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A New Species of the Genus *Anthocoris* (Hemiptera: Heteroptera: Anthocoridae) Found in Leaf-Rolling Galls on *Ficus benghalensis* L. in Southern India

KAZUTAKA YAMADA[1,2] AND CHANDISH R. BALLAL[3]
[1]*Institute of Natural and Environmental Sciences, University of Hyogo, Yayoigaoka 6-chome, Sanda-shi, Hyogo 669-1546, Japan.*
[2]*Museum of Nature and Human Activities, Hyogo, Yayoigaoka 6-chome, Sanda-shi, Hyogo 669-1546, Japan.*
yamada.kaz@gmail.com; https://orcid.org/0000-0002-4210-6693
[3]*ICAR-National Bureau of Agricultural Insect Resources, H. A. Farm P. O, Bellary Road, Bangalore 560 024, Karnataka, India.*
ballalchandish@gmail.com; https://orcid.org/0000-0003-4968-8742

Abstract

A new species of flower bug, ***Anthocoris rajai* new species**, is described from Karnataka State, southern India. The new species is associated with leaf margin roll galls on *Ficus benghalensis* Linnaeus (Moraceae) made by its assumed prey *Gynaikothrips* sp. (Thysanoptera: Phlaeothripidae) or psyllids (Hemiptera: Sternorrhyncha: Psyllidae). The new species is distinct from other congeners by the yellowish-brown to darker reddish-brown dorsum with whitish or subhyaline markings on clavus, endocorium, and membrane; the long labium just reaching the middle of the mesosternum; and the abdominal sternum without a pair of membranous areas. Relationships within the genus *Anthocoris* Fallén and their association with gall-forming insects are discussed. A key to Indian species of the genus is also provided.

Key words: Heteroptera, Anthocoridae, *Anthocoris*, new species, *Ficus*, leaf rolling galls, India

Introduction

The flower bug genus *Anthocoris* Fallén, 1814 (Heteroptera: Anthocoridae: Anthocorini) comprises more than 80 species worldwide (e.g., Henry 1988; Cassis and Gross 1995; Péricart 1996; Bu and Zheng 2001; Carpintero 2002; Yamada et al. 2010a; Lewis and Horton 2012; Aukema et al. 2013; Moulet et al. 2017, 2018; Yamada and Yasunaga 2021; Tang et al. 2025). Most species occur in the Holarctic Region, with Asia being particularly diverse. China, for example, currently has 47 recorded species (Bu and Zheng 2001, Tang et al. 2025).

Despite the increasing knowledge of *Anthocoris* species in Asia, the fauna of the genus in the Indian subcontinent remains poorly documented. To date, eight species have been recorded from India (Ballal et al. 2018), a number that remains relatively low compared with those reported from adjacent regions, such as China, particularly in the Himalayan region (Bu and Zheng 2001). Moreover, studies on Indian Anthocoridae have focused mainly on economically important species associated with agricultural pests, and information on their overall diversity, distribution, and biology remains fragmentary. In particular, species associated with gall-forming insects on woody plants have rarely been documented from the region (e.g., Yamada et al. 2011, Yasunaga et al. 2015).

Recent field investigations in agroecosystems conducted by the ICAR-National Bureau of Agricultural Insect Resources (ICAR-NBAIR) yielded several anthocorid specimens collected from leaf-rolling galls on *Ficus benghalensis* L. (Moraceae) induced by *Gynaikothrips* sp. (Thysanoptera: Phlaeothripidae) or psyllids (Hemiptera: Sternorrhyncha: Psyllidae) in Karnataka, southern India. Detailed examination revealed that these specimens represent an undescribed species of *Anthocoris*. The discovery of this species not only increases the known diversity of the genus in India but also provides new information on its ecological association with thrips or other insects that induced galls on woody plants.

In the present paper, we describe this new species of *Anthocoris* from southern India. Diagnostic characters, illustrations of the male and female genitalia, and a key to the Indian species of *Anthocoris* are provided. Relationships of this new species within the genus and its association with gall-forming insects are discussed.

