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Taxonomic and morphological studies on the genus *Chrotogonus* Serville, 1838 (Pyrgomorphidae: Orthoptera) from Pakistan, with reference to their habitats

Samiullah Soomro*^{ID} Riffat Sultana^{ID}

Department of Zoology, University of Sindh, Jamshoro, Sindh, Pakistan.

*Corresponding author: samiqau373@gmail.com

E-mail address: riffat.sultana@usindh.edu.pk

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Abstract:

Species of genus *Chrotogonus* (surface grasshoppers) are phytophagous and damaging to various economical important plants in their seedling stages. In order to know the biodiversity of surface grasshoppers, the detailed study has been conducted from four provinces of Pakistan. During this study, biodiversity, taxonomy, diagnosis, morphometric analysis, habitat, global distribution, and remarks of each species have been described. Total of 826 specimens were collected and sorted out into three species and three subspecies: *C. (Chrotogonus) homalodemus homalodemus* (Blanchard, 1836), *C. (Chrotogonus) homalodemus* (Blanchard, 1836), *C. (Chrotogonus) trachypterus trachypterus* (Blanchard, 1836), *C. (Chrotogonus) trachypterus robertsi* Kirby, 1914, *C. (Chrotogonus) trachypterus* (Blanchard, 1836) and *C. (Chrotogonus) turanicus* Kuthy, 1905 based on newly constructed morphological keys and previous literature. The species *C. (Chrotogonus) turanicus* presented as a new record from Pakistan.

Keywords: *Chrotogonus*, New record, Orthoptera, Pyrgomorphidae, *turanicus*.

Introduction:

Pyrgomorphidae family contains about 500 species and is the most colorful family of grasshopper families distributed Worldwide^{1,2}. The genus *Chrotogonus* is from the most wide-ranged genera of Pyrgomorphidae that contains about 19 species world-wide. Most of the species are found in Africa and Indian sub-continent. Genus *Chrotogonus* is common phytophagous and distributed almost in Africa and South Asia including Pakistan and India³⁻⁶. Species of genus *Chrotogonus* are damaging to economically important plant species (cotton, wheat, sugarcane, jowar, maize, groundnut, millet and vegetables) particularly in their seedling stages⁷⁻¹⁰, but *C. trachypterus* was found most serious pest of rice crops as compared to other crops¹¹⁻¹⁴. Sometimes repeated sowings are required due to severe damage of both nymphs and adults on leaves and tender shoots of plants^{1,4}. A detailed comprehensive study of *Chrotogonus* has been described by Keven¹⁵. It has been reported that *Chrotogonus* persist in various habitats including gardens, bare soil, sandy soil, along with roadsides and in many field crops in Africa and Asia. Wagan and Riffat observed that it has rough body including many tubercles with granules on surface of body³. It has been described that *Chrotogonus trachypterus*

(Indo Iranian species) basically has two forms *Chrotogonus trachypterus trachypterus* and *Chrotogonus trachypterus robertsi* which are two subspecies and persist in the eastern and western sides of Indus plains respectively. Further, Keven mentioned that *C. trachypterus robertsi* are found in Baluchistan and Afghanistan in their arid zones along with eastern Palearctic Eremian. He described about *C. trachypterus trachypterus* as North Indian sub-species found in low arid regions hence persist in South of Himalayas from Baluchistan to India. He recorded its presence more abundant in oriental region as compared to palearctic region. He also compared another species *Chrotogonus homalodemus homalodemus* with these two: *C. trachypterus trachypterus* and *C. trachypterus robertsi* by showing small differentiating character that is slightly slender and found in sandy regions of Baluchistan (Mekran)¹⁵. No wide-ranging study on the genus *Chrotogonus* has been done in Pakistan so this study has been carried out to identify the biodiversity, ecology, distribution, and taxonomic status of the genus *Chrotogonus* from Pakistan.

Methodology:

Extensive surveys were carried out in four provinces (Punjab, Sindh, Balochistan and Khyber Pakhtun) of Pakistan and 826 specimens of grasshoppers were collected with the help of traditional hand net from agricultural crops, hilly areas, deserted and semi deserted plains having the vegetation of grasses, herbs and shrubs¹⁵, during March 2018 to September 2019. Specimens were

brought to Department of Zoology, University of Sindh, Jamshoro, Sindh, Pakistan and sorted out into six species (Table. 1) on the basis of data present on Orthopteran species file (<http://orthoptera.speciesfile.org/>) and previous literature^{3,8}. Reliable identification and new records morphological keys have been created on the basis of strong differentiating characters.

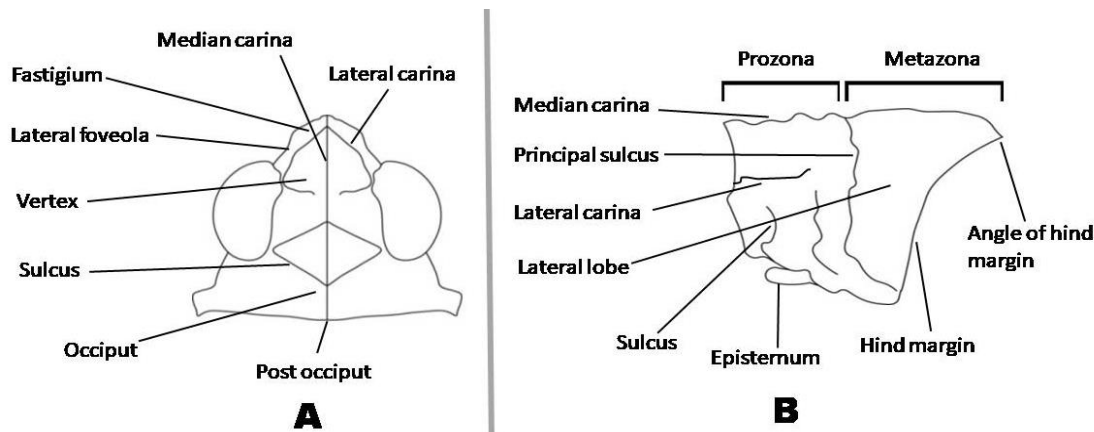


Figure 1. A- Dorsal view of head, B- Lateral view of pronotum.

Photographs of the various species were taken. Line drawings (in millimeters) were made with a camera lucida fitted on a microscope (Ernst Leitz Wetzlar Germany 545187) and these were improved with the help of the software Adobe illustrator CC-2015. Moreover, illustrations were made to differentiate species on the basis of their structures (Fig. 1). Moreover, morphometrical measurement of various body parts microscope (Oculas) 10x10 graph, compass, divider, and rule has been used. In some cases, electronic digital calliper has been also used (Wings and Tegmina).

