



# Notes on *Acanthaspis quinquespinosa* Complex (Hemiptera: Reduviidae: Reduviinae) with Description of a New Species from Pakistan

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## ABSTRACT

*Acanthaspis* Amyot and Serville, 1843, is the second-largest genus within the subfamily Reduviinae. *Acanthaspis quinquespinosa* (Fabricius, 1781), is a common species in Pakistan. Due to its variable color patterns, its taxonomic distinction from *Acanthaspis flavipes* Stål, 1855 has been confounded. The genitalia in Reduviidae are commonly used for species identification and in present studies, because of identical genitalia, *A. flavipes* Stål, 1855 stat. restit. is restored as a junior synonym of *A. quinquespinosa*. The authors surveyed different locations of Pakistan for members of Reduviinae. In this context, *Acanthaspis rafiqi* Shah and Cai sp. nov., is described, including descriptions of genitalia and detailed illustrations giving important diagnostic characters. Interestingly, this species has relatively similar body size and color patterns including the structure of male pygophore and parameres, however, differs from *A. quinquespinosa* in the structure of the phallus.

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### Authors' Contribution

SIAS and AA collected specimens. WC borrowed specimens, acquired the funds and reviewed and editing the manuscript. SIAS and WC conceived and conducted the study. SIAS wrote the manuscript.

### Key words

Reduviinae, *Acanthaspis flavipes*, *Acanthaspis quinquespinosa*, Hemiptera, Heteroptera

## INTRODUCTION

The subfamily Reduviinae is polyphyletic (Hwang and Weirauch, 2012) and one of the most heterogeneous within Reduviidae, including more than 1,070 species under the 141 genera (Melo, 2007). The members of this subfamily are cosmopolitan, reaching their greatest diversity in the old and new world tropics (Schuh and Slater, 1995; Weirauch *et al.*, 2014). The genus *Acanthaspis* was established by Amyot and Serville (1843) for the type species *Acanthaspis sexguttata* (Fabricius, 1775) and currently it is the second-largest genus in Reduviinae (Hwang and Weirauch, 2012), with 124 species (ITIS, 2020). Ambrose (2006) listed 98 species in 25 genera of Reduviinae in the Indian checklist of assassin bugs, of which 42 belonged to *Acanthaspis*.

*Acanthaspis quinquespinosa* (Fabricius, 1781) is a

and is the common species of this genus in Pakistan. This crepuscular, multivoltine assassin bug (Sahayaraj, 1991), species can be easily recognized by its black or piceous-black habitus with light to dark yellowish or orangish markings and castaneous legs. However, as the color patterns of pronotum and legs may vary, the taxonomic status of related members remains confusing to some extent (Cao *et al.*, 2014). *Acanthaspis flavipes* was described by Stål in 1855, as a distinct species, but was subsequently treated as either a variety of *A. quinquespinosa* (Stål, 1874) or remained a distinct species by different authors (Distant, 1904; Maldonado-Capriles, 1990). During our recent and ongoing survey of reduviines from Pakistan, we had the opportunity to examine specimens of *Acanthaspis* we collected nocturnally, in areas dominated by semiarid scrub jungle. This included a long series of *A. quinquespinosa*, supplemented with some museum specimens. In the present paper, we redescribe *A. quinquespinosa*, images of the habitus and male genitalia as well as types species images are also provided. Thus, we confirm its conspecificity with *A. flavipes* and also described a new species from Pakistan with relatively similar body size and color patterns, but the male genitalia is comparatively different. Furthermore, we describe and illustrate diagnostic morphological characters which will be helpful for the identification within this species complex.

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## MATERIALS AND METHODS

This study is based on materials preserved in the Pakistan Museum of Natural History (PMNH), Islamabad, the National Insect Museum (NIM) at National Agricultural Research Center (NARC), Islamabad, Pakistan and Entomological Museum, China Agricultural University (CAU), Beijing. The external morphological structures were examined by using the Nikon SMZ-745 dissecting microscope. The males pygophores i.e. PMNH-59294, PMNH-59307 and, NIMISB-10020 (previously known as *A. flavipes*), PMNH-59300, NIMISB-10018 and, NIMISB-10023 from *A. quinquespinosa*, whereas PMNH-59292, and CAUBJ-1005 from *Acanthaspis rafiqi* Shah and Cai sp. nov. were extracted, soaked in lactic acid for six hours at 28°C, boiled with 20% lactic acid for 20 minutes, rinsed in distilled water and finally, the internal genitalia were extracted from these pygophores under the microscope. The studied genitalia were placed in vials with glycerol and pinned under the corresponding specimens. Photographs were captured by using Canon 7D Mark II digital camera on Olympus BX51 fluorescent and Olympus SZX7 microscopes. The stacking of images was done with Helicon Focus (version 5.3, method C). The measurements were obtained using a calibrated micrometer eyepiece. Morphological terminology mainly follows that of Distant (1904) and Cao *et al.* (2014).

## TAXONOMY

Family: Reduviidae Latreille, 1807

Subfamily: Reduviinae Latreille, 1807

Genus: *Acanthaspis* Amyot and Serville, 1843

*Acanthaspis* Amyot and Serville, 1843

*Acanthaspis* Amyot and Serville, 1843: 336; Stål, 1865: 122, 126; Stål, 1866: 241; Stål, 1868: 125; Stål, 1874: 65, 71; Distant, 1904: 257; Oshanin, 1908: 522; Jeannel, 1919: 187, 214; Schouteden, 1931: 129; Wu, 1935: 457; 295; Hsiao, 1976: 88; Hsiao and Ren, 1981: 448; Putshkov and Putshkov, 1985: 79; Maldonado Capriles, 1990: 383; Aukema and Rieger, 1996: 186; Putshkov and Putshkov, 1996: 186; Ambrose, 1999: 21; Afzal, 2005: 335; Cao *et al.*, 2014: 4; Mukherjee, 2015: 346; Bhagyasree, 2017: 150.

*Platyeris* Burmeister, 1835: 233 (part).

*Tetroxia* Amyot and Serville, 1843: 334 (part).

*Mardania* Stål, 1859: 189 (part).

*Plynus* Stål, 1874: 71 (subgenus of *Acanthaspis*).

*Leptacanthaspis* Jeannel, 1917: 51 (subgenus).

### Type species

*Reduvius sexguttatus* (Fabricius, 1775: 832); by subsequent designation (Kirkaldy, 1903: 231).

### Distribution

Indomalayan and Afrotropical regions.

*Acanthaspis quinquespinosa* (Fabricius, 1781)

(Figs. 1–10, 19)

*Reduvius quinquespinosus* Fabricius, 1781: 382; Fabricius, 1787: 313; Fabricius, 1794: 206; Wolff, 1800: 39.

*Zelus quinquespinosus*: Fabricius, 1803: 286.

