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## Taxonomic study of genus *Sphaerophoria* Le Peletier et Serville (Diptera: Syrphidae) with three species from Northern Dry Mountains region of Pakistan

**Fazli Subhan and Maqsood Shah**

### Abstract

To explore the syrphid flies of Northern Dry Mountains Region of Pakistan, collection survey was conducted from 2012-2014 each month in different localities of the study area during active season. Species identification of collected specimen was performed with the help of relevant literature. Three species of genus *Sphaerophoria* Le Peletier et Serville, 1828 i.e., *Sphaerophoria bengalensis* Macquart, 1842, *Sphaerophoria indiana* Bigot, 1884 and *Sphaerophoria scripta* (Linnaeus, 1758) were recorded in the said region. Diagnostic character with distribution, flower records, illustrations and synonymy are provided for each species. The male genitalia of all the species were figured.

**Keywords:** Taxonomy, *Sphaerophoria*, Northern Dry Mountains region, Pakistan

### 1. Introduction

Genus *Sphaerophoria* Le Peletier et Serville, 1828 belongs to family Syrphidae, subfamily Syrphinae and tribe Syrphini. Fabricius (1775) <sup>[21]</sup> considered *Sphaerophoria* as a subgenus of *Syrphus*. The adults of *Sphaerophoria bengalensis* Macquart, *Sphaerophoria indiana* Bigot and *Sphaerophoria scripta* (Linnaeus) are pollinator while their larvae feed on different species of Aphididae, some Psyllidae, and Lepidoptera larvae (Rojo *et al.*, 2003) <sup>[50]</sup>. The larvae of these species are biological control agents and play an important role in the ecosystem. Linnaeus (1758) <sup>[38]</sup> initiated the taxonomic study on *Sphaerophoria* as *Musca scripta*. Linnaeus was followed by Different authors (Fabricius, 1775 <sup>[21]</sup>; Meigen, 1822 <sup>[45]</sup>; Macquart, 1842 <sup>[41]</sup>; Bigot, 1884 <sup>[15]</sup>). The taxonomic information of these three species can be found in (Brunetti, 1915, 1923 <sup>[16, 18]</sup>; Bankowska, 1964 <sup>[9]</sup>; Joseph 1967, 1970 <sup>[32, 33]</sup>; Vockeroth 1969, 1971 <sup>[64, 65]</sup>; Knutson 1973 <sup>[35]</sup>; Speight 1973 <sup>[59]</sup>; Ghorpade, 1981, 1994, 2009 <sup>[23, 24, 25]</sup>; Skuffin, 1982 <sup>[58]</sup>; Datta and Chakraborti, 1983 <sup>[20]</sup>; Stubbs and Falk 2002 <sup>[61]</sup>; Claussen and Weipert, 2003 <sup>[19]</sup>; van Veen, 2004 <sup>[63]</sup>; Barkalove, 2011 <sup>[13]</sup>). Alam *et al.* (1969) <sup>[1]</sup> started study of *Sphaerophoria* in Pakistan. Later on Aslamkhan *et al.*, (1997) <sup>[8]</sup>, Arif (2001) <sup>[6]</sup> and Arif *et al.* (2001) <sup>[7]</sup> reported different species of *Sphaerophoria* but did not described the male genitalia. Keeping in view importance of these Syrphidae' collection and the target area, current research survey was performed to study external morphological and male Genitalic characters of these insects. We report three species new to Northern Dry Mountains Region. Pakistan has been divided into ten agro-ecological zones on the basis of physiography, Geology, Climate, agriculture land use and water availability in perennial canals, seasonal canals and ground water. Northern Dry Mountains Region is one of the important agro-ecological region covering Gilgit-Baltistan, Chitral, Lower Dir, Upper Dir, Swat, Buner, Malakand agency, Bajaur Agency, Mohmand Agency, Khyber Agency, FR Kohat and FR Peshawar (Anonymous, 1980) <sup>[5]</sup>.

