

Comparative Studies on the External Morphology of three Species of the Genus *Acrotylus* Fieber. (Orthoptera)

SYED ADEEL AKHTAR SHAH, ANJUM SUHAIL¹, MUHAMMAD ARSHAD, M. TAYYIB, M. ASGHAR AND SYED AZADAR HUSSAIN NAQVI

Department of Agri. Entomology, University of Agriculture, Faisalabad, Pakistan

¹Corresponding author's e-mail: dranjumsuhailuaf@yahoo.com

ABSTRACT

Grasshoppers are important species of insects but comparatively little information is available in the literature on morphology of species of the genus *Acrotylus* (Fieber). No significant efforts seem to have been done to study their external morphology, which forms the basis for ascertaining the characters of taxonomic value for the correct identification of this important group of insects. The present study investigated the comparative external morphology of three grasshopper species, *Acrotylus humbertianus* (Saussure), *A. insubricus* (Scopoli) and *A. longipes longipes* (Charpentier) on the basis of key characters. These species are very closely related with their morphological characteristic features, which are difficult to key out, this study will create easiness for the future researchers.

Key Words: Morphological variation; *Acrotylus*; Taxonomy

INTRODUCTION

Grasshoppers are of great economic importance, because they constitute an important group of pests and pose a constant threat to cereal crops, vegetables, orchards, grassland and forest plantations all over the world. Grasshopper species of the genus *Acrotylus* belong to the subfamily Oedipodinae of the family Acrididae and are well known cosmopolitan creatures. They are the polyphagous and voracious feeders, which can play havoc with almost every type of vegetation. In recent decades it has become increasingly obvious that species of *Acrotylus* are becoming serious pests, being particularly able to adapt from their natural habitat to irrigated crop areas. They are found in rocky areas, uncultivated fields, sandy soils, grassy fields and near maize, sorghum, groundnut and vegetable fields.

Moeed (1966) reported three species: *Acrotylus humbertianus*, *A. longipes longipes* and *A. longipes subfasciatus* from Dadu and Hyderabad. Ahmed (1975-80) and Perwin (1983) recorded these three species from Tharparkar, Thatta, Badin, Hyderabad and Karachi, respectively. Holzapfel (1970) reported that *A. insubricus* is widespread on Gran Canaria. This species is mainly found on open soil (including paths & roads), where it attracts attention due to its red hind wings. Ahmad (1958) found that *Acrotylus humbertianus* damages crops like sorghum, maize and seedlings of cotton and also feeds on leaves of common weeds like Dila, Baru and on cabbage leaves during winter (Wahla, 1959).

The importance of the study of insect morphology in every field of entomology cannot be overemphasized, because it constitutes, a basis for understanding the fundamentals of the organization of insects in relation to that of other living organisms for tracing out the path of

their evolution and afford reliable information for the proper comprehension of insect physiology. Besides, morphology provides a bedrock for all taxonomic work, without which no further development is possible both in pure and applied fields. Although some work has been done on the taxonomy of grasshoppers (Suhail, 1994), the systematic state of the genus *Acrotylus* is in such disarray that it has been almost impossible to identify specimens with stable names or in many cases, to separate one species from another. Comparatively, little information is available in the literature on the morphology of this important group of insects. No significant efforts seem to have been made to study their external morphology, which forms the basis for ascertaining the characters of taxonomic value for their correct identification. Therefore, the present study was undertaken to investigate the comparative external morphology of three grasshopper species; *Acrotylus humbertianus* (Saussure), *A. insubricus* (Scopoli) and *A. longipes longipes* (Charpentier).

MATERIALS AND METHODS

Adult specimens of *Acrotylus humbertianus*, *A. insubricus* and *A. longipes longipes* were collected from grassland, dry vegetation, rangelands, graveyards and rocky areas by hand nets, hand picking and pit fall traps. The specimens were killed in a cyanide bottle and preserved in a solution of alcohol and glycerine (10:1) in a wide mouth glass bottle. Some insects were also pinned and properly set for keeping in insect storage boxes in dry conditions for use in further studies.