Results and discussion:

The highest number of specimens of *Chrotogonus* was collected which is 329 from Sindh and lowest number which is 118 from Khyber Pakhtun. *C. (Chrotogonus) trachypterus trachypterus* was recorded as the most abundant species with highest number 368 (44.55%) and *C. (Chrotogonus) turanicus* was recorded as the least abundant species with lowest number 8 (0.96%) (Fig. 2).

Table 1. Distribution of genus *Chrotogonus* in four provinces of Pakistan

Species/Subspecies	Provinces				
	Balochistan	Punjab	Sindh	Khyber Pakhtun	Pakistan
<i>Chrotogonus homalodemus homalodemus</i>	47	39	89	34	209
<i>Chrotogonus homalodemus</i>	32	45	48	24	149
<i>Chrotogonus trachypterus trachypterus</i>	79	91	140	58	368
<i>Chrotogonus trachypterus robertsi</i>	2	16	21	-	39
<i>Chrotogonus trachypterus</i>	6	20	27	-	53
<i>Chrotogonus turanicus</i>	-	2	4	2	8
Total	166	213	329	118	826

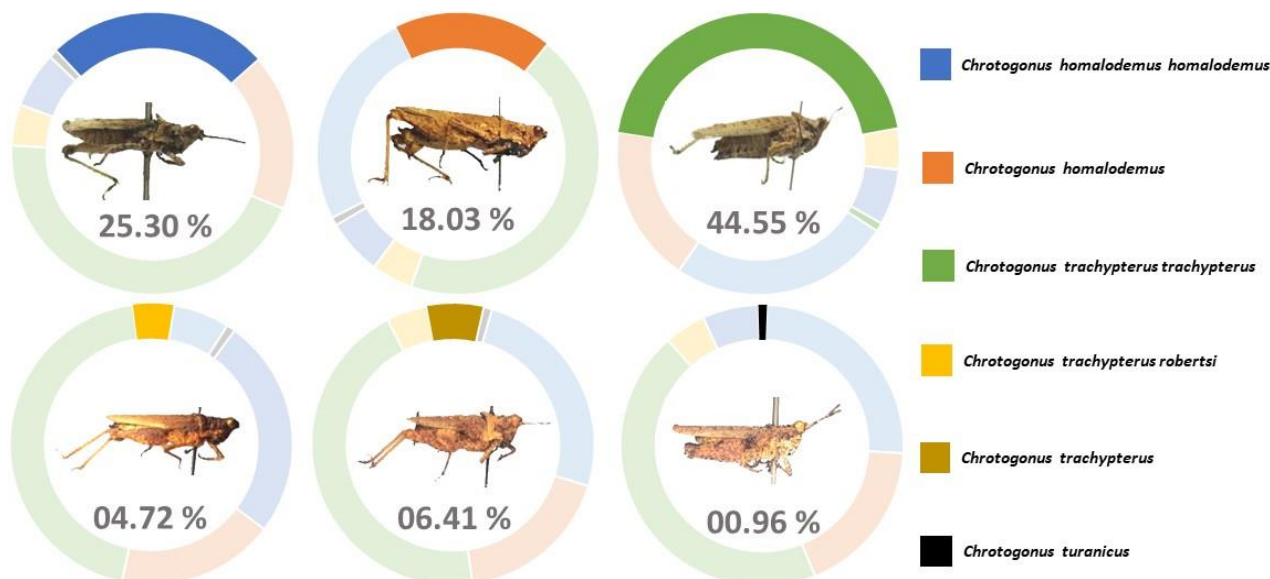


Figure 2. Percentage of species of genus *Chrotogonus* in four provinces of Pakistan

Genus *Chrotogonus* belongs to family Pyrgomorphidae of suborder Caelifera and order Orthoptera. Pyrgomorphidae is the most colorful

family of grasshoppers and species of genus *Chrotogonus* are known as surface grasshoppers due to geophilous in nature.

Key to six species/subspecies of genus *Chrotogonus*

- 1 Pronotum is crown shaped from upper surface but slightly darker hind margin and angle of hind margin with brownish cone shaped at posterior shoulder and disk *C. homalodemus*
- Pronotum is not crowned shaped from upper surface but whitish hind margin and angle of hind margin with creamy whitish cone shaped at posterior shoulder and disk *C. h. homalodemus*
- 2 Pronotum median carina dim but male characterize with sharply defined hind margin and angle of hind margin and the principal sulcus irregularly trilobate *C. t. robertsi*
- Pronotum median and lateral carinae marked only on metazona with depressed hind margin and angle of hind margin and the principal sulcus not irregularly trilobate *C. t. trachypterus*
- 3 Pronotum have lateral and median carinae narrower with broader hind margin and angle of hind margin at posterior *C. trachypterus*
- Pronotum have lateral and median carinae broader with narrower hind margin and angle of hind margin at posterior *C. turanicus*

1. *Chrotogonus (Chrotogonus) homalodemus*

Diagnosis

Generally, the body size is small to medium of all specimens of species *Chrotogonus (Chrotogonus) homalodemus*. With dark yellowish

color and shades on the head, pronotum and tegmen. Ventral side of the abdomen is brownish and without dark dots unlike *C. homalodemus homalodemus* which is important differentiating character of this species (Fig. 3).

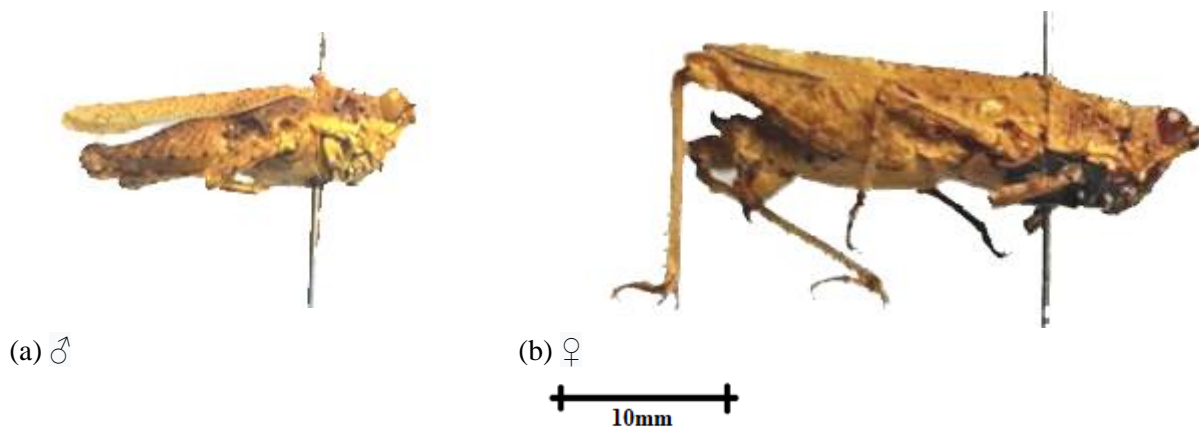


Figure 3. *C. (Chrotogonus) homalodemus*: (a) ♂; (b) ♀

Head and pronotum

Fastigium of vertex is wide to narrow in female more than male. Vertex is conical but less than *C. homalodemus homalodemus* and in color slightly light brown. Lateral foveola is as an outgrowth and darker than vertex in color. Median carina arises from fastigium of vertex towards the end of posterior of head and lateral carina is absent alike *C. homalodemus homalodemus*. In male, occiput has triangular shaped sulcus (upper and lower equal in size) from both sides of median carina and in female has no sulcus on head. In male, post occiput