### 2. Materials and Methods

To explore the Syrphid flies of Northern Dry Mountains Region of Pakistan, intensive and extensive collection-cum-survey trip was conducted in different localities of the study area during active season. Syrphidae were collected during the day time. Preferably the sunny days were chosen for collection. Specimens were mainly collected by insect hand net, however pan traps of white, florescent blue and florescent yellow were used for the collection of Syrphidae, which were placed in a line with alternate colors at open, visible place. The collected specimens were killed in plastic bottle having ethyl acetate, into the bottom of which absorbing paper was set to absorb the killing fluid. Field data of specimens were properly

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recorded (Martin, 1977) [42]. McAlpine (1981) [44] terminology was used for morphology, as particularly applied to Syrphidae by Thompson (1999) [62]. Specimens were identified according to keys, descriptions and illustrations of the following references: Brunetti (1923) [18], Vockeroth (1969) [64], Ghorpadé (1994) [24], Van veen (2004) [63]. Stereomicroscope Nikon SMZ 745T was used for observation and identification of specimens. Google Earth was used to locate the collection localities, and to get the geographic coordinates. Collectors' names are given when the material was taken other than by the first author.

**Male Genitalia Examination:** The specimens were relaxed in relaxing jar to study the male genitalia of *Sphaerophoria* species. The genitalia were extracted with the help of hooked tip, entomological pin and cleared by boiling in water-diluted KOH (10%) pellets for 7-13 minutes. The genitalia were immersed in glacial acetic acid to neutralize the KOH for five minutes after washing in hot water. Dehydration was performed by passing through a series of ethanol of increasing concentration. The genitalia were stored in microvial containing glycerine after examining under stereomicroscope. Knutson (1973) [35] was followed for terminology of male genitalia.

### 3. Results and Discussion

#### Genus *Sphaerophoria* Le Peletier et Serville

1828. *Sphaerophoria* Lepeletier and Serville [37] in Latreille *et al.*, *Encycl. Meth. His. Nat.* 10(2): 513 (as subgenus of *Syrphus* Fabricius, 1775).

Type species: *Musca scripta* Linnaeus, 1758.

1840a. *Melithreptus* Loew [39]. *Öffentl. Prof. K. Friedrich-Wilhelm-Gymnasiums zu Pozen*, 27.

1840b. *Melithreptus* Loew [40]. *Isis (Oken's)*. 577. Unjustified new name for *Sphaerophoria* Lepeletier & Serville; Preoccupied by *Melithreptus* Vieillot 1816.

1856. *Melithropus* Haliday [29] in Walker, *Ins. Brit.*, Dipt. 3: 21, as new name for *Melithreptus* Loew, 1840, a junior homonym of *Melithreptus* 1816.

1945. *Nesosyrphus* Frey [22], *Commentat. Boil.* 8(10): 60 (as

subgenus of *Sphaerophoria*).

Type-species, *Sphaerophoria nigra* Frey, 1945.

**Diagnosis:** The genus can be identified by more smaller and slender body; abdomen, thorax and head has bright color except sometime completely black; abdomen not margined completely; ventral scutellar fringe present laterally or absent; mesonotum brightly yellow, clearly differentiated from dark dorsum; abdomen in male elongated and cylindrical, longer than wing; tergum 9 of male broader than abdomen; terminalia of male large and hemispherical.

**Distribution:** Oriental, Holarctic, Northern Afrotropical, Australian Vockeroth (1969) [64]; Nearctic, 9 species (Vockeroth, 1992) [66]; Palearctic, 28 species (Peck, 1988) [47] reached to 33 (Barkalov, 2011) [13]; 12 species listed in the Indian sub-continent checklist (Ghorpadé, 2014) [26].