For morphological studies, different body parts were detached from the specimens and put in 10% potassium hydroxide solution for clearing. The harder parts were

boiled for 1 - 2 h in the above solution to make them clear, transparent and glossy. When the parts had become transparent, they were dipped in glacial acetic acid for 5 - 10 min to remove the residues of potassium hydroxide (KOH) and finally were washed with distilled water for 10 min in watch glass to remove traces of salt. After washing, the parts were stained for 10 min in acid fuchsin in watch glass. For proper dehydration and removal of excessive stain, the parts were passed through ascending grades of alcohol i.e., 30%, 50%, 70%, 95% and absolute alcohol for 5 - 10 min and dipped in xylene for 5 - 10 min to remove the excessive alcohol. They were then immersed in clove oil for twelve hours to fix the stain and to clear them. After dipping in xylene, the parts were mounted on slides in Canada balsam some of the delicate parts were mounted directly in Hoyers medium. The prepared slides were examined under the binocular microscope M3B for the study of morphological features. The measurements (length & width) of morphologically important body parts were taken with an ocular and stage micrometers. The illustrations were prepared with the help of a camera lucida. For the presentation of results, the terminology of Snodgrass (1935) and Dirsh (1965) was followed for general description. The terminology of Wagan (1984) was followed for the description of mouthparts.

List of Abbreviations

Head

Aclp: Ante-clypeus	M: Mandible
Clp: Clypeus	O: Ocellus
Clas: Clypeo-labral sulcus	Oc: Occiput
E: Compound eye	Ocs: Occipital sulcus
Ep: Epicranium	Os: Ocular sulcus
Es: Epicranial suture	Fa: Fastigium
Pge: Postgena	Ts: Trans sulcus
Fclps: Fronto-clypeal sulcus	Sge: Subgena
Ff: Frontal furrow	Sgs: Subgenal sulcus

Antennae

Fr: Frons	Sos: Sub-ocular sulcus
Fs: Frontal sulcus	Ge: Gena
Vx: Vertex	Lm: Labrum

Mouth parts

Mxp: Maxillary palpus	Pas: Prastipes
Pf: Palpifer	Ga: Galea
H: Hair	Jca: Juxta-cardo
Lc: Lacinia	St: Stipes
Vca: Vera- cardo	Md: Mexadents

Thorax

Mz: Metazona	No: Notalia
Pe: Proepisternum	Pz: Prozona
Ll: Lateral lobe	Tf: Transverse furrow

Legs

Mc: Median carina

Legs

Ar: Arolium	Sp: Spur
Spi: Spine	Cl: Claw
Ta: Tarsus	Cx: Coxa
DI: Dorsal lobe	Tbsp: Tibial spines
Fm: Femur	Tr: Trochanter
Ir: Inner row	VI: Ventral lobe
Or: Outer row	

Wings

1A: Anal -1	Ma: Anterior media
2A: Anal-2	Mp: Posterior media
3A: Anal-3	Pc: Precosta
4A: Anal-4	Pcu: Postcubitus
C: Costa	R: Radius
Cu: Cubitus	R1: Radial branch
Cu ₁ : Cubitus -1	Rs: Radial sector
Cu ₂ : Cubitus-2	Rs-1:Radial sector branch
I: Intercalate vein	Rs-2:Radial sector branch
M: Media	Rs-3:Radial sector branch
Vd: Dividing veins	Sc: Subcosta

Abdomen

Ap: Apical valve of penis	Apd: Apodemes of cingulum
B: Bridge of epiphallous	Bp: Basal valve of penis
Il: Inner lophus	Ppc: Posterior process of cingulum
Ol: Outer lophus	Vpc: Valvular plate of cingulum.

RESULTS AND DISCUSSION

The structure and comparative morphology of various body parts of three species of the genus *Acrotylus* have been described in the present study. As information about the external morphology of *A. humbertianus*, *A. insubricus* and *A. longipes longipes* is, meager, the results are also compared with some other species of the genus *Acrotylus* belonging to the subfamily Oedipodinae of the family Acrididae.

Body of *A. humbertianus* fulvous grey, ventral surface grayish yellow, pubescent, small size with length male (14 – 17 mm), female (18 – 22 mm) but in *A. longipes longipes* it is hairy medium sized with length male (14 – 18 mm), female (18.5 – 24 mm) and in *A. insubricus* it is thickest, relatively longer with length male (15 – 18 mm), female (19 – 25 mm). Similar observations were made by Bei-Bienko and Mishchenko (1951), Ahmad (1958), Harz (1975) and Suhail (1994).