is slightly convex shaped and whereas in female is more than male (Figs. 3 and 4).

Pronotum is crown shaped from upper surface but slightly darker hind margin and angle of hind margin with brownish cone shaped at posterior shoulder and disk. Principle sulcus folds before extending towards lateral lobes. Wrinkled lateral carinae lengthen to posterior disk. Episternum large and widen to anterior lobe of pronotum in male and in female it is short. Prozona has two incomplete sulci in male and three incomplete sulci in female (Figs. 3 and 4).

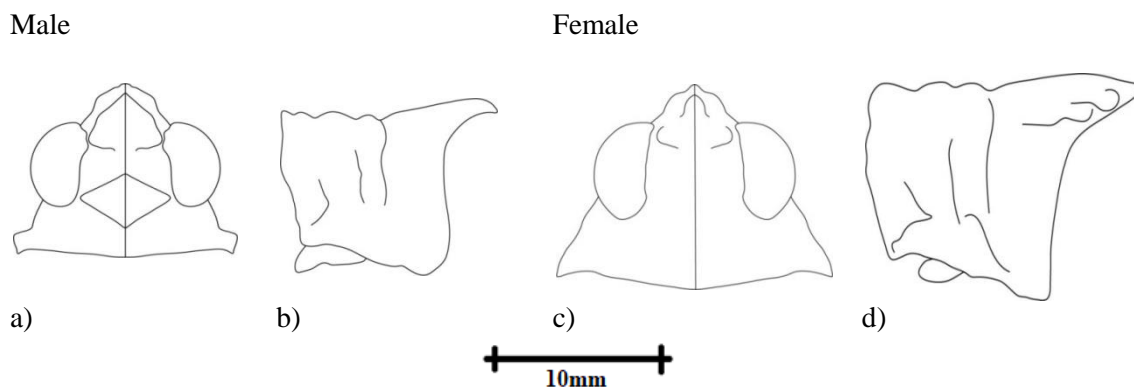


Figure 4. *C. (Chrotogonus) homalodemus* ♂: a) DV Head b) LV Pronotum. ♀: c) DV Head d) LV Pronotum.

Morphometry (♂n=05) (♀n=05) (mm)

Male: Length of head 00.91 ± 00.19 ; Length of Pronotum 01.40 ± 00.00 ; Length of tegmen 15.60 ± 01.14 ; Length of wing 14.60 ± 01.14 .

Female: Length of head 01.26 ± 00.19 ; Length of Pronotum 01.82 ± 00.51 ; Length of tegmen 16.00 ± 03.46 ; Length of wing 14.60 ± 03.28 .

Habitat and host plants

Chrotogonus homalodemus is found probably for the whole year around in different seasons with fluctuate population. Ecologically, species of *C. homalodemus* occurred in varieties of habitats but

most commonly in soil of arid, deserts with semi deserts soil, meadows on grounds and open grasslands grounds, as well as in cultivated concerned areas such as crop fields and in bushes along with roadsides, found on seedling plants. It is recorded as pest of crops grown agricultural lands. It damages various parts of cultivated plants like the tender leaves, flowers and tender pods. There are various host plants affected by this species: *Phaseolus* (Beans Cereals), *Gossypium herbaceum* (Cotton), *Triticum aestivum* (wheat), *Oryza sativa* (rice), *Desmostachya bipinnata* (grass), *Hordeum*

Vulgare (barley), *Saccharum officinarum* (sugar cane), *Zea mays* (maize), *Cicer arietinum* (chickpea), *Pisum sativum* (field pea) and *Trifolium* (Clover).

Global distribution

This species is found in Egypt, Iran, West Pakistan, Sudan, Chad, Ethiopia, Kenya, Nigeria, Somalia, Yemen and Pakistan¹⁶⁻¹⁸. Recently, it has been reported from Sindh, Punjab, Balochistan and Khyber Pakhtun provinces of Pakistan.

Remarks

Hosny¹⁶ reported that *C. homalodemus* exist all year around in Egypt. This species is Terrestrial because of their habitat. Zohdy^{17, 18} mentioned that this species of *Chrotogonus* is a pest of seedling plants. Currently, it has been reported that this species is from Khairpur Mir's for the first time. While it's large numbers of specimens were also collected

from this location. This species is mostly found in sandy, crop field and rocky habitat. Body color matches with the soil and can be commonly spotted in ploughed field and roadside grasses. While it was also noticed that size and shape are variable in the same individuals of same locality.

2. *Chrotogonus (Chrotogonus) homalodemus homalodemus*

Diagnosis

Generally, the body size is smaller and cream brown in color with small dark shades above the tegmen. The row of black spots on the underside (ventral side) of the body is an important character. Along the black spots, the squat shape of this species is also helpful in identification of this subspecies (Fig. 5).

