(Orthoperta: Acrididae) a major paddy pest in Pakistan. J. Biol. Sci. 7(7): 1282-1286

Riffat, S and Wagan, M.S.(2007). Comparative studies on the Ovipositional behaviour of *Hieroglyphus* species *(*Hemiacridinae: Acrididae: Orthoptera) from Pakistan. Pak. J. Zool. 39(5): 321-325

Riffat, S and Wagan, M.S (2007).Some studies of growth, development and fecundity of grasshopper *Hieroglyphusoryzivorus* Carl, (Orthoperta: Acrididae) on food plants in Sindh . Pak. Entomol. 29 (1):9-13

Riffat, S and Wagan, M.S.(2008).Mating behaviour of *Hieroglyphus* species (Hemiacridinae: Acrididae: Orthoptera) from Pakistan. Pak. J. Zool. 40(1): 19-23

Riffat, S and Wagan, M.S (2008). Incidences of *Hieroglyphus oryzivorus* Carl (Hemiacridinae: Acrididae: Orthoptera) from various districts of Sindh province. Proc. Ist. Int. Conf. Sind. Agri. Uni. pp 108-110

Riffat, S and Wagan, M.S (2008). Notes on the taxonomy, distribution and ecology of *Hieroglyphus nigrorepletus* I. Bolivar,1912 *(*Hemiacridinae: Acrididae: Orthoptera) a major paddy pest in Pakistan. Pak. J. Zool.40 (1): 19-23

Riffat, S and Wagan, M.S (2009).. A comparative study on the morphology of egg pods, egg development and hatching of three *Hieroglyphus* species (Acrididae: Orthoperta) Pak. J. Zool. 41(2): 143-148

Riffat, S and Wagan, M.S (2009).Studies on morphology and ecology of grasshopper *Hieroglyphus oryzivorus* Carl, 1916 (Acrididae: Orthoperta) Pak. J. Zool. 41(4): 329-334.

Riffat, S and Wagan, M.S (2010).The effects of various host plants on nymphal development and egg production in *Hieroglyphus perpolita* (Uvarov) (Hemiacridinae: Acrididae: Orthoptera) Trop. Zool 23(1): 1- 7

Riffat, S and Wagan, M.S (2010). Systematic status and ecology of *Hieroglyphus perpolita* (Uvarov, 1932) (Acrididae: Orthoperta) of Pakistan Pak. J. Zool 42(6):67-72

Riffat, S and Wagan, M.S (2010). Comparative study on the immature stages of three *Hieroglyphus* species (Acrididae: Orthoperta) from Pakistan. Pak. J. Zool 42(6): 809-816

Riffat S, Wagan M.S, and Panhwar W.A.(2012). Distribution and incidence of Tettigonioidea (Ensifera) Orthoptera from Sindh Pakistan. Pak. j. entomol. karachi 27 (2): 117-122.

Riffat, S. and M.S. Wagan.(2012).Taxonomy of Tettigonioidea (Ensifera) of Pakistan. First Tech. Rep. (PSF), Res. No S-SU/Bio (423) Islamabad.pp1-111

Tan, M.K.(2011).The Copiphorini (Orthoptera:Tettigoniidae:Conocephalinae) in Singapore.Nat.Sing.4:31-42

Thunberg, C.P.(1815). Hemipterorum maxillosorum genera illustrata.- Mem.Acad.Sc.St.-Petersb., V:211-301

Uvarov, B.P.(1921).The geographical distribution of Orthoptera insects in the caucuses and Western Asia, Pro.Zool.Soc.London 31:447-472

Vickery, V.R. And D.K.Mce. Kevan.(1983). A monograph of the orthopteroid insects of Canada and adjacent regions.Mem. Lyman ent. Mus. Res. Lab. 13: (I) i–xxii 1–679; (II) i–iv 680–1462.

Wagan, M.S.(1990). Grasshopper (Acrididae) of Sindh. Pakistan Science Foundation, Islamabad 110 pp.

Walker, F.(1869).Catalogue of the specimens *Dermaptera saltatoria* in the collection of British Museum.II.London:225-423