SENRA Academic Publishers, British Columbia
Vol. 7, No. 3, pp. 2505-2514, October 2013
Online ISSN: 1920-3853; Print ISSN: 1715-9997

Canadian Journal of pure&applied sciences

SYSTEMATIC STUDIES AND HOST SPECIFICITY OF *SCELIO* (HYMENOPTERA: SCELIONDAE) EGG PARASITOIDS OF ORTHOPTERA FROM PAKISTAN

*Riffat Sultana[1], Yawar S Wagan[1], M Naeem[2], M Saeed Wagan[1] and Imran Khatri[3]
[1]Department of Zoology, University of Sindh, Jamshoro
[2]Institute of Pure and Applied Biology, Baha Uddin Zakariya University, Multan
[3]Department of Entomology, Faculty of Crop Protection, Sindh Agriculture University, Tandojam, Pakistan

ABSTRACT

The species of genus *Scelio* L. are exclusively parasitoids of Orthoptera eggs in many countries including Pakistan. During the present study information is presented on the general morphology, along with measurement of different body parameters, distribution and host specificity of this genus from Pakistan. Three species are recognized as valid for the Pakistani fauna i-e *Scelio hieroglyphi* (Timb.), *S. aegypticus* Priesner and *S. mauritanicus* Risbec from three host species of grasshoppers viz: *Hieroglyphus perpolita* (Uvarov), *H. oryzivorus* Carl and *H. nigrorepletus* I. Bolivar. Beside this, identification keys are also provided for *Scelio* and male of *S. aegypticus* is described for the first time from Pakistan.

Keywords: *Scelio,* distribution, morphology, parasitoids, Orthoptera, biological control, host association.

INTRODUCTION

The species of genus *Hieroglyphus* are voracious and destructive pest of rice, sugarcane, wheat, maize and minor pest of millets and fodder crops in Pakistan and India (Roonwal, 1978; Riffat and Wagan, 2008-2011). This genus is comprised on 10 species among these 3 species namely; *H. perpolita* (Uvarov), *H. oryzivorus* Carl and *H. nigrorepletus* Bolivar occurring in Pakistan. This genus is considered polyphagous and causes damage of millions of Pak rupees annually. It also has the tendency to produce the swarm (Ghouri and Ahmed, 1960; Qadari, 1971; Moizuddin 2001; Riffat and Wagan, 2008). It is of great economic consequence to the farmers of Pakistan. Hence, *Hieroglyphus* has been designated as a major pest of cash crops in Pakistan (Riffat and Wagan, 2009-2011). Control of these grasshoppers involves "Knock off" chemical pesticides. Pesticide expenses reaches in billions of Pak rupees each year. However, because of increasing concern on its effect on non-target organism, human health and persistence in the environment there is the need for environmental friendly alternative biological control that involve the use of natural enemies and pathogens to control pests, among these genus *Scelio* of Hymenoptera are very important in reducing field population of grasshoppers.

The first member of *Scelio* Latreille was described by Walker (1839) from the Australia. It is one of the largest genera of Scelionid Wasps with more than 225 described species (Dangerfield *et al*., 2001). These are obligate endoparasitoids of the eggs of grasshoppers and locusts in many countries. They are considered important natural enemies, regulating populations of acridids in both agricultural and natural habitats. *Scelio* are commonly responsible for keeping the locusts plagues in check (Dodd, 1927). He further, stated that during outbreak of *Locusta danica* Linnaeus in the coastal districts of North Queensland Australia, numerous *Scelio* species are considered important within the overall management of various acridid pests. *S. pembertoni* Timb. has been employed successfully as a classical biological control agent against *Oxya japonica* (Thunberg) in Hawaii (COPR, 1982). Dysart (1992) reported that *S. parvicornis* Dodd is being used against *Melanoplus* species in North America. Though, for several decades *Scelio* has featured prominently in biological studies on grasshoppers and locusts, but little is known about other members of this genus including some association with important pests in Pakistan.

Available literature revealed that, that biological studies on *Scelio* have probably been more extensively carried in world (e.g. Dodd, 1927; Birch, 1945; Nixon, 1958; Casimir, 1962; Greathead, 1963, 1992; Rees, 1973, 1985; Farrow, 1981; Baker *et al*., 1985, 1995, 1996; Wardaugh, 1986; Lecoq and Sukirno, 1999; Dangerfield *et al*., 2001; Matthwe, 2009) and from Pakistan (Ahmed *et al*., 1973; Irshad, 1977; Irshad *et al*., 1977, 1978 and Mahmood and Qazi, 1989) gave inadequate information on biological aspects and incidences of *Scelio*. However, despite this interest no stress seems to have been placed on the economic importance and taxonomic status of *Scelio* from this region. It was therefore, felt necessary to undertake this study from this region.

*Corresponding author email: riffatumer2@hotmail.com

MATERIALS AND METHODS

Study site

For the collection of egg-pods different climatic zones of country were visited time to time during the year 2011 (Map-I). The egg-pods were collected from the agricultural fields of rice, maize, sugarcane, millets, fodder crops and their surrounding vegetations (Fig. 2 a-f).