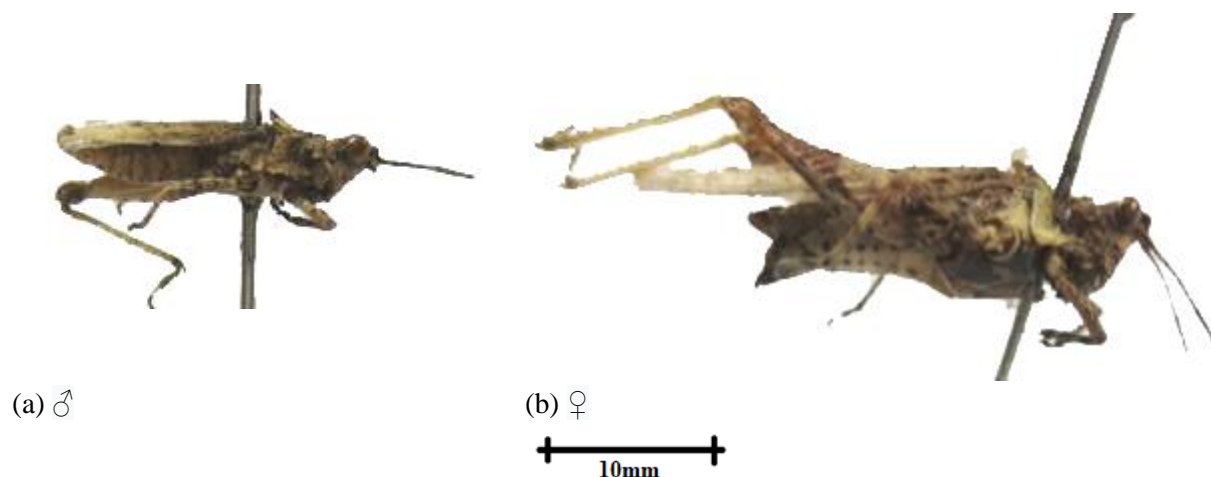


Figure 5. *C. (Chrotogonus) h. homalodemus*: (a) ♂; (b) ♀

Head and pronotum

Fastigium of vertex is narrow in front with a grooved shaped in female and without grooved in male. Vertex is conical and in color slightly dark brown. Two sulcus (Plural) arise at vertex. Lateral foveola is wrinkled and dark brown in color. Median carina arises from grooved shaped of Fastigium of vertex towards the end of posterior of head. Lateral carina in head is absent. In male, occiput has triangular shaped sulcus from both sides of median carina (upper sulcus are greater than lower) and in female has no sulcus on head. In male, postocciput is slightly convex shaped and whereas in female is straight (Figs. 5 and 6).

Pronotum is not crowned shaped from upper surface but whitish hind margin and angle of hind margin with creamy whitish cone shaped at posterior shoulder and disk. Principle sulcus extends towards lateral lobes despite folding and in female another sulcus arises from median carina till lateral carina.

Wrinkled lateral carina emerges from anterior lobe and lengthens to posterior disk in female and in male incomplete lateral carina present only on prozona. Episternum is short. Prozona has three incomplete sulci in male and one incomplete sulcus in female. Suture is whitish yellow and sometimes dark brown because of camouflaged (Figs. 5 and 6).

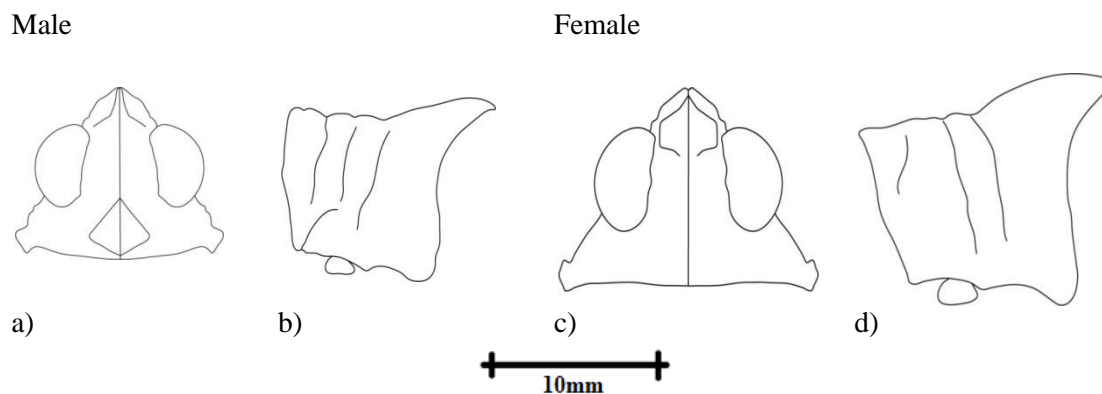


Figure 6. *C. (Chrotogonus) h. homalodemus* ♂: a) DV Head b) LV Pronotum. ♀: c) DV Head d) LV Pronotum.

Morphometry (♂ n=05) (♀ n=05) (mm)

Male: Length of head 00.91 ± 00.19 ; Length of Pronotum 01.40 ± 00.00 ; Length of tegmen 15.60 ± 01.14 ; Length of wing 14.60 ± 01.14 .

Female: Length of head 01.26 ± 00.19 ; Length of Pronotum 01.82 ± 00.51 ; Length of tegmen 16.00 ± 03.46 ; Length of wing 14.60 ± 03.28 .

Habitat and host plants

This subspecies is mostly found on the open surfaces, moist clay soil but sometimes also found in Grass (*Cynodon dactylon*), Barley (*Hordeum vulgare*), Bajra (*Pennisetum glaucum*) and Jowar (*Sorghum vulgare*).

Global distribution

This sub-species is found in UAE, Oman, Eremian zone, NE-Africa, Egypt, Palestine, Jordan, Saudi Arabia, Chad, Arabian Peninsula, Yemen, Ethiopia, Nigeria and Pakistan^{3, 19, 20}. Recently, it has been reported from Sindh, Punjab, Balochistan and Khyber Pakhtun provinces of Pakistan.

Remarks

Gillett¹⁹ described that this subspecies is also known as minor pest of crops and found in different habitats e.g. gardens, bushes, desert and plane areas. Bader²⁰ mentioned that this species usually hides under dry vegetation on loose soil or sandy areas. Riffat and Wagan³ reported that *C. homalodemus homalodemus* is mostly similar to *C. trachypterus trachypterus* and *C. trachypterus robertsi* with some differences being smaller and more slender occurs in the sandy area.

3. Chrotogonus (Chrotogonus) trachypterus robertsi

Diagnosis

Generally, the body size is smaller to medium and uniform brownish grey, robustly tuberculate. Ventral side of abdomen is smooth, with a double row of brown spots. General body and femur of specimens of this sub species are healthy and robust as compared to other species and sub species (Fig. 7).

