

Systematic Status and Ecology of *Hieroglyphus perpolita* (Uvarov, 1932) (Acrididae: Orthoptera) of Pakistan*

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Abstract. The grasshopper species *Hieroglyphus* are well known as major pest of rice, sugarcane, wheat and maize in many countries of the world including Pakistan. However, no information is available regarding *H. perpolita* (Uvarov). Therefore, a study was carried out on taxonomy, morphology, distribution and ecology of *H. perpolita* from Pakistan during the year 2005-2007. In *H. perpolita* pronotum cylindrical dorsum crossed by four wide sulci, prosternal process bifurcate. Lophi elongate, zygoxa of cingulum narrow; rami broad; apodemes slightly shorter than basal valves of penis. Further, other significant differences are studied in *H. perpolita* on the bases of morphological traits as well as on genitalia components. This species occurs in macropterous form with two distinguish color forms: shining yellow and dark green. *H. perpolita* is univoltine and crossed six nymphal stages to become adult. Hoppers usually begin to emerge in second week of June, but by middle of July most of the hoppers become adults. In addition to this, a close interaction of *H. perpolita* with *Saccharum bengalense* was also studied.

Key words: *Hieroglyphus perpolita*, genitalia, *Saccharum bengalense*.

INTRODUCTION

The representative of the genus *Hieroglyphus* Krauss are pest of rice, sugarcane, wheat and maize in Pakistan, India, Bangladesh, China, Thailand and Africa (Riffat and Wagan, 2007a; Uvarov, 1922; Roonwal, 1978; Mason, 1973). Beside, its economic importance this genus has a number of fascinating characteristics: long diapauses in embryonic stage, an annual hatching rhythm, distinguished colors and forms morphism (Roonwal, 1976a; Wagan and Riffat, 2006) and tendency to produce the swarm (Ghoury and Ahmed, 1960).

Several authors have made reference to *Hieroglyphus* spp. (Uvarov, 1922; Bhatia *et al.*, 1965; Singh, 1972; Mason, 1973; Alam and Alam 1977; Irshad *et al.*, 1977; Hashmi, 1994; Moizuddin, 1988; Karim and Riazuddin, 1999; Riffat *et al.*, 2007). Breeding habits of *Hieroglyphus* spp. have been studied by Roonwal (1945, 1976a,b, 1978), Srivastava (1956), Pradhan and Peshwani (1961), Jotwani and Butani (1978), Siddiqui (1986, 1989), Wagan and Riffat (2006) and Riffat and Wagan (2007, 2008).

However, no information concerning *H. perpolita* (Uvarov) is available in literature except for Uvarov (1922) and Mason (1973) who have briefly described its morphology. The objective of this study was to provide a comprehensive account on the taxonomy, period of hatching and zonal distribution of *H. perpolita* in Pakistan. Furthermore, a significant account on the habits and habitat of this pest in field will be instrumental in understanding and devising population management strategies, which could help avoid or prevent any possible future outbreak.

MATERIALS AND METHODS

Collection, killing and preservation of grasshoppers

The specimens of *H. perpolita* were collected from the agricultural fields surrounded by vegetation of grasses and maize with the help of traditional insect hand-net (8.89 cms in diameter and 50.8 cms in length) as well as by hand picking. The collection was made during the year 2005-2007 in the months of June to August from various provinces of Pakistan. The collected material was preserved by conventional method and deposited in Entomological Museum, Department of Zoology, University of Sindh.

Dissection of phallic complex

For the study of male and female genitalia the method described by McEkevan *et al.* (1969) and

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Randell (1963), respectively was adopted.

The diagrams were all drawn with the help of ocular square reticule. The terminology followed here is basically that adopted by Dirsh (1956, 1957) with regard to the phallic complex and female genitalia.