Collection of egg-pods

For the collection of egg-pods of grasshoppers method described by Irshad *et al*. (1977) was adopted. The egg-pods of grasshoppers were collected through scraping soil with a sharpened hand hoe, thus exposing the concealed froth-plug of the egg-pod. Afterwards the pod was dug out along with soil in which it was laid, and placed in plastic container of (8x8cm) each being kept separately for further studies. Excursions were made to collect grasshopper eggs throughout the year (particular during the months of May to August) but very few were encountered from June to July (it might be due to hatching period of pest). Egg-pods were collected from all the provinces of Pakistan but a large number of egg-pods were collected from the northern areas of Pakistan, the possible reason might be favorable climatic condition of region.

Laboratory incubation and identification

Collected egg-pods of different host species were reared under laboratory conditions at 28±2°C and 39±2°C temperature with relative humidity of 26 to 61%, eggs were reared in glass jars of (12x6cm) thick layer of sand. These temperature and relative humidity regimes are similar to field conditions. The top of the glass jar was tightly covered with muslin cloth and (3cm) and the bottom with thick layer of sand. Water was given through pipette daily in sufficient quantity to make the eggs wet and viable. Emerging nymphs and parasitoids were separated daily into rearing jars. Parasitism ratio was noted and identification of *Scelio* species was carried out.

Material Examined:

Sindh: Jacobabad,nr Jacobabad, June 2011, 2♂,3♀ (Wagan); Shikarpur, Gari Yaseen, July 2011, 4♂,3♀ (Wagan and Khatri); Sukkur Pano Aki, July 2011, 5♂,4♀ 7 (Umer and Wagan); Ghotki: Mirpur Mathelo, August 2011, 2♂,9♀ (Umer and Khatri); Khairpur; Ranipur, August 2011, 5♂4♀ (Wagan and Khatri); Larkana NawDero, September2011, 6♂,8♀ (Wagan); Thatta: Sujawal September 2011, 1♂, 7♀ (Umer, 2011); Karachi: Malir, September 2011, 2♂, 3♀ (Umer and Khatri); Badin: Matli, Ocotber 2011, 5♂, 3♀ (Wagan and Khatri); Sanghar: Sanghar proper, September 2011, 6♂,4♀ (Wagan and Umer), Mirpurkhas, old Mirpurkhas October 2011, 5♂,4♀ (Khatri); Umerkot, Umerkot proper, October 2011, 4♂,3♀ (Umer and Wagan), Hyderabad: Tando. M. Khan**,** September 2011, 5♂,4♀ (Umer and Wagan); **Serri**, August 2011) 2♂,3♀, (Khatri); Hasri, September 2011, 4♂,3♀, (Wagan); Tando-Allahyar, October 2011, 1♂,1♀ (Umer and Khatri); Dadu, July 2011, 3♂,6♀(Wagan and Umer) ; Jamshoro, June 2011, 2♂,3♀, (Umer); Nawabshah (Now S. Benazirabad), July 2011, 2♂,3♀ (Wagan); **Punjab:** Chakwal, Dodual, June 2011, 4♂,3♀, (Umer), Rawalpindi: Seraykharboza, June 2011, 2♂,3♀, (Umer and Wagan), Islamabad: Selmidam, June 2011, 2♂,1♀(Umer & Wagan); Faisalabad, July 2011, 2♂,2♀(Wagan), Multan: Multan proper, August 2011, 2♂,3♀(Umer); Lahore, August 2011, 2♂, 1♀ (Umer); Gujrat: Gujrat proper, September 2011, 3♂,2♀ (Khatri); Gujranwala, August 2011, 2♂, 2♀ (Umer and Wagan); D.G. Khan, September 2011, 2♂,2♀ (Wagan); Bhawal Nagar, October 2011, 2♂,3♀(Umer and Wagan); R. Yar Khan, June 2011, 2♂,2♀ (Umer and Wagan); **Kyber Pakhtunkhwa:** Mansehra, June 2011, 7♂,5♀ (Umer), Shinkari, June 2011, 3♂,8♀(Umer); Dadual near Hazara University, June 2011, 5♂,6♀ (Wagan and Umer), Abbotabad near Army Public School, July 2011, 7♂,8♀ (Umer), Haripur, Sokka July 2011, 7♂,6♀ (Umer and Wagan), Swat, Swat proper, August 2011, 5♂,6♀ (Wagan); **Balochistan:** Lasbela: Uthal August 2011, 4♂,6♀ 9 (Wagan and Khatri) and Loralai, August 2011, 6♂,4♀ (Wagan and Khatri).

STATISTICAL ANALYSIS

Data was analyzed with the help of statistical software SPSS version 10.0. Obtained data from experimental groups was subjected to one-way analysis of variance (ANOVA), with repeated measures and significant means were determined using Latter Significantly Different Range Test (LSD). The terminology for morphological terms adopted here is mostly taken from the scheme of Masner (1980) and Galloway and Austin (1984).

