

Ant floral visitation and evidence for ant-mediated pollination in Indian flora- A review

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Abstract

Ants, traditionally recognized as biotic plant defences, also contribute significantly to the pollination of certain plant species. This review synthesizes Indian records of flower visiting ants and evaluates the strength of evidence for ant mediated pollination. In India, 20 ant taxa representing five subfamilies have been documented as floral visitors and pollinators of 44 plant taxa across 22 families. The subfamily Formicinae is the most diverse subfamily, with eight taxa, followed by Myrmicinae with seven taxa, Pseudomyrmecinae and Dolichoderinae with two taxa each, and Ponerinae with one. Host plant associations reveal that tree flowers are the most frequently visited, compared to those of herbs, climbers, and shrubs. Among the 44 plant taxa, *Brassica juncea* attracted the highest number of ant visitors (seven taxa). At the family level, Brassicaceae (seven ant taxa) was the most frequently visited plant family in India, followed by Cucurbitaceae, Fabaceae, Primulaceae, Rosaceae and Sapindaceae (four ant taxa each). Keywords: Ants, floral visitors, pollinators, pollination, Plants-ant interaction, India.

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Introduction

Ants (Insecta: Hymenoptera: Formicidae) are highly diverse and abundant insects distributed in almost all terrestrial habitats. They play important ecological roles, including soil aeration, nutrient cycling, seed dispersal, predation, and mutualistic interactions with plants. These ant-plant interactions have a long evolutionary history, spanning a continuum from mutualism to antagonism (de Vega & Gómez, 2014) ^[17]. Since Janzen's epoch-making studies (1966, 1977) ^[30, 31] on the role of ants as biotic plant defences, numerous investigations have demonstrated that ants reduce herbivory rates (Bruna *et al.*, 2004 ^[9]; Del-Claro *et al.*, 2006), herbivore abundance (Letourneau & Barbosa, 1999) ^[39], and species richness (Crutsinger & Sanders, 2005) ^[14].

Beyond their well-recognized role as biotic plant defences, ants also interact extensively with flowers. Historically, such visitation has often been regarded as detrimental, with ants frequently labelled as classical nectar thieves (Rostás & Tautz, 2011) ^[54]. Several objections have been raised against their potential role as pollinators. Some authors argue that the small body size of ants limits effective pollen transfer to the stigma (Armstrong, 1979; Inouye, 1980) ^[3, 28], while others emphasize that their smooth integument reduces pollen adhesion (Armstrong, 1979) ^[3]. Furthermore, because worker ants are wingless, they are considered incapable of dispersing pollen between flowers (Proctor & Yeo, 1973) ^[51]. In addition, the presence of metapleural glands, which secrete antibiotic compounds that protect ants against pathogenic microorganisms, has been suggested to render pollen unviable and thus unsuitable for pollination (Yek & Mueller, 2011) ^[69]. Lastly, their frequent grooming works against their role as pollinators (Faegri and van der Pijl, 1979) ^[23].

Pollination is the best-studied mutualistic interaction between insects and higher plants. Though ant pollination has historically received far less attention than other pollination syndromes, including melittophily (bee pollination), myophily (fly pollination), psychophily (butterfly pollination), phalaenophily (moth pollination), and cantharophily (beetle pollination) in India.

However, an increasing body of research highlights the potential positive contributions of ants, necessitating a re-evaluation of earlier generalizations (de Vega & Gómez, 2014) ^[17]. Accordingly, the present review aims to: (i) document Indian ant taxa recorded as floral visitors, (ii) harmonize their host-plant associations and taxonomic status, and (iii) evaluate ant preferences for floral traits such as colour and fragrance.

Floral Traits for Ant Pollination

In 1974, James C. Hickman provided the first detailed description of ant pollination, outlining what he termed the "syndrome" of ant pollination, the suite of traits that plants adapted to pollination by ants are expected to possess. According to his study, such plants are typically prostrate or small in stature, with limited synchrony in flowering within individual plants, thereby encouraging movement of ants between different individuals. They often occur in dense populations, reducing the likelihood of ants returning to the ground after visiting flowers. The flowers themselves are generally small, open, and sessile, with nectaries accessible to short-tongued insects and producing only limited amounts of nectar. In addition, they usually contain few ovules and relatively little pollen. Finally, ant-pollinated plants are most likely to occur in habitats characterized by high ant activity, such as hot, dry environments, as well as arid, semi-alpine, and alpine regions (de Vega & Gómez, 2014) ^[17].