#### 3.1 *Sphaerophoria bengalensis* Macquart, 1842 (Figs. 1-11)

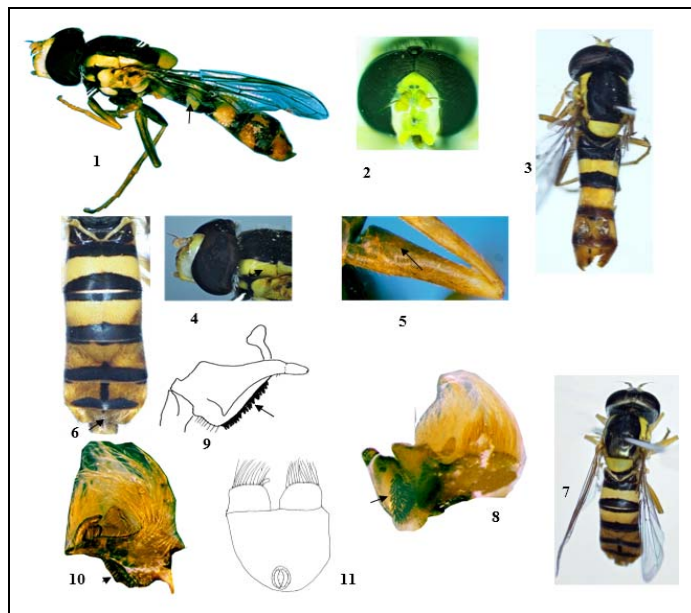
1842. *Sphaerophoria bengalensis* Macquart [41], *Dipt. Exot.* 2(2): 104.

1915. *Sphaerophoria* "form I" *flavoabdominalis* Brunetti [16], *Rec. Indian Mus.* 11(3): 214.

1964. *Sphaerophoria turkmenica* Bankowska [9], *Ann. Zool., Warsz.* 22(15): 345.

**Diagnosis:** Basoflagellomere wholly yellow; antennal segment 3 completely yellow, lunule yellow (Fig. 4); scutellum only with yellow pile; femur 1 only with yellow pile (Fig. 5); tergum 2 with yellow strip reaching lateral margins in total width (Fig. 1); female frons with median black vitta narrower than adjacent yellow areas, tergum 2 possessing fascia posteriorly notched in centre, tergum 6 yellow with a subtriangular vertical black spot (Fig. 6).

**Male Genitalia:** The inner surface of surstylus has extensive patch of short stout setae, inner lobe has broadened apex (Figs. 8-11).



**Fig 1-11:** 1-5, Male *Sphaerophoria bengalensis*. 1. Male habitus, tergum 2 with yellow strip reaching lateral margin in total width, lateral view. 2. Head, lateral view. 3. Male habitus, dorsal view. 4. Head, anterior view. 5. Femur only yellow hairs. 6. Female abdomen with tergum 6 yellow with a subtriangular vertical black spot. 7. Female habitus, dorsal view. 8-11. Male genitalia. 8. Lateral view showing inner view of surstylus with short stout setae. 9-10. Surstylus, lateral view, arrow on figs. shows setae. 11. Epandrium, dorsal view.

**Material Examined: Khyber Pakhtunkhwa:** 2♀, Thal, 35°25'5.56"N 72°10'25.73"E, 03-v-2013; 1♂, Sheringal, 35°16'53.83"N 72° 0'25.34"E, 04-v-2013; 1♀, Kalam, 35°29'12.68" 72°34'47.00"E, 6-v-2013; 3♂, 1♀, Timergara, 34°49'38.36"N 71°50'12.01"E, 25-iv-2014: FATA: 1♂, 1♀, Bajaur Agency, Damadola, 34°47'54.88"N 71°27'58.38"E, 22-iv-2014; 1♂, 1♀, Fr Kohat, Akhurwal, 33°43'57.93"N 71°30'50.68"E, 8-iv-2014.