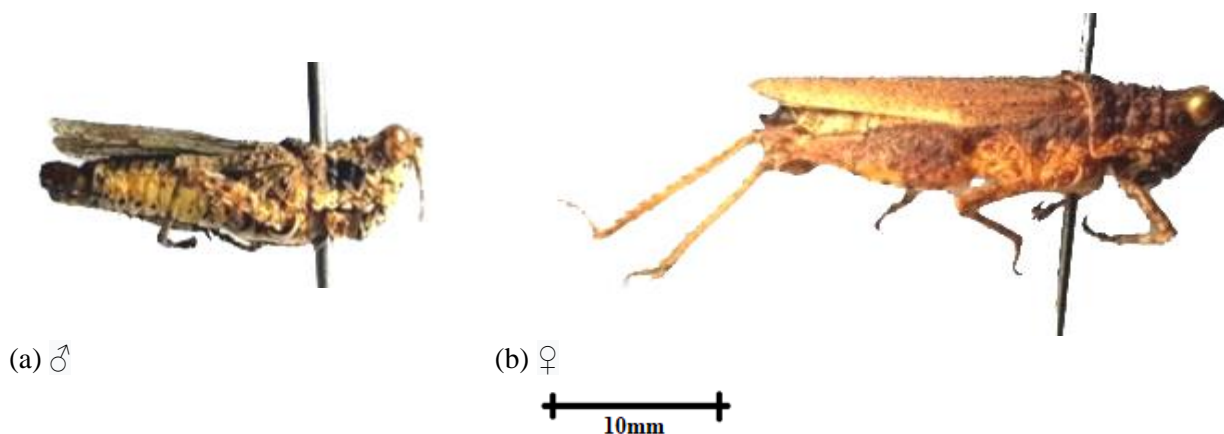


Figure 7. *C. (Chrotogonus) trachypterus robertsi*: (a) ♂; (b) ♀

Head and pronotum

Fastigium of vertex is narrow in front with a grooved shaped in female and without grooved in male. Vertex is more conical in female than male. Lateral foveola is arisen apart from vertex. Median

carina arises from fastigium of vertex towards the posterior end of head. Two sulcus emerge from the fastigium of vertex and extends towards occiput as a conical shape more prominent in female. Lateral carina in head is absent. In male occiput, sulcus

arise from both sides of median carina form small triangular shape structure and female has no any sulcus on head. In male, postocciput is convex with prominent angular shaped posterior ends and whereas in female postocciput is straight and posterior ends curved toward pronotum (Figs. 7 and 8).

Pronotum median carina are dim, but male is characterized with sharply defined hind margin and angle of hind margin and the principal sulcus

irregularly trilobite. Principle sulcus extends down towards shoulder and in female it folds to form another sulcus. Wrinkled lateral carina emerges from anterior lobe and lengthens to principle sulcus. Episternum large and widen to anterior lobe of pronotum in male and in female it is short. Anterior of prozona is arisen and metazona is flattened. Prozona has two incomplete sulci in male and one incomplete sulcus in female (Figs. 7 and 8).

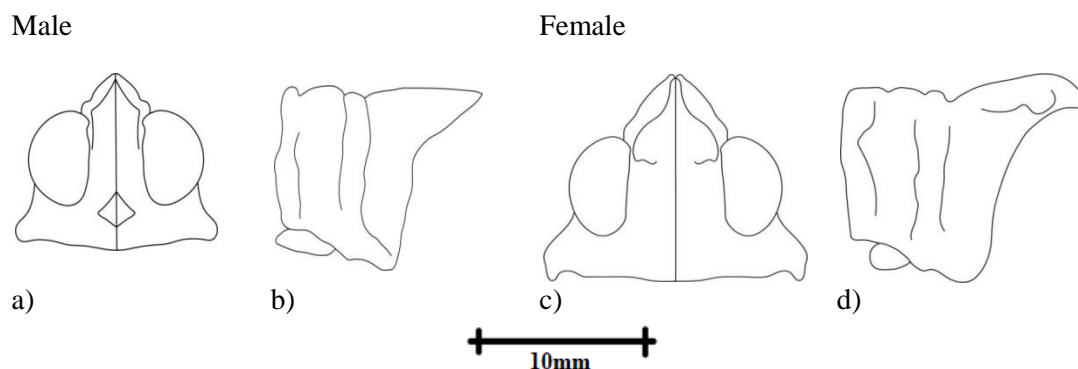


Figure 8. *C. (Chrotogonus) trachypterus robertsi* ♂: a) DV Head b) LV Pronotum. ♀: c) DV Head d) LV Pronotum.

Morphometry (♂n=05) (♀n=05) (mm)

Male: Length of head 00.84 ± 00.09 ; Length of Pronotum 10.30 ± 00.11 ; Length of tegmen 09.23 ± 00.12 ; Length of wing 07.15 ± 00.11 .

Female: Length of head 01.24 ± 00.07 ; Length of Pronotum 13.26 ± 00.05 ; Length of tegmen 12.86 ± 00.24 ; Length of wing 08.62 ± 00.10 .

Habitat and host plants

Dry sandy soil with sparsely growing thorny herbs and wild grasses are common areas where these specimens originate. They are often found in hilly areas of Pakistan near the fields of Cotton, tobacco, mustard, wheat, rice, and many other crops this species persist.

Global distribution

This sub-species is found in West Azerbaijan, Iran, Afghanistan, Indian Subcontinent and Pakistan^{21,22}. Recently, it is reported from Sindh, Punjab and Balochistan provinces of Pakistan.

Remarks

Joseph²¹ mentioned that this sub-species is found in both West Pakistan and Iran but recorded as major

pest in West Pakistan and minor pest in Iran and found in other areas with some importance. Further, he reported that this sub-species is found in cotton, tobacco, tomato, mustard, wheat, rice and other crops²². In addition to this, he also listed *C. (Chrotogonus) t. robertsi* as polyphagous insect²³. Kevan²⁴ described detailed study on the morphometry of this species and further explained that specimens of this species are preserved in British Museum London.

4. *Chrotogonus (Chrotogonus) trachypterus trachypterus*

Diagnosis

Generally, the body size is small to medium and muddy brown color with rough bands of dark brown colors on tegmen. Brown pale ventrally with black dots on thorax, metazona and lateral side of abdomen are differentiating characters of this sub species (Fig. 9).