RESULTS AND DISCUSSION

Key to sexes of *Scelio* occurring in Pakistan

1. Antennal segment mean 12.26+1.03 with distinct apical club, metasoma often enlogate and tapering at base..... Female

--- Antennal segment mean 8.5+0.80 without apical club metasoma rounded and broad at apex..... Male

Key to females of *Scelio* species occurring in Pakistan

1. Pronotum densely punctuate and not visible except from cervix 2

--- Not as above .....*S. aegypticus*

2. Wings moderately infuscate, costa shorter .... *S. hieroglyphi*

----Wings normal deep smoky with basal portion sub-hyaline .....*S. mauritanicus*

Morphological description of *Scelio* Species
***Scelio hieroglyphi* (Timberlake)** (Fig.1a, Table 1)

Female
Length **(**4.70-5.30mm) (mean 4.70±0.20mm)

Color
Dark brown body with sculpturing of the different region. Coxae brownish, trochanter and femur brownish-yellow, tibia and tarsi light yellow, eyes grey, mouthparts dark brown and ovipositor with light yellow, fore-wings with light burnt amber, one fourth of anterior margin lighter along with the pterostigma and stigmal vein, area of radial vein seems tinted deeper than the ground color. The medial of lighter tinted by colorless area abdomen jet black and terminally pointed legs bright reddish-yellow. Antennae black, head black, abdomen dark brown, black along its lateral margins.

Head
Head normal except that the vertex is broader and more transverse and reticulate. Sculptured with short, sliver-grey hairs on the head. Eyes larger with grey coloration, its diameter is about two thirds of the entire face, lateral ocelli touching the margin of the eyes five carinae on the lateral side of the face and covering towards the oral opening four of them project more or less vertically downwards, the reticulation on the genual carina being confined to a band-like area interspersed with silver white hairs. Middle of the vertex bearing reticulation similar to those on the frons. Antennal segments (8.87±0.80) and length (1.53±0.03mm) and scape approximately one-third the length of the antennae longish, colorless hairs on the outer margin of antennae. The antennal curve, mandibles bear two teeth with the upper tooth seems slightly longer than lower.

Mesosoma
Mesosoma shining blackish with sculpturing characteristic. Pronotum densely punctate, and hardly visible except near the cervix and anterior parts to mesonotum from the neck margin it is very narrow and rounded off anterior the pronotum have numerous reticulations and hairs like those of the mesonotum. Propleuron bears a minute smooth shining area and ventral reticulations are noticeable which become coarser downwards. Mesonotum somewhat looks pentagonal and its distal margin bordering the scutellum broadest and becoming narrow along the pronotal border, entire dorsal region covered with delicate reticulations from the anterior to the posterior margins. The individual cells of the reticulations having very fine yellowish tinged silver-white hair. The thicker sclerotised areas form the anterior-lateral parts of the metanotum on either side which the sub-ellipsoida area form the mid-dorsal part the reticulations occur on the metapleuron and meta-

Table 1. Measurements of various body parts of *S. hieroglyphi*.

Body Parameter (mm)	n	Female	LSD	Min-Max
Length of head	15	0.69±0.04	A**	0.6-0.8
Length of pronotum	15	1.41±0.06	B	1.3-1.5
Length of antenna	15	1.53±0.03	C	1.5-1.6
Antennal segments	15	8.87±0.80	D	8.0-10.0
Length of forewings	15	3.63±0.1	E	3.45-3.85
Length of hind wings	15	4.51±0.09	F	4.40-4.72
Length of femur	15	2.46±0.08	G	2.30-2.60
Length of hind tibia	15	1.82±0.06	H	1.70-1.90
Total Body length	15	4.5±0.130	I	5.30-4.70

Note: *Mean± Standard deviation. **The letter indicate a significant difference (P<0.01) according to LSD test.

a b c

Fig.1. (a) *Scelio hieroglyphi (b) S. aegyptiacus (c) S. mauritanicus.*

Table 2. Measurements of various body parts of *S. aegyptiacus*.

Body Parameter (mm)	n	Male	LSD	Min-Max	n	Female	LSD	Min-Max
Length of head	15	0.55±0.04	A**	0.5-0.6	15	0.72±0.08	A**	0.6-0.8
Length of pronotum	15	0.99±0.08	B	0.87-1.05	15	1.23±0.01	B	1.22-1.25
Length of antenna	15	2.18±0.08	C	2.10-2.30	15	1.45±0.01	C	1.20-1.75
Antennal segments	15	8.5±0.80	D	8.0-10.0	15	12.67±1.11	D	11.0-15.0
Length of forewings	15	2.74±0.20	E	2.27-2.90	15	3.16±0.04	E	3.12-3.27
Length of hind wings	15	1.93±0.01	F	1.92-1.96	15	2.70±0.19	F	2.40-2.90
Length of femur	15	5.31±0.16	G	5.0-5.66	15	5.77±0.12	G	5.60-5.90
Length of hind tibia	15	4.68±0.10	H	4.50-4.90	15	4.70±0.07	H	4.70-4.90
Total body length	15	3.5±0.22	I	3.15-3.85	15	4.20±0.20	I	4.0-4.60

Note: *Mean± Standard deviation

episternum acutely consist of oblique characteristic and forming distinct parallel ridges however on the meta-epimeron these reticulations are somewhat irregular.