**Distribution:** India; China; Iran; Korea; Japan; Nepal (Peck, 1988) [47]; North Caucasus (Guzeripl' village) (Skufjin, 1982) [58]; Afghanistan (Bańkowska, 1964: 345, 1967, 1968, 1969) [9, 10, 11, 12]; Ghorpadé, (2009, 2014) [25, 26]; India (Brunetti, 1915) [16]; knutson *et al.*, 1975 [36]; Peck, 1988 [47]; Ghorpadé, 1994, 2009, 2014 [24, 25, 26]; Shah *et al.*, 2014 [56]; Mitra *et al.*, 2015 [46]; Pakistan: Punjab (Multan, Khanewal, Muzaffargarh) Balochistan, (Brunetti, 1915) [16]; knutson *et al.*, 1975 [36]; Peck, 1988 [47]; Ghorpadé, 1994, 2009, 2014 [24, 25, 26]; Arif *et al.*, 2001 [7]; Sajjad *et al.*, 2008 [54]; Saeed *et al.*, 2008 [51]; Ghorpadé and Shehzad, 2013 [28]). The described species is collected for the first time from localities of Khyber Pakhtunkhwa (Thal, Sheringal, Kalam, Timergara) and Federally Administered Tribal Areas: Bajaur Agency (Damadola), Fr Kohat (Akhurwal).

**Flower Records:** *Brassica*, *Daucus* and *Allium* sp. (Abrol, 1993) [3] Sajjad and Saeed (2010) [52] and Sajjad *et al.*, (2010) [53] gave name of 29 and 26 plant species respectively, visited by *S. bengalensis*. The species was collected from *Daucus*

*carota*, *Coriandrum sativum*, *Brassica campestris* in the present study.

**Comments:** The species can be easily recognized by the mesonotal lateral margins complete and facial black median vitta very weak, characters shared with *Sphaerophoria scripta* and *Sphaerophoria Indiana*; it can be separated from both species by the combination of characters: basoflagellomere wholly yellow; tergum 2 with yellow fascia reaching lateral margins without narrowing and the inner surface of surstylus of male genitalia has extensive patch of short stout setae. The species is widely distributed and first time reported from Khyber Pakhtunkhwa.

### 3.2 *Sphaerophoria Indiana* Bigot, 1884 (Figs. 12-20)

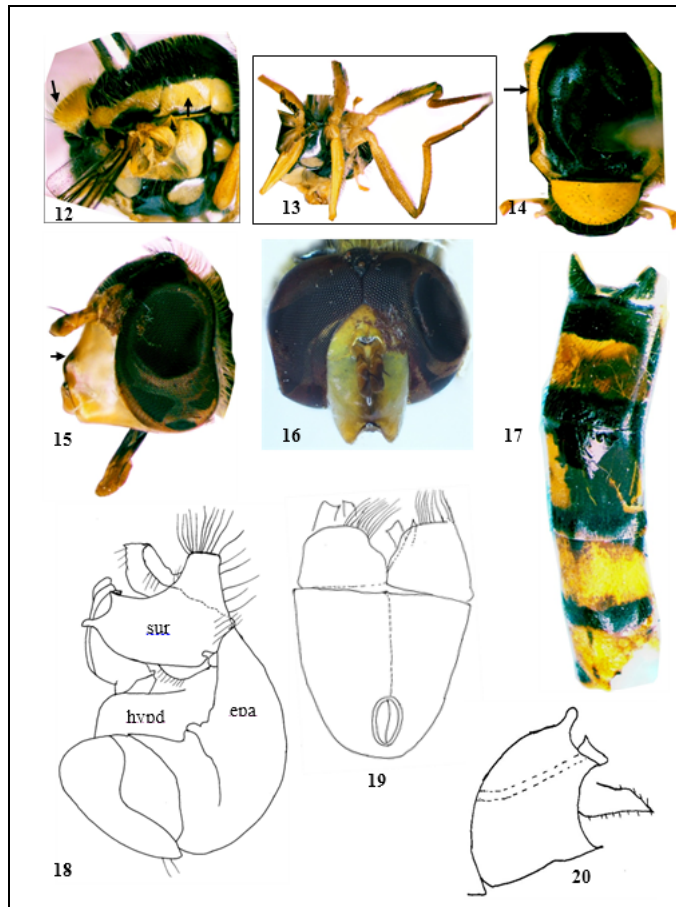
1884b. *Sphaerophoria Indiana* Bigot [15], Ann. Soc. Entomol. Fr. (6) 4: 99

1915. *Sphaerophoria* "form 3" *nigritarsis* Brunetti [16], Rec. Indian Mus. 11: 214.