Material examined

The specimens examined for this study were collected from Sindh: Jacobabad, Shikarpur, Gari Yaseen, Sukkur Pano Akil, Ghotki, Mirpur Mathalo, Khairpur, Ranipur, Larkana, Nao Dero, Thatta, Sujawal, Sonda Gharro, Karachi, Malir, Badin, Mati, Sanghar, Mirpurkhas, Umerkot, Hyderabad: Tando Mohammed Khan, Serri Husri, Dadu, Jamshoro, Kotri, Nawabshah, Punjab: Chakwal, Dodual, Rawalpindi, Seraykharboza, Islamabad, Selmidam, Multan, Lahore, Gujrat, D.G. Khan, Bahawalnagar, Rahim Yar Khan, N.W.F.P: Mansehra, Shinkari, Battle, Hajiabad, Ghandai, Dadual, Mara, Abbotabad, Haripur, Sokka, Swat, Balochistan: Barkhan, Lasbela, Uthal, Loralai.

RESULTS

Hieroglyphus perpolita (Uvarov, 1932) (Fig. 1)

Size medium to large. Moderately robust (Fig. 2). Integument shallowly pitted, shiny. Densely hairy on ventral surface of abdomen. Antenna (25-28) segmented shorter than head and pronotum together. Fastigium of vertex about twice as broad as long, frontal ridge widening downwards, shallowly sulcate. Pronotum cylindrical dorsum crossed by four wide sulci, metazona shorter than prozona, its posterior margin widely obtuse angular. Prosternal process bifurcate. Mesosternal interspace narrowly open, metasternal interspace closed.

The elytra extending well beyond the apex of the abdomen and wings perfectly well developed. Hind femur moderately robust, thick. Male supra anal plate angular with obtuse apex. Cercus simple thick longer than supra anal plate slightly down curved, with sub acute apex, subgenital plate with sub acute apex.

Phallic complex (Fig. 1)

Epiphallus size small, ancorae of medium

length, turning outwards; lophi elongate, not lobe-shaped pointed inwards, with subacute apices. Zygoma of cingulum narrow; rami broad; apodemes slightly shorter than basal valves of penis moderately broad with obtuse apices. Arch of cingulum with small denticle in the anterior part. Apical valves of penis narrow, shorter than valves of cingulum, narrowing at apex; valves of cingulum slightly upcurved, with subacute apex; basal valves of penis robust, slenderly expended at end; dorsal ridge of valves smooth at basal end; gonopore process elongate, narrowing towards truncate apex.

Coloration

General coloration green yellow, with yellowish buff patches on the pronotum, the transever suli of pronotum are very thick and blackish. Antenna yellowish to reddish-brown, darker at apex. Face and mouthpart yellowish-brown in ♂ or dark greenish in ♀. Wings hyaline, veins green, grey or brownish buff. Hind femora organ-colored on the outer side and reddish below, hind tibia bluish-grey with black band at base, spines buff with blackish tips apical half and hind tarsus bluish.

Female (Fig. 2)

♀ generally similar to the ♂ but larger and more robust. Difference in antennae segment (26-29) and fastigium of vertex approximately three time as broad as long; subgenital plate trilobate (Fig.3C) with outer lobes shorter than medium lobe; medium lobe with two spiny ridges converging towards apex, lower valves of ovipositor with external lateral projection forming ridge across ventral surface. Spermatheca (Fig. 3D-F) with preapical diverticulum straight or curved at distal end, apical diverticulum half the length of preapical diverticulum.

Measurements (mm) of different body parts of *H. perpolita*.

	Male (n=30)		Female (n=30)	
	Mean ±SD	Range	Mean ±SD	Range
Antennal segment	27.36±0.7	25-28	27.64±0.9	26-29
Antennal length	13.7±1.5	10.85	15.78±2.0	9.1-16.45
Length of head	4.96±0.3	4.2-5.25	6.94±0.5	6.3-9.45
Dis: between two eyes	1.71±0.13	1.4-2.1	2.91±0.3	2.45-3.5
Length of pronotum	7.37±0.8	6.3-8.75	10.38±0.18	9.8-10.5
Length of tegmina	31.7±2.7	24-39	41.9±3.7	31-49
Length of femur	18.7±1.2	17-21	25.1±1.5	21-28
Total body length	40.1±2.4	29-41	49.7±3.6	43-59