*Acanthaspis flavipes* Stål, 1855: 187; Distant, 1904: 262; Maldonado Capriles, 1990: 385; Ambrose, 1999: 30; Afzal, 2005: 338; Ambrose, 2006: 2403; Bhagyasree, 2017: 151. Syn. by Stål 1874: 72 (stat. restit.).

*Acanthaspis quinquespinosa*: Stål, 1867: 241; Lethierry and Severin, 1896: 105; Distant, 1904: 257; Bergroth, 1915: 178; Hoffmann, 1944: 18; Hsiao and Ren, 1981: 455; Maldonado Capriles, 1990: 387; Aukema and Rieger, 1996: 186; Putshkov and Putshkov, 1996: 186; Ambrose, 1999: 30; Afzal, 2005: 340; Ambrose, 2006: 2403; Cao *et al.*, 2014: 48; Mukherjee, 2015: 352; Bhagyasree, 2017: 153.

*Acanthaspis quinquespinosa* var. *flavipes*: Stål, 1874: 72. (stat. restit.).

*Acanthaspis quinquespinosa* var. *geminata* Reuter, 1881: 72. Syn. by Distant, 1904: 262.

### Diagnosis

Habitus medium-sized, generally piceous-black (Figs. 1, 2, 3) or chocolate-brown (Fig. 4); head subequal or slightly longer than first antennal segment; posterior pronotum with two basal spines or tubercles (gibbosities).

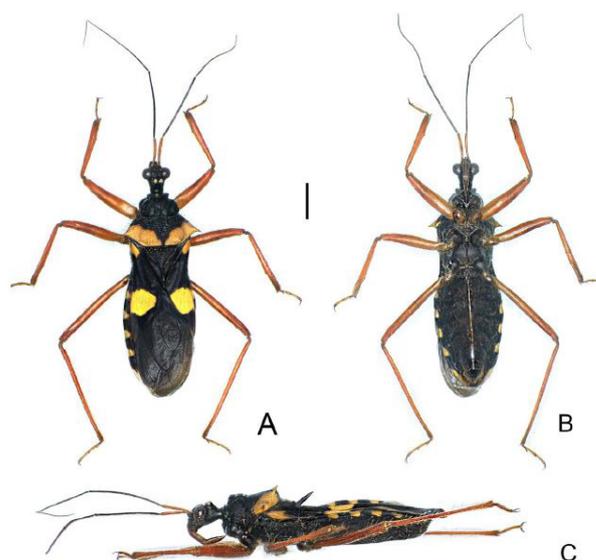


Fig. 1. *Acanthaspis quinquespinosa* (Fabricius, 1781), ♂ habitus. A, Dorsal view; B, Same, ventral view; C, Same, lateral view. Scale bar: 3.00 mm.

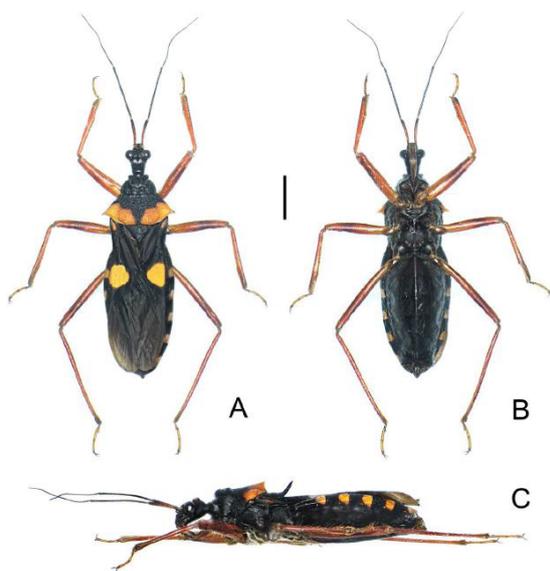


Fig. 2. *Acanthaspis quinquespinosa* (Fabricius, 1781), ♀ habitus. A, Dorsal view; B, Same, ventral view; C, Same, lateral view. Scale bar: 3.00 mm.

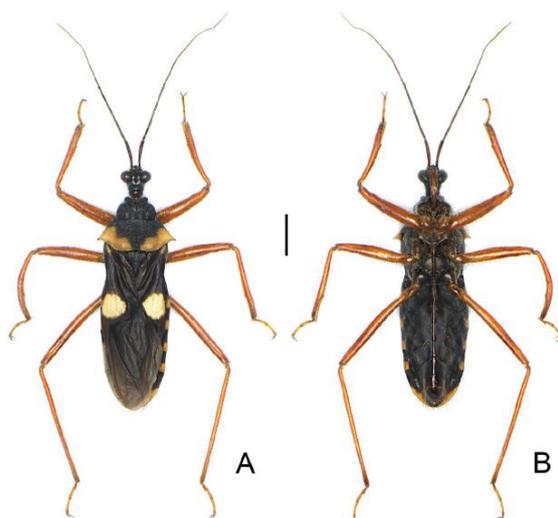


Fig. 3. *Acanthaspis flavipes* Stål, 1855 (previously known), ♂ habitus. A, Dorsal view; B, Same, ventral view. Scale bar: 3.00 mm.

#### Redescription

**Coloration:** Habitus black to piceous-black with light to dark yellowish or orangish markings; first antennal segment, labium, spot next to ocelli and legs (except coxae and tarsi) castaneous or dark reddish brown (femora medially dark-colored); eyes, antennal segments II-IV, neck, posterior area of prosternum, proacetabula, thoracic-sterna and coxae dark to light chocolate-brown; ocelli

and tarsi light golden or pale; head, pronotum (excluding area around humeral angles, lateral posterior margins and spines or tubercles at posterior lobe) scutellum and thoracic-pleura black to piceous-black; in male area around the humeral angles, spines or tubercles and lateral impressions of posterior pronotal lobe with a series of light to dark yellowish color (Fig. 5A, C–D), in female, corresponding areas light to dark orangish (Fig. 6A–C), however, color markings and their patterns can be variable; abdomen with combination of chocolate-brown and dark black to piceous-black; in male connexivum dark black to piceous-black and yellowish (Fig. 8A, B), while, in female piceous-black and dark orangish (Fig. 8C, D); at the base of hemelytra, a small spot, corium with a large light to dark yellowish or sometimes white to creamy spot (Figs. 1A, 2A, 3A, 4A, C) approaching to costal margin; corium slightly dark chocolate-brown while, with membrane light brown; hindwings mostly white with robust brownish veins (Fig. 7B).

