



## TAXONOMIC STATUS OF TRIBE SPHINGONOTINI (OEDIPODINAE: ACRIDIDAE) WITH SPECIAL REFERENCE TO ITS PHALLIC COMPLEX

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#### Author's contribution

B.A.B designed the study dissected the material took the spermatheca S.K drawing the samples for further analyzed M.R collected the material from various localities. F.S compiles the result for submission and revised the whole data.

#### Key words:

Sphingonotini, Phallic complex, Taxonomy, Spermatheca, Tribe.

### ABSTRACT

Genus *Sphingonotus* Fieber; was considered as agricultural pest. During present study 12 species and subspecies of this tribe were collected from different localities of Pakistan i-e *S. savignyi* Saussure, *S. hussaini* Baloch and Wagan, *S. longipennis* Saussure, *S. nebulosis tokhai* n. sp, *S. balteatus himalayanus* Uvarov, *S. balteatus balucha* Uvarov, *S. sindhensis* n. sp, *S. akbari* Wagan and Baloch, *S. maculatus petraeus* Bei-Bienko, *S. rubescens afghanicus* Mistchenko, *S. rubescens subfasciatus* Mistchenko and *S. rubescens rubescens* (Walker). These have been described with illustrations of phallic complex and description also provided. Presently the distribution of *Sphingonotus* and key characters of the genitalia such as Epiphallus with moderately wide bridge, narrow ancorae and bilobate lophi were given. Spermatheca is a coiled duct of ectodermal origin. It is of varying sizes and shapes. The spermatheca usually dilates to form a sac like structure, for storing the sperms which enter during copulation. On other hand the present study will make the unique support for new research workers in future.

## 1. INTRODUCTION

It's known fact that Acridoidea is an important super family of the sub-order caelifera (Short-horned Grasshoppers with segmented tarsi and having a short ovipositor). This super family has been comprised of maximum diversity and further more divided into various families of which the families Acrididae and Catantopidae; that are widely distributed in country. Usmani [1], Usmani *et al.*, [2] did works on the taxonomy and genitalia of the grasshoppers. Many scientists reported that grasshoppers attribute feeding change with changes in the vegetation Moed [3], Capinera and Sechrist [4], Kumar and Usmani [5], Hawagry [6], Otte *et al.*, [7], Wagan and Naheed [8], Bie-Bienko and Mischenko [9], Jago [10], Wagan [11], Yousuf [12] Eades *et al.*, [13] after Dirsh [14] who proposed classification in Acridoidea based on the Phallic

complex as well as Ritchie [15, 16], Tokhai [17], were studied the Phallic complex. Vickery and Kevan [18] and Otte [19, 20], pointed out that the phallic complex in the two different families shows variation in almost every respect; as subfamily Oedipodinae distinguish rather than other tribes of grasshoppers species. Although, the tribe Sphingonotini, of which the sub family Oedipodinae was first recognized as a family by Walker [21], with Oedipoda as the type genus; are commonly called as band winged grasshoppers and are brightly colored; they often flash their wings during flight. The known character has been used for taxonomic purpose at species and sub species level. The hind wings almost are yellowish, orange or reddish at base; with a broad black band that crossing near the center of the hind wings. The species represented in this tribe have been collected from various fields are briefly described. The grasshoppers which belong to tribe

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Sphingonotini usually found in open and shiny areas and known as geophiles. During the present study author has been focus on morphological characters, distribution and different components of genitalia.

## 2. MATERIAL AND METHODS

### Killing and preservation:

Adult specimens of genus *Sphingonotus* were collected from different parts of Pakistan i.e grassland, dry vegetation, rangelands, along the roadsides and rocky areas. The following method has been adapted from Vickery and Kevan [18]. The collection of grasshoppers was made with the help of insect net and was killed by potassium cyanide in standard entomological killing bottles. The specimens were not left too long (1/2 hours) in cyanide because the color of specimens may turn into black or they may be spoiled. The insect pins were inserted on the pronotum posterior to transverse sulcus and a little to the right of the median dorsal carina. The specimen was then stretched on the stretching board and attention was paid to the antennae, wings and legs in order to display important taxonomic characters. Dust particles and other undesirable matter were removed with the help of dry camel hairbrush. The fully dried specimens were removed from stretching boards and were stored in standard entomological boxes with labels showing locality, date of collection and collector name.