Taxonomic Diversity of Flower-Visiting Ants and Ant Pollinators in India

Of the ten ant subfamilies reported from India (Bharti *et al.*, 2016)^[7], only five are known to be anthophilous. In total, 20 taxa have been documented as floral visitors and/or pollinators in India, some of which are identified only to the generic level. Among these five subfamilies, Formicinae is the most represented subfamily, with eight taxa, followed by Myrmicinae with seven taxa, Pseudomyrmecinae and Dolichoderinae with two taxa each, and Ponerinae with a single taxon (Tables 1–5). Collectively, these 20 ant taxa

have been recorded as floral visitors and pollinators of 44 plant taxa (Table 6).

1. Subfamily Dolichoderinae

Members of the ant subfamily Dolichoderinae are characterized by the presence of a single petiole and the absence of a functional sting. In India, only two species belonging to two genera have been documented as floral visitors and pollinators of four plant species. Of these, *Technomyrmex albipes* has been recorded as a floral visitor and effective pollinator of both trees and climbers, whereas *Tapinoma melanocephalum* has been reported exclusively as a floral visitor of climbers (Table 1).

Table 1: Literature-reported flower associations of subfamily Dolichoderinae in India

No	Species	P/V	Host Plant	Structural Habit	Source
1	<i>Technomyrmex albipes</i> (Smith, 1861)	P/V	<i>Momordica charantia</i>	Climber	Yogapriya <i>et al.</i> , 2022 ^[70]
		P	<i>Syzygium occidentale</i>	Tree	Das & Das, 2023 ^[16]
2	<i>Tapinoma melanocephalum</i> (Fabricius, 1793)	V	<i>Hylocereus undatus</i>	Climber	Reddy <i>et al.</i> , 2024 ^[53]
		V	<i>Hylocereus polyrhizus</i>	Climber	Reddy <i>et al.</i> , 2024 ^[53]

Abbreviations used: P = pollinator; V = floral visitor

2. Subfamily Formicinae

The ant subfamily Formicinae is distinguished by the absence of a functional sting and the presence of an acidopore, a circular, hair-fringed orifice at the gastral apex that enables the ejection of formic acid for defence and prey immobilisation. In India, eight Formicinae taxa were recorded in association with a broad range of flowering plants, representing multiple plant families and structural

habits. *Camponotus compressus* (Fabricius, 1787) is reported as a floral visitor and pollinator across all plant growth forms. *Oecophylla smaragdina* occurs on climbers, shrubs, and trees, while *Anoplolepis gracilipes* and *Polyrhachis dives* are found associated with climbers and herbs, respectively. *Lasius niger* and *Formica rufa* are found only on trees (Table 2).

Table 2: Literature-reported flower associations of subfamily Formicinae in India

