

## Description of dealate of *Myrmecina urbanii* Tiwari (Hymenoptera: Formicidae) from Karnataka, India, with notes on worker castes

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### Abstract

The dealate of the myrmicine ant, *Myrmecina urbanii*, is described. The genus *Myrmecina* is known to show queen polymorphism, wherein wingless “intermorphs” which are morphologically intermediate between gynomorphs and worker castes are known to occur and lay eggs. *M. urbanii* is known from worker castes only. In the present study, few workers, which are intermediate between queen and worker castes, are also observed. Based on the external morphology and morphometric measurements, variations across the worker castes are also discussed in this study. The workers exhibited considerable variations, especially in the pattern of striations on their thorax and in their body size. The morphometric study of workers implies the presence of intercastes in this species, even though the ovarian status of none of the workers was examined.

**Keywords:** *Myrmecina*, dealate, worker, morphometry, intercastes.

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### Introduction

The genus *Myrmecina*, contains 53 extant species and one subspecies (<http://www.antweb.org>, dated 06/02/18). This leaf-litter ant is distributed throughout the Europe, northern Africa, from southern Canada to southern Mexico, India, Sri Lanka, Korea, Japan, Fiji, the Solomon Islands and Australia (Shattuck, 2009; Wong & Guenard, 2016).

Tiwari (1994) described two species of this genus, *M. urbanii*, and *M. vidyae* from Kerala, India, based on the worker caste. Later, Sunil *et al.* (1997), Varghese (2004), Narendra and Kumar (2006) reported the genus *Myrmecina* from Karnataka, again based on the worker caste. Saranya *et al.* (2013) reported *M. striata* from Periyar Tiger Reserve in South Western Ghats. Parui *et al.* (2015) reported *M. urbanii* from Orissa. A recent update of the ants of India by Bharti *et al.* (2016) reported 4 species of *Myrmecina* from India.

Even though the biology and colony structure of this genus are poorly understood, the following studies have investigated these areas: Kutter (1916), Ohkawara *et al.* (1993), Buschinger (2001, 2003, 2005), Murakami *et*

*al.* (2002), Huang *et al.* (2008) and Zhou *et al.* (2008).

Tsuji *et al.* (2001) reported uniclonality in *Myrmecina* species from Indonesia. Buschinger and Schreiber (2002) have described queen polymorphism in *M. graminicola* (Latreille) and Buschinger *et al.* (2003) reviewed the geographic distribution of queen polymorphism in *M. graminicola* (Latreille). The phylogeny and evolutionary history of queen polymorphism in the genus *Myrmecina* was studied by Steiner *et al.* (2006). Miyazaki *et al.* (2010) looked at the ergatoid queen development in *M. nipponica* Wheeler.

Studies by Plateaux (1970) showed that the dimensions of head, thorax and gaster of intercastes increased independently of one another in *Leptothorax nylanderii* (Forster). In the ant family Formicidae, the presence of intercastes and their occurrence was reported by Ohkawara *et al.* (1993); Düssmann *et al.* (1996); Kikuchi *et al.* (1999) and Molet *et al.* (2009; 2012). Few earlier studies have focused on the characteristics of intercastes in ants (Buschinger & Winter, 1975; Francoeur *et al.*, 1985; Peeters,

1991, 2012). The morphological variability of intercastes in *T. nylanderi* was studied by Okada *et al.* (2013).

In this study, the dealate of *Myrmecina urbanii* is described and notes on worker castes are provided. Even though, *M. urbanii* has appeared in distribution records and checklists, neither its different castes nor its biology is studied. Recently, while studying the ant fauna of the Indian Institute of Science campus, the present author has come across 2 dealates and few individuals belonging to the worker castes of *M. urbanii*, and perhaps some intermediate forms also. Since the reproductive caste of this species is not presently known, it is described here, along with morphometric measurements of worker castes and discussed the morphological variations within the worker castes. Based on the results of this study, presence of intercastes in *M. urbanii* is suggested here.

### Materials and Methods

All observations and measurements were taken using a WILD Stereo Zoom microscope. All specimens of *M. urbanii* were obtained from Winkler samples. Voucher specimens are deposited in the Insect Museum at the Centre for Ecological Sciences, Indian Institute of Science, Bangalore. The images of *M. urbanii* were taken by the SEM facility at SSCU, Indian Institute of Science.