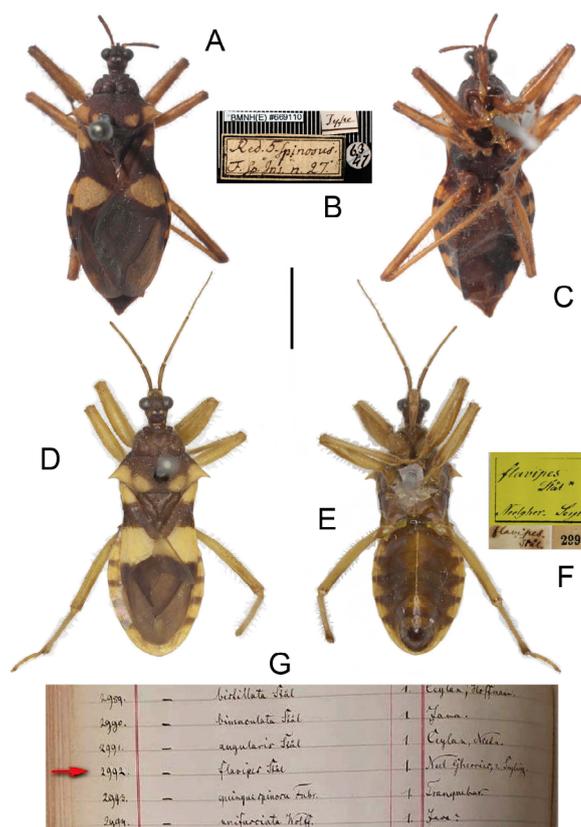


Fig. 4. *Acanthaspis quinquespinosa* (Fabricius, 1781), ♀ (A–C), syntype habitus, label; *Acanthaspis flavipes* Stål, 1855, ♂ (D–G), holotype habitus, label, page excerpt from catalogue available at MFNB. A, C, Dorsal view; D, E, Ventral view. Scale bar: 5.00 mm. A–C, Photographed by Valérie Lemaitre (NHMUK, London); D–G, Photographed by Dr. Jürgen Deckert (MFNB, Berlin).

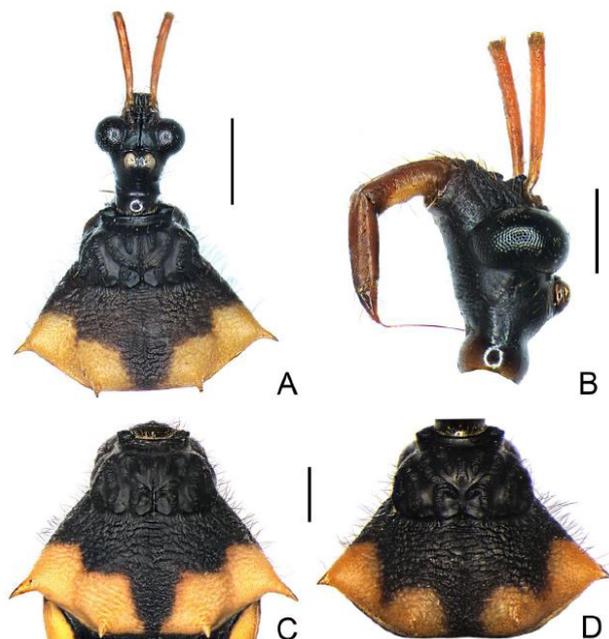


Fig. 5. *Acanthaspis quinquespina* (Fabricius, 1781), ♂ (A–C); *Acanthaspis flavipes* Stål, 1855 (previously known), ♂ (D). A, Head, antennal scape and pronotum with different color patterns and distinct spines; B, Head with antennal scape, distinct neck and labium with its stylet; C, Pronotum with different color patterns; D, Pronotum with different color patterns and tubercles. A, C–D, Dorsal view; B, Lateral view. Scale bar: A, 2.00 mm; B–D, 1.00 mm.

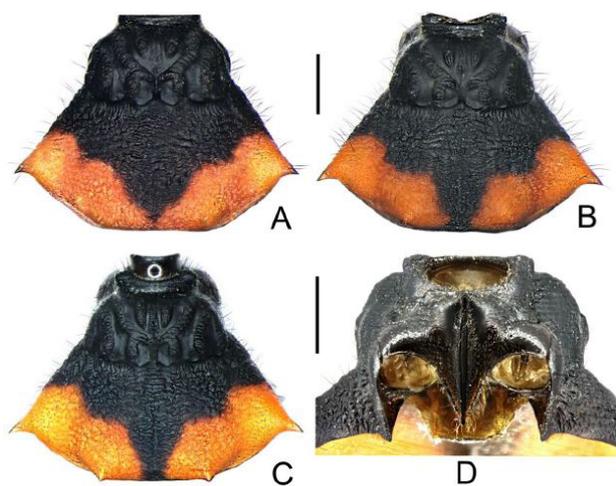


Fig. 6. *Acanthaspis flavipes* Stål, 1855 (previously known), ♀. A, Pronotum furnished with indistinct tubercles and different color patterns; B, Pronotum bearing tubercles (gibbosities) with different color patterns; C, Pronotum with distinct tubercles; D, Stridulitrum. A–C, Dorsal view; D, Ventral view. Scale bar: 1.00 mm.

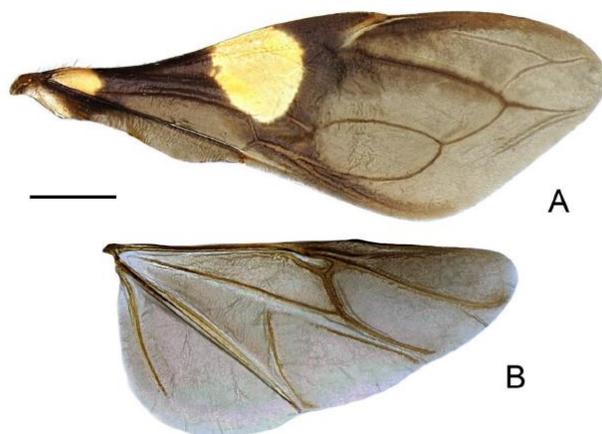


Fig. 7. *Acanthaspis quinquespina* (Fabricius, 1781), ♂. A, Hemelytra with distinct basal spot; B, Hindwing. A–B, Dorsal view. Scale bar: 2.00 mm.

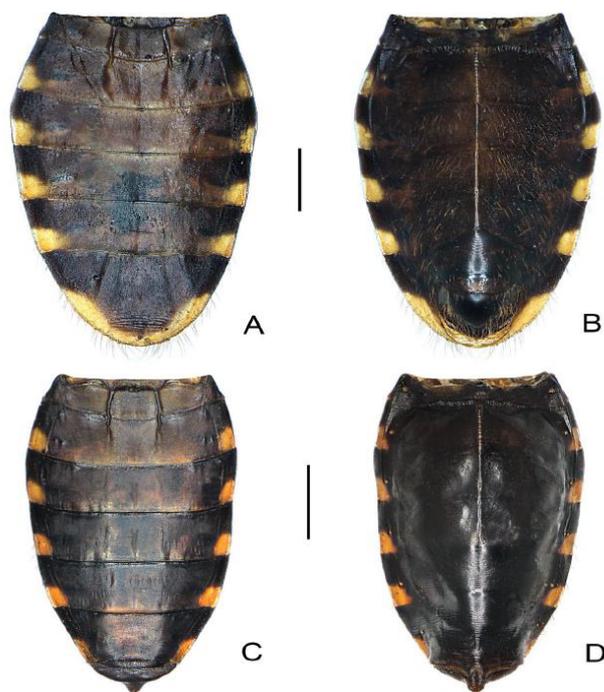


Fig. 8. *Acanthaspis quinquespina* (Fabricius, 1781). ♂ (A–B); ♀ (C–D). A–B, Abdomen with dark yellowish connexivum, distinct scent glands on tergites III–IV and central ridge; C–D, Abdomen with dark orangish connexivum, reduced scent glands and medial half approaching central ridge. A, C, Dorsal view; B, D, Ventral view. Scale bar: 2.00 mm.