No	Species	P/V	Host Plant	Structural Habit	Source
1	<i>Anoplolepis gracilipes</i> (Smith, 1857)	P	<i>Salacia oblonga</i>	Climber	Das & Das, 2023; Krishnasree <i>et al.</i> , 2022 ^[16, 33]
		P	<i>Salacia gambleana</i>	Climber	
2	<i>Camponotus compressus</i> (Fabricius, 1787)	P	<i>Psidium quajava</i>	Tree	Vinod & Sattagi, 2018 ^[67]
		P/V	<i>Malus domestica</i>	Tree	Arya & Badoni, 2023; Saharan & Abrol, 2023 ^[4, 57]
		P	<i>Helianthus annuus</i>	Herb	Thakur <i>et al.</i> , 2023 ^[66]
		P	<i>Fragaria x ananassa</i>	Herb	Abrol <i>et al.</i> , 2017 ^[1]
		P/V	<i>Litchi chinensis</i>	Tree	Srivastava <i>et al.</i> , 2017 ^[63]
		V	<i>Carica papaya</i>	Tree	Dey <i>et al.</i> , 2016 ^[21]
		V	<i>Leucas aspera</i>	Herb	Kulloli <i>et al.</i> , 2011 ^[34]
		P/V	<i>Brassica juncea</i>	Herb	Adlin Prajula <i>et al.</i> , 2024; Wahid <i>et al.</i> , 2025 ^[2, 68]
		V	<i>Acacia senegal</i> = <i>Senegalia senegal</i>	Tree	Bhatnagar <i>et al.</i> , 2022 ^[8]
		P	<i>Lagenaria siceraria</i>	Climber	Prajapati <i>et al.</i> , 2022 ^[50]
		V	<i>Bruquiera gymnorrhiza</i>	Tree	Gaine <i>et al.</i> , 2021 ^[24]
		V	<i>Acanthus ilicifolius</i>	Shrub	Chatterjee <i>et al.</i> , 2023, 2025 ^[10, 11]
		V	<i>Avicennia marina</i>	Tree	Chatterjee <i>et al.</i> , 2025 ^[10]
		V	<i>Avicennia officinalis</i>	Tree	Chatterjee <i>et al.</i> , 2025 ^[10]
		V	<i>Aegiceras corniculatum</i>	Tree	Chatterjee <i>et al.</i> , 2025 ^[10]
		V	<i>Hylocereus undatus</i>	Climber	Reddy <i>et al.</i> , 2024 ^[53]
		V	<i>Hylocereus polyrhizus</i>	Climber	
3	<i>Camponotus</i> sp.	P	<i>Punica granatum</i>	Tree	Dhokane & Chavan, 2025 ^[22]
		P	<i>Prunus persica</i>	Tree	Arya & Badoni, 2023 ^[4]
		P	<i>Prunus armeniaca</i>	Tree	Arya & Badoni, 2023 ^[4]
		V	<i>Malus domestica</i>	Tree	Mattu & Nirala, 2013 ^[41] ; Thakur & Mattu, 2014; Mattu & Bhagat, 2015 ^[40, 65]
		V	<i>Litchi chinensis</i>	Tree	Kumari <i>et al.</i> , 2023 ^[37]
		V	<i>Brassica juncea</i>	Herb	Roy <i>et al.</i> , 2016 ^[55]
		P	<i>Malus</i> sp.	Tree	Sharma & Mitra, 2012 ^[60]
		P	<i>Pyrus communis</i>	Tree	Sharma & Mitra, 2012 ^[60]
		P	<i>Prunus amygdalus</i>	Tree	Sharma & Mitra, 2012 ^[60]

		V	<i>Coriandrum sativum</i>	Herb	Sikdar <i>et al.</i> , 2019; Sharma & Meena, 2019 ^[59, 61]
		V	<i>Foeniculum vulgare</i>	Herb	Sikdar <i>et al.</i> , 2019 ^[61]
		V	<i>Pyrus communis</i>	Tree	Sharma & Mitra, 2012; Thakur & Mattu, 2014 ^[60, 65]
		V	<i>Prunus amygdalus</i>	Tree	Thakur & Mattu, 2014 ^[65]
		V	<i>Trachyspermum ammi</i>	Herb	Meena <i>et al.</i> , 2021 ^[42]
		V	<i>Caesalpinia nuga</i>	Climber	Mitra, 2018 ^[43]
		V	<i>Rhizophora mucronata</i>	Tree	Mitra, 2018 ^[43]
		V	<i>Suaeda maritima</i>	Shrub	Mitra, 2018 ^[43]
		V	<i>Citrus sinensis</i>	Tree	Kumar <i>et al.</i> , 2023 ^[36]
		V	<i>Ziziphus mauritiana</i>	Tree	Devi <i>et al.</i> , 1989 ^[19]
4	<i>Formica rufa</i> Linnaeus, 1761	P	<i>Prunus avium</i>	Tree	Dar <i>et al.</i> , 2018 ^[15]
5	<i>Formica</i> sp.	V	<i>Litchi chinensis</i>	Tree	Kumari <i>et al.</i> , 2023 ^[37]
		P/V	<i>Brassica juncea</i>	Herb	Devi <i>et al.</i> , 2017 ^[20]
6	<i>Lasius niger</i> (Linnaeus, 1758)	P	<i>Annona squamosa</i>	Tree	Dhokane & Chavan, 2025 ^[22]
7	<i>Oecophylla smaragdina</i> (Fabricius, 1775)	P/V	<i>Mangifera indica</i>	Tree	Bana <i>et al.</i> , 2021; Phadatare <i>et al.</i> , 2019; Munj <i>et al.</i> , 2017 ^[5, 44, 49]
		V	<i>Leonotis nepetifolia</i>	Shrub	Kulloli <i>et al.</i> , 2011 ^[34]
		P	<i>Rauvolfia micrantha</i>	Shrub	Kulloli & Sreekala, 2009 ^[35]
		V	<i>Humboldtia vahliana</i>	Tree	Kumary <i>et al.</i> , 2017 ^[38]
		P/V	<i>Lagenaria siceraria</i>	Climber	Subhakar & Sreedevi, 2015 ^[64]
		P/V	<i>Luffa acutangula</i>	Climber	
		P	<i>Salacia oblonga</i>	Climber	Das & Das, 2023; Krishnasree <i>et al.</i> , 2022 ^[16, 33]
		P	<i>Salacia gambleana</i>	Climber	
		V	<i>Acanthus ilicifolius</i>	Shrub	Chatterjee <i>et al.</i> , 2023, 2025 ^[10, 11]
		V	<i>Avicennia marina</i>	Tree	Chatterjee <i>et al.</i> , 2025 ^[10]
		V	<i>Avicennia officinalis</i>	Tree	Chatterjee <i>et al.</i> , 2025 ^[10]
		V	<i>Aegiceras corniculatum</i>	Tree	Chatterjee <i>et al.</i> , 2025 ^[10]
		V	<i>Rhizophora mucronata</i>	Tree	Mitra, 2018 ^[43]
		V	<i>Ziziphus mauritiana</i>	Tree	Devi <i>et al.</i> , 1989 ^[19]
8	<i>Polyrhachis dives</i> Smith, 1857	P	<i>Coriandrum sativum</i>	Herb	Patil & Jagdale, 2025 ^[47]