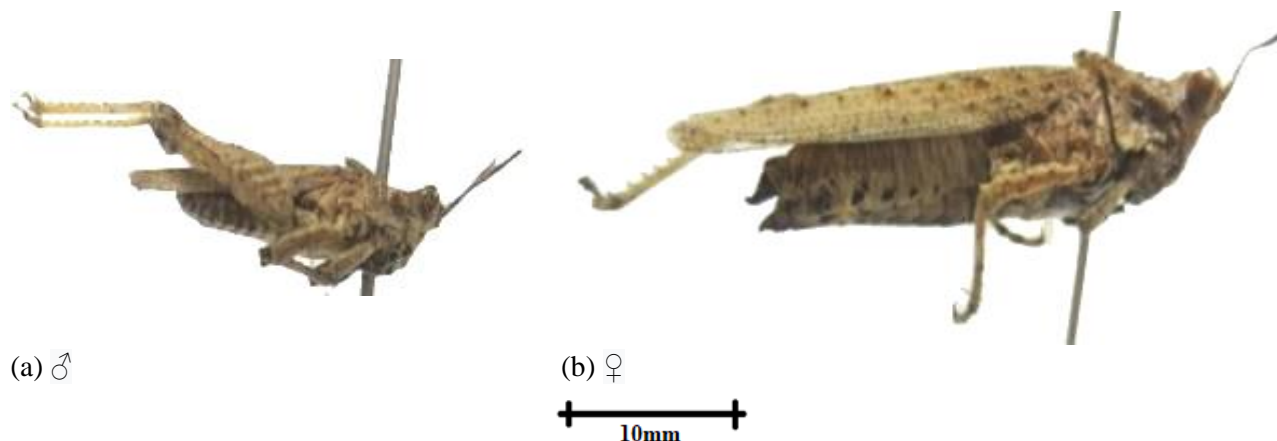


Figure 9. *C. (Chrotogonus) trachypterus trachypterus*: (a) ♂; (b) ♀

Head and pronotum

Fastigium of vertex is narrow in front with a grooved shaped in female more than male. Vertex is conical in female and wide conical in male with brown color. Two sulcus (Plural) arise to form a triangular shape at vertex in male where as in female no any sulcus found. Vertex forms an umbrella shaped structure. Complete median carina arises from grooved shaped fastigium of vertex towards the end of posterior of head. Lateral carina in head is absent. In male occiput, triangular shaped sulcus from both sides of median carina (upper sulcus are smaller than lower). Postocciput is slightly convex shaped. Eyes are depressed as compared to other species of *Chrotogonus* (Figs. 9 and 10).

Pronotum median and lateral carina marked only on metazona with depressed hind margin and angle of hind margin and the principal sulcus not irregularly trilobite. Principle sulcus extends towards lateral lobes and in female it extends entirely to shoulder. There is no any lateral carina on prozona. Anterior of pronotum extends towards head. Episternum large and widen to form ear shaped structure in male and in female it is short. Prozona has two incomplete sulci in male and in female sulci form an eye shaped structure. Pronotum has granules. Median carina goes up to the end of pronotum with greater metazona than prozona (Figs. 9 and 10).

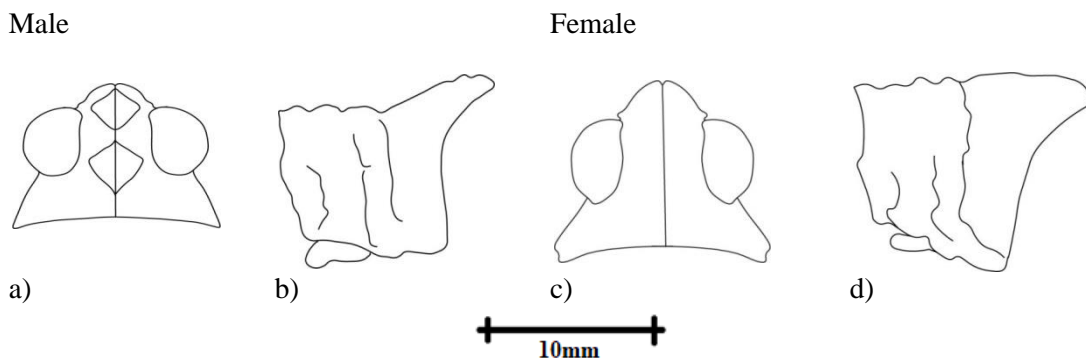


Figure 10. *C. (Chrotogonus) trachypterus trachypterus* ♂: a) DV Head b) LV Pronotum. ♀: a) DV Head b) LV Pronotum.

Male: Length of head 02.06 ± 00.08 ; Length of Pronotum 02.62 ± 00.17 ; Length of tegmen 12.40 ± 00.54 ; Length of wing 11.40 ± 00.54 ; Total body length 17.30 ± 00.83 .

Female: Length of head 02.41 ± 00.31 ; Length of Pronotum 03.67 ± 00.17 ; Length of tegmen 16.90 ± 01.34 ; Length of wing 16.00 ± 01.41 .

Habitat and host plants

Bare grounds along with the association of herbs and low grasses are distributional areas of this sub

species. They are distributed on the surface of soil (grounds) having best habitat. These are severe pest of vegetables, alfalfa, early growth stages of Gramineae and many other crops. Its host plants reported as cotton, wheat, alfalfa, sorghum, maize, ground nut, tobacco, and lawn grasses.

Global distribution

This sub species occurs in Afghanistan, India, Bangladesh, Iran, Nepal and Pakistan^{3, 25- 29}. Recently, it has been reported from Sindh, Punjab,

Balochistan and Khyber Pakhtun provinces of Pakistan.

Remarks

Mandal²⁹ reported that all members (nymphs and adults) of *Chrotogonus* found throughout the year, it may be possible because *Chrotogonus* has three generations/year. Haldhar²⁷ described that it is also present in nurseries, gardens and wheat fields along with in plains, grasses, and vegetable fields. Color of body matches the soil. The leaves of cotton and wheat fed by nymph and adult of *C. t. trachypterus* by cutting germinating plants. Riffat and Wagan³ mentioned that

main life form of this species is Terri-deserticole. Keven²⁴ described that mostly they are found in less arid regions and this species present in eastern side of Indus plains.

5. *Chrotogonus (Chrotogonus) trachypterus*

Generally, the body size is small to medium with brown and wrinkled with tuberculate. Dorsal side of abdomen is brown and whereas beneath looking pale having no darkish spots but with darkish tinge. Yellow eyes and eighteen dark dots present on the ventral side of abdomen is strong differentiating character of this species (Fig. 11).