The linear measurements and indices employed in this study are described below:

HL	Head length: Length of head from the posterior margin of the head to the anterior extremity of the clypeus
HW	Head width: Maximum width of head, including the eyes
EL	Eye length: Length of compound eye measured in the same view as HL
SL	Scape length: Length of the first antennal segment, excluding the radicle
ANTML	Antennomere length: Total length of funiculus
MSL	Mesosoma length: Maximum measurable length of mesosoma in dorsal view
MSW	Mesosoma width: Maximum measurable width of mesosoma in dorsal view
PTL	Petiole length: Maximum length of

	petiole, measured in dorsal view
PTW	Petiole width: Maximum width of petiole, measured in dorsal view
PTH	Petiole height: Maximum height of petiole, measured in profile
PPTL	Postpetiole length: Maximum length of postpetiole measured in dorsal view
PPTW	Postpetiole width: Maximum width of postpetiole measured in dorsal view
PPTH	Postpetiole height: Maximum height of postpetiole measured in profile
GL	Gaster length: Maximum length of gaster measured in dorsal view
GW	Gaster width: Maximum width of gaster measured in dorsal view
GH	Gaster height: Maximum height of gaster measured in profile
TL	Total length: Maximum measurable length in profile.
CI	Cephalic index: $HW/HL \times 100$
SI	Scape index: $SL/HW \times 100$
PTLI	Petiole length index: $PTH/PTL \times 100$
PTWI	Petiole width index: $PTW/PTL \times 100$
PPTLI	Postpetiole length index: $PPTH/PPTL \times 100$
PPTWI	Postpetiole width index: $PPTW/PPTL \times 100$
GLI	Gaster length index: $GL/HW \times 100$

### Genus *Myrmecina* Curtis

*Myrmecina* Curtis, 1829, **6**: 242 - 288: Type-species: *Myrmecina latreillii* (Junior synonym of *Formica graminicola* Latreille 1802), by monotypy.

**Worker Diagnosis:** Head with sharp longitudinal carinae on venterolateral margin of head; antennae 12 segmented with a well-formed 3 segmented club; antennal scrobes absent; petiole sessile and longer than broad with subpetiolar process; propodeum armed with long and curved spines.

*Myrmecina urbanii* Tiwari, 1994

*Myrmecina urbanii* Tiwari, 1994, **94** (2 - 4): 151 - 158 (ZSI)

**Worker Diagnosis:** As specified by Tiwari (1994), *M. urbanii* workers are characterized by deep striations on head, mesosoma and petiole, with a characteristic “Y” appearance on thorax.

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Other characters are: antennae 12 segmented with 3 segmented club; basal funicular segments broader than long, apical 3 segments much longer than other segments. Small teeth on antero-lateral corners of pronotum and metanotum; propodeal spines long, thick and curved upwards; petiole longer than broad with a distinct subpetiolar process.

**Dealate:** (Plate 1, Figs. 1 – 4; Table 1) Head slightly broader than long (CI 104) with lateral margin almost straight, posterior corners rounded and broadly emarginated at middle; mandibles large and convex, masticatory margin with 10 blunt and broadly worn teeth spaced at regular intervals; palp formula 3:2; clypeus narrow, broadly concave in the middle and more or less transverse apically with ridges or carinae laterally; frontal area not well differentiated, frontal lobes partially covering the antennal sockets, antennal scrobes absent; antennae with 12 segments, with 3 segmented club; scape long, slightly curved in the middle, funicular segments 1 - 8 broader than long, 9 - 11 longer than broad, the apical segments longer than the preceding 2 segments put together; eyes small, (larger compared to that of workers, EL 0.04mm in workers), convex and projects partially outside the margin of head; eyes surrounded by a pale area and located laterally below the mid-length of the head; ocelli present on vertex; mesosoma broad, gibbous, not wider than head, much wider and longer than that in worker, pronotum broader than long, humeral angles rounded, promeso and meso-metanotal sutures distinct dorsally and laterally, metanotum distinct, slightly produced backwards, rounded posteriorly, propodeum armed with a pair of long, stout spines, directed backwards; petiole sessile, first node as long as broad, flat dorsally with almost straight lateral margins, postpetiole as long as the first node, 1.28x broader than long, rounded dorsally and laterally with a well formed subpetiolar process; legs short and thick; gaster broadly oval, 1.17x longer than broad, first tergite comprises  $\frac{3}{4}$ <sup>th</sup> gaster length, lateral angle of first gastral tergite projects forward; dorsum more or less rounded.

Head, thorax and postpetiole coarsely striated, dorsum of petiole finely striated, head

and thorax longitudinally striated, while pronotum transversely striated, the striations on thorax do not converge in a “Y” shape as in workers (in workers, striations on thorax are transverse) mandibles, clypeus and gaster smooth.

Pilosity long, abundant, with a few long and straight setae at the anterior margin of clypeus, pubescence moderate.