**Diagnosis:** Male femur 1 anteriorly 1/2 more or less wholly black pilose; face completely yellow except faintly brownish dark median facial tubercle (Figs. 15, 16); scutellum yellow pilose atleast on one fourth (Fig. 12).

**Male Genitalia:** The surstylus inner lobe is shorter and bluntly rounded (Figs. 18-20).

**Female:** unknown.



**Fig 12-20:** *Sphaerophoria Indiana*, male. 12. Scutellum (yellow hairs), scutum and pleuron (yellow lateral margin complete), lateral view. 13. Leg, ventral view. 14. Thorax, dorsal view. 15. Head, face completely yellow except faintly brownish dark median facial tubercle, lateral view. 16. Head, anterior view. 17. Abdomen, dorsal view. 18-20. Male Genitalia. 18. Male terminalia dry specimen, nearly lateral view. 19. Anteroventral lobe of surstylus. 20. Epandrium, dorsal view. 21. Surstylus, lateral view.

**Material Examined: Khyber Pakhtunkhwa:** 1♂, Buner, Gokand, 34°38'56.17"N 72°31'12.24"E, 30-iv-2014.

**Distribution:** Mongolia; China; Korea; Japan; Oriental Region (Peck, 1988) [47]; Afghanistan (Bańkowska, 1964 [9]; Skuffin, 1982 [58]; Peck, 1988 [47]); India (Brunetti, 1915, 1917, 1923 [16, 17, 18]; Rahman, 1940 [49]; Joseph, 1967, 1970 [32, 33]; Knutson *et al.*, 1975 [36]; Mathur, 1983 [43]; Peck, 1988 [47]; Ghorpadé, 1994, 2014 [24, 26]; Bhattacharya *et al.*, 2012 [14]; Shah *et al.*, 2014 [56]; Mitra *et al.*, 2015 [46]); Nepal (Knutson *et al.*, 1975 [36]; Kapoor *et al.*, 1979 [34]; Claussen and weipert, 2003 [19]); Pakistan: Punjab (Murree, Faisalabad, Lahore); Khyber Pakhtunkhwa (Kohat, Darra Adam Khel, Swat, Peshawar) (Aslamkhan *et al.*, 1997 [8]; Arif, 2001 [6]; Arif *et al.*, 2001 [7]; Ghorpadé and Shehazd, 2013 [28]). Buner, Gokand (in present study).

**Flower Records:** *Chrysanthemum* sp, Candytuft and Grass (Singh *et al.*, 1985) [57]; *Brassica*, *Daucus* and *Allium* sp. (Abrol, 1993) [3]; coriander, pea and wheat (Anand *et al.*, 1967) [4]; sorghum, grasses (Arif *et al.*, 2001) [7]. *Allium cepa*, *Coriandrum stivum* (in current study).

**Comments:** The species can be recognized with the combination of the following characters: Male femur 1 anteriorly 1/2 more or less wholly black pilose; face completely yellow except faintly brownish dark median facial tubercle; scutellum yellow pilose atleast on one fourth. The specimen was key out as a *S. Indiana* according to Ghorpadé (1994) [24]. In our examined material, there is a faintly brownish dark median facial tubercle, remaining characters agree with the published description (Brunetti, 1923) [18]. Moreover, our specimen male genitalia figure shows very close resemblance with Ichigo (2008: 52-53) [31], Vockeroth (1971: 1630) [65] and Skuffin (1982: 138) [58] figure of the *S.*