### Study of genitalia:

For the study of male genitalia Kevan *et al.*, [22] method was adopted. The method of softening the abdominal terminalia was not followed by immersing these in hot water, but by relaxing the whole insect over water in a small dessicator (to which a few drops of phenol / 70% alcohol had been added) to prevent fungal growth was used. The period of relaxing was usually about 24 hours. They were the thoroughly washed in tap water and examined in glycerol on a cavity slide (without a cover glass), using a stereoscope dissecting binocular microscope. Finally the micro vials were pinned through their rubber stopper beneath the insects from which the phallic structure had originally been extracted.

### Study of female genitalia:

For the study of female genitalia. Randell [23] method has been adopted. The spermatheca lies just above the vagina was also removed. The dissected sub-genital plate and spermatheca was then washed with 10% potassium hydroxide solution and examined in water and stored as above. The diagrams were drawn with the help of "Ocular square Reticule" placed in right eye piece of the stereoscopic dissecting binocular microscope. All the

measurements are given in the millimeter. The scheme of measurement followed is that of Hollis [24]. The terminology with regard to phallic complex and female genitalia is adopted is that of Dirsh [25].

## 3. RESULTS

### a. *Sphingonotus (Sphingonotus) savignyi* Saussure, 1884

#### Unique characters

Antenna long, filiform about 26-28 segments, longer than head and pronotum together. Head sub globular, shorter than pronotum. Pronotum saddle shaped, constricted in prozona; median carina indistinct in prozona, crossed by three sulci; lateral carinae absent; posterior margin obtuse angular. Tegmina and wings fully developed, reaching to the middle of hind tibia, obtuse rounded at apex. Hind tibia elongated with 10 inner and 9 outer black tipped sharp spines.

#### Phallic complex

Apical valve of penis slightly larger than the valve of cingulum; valve of penis laterally placed, narrow and with acute apices at apex. Valve of cingulum usually upwarded, and thin, with acute apices at apex. Arch of cingulum flat. Apodemes shorter, stout, with incurved median process, directed anteriorly having rounded apices. Zygoma wide, thick. Rami flattened, smaller, and extending into the sheath dorsally lobe like. Epiphallus Bridge shaped, bridge slightly wide, curved, forming a strip between the lateral plates. Ancorae large, upwarded, heavily incurved with acute apices, actangular at base. Lophi diverging slightly from the lateral plates; lophi divided in lobate forms.

**Table 1-** Measurements in millimeters (mm)

Parameters	Male (n = 20)		Female (n = 22)	
	Mean±SD	Range	Mean±SD	Range
L.B	17.95±6.41	16-21	25.77±4.21	24-27
L.A	8.15± 1.34	8-9	10.27±4.50	9-12
L.P	4.44± 2.04	4-5	5.70±1.80	5.2-6
L.T	26.1±7.40	19-24	27.90±9.37	24-30
M.W.T	4.72 ± 1.67	4.2-5	5.45±4.17	4-6
L.H.F	9.9 ± 2.40	9-11	12.77±4.21	11-14
M.W.H.F	3.65 ± 2.12	3-4	4.74±1.71	4.2-5
L.H.T	8.88 ± 0.74	8-9	11.86±4.75	10-13

\***Note:** L.B = Length of Body, L.A = Length of Antennae, L.P = Length of Pronotum, L.T = Length of Tagmina, M.W.T = Maximum Width of Tagmina, L.H.F = Length of Hind Femur, M.W.H.F = Maximum Width of Hind Femur, L.H.T = Length of Hind Tibia.

**Species relation note:** This species is very closely related to *S. arabicus* Mishchenko in having S-shaped intercalary vein. Earlier, Ahmed [26], Wagan

[11], Yousuf [12], Thokhai [17] recorded this species from the various provinces of the Pakistan.

**Spermatheca**

The pre-apical diverticulum is absent where as apical- diverticulum sac like, conical, and oval rounded.

**b. *Sphingonotus hussaini* Baloch and Wagan (2000)**

**Unique characters**

Antennae 25 segmented, longer than head and pronotum together. Head strongly projecting above pronotum. Face vertical, frontal ridge generally broad, weakly concave, wide between antennae. Pronotum short and broad; median carina slightly indicated in prozona, but distinct in metazona, lateral carinae well developed in metazoan. Metazona with distinct wrinkles, its posterior margin acute. Tegmina almost reaching to the apex of hind tibia. Hind femur with a slightly wavy upper carina.