Head, part of thorax and gaster dark ferruginous, mesonotum and petiole little lighter shade, mandibles, clypeus, antennae, tip of the first gastral tergite and the remaining tergites reddish yellow and legs paler.

**Measurements:** TL 4.40, HW 1.00, HL 0.96, EL 0.10, SL 0.76, ANTML 1.20, MSL 1.16, MSW 0.80, PTL 0.28, PTW 0.28, PTH 0.28, PPTL 0.28, PPTW 0.36, PPTH 0.32, GL 1.44, GW 1.12, GH 0.80, CI 104, SI 76, PTLI 100, PTWI 100, PPTLI 114, PPTWI 128, GLI 144.

**Materials Examined:** 2 dealates; INDIA: Karnataka: Bangalore (13° 01'N 77° 34'E): Malleswaram: Indian Institute of Science Campus: 21.xii.2009, Coll. Thresiamma Varghese, Centre for Ecological Sciences (Collected by Winkler method) (One specimen prepared for SEM studies is not included in the morphometry studies).

**Details of worker castes examined:** 3 Workers: Same data as dealates: INDIA: Karnataka: Bangalore (13° 01'N 77° 34'E): Malleswaram: Indian Institute of Science Campus: 4.xii.2009, Coll. Thresiamma Varghese. 4 workers, same locality, except the date of collection, 21.xii.2009.

**Notes on worker castes** (Plate 2. Figs. 1-5; Plate 3. Figs. 1-6)

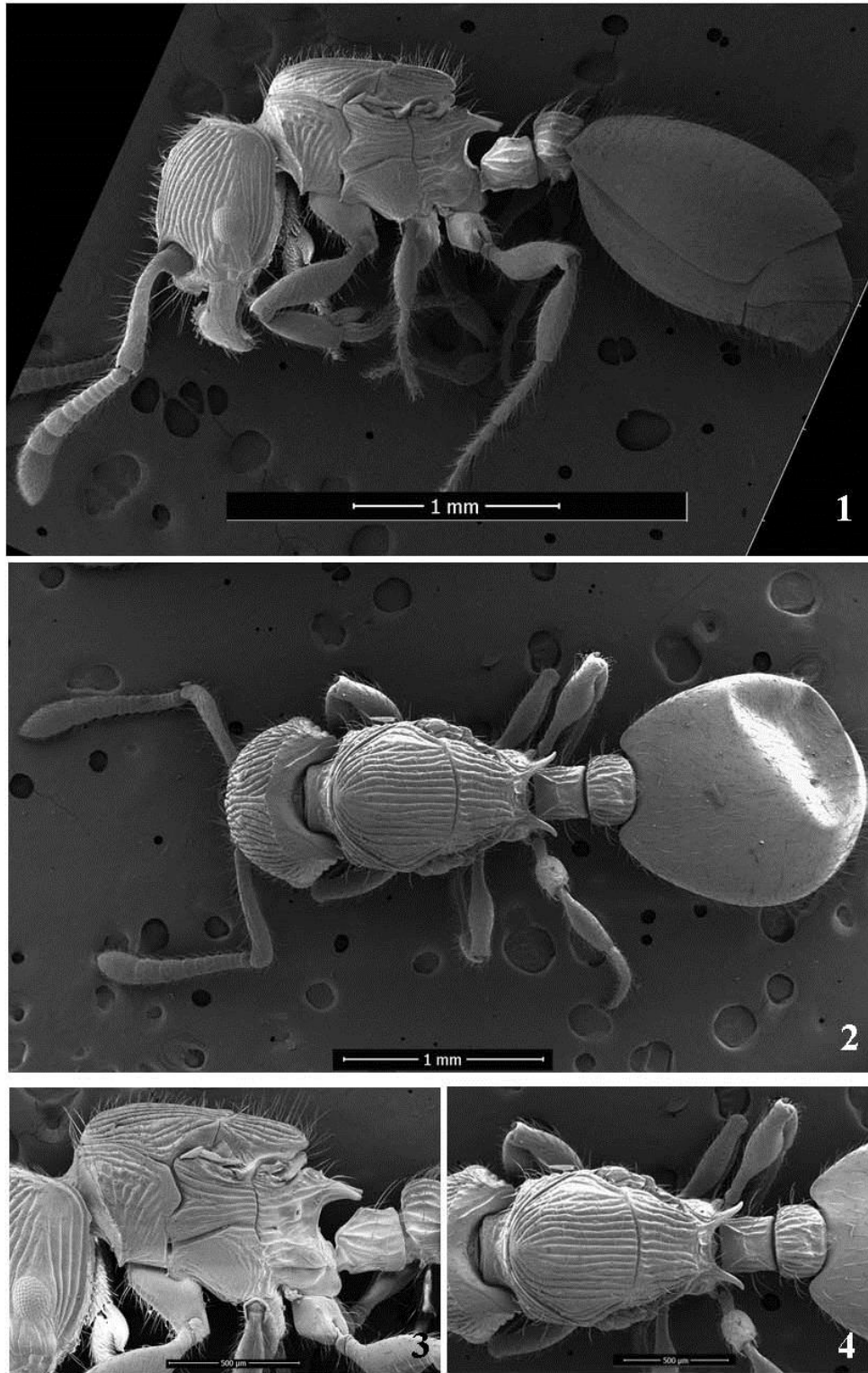
The description of *M. urbanii* Tiwari, 1994 was based on two worker specimens, whose body lengths were 3.20mm, 3.40mm, with a head width of 0.73 and 0.75mm respectively. The present study shows that the total length of worker specimens varied from 2.96 - 4.20mm, with a head width of 0.72 - 1.00mm (N = 7). The morphometric values of these workers are provided in Table 1.