Abbreviations used: P = pollinator; V = floral visitor

3. Subfamily Myrmicinae

Myrmicinae are characterized by a two-segmented waist (petiole plus postpetiole), with abdominal segment III markedly reduced relative to segment IV. Most taxa retain a functional ovipositor-derived sting. In India, seven taxa have been documented as flower visitors and pollinators of

nine plant taxa. Among these, *Crematogaster brunnea*, *Holcomymex* sp., and *Monomorium indicum* were reported only from trees; *Monomorium carbonarium* only from climbers; *Pheidole* sp. and *Solenopsis* sp. only from herbs. In contrast, *Solenopsis geminata* is associated with both herbs and trees (Table 3).

Table 3: Literature-reported flower associations of subfamily Myrmicinae in India

No	Species	P/V	Host Plant	Structural Habit	Source
1	<i>Crematogaster brunnea</i> Smith, 1857	V	<i>Aegiceras corniculatum</i>	Tree	Mitra, 2018 ^[43]
2	<i>Holcomymex</i> sp.	P/V	<i>Prunus persica</i>	Tree	Sharma & Mitra, 2012; Thakur & Mattu, 2014 ^[60, 65]
3	<i>Monomorium indicum</i> Forel, 1902	P	<i>Mangifera indica</i>	Tree	Chauhan, 2023 ^[12]
		P/V	<i>Litchi chinensis</i>	Tree	Bathari <i>et al.</i> , 2018 ^[6]
4	<i>Monomorium minimum</i> = <i>Monomorium carbonarium</i> (Smith, 1858)	P	<i>Luffa acutangula</i>	Climber	Patil & Jagdale, 2021 ^[46]
		P/V	<i>Momordica charantia</i>	Climber	Yogapriya <i>et al.</i> , 2022 ^[70]
5	<i>Pheidole</i> sp.	V	<i>Trifolium alexandrinum</i>	Herb	Jat <i>et al.</i> , 2013 ^[32]
6	<i>Solenopsis geminata</i> (Fabricius, 1804)	V	<i>Brassica juncea</i>	Herb	Roy <i>et al.</i> , 2014 ^[56]
			<i>Aegle marmelos</i>	Tree	Singhal <i>et al.</i> , 2011 ^[62]
7	<i>Solenopsis</i> sp.	V	<i>Brassica juncea</i>	Herb	Roy <i>et al.</i> , 2016 ^[55]

Abbreviations used: P = pollinator; V = floral

4. Subfamily Ponerinae

The ant subfamily Ponerinae is characterized by a single-segmented petiole and a distinct gastral constriction between the first and second segments. Only one species, *Diacamma rugosum*, belonging to this subfamily, has been documented as a floral visitor of an herbaceous plant in India (Table 4).