**Table 2-** Measurements in millimeters (mm)

Parameters	Female(n=1)
L.B	17.0
L.A	8.0
L.P	3.0
L.T	15.0
M.W.T	4.0
L.H.F	8.2
M.W.H.F	3.0
L.H.T	9.0

\*Note: L.B = Length of Body, L.A = Length of Antennae, L.P = Length of Pronotum, L.T = Length of Tagmina, M.W.T = Maximum Width of Tagmina, L.H.F = Length of Hind Femur, M.W.H.F = Maximum Width of Hind Femur, L.H.T = Length of Hind Tibia.

**Species relation note:** This species is closely related to *S. eurasius eurasius* Mishchenko (1936) in having the general body form and the inner side of hind femur is with black pre apical spots. My studies based on the female holotype shows that its spermatheca is unique having elongated large pre apical diverticulum.

**Spermatheca**

The spermatheca with pre-apical diverticulum fairly large, straight upwardly finger like actutly rounded at apex. Apical diverticulum sac like elongated, smoothly rounded at base.

**c. *Sphingonotus longipennis* Saussure, 1884**

**Unique characters**

Antennae long and thin, filiform. Head subglobular, shorter than pronotum. Pronotum saddle-shaped, smooth constricted in prozona, median carina very low, lateral carinae absent. Tegmina and wings fully

developed apices acute rounded. Hind femur short, dorsal carina entire and expanded in the form of lobe.

**Phallic complex**

Apical valve of penis slightly larger than the valve of cingulum; valve of penis vertically upward and thick, tapered at apex with pointed acute-apices. Valve of cingulum is shorter than the valve of penis. Arch of cingulum upraised. Rami well developed, flap like inflections extending into the sheath dorsally. Epiphallus Bridge shaped bridge fairly wide, thickening slightly curved. Anterior projections few laterally upwarded. Ancorae large, smoothly wavy upwarded; Lophi laterally placed.

**Table 3-** Measurements in millimeters (mm)

Parameters	Male(n=09)		Female (n=13)	
	Mean±Sd	Range	Mean±Sd	Range
L.B	15.28±2.38	14.3-16.2	20.92±6.54	18-23
L.A	5.97±2.01	5.1-6.7	8.38±3.00	7-9
L.P	2.45±1.14	2.2-3.0	4.32±1.01	4.2-5
L.T	15.46±1.26	15.4-16.0	22.92±6.08	20-25
M.W.T	3.23±0.83	3-3.5	4.51±1.14	4.3-5
L.H.F	8.61±1.17	8.5-9.0	11.15±2.76	10-12
M.W.H.F	2.5±1.27	2-3.1	3.22±1.01	3.2-4
L.H.T	8.43±1.23	8-9.0	9.67±1.21	9.3-10

\*Note: L.B = Length of Body, L.A = Length of Antennae, L.P = Length of Pronotum, L.T = Length of Tagmina, M.W.T = Maximum Width of Tagmina, L.H.F = Length of Hind Femur, M.W.H.F = Maximum Width of Hind Femur, L.H.T = Length of Hind Tibia.

**Species relation note:** This species is very closely related to *S. mongolicus* Saussure on the basis of graceful body form but can easily be separated in having large size, dark band of the wing.

**Spermatheca**

The pre – apical diverticulum is absent. Apical diverticulum finger like, elongated, rounded at base.

**d. *Sphingonotus nebulosis tokhai* n.sp**

**Unique characters**

Antennae long, filiform, longer than head and pronotum together. Head smoothly punctured and weakly projecting above the pronotum. Fastigium of vertex strongly sloping, vertex little raised with margins; foveolae of vertex indistinct and weakly punctured. Pronotum saddle shaped, weakly compressed in prozona; transverse furrows distinct. Hind femur slender, dorsal carina entire and protruded in the form of flat lobe, dorsal genicular lobes comparatively rounded.

**Female holotype**

Cerci moderate, cylindrical with blunt apices, dorsally ovipositor of the smooth structure; without a deep narrow notch and toothed-like process.

**Table 4-** Measurements in millimeters (mm)

Parameters	Female(n = 4)
	Mean ± Sd
L.B	28.82±0.52
L.A	10.15±0.28
L.P	5.45±0.63
L.T	32.62±0.70
M.W.T	6.76±0.47
L.H.F	16.17±0.37
M.W.H.F	3.06±0.46

\*Note: L.B = Length of Body, L.A = Length of Antennae, L.P = Length of Pronotum, L.T = Length of Tagmina, M.W.T = Maximum Width of Tagmina, L.H.F = Length of Hind Femur, M.W.H.F = Maximum Width of Hind Femur.