Head. In *A. humbertianus* the head finely punctured, about as long as Pronotum with length male (2 - 2.5 mm) but in *A. longipes longipes* and *A. insubricus* it is thicker and slightly shorter than the Pronotum with length male (2 - 2.3 mm).

Similar observations were made by Wagan (1984), who described the length of head of these three species of the genus *Acrotylus*.

Fastigium of vertex in *A. humbertianus* slightly oblong, depressed, margin well extended backward between the eyes in the alavartex region but in *A. longipes longipes* and *A. insubricus* a little longer than its maximum width, wide at apex, its surface rather flat and lowered between the strongly raised lateral carinae (Fig. 1). These observations agree with the investigations of Harz (1975) and Ahmad (1958). Frontal ridge in *A. humbertianus* narrow at the base, widened between the antennae, finely punctured, margin well raised, reaching the epistomal suture, slightly narrowed in the middle but in *A. insubricus* wide, with the groove strongly narrowed upward and very narrowed on the boundary with the vertex, vertex with raised lateral margin, depressed, anteriorly narrower and in *A. longipes longipes* generally in upper most part sulcate or concave (Fig. 2) These findings resemble those of Bei-Bienko and Mishchenko (1951), Ahmad (1958) and Harz (1975). In *A. humbertianus* fastigial foveolae present sometimes indistinct but in *A. insubricus* and *A. longipes longipes* triangular but hardly indicated (Fig. 3). This finding is similar to that of Ahmad (1958). The interocular distance in *A. longipes longipes* in male twice length of eye, in female not quite as long but in *A. humbertianus* and *A. insubricus* it is 1.5 times the width of an eye in dorsal view (Fig. 3). Similar observations were made by Harz (1975). In *A. humbertianus* antennae filiform, longer than the head and Pronotum together, with length male 6 - 7.5 mm, while in *A. longipes longipes* male surpassing Pronotum with length male 6 - 7 mm, the longest segment in both sexes about 2.5 times as long as wide but in *A. insubricus*, stout and slightly longer than head and Pronotum with length male (6 - 6.5 mm), the longest segment in male about 1.5 times as long as wide. The data agree with the results of Bei-Bienko and Mishchenko (1951). The antennal segments range from 24 - 25 in *A. humbertianus* and *A. longipes longipes* but vary from 22 - 23 in *A. insubricus* (Fig. 4). These results are in conformity with the results of Wagan (1984).

The labrum is oval with a shallow apical notch in *A. humbertianus*, but somewhat oval with very shallow apical notch in *A. insubricus* and *A. longipes longipes*. These observations agree with those of Gangwere (1960). The classification of mandibles given in the present study, based on the shape and number of dents agrees with that proposed by Chapman (1964) and Gangwere (1965). The parastipes is a relatively long, rectangular and broad strip in *A. humbertianus*, a long triangular strip in *A. insubricus*, while it is a conical strip in *A. longipes longipes* (Fig. 5), which complements results of Ahmad (1958). The labium is the least specialized mouthpart in terms of external morphology and shows little variation as reported by Gangwere (1965).

Thorax. Pronotum in *A. humbertianus* short, wide and saddle shaped, constricted towards the front margin, hind margin raised, nearly straight, its posterior margin rounded,