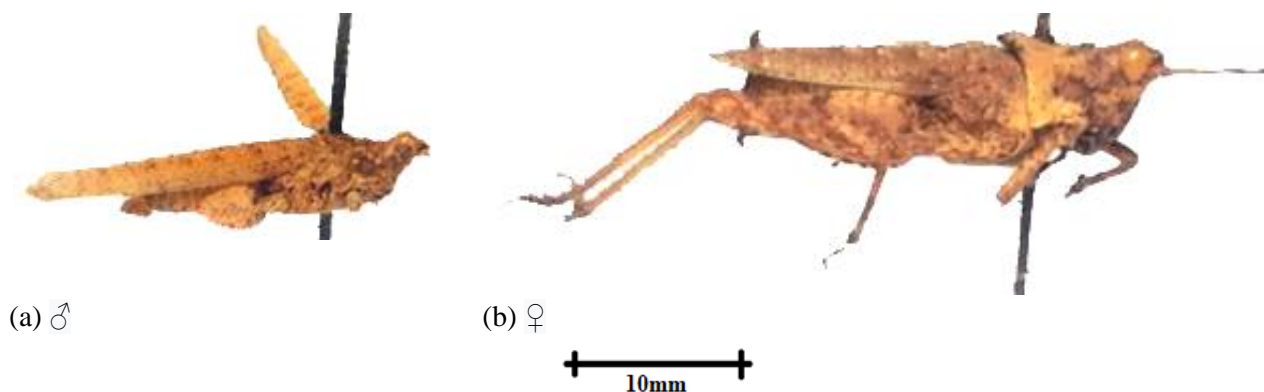


Figure 11. *Chrotogonus (Chrotogonus) trachypterus*: (a) ♂; (b) ♀

Head and pronotum

Fastigium of vertex is wide narrow in front with a slightly grooved shape in female and without grooved in male. Vertex is concaved and in color dense brown. Two sulcus (Plural) arise from fastigium at vertex and two other sulcus are present on vertex. Lateral foveola is not prominent. Median carina arises from grooved shaped fastigium of vertex towards the end of posterior of head in female but in male not present. Lateral carina in head is absent. In male occiput, two sulcus are present without emerging from median carina. In both, male and female postocciput is straight but in male terminal ends are lobed shapes. Head has

irregular borders despite of regular shape (Figs. 11 and 12).

Pronotum has lateral and median carina narrower with broader hind margin and angle of hind margin at posterior. Two incomplete sulci extend towards lateral lobes and in female sulcus folds to form another sulcus. Anterior of pronotum wrinkled in male and flattened in female. Episternum large and widen to form ear shaped structure in both male and female. Prozona has two incomplete sulci. Below the pronotum sternum is yellowish. Pronotum was yellowish brown and short but broad with presence of tubercles (Figs. 11 and 12).

Male

Female

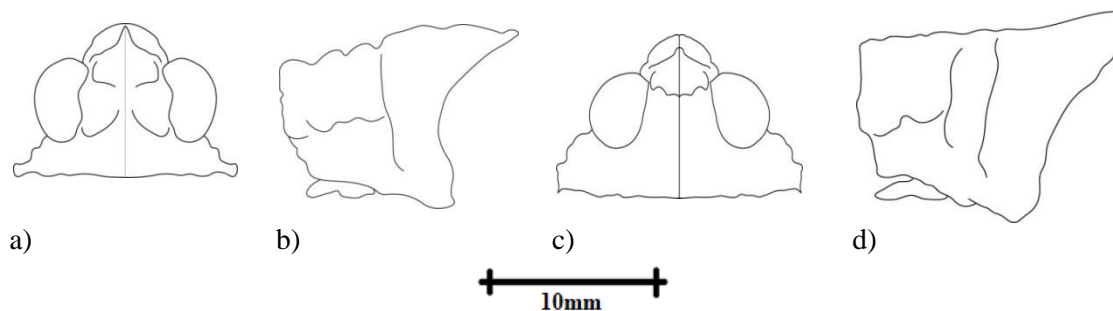


Figure 12. *C. (Chrotogonus) trachypterus* ♂: a) DV Head b) LV Pronotum. ♀: a) DV Head b) LV Pronotum.

Morphometry (♂n=05) (♀n=05) (mm)

Male: Length of head 02.12 ± 00.08 ; Length of Pronotum 02.52 ± 00.18 ; Length of tegmen 11.80 ± 00.61 ; Length of wing 11.01 ± 00.49 .

Female: Length of head 02.41 ± 00.31 ; Length of Pronotum 03.52 ± 00.18 ; Length of tegmen 15.90 ± 01.34 ; Length of wing 15.01 ± 01.23 .

Habitat and host plants

C. (Chrotogonus) trachypterus feeds on foliage and tender shoots. Specimens of this species scatter on emergence and feed on almost any green vegetation. Injurious to germinating crops and may inflict severe damage to cotton. It is found throughout the year but are less active during winter season both adult and hoppers. During field survey, specimens of this species are found on number of host plants: (cotton), (wheat), (alfalfa), (sun-flower), (sorghum), (maize), (groundnut), (tobacco), (paddy nurses), (potato) and (tomato) but majority on cotton crop.

Global distribution

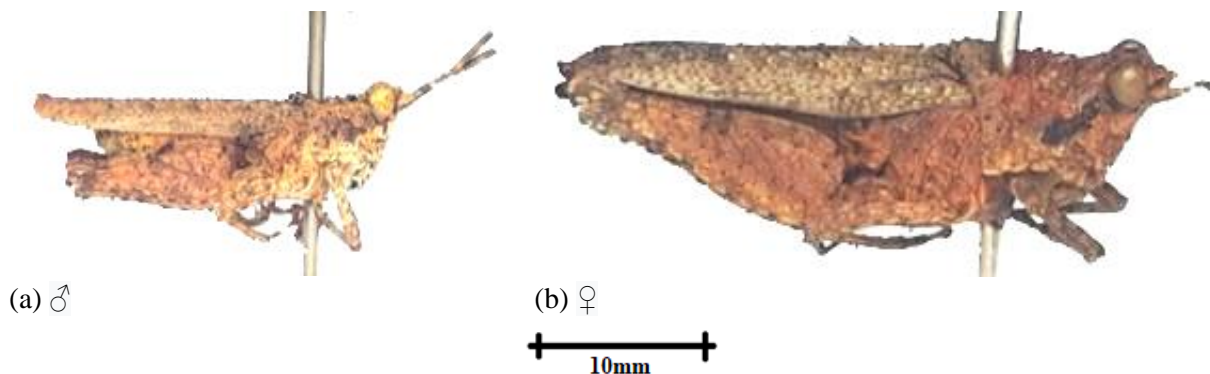


Figure 13. *Chrotogonus (Chrotogonus) turanicus*: (a) ♂; (b) ♀

Head and pronotum

Fastigium of vertex is narrow in front with a grooved shape. In male, fastigium of vertex is narrower as compared to other species of *Chrotogonus*. Vertex is conical and having wrinkled border. Two irregular sulci emerge at vertex and extend toward occiput. Lateral foveola is prominent wrinkled and darker than vertex. Median carina arises from grooved shaped fastigium of vertex towards the end of posterior of head. Lateral carina in head is absent. In male, occiput has two sulci form a butterfly like structure and female has sulcus extends from median carina towards eyes on head. In both, male and female postocciput is slightly

This species is found in Iran, India, Egypt, Afghanistan, and Pakistan^{24, 30-33}. Recently, it has reported from Sindh, Punjab and Balochistan provinces of Pakistan.

Remarks

This species is the major pest of cotton. Ayyanna and colleagues³² reported feeding of this species on sunflower whereas Syed and colleagues³³ reported that sun-flower is preferable food further this species is one of the most common grasshoppers of the Sindh, feeding on foliage and tender shoots and looking stout with mud-like color.

