Sindh Univ. Res. Jour. (Sci. Ser.) Vol.46 (1): 01-04 (2014)

SINDH UNIVERSITY RESEARCH JOURNAL (SCIENCE SERIES)

Taxonomic study on the Occurrence of *Trilophidia annulata* (Thunberg) (Oedipodinae: Acrididae: Orthoptera) from Pakistan

B. A. BUGHIO[++], R. SULTANA, M. S. WAGAN, M. A. RAFI

Department of Zoology, University of Sindh, Jamshoro, Pakistan

Received 28th October 2013 and Revised 14th February 2013

Abstract: The species of *Trilophidia* are the severe pest of cereal crops; vegetables, and agricultural field in Pakistan including India. Its external morphology, phallic complex and distributions of *Trilophidia annulata* was also provided. Its numbers increased at peak level in April to September until December. During the present study characteristics of taxonomic importance, such as the structure of pronotum, number of antennal segments, number of tibial spines and significant features of phallic complex was studied in detail in order to determine the distribution and status of pest in agricultural fields. Beside this, its distribution and occurrence at the district level are also studied.

Keywords: Orthoptera, *Trilophidia annulata*, Phallic Complex, Distribution.

1. INTRODUCTION

The genus *Trilophidia annulata* was erected by Stål in (1873) and stated that this genus poses constant threat to cereal crops; vegetables, and agricultural fields. Taxonomic studies of many grasshoppers have been done by (Kirby 1914, Mishchenko1936, Bei-Bienko, and Mishchenko1951,Uvarov1966, Dirish 1956, 1975, Moeed 1966, Ahmed 1980, Ritchie1981-82 Wagan and Solangi 1990, Baloch 2000; Garai 2001 and Riffat and Wagan 2012) on the basis of different features. But there is inadequate work done on the *Trilophidia annulata* from this region. Kirby's (1914) carried the faunistic studies on acrididae but, there are two contradictory views on Kirby's fauna. Roonwal (1958) found it still useful whereas Uvarov (1977) considered it as outdated. In fact Kirby's description covered those grasshoppers' species, which were mostly found in plains of India; particularly in its southern parts. It also included studies on some grasshopper's species occurring in areas, which are now part of Pakistan. The *Trilophidia annulata* (Thunberg) had been widely distributed throughout Pakistan. This species commonly occurs at mixed agricultural crops, pasture lands; where they damage upper part of the plants. Hence it's considered as pest of agricultural fields the species cause heavy damage when their numbers increased in favorable climatically conditions. At the present detail observation has been made on the phallic complex. Earlier, Hubbell (1932) Otte, (2002) stated that the Phallic complex characters are considered authentic and useful in diagnosing and separating species from one another.

Beside this, Eberhard (1985) argued for the reinterpretation of the function of male genitalia where as external and internal characters have been discussed by many workers in Past decades for example. Roberts, 1940; Powers (1942), Roberts, 1941; Uvarov (1942), Rehn, 1960; Dirsh (1956;1961), Helwig (1958) and Eades (1962) Noushaba,1967; Memon,1968; Keeping in view, the importance of this grasshopper, present attempt has been made. Furthermore, phallic characters are presumed as a tool for insect systematic and plays key role for identification, hopefully this information will be usefully in Pakistan and adjacent areas and the results will be instrumental for the pest management strategies to control the pest.

2. MATERIALS AND METHODS

Study Site:

An extensive survey trip was made to various provinces of Pakistan **(Map. I)** from **Sindh:** Karachi, Jamshoro, Thatta, Badin, Mirpurkhas, Hyderabad, Khairpur, Benazirabad, Dadu, Larkan and Sukkur, from **Balochistan:** Jafarabad, Jhal Magsi, Kalat, Mustung and Sibi division from **Punjab:** Chakwal, Dera-Ghazi Khan, Faisalabad, Hafizabad, Jhang, Lahore, Rawalpindi and Rahim.Yar Khan and from **Khyber Pakhtunkhwa:** Abbotabad, Haripur, Mansehra, Peshawar, Swat, Noushera and Mardan were visited time to time in order to collect the more material. The specimens were collected from various habitats known for the pest i.e. grass lands, wild vegetation, crop fields, grasses grown along the roadsides and from various herbs and shrubs. Collection was done by adopting the methods described by Vickery and Kevan (1983) that involve use of aerial nets and Potassium Cyanide (KCN) for collection and killing of insects respectively.