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Materials and methods

All specimens were killed and preserved in 70–80% ethyl alcohol just after collecting. They were then dried and mounted for examination. Examinations of external characters and genitalia were performed using a binocular microscope (Stereoscopic Zoom Microscope SMZ1500; Nikon, Tokyo, Japan). Male genitalia were dissected after maceration in hot 5% potassium hydroxide solution until the organs became transparent. Female genitalia were dissected after being heated in hot 1% potassium hydroxide solution, following the method of Ke and Bu (2007). These genital structures were dissected with micro-pins in glycerin on a well-glass slide under a binocular microscope (Stereoscopic Zoom Microscope SMZ1500; Nikon). Photographs (Figs. 1–4) were taken using a digital camera (EOS 70D; Canon, Tokyo, Japan) equipped with an extreme macro lens (MP-E 65 mm F2.8 1–5×; Canon) and a flashlight (Speedlite 430EX III-RT; Canon). Line drawings (Figs. 5–10) were created principally with the aid of an eyepiece grid. The photographs were combined using an auto montage software, Zerene Stacker (Zerene Systems LLC, Washington, USA). All digital images were edited and assembled using Adobe Photoshop CC 2025 (Adobe Inc., California, USA). All measurements are presented in millimeters. Terminology generally follows Bu and Zheng (2001) and Yamada et al. (2010a) for external morphology and Horton and Lewis (2011) for genital structures.

Type specimens are deposited in the ICAR-National Bureau of Agricultural Insect Resources (ICAR-NBAIR), Bangalore, India.

Taxonomy

Anthocoris rajai Yamada and Ballal, new species

https://zoobank.org/urn:lsid:zoobank.org:act:E6A36A81-6431-4F20-834D-207357497EEF
(Figs. 1–11)

Type material. Holotype ♀ (Figs. 3, 4), 'INDIA: Karnataka, \ Bangalore, Yelahanka, \ X 2015, on *Ficus benghalensis*' [white square] (ICAR-NBAIR). **Paratypes**. INDIA: 3♂♂ (one in Figs. 1, 2, one in Figs. 6–9) 5♀♀ (one in Fig. 5, 10), same data as for holotype (ICAR-NBAIR); 2♂♂ 2♀♀, Karnataka, Bangalore, Hebbal, 14.iii.2014, on *Ficus benghalensis* (ICAR-NBAIR); 1♀, Karnataka, Bangalore, Hebbal, iii.2012, associated with leaf rolling gall on *Ficus benghalensis* (ICAR-NBAIR).

Differential diagnosis. Distinguished from all other known congeneric species by the following combination of characters: Body slender, strongly shiny, sparsely covered with suberect, simple, yellowish setae; body coloration yellowish brown to darker reddish brown; clavus of hemelytron mostly whitish or subhyaline, with basally yellowish brown and distally darker reddish brown to nearly fuscous; endocorium darker reddish brown on basal one-third, yellowish brown or subhyaline on median portion, and fuscous distally; cuneus wholly fuscous; labium long, just reaching middle of mesosternum; supracoxal area of metapleuron present, not close to ostiolar peritreme; and abdominal sternum without a pair of membranous areas.

Description. ***Coloration.*** Body yellowish brown to darker reddish brown on dorsum (Figs. 1–4, 11). Head darker reddish brown; eyes reddish brown to fuscous; ocellus red to reddish brown (Figs. 1–4). Antennal segment I and II yellowish brown; segment III fuscous on apical half to two-thirds, yellowish brown basally; segment IV entirely fuscous (Figs. 1–4). Labium fuscous to darker reddish brown, sometimes tinged with light brown on segment I and II (Figs. 2, 4). Pronotum darker reddish brown, nearly fuscous on posterior lobe (Figs. 1, 3). Scutellum darker reddish brown, nearly fuscous distally (Figs. 1, 3). Clavus mostly whitish or subhyaline, with basally yellowish brown and distally darker reddish brown to nearly fuscous; endocorium darker reddish brown on basal one-thirds, yellowish brown or subhyaline on median portion, and fuscous distally; embolium darker reddish brown on basal half, yellowish brown or subhyaline on distal half; cuneus wholly fuscous; membrane smoky brown, with basal and innermost portions and area behind apex of cuneus whitish or subhyaline (Figs. 1, 3). Legs yellowish brown to reddish brown; hind femora tinged with fuscous at apex; tibiae fuscous tinge, with yellowish brown at base (Figs. 2, 4). Venter of thorax darker reddish brown (Figs. 2, 4). Abdomen darker reddish brown to nearly fuscous, basally with pale yellow or yellowish brown (Figs. 2, 4).