Table 4: Literature-reported flower associations of subfamily Ponerinae in India

No	Species	P/V	Host Plant	Structural Habit	Source
1	<i>Diacamma rugosum</i> (Le Guillou, 1842)	V	<i>Brassica juncea</i>	Herb	Roy <i>et al.</i> , 2014 ^[56]

Abbreviations used: P = pollinator; V = floral visitor

5. Subfamily Pseudomyrmecinae

The ant subfamily Pseudomyrmecinae is characterized by hypertrophied compound eyes, a well-developed postpetiole, and a robust functional sting. In India, only two taxa,

have been reported, as flower visitors and pollinators of seven plant taxa. *Tetraponera rufonigra* has been recorded from both trees and shrubs, whereas unidentified *Tetraponera* sp. has been reported from both herbs and climbers (Table 5).

Table 5: Literature-reported flower associations of subfamily Pseudomyrmecinae in India

No	Species	P/V	Host Plant	Structural Habit	Source
1	<i>Tetraponera</i> sp.	V	<i>Brassica juncea</i>	Herb	Roy <i>et al.</i> , 2016 ^[55]
			<i>Salacia oblonga</i>	Climber	Das & Das, 2023; Krishnasree <i>et al.</i> , 2022 ^[16, 33]
			<i>Salacia gambleana</i>	Climber	
2	<i>Tetraponera rufonigra</i> (Jerdon, 1851)	V	<i>Acanthus ilicifolius</i>	Shrub	Chatterjee <i>et al.</i> , 2023, 2025 ^[10, 11]
		V	<i>Avicennia marina</i>	Tree	Chatterjee <i>et al.</i> , 2025 ^[10]
		V	<i>Avicennia officinalis</i>	Tree	
		V	<i>Aegiceras corniculatum</i>	Tree	

Abbreviations used: P = pollinator; V = floral visitor

Plant-Ant Interaction

Literature records indicate that 44 plant taxa belonging to 22 families are visited and/or pollinated by 20 ant taxa in India (Table 6). *Brassica juncea* attracted the highest number of ant visitors (seven taxa), followed by *Aegiceras*

corniculatum and *Litchi chinensis*, each visited by four taxa. At the family level, Brassicaceae was the most frequently visited (seven ant taxa), followed by Cucurbitaceae, Fabaceae, Primulaceae, Rosaceae and Sapindaceae (four ant taxa each). (Table 6).

Table 6: List of plant species, families and their flower odour visited/pollinated by ants in India