Fig. 1. Dorsal view of head

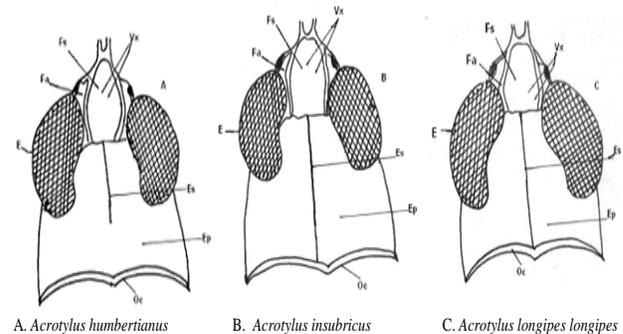


Fig. 2. Lateral view of head

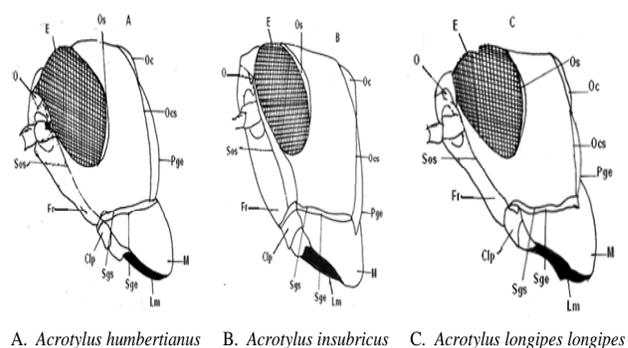
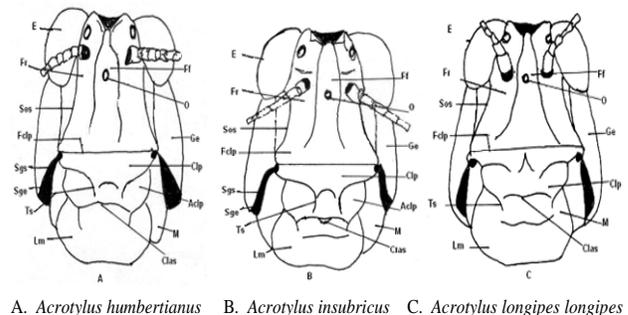
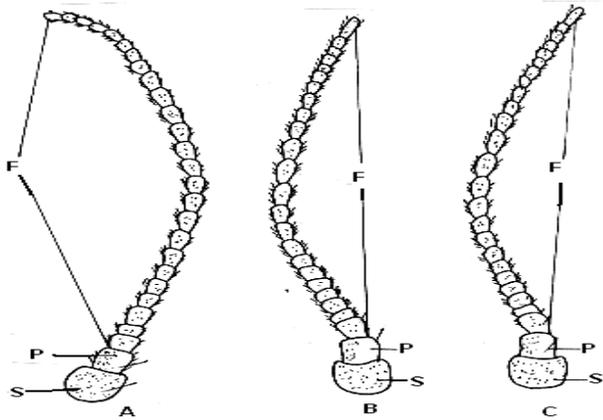


Fig. 3. Facial view of head



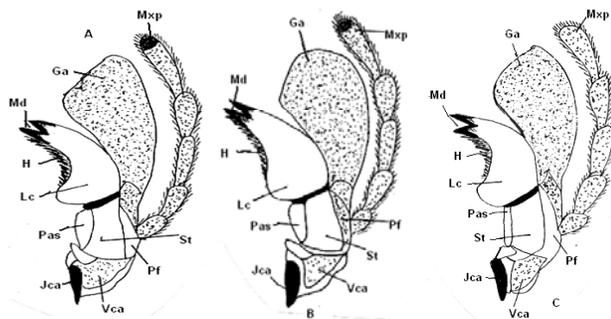
while in *A. insubricus* it is very short, wide, constricted in front of middle and apparently saddle shaped, Prozona uneven, Metazona flat, a little or not more than 1.5 times longer than the prozona, posterior margin widely rounded without a separate posterior angle, lateral lobes with a very blunt, rounded and antero-ventral angle and in *Acrotylus longipes longipes* Pronotum more or less smooth on disc, Metazona almost with longitudinal ridges just indicated, Prozona in dorsal view having no inverse triangular elevation, a very small whitish convex spot on each side situated at the very anterior margin of the transverse groove (Fig. 6 & 7). Similar observations were also made by Wagan (1984), Bei-Bienko and Mishchenko (1951) and Ahmad (1958). Median longitudinal carina in *A. insubricus* interrupted by two transverse grooves but in *A. humbertianus* and *A. longipes longipes* it is often clear in

Fig. 4. Antennae



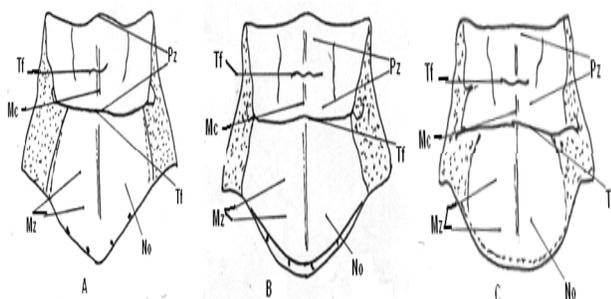
A. *Acrotylus humbertianus* B. *Acrotylus insubricus* C. *Acrotylus longipes longipes*