**Table 1. The morphometric values of the dealate and the workers of *M. urbanii***

<b>Parameters</b>	<b>Dealate</b>	<b>W*1</b>	<b>W2</b>	<b>W3</b>	<b>W4</b>	<b>W5</b>	<b>W6</b>	<b>W7</b>
<b>TL</b>	4.40	3.60	3.52	3.56	3.04	2.96	3.80	4.20
<b>HL</b>	0.96	0.80	0.84	0.84	0.76	0.72	0.88	1.00
<b>HW</b>	1.00	0.80	0.80	0.80	0.76	0.72	0.92	1.00
<b>EL</b>	0.10	0.04	0.04	0.04	0.04	0.04	0.04	0.04
<b>SL</b>	0.76	0.72	0.76	0.80	0.68	0.64	0.76	0.80
<b>ANTML</b>	1.20	0.92	0.96	0.92	0.92	0.80	1.00	1.00
<b>MSL</b>	1.16	0.84	0.88	0.92	0.88	0.76	0.96	1.00
<b>MSW</b>	0.80	0.60	0.64	0.60	0.52	0.52	0.64	0.68
<b>PTL</b>	0.28	0.28	0.28	0.28	0.24	0.20	0.28	0.28
<b>PTW</b>	0.28	0.20	0.24	0.24	0.20	0.20	0.24	0.32
<b>PTH</b>	0.28	0.20	0.20	0.20	0.20	0.20	0.24	0.28
<b>PPTL</b>	0.28	0.24	0.24	0.24	0.20	0.20	0.24	0.28
<b>PPTW</b>	0.36	0.28	0.28	0.28	0.28	0.24	0.32	0.36
<b>PPTH</b>	0.32	0.24	0.28	0.28	0.28	0.24	0.28	0.32
<b>GL</b>	1.44	1.12	1.12	1.20	1.12	0.96	1.24	1.36
<b>GW</b>	1.12	0.84	0.88	0.88	0.84	0.88	0.92	1.08
<b>GH</b>	0.80	0.68	0.68	0.72	0.60	0.56	0.72	0.80
<b>CI</b>	104	100	95	95	100	100	104	100
<b>SI</b>	76	90	95	100	89	88	82	80
<b>PTL1</b>	100	71	71	71	83	100	85	100
<b>PTWI</b>	100	71	85	85	83	100	85	114
<b>PPTLI</b>	114	100	116	116	140	120	116	114
<b>PPTWI</b>	128	116	116	116	140	120	133	128
<b>GLI</b>	144	140	140	150	147	133	134	136

\*Note: W1 - W7 (Workers 1 – 7) (All values are in millimeters)

**Plate 1**



**Plate 1. Figures 1-4. *M. urbanii*, dealate: 1. Profile of *M. urbanii*; 2. Dorsal view of *M. urbanii*; 3. & 4. Mesosoma, profile and dorsal view of *M. urbanii*.**