No	Family	Host Plant	Flower odour	Ant species visited
1	Acanthaceae	<i>Acanthus ilicifolius</i> Linnaeus, 1753	Odourless to faintly fragrant	<i>Camponotus compressus</i> , <i>Oecophylla smaragdina</i> , <i>Tetraponera rufonigra</i>
2	Acanthaceae	<i>Avicennia marina</i> (Forssk.) Vierh., 1907	highly sweet fragrant	<i>Camponotus compressus</i> , <i>Oecophylla smaragdina</i> , <i>Tetraponera rufonigra</i>
3	Acanthaceae	<i>Avicennia officinalis</i> Linnaeus, 1771	Rancid or fetid smell	<i>Camponotus compressus</i> , <i>Oecophylla smaragdina</i> , <i>Tetraponera rufonigra</i>
4	Amaranthaceae	<i>Suaeda maritima</i> (L.) Dumort., 1827	Odourless or nearly odourless	<i>Camponotus</i> sp.
5	Anacardiaceae	<i>Mangifera indica</i> Linnaeus, 1753	Strong, sweet fragrance	<i>Oecophylla smaragdina</i> , <i>Monomorium indicum</i>
6	Annonaceae	<i>Annona squamosa</i> Linnaeus, 1753	Strong, sweet, fruity, aromatic	<i>Lasius niger</i>
7	Apiaceae	<i>Coriandrum sativum</i> Linnaeus, 1753	Mild, sweet, vegetal aromatic fragrant	<i>Camponotus</i> sp., <i>Polyrhachis dives</i>
8	Apiaceae	<i>Foeniculum vulgare</i> Mill., 1768	Mild, sweet, herbaceous fragrant	<i>Camponotus</i> sp.
9	Apiaceae	<i>Trachyspermum ammi</i> Sprague, 1929	Mild, aromatic fragrance	<i>Camponotus</i> sp.
10	Apocynaceae	<i>Rauvolfia micrantha</i> Hook.f., 1882	Mild fragrant	<i>Oecophylla smaragdina</i>
11	Asteraceae	<i>Helianthus annuus</i> Linnaeus, 1753	Mild, sweet, natural fragrance	<i>Camponotus compressus</i>
12	Brassicaceae	<i>Brassica juncea</i> (L.) Czern., 1859	Mildly sweet	<i>Camponotus compressus</i> , <i>Camponotus</i> sp., <i>Formica</i> sp., <i>Solenopsis geminata</i> , <i>Solenopsis</i> sp., <i>Diacamma rugosum</i> , <i>Tetraponera</i> sp.
13	Cactaceae	<i>Hylocereus polyrhizus</i> (F.A.C. Weber) Britton & Rose, 1909	Strong, sweet fragrance	<i>Tapinoma melanocephalum</i> , <i>Camponotus compressus</i>
14	Cactaceae	<i>Hylocereus undatus</i> (Haworth) D.R.Hunt, 2017	Strong, sweet, floral fragrance	<i>Tapinoma melanocephalum</i> , <i>Camponotus compressus</i>
15	Caricaceae	<i>Carica papaya</i> Linnaeus, 1753	Sweet, Pleasant fragrance	<i>Camponotus compressus</i>
16	Celastraceae	<i>Salacia gambleana</i> Whiting & Kaul, 1940	Faint or mildly fragrant	<i>Anoplolepis gracilipes</i> , <i>Oecophylla smaragdina</i> , <i>Tetraponera</i> sp.
17	Celastraceae	<i>Salacia oblonga</i> Wall. ex Wight & Arn., 1834	Faint or mildly fragrant	<i>Anoplolepis gracilipes</i> , <i>Oecophylla smaragdina</i> , <i>Tetraponera</i> sp.
18	Cucurbitaceae	<i>Lagenaria siceraria</i> (Molina) Standl., 1930	Mild, sweet fragrance	<i>Camponotus compressus</i> , <i>Oecophylla smaragdina</i>
19	Cucurbitaceae	<i>Luffa acutangula</i> (L.) Roxb., 1832	Mild, sweet fragrance	<i>Oecophylla smaragdina</i> , <i>Monomorium carbonarium</i>
20	Cucurbitaceae	<i>Momordica charantia</i> Linnaeus, 1753	Mild, sweet fragrance	<i>Technomyrmex albipes</i> , <i>Monomorium carbonarium</i>
21	Fabaceae	<i>Caesalpinia nuga</i> (L.) W.T. Aiton, 1811	Sweet fragrant	<i>Camponotus</i> sp.
22	Fabaceae	<i>Humboldtia vahliana</i> Wight, 1840	Mild, sweet fragrance	<i>Oecophylla smaragdina</i>
23	Fabaceae	<i>Senegalia senegal</i> (L.) Britton, 1930	Sweet, honey-like, fragrant	<i>Camponotus compressus</i>
24	Fabaceae	<i>Trifolium alexandrinum</i> Linnaeus, 1753	Faint or mild fragrance	<i>Pheidole</i> sp.
25	Lamiaceae	<i>Leonotis nepetifolia</i> (L.) R.Br., 1810	Strong, herbaceous fragrance	<i>Oecophylla smaragdina</i>
26	Lamiaceae	<i>Leucas aspera</i> (Willd.) Link, 1822	Faint or mild fragrance	<i>Camponotus compressus</i>