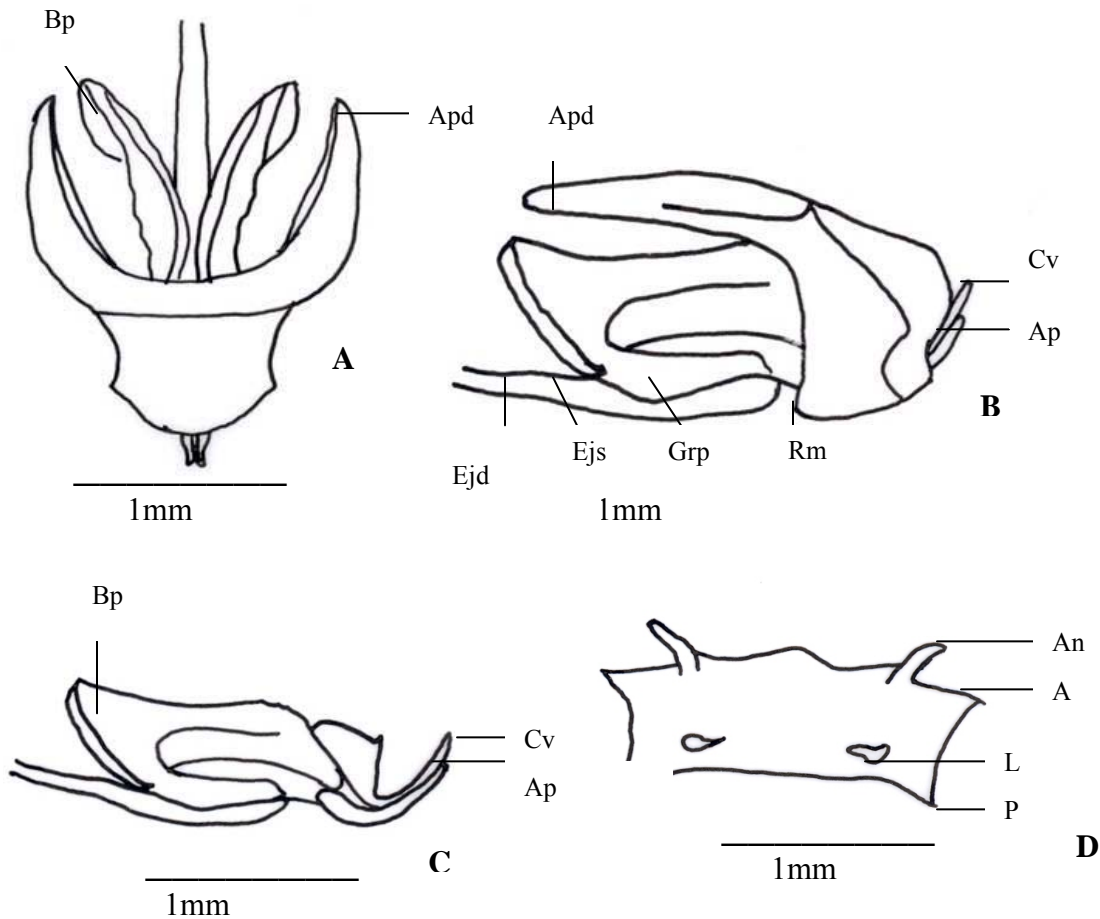


Fig. 1. Phallic of *Hieroglyphus perpolita* complex: A, from above, with epiphallus and ectophallic membrane removed; B, same lateral view; C, endophallus lateral view; D, epiphallus, dorsal view.
A, ancorae; Ac, arch of cingulum; An, anterior process of epiphallus; Ap, apical valves of penis; Apd, apodemes; Bp, basal valves of penis; Cv, valve of cingulum; Ejd, ejaculatory duct; Ejs, ejaculatory sac; Grp, gonopore process; P, posterior process; L, lophus; Rm, ramus of cingulum.