Fig. 5. Maxilla (Mouth part)



A. *Acrotylus humbertianus* B. *Acrotylus insubricus* C. *Acrotylus longipes longipes*

Fig. 6. Pronotum

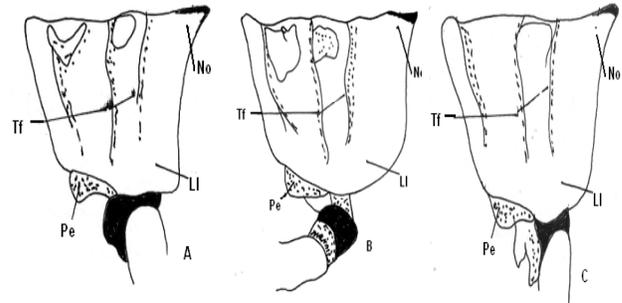


A. *Acrotylus humbertianus* B. *Acrotylus insubricus* C. *Acrotylus longipes longipes*

metazoan (Fig. 6). The mesosternal space is about twice as wide as its greatest length in *A. humbertianus* but in *A. insubricus* and *A. longipes longipes*, it is about three times wider than its greatest length. These results are in conformity with those of Wagan (1984).

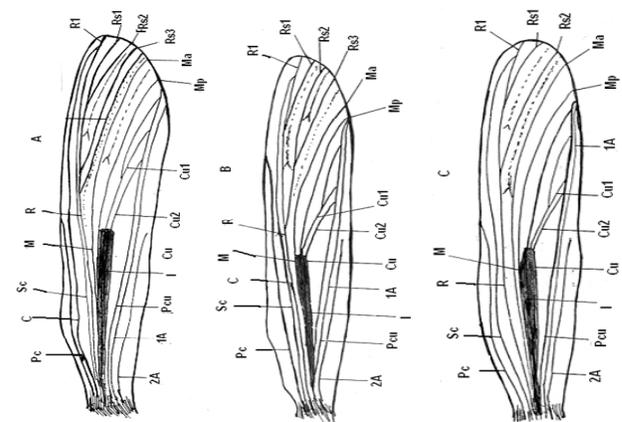
The wings in *A. insubricus* coloured at the base, with or without dark bands, the dark bands if present not reaching by their posterior margin or it is narrow, short or entirely absent, while in *A. humbertianus* yellow near the base with a white incomplete dark band reaching or nearly reaching the anal veins and in *A. longipes longipes* yellow or orange at the base (Fig. 9). The data agree with the investigation of

Fig. 7. Propleuron (Prothorax)



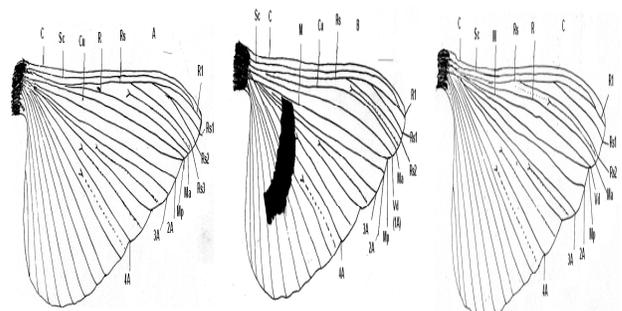
A. *Acrotylus humbertianus* B. *Acrotylus insubricus* C. *Acrotylus longipes longipes*