*Vestiture*: Male and female macropterous, habitus medium-sized (Figs. 1–4); head, labium, first antennal segment, lateral margins of pronotal region, the tip of

scutellum clothed with reddish-brown or ochraceous, short and long, erect and slightly procumbent stiff setae and long hairs; apically pedicel, flagellomeres and tip of stridulitrum amalgamated with chocolate-brown short stiff setae and long hairs; maxillary plates, thoracic-pleura and ventrally abdomen infested with short adpressed creamy-white or light-brown setae while, most of the dorsum of abdomens glabrous; anterior margin of the collar with stiff erect light-brown setae; antennal sockets posteriorly bearing few stiff bristles; ventrally pro-trochanters and pro- and mesofemora densely furnished with reddish-brown long pilose whereas, pilosity of pro-, meso- and metatibiae short.

**Structure:** Head oblong, slightly longer than first antennal segment; length of anteocular region shorter than postocular region including neck; neck subequal in length with anteocular region whereas, its greatest width individually subequal with basal two labial segments; mandibular plates slightly higher than clypeus (Fig. 5B); maxillary plates feebly rugose; gula smooth shiny; medial lobe of head divided into two plates (Fig. 5A) separated by interocular sulcus close to mandibular plates; eyes reniform, protruding; ocelli distinctly protuberant (Fig. 5A-B), slightly apart from each other; neck much distinct; rostrum robust, first visible segment subequal to the second visible segment, medial longitudinal groove very prominent; first antennal segment cylindrical, third-longest followed by second.

Collar process produced; anterior lobe of pronotum strongly sculptured, elevated (Figs. 5A, C,D, 6A-C); posterior lobe of pronotum rugose, anteriorly slightly declivous, median sulcus indistinct, posterior margin broken with a pair of spines or tubercles (Figs. 5A, C, D, 6A-C), sometimes these tubercles indistinct or reduced (Fig. 6A); humeral angles spinously projecting; scutellum “Y-shaped”, flat at the base, middle wrinkled and its apex produced with a long obliquely tapered spine; prosternum (Fig. 6D) “V-shaped” with a long deep stridulatory groove; proepisternum, meso- and metapleura depressed, proepimeron rugose, proacetabula sulcated while, meso- and metaacetabula smooth.

Male hemelytra of slightly surpassing abdominal tip while, female nearly reaching it, hemelytron at base narrowed, apical margin short, anal margin distinctly long, membrane oval, clavus distinct (Fig. 7A) and outer cell slightly larger than inner cell; anterior margin of hindwing straight, secondary veins (SV) prominently “V-shaped” (Fig. 7B); procoxae longer than meso- and metacoxae; mesofemora less incrassate than pre-femora and more from metafemora; pro- and mesotibiae with fossula spongiosae; metatibiae in male 1.76 times longer than protibiae and 1.58 times than mesotibiae whereas, in female metatibiae

1.73 times than protibiae and 1.57 times from mesotibiae.

Central ridge ventrally conspicuous (Fig. 8D), but in female attaining only on medial half; in female second tergite subdivided into three subparts, connexivum slightly exposed at repose condition; in male scent glands situated only at tergites III-IV (Fig. 8A) whereas, in female completely reduced (Fig. 8C); male seventh sternite extending beyond the pygophore, eighth distinctly visible; female abdomen slightly narrowed elongate (Fig. 8C-D), seventh tergite concave, eighth convex, tenth not fused with ninth, first valvifer narrowed long, first valvula indistinct, styloid visible at dorsal view with a sharp apex.

Male genitalia (Figs. 9, 10): Pygophore 2.64 mm long and 2.21 mm wide, conflated with thick setae of varying lengths, medially distended, posterior margin broadly produced caudad while, median process of pygophore absent (Fig. 9E-F); paramere club-shaped with 1.25 mm in length, ventrally long pilose, dorsally flat, medially curved and, thickened and apical tine sclerotized (Fig. 9A-C); basal plate and processus of capitatus are robust, supported by a thickened basal plate bridge (Fig. 10A, C); pedicel split, dorsally straight and ventrally convex (Fig. 10B, C); struts erect (1.49 mm long), submedially swollen and apically narrowed (Fig. 10A, B); dorsal phallosomal sclerite strongly sclerotised (Fig. 10A, D), approaching downward to medial half of struts with its median apical process wide and concave (Fig. 10A), with a club-shaped (0.92 mm long) basal, medial, dorsal lobe of the endosoma behind (Fig. 10A, B-D); remaining endosomal portion mostly membranous.

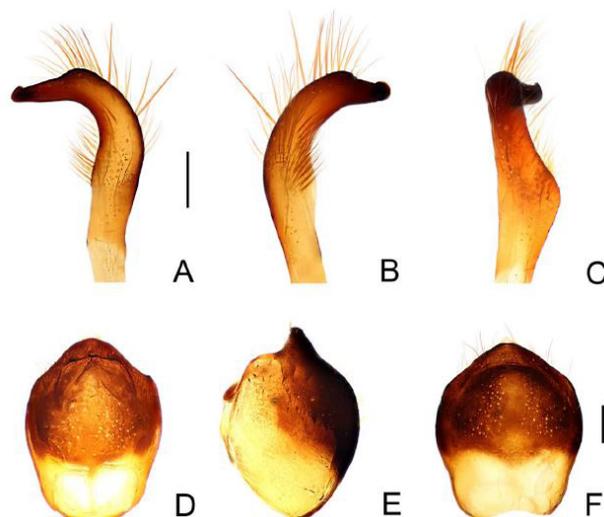


Fig. 9. *Acanthaspis quinquespinosa* (Fabricius, 1781), ♂ (A-F). A-C, Parameres; D-F, Pygophore. A-C, Different view; D, Dorsal view; E, Lateral view; F, Ventral view. Scale bar: A-C, 0.25 mm; D-F, 0.50 mm.