**Species relation note:** This subspecies is very closely related to *S. nebulosus anatolica* Uvarov but 4 mm longer. In this new sub species the base s of wings transparent and hind tibia light yellowish whereas in *S. nebulosus anatolica* the base s of wings light greenish blue and hind tibia greenish blue.

**Spermatheca**

The spermatheca with pre-apical diverticulum straight upwarded smaller, rectangular at apex. Apical diverticulum larger sac-like oval rounded at base.

**e. *Sphingonotus balteatus himalayanus* Uvarov, 1923**

**Unique characters**

Antennae filiform, about 26, segments, longer than head and pronotum together. Head subglobular, shorter than pronotum. Fastigium of vertex concave. Pronotum saddle-shaped constricted in prozona, median carina distinct in metazona; dorsum crossed by three sulci. Hind femur short and stout, dorsal carina sharp. Hind tibia elongated with 11 inner and 9 outer black or shining brown tipped spines.

**Phallic complex**

Apical valve of penis, vertically straight, slightly thick, smaller than the valve of cingulum; tapered at apex with obtuse rounded apices. Valve of cingulum fairly thin; with pointed tip. Rami appear as flap lobe like extending into the sheath dorsally. Epiphallus Bridge shaped; bridge fairly straight, thickening and wide. Anterior projections laterally protruding. Ancorae large, straight upwardly, convex at apex with obtuse rounded apices, wide at base with rectangular process. Lophi diverging sharply from the lateral plates.

**Spermatheca**

The pre-apical diverticulum straight upwardly slightly lateral sided, thick, with obtuse rounded apices at apex. Apical diverticulum sac like conical, dilated and rounded at the base.

**Table 5-** Measurements in millimeters (mm)

Parameters	Male (n = 11)		Female (n =8)	
	Mean±Sd	Range	Mean±Sd	Range
L.B	25.52±5.91	23-25	28.18±15.74	32-34.1
L.A	13.72± 4.28	12-13	13.37±1.34	13-14
L.P	5.36±1.56	5-6	6.4± 0.97	6.2-7
L.T	29.27± 1.46	29-30	38.62±1.35	38-39
M.W.T	4.45 ±1.64	4-5	7.5± 1.09	7.2-8
L.H.F	12.70± 1.27	12.2-13	16.82±2.27	16-17.1
M.W.H.F	3.05 ± 0.46	3-3.1	5.07± 0.87	5-5.1
L.H.T	10.06± 0.43	10-10.1	13.31±0.68	13-13.1

\*Note: L.B = Length of Body, L.A = Length of Antennae, L.P = Length of Pronotum, L.T = Length of Tagmina, M.W.T = Maximum Width of Tagmina, L.H.F = Length of Hind Femur, M.W.H.F = Maximum Width of Hind Femur, L.H.T = Length of Hind Tibia.

**Species relation note:** This subspecies is closely related to *S. balteatus balteatus* Uvarov, in having general body appearance but can easily separated from the same in having hind femur short and stout, dorsal carina sharp and band on wings wide posteriorly.

**f. *Sphingonotus balteatus balucha* Uvarov, 1933**

**Unique characters**

Antennae long, filiform, about 24 segments, larger than head and pronotum together. Head subglobular. Fastigium of vertex narrow. Pronotum saddle shaped, markedly constricted in prozona, median carina raised in the anterior margin of prozona. Hind femur short and stout, dorsal carina entire, hairy and acute.

**Table 6-** Measurements in millimeters (mm)

Parameters	Female(n = 3)
	Mean ± Sd
L.B	40.56±1.14
L.A	8.86±0.44
L.P	6.06±0.21
L.T	48.66±0.51
M.W.T	6.53±0.37
L.H.F	18.86± 0.44
M.W.H.F	4.53±0.60

\*Note: L.B = Length of Body, L.A = Length of Antennae, L.P = Length of Pronotum, L.T = Length of Tagmina, M.W.T = Maximum Width of Tagmina, L.H.F = Length of Hind Femur, M.W.H.F = Maximum Width of Hind Femur.