6. *Chrotogonus (Chrotogonus) turanicus*

Generally, the body size is medium and woody brown color with translucent rough tegmina, pronotum and head. Ventral side of the abdomen is dark brown fourteen black dots. Rough marks on pronotum and head are most differentiating character of this species (Fig. 13).

convex shaped. Male has robust bean shapes eyes (Figs. 13 and 14).

Pronotum have lateral and median carina broader with narrower hind margin and angle of hind margin at posterior. Two complete sulci extend towards lateral lobes and in female two incomplete sulci. Anterior of pronotum is depressed downward in male and flattened in female. Episternum large and widen to form ear shaped structure in both male and female. Prozona and metazona are wrinkled irregularly. Pronotum have small tubercles at whole and more prominent on hind margin (Figs. 13 and 14).

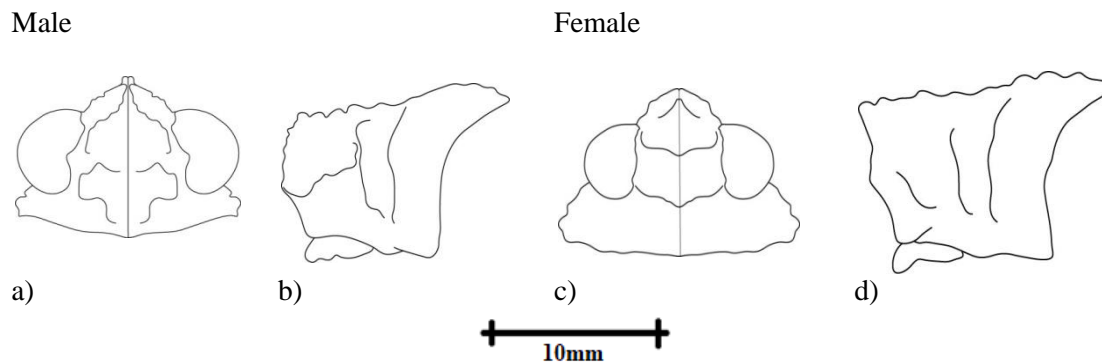


Figure 14. *C. (Chrotogonus) turanicus* ♂: a) DV Head b) LV Pronotum. ♀: a) DV Head b) LV Pronotum.

Morphometry (♂n=05) (♀n=05) (mm)

Male: Length of head 02.81 ± 00.51 ; Length of Pronotum 03.22 ± 00.21 ; Length of tegmen 08.21 ± 00.90 ; Length of wing 07.19 ± 00.39 .

Female: Length of head 03.17 ± 00.66 ; Length of Pronotum 03.97 ± 00.44 ; Length of tegmen 09.24 ± 01.12 ; Length of wing 08.01 ± 01.52 .

Habitat and host plants

This species is mostly distributed in deserted areas and bare grounds and observed on the surface of soil hence known as herpetobiont. Its host plants in fields were enlisted as cotton, wheat, and lawn grasses. The active time period of this species in field has been noted from 10 am to 12:30pm in March to September. The most favorable habitat of this species is short grasses in deserted areas where its abundant numbers were present.

Global distribution

Presence of this species has been recorded in Kazakhstan, Hungary museum, India and Pakistan³⁴⁻³⁹. Currently, this species reported for the first time from Pakistan. Khyber Pakhtun: Besides, Guest house, Hazara University Mansehra with latitude $34^{\circ}25'17''N$ and longitude $73^{\circ}15'03''E$. Punjab: Cholistan University of veterinary and Animal Sciences, Bahawalpur with latitude $29^{\circ}19'26''N$ and longitude $71^{\circ}38'38''E$.

Remarks

Blackith and Keven³⁶ reported that *C. (Chrotogonus) turanicus* is including in stout group along with homalodemus and trachypteris. Puskas³⁷ mentioned this species as preserved specimens in Hungarian Natural History Museum (Budapest, Hungary). Medetov³⁸ described that *C. (Chrotogonus) turanicus* species are herpetobiont and found in deserts of Middle Asia and Kazakhstan.

Conclusion:

The present study is an accurate addition of biodiversity, habitat and taxonomy of fauna of surface grasshoppers along with a new record from Pakistan. In addition, it not only assists in the

reliable identification of surface grasshoppers based on taxonomic keys and morphological characteristics but also presents the pest status of species along with host plants. This study could be beneficial for future researchers to diagnose and control the pest status of these species. Further, cryptic nature of this genus strongly suggests molecular tools to know its reliable systematics and evolutionary relationship with host plant species.

Authors' Declaration:

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are mine ours. Besides, the Figures and images, which are not mine ours, have been given the permission for republication attached with the manuscript.
- Ethical Clearance: The project was approved by the local ethical committee in University of Sindh, Pakistan.

Authors' Contributions Statement:

S.S. This is a first author, he did all the methods in this study beginning in collect samples, data analysis and writing it. R.S. she is the supervisor, concepted and designed the research, help in review the search (writing and explanation the results and discuss them).

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دراسات تصنيفية ومورفولوجية على جنس *Chrotogonus* Serville، 1838 (Pyrgomeridae: Orthoptera) من باكستان، مع الإشارة إلى مواطنها

رفعت سلطنة

سميع الله سومرو*

قسم علم الحيوان، جامعة السند، جامشورو، السند، باكستان.

الخلاصة:

الأنواع من جنس *Chrotogonus* (الجنادب السطحية) هي نباتية وتضر بالنباتات الاقتصادية الهامة المختلفة في مراحل الشتلات الخاصة بهم. من أجل معرفة التنوع البيولوجي للجنادب السطحية، أجريت الدراسة التفصيلية من أربع مقاطعات في باكستان. خلال هذه الدراسة، تم وصف التنوع البيولوجي، والتصنيف، والتشخيص، والتحليل المورفومتري، والموطن، والتوزيع العالمي والملاحظات الخاصة بكل نوع. تم جمع ما مجموعه 826 عينة وفرزها إلى ثلاثة أنواع وثلاثة أنواع فرعية: *C. (Chrotogonus) homalodemus homalodemus* (Blanchard, 1836)، *C. (Chrotogonus) trachypterus robertsi* Kirby, 1914، *C. (Chrotogonus) trachypterus trachypterus* (Blanchard, 1836)، *C. (Chrotogonus) turanicus* Kuthy, 1905 و *C. (Chrotogonus) turanicus* كسجل جديد من باكستان.

الكلمات المفتاحية: كروتوجونوس، تسجيل جديد، أورثوبترا، Pyrgomeridae، تورانيكوس.