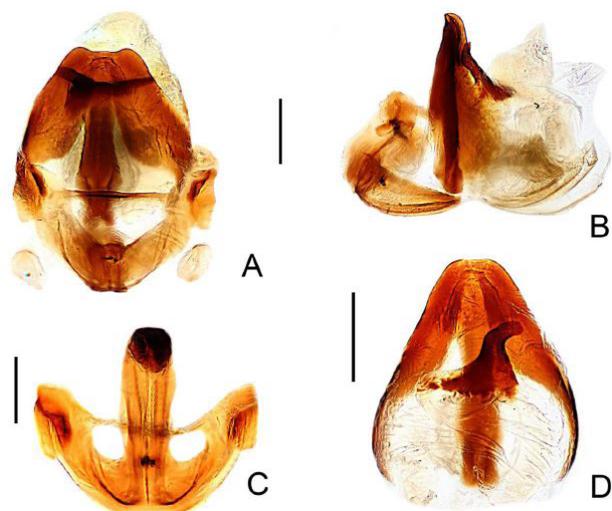


Fig. 10. *Acanthaspis quinquespinosa* (Fabricius, 1781), ♂. A–B, Phallus; C, Phallobase; D, Phallosoma. A, Dorsal view; B, Lateral view; C–D, Ventral view. Scale bar: A–B, D, 0.50 mm; C, 0.25 mm.

#### Measurements

In mm, male (n= 4)/female (n= 4). Body length to apex of fore wings 19.92–20.02/17.00–18.10; body length to apex of abdomen 19.17–19.20/17.45–17.55; length of abdomen 11.02–11.15/9.50–9.55; greatest width of abdomen 6.18–6.22/5.00–5.02; head length 2.15–2.15/2.15–2.15; length of anteoocular part 0.40–0.40/0.50–0.50; length of postocular part 1.00–1.00/0.95–0.95; length of antennal segments I–IV= 2.00–2.10/1.90–1.95, 4.00–4.05/3.46–3.55, 5.20–5.25/4.29–4.30, 2.85–2.90/ missing; length of visible rostral segments I–III= 1.35–1.38/1.32–1.33, 1.35–1.35/1.25–1.25, 0.50–0.50/0.50–0.52; length of anterior pronotal lobe 1.80–1.85/1.50–1.52; greatest width of anterior pronotal lobe 2.65–2.68/2.50–2.52; length of posterior pronotal lobe 2.50–2.55/2.00–2.05; greatest width of posterior pronotal lobe 5.00–5.10/4.70–4.75; length of hemelytron 14.86–15.05/11.20–11.42; greatest width of hemelytron 5.51–5.55/3.80–3.82; length of hind wing 11.19–11.25/8.50–8.52; greatest width of hind wing 5.84–5.85/4.00–4.05; lengths of fore leg trochanter 1.10–1.10/1.00–1.00, femur 5.20–5.30/4.20–4.25, tibia 4.60–4.62/4.50–4.55; lengths of middle leg trochanter 1.20–1.20/1.10–1.10, femur 5.00–5.20/4.30–4.37, tibia 5.10–5.15/4.50–4.55; lengths of hind leg trochanter 1.20–1.20/1.10–1.10, femur 7.00–7.10/6.90–7.01, tibia 8.10–8.18/7.00–7.10.

#### Material examined

3♂, 2♀, ix.2017, Peshawar, leg. Syed Ishfaq Ali Shah (PMNH-59294, PMNH-59295, PMNH-59296,

PMNH-59297, PMNH-59298); 4♂, 4♀, x.2017-18, Swabi, leg. Azaz Ahmad (PMNH-59299, PMNH-59300, PMNH-59301, PMNH-59302, PMNH-59303, PMNH-59304, PMNH-59305, PMNH-59306); 2♀, viii.2017, Margalla Hills (Islamabad), leg. Azaz Ahmad (NIMISB-10016, NIMISB-10017); 6♂, 2♀, ix.2018-19, Arja Village (Baugh), leg. Khifza Niaz (NIMISB-10018, NIMISB-10019, NIMISB-10020, NIMISB-10021, NIMISB-10022, NIMISB-10023, NIMISB-10024, NIMISB-10025); 3♂, 2♀, viii.2019, Muzaffarabad, leg. Azaz Ahmad (PMNH-59307, PMNH-59308, PMNH-59309, PMNH-59310, PMNH-593011); 2♂, vii.1986, Lower Dir, leg. Afzal, PMNH-4694, PMNH-4692.

#### Distribution

Pakistan [Baugh, Islamabad, Lower Dir, Muzaffarabad, Peshawar, Swabi, (Fig. 19)], China, India, Myanmar, Nepal and Sri Lanka.

#### *Acanthaspis rafiqi* Shah and Cai sp. nov.

(Figs. 11–19)

#### Diagnosis

Habitus similar to *A. quinquespinosa* however, it can be easily differentiated with the following; head distinctly longer than antennal scape; no spines or tubercles at the posterior lobe of pronotum, typically furnished with four spots (Figs. 11, 12, 13C–D); antennae (Fig. 13B), labium (Fig. 13A) and legs (Fig. 15A–D) are light to dark brownish; scent glands in female situated at third tergite while, fourth indistinctly present and fifth reduced (Fig. 16A); dorsal phallosomal sclerite short (Fig. 17A, C) with its apex and basal marginal areas are serrate (Fig. 17A, C), basal, medial, dorsal lobe of the endosoma smaller than *A. quinquespinosa*.

#### Description

**Coloration:** Generally body black to piceous-black and dark chocolate-brown; first antennal and labial segments, a spot next to ocellar area and legs (excluding tibiae and tarsi) dark chocolate-brown; antennal segments II–IV, thoracic-sterna, membrane of hemelytra and ventrally abdomen brown; second and third labial segments light brownish, tarsi ochraceous and tibiae brownish; dorsum of abdomen piceous-black with brown-tinged; head, stridulitrum, pronotum (excluding posterior pronotal lobe posterior area and humeral spines) and thoracic-pleura piceous-black; humeral spines and posteriorly posterior lobe of pronotum furnished with four beige color spots (in male light beige, Fig. 13C while, in female with slightly darker beige, Fig. 13D); basal spot of hemelytra and spot to corium light pale in male whereas, in female it darker

pale; hindwings white with soil type brownish veins (Fig. 14C), connexiva precisely with combination of pale, piceous-black and dark chocolate-brown.



Fig. 11. *Acanthaspis rafiqi* Shah and Cai, sp. nov., ♂ habitus. Scale bar: 3.00 mm.

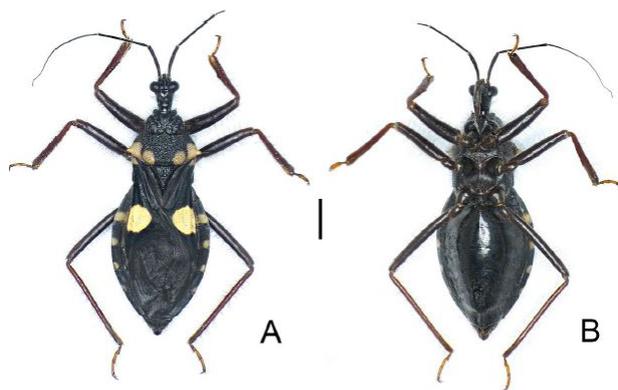


Fig. 12. *Acanthaspis rafiqi* Shah and Cai, sp. nov., ♀ habitus. A, Dorsal view; B, Same, ventral view. Scale bar: 3.00 mm.