FIGURES 1–4. *Anthocoris rajai* **n. sp.** 1, 2, Paratype, male. 1, Dorsal view. 2, Lateral view. 3, 4, Holotype, female. 3, Dorsal view. 4, Lateral view. Scale bars = 1.0 mm.

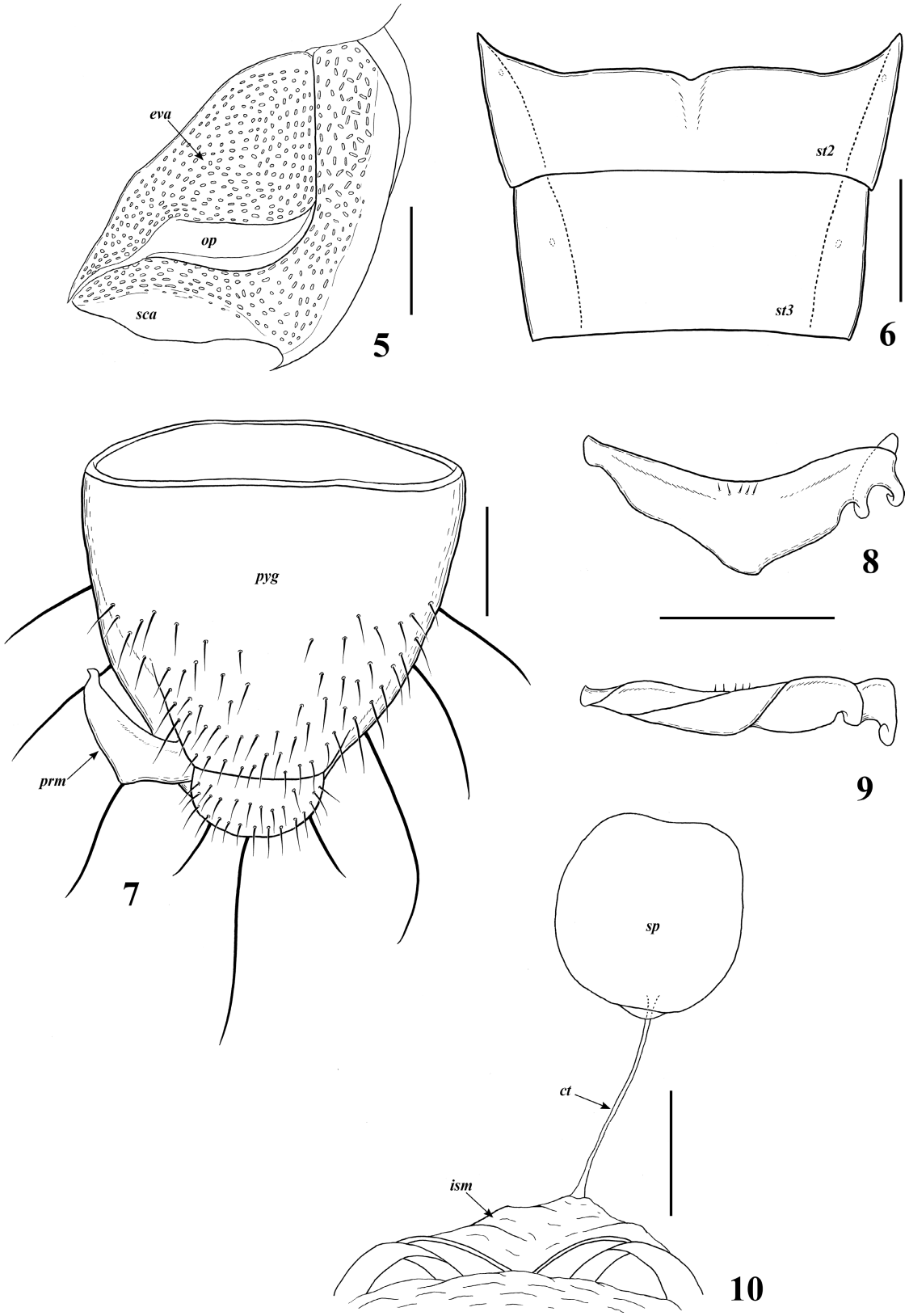
Structure. Body slender, strongly shiny on dorsal and ventral surfaces, sparsely covered with suberect, simple, yellowish setae (Figs. 1, 3). Head cylindrical, impunctate, length (excluding neck) a little shorter than width across eyes; three pairs of long, stout, erect seta on the dorsal surface of the head, one on anterior clypeus, one in front of eye, and one behind ocellus; anteocular region approximately as long as length of eye in dorsal view in male, much longer than length of eye in female; vertex approximately twice as wide as eye in dorsal view in male, approximately 3.4 times as wide as eye in female; postocular region constricted, demarcated by transverse shallow furrow; neck long, smooth, highly polished; eye oblong, male bigger than female, not exceeding level of dorsal and ventral surfaces of head in lateral view (Figs. 1, 3). Antennae densely covered with short, decumbent, yellowish setae interspersed with long, erect setae, of which the longest are as long as or slightly shorter than width of corresponding segment; segment I just reaching apex of head in male, not reaching apex of head in female, sparsely covered with short setae; segment II gradually thickened toward apex, slightly thicker in the male than in the female, approximately 0.9 times as long as head width across eyes; segment III approximately 0.7 times as long as segment II; segment IV approximately 1.1 times as long as segment III. Labium just reaching middle of mesosternum; segment III approximately 2.5–2.7 times as long as segment II; segment IV approximately half as long as segment III (Figs. 2, 4).