Fig. 8. Male tegmen



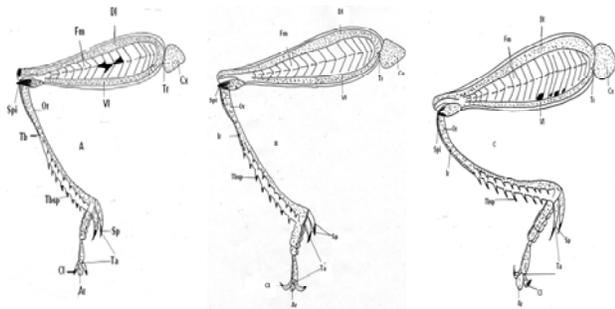
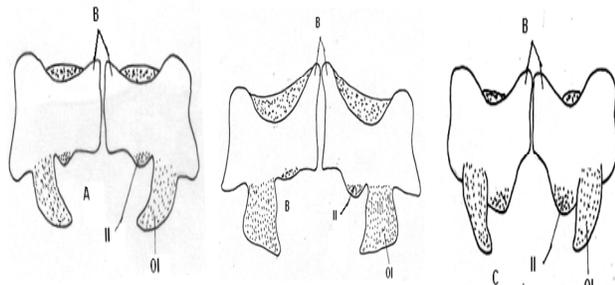
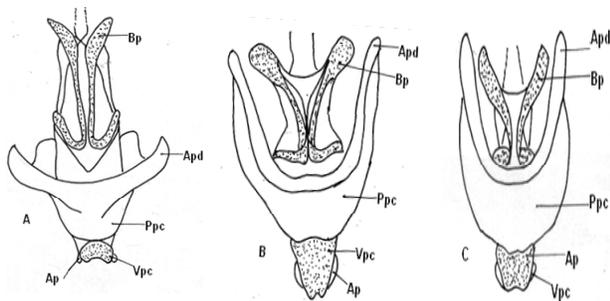
A. *Acrotylus humbertianus* B. *Acrotylus insubricus* C. *Acrotylus longipes longipes*

Fig. 9. Male hind wing



A. *Acrotylus humbertianus* B. *Acrotylus insubricus* C. *Acrotylus longipes longipes*

Ahmad (1958), Wahla (1959) and Bland (2001). Male tegmen is longer (17 – 19 mm) and wider (2.50 - 3.00 mm) in *A. longipes longipes*, but medium length (16 – 19 mm) and width (2.5 - 2.75 mm) in *A. humbertianus*, while smaller length (14.50 - 16.00 mm) and width (3.00 - 3.25 mm) in *A. insubricus*. Similar observations were also made by Suhail (1994). The apex of tegmina in *A. humbertianus* with distinct dark speckles, extending beyond the middle of hind tibia, in the basal half brownish, with a light spot at the anterior margin, while in *A. longipes longipes* apex without dark speckles, narrow about 7 - 8 times longer than wide in the middle, generally surpassing the middle of the stretched

Fig. 10. MetalegA. *Acrotylus humbertianus* B. *Acrotylus insubricus* C. *Acrotylus longipes longipes***Fig. 11. Epiphallous (Genitalia)**A. *Acrotylus humbertianus* B. *Acrotylus insubricus* C. *Acrotylus longipes longipes***Fig. 12 Aedegus**A. *Acrotylus humbertianus* B. *Acrotylus insubricus* C. *Acrotylus longipes longipes*

hind tibia, front margin with 3 dark areas with well developed pale sections in between and in *A. insubricus* it is narrow, long in the apical half, shiny and transparent, the spurious median vein diagonally situated, but towards the apex it gradually approaches medial vein (Fig. 8). The same observations were also by Wagan (1984), Bei-Bienko and Mishchenko (1951) and Ahmad (1958). The radial sector is subdivided into three branches named Rs1, Rs2, Rs3 in *A. insubricus* and *A. humbertianus* but in *A. longipes longipes* subdivided into two branches named Rs1, Rs2 (Fig. 8). These results partially conform to those of Ahmad (1958).

The hind femur is long (9 – 11 mm) and wide (2 - 2.50 mm) in *A. longipes longipes*, but medium length (9 – 10 mm) and width (2.0 - 2.4 mm) in *A. humbertianus*, while shorter length (9.0 - 9.50 mm) and width (2.0 - 2.2 mm) in *A. insubricus*. Similar observations were made by Suhail (1994) in the genus *Acrotylus*. In *A. humbertianus* hind

femur with two black bands on its inner side, hind knee black on the inner aspect, while in *A. insubricus* front and middle femora and a tibia slender and in *A. longipes longipes* about 4 times as long as its maximum height with pale inner side, dorsally with dark spots as reported by Bei-Bienko and Mishchenko (1951) and Ahmad (1958). The hind tibia in *A. humbertianus* pale slender, with 10 inner and 8 outer black-tipped spines but in *A. longipes longipes* and *A. insubricus* pale slender with 11-inner and 8-outer black tipped spines (Fig. 10) as reported by Wagan (1984).