**Vestiture:** Male and female both macropterous; body medium-sized, generally elliptic (Figs. 11, 12) and heavily ochraceous pilose; clypeus, area posterior to antennifers,

gena, labium, lateral margins of pronotum, basal and lateral margins of coria, scutellum, apical tip of prosternum, connexival margins and ventrally abdomen conflated with short and long, erect and decumbent hairs but, dorsum of abdomen mostly glabrous; antennae with short stiff setae; thoracic-sterna and gula smooth shiny; prothrochanters densely clothed with short hairs while, pilosity of pro and mesofemora more than metafemora and pro-, meso- and metatibiae longer pilose.

**Structure:** Head oblong, oviform and distinctly longer than the first antennal segment whereas, its greatest width individually subequal with basal two labial segments; length of anteocular region smaller than the postocular region including neck (Fig. 13A, B) while, its neck equal or subequal in length with anteocular region; mandibular plates elevated than clypeus; maxillary plates and area of buccula distinctly separated from gula; medial lobe of head divided into two promising sclerotized plates separated by a distinct interocular suture extended to mandibular plates (Fig. 13B), each plate bearing a transverse dark chocolate-brown spot; antennifers tuberculate; eyes reniform, protruding outside; ocelli protuberant, occurring apart from each other (Fig. 13B); rostrum robust, first visible segment subequal to second visible segment, slightly curved, (Fig. 13A) and medially split with a longitudinal groove; first antennal segment cylindrical.

Collar process small but, distinct; male posterior pronotal lobe 1.92 times wider than anterior pronotal lobe while, in case of female it is 1.96 times; anterior lobe of pronotum strongly sculptured and elevated whereas, posterior lobe rugose and slightly declivous anteriorly; humeral angles spinously produced (Fig. 13C, D); posterior pronotal lobe furnished with four spots, two to each close to humeral spines and two posteriorly adjacent to humeral spots, each of posterior spot medially bearing a very indistinct small tubercle (sometimes might be reduced) or much acute indistinct spines; scutellum “Y-shaped”, its spine inclined to the abdomen; proepisternum and mesopleura smooth while, proepimeron and metapleura feebly rugose; proacetabula sulcated while, meso- and metaacetabula mostly smooth; stridulitrum “V-shaped” with 1.5 mm long, deep prosternal groove (Fig. 14B), its apical tip almost extending beyond the procoxal cavities.

Hemelytra of male and female not surpassing abdominal tip; outer cell of hemelytron rectangular, inner cell ovate, basal junction bearing a small indistinct spot, apically corium with a large round spot approaching anterior margin; clavus distinct (Fig. 14A); hindwing anterior margin straight (Fig. 14C), humus short but distinct, secondary veins distinctly separated; pro-coxae about two times as long as wide; meso-femora less incrassate than profemora and more from metafemora (Fig. 15); pro- and mesotibiae with spongy furrows (Fig.

15B) leading medially to basal portion of tarsi; metatibiae longer than pro- and mesotibiae.

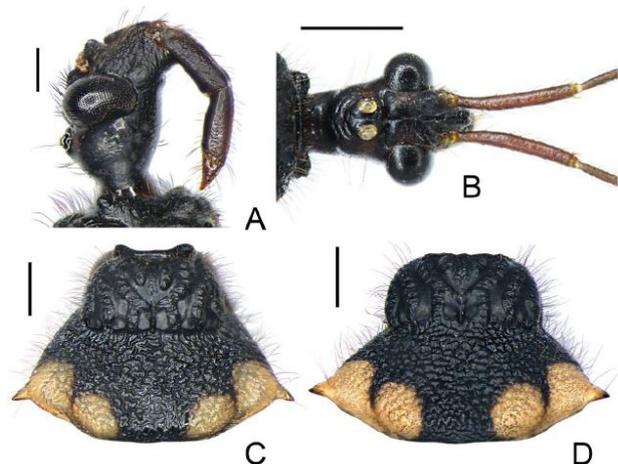


Fig. 13. *Acanthaspis rafiqi* Shah and Cai, sp. nov., ♂ (A–C); ♀ (D). A, Head and labium; B, Head, antennal scape, distinct neck and collar process; C, pronotum consisting of four light beige spots; D, pronotum with four dark beige spots. A, Lateral view; B–D, Dorsal view. Scale bar: A, 0.50 mm; B–D, 1.00 mm.

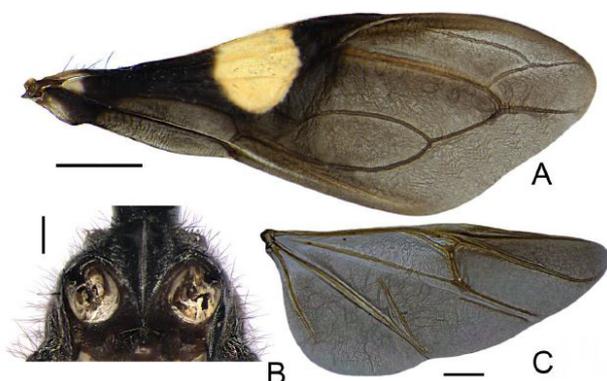


Fig. 14. *Acanthaspis rafiqi* Shah and Cai, sp. nov., ♂. A, Hemelytra with indistinct basal spot; B, Prosternum with deep medial groove; C, Hindwing. A, C, Dorsal view; B, Ventral view. Scale bar: A, 2.00 mm; B, 0.50 mm; C, 1.00 mm.

Female abdomen oblong, ovoid (Fig. 16A, B), second tergite subdivided into three subparts, connexivum conspicuously exposed at repose; ventrally central ridge in male abdomen prominent than female; in female, scent glands situated at third tergite while, fourth indistinct, seventh tergite concave, eighth narrowed and convex, ninth and tenth triangular and distinctly fused (Fig. 16C, D), first valvifer plates triangular with anterior margin convex and posterior margin straight, first valvula indistinct than first

valvifer and styloid long pointed.

*Male genitalia* (Fig. 17): Pygophore, parameres and basal plate same as in *A. quinquespinosa*, but pygophore comparatively smaller in size i.e. 2.31 mm long and 2.04 mm wide; basal plate bridge 1.7 mm long; pedicel fused (Fig. 17B), dorsally straight, ventrally with a slight curve; struts 1.32 mm long, basally fused, submedially distended and apically narrowed (Fig. 17D); apical tip and basal portion of dorsal phallosclerite conspicuously serrate and sclerotized (Fig. 17A, C, D); basal, medial, dorsal lobe of the endosoma sclerotized and pointed (Fig. 17A, C) with 0.33 mm long length, remaining endosoma membranous.