Pronotum with pairs of long, stout, erect seta on midline of collar and on each anterior and posterior angle; anterior margin slightly concave, 0.75–0.77 times as long as mesal length; lateral margin very slightly curved; lateral carina slightly expanded anteriorly, more obscure posteriad; posterior margin strongly concave inwardly, 2.2–2.3 times as wide as anterior margin; collar long, transversely rugose, sparsely with long setae; callus extremely swollen, polished, impunctate, sides strongly bulging, demarcated posteriorly by deep transverse impression; deep impression with short parallel carinae and coarse punctures; posterior lobe behind callus sparsely covered with long, yellowish setae (Figs. 1, 3). Scutellum smooth, sub-equilateral, wider at base than long, depressed through middle, with a long, stout, erect seta near basal angle (Figs. 1, 3). Hemelytron sparsely covered with long, yellowish setae; costal margin slightly sinuate; endocorium approximately 1.6 times as wide as maximum width of embolium; cuneal margin approximately 0.9 times as long as embolial margin; membrane with three veins, outermost vein distinct and basally curved, inner two veins indistinct and very slightly curved. Ostiolar peritreme wide, gently curved anteriorly, gradually narrowing toward apex and then continued by a fine carina that reaches the anterior margin of metapleura; outer (posterior) margin of ostiolar peritreme not close to supracoxal area; supracoxal area wide (Fig. 5). Legs covered with setae of various lengths; forecoxae developed, approximately 0.6 times as long as and almost same width as forefemora; forefemora slightly thicker than midfemora, with a long erect setae near base of ventral surface; foretibiae thickened toward apex, densely covered with slender spines on apical half, bearing a short stout spine and a tibial comb at apex; midfemora with a long erect setae near base of ventral surface; midtibiae nearly straight, covered with setae of various lengths, longest setae approximately as long as width of midtibia, bearing slender spines on apical half, with a short stout spine and a tibial comb at apex; hind femora almost same width of forefemora, sparsely covered with short setae; hind tibiae nearly straight, covered almost entirely with setae of various lengths, longest setae approximately as long as width of hind tibia, bearing slender spines on apical half, with a short stout spine and a tibial comb at apex; fossula spongiosa present on apex of all tibiae, enlarged on foretibiae and small on mid and hind tibiae. Abdominal sternum without a pair of membranous areas; dorsal laterotergites not fused with mediotergites on abdominal segments II and III; side of abdomen reflexed dorsally (Fig. 6).