[++]Corresponding Author: barkatali2009@gmail.com

Map- I Showing the collection of *Trilophidia annulata* in various districts of Pakistan

For the confirmation of specimens, male genitalia were dissected and examined under Stereoscope Dissecting Binocular Microscope. Examination of male genitalia was done by following the method of Kevan *et al.*, (1969) with minor additions as follows. Softening of abdominal terminalia was carried out by relaxing whole insect specimen in a small humid chamber, to which a few drops of 70% alcohol was added to prevent fungal growth. On relaxing, supra-anal plate of specimens were raised smoothly with the help of a sharp pointed needle and cut laterally. The whole phallic complex was then taken out and immersed in 10% hot potassium hydroxide solution for 5 to 10 hours to get rid of unsclerotized and non chitinous tissues. It was then thoroughly washed under tap water and examined in glycerol by placing on a cavity slide without a cover glass.

For studying female genitalia, Randel (1963) was followed. On relaxing specimens (as cited above), an incision with the help of fine scissors was made on each side of abdomen where tergum meets the sub genital plates. The incision was continued anteriorly to allow removal of the extra plate. Sub genital plate was then depressed with the help of forceps and a third cut was made at its base for its removal**.** Spermatheca lying just above the vagina was also removed and the dissected sub genital plate and spermatheca was then washed with 10% potassium hydroxide solution and examined as above. Specimens are identified taxonomically on the basis of external body features following length of pronotum, tegmina, femur, antennal segment and total body lengh etc. Beside this, all the diagrams were drawn with the help of "Ocular square Reticule" placed in eye piece of the Stereoscopic Dissecting Binocular Microscope.

All measurements were taken following the methods of Hollis (1965) amd given in millimeter (mm) while terminology of Dirsh (1956; 1957) was adopted for phallic complex and female genitalia of studied species.

3. RESULTS AND DISCUSSIONS

About 217 specimen 93 males 124 females were collected from Sindh, Balochistan Punjab and Khyber Pakhtunkhwa of Pakistan from variable habitats. Its detail description regarding diagnostic features, general coloration, phallic complex and spermatheca are as under:

Trilophidia annulata (Thunberg)

Diagnostic features

Body small, strongly rugose, tuberculate and hairy; Antennae filiform, 22-24 slightly thickened in apical third, longer than head and pronotum taken together; head sub-conical; eyes prominent and rounded; fastigium of vertex angular, concave, with truncate apex and undulated lateral carinulae; fastigial foveolae visible above; frons slightly oblique and straight; frontal ridge shallowly sulcate, with parallel lateral carinulae; pronotum tectiform and strongly tuberculate, median carina forming two high tooth like projections in prozona sharply indicated in the posterior region, dorsum crossed by two sulci; lateral carinae irregular, in front of first sulcus forming three or four tooth-like tubercles; metazona longer than prozona with posterior margin acutely angular having obtuse apex; mesosternal interspace wider than long; metasternal interspace open; tegmina well developed having membrane semi transparent, opaque at base, narrow, longer than the tip of abdomen, rounded at apex, with dark brown spots; wings hyaline and well developed, slightly colored at base and cloudy along the apical margin; hind femur compressed, expanded towards base, with distinct median carinae, black on inner side and with two dark bands and spinose; Arolium small; male supra-anal plate elongate and angular; cerci narrow and conical having obtuse apex; sub-genital plate short and conical; ovipositor short and robust with curved valves, lower valve with small external lateral projection; epiphallus having narrow bridge, short ancorae and lobate form lophi, indistinctly bilobate **(Table.1)**.

General coloration:

Dark brown; pronotum mostly spotted with a row of black spots at posterior margin; membrane of tegmina opaque at base and transparent towards apex having numerous small spots; wings transparent; smoky at the anal margin; hind femur with two black bands; hind tibia having two black and white bands.

Table.1 Measurements of different body parts of *Trilophidia annulata* (mm)

Body Parameters	Male (n = 30)		Female (n = 30)	
	(Mean ± Sd)	(Range)	Mean ±Sd)	(Range)
Length of Body	14.7± 4.00	13-16	19.37± 2.41	18-21
Length of Antennae	6.58± 2.63	5-8	6.25± 3.41	5-8
Length of Pronotum	3.67± 1.42	3-4	6.12± 2.68	5-8
Length of Tegmina	15.75± 3.29	14-17	18.63± 4.25	16-20.1
Maximum width of Tegmina	2.76± 2.21	2-3	3.2± 1.92	2.2-4
Length of hind Femur	8.76± 2.50	8-10	9.75± 3.68	7-11
Maximum width of hind Femur	3.22± 1.31	3-4	3.87± 1.20	3-4
Length of hind tibia	7.4± 1.26	7-8	8.88± 1.76	8-10

Phallic complex:

Apical valve of penis slightly thick, tapered and pointed indefinitely, tip raised vertically and is larger than that of cingulum's; apical valve of cingulum convex, narrow and with pointed tip; arch of cingulum flattened and well developed; basal bridge folded with straight sub margins; apodemes stout, shorter, produced anteriorly with knob like shape and having obtuse rounded apices; zygoma remarkable, apically wide and rectangular; rami large (almost pentagonal) and lobe like extending into the sheath dorsally with rounded sub acute margins; gonopore processes elongated with few thickening at middle and with truncated apices; ejaculatory sac moderate and produced anteriorly; epiphallus bridge shaped, bridge straight, narrow to moderately wide; anterior projections laterally protruding reaching only one half of the ancorae and with obtuse rounded apices, anterior part almost wider; posterior projection forming shallow transverse depression at base; Ancorae smaller; fairly wide and with sub acute rounded process at base; incurved at apex with obtuse rounded apices; lophi diverging sharply from the lateral plates, raised straight with broad apical lobate parts, convex towards the posterior portion ending into small rounded terminal processes, besides the lateral plates rounded circular sclerites.