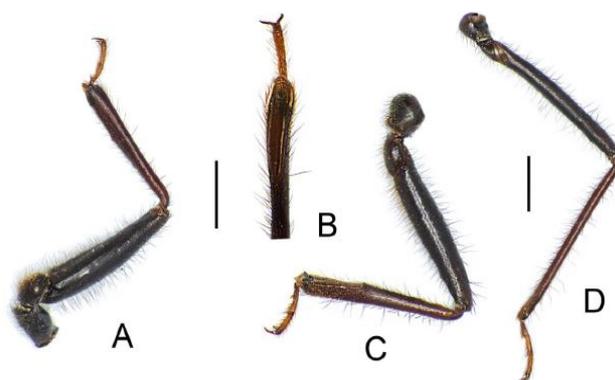


Fig. 15. *Acanthaspis rafiqi* Shah and Cai, sp. nov., ♀. A, Proleg; B, fossula spongiosa; C, mesoleg; D, metaleg. A, C–D, Lateral view; B, Ventral view. Scale bar: 2.00 mm.

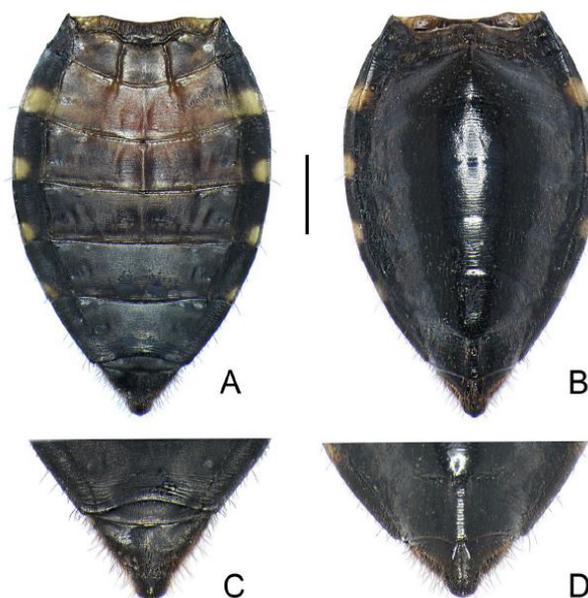


Fig. 16. *Acanthaspis rafiqi* Shah and Cai, sp. nov., ♀. A–B, Abdomen; C–D, Abdominal venter. A, C, Dorsal view; B, D, Ventral view. Scale bar: A–B, 2.00 mm.

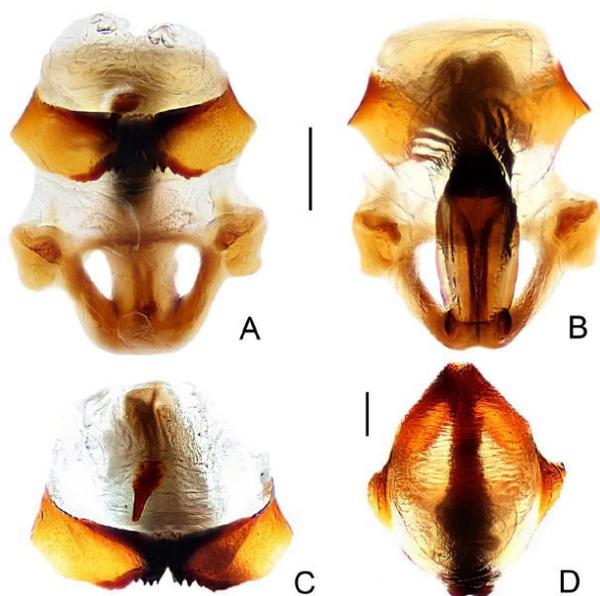


Fig. 17. *Acanthaspis rafiqi* Shah and Cai, sp. nov., ♂. A–B, Phallus; C, Apical most portion of phallosoma; D, Phallosoma. A, C, Dorsal view; B, D, Ventral view. Scale bar: A–B, 0.50 mm; D, 0.25 mm.

#### Measurements

In mm, male (n= 2)/female (n= 3). Body length to apex of fore wings 16.00–16.20/16.16–16.24; body length to apex of abdomen 16.50–16.75/17.14–17.18; length of abdomen 10.02–11.05/10.10–10.15; greatest width of abdomen 5.60–5.62/6.40–6.40; head length 2.70–2.70/2.50–2.50; length of anteocular part 0.50–0.50/0.40–0.40; length of postocular part including eyes 1.50–1.50/1.70–1.70; length of antennal segments I–IV= 1.85–1.90/2.10–2.15, 3.20–3.25/3.50–3.52, missing/missing, missing/missing; length of visible rostral segments I–III= 1.20–1.22/1.20–1.20, 1.10–1.10/1.10–1.10, 0.45–0.45/0.50–0.52; length of anterior lobe of pronotum along the collar 1.60–1.62/1.50–1.52; greatest width of anterior lobe of pronotum 2.60–2.60/2.50–2.53; median length of posterior lobe of pronotum 2.0–2.05/2.0–2.10; greatest width of posterior lobe of pronotum along spine 5.00–5.05/4.90–4.90; length of hemelytron 12.02–12.10/13.36–13.42; greatest width of hemelytron 4.20–4.22/4.50–4.52; length of hind wing 7.95–8.01/8.60–8.63; greatest width of hind wing 3.40–3.40/3.60–3.62; lengths of fore leg trochanter 1.00–1.00/1.00–1.00, femur 4.50–4.53/4.60–4.63, tibia 3.95–3.98/4.00–4.05; lengths of middle leg trochanter 0.95–0.95/1.00–1.00, femur 4.30–4.35/4.60–4.65, tibia 4.40–4.42/4.50–4.55; lengths of hind leg trochanter 1.00–1.00/1.10–1.10, femur 6.00–6.10/6.00–6.05, tibia 6.50–6.55/6.70–6.78.

#### Types material

Holotype: 1♂, Azad Jammu and Kashmir State, Baugh, Arja Village; x.2019, leg. Khifza Niaz (PMNH-59292).

Paratypes: 1♂, Islamabad, Margalla Hills, viii.2017, leg. Azaz, Ahmad (CAUBJ-1005); 1♀, Azad Jammu and Kashmir State, Baugh, Arja Village, x.2019, leg. Khifza Niaz (PMNH-59293); 1♀, ix.1982, Islamabad, leg. Abro (PMNH-1638), 1♀, x.1983, locality unknown, leg. Abro (PMNH-3358).

#### Etymology

This new species is named in honor of Muhammad Rafiq, former head of Entomology Section and Principal Scientific Officer, Central Cotton Research Institute, Multan, Punjab, Pakistan for his long distinguished and superior service to the institution.