Comparative account

This species is very closely related to *H. annulicornis* Shiraki in having male cercus with simple apex and posterior margin of pronotum obtuse angular but can easily be separated from the same in having four sulci on pronotum, the prosternal process is bifurcate and the female subgenital plate is trilobate whereas prosternal process conical and subgenital plate with subacute median lobe in *H. annulicornis* however, other difference are noted in the description.

Ecological account (Fig. 4)

H. perpolita possesses some unique

characteristics regarding their habits and habitat. It is collected mostly from the *Saccharum bengalense* locally called Sarkanda in Pakistan (these plants having thick and coarse (thorny) leaves) near the cultivated fields of *Zea mays* (maize) and *Arachis hypogaea* (peanut).

This species occurs in macropterous form with two distinguish color forms i-e shining yellow and dark green. Color forms not reported previously. The eggs of *H. perpolita* hatch earlier than other species of *Hieroglyphus*. There is one generation in a year. Eggs generally hatch after first rain, if there is no rain the hatching of egg is delayed till July. Usually hoppers begin to emerge in second

week of June, but by middle of July most of hoppers become adults. However, a mixture of hoppers (Stages V to VI) and adults could be found till August, but the proportion of hoppers and adults was consistently higher in *S. bengalense* plants than elsewhere.

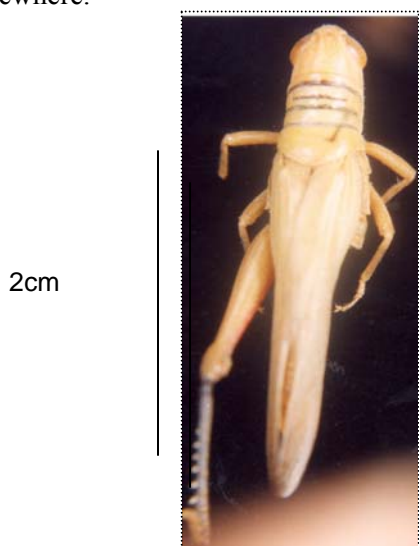


Fig. 2. Female of *H. perpolita* (Uvarov, 1932).

H. perpolita is sluggish in nature. It is mostly associated in Pakistan with the presence of a graminacious plant, *S. bengalense*. Adults and hoppers both feed voraciously on *S. bengalense*. This species mostly live in aggregation. It cannot be seen easily until the plant is disturbed. On slight disturbance, the grasshoppers start moving one after the other and hide into the lower portion of the plant. They prefer thorny bushes rather than other plants, which do not provide protection from enemies. Approximately >200 specimens were noted from a single *S. bengalense* plant of 6-7 feet height. The eggs are laid in the root of same plants, which remain undisturbed when nearby land is ploughed for cultivation. They are only destroyed when the plant is burnt.

There is close interaction of *H. perpolita* with *S. bengalense* in the field. If insect is not able to retract into the *S. bengalense* and this plant refuge is absent from the side of the field, then its population will be affected and they move to nearby cultivated fields and would cause extensive damage while moving from field to field over large areas.

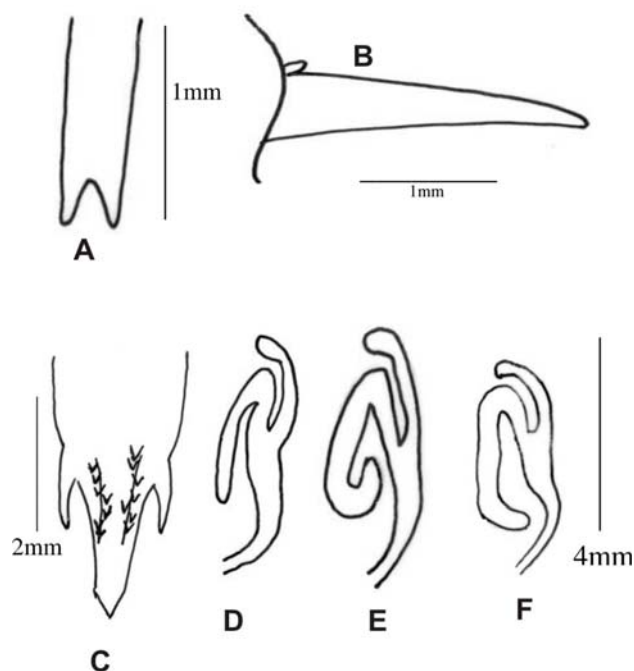


Fig. 3. *H. perpolita*; A, prosternal process; B, cercus, lateral view, C, subgenital plate, ventral view, D-F, variation of spermatheca.