Abdomen. Ventral ovipositor valves in *A. humbertianus* short, moderately sclerotized, slightly incurved on external lateral surface, spermatheca with finger like subapical diverticulum but in *A. insubricus* and *A. longipes longipes* valves strongly sclerotized with strongly curved apices, spermatheca without subapical diverticulum. Similar observations were made by Ahmad (1958) and Moizuddin (1994). The apical valve of penis is short to moderate length and thick in *A. humbertianus*, while it is long, slender and upward detected in *A. insubricus* and *A. longipes longipes*. Valvular plate of cingulum bears small emargination at apex in *A. longipes longipes* but shallow and well defined emarginations at apex in *A. insubricus*, while it is very large, upcurved and rolled almost into a cylinder with enlarged apex in *A. humbertianus* (Fig. 11 & 12). The same structure was reported by Bei-Bienko and Mishchenko (1951).

CONCLUSION

The systematic state of the genus *Acrotylus* is very confusing and almost impossible to identify specimens with stable names or in many cases, to separate one species from another. In Pakistan, comparatively, little information is available in the literature on the morphology of this important group of insects and no significant efforts seem to have been made to study their external morphology, which forms the basis for ascertaining the characters of taxonomic value for their correct identification. Therefore, the present study will be helpful to key out the given species, *Acrotylus humbertianus* (Saussure), *A. insubricus* (Scopoli) and *A. longipes longipes* Charpentier in compression with other species, if found in Pakistan. Some new and descriptive morphological characters are also given for the easiness of future researchers.

REFERENCES

- Ahmad, M.M., 1958. The Acrididae of Lyallpur. *M.Sc.Thesis*, p: 112. Punjab University, Lahore, Pakistan
- Ahmed, F.U., 1975 - 1980. *Survey of Grasshoppers in Arid and Semi Arid Regions of Pakistan*. PL-480 No. Pk. ARM-20
- Bei-Bienko, G.Y. and L.L. Mishchenko, 1951. *Locusts and Grasshoppers of USSR and Adjacent Countries*, p: 400. Pt I and II, Monston, Jerusalem
- Bland, R.G., 2001. Additions to the Orthoptera (*sens. lat.*) of the Canary Islands. *J. Orth. Res.*, 10: 113-9
- Chapman, R.F., 1964. The structure and wear of the mandibles in some African grasshoppers. *Proc. Zool. Soc. Lond.*, 142: 107-12
- Dirsh, V., 1965. *The African Genera of Acridoidea*, p: 579. Cambridge University Press

- Gangwere, S.K., 1960. The use of mouthparts of Orthoptera during feeding. *Ent. News*, 71: 193–206
- Gangwere, S.K., 1965. The structural adaptation of mouthparts in Orthoptera and allies. *EOS. Madrid*, 40: 67–85
- Harz, K., 1975. *The Orthoptera of Europe II. Series Entomological*, Vol. 11, p: 939. Hague
- Moed, A., 1966. Taxonomy of Tetrigidae (Orthoptera: Tetrigoidea) and Acridinae and Oedipodinae (Acridoidea: Orthoptera) of Hyderabad region. *M.Sc. Thesis*, University of Sind
- Moizuddin, M., 1994. Studies on the grasshopper *Acrotylus humbertianus* Saussure (Orthoptera: Acridoidea) with special reference to its habitat and male and female genitalia from Lasbela, Balochistan. *Zoological- Society of Pakistan*, 14: 51–60
- Perwin, R.H., 1983. Seasonal incidence of grasshoppers in Karachi (Pakistan). *Bull. Zool.*, 1: 67–77
- Snodgrass, R.E., 1935. *Principles of Insect Morphology*, p: 667. Mc Graw Hill Book Co., New York, London
- Suhail, A. 1994. Taxonomic studies on Acridoidea (Orthoptera) of Pakistan. *Ph.D. Thesis*, p: 343. Department of Agri. Entomology, University of Agriculture, Faisalabad
- Wagan, M.S., 1984. A comparative study of structural adaptation of mouthparts in Orthoptera from Sind. *Pakistan J. Zool.*, 16: 101–2
- Wahla, A.M., 1959. Studies on *Acrotylus humbertianus* Saussure Acrididae: Orthoptera. *Ph.D. Thesis*, Department of Agri. Entomology, University of Agriculture, Faisalabad, Pakistan

(Received 07 May 2007; Accepted 20 August 2007)