#### Distribution

Pakistan (Baugh, Islamabad) (Fig. 19).

#### Biology

The holotype was collected at night from the boulder-clay and stones (Fig. 18A, B), which was nearby covered with dense natural vegetation and trees. The paratype female was collected close to the male holotype, while, one paratype male was collected from a dead tree trunk at early night time.



Fig. 18. Habitat of *Acanthaspis rafiqi* Shah and Cai, sp. nov., in Arja village, District Baugh, Azad Jammu and Kashmir State, Pakistan.

## DISCUSSION

*Acanthaspis quinquespinosa* was found in a wide variety of habitats, mainly moist environments with stones around, and was seen near trees bases in scrub jungles. These findings are similar to those of Sahayaraj (2007), who reported this species from tropical rainforests, scrub jungles and agroecosystems in India. This reduviid is a potential biocontrol agent as it voraciously predate on larval and nymphal stages of insect many pests, such as

*Spodoptera exiguae* Hubner, (Butani, 1958); *Mylabris purlata* (Thunberg), (Ambrose, 1988); *Odontotermes wallonensis* Wasmann, (Rajagopal, 1984); *Dysdercus koenigii* (Fabricius) and *D. laetus* Kirby, (Lakkundi, 1989); *Helicoverpa armigera* Hubner, *Spodoptera litura* (Fabricius), *Pectinophora gossypiella* (Saunders) and *Corcyra cephalonica* (Stainton), (Sahayaraj, 1991).

*Acanthaspis quinquespinosa* syntypes (Fig. 4A, B), [(British Museum of Natural History, E-669110), (BMNH, E-669111), Zimsen 1964] and *A. flavipes* type (Fig. 4C, D) of (Museum für Naturkunde Berlin, 2002) images were examined. The habitus of these type species were mostly light to dark chocolate-brown and mild piceous-black, whereas the specimens that we collected were only representing dark piceous-black habitus. However, the first antennal segments, the labium, spot next to ocelli and legs were similar to those of type specimens. Likewise, Ishikawa (2016) reported discontinuous intraspecific variation in other members of the Reduviinae. Lakkundi (1989) observed adults of *A. quinquespinosa* with light and dark black habitus from two different localities.

Lateral and basal spines of pronotal regions of type *A. flavipes* (Fig. 4C, D), *A. quinquespinosa* and *A. flavipes* illustrated by Chandra *et al.* (2012) including the image of *A. quinquespinosa* (UCR-ENT-00014950, India, 1949) uploaded on <http://research.amnh.org/pbi/heteropteraspeciespage/speciesdescriptionall.php> as well as specimens collected by us (Figs. 5A, C, D, 6A, C) had a series of light to dark yellowish or dark orangish color patches. Whereas, syntype *A. quinquespinosa* (Fig. 4A, B) and the similar species illustrated by Cao *et al.* (2014) and Chandra *et al.* (2014) had a spot around the lateral and basal spines. Almost similar findings are mentioned by Cao *et al.* (2014) regarding the coloration, who recorded six kinds of variations on posterior lobe of pronotum in Chinese individuals of *Acanthaspis cincticus* Stål (1859), and those of Ambrose and Livingstone (1987), and Sahayaraj (2007), who observed color polymorphism and different ecotypes of the genus.

In accordance with images of types species and key provided by Distant (1904), the specimens of *A. quinquespinosa* complex were grouped based on spines (Fig. 5A, C), tubercles (distinct/indistinct, Figs. 5D, 6A, B) and tubercles surmounted with very short tips (Fig. 6C). A pair of spines at pronotal lobe in *Acanthaspis quinquespinosa* were mentioned by Distant (1904), Afzal (2005), Khot and Hegde (2010), Cao *et al.* (2014) and, Mukherjee (2015), whereas, *A. flavipes* was mentioned with discal tubercles (Distant, 1904; Afzal, 2005). Moreover, distinct tubercles were observed in specimens of *A. flavipes* (collected by M.S.K., a data label preserved at the entomological museum, Center for Agriculture and

Biosciences International (CABI), Rawalpindi, Pakistan. The specimens having distinct/indistinct tubercles or tubercles surmounted with short tips had genitalia identical to *A. quinquespinosa*. The dissected genitalia of *A. quinquespinosa* and *A. flavipes* completely match with those illustrated by Cao *et al.* (2014). Therefore, we strongly agree with Maldonado Capriles (1990), Ambrose (2006) and Afzal (2005), who followed Stål (1874), about synonymy of *A. flavipes* with *A. quinquespinosa*. We could not find any other differences in morphological characters and thus, *A. flavipes* Stål (1855) stat. restit. is restored as a junior synonym of *A. quinquespinosa*.

Moreover, *Acanthaspis rafiqi* Shah and Cai sp. nov., the pygophore and parameres are the same in structure with *A. quinquespinosa*, but differ in the structure of the phallus. The pedicel of *A. quinquespinosa* is split and curved (Fig. 10B, C), while in *A. rafiqi*, it is fused, slightly curved and thickened (Fig. 17B). The dorsal phallosclerite of *A. quinquespinosa* is long (Fig. 10A, D), medial apical process apically concave and fused with strut; posterior to the dorsal phallosclerite, a club-shaped basal, medial dorsal lobe of the endosoma (Fig. 10A, D). In the case of *A. rafiqi*, the dorsal phallosclerite is short (Fig. 17A, C), its apex and marginal areas over the strut are serrate (Fig. 17A, C) and sclerotized. The basal, medial, dorsal lobe of the endosoma is 5.45 times smaller than that of *A. quinquespinosa*.

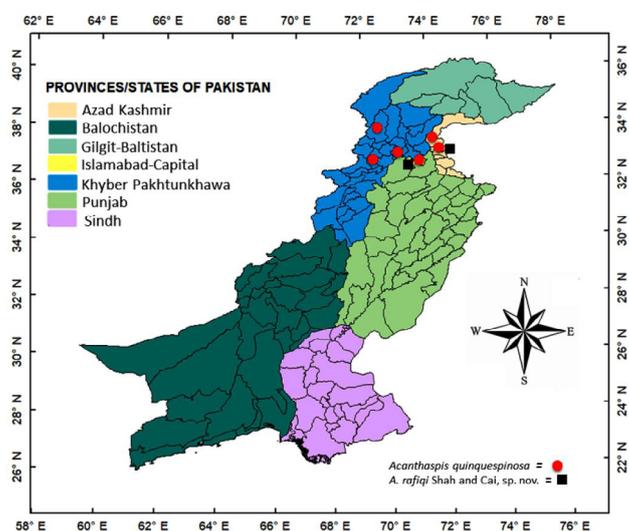


Fig. 19. Distribution of *Acanthaspis quinquespinosa* (Fabricius, 1781) and *A. rafiqi* Shah and Cai, sp. nov., in various localities of Pakistan.

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#### Statement of conflict of interest

The authors have declared no conflict of interest.

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