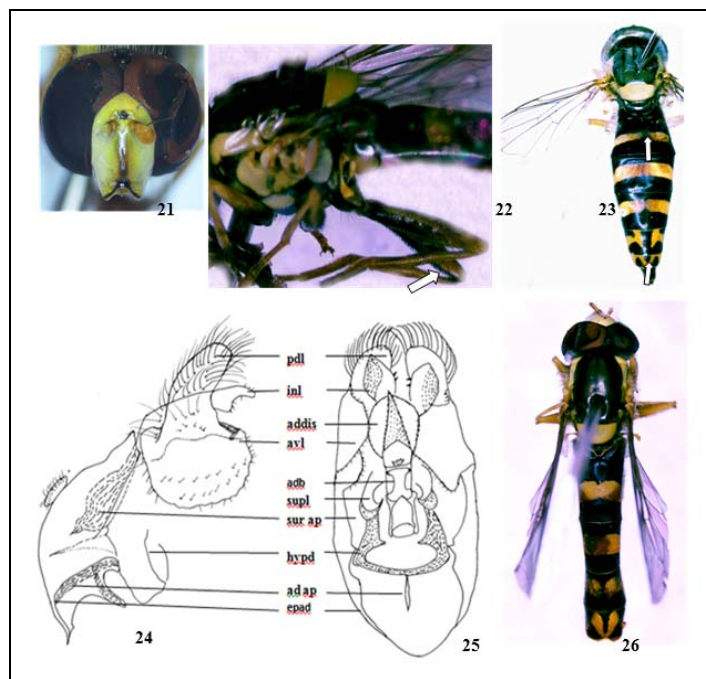
*Indiana* male terminalia. The geographical distribution of species include Oriental, Central and eastern Palaearctic region, Siberia, Russian Far East (Barkalov, 2011) [13]. The species is collected from Khyber Pakhtunkhwa (Buner, Gokand) in the current study.

### 3.3 *Sphaerophoria scripta* (Linnaeus, 1758) (Figs. 21-26)

1758. *Musca scripta* Linnaeus [38], Syst. Nat. Ed. 10, 1: 594.  
1763. *Musca labatrix* Scopoli [55], Entom. Carniolica. : 346.  
1780. *Musca Invisito* Harris [30], Expos. Eng. Ins.: 83.  
1845. *Sphaerophoria* Strigata Staeger [60], Nturh. Tidskr. (2) 1: 362.  
1909. *Sphaerophoria scutellata* Portevin [48], Ann. Ass. Nat. 14: 25.  
1915. *Sphaerophoria* "form 2" Brunetti [16], Rec. Indian Mus. 11: 215.  
1924. *Sphaerophoria violacea* Abreu [2], Mems R. Acad. Cieñe. Artes. 19(1): 70.  
1967. *Sphaerophoria brunetti* Joseph [32], Orient. Ins. 1: 243.

**Diagnosis:** Femur 1 almost completely black haired; male femur 3 with heavy black spinules posteroventrally on apical one-third (Fig. 22); female femur 3 with thick black pile posteroventrally on apical one-third, tergum 2 with yellow fascia deeply notched on hind margin or narrowly divided in centre, tergum 6 with a subtriangular anteromedian black spot surround by two similar spots on posterior margin (Fig. 23).

**Male Genitalia:** Posterodorsal lobes of surstyli long, with long, dense pile on most of surface; large, bare, median triangular area with no hairs at lobes bases; anteroventral lobes large, ventral margin rounded, Inner lobes broad, hook like apically. Superior lobe with basal portion long (Figs. 24-25).



**Fig 21-26:** 21, 22, 24-26 *Sphaerophoria scripta*, male. 21. Head, anterior view. 22. Pleuron lateral view, male femur 3 with heavy black spinules posteroventrally on apical one-third. 23. Female habitus, tergum 2 with yellow fascia deeply notched on hind margin or narrowly divided in centre, tergum 6 with a subtriangular anteromedian black spot surround by two similar spots on posterior margin, dorsal view. 24. Male genitalia, lateral view. 25. Male genitalia, ventral view. Acronyms: Ad ap, aedeagal apodeme; adb, aedeagal base; ad dis, distal part of aedeagus; avl, anteroventral lobe of surstylus; cerc, cercus; epad, epandrium; hypd, hypandrium; inl, inner lobe of surstylus; pdl, posterodorsal lobe of surstylus; supl, superior lobe; sur, surstylus; sur ap, surstyler apodeme. 26. Male habitus, dorsal view.