Male genitalia (Figs. 7–9): Pygophore conical, rather pointed apically, asymmetrical, covered with 7–9 long, stout setae intermixed with short, suberect setae along outer margin and on posteroventral surface, of which the longest are approximately half length of pygophore (Fig. 7); mid-dorsal surface hirsute with suberect setae; paramere lamellate, gently curved, medially broadened, approximately 3.6 times as long as maximum width, a little twisted, with a few very short setae at middle of dorsal surface, outer margin slightly protrude at middle, hooked at apex, with longitudinal groove in form of shallow depression (Figs. 8, 9).

Female genitalia (Fig. 10): Genital segments (segments VII to IX) laterally covered with long, stout setae, longest setae much longer than length of sternum VIII; copulatory tube fused on almost middle of intersegmental membrane between sterna VII and VIII, approximately 0.15 mm in length, very thin (Fig. 10); trunk of conductive tissue not pronounced (Fig. 10).

Measurements. [♂♂ (n = 3) / ♀♀ (n = 6), holotype in parentheses]. Body length 3.05–3.25 / 3.10–3.50 (3.50); head length (excl. neck) 0.45–0.46 / 0.45–0.49 (0.49); head width across eyes 0.48–0.51 / 0.41–0.49 (0.49); vertex width 0.25–0.26 / 0.26–0.29 (0.29); length of antennal segments I—0.15–0.18 / 0.14–0.16 (0.16), II—0.41–0.48 /



FIGURES 5–10. Morphological details of *Anthocoris rajai* **n. sp.** 5, Ostiolar peritreme and evaporatorium, female, left lateroventral view. 6, Abdominal sterna II–III (setae omitted), male, ventral view. 7, Pygophore with paramere (ejaculatory bulb omitted), dorsal view. 8, 9, Paramere, two different views. 10, Copulatory tube and sperm pouch, dorsal view. Abbreviations: **ct**—copulatory tube, **eva**—evaporatorium, **ism**—intersegmental membrane, **op**—ostiolar peritreme, **prm**—paramere, **pyg**—pygophore, **sca**—supracoxal area, **sp**—sperm pouch, **st2–3**—abdominal sternum II to III. Scale bars = 0.2 mm for 6, 0.1 mm for 5, 7–10.

FIGURE 11. Living individual of *Anthocoris rajai* **n. sp.**

0.37–0.44 (0.43), III—0.32–0.34 / 0.30–0.33 (0.33), and IV—0.35–0.38 / 0.35–0.39 (0.39); length of labial segments II—0.19–0.21 / 0.20–0.22 (0.21), III—0.51–0.54 / 0.51–0.56 (0.56), and IV—0.26–0.29 / 0.26–0.28 (0.27); anterior pronotal width 0.37–0.40 / 0.38–0.42 (0.42); mesal pronotal length 0.48–0.51 / 0.51–0.56 (0.56); basal pronotal width 0.85–0.91 / 0.79–0.99 (0.99); length of embolial margin 0.89–0.94 / 0.91–1.02 (0.99); length of cuneal margin 0.59–0.60 / 0.58–0.64 (0.64); maximum width across hemelytra 0.82–0.83 / 0.82–0.96 (0.96).

Etymology. Named in honor of late Mr. Raja Kola, who was a young insect collector in the second author's laboratory (ICAR-NBAIR, Bangalore, Karnataka, India) and actively collected anthocorid specimens from different host plants but regrettably left for his heavenly abode on 26th May 2019.

Distribution. Karnataka State, southern India.

Discussion

Relationships within closer Anthocoris-species groups

Ke and Bu (2007) proposed thirteen species groups in the genus *Anthocoris* based on the body form, color pattern of forewing, morphology of sternum II and III, and male and female genitalia, and partly retained previously proposed species groups by Hill (1957), Péricart (1972), and Bu and Zheng (2001). The general appearance of *A. rajai* **n. sp.** is similar to that of *miyamotoi* group, consisting of *A. dividens* Bu and Zheng, 2001, *A. miyamotoi* Hiura, 1959, and *A. muraleedharani* Yamada, 2010a, by sharing the following characters: body narrowly elongate; collar area relatively extensive and strongly swollen; paramere lamellate or sinuate; and copulatory tube attached to almost middle of intersegmental membrane between sterna VII and VIII, apical part of copulatory tube or its whole except basal part extremely thin. However, *A. rajai* **n. sp.** does not possess membranous areas on abdominal sternum and has a different coloration on hemelytra from *miyamotoi* group.