Wings

Moderately infuscate, costa shorter and merges with sub-costa, which at the anterior margin having 4-5 microchaetae about its point of origin winged marginal very faint pterostigma somewhat sub-ovoidal and marked all over by numerous irregulative granulations, on the anterior margin of pterostigma there is a pair of distinct ting circular sports which placed longitudinally the stigmal runs somewhat obliquely distal and downwards like a finger shaped process, its proximal reign seems narrower than its distal region, which is well rounded off and having a pairs of similar circular spots. One above the other examination under the high magnification revealed that stigmal appears to be faintly continuous near about the middle of pterostigma.

Metasoma

Moderately spindle – shaped, terminally pointed it is black and shining having six tergites, which are closely opposed to each other. All these tergites and sternites are transverse with the exception of the terminal one, the width and length of each of the six tergites. The total length of the abdomen related to that of thorax and head together. The first three tergites are broader from the posterior region while the remaining last three are broadest anteriorly, sculpturing is prominent on the Ist tergum with longitudinal ridges tending to anastomose mid-dorsally while on the 2nd segment tergum the ridges are parallel middorsally and bear a semilunar transverse impression, however, on the 3rdtergum these ridges are parallel but less prominent than Ist tergum as far as remaining tergites (IV,V,VI) are concerned these ridges are straight and regular manner but somewhat look very thinner. The sternites also having these similar ridges except these are not present on Ist and 2ndtergites, which bear irregular reticulation on anterior side and more or less parallel ridges on posterior side 6thtergit sub-cylindrical with the ridges anastomosing with one another prominent lateral keel on the femur, along the pleural region of the abdomen. Golden-yellowish hairs on the abdomen fore-legs are concolorous, testacerous except the coxae white are dark, femur longer as four times and bears a groove on the inner side, tibia shorter than femur three fairly long slightly curved stout spines are present on the tarsus.

Male unknown

Distribution

This species is widely distributed in the India, Pakistan, South-Africa, China and Western Australia.

Host specificity

Earlier Roonwal (1978) reported single hymenopterous species from the egg-pods of *H. nigrorepletus* and Rao (1952) reported *Scelio* from the *H. banian* from India , Shah *et al*. (1998) reported *S. africans* from the egg-pods of *H. daganensis* from Northern Benin. Similarly, Irshad *et al*. (1978) recorded *S. hieroglyphi* from the egg-pods of *H. banian* Rao (1952) and Pruthi and Mani (1942) of *S. hieroglyphi* from the egg-pods of *H. nigrorepletus*. Irshad *et al*. (1978) reported that when *S. hieroglyphi* was reared only from the northern hills parasitizing on the whole about 7% *H. banian* egg-pods since *H. banian* oviposits mostly on the bunds the parasite was only recovered from this habitat. Roonwal (1976) reported mild infestation of *Scelio* and stated that only 232 parasitoids emerging from 280 egg-pods of *H. nigrorepletus* from India. Further, Murai (1959) reported severe infestation of *S. muraii* Watanable and *S. tsuruokensis* Watanable upon the *Oxya japonica* Willemse and *O. velox* Fabricius from Shonai district Yamagata at present this species is being reported for the first time and constricted new record for Sindh province.

Comments

Mukerji (1953) misidentified *S. hieroglyphi* as *S. oviphagae* but after the careful examination of Rao (1952) proved that *S. oviphagae* is somewhat identical

Fig. 2. (a-d) Oviposition sites of *Hieroglyphus* species occurring in Pakistan (Field View); (e-f) Egg-pods of *H. perpolita.*

with *S. hieroglyphi* but it is separate species rather than sibling species. Present study agreed with the view of Rao (1952). Roonwal (1978) also stated that *S. hieroglyphi* successfully parasitized and completed its life history on several other grasshoppers Viz: *Atractomorpha crenulata*, *Oedaleus nigrofasciatus* Sauss, *Oxya multidentata* Will and *Phlaeoba* species. At present we have reported this species from various provinces of Pakistan. The following host species of grasshoppers were recorded: *Hieroglyphus nigrorepletus* Bolivar, *H. oryzivorus* Carl, *H. perpolita* (Uvarov), *Trilophidia annulata*, Thunberg), *Eyprepocnemis roseus* Uvarov, *Heteracirs littoralis* (Rambur) and *H. adspersa* (Redtenbacher) Rao (1952), Mukerji (1953), Roonwal (1978), Irshad *et al*. (1978) did not report this species from the *H. oryzivorous* during present study *H. oryzivorous* is reported as new host for this species.

***Scelio aegyptiacus* Priesner** (Fig. 1b, Table 2)

Female
Length **(**4.0-4.6mm), (mean 4.20±0.20mm)

Color
Body shining black, bright-reddish, yellowish legs, coxae with dusky blackish coloration, antennae black but the scape dark reddish and more or less dusky, joints in antenna yellowish in color. Forewings light smoky with pale coloration, at the base venation obscure and pale, femur with grayish- brown.

Head
It is normal in appearance, highly polished, vertex and frons with large circular and confluent punctures toward the occiput those punctures are irregular arranged and continued on either side of antennal impression. Antennae with (12.67±1.11) segment and length (1.45±0.20mm) Antennae stout, scape as longer as the next five joints combined pedicel also one-third longer than its greatest width as described in *S. mauritanicus*. The mouth with short converging strinae and all punctures having a fine seta.