Female:

Usually similar to male but larger in size; antennae slender having 26-28 segments; cerci small; ovipositor short and robust with curved and pointed valves, lower valve with basal external projection.

Spermatheca:

Pre-apical diverticulum short, raised straight and is slightly thick, obtuse rounded at apex; apical diverticulum sac like with broadened middle process, angularly rounded at base.

Repository

The material has been deposited in the Museum of Entomology, Department of Zoology, University of Sindh Jamshoro, Sindh - Pakistan.

Remarks:

This species is very closely related to. *T. cinabarina* Brancrik in having general appearance but can easily be separated from the same by the hyaline wing and by the other characters as noted in the description. This species occurs in the cultivated fields of maize, vegetables and untilled fields having the vegetation of grasses. It is widely distributed species in Pakistan. Ahmed (1980) and Yousuf (1996) recorded this species from the various provinces of Pakistan. Moeed (1966) Wagan and Solangi (1990) also reported this species from different parts of Sindh, while Baloch (2000) recorded this species from Punjab. At the present we have collected fair numbers of specimens from all over the country and confirmed its presence in Pakistan.

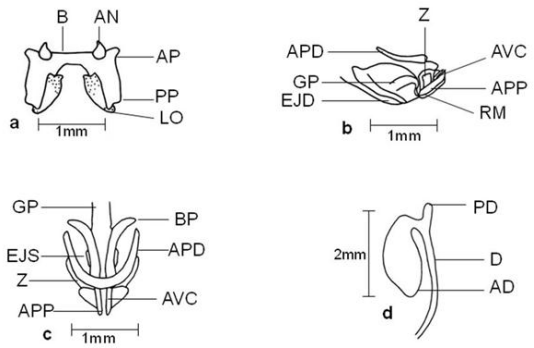
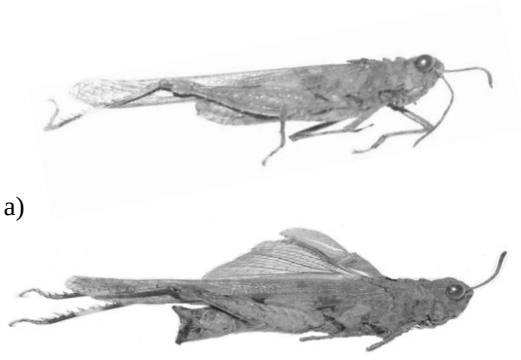


Fig-I *Trilophidia annulata,* genitalia a) Epiphallus. b) Endophallus and Cingulum lateral view. c) Same dorsal view. d) Spermatheca.



a)

b)

Fig-2: a) *Trilophidia annulata,* Male;b)Female

REFERENCES:

Ahmed F.U. (1980). Survey of Grasshoppers in Arid and semi Arid region of Pakistan Final Rep. Pl-480 No.P.K-ARS-20 (FG-Pa-21), 500Pp.

Baloch, N. (2000). Survey and taxonomy of grasshoppers belonging to family Acrididae (Orthoptera) of the Punjab. Ph.D. Thesis, University of Sindh. 1-197.

Bei-Beinko G. Y, L. L. Mishchenko (1951). Locust and Grasshoppers of U.S.S. R and adjacent countries. 1 & 2 Monson, Jerusalem 691Pp. China.

Dirsh V. M. (1956). The Phallic complex in Acridoidea (Orthoptsa) in relation to taxonomy. Trans. R. Ent. Soc. Lond., 108 **(66):** 223-256.

Dirsh. V.M., (1957).The spermatheca as a taxonomic character in Acridoidea (Orthoptera) .Proc. R. Ent. Soc. Lond. **(32)**: 107-114.

Eades, D.C. (2000). Evolutionary relationships of phallic Structures. Acridomarpha (Orthoptera). J. Orthoptera Res. **(9)**: 18-40.

Eberhard, W. G. (1985). Sexual selection and animal genitalia. Massachusetts, Harvard University Press.

Garai, A. (2001). Orthopteroid Insects from Pakistan. Esperiana, Bd **(9):** 431-447.