Plate 2

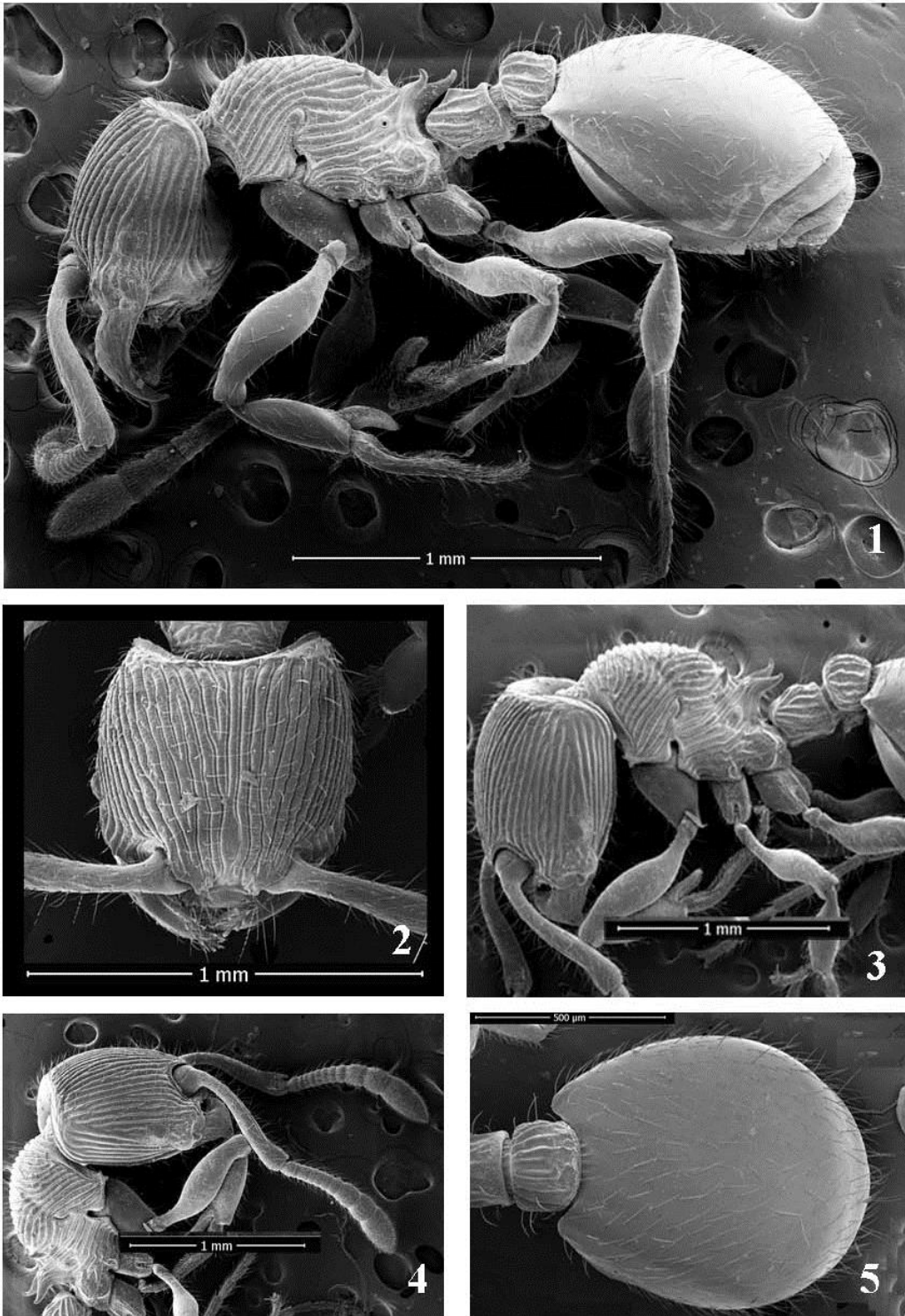


Plate 2. Figures 1–5. *M. urbanii* worker caste: 1. Profile of *M. urbanii*; 2. Head, frontal view; 3. Mesosoma, profile; 4. Antennae; 5. Gaster, dorsal view.