Mesosoma
Thorax two-thirds longer than its greater width from the dorsal-aspect however from the lateral margin it is one-half longer than high, the pronotum not abruptly declivous as in other species, coarsely, rugose- punctate pronotum and having fine pubescence, the anterior lateral angles are minutely toothed. Scutum also having large circular, confluent punctures and fine inconspicuous pubescence however, these punctures seems less dense on the lateral lobes of the seutum. Propodeum moderately longer with fine densely punctuate meson with two noticeable longitudinal carinae the mesopleurae with strong longitudinally striate. Metapleurae with longitudinally rugose punctuation.

Wings
Normal light smoky, whitish, the basal portion pale and venation also the pale-yellowish in color. Dark-light stigmal spot are also present in the different margin of the wings, submarginal vein yellow, indistinct the stigmal vein deep fuscous and very conspicuous the stigmal spot hardly marked.

Metasoma
Abdomen scarcely more than twice as long as its greatest width first segment short transverse and one third as long as its basal width. The width and length of six tergites vary from each other. First tergit strongly striate and between the striae shallow rugose, 2 fine very densely striate and between the striae than 2 these striae are irregular and broken from the outline of the abdomen however, the surface between these striae quite strong rugose. The sculpture between finer and there is definite median stria. Lateral margin of abdomen having shallow indefinite punctuation and numerous fine setae.

Male
As the ♀, but coxae and femora blackish, Antenna with (8.0±10.0), (Mean 8.5±0.80) segments its length (2.18±0.08mm) with wholly black coloration. Scape rather shorter, pedicel smaller and seems hardly longer than its greater width. The other character are agreeing with the female with exception of the punctuation of the head is inclined to be reticulate and rogues punctuate. Striae on the abdomen segments denser and more irregular compare to ♀ the meson not smooth and the surface between the striae fine sculptured. The width and length of tergite in ♂ also reported differ with each other as was noted for female. Forewings sub-hyaline, the venation pale-yellowish and the stigmal spot was recorded very smaller.

Distribution
This species mostly occur in India, Pakistan and Australia

Comments
This is most common collected species of *Scelio* from Pakistan and having considerable economic importance because of the pest status of its host's grasshopper species. The male of this species has not described previously. Earlier, Irshad *et al.* (1978) reported this from hilly area of Rawalpindi. He also reported that parasites seem to prefer to attack eggs on bunds (artificial embankment in the field) rather than eggs in the field. He also reared this species on the *Aiolopus thalassinus* and *Stenohippus* species, which are not associated with paddy. But at the present this species is reported from *Hieroglyphus* egg pods which are considered major pests of rice, sugarcane, maize and other fodder crops in Pakistan (Riffat and Wagan, 2008). It is interesting to note that Irshad *et al*. (1978) could not report a single host of *Hieroglyphus* species (effective by *Scelio*) it might be due to less survey in that particular locality. During the present study we have collected *Scelio* spp. from 9 hosts 3 belonging to genus *Hieroglyphus* while remaining 6 are also severe pests of agricultural crops. Present study is recommended that this is fairly widely distributed species occurring in all the ecological zones of Pakistan and might be used as bio-control agent.

Host specificity
S. aegyptiacus is not only associated with *Hieroglyphus* species but during the present study following host species viz: *Oxya hyla hyla* Serville, *Aiolopus thalassinus* (Fabricius), *A. thalassinus thalassinus* Fabricius, *A. tamulus* Fabricius, *A. simulatirx simulatirx* (Walker) and *Acrotylus* sp. was also reported as host species. Extensive survey of grasshopper's fauna showed that this species having greater host range and almost affecting all species of grasshopper present in their permissive area.

Table 3. Measurements of various body parts of *S. mauritanicus*.

Body Parameter(mm)	n	Female	LSD	Min-Max
Length of head	15	0.50±0.05	A**	0.4-0.6
Length of pronotum	15	1.42±0.06	B	1.3-1.5
Length of antenna	15	2.66±1.34	C	2.4-2.8
Antennal segments	15	12.26±1.03	D	10.0-13.0
Length of forewings	15	1.83±0.07	E	1.70-1.92
Length of hind wings	15	1.52±0.04	F	1.49-1.60
Length of femur	15	7.12±0.33	G	6.50-7.42
Length of hind tibia	15	5.83±0.22	H	5.54-6.20
Total body length	15	4.25±0.1	I	4.0-4.5

Note: *Mean± Standard deviation.
**The letter indicate a significant difference (P<0.01) according to LSD test

Scelio mauritanicus Risbec (Fig. 1c, Table 3)

Female:
Length (4.0-4.5mm), (mean 4.25±0.1mm)

Color
Body dark blackish, coxae blackish, legs yellowish-reddish in appearance, the femur duskeygraish, antennae with (12.26±1.03) segments and length (2.66±1.34mm), antennae black and brownish toward apex. The pedicel and base of the scape brownish together dark, abdomen pointed blackish having the sharp shinning on the surface fore-wings bears light brownish amber hind-wing hyaline. Fore-legs are concolorous, wings brownish except the basal third. Fore wings deep smoky.