**Species relation note:** This subspecies is very closely related to *S. balteatus himalayanus* Uvarov in general body form and in the structure of pronotum but can easily be separated by the characters as noted in the keys and description.

**Spermatheca**

The spermatheca with pre-apical diverticulum laterally placed, thick, fairly wide with obtuse rounded apices. Apical diverticulum sac like, widened and smoothly rounded at base.

g. *Sphingonotus sindhensis* n. sp**Unique characters**

Antennae filiform 20-22 segmented longer than the head and pronotum together. Head strongly globular fastigium of vertex slightly rises but roundly sloping over the frons. Eyes oval rounded. Pronotum saddle shaped smoothly punctured, constricted in prozona, median carina indistinct in prozona, crossed by three sulci, angle of the hind margin rounded.

Table 7- Measurements in millimeters (mm)

Parameters	Holotype	Paratype
L.B	30.0	30.0
L.A	8.0	8.0
L.P	6.0	6.5
L.T	33.0	32.0
M.W.T	7.0	6.5
L.H.F	15.0	14.3
M.W.H.F	4.0	4.0
L.H.T	14.0	13.5

\*Note: L.B = Length of Body, L.A = Length of Antennae, L.P = Length of Pronotum, L.T = Length of Tagmina, M.W.T = Maximum Width of Tagmina, L.H.F = Length of Hind Femur, M.W.H.F = Maximum Width of Hind Femur, L.H.T = Length of Hind Tibia.

**Species relation note:** This new species is related to *S. longipennis* Saussure (1936) but 2mm smaller and the hind femur is without any band from the inner side. In this new species the black band of hind wing is well developed and is spread from one end to the other end. Where as in *S. longipennis* the black band is far from reaching the inner margin.

**Spermatheca**

The spermatheca cylindrical elongated and convex towards the apex. Pre-apical diverticulum smaller and finger like in form, apical diverticulum sac like, smoothly rounded at base.

h. *Sphingonotus akbari* Wagan and Baloch (2001)**Unique characters**

Antennae slender slightly longer than head and pronotum together. Head moderately projecting above pronotum. Fastigial foveolae absent. Fastigium of vertex narrow, with low, well defined margins and without carinula transverse groove well developed. Tegmina long narrow with parallel sides and dense venation and reticulation. Hind femur more than four times longer than broad.

**Phallic complex**

The epiphallus is attached to the ninth sternite and to the zygoma by muscular tissues. Epiphallus bridge shaped, bridge fairly straight moderately thick, anterior projections flat, rectangular protruding up ward, lateral boundaries slightly incurved, posterior projections continued, but deep and in cylindrical

form having oval rounded margins. Ancorae strongly stout laterally placed, median large, conical, but sharply pointed at apex, little wide at base. Lobes of lophi although tube like in form, slightly incurved to inner side.

Table 8- Measurements in millimeters (mm)

Parameters	Male (n = 16)		Female (n = 12)	
	Mean±Sd	Range	Mean±Sd	Range
L.B	15.3±3.89	14-16.2	19.66±2.93	18-21
L.A	6.5±1.87	6-7	6.98±0.68	6.8-7
L.P	2.15±2.70	2-3.1	3.42±0.86	3-3.5
L.T	15.96±1.79	15.2-16.2	18.96±1.26	18.8-19.5
M.W.T	3.17±0.89	3-3.2	3.99±0.64	3.5-4.2
L.H.F	7.18±1.99	7-8.1	10.25±3.18	10-11.5
M.W.H.F	2.03±1.09	2-2.1	2.91±1.05	2.5-3
L.H.T	8.01±0.83	7.8-8.4	10.4±1.76	9.8-11

\*Note: L.B = Length of Body, L.A = Length of Antennae, L.P = Length of Pronotum, L.T = Length of Tagmina, M.W.T = Maximum Width of Tagmina, L.H.F = Length of Hind Femur, M.W.H.F = Maximum Width of Hind Femur, L.H.T = Length of Hind Tibia.

**Species relation note:** This species is very closely related to *S. lavandulus* Popov, in having general body form and the inner side of hind femur is without any fascia but can easily be separated from the same in having the metazona of pronotum about the length of prozona and the lophal lobe of the lophus is larger than broad and the ancorae is sharply incurved and by the other characters as noted in the keys and description.