27	Lythraceae	<i>Punica granatum</i> Linnaeus, 1753	Odourless to faintly fragrant	<i>Camponotus compressus</i>
28	Myrtaceae	<i>Psidium guajava</i> Linnaeus, 1753	Mild, sweet fragrance	<i>Camponotus compressus</i>
29	Myrtaceae	<i>Syzygium occidentale</i> (Bourd.) Gandhi, 1976	Mild, sweet fragrance	<i>Technomyrmex albipes</i>
30	Primulaceae	<i>Aegiceras corniculatum</i> (L.) Blanco, 1837	highly sweet fragrant	<i>Camponotus compressus</i> , <i>Oecophylla smaragdina</i> , <i>Crematogaster brunnea</i> , <i>Tetraponera rufonigra</i>
31	Rhamnaceae	<i>Ziziphus mauritiana</i> Lam., 1789	Strong, unpleasant fragrance	<i>Camponotus</i> sp., <i>Oecophylla smaragdina</i>
32	Rhizophoraceae	<i>Bruguiera gymnorhiza</i> (L.) Savigny, 1798	Odourless to faintly fragrant	<i>Camponotus compressus</i>
33	Rhizophoraceae	<i>Rhizophora mucronata</i> Lam., 1804	Very mild fragrance	<i>Camponotus</i> sp., <i>Oecophylla smaragdina</i>
34	Rosaceae	<i>Fragaria x ananassa</i> Duchesne ex Rozier, 1785	Faint delicate floral fragrance	<i>Camponotus compressus</i>
35	Rosaceae	<i>Malus domestica</i> (Suckow) Borkh., 1803	Sweet, floral fragrance	<i>Camponotus compressus</i> , <i>Camponotus</i> sp.
36	Rosaceae	<i>Malus</i> sp.	Sweet, floral fragrance	<i>Camponotus</i> sp.
37	Rosaceae	<i>Prunus amygdalus</i> Batsch, 1801	Sweet, floral fragrance	<i>Camponotus</i> sp.
38	Rosaceae	<i>Prunus armeniaca</i> Linnaeus, 1753	Sweet, floral fragrance	<i>Camponotus</i> sp.
39	Rosaceae	<i>Prunus avium</i> Linnaeus, 1755	Very faint, floral fragrance	<i>Formica rufa</i>
40	Rosaceae	<i>Prunus persica</i> (L.) Batsch, 1801	Mild, sweet, floral fragrance	<i>Camponotus</i> sp., <i>Holcomyrme</i> sp.
41	Rosaceae	<i>Pyrus communis</i> Linnaeus, 1753	Mild, faint or slightly unpleasant fragrance	<i>Camponotus</i> sp.
42	Rutaceae	<i>Aegle marmelos</i> (L.) Corrêa, 1880	Sweet fragrance	<i>Solenopsis geminata</i>
43	Rutaceae	<i>Citrus sinensis</i> (L.) Osbeck, 1765	Sweet, highly citrus like fragrant	<i>Camponotus</i> sp.
44	Sapindaceae	<i>Litchi chinensis</i> Sonn., 1782	Strong, sweet fragrance	<i>Camponotus compressus</i> , <i>Camponotus</i> sp., <i>Formica</i> sp., <i>Monomorium indicum</i>

Literature-based analyses of host-plant associations reveal that tree flowers are the most frequently visited by ants, compared to those of herbs, climbers, and shrubs (Fig. 1). Tree flowers supported the highest proportion of ant taxa

(36.4%), followed by herbs (27.3%) and climbers (24.2%). In contrast, shrubs were comparatively less visited, supporting only a small fraction (12.1%) of the records (Fig. 1).

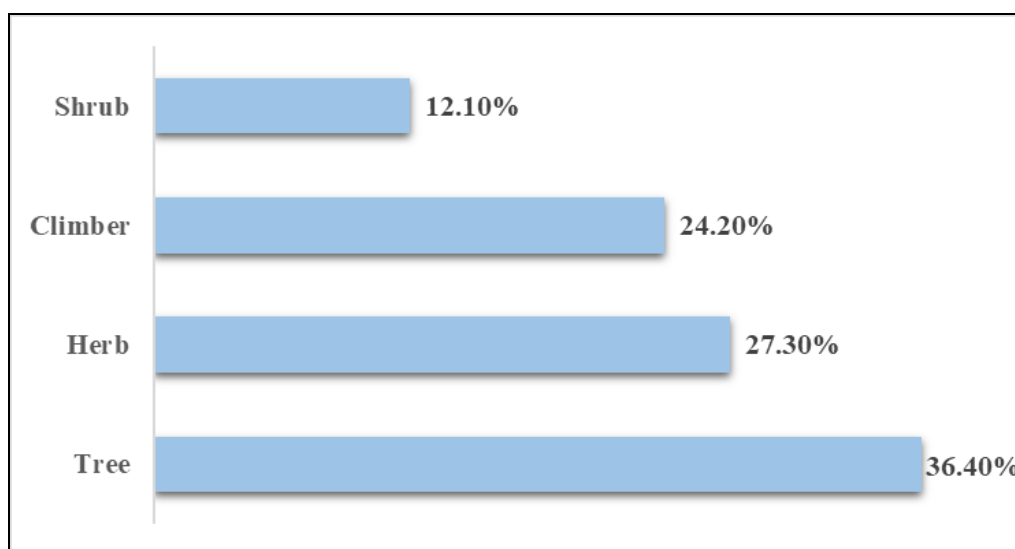


Fig 1: Distribution of unique flower-visiting ant-taxon and host-plant structural-habit associations in India