Furthermore, *A. rajai* **n. sp.** also resembles the species in *angustatus* group based on having a similar body shape, strongly swollen collar area, post-collar being depressed deeply, shiny hemelytra with relatively long, sparse

pubescence, and lamellate, curved paramere without longitudinal groove. But it is readily distinguished from them by the lacking membranous areas on abdominal sternum and medially broadened paramere.

In *miyamotoi* and *angustatus* groups, presumed to be closely related to *A. rajai* **n. sp.**, the absence of membranous areas on abdominal sternum observed in *A. rajai* **n. sp.** is a highly distinctive character. However, similar morphological features have been found in various other species groups (*albiger* group, *flavipes* group, *fulvipennis* group, *nemorum* group, *thibetanus* group), suggesting that this trait may have evolved independently across different lineages in the *Anthocoris* (Tang et al. 2025, 2026). Although *A. rajai* **n. sp.** cannot be confidently assigned to any currently recognized species group, it appears to show a closer affinity to the *miyamotoi* group, sharing several morphological features with members of that group except for the absence of the abdominal membranous areas.

Anthocoris rajai **n. sp.** is most similar in the lamellate and medially broadened male paramere to *A. muraleedharani* from India and *A. dividens* from China, but distinguished from *A. muraleedharani* by the inner margin gently curved (in *A. muraleedharani*, nearly straight and weakly convex on subapical portion, see Yamada et al. 2010a, Fig. 8) and the length being approximately 3.6 times as long as maximum width (in *A. muraleedharani*, approximately 2.5 times as long as maximum width, see Yamada et al. 2010a, Fig. 8), and from *A. dividens* by the apically narrowed and hooked apex (in *A. dividens*, acute toward apex and without an apical hook, see Bu and Zheng 2001, Fig. 219) and a few very short setae present at middle of dorsal surface (in *A. dividens*, absent or not confirmed from illustration by Bu and Zheng 2001, Fig. 219).

Association of Anthocoridae with gall-forming insects

Some species of Anthocoridae exhibit a strong preference for gall-forming insects on *Ficus* trees. In particular, species of *Montandoniola* Poppius, 1909 are well-known predators of several tubuliferan thrips that produce leaf-margin curl galls. *Montandoniola* species stealthily invade these galls and reside within them as if they were members of the colony, selectively preying on the thrips, especially the soft-bodied nymphs. Adults of *Montandoniola* also resemble the resident thrips in both form and coloration, and similarly raise the abdominal tip dorsally (Yamada and Ballal, personal observations). *Montandoniola indica* Yamada, 2011 was observed to be an efficient predator of gall forming thrips, *Liothrips karnyi* (Bagnall, 1914) (Thysanoptera: Phlaeothripidae) infesting black pepper leaves in Kerala State, southern India (Yamada et al. 2011), and also recorded preying on *Gynaikothrips uzeli* (Zimmermann, 1900) infesting *Ficus retusa* L. in Karnataka State (Ballal et al. 2012).

Species of *Macrotrachelia* Reuter, 1871 and *Macrotracheliella* Champion, 1900 are also associated with ornamental fig (*Ficus*) trees; they invade leaf-curl galls induced by thrips or mealybugs and feed on their inhabitants (Paine 1992). *Cardiastethus rugicollis* Champion, 1900 has also been reported from *Ficus* galls induced by *Gynaikothrips ficorum* (Marchal, 1908) in Puerto Rico (Dozier 1926, Wolcott 1953). *Rajburicoris keralanu*s Yamada, 2010b was found within leaf-curl galls induced by the thrips *Liothrips karnyi* on black pepper leaves in Kerala State, southern India. However, the abundance of *R. keralanus* within the galls was markedly lower than that of *Montandoniola* sp., with only a few individuals being observed (Yamada et al. 2010b).