Head
Larger with dense puncture, which not confluent, mouth converging strine. Depressed and smooth area above antennal insertation ocelli larger, vertex between these ocelli smooth and shining, several punctures just behind the anterior ocellus while the posterior ocelli medially, there is a transverse raw of five large punctures and three short oblique raw of punctures on each side, Behind these punctures the strong longitudinal groves running on the oceipt, cheeks narrow with large confluent punctures forming long sulci; frons also having numerous large circular punctures. Antennae longer, broad and smooth fore-wings deeply smoky its basal portion paler and yellowish venation pale-yellowish. Antennal scape as long as the next form joint combined; pedicel twice as longer as it greater width.

Mesosoma
Mesosoma shining blackish with numerous hair. Pronotum coarsely, shallow and rugose. Scutum with large circular confluent punctures. Median lobe of pronotum smooth and shining and without sculpture except for the scattered observe puncture having the pale-yellowish setae; propodeum shorter at meson its posterior angle truncate densely finely punctuate on the lateral side silvery pubescence longitudinally punctuation, mesopleurae with strong striate from above; metapleurae with strong confluent punctuation. On the fore-wings very obscure and small distinct stigmal spot are also present.

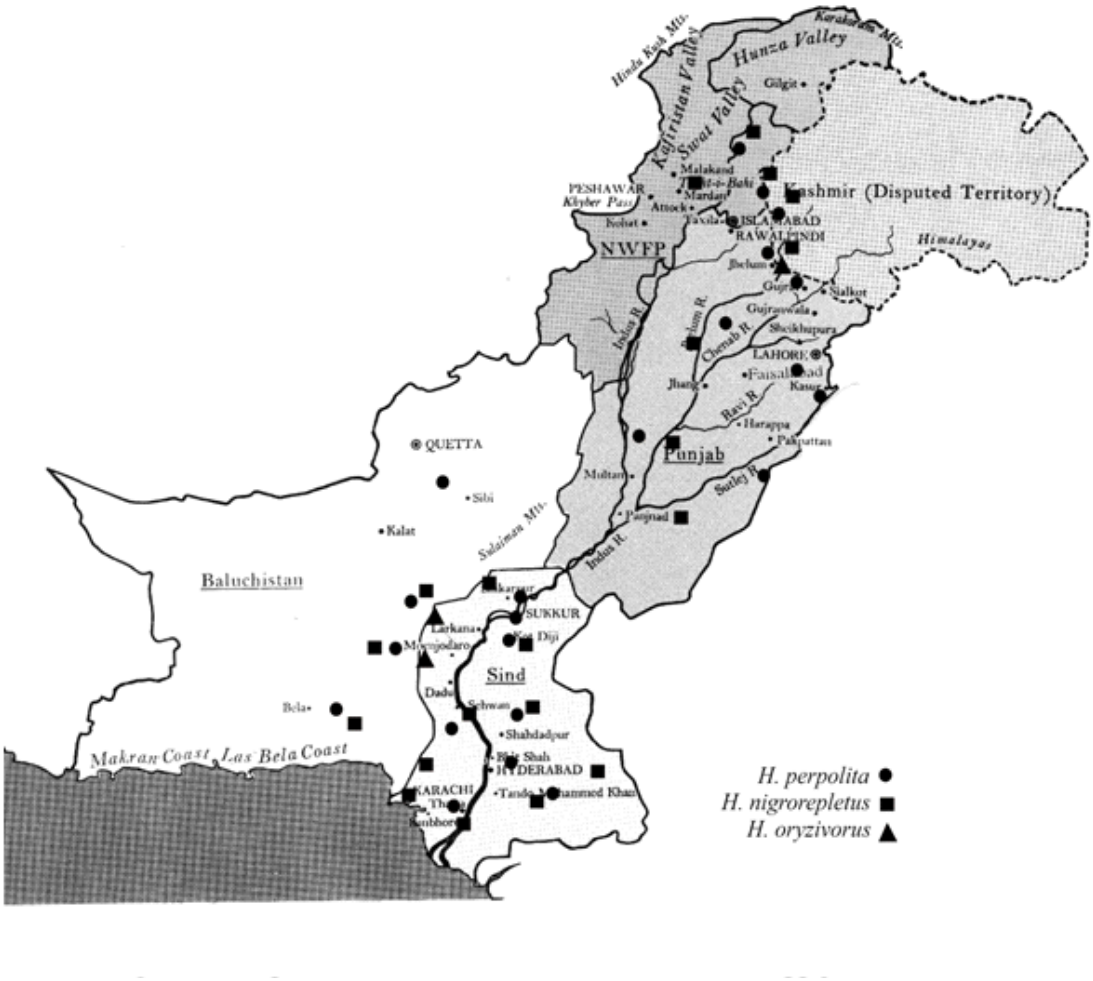
Wings
Normal deep smoky the basal portion sub-hyaline, venation pale-yellowish and very obscure and a small distinct stigmal spots also present.

Metasoma
Abdomen moderately slender 2.5 times as longer as its greater width its 1st segment hardly more than one-half as long as its basal width at base the width and length of the six tergites from (I to Vi) are related in the proportion of each other. First segment strongly striate and rugose between the striate; 2-6 very fines and densely striate are present except for the broadly smooth posterior margins 3-6 fine setae scattered on entire surface.