Plate 3

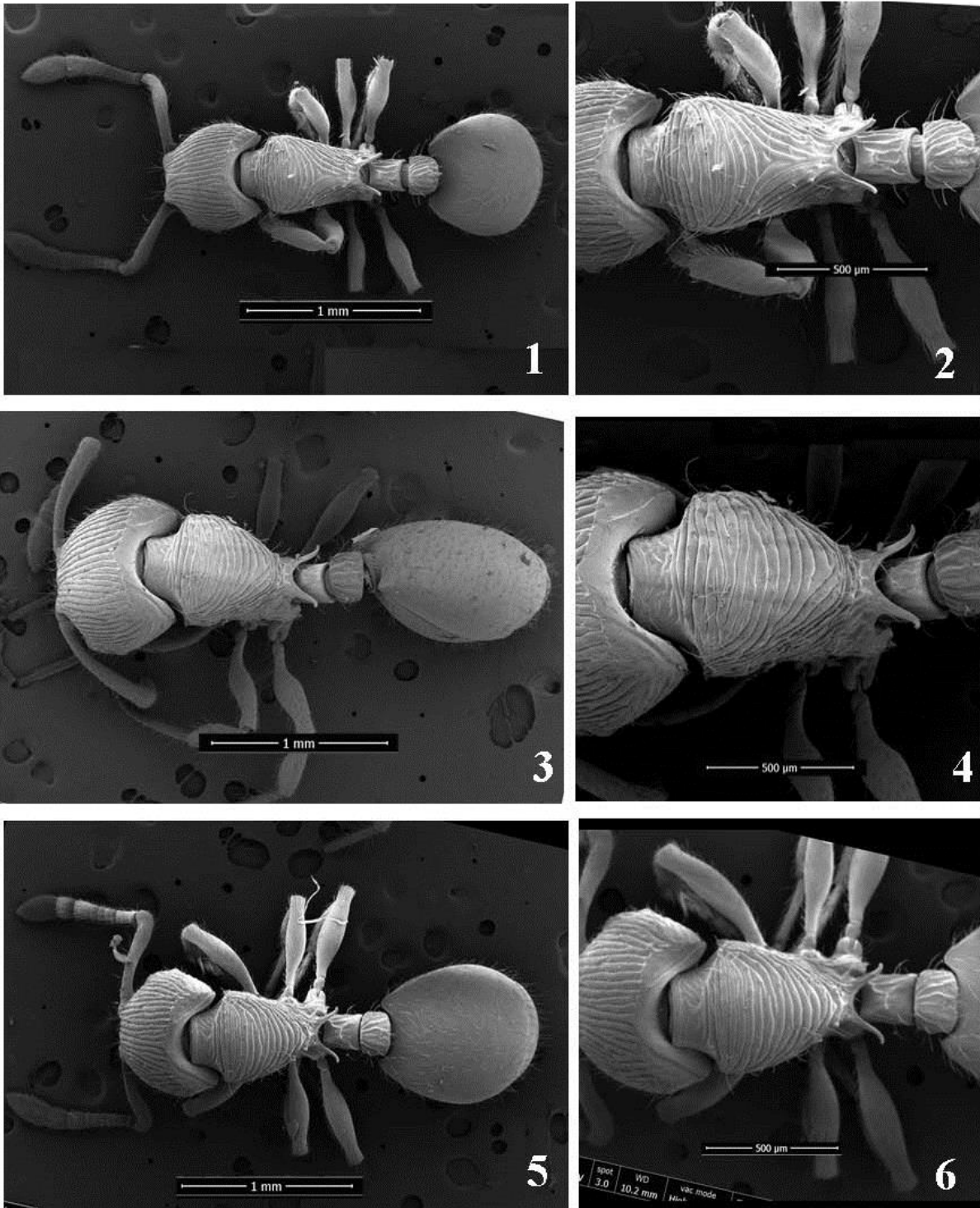
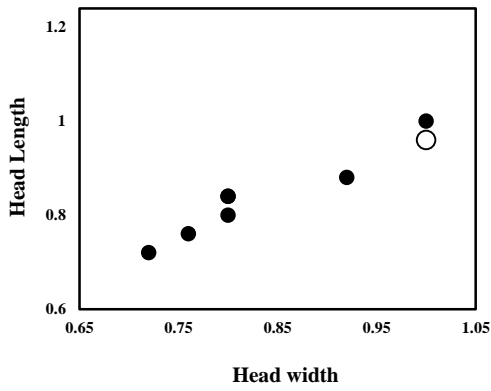
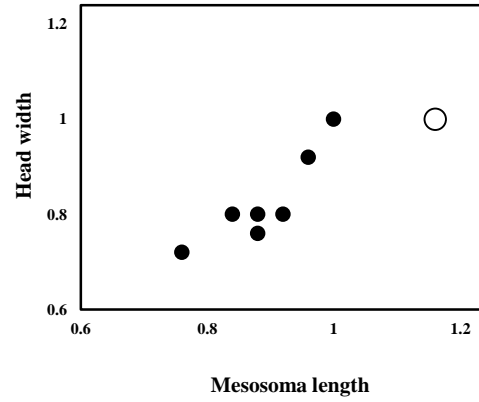


Plate 3. Figures 1-6. *M. urbanii* workers of different sizes: 1. & 2. Small worker, dorsal view. 3. & 4. Medium size worker, dorsal view. 5. & 6. Larger worker, dorsal view.