**Spermatheca:**

The spermatheca sac like and elongated, pre-apical diverticulum slightly thick and with rounded acute apices at apex. Apical diverticulum rounded at base.

i. *Sphingonotus maculatues petraeus* Bei – Bienko**Unique characters**

Antennae filiform, about 26 -27 segments, longer than head and pronotum together. Head sub conical, shorter than pronotum. Fastigium of vertex small sloping and triangular anteriorly. Fastigial foveolae small and indistinct. Tegmina and wings fully developed, with obtuse rounded apices. Hind femur short, dorsal carina entire, dorsal genicular lobes rounded.

**Phallic complex**

Apical valve of penis slightly larger than the valve of cingulum. Arch of cingulum well marked, flattened. Zygoma remarkable with wide apical rounded lobate part. Rami visible conical butterfly- wing shaped extending into the sheath dorsally. Epiphallus Bridge shaped, slightly curved. Ancorae large straight upwardly, convex at apex with obtuse rounded apices. Lophi diverging sharply from the lateral

plates; median lobes concave at inner and outer margins.

**Table 9-** Measurements in millimeters (mm)

Parameters	Male (n = 8)		Female (n = 9)	
	Mean±Sd	Range	Mean±Sd	Range
L.B	15.38±6.64	17-18.2	21.88 ±2.20	21-23
L.A	5.88±0.70	5.8-6.1	8.13±0.51	8-8.2
L.P	3.6±0.66	3.5-4.0	4.68 ±1.02	4.3-5
L.T	17.47±1.62	17-18.3	25.66±1.39	25-26
M.W.T	3.32±1.11	3.2-4.0	5.06 ±0.38	5-5.1
L.H.F	9.43±1.14	9.5-10.0	11.77 ±1.23	11-12
M.W.H.F	3.06±0.37	3.0-3.1	4.02 ±0.63	4-4.1
L.H.T	8.68±0.92	8.7-9.0	9.73 ±1.12	9.2-10

\*Note: L.B = Length of Body, L.A = Length of Antennae, L.P = Length of Pronotum, L.T = Length of Tagmina, M.W.T = Maximum Width of Tagmina, L.H.F = Length of Hind Femur, M.W.H.F = Maximum Width of Hind Femur, L.H.T = Length of Hind Tibia.

**Species relation note:** This subspecies is related to *S. predtetschenskyi* Mistsh on the basis of morphological form but can easily be separated from the same in having fastigium of vertex small sloping and triangular, median carinula absent. Tegmina with two distinct bands, third band broken into speckles.

**Spermatheca**

The pre-apical diverticulum shorter, with obtuse rounded apices. Apical diverticulum sac like, somewhat elongated, oval rounded at base.

**j. *Sphingonotus rubescens afghanicus* Mistchenko, 1937**

**Unique characters**

Antennae filiform about 16-18 segments, longer than head and pronotum together. Head sub globular, shorter than pronotum. Fastigium of vertex slightly wide. Fastigial foveolae indistinct, frontal ridge flat fairly. Hind femur slender, smaller dorsal carina few weak, lower apical genicular lobes narrower than upper ones.

**Phallic complex**

Apical valve of penis is about parallel to the apical valve of cingulum; valve of penis laterally straight, thin. Apodemes stout, finger like, sloping towards anteriorly; having rounded process. Zygoma weakly developed. Rami well developed, extending into the sheath dorsally lobe like. Epiphallus Bridge shaped, bridge transversely incurved. Ancorae laterally placed horn type in shape. Lophi diverging sharply from the lateral plates.

**Spermatheca**

The spermatheca with pre-apical diverticulum, wide, laterally placed, obtusely rounded at apex and sac like down curved apical diverticulum.

**Table 10-** Measurements in millimeters (mm)

Parameters	Male (n = 3)		Female (n = 7)	
	Mean±Sd	Range	Mean±Sd	Range
L.B	16.73±0.90	16-17.2	25.75 ± 5.17	23-30
L.A	6.2±0.54	6-6.4	9.0 ± 1.41	8-10
L.P	4.0±00	4.0	5.25 ± 1.53	5-6
L.T	19.66±08	19.5-20.0	25.75 ± 2.52	24-27
M.W.T	4.0±00	4.0	5.0 ± 00	5.0
L.H.F	8.76±0.31	8.6-9.0	12.33 ± 0.08	12-13
M.W.H.F	2.83±0.37	3.0	3.66 ± 80	3-4
L.H.T	8.13±0.54	8.0-8.2	11.33 ± 0.08	11-12

\*Note: L.B = Length of Body, L.A = Length of Antennae, L.P = Length of Pronotum, L.T = Length of Tagmina, M.W.T = Maximum Width of Tagmina, L.H.F = Length of Hind Femur, M.W.H.F = Maximum Width of Hind Femur, L.H.T = Length of Hind Tibia.