DISCUSSION

Earlier Mason (1973), Mazhar (1993) and Yousuf (1996) recorded this species from Punjab Riffat *et al.* (2002) reported its incidence from Zhob division of Balochistan. On contrary to this, Janjua (1957), Ahmed (1980) and Qadri (1971) did not report a single specimen of *H. perpolita* from any specific region. It might be due to the distinct and peculiar habitat of this pest.

During present investigation a fairly large number of specimens have been collected from all over the Pakistan. Collection of such greater numbers of adults and nymphs show that their distribution has been extended to new localities.

Mason (1973) did not study a single male specimen of *H. perpolita* from Pakistan. Furthermore her material includes single male and female from Iran and seven females from Pakistan. Present study based on large number of specimens collected from all over the country show certain variations in the genitalia *i.e.* two ridge of median lobe of female sub-genital plates are provided with

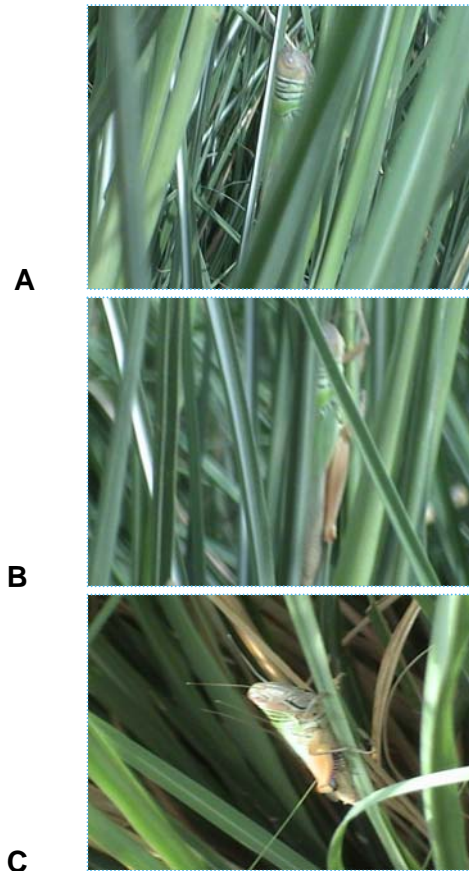


Fig. 4. Interaction of *H. perpolita* with *Saccharum bengalense* A-C in the field.

strong teeth, the apical diverticulum of spermatheca is not curved distally whereas Mason (1973) stated that in *H. perpolita* the ridge of female sub-genital plate are smooth and apical diverticulum is curved distally; anterior process of epiphallus is very short and the apical valves of cingulum and penis are upcurved, the arch of cingulum have small tooth in the interior portion. While Mason (1973) observed that in *H. perpolita* the anterior process of epiphallus is well developed and large and the apical valves of cingulum and penis are almost straight.

The above differences in male genitalia also appear to be variations within the species. Ingrisch (1989) has pointed out that the phallic complex is due to individual variation. McEkevan and Lee (1974) have even shown that its form can change in adult grasshopper with age. Small difference is shape, especially when compared drawing of other

authors should not be overestimated Ingrisch (1989).

Throughout the genus *Hieroglyphus* there is great variation in the form of spermatheca (Katiyar, 1960; Mason, 1973; Moizuddin, 1988) but the greatest diversity has been found in the *H. perpolita* between and within group (Figs. 3D-F). These differences in the spermatheca appear to be variations within the species.

Presently morphology and genitalia has been sufficiently studied and will form a basis for the identification. Further ecological studies will be instrumental in understanding and devising population management strategies, which could help to avoid or prevent any possible future outbreak.

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