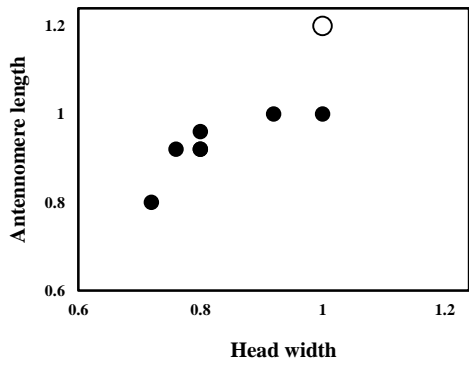
Plate 4



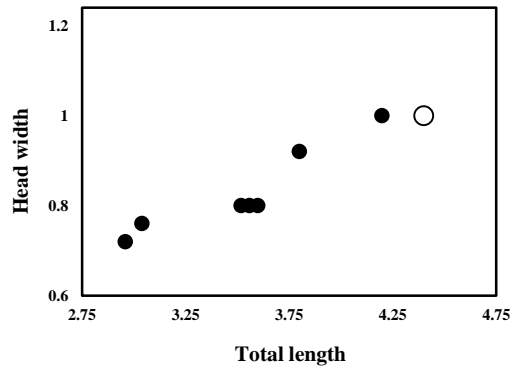
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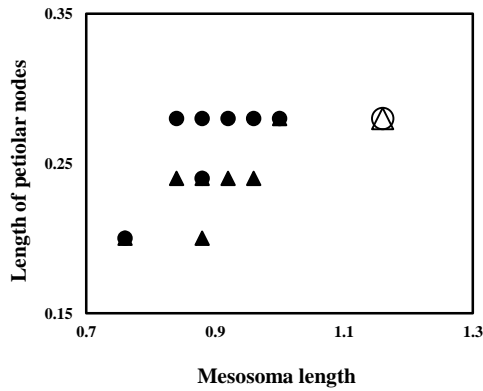
2