**Species relation note:** This subspecies is closely related to *S. rubescens rubescens* Walker in having general body form and by structure of pronotum as usually hind femur thick and slender but differ from the same in having tegmina with irregular brown speckles.

**k. *Sphingonotus rubescens subfasciatus* Mistchenko**

**Unique characters**

Antennae filiform about 25 segments, longer than head and pronotum together. Head sub globular shorter than pronotum. Fastigium of vertex wide, flattened. Pronotum oblique, saddle shaped constricted in metazona; median carina very weak. Hind femur stout moderate, slender, dorsal carina visible.

**Table 11-** Measurements in millimeters (mm)

Parameters	Female (n = 5)	
	Mean ± Sd	Range
L.B	25.24±1.52	24.2-26.0
L.A	7.56±0.85	7.4-8.0
L.P	4.52±0.94	4.3-5.0
L.T	28.46±0.98	28.2-29.0
M.W.T	4.56±1.00	4.3-5.2
L.H.F	12.84±0.33	12.6-13.0
M.W.H.F	2.5±0.91	2.2-3.0

\*Note: L.B = Length of Body, L.A = Length of Antennae, L.P = Length of Pronotum, L.T = Length of Tagmina, M.W.T = Maximum Width of Tagmina, L.H.F = Length of Hind Femur, M.W.H.F = Maximum Width of Hind Femur.

**Species relation note:** This subspecies is closely related to *S. maculatus extimus* Bei-Bienko on the basis of general body form and pronotum but can easily be separated from the same in having hind femora at the inside with one dark band tegmina with two smoky bands and small speckles in the apical part body is covered with sparsely hairs.

## Taxonomic Status of tribe Sphingonotini

### Spermatheca

The spermatheca has a short pre-apical diverticulum and down curved apical diverticulum sac like.

#### 1. *Sphingonotus rubescens rubescens* (Walker, 1870)

##### Unique characters

Antennae filiform, about 25 segments, longer than head and pronotum together. Head subglobular, shorter than pronotum. Fastigium of vertex wide, narrow in front will well develop lateral and median carinulae, roundly sloping over frons. Hind femur moderate, dorsal carina short, lower apical genicular lobes larger than upper ones.

##### Phallic complex

Apical valve of penis slightly larger than the valve of cingulum, valve of penis vertically straight and scissor like at apex. Zygoma thick Strip like. Rami flat disc shaped expanded into the sheath dorsally with oval rounded boundaries. Epiphallus Bridge shaped, bridge straight slightly thick and forming a narrow strip between the lateral plates. Ancorae large, upward slightly hook-shaped. Lophi bark like in shape diverging sharply from the lateral plates, outer lobes broad and angularly rounded ending in straight oval rounded process.

**Table 12-** Measurements in millimeters (mm)

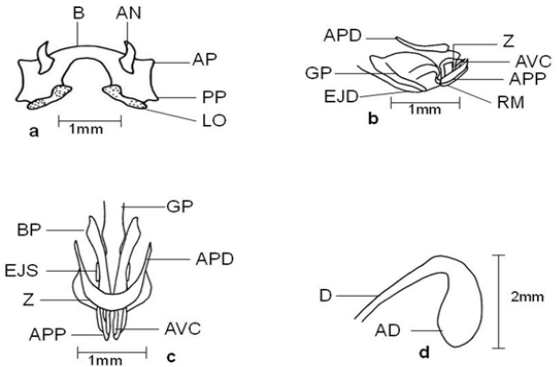
Parameters	Male (n = 18)		Female (n = 20)	
	Mean±Sd	Range	Mean±Sd	Range
L.B	20.64± 4.80	18-22	24.53±10.07	19-28
L.A	8.5± 3.08	7-10	8.69 ± 4.67	7-11
L.P	4.57± 1.83	4-5	5.30 ± 3.23	4-6
L.T	23.64± 6.40	20-27	27.53±11.81	23-32
M.W.T	4.21± 1.51	4-5	4.69 ± 3.21	4-6
L.H.F	10.30± 3.23	9-11	11.92 ± 4.75	9-13
M.W.H.F	3.15± 1.28	3-4	3.69 ± 1.64	3-4
L.H.T	9.7± 2.25	8-10	10.15 ± 4.47	8-12

\*Note: L.B = Length of Body, L.A = Length of Antennae, L.P = Length of Pronotum, L.T = Length of Tagmina, M.W.T = Maximum Width of Tagmina, L.H.F = Length of Hind Femur, M.W.H.F = Maximum Width of Hind Femur, L.H.T = Length of Hind Tibia.