Several species of *Anthocoris* prey on aphids inhabiting plant galls (Anderson 1962, Valenti et al. 1996). *Anthocoris whitei* Reuter, 1884 and *A. bakeri* Poppius, 1913 are associated with manzanita on which they occur as predators in aphid galls (Anderson 1962, Valenti et al. 1996). *Anthocoris whitei* is also associated with psyllids on *Purshia* DC. ex Poir. and *Cercocarpus* Kunth species in Oregon and British Columbia (Anderson 1962, Valenti et al. 1996). *Anthocoris japonicus* Poppius, 1909 preys on *Paracolopha morrisoni* (Baker, 1919) on *Zelkova serrata* (Thunb.) Makino, and also utilizes abandoned galls produced by this aphid as temporary shelters (Miyamoto 1965). No records of association with thrips or other insects-induced *Ficus* galls have been reported so far; however, a possibly undescribed species of *Anthocoris* had been discovered on *Ficus* galls in southern India (Poorani and Yamada, unpublished data, see Yasunaga et al. 2015).

In the present study, this previously recognized but undescribed species is described as new to science. All specimens of the new species were collected from leaf-rolling galls induced by *Gynaikothrips* sp. (Thysanoptera: Phlaeothripidae) or jumping plant lice (Hemiptera: Sternorrhyncha: Psyllidae) on Indian Banyan, *Ficus benghalensis*. Inside the leaf margin roll galls, numerous individuals of *Gynaikothrips* sp. were observed, together with psyllids, mealybugs (*Pseudococcus* sp.), and scale insects (*Coccus formicarii* (Green, 1896)), ants, and mites. All of these insects are potential prey for this new species; however, the thrips and/or psyllids are considered the most likely prey in terms of population size.

The collecting sites were urbanized areas in Hebbal and Yelahanka, Bangalore, southern India, close to human settlements. Individuals were found in Hebbal in March and in the Yelahanka area in June and October. More numbers were collected in June, corresponding to the rainy season in Bangalore.

A key to the species of *Anthocoris* from India

1. Body narrowly elongate; collar area relatively extensive and strongly swollen; callus extremely swollen, sides strongly bulging, demarcated posteriorly by deep transverse impression; clavus and endocorium of hemelytron with whitish or subhyaline markings 2
- Body elongate-oval; collar area long but not swollen; callus moderately swollen, sides not bulging, demarcated posteriorly by weak transverse impression; clavus and endocorium of hemelytron without whitish or subhyaline markings. 3
2. Body black to blackish brown; labium short, slightly exceeding fore coxae (India: Karnataka) . . . . . ***A. muraleedharani* Yamada, 2010**
- Body yellowish brown to darker reddish brown; labium long, just reaching middle of mesosternum (India: Karnataka) . . . . . ***A. rajai* new species**
3. Pronotum yellowish brown to reddish brown, sometimes with fuscous tinge on posterior part (India: Himachal Pradesh; Europe, North Africa, Palaearctic). . . . . ***A. minki* Dohrn, 1860**
- Pronotum black to blackish brown. 4
4. Basal half of embolium distinctly light-colored, other areas of hemelytron dark brown to blackish brown. 5
- Embolium yellowish brown to reddish brown, inner portion dull and outer portion shiny 7
5. Antennal segments II and III pale brown; femora yellowish brown 6
- Antennal segments II and III black to blackish brown; femora black to blackish brown (India: West Bengal) . . . . . ***A. indicus* Poppius, 1909**
6. Femora with blackish brown annulation near apex (India: Himachal Pradesh). . . . . ***A. annulipes* Poppius, 1909**
- Femora without annulation (India: Himachal Pradesh; China) . . . . . ***A. dimorphus* Zheng, 1984**
7. Antennal segment III blackish brown; femora blackish brown 8
- Antennal segment III pale yellow with fuscous tinge at apex; femora yellowish brown (India: Jammu and Kashmir; Armenia, Kazakhstan, Kirgizia, Tajikistan, Iran, China) . . . . . ***A. flavipes* Reuter, 1884**
8. Antennal segment II pale brown or yellowish brown and darkened at base and apex; hemelytron more or less brown or reddish brown at base, a strip along the inner embolium dull or pruinose, the outer portion of the embolium shiny; membrane smoky dark brown, with three whitish markings (India: Himachal Pradesh; Holarctic Region) . . . . . ***A. confusus* Reuter, 1884**
- Antennal segment II blackish brown; hemelytron with clavus, endocorium, and embolium yellowish brown, and cuneus deep brown; membrane smoky dark brown, without whitish markings (India: Tamil Nadu) . . ***A. nilgiriensis* Muraleedharan, 1977**

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