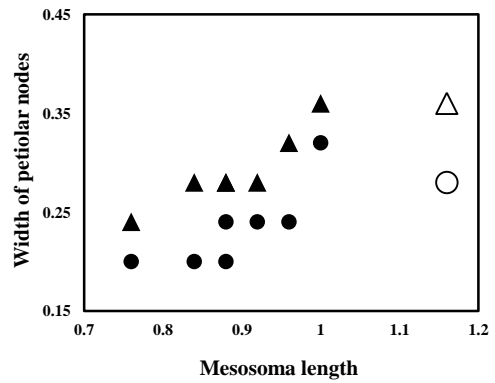
3



4



5

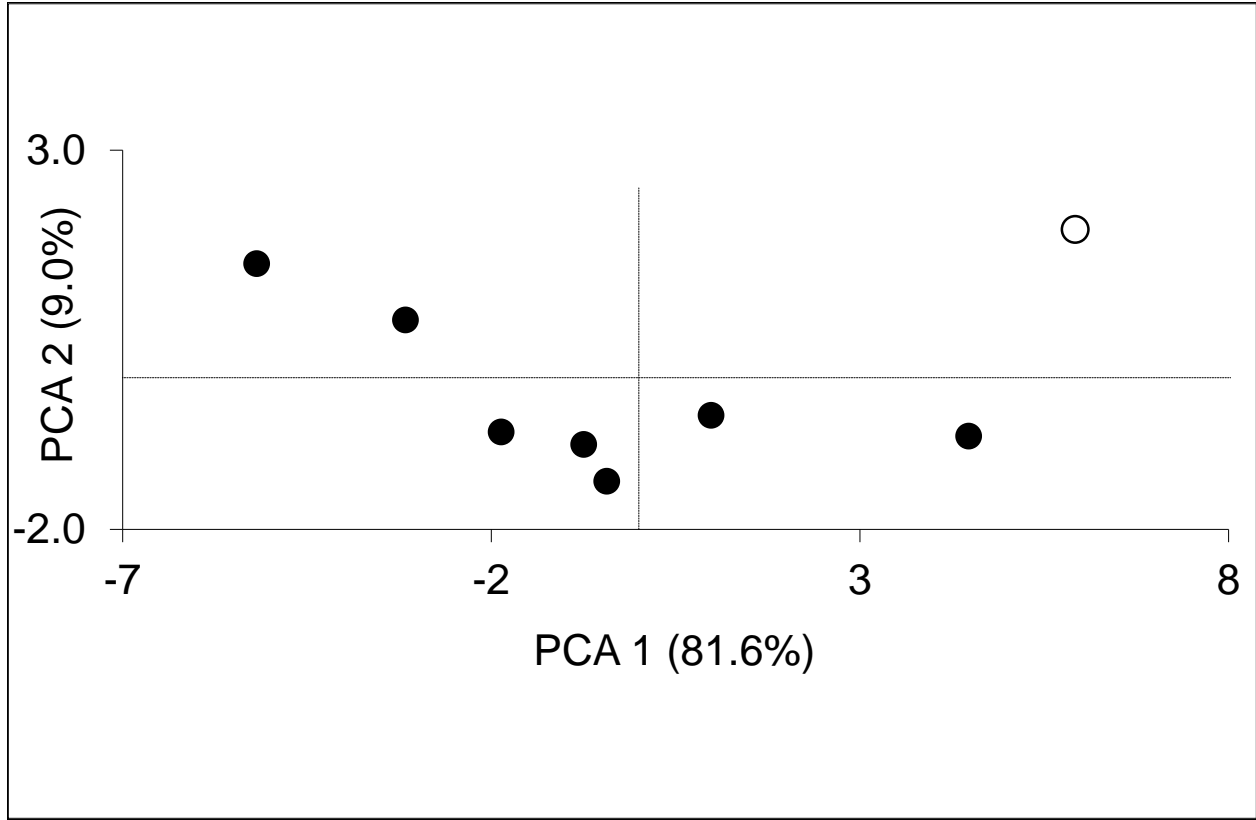


6

**Plate 4. Figures 1–6.** Bivariate plots of various morphometric measurements of *M. urbanii* dealate and workers. **1.** Head length versus head width. **2.** Head width versus mesosoma length. **3.** Antennomere length versus head width. **4.** Head width versus total length. **5.** Length of petiolar segments versus mesosoma length. **6.** Width of petiolar segments versus mesosoma length (Open bullets denote dealate and closed ones denote workers).



**Plate 5**



**Plate 5.** Principal Component analysis of various body parameters of *Myrmecina urbanii* dealate and workers (Open bullets denote dealate and closed ones denote workers).

Morphometric values of different parameters show extensive variations across worker castes. One of the workers seems to be very close to the dealate in many of the body parameters (Plate 4 and 5). As shown in Table 1, the highest value for the above parameters and other parameters in some worker castes are very similar to those of dealates. Additionally, there are two specimens (W4 and W5 in Table 1), which are smaller in measurements than that of earlier specimens. The morphometric values of those two specimens are lesser than that of the smaller specimens in the earlier report by Tiwari (1994) (Table 1). More samples from different colonies and all individuals of at least a few colonies will be needed to fully understand the colony structure in this ant species.

**Distribution and Biology:** This genus and species was described from India, Kerala,

Thekkady, for the first time by Tiwari (1994). Sunil *et al.* (1997), Narendra & Kumar (2006) and Varghese (2004) reported this species in Bangalore, Karnataka. Later studies by Saranya *et al.* (2013), Parui *et al.* (2015) and Bharti *et al.* (2016) reported this species from Periyar, Orissa and Tamil Nadu respectively. Further observations by this author revealed that this species nests in leaf litter. It forages individually and has the ability to hide swiftly among the leaf litter.

**Discussions**

Considering the existence of queen polymorphism and intercastes (Kutter, 1977; Ohkawara *et al.*, 1993; Murakami *et al.*, 2002; Buschinger and Schreiber, 2002; Buschinger *et al.*, 2003; Steiner *et al.*, 2006; Okada *et al.*, 2013) in many species of *Myrmecina* and other genera, it is reasonable to assume that their

might exist an intercaste in *M. urbanii* as well. Since the ovarian status of *M. urbanii* individuals was not studied, individuals have not been classified formally into workers and intercastes, though the presence of an intercaste is suspected, as indicated by their morphology and by their morphometric values. Even though some of these forms are very similar to dealates (in many parameters), none of them possessed ocelli. The study by Ohkawara *et al.* (1993) reported that most of the medium intercastes and all major intercastes of *M. graminicola nipponica*, possessed one ocelli and well developed ovarioles, while the minor intercastes lack ocelli, but possessed a spermatheca. The striations, especially on the mesosoma clearly vary across the different size forms and are as seen in figures from 1-6 in Plate 3. The “Y” pattern is almost missing in larger bodied individuals and the mesonotum tends to differentiate from pronotum, suggesting a similar pattern of clear differentiation of mesonotum, as observed in major intercastes, alates and queen of *M. graminicola nipponica*.

Without a detailed study of individuals from different colonies, including morphometric measurements and dissections to check for the ovarian status, it is difficult to conclude whether these inter-individual variations are caused by the presence of intercastes, worker or queen polymorphism. The morphometric measurements do not indicate any allometric growth causing soldier castes, which rules out the possibility of any soldier caste in this species. On the contrary, the presence of at least 2 individuals, which are almost as large as dealate in body length and gaster length, and few individuals intermediate between these individuals and the typical worker form, might be indicating an “intercaste” in this species.

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