Male unknown:

Distribution
This species restrains very wide range and distributed in: India, Pakistan, northern Benin, Australia, South Africa, New Zealand and Eastern Africa.

Host specificity
Irshad *et al*. (1978) recorded this species from the egg-pods of *Eyprepocnemis roseus* (Uvarov) from the Rawalpindi- Pakistan however, Shah *et al*. (1998) reported this from the wide range of host species viz: *Teleogryllus gracilipes, Zacompsa festa,* including *Hieroglyphus daganensis*. At the present we reported this species from the egg-pods of *H. nigrorepletus, Eyprepocnemis roseus* (Uvarov) and *Locusta migratoria* (Linnaeus). Presently we are an opinion with Irshad *et al.* (1978) that this species significantly affect the egg-pods of *Eyprepocnemis roseus*.



Map 1. Localities in Pakistan from where from where the egg-pods were collected.

Comments

This species effect the wide range of host species of grasshopper in the field which include *H. nigrorepletus, Eyprepocnemis roseus* and *Locusta migratoria* from Pakistan (Irshad *et al*., 1978), while from northern Benin it is reported as sever pest of *Cataloipus fuscocoeruleipes*, *Hieroglyphus daganensis*, *Kraussaria angulifera, Tylotropidius gracilipes and Zacompsa festa* (Shah *et al*., 1998). At the present we collected a large number of this species from the eggs pods of *H. nigrorepletus*. However, overall findings on these natural enemies suggest that this species have wide host range and widely distributed in areas which were visited. Therefore, they can be tried in area with different conditions against many grasshoppers' species.

ACKNOWLEDGMENTS

This study was funded by Higher Education Commission Islamabad for Research project (HEC No. 20-1762 / RandD/10) and is highly acknowledged. We are also thankful to Dr. M. Irshad NARC Islamabad for the confirmation of *Scelio* species. The first author is highly thankful to Prof. Dr. M. Tahir Rajput, Dean Faculty of Natural Sciences for facilitating the project.

REFERENCES

Ahmed, F., Irshad, M. and Ali, R. 1973. Natural enemies of grasshoppers in Pakistan. Report Commonwealth Institute of Biological Control. 1972.59-60.

Baker, GL., Pigott, R. and Gallowayi, I. 1985 .The phonology of *Scelio* spp. (Hymenoptera: Sceliondae), parasite of acrdidid eggs (Orthoptera: Acrididae) in south east Australia. In: Proceeding 4th Australasian Conference on grassland invertebrate ecology. Ed. Chapman, RB. Christchurch, Caxton Press. 285-275.

Baker, GL. and Pigott, R. 1995. The impact of biotic factors on *Chortoicetes terminifera* (Walker) in invasion areas of south-eastern. Aust. J. Orth. Res. 4:49-55.

Baker, GL, Dysart, RJ. and Pigott, R. 1996. Parasitism of grasshoppers and locust eggs (Orthoptera: Acrididae) by *Scelio* spp. (Hymenoptera: Sceliondae) in southern Australia Aust. J. Zool. 44:427-443.

Birch, LC. 1945. Diapause in *Scelio chortoicetes* Frogg (Sceliondae), a parasite of the eggs of *Austroicetes curciata* Sauss. J. Aust. Inst. Agri. Sci. 11:189-190.

Casimir, M. 1962. Histology of outbreak of the Australian plague locust, *Chortoicetes terminifera* (Walk.) between 1933 and 1959 and analysis of the influence of rainfall on these outbreaks. Aust. J. Agri. Res. 13:886-903.

COPR (Centre for Overseas Pest Research). 1982. The locust and grasshopper Agricultural manual. Centre for Oversea pest Research, London. pp690.

Dodd, AP. 1927. The genus *Scelio* Latreille in Australia. Proceed. Royal Soc. Queensland 38:127-178.

Dysart, RJ. 1992. Grasshopper egg parasites (*Scelio* spp.) from Australia as candidates for biocontrol introduction. Metalepta. 14(1):5.

Dangerfield, P., Austin, A. and Baker, G. 2001. Biology, Ecology and Systematic of Australian *Scelio*: Wasp Parasitoids of Locust and Grasshopper Eggs. CSIRO Publishing. 1-254.

Farrow, RA. 1981. Aerial dispersal of *Scelio fulgidus* (Hym: Sceliondae), a parasite of the eggs of locusts and grasshoppers (Orth: Acrididae). Entomophaga. 26:349-355.

Ghouri, ASK. and Ahmed, H. 1960. Swarming of *Hieroglyphus nigrorepletus* Pl. Prot. Bull. FAO. 8:135-136.

Galloway, ID. and Austin, AD, 1984. Revision of Scelioninae (Hymenoptera: Sceliondae) in Australia. Aust. J. Zool. (Suppl. Series) 99:1-138.

Greathead, DJ. 1963. A review of insect enemies of Acridoidea (Orthop.) Tran. Royal Ent. Soc. London. 437-517.