Helwig, E. R. (1958).Cytologyand Taxonomy. Bios, **(29)**: 58-72.

Hollis, D. (1965) A Revision of the genus *Trilophidia* stal.*Trans. R. ent. Soc*. Lond. 117 (b): 245-262.

Hubbell T. H. (1932). A revision of the Puer group of the North American genus Melanoplus, with remarks on the taxonomic value of the concealed male genitalia in the Cyrtacanthacridinae (Orthoptera, Acrididae). Miscellaneous Publications Museum of Zoology, University of Michigan **(23)**: 1–64.

Kirby W. F. (1914). Orthoptera (Acrididae) The fauna of British India including Ceylon and Burma London Taylor and Francis 276Pp.

Kevan, D.K. McE., S.S. Akbar, Y.C. Chang (1969). The concealed copulatry structures of the Pyrogomorphidae (Orth.:Acrididae) pt. I. Introduction EOS. Mdr 44Pp.

Memon, S, (1968). Classification of three subfamilies of acrididae (Acridoidea, Orthoptera) primarily on the basis of genitalia and spermatheca. M.Sc. Thesis. University of Sind.

Mistchenko, L. L. (1936). Revision of Palaearctic species of the genus *Sphingonotus* fieber (Orth. Acrid).*Eos*. 12 **(3-4):** 65-282

Mooed, A. (1966). Taxonomy of Tetrigidae (Tetrigoidea, Orthoptera) andAcridinae & Oedipodinae (Acrididae, Acridoidea, orthoptera) of Hyderabad region. M.Sc Thesis, University of Sindh. 260Pp.

Noushaba, N. (1967). Taxonomy of Acridinae(acrididae, Acridoidea, Orthoptera) of Hyderabad Region on the basis of male genitalia. M.Sc. Thesis. Univ. of Sind.

Otte, D. (2002). Studies of *Melanoplus*. 1. Review of the Viridipes group (Acrididae: Melanoplinae). Journal of Orthoptera Research **(11)**: 91-118.

Powers, P. B. A. (1942). Metrical studies on Spermatogonial Chromosomes of Acrididae (Orthoptera). J. Morph. **(71):** 523-576.

Rehn, J. A.G.O. and H. J. Grant, (1960). A new concept involving the sub-family Acridinae (Orthoptera Acridoidea) Trans. Amer. Ento. Soc., **(86)**: 173-185.

Randel, R. L. (1963) On the presence of concealed genitalia structures in female Caelifera (Insecta: Orthoptera). Trans. Amer. Ent. Soc., **(88)**: 247260.

Roberts, H. R. (1941). A comparativ study of the subfamilies of Acrididae (Orthoptera) primarily on the Basis of their phallic structure. *Proc.Acad.nat. Sci. Phild.,* **(93)**: 201-246 90 figs. Acridiae (Orthoptera). J. Morph.71. 523 576.

Riffat, S. and M. S. Wagan. (2012). Review of genus *Hieroglyphus* Krauss 1877 (Hmiacridinae: Acrididae: Orthoptera) with description of one new species from Pakistan. *Pak. J. Zool*. 44 **(1):** 43-51.

Ritchie, J. M. (1981) A taxonomic revision of the genus *Oedaleus* Fieber (Orthoptera Acrididae). *Bull. Brit. Mus. nat.Hist (Lond)* 42 **(3):** 83-183.

Ritchie, J. M. (1982) A taxonomic revision of the genus *Gastrimargus* Saussure (Orthoptera :Acrididae) *Pak. J. Zool.* 44 **(4):** 239-329.

Roberts, H. R. (1941). A comparativ study of the subfamilies of Acrididae (Orthoptera) primarily on the Basis of their phallic structure. *Proc.Acad.nat. Sci. Phild.,* **(93)**: 201-246 90 figs. Acridiae (Orthoptera). J.Morph.71. 523 576.

Roonwal, M.L. (1958) Bibliographia Acrididiorum. *Rec.Ind.Mus.* **(56):** 611Pp.

Uvarov. B. P. (1942). NewAcrididae from India and Burma. *An. Mag. Nat.Hist.* **(9)**: 587- 607.

Uvarov, B. P., (1966).Grasshoppers and Locust: A hand book of General Acridology. Cambridge Univ. **(1):**1-481

Uvarov, B.P. (1977). Grasshoppers and Locusts. A hand book of general acridology. Cambridge Univ. Press (London) 2: X + 613 Pp.

Vickery, V. R. and D. K. McE, (1983). A. Monograph of the Orthopteroid Insects of the Canada Adjacent Regions, Mem. Lyman. Ent. Mus. Res. Lab. V. **(1 & 2):**

Wagan, M. S., S. M. Solangi, (1990). Distribution and incidence of grasshoppers (acrididae) of Sind. Biol. San. Veg. Plagas. (Fuera deserie) **(20):** 125-129.