**Material Examined: Khyber Pakhtunkhwa:** 2♂, Chitral, 35°55'1.74"N 71°48'54.07"E, 15-v-2013; 2♂, Bumborat, 35°41'33.28"N 71°40'26.63"E, 20-vi-2013; 1♀, 1♂, Mahodand, 35°42'8.33" N 72°39'32.30"E, 30-viii-2013; 2♀, Thal, Apple tree flowers, 35°25'5.56"N 72°10'25.72"E, 3-v-2013; 2♂, Timergara, 34°49'38.36"N 71°50'12.01"E, 20-vi-2013; FATA: 2♂, Bajaur Agency, Inayath kalay, 34°45'21.88"N 71°27'25.83"E, 22-iv-2014; Gilgit Baltistan: 1♀, Naltar, near South of PAF (Pakistan Air Force) Mess, moist herb- rich meadows, 36°9'26.25"N 74°11'24.03"E, 13-vii-2013; 1♀, Gahkuch, 36°10'46.92"N 73°46'15.15"E, 18-v-2013; 1♂, Hunza, 36°18'27.92"N 74°37'7.89"E, 01-vii-2013.

**Distribution:** Europe; North Africa; Nearctic Region; Oriental Region; Afghanistan; Syria; Mongolia (Peck, 1988) [47]; Afghanistan (Bańkowska, 1964, 1967, 1968, 1969 [9, 10, 11, 12]; Peck 1988 [47]; Ghorpadé, 1994, 2014 [24, 26]); India (Brunetti, 1915, 1917 [16, 17]; Joseph, 1967 [32]; Knutson *et al.*, 1975 [36]; Datta and Chakraborti, 1983 [20]; Ghorpadé, 1994, 2014 [26, 26]; Shah *et al.*, 2014 [56]; Mitra *et al.*, 2015 [46]); Nepal (Knutson *et al.*, 1975 [36]; Kapoor *et al.*, 1979 [34]; Claussen and Weipert, 2003 [19]); Pakistan: Khyber Pakhtunkhwa (Peshawar, Dara Adam Khel, Swat, Hangu), Punjab (Multan) (Arif, 2001 [6]; Arif *et al.*, 2001 [7]; Ghorpadé and Shehzad, 2013 [28]; Ghorpadé, 2014 [26]). The described species is collected for the first time from localities of Khyber Pakhtunkhwa (Chitral, Bumborat, Mahodand, Thal, Timergara) Federally Administered Tribal Areas (Bajaur Agency) and Gilgit Baltistan (Gahkuch, Naltar, Hunza).

**Flower Records:** *Solanum nigrum*, *Ammania* Sp., *Justicia simplex*, *Digitaria sanguinalis*, *Cynodon* sp., *Cannabis* sp., *Chrysanthemum* sp., *Cannabis sativa*, *Chenopodium ambrosioides*, *Polygonum orientale*, *Nicotiana plumbaginifolia*, *tridax* sp. and *Lantana Camara* Datta and Chakraborti (1983) [20]; tobacco, ber and wild grasses Arif *et al.*, (2001) [7]; Saeed *et al.* (2008) [51] and Sajjad *et al.* (2008) [54] listed the species pollinating *Allium cepa*; The described species is collected from *Malus domestica*, *Brassica campestris*, *Solanum nigrum* and *Allium cepa* during current survey.

**Comments:** *Sphaerophoria scripta* can be recognized by the mesonotum lateral yellow margins complete; facial black median vitta very weak, characters shared with *Sphaerophoria bengalensis* and *Sphaerophoria bengalensis* and *Sphaerophoria Indiana*; it can be separated from the latter two species by having femur 3 with strong black spinules posteroventrally on apical 1/3 in male, while female has slightly stronger bristles on the posteroventral surface of femur 3.

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