Greathead, DJ. 1992. Natural enemies of tropical locusts and grasshoppers: their impact and potential as biological control agents. In: Biological control of locust and grasshoppers. Eds. Lomer, CJ. and Prior, C. Wallingford, Oxon, CAB. International. 105-121.

Irshad, M. 1977. A note on occurrence of nematodes as internal parasites of grasshoppers in Pakistan. Agri. Pak. 28:285-87.

Irshad, M. Ghani, MA. and Ali, R. 1977. Studies on grasshoppers occurring in the grassland and their natural enemies in Pakistan. Pak. J. Sci. Ind. Res. 22:89-91.

Irshad, MM. Ahmed. M. Ghani, MA. and Ali, R. 1978. Parasites of grasshopper (Acridoidea: Orthoptera) eggs: distribution and life history of *Scelio* spp. (Hymenoptera: Sceliondae) in Pakistan. The Canad. Entom.110:449-454.

Lecoq, M. and Sukirno. 1999. Drought and an exceptional outbreak of the oriental migratory locus, *Locusta migratoria manilensis* (Meyen, 1835) (Orthoptera: Acrididae). Ind. J. Orth. Res. 8:153-161.

Mahmood, TZ. and Qazi, MH., 1989. Density and parasitism of grasshopper egg pods in Pakistan. Insect. Sci. Appl. 10:63-68.

Matthew, JY., Alejandro, AV., Andrew, P., Lubomir, M. and Norman, FJ. 2009. Revision of *Scelio pulchripennis* group species (Hymenoptera, Platygastroidea, Platygastridae). Zookeys. 20:53-118.

Mukerji, S. 1953. On a new species of Scelionidae *Scelio oviphagus* sp. nov. (Serphidae- Proctotrypoidea: Hymenoptera) parasitic on eggs of *Hieroglyphus nigrorepletus* I. Bol. in Ajmer India. Ind. J. Ent. 14:209-213.

Murai, S. 1959. Studies on the egg parasites of the grasshoppers *Oxya japonica* Willemse and *O.velox* Fabricius, VI. Especially on the power of the oviposition and the distribution pattern in host eggs of the parasites. *Scelio muraii* Watanabe and *S. tsuruokensis* Watanabe. Bull.Yam. Uni. (Agri. Sci.). 3.65-72.

Masner, L. 1980. Key to genera of Scelionidae of the Holarctic Region, with descriptions of new genera and species (Hymenoptera: Proctotrupoidae). Memoirs of Ent. Soc. Canad. 113:1-54.

Moizuddin, M. 2001. Studies on the habitats and life cycle of rice grasshopper *Hieroglyphus nigrorepletus* Bolivar (Orthoptera: Acridoidea) in the desert area of Lasbela, Balochistan. Proc. Pak. Congr. Zool. 21:123-131.

Nixon, GEJ. 1958. A synopsis of the African species of *Scelio* Latrelle (Hymenoptera: Proctotrupoidea: Scelionidae).Tran Royal. Ent. Soc London. 110:303-318.

Pruthi, HS. and Mani, MS. 1942. Distribution hosts and habits of the Indian Serphoidea and Bethyloidea. Memoirs of the Ind. Musm.13:405-444.

Qadri, MAH. 1971. Outbreak of pests in Pakistan (Abstr). In: Cento Report of panel Treaty Organization. Scientific Coordination Board CENTRO Rep. No. SCB/71/2/D7.

Rao, YR. 1952. Scelionids as parasites of eggs of Orthoptera. Ind. J. Ent. 14:174-175.

Ress, NE. 1973. Arthropod and nematode parasites, parasitoids, and predators of Acrididae in Amercia north of Mexico. USDA Tech. Bull. 1460:288.

Ress, NE. 1985. Suitability of selected North American grasshopper species as hosts for grasshopper parasites from Pakistan. Agri. Ecosys. Enviro12:157-163.

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

Riffat, S. and Wagan, MS. 2008[b]. 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, MS. 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, MS. 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, MS. 2011. Test of few insecticides against the various developmental stages of *Hieroglyphus* Species (Hemiacridinae: Acrididae: Orthoptera). Pak. J. Zool. 43(5):941-946.

Roonwal, ML. 1976. Ecology and biology of the grasshoppers *Hieroglyphus nigroreplet* Bolivar (Orthoptera: Acrididae) 1. Eggs pods, diapause, prolonged viability and annual hatching rythum Zool. Angew. Berlin. 63:171-185.

Roonwal, ML. 1978. The phadka grasshopper and its control. India Farming. 27(10)3-6.

Shah, PA., Godonou, I., Gbongboui, C., Hossou, A. and Lomer, CJ. 1998. Survival and mortality of grasshopper egg pods in semi-arid cereal cropping areas of northern Benin. Bull. Ent. Res. 88(4):451-459.

Walker, F. 1839**.** *Monographia Chalciditum*, London: Hyppolite Bailliere. 2:100.

Wardaugh, KG. 1986. Diapause strategies in the Australian plague locust, *Chortoicertes terminifera* (Walker)). In: The evolution of insect life cycle. Eds. Taylor, F. and Karban, R. Springer-Verlag. New York. 89-104.

Received: May 15, 2013; Revised: Aug 5, 2013; Accepted: Aug 7, 2013