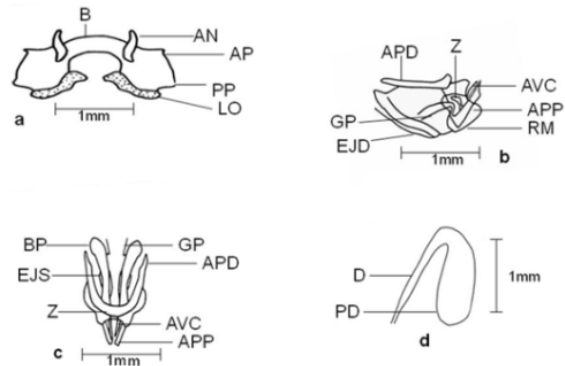
**Species relation note:** This subspecies is closely related to *S. elegans* Mishchenko in having tegmina with two dark fasciae, wings slightly bluish at base and without band but can easily be separated from the same in having intercalary vien in discoidal area of tegmina S-shaped.

### Spermatheca

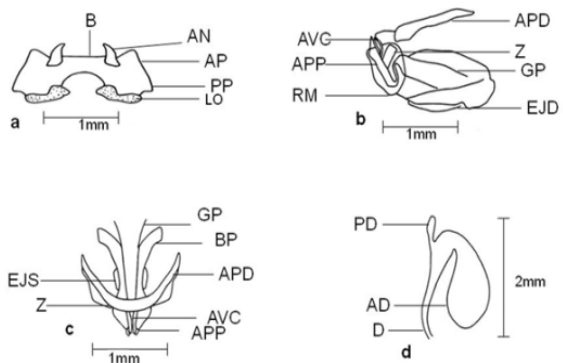
The pre-apical diverticulum smaller, laterally placed with obtuse rounded apex. Apical diverticulum sac like conical with incurved median process, angularly rounded at base.



**Figure 1-** *S. savignyi*, genitalia.



**Figure 2-** *S. longipennis*, genitalia



**Figure 3-** *S. balteatus himalayanus*, genitalia

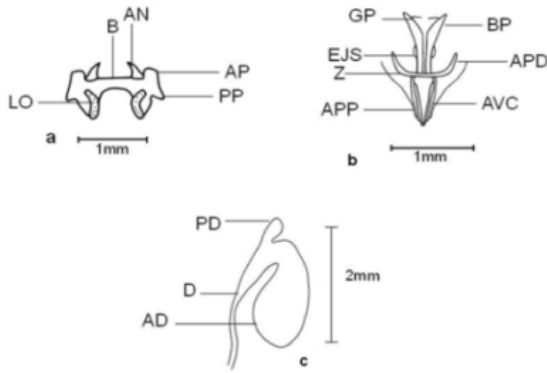


Figure 4- *S. akbari*, genitalia

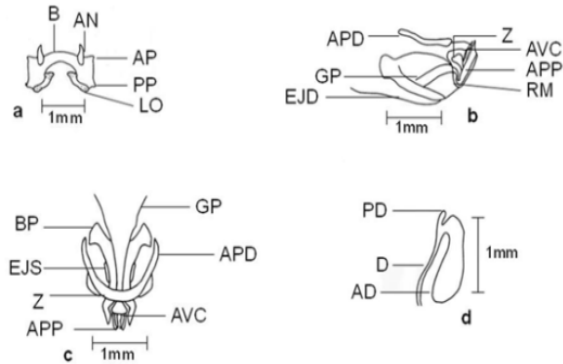


Figure 5- *S. maculatus petraeus*, genitalia.

\*Note: Explanation of a) Epiphallus b) Endophallus and Cingulum lateral view c) Same dorsal view d) Spermatheca.

#### 4. CONFLICT OF INTEREST

The authors have declared that there is no conflict of interest regarding the publication of this article.

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