At the species level, distinct preferences in floral visitation were evident. *Oecophylla smaragdina* (Fabricius, 1775) was recorded visiting flowers of all plant structural habits except herbs. *Tetraponera rufonigra* (Jerdon, 1851) was restricted to trees and shrubs, whereas *Technomyrmex albipes* (Smith, 1861) was recorded only on trees and climbers. *Lasius niger* (Linnaeus, 1758), *Crematogaster brunnea* Smith, 1857, and *Monomorium indicum* Forel, 1902, were recorded exclusively on tree flowers. In contrast, *Solenopsis geminata* (Fabricius, 1804) was observed on both herbaceous and tree flowers. In contrast, *Tapinoma melanocephalum* (Fabricius, 1793), *Anoplolepis gracilipes* (Smith, 1857), and *Monomorium carbonarium* (Smith, 1858) visited only climber flowers. Notably, *Polyrhachis dives* Smith, 1857,

Diacamma rugosum (Le Guillou, 1842), *Pheidole* sp. and *Solenopsis* sp. were recorded only on herb flowers from India (Tables 1-5).

Floral volatiles play a crucial role in attracting diverse insect pollinators, and it is reasonable to infer that floral scent is also important for foraging ants (Rostás & Tautz, 2011) [54]. In this review, most ant-visited plant species were found to possess fragrant flowers (Table 6).

Discussion

Pollination is widely recognized as the best-studied mutualistic interaction between animals and higher plants. According to Ollerton *et al.* (2011) [45], the global number of animal-pollinated angiosperms is estimated at 308,006

species, representing 87.5% of the species-level diversity of flowering plants. Among these, the majority depend on insects for pollination. Despite the acknowledged ecological role of ants in this process, research on flower-visiting ants in India remains limited.

Therefore, in this review current knowledge of ant-mediated pollination in India is summarized from available literature and published records. Although investigations have been conducted across different states, the information remains fragmentary and inadequate, and accurate taxonomic identification continues to pose challenges in determining the actual number of species involved. To date, 20 ant taxa, including both identified species and taxa identified only to genus level, have been reported as V, P or both V and P in India. Four additional taxa, *Camponotus longus* (as reported by Dar *et al.*, 2018) ^[15], *Camponotus pennsylvanicus* (as reported by Yogapriya *et al.*, 2022) ^[70], *Camponotus vicinus* (as reported by Dhokane & Chavan, 2025) ^[22] and *Dorymyrmex* sp. (as reported by Yogapriya *et al.*, 2022) ^[70], were excluded from this review, as they are not reported from India (Bharti *et al.*, 2016) ^[7].

In contrast to earlier theories emphasizing the limitations of ant pollination, recent perspectives highlight the positive aspects of ant activity at flowers, which have received comparatively little attention. One of the principal criteria for assessing pollinator effectiveness is the abundance and frequency of floral visitation, since repeated and consistent visits increase the probability of successful pollen transfer. Ants, by virtue of their exceptionally high abundance and frequent visitation to flowers, exhibit traits that may enhance their potential role as pollinators (Herrera, 1987, 1989; Ivey *et al.*, 2003; Rader *et al.*, 2009) ^[25, 26, 29, 52].

Pollinators employ floral traits such as odour, shape, size, and colour as sensory cues to locate pollen and nectar resources and to discriminate among different flower species (Chittka & Raine, 2006) ^[13]. Evidence from studies conducted in India indicates that the majority of ant species exhibit a marked preference for fragrant flowers.

Compared with other pollination syndromes such as melittophily (bee pollination), myophily (fly pollination), psychophily (butterfly pollination), phalaenophily (moth pollination), and cantharophily (beetle pollination), ant-mediated pollination has historically received far less attention. In fact, while nearly two-thirds of all angiosperms rely on insects for pollination, only about 30 published reports document ants as pollinators worldwide (Peakall *et al.*, 1991; Schoonhoven *et al.*, 2005) ^[48, 58], and even fewer studies have experimentally confirmed their role (Rostás & Tautz, 2011) ^[54].

This review provides a consolidated account of published records of ant-mediated pollination in India. At present, only 20 ant taxa have been recorded as floral visitors and pollinators of 44 plant taxa, which represents a relatively small number compared with records for other insect pollinators. The available information remains fragmentary, and comprehensive future studies are therefore essential to advance our understanding of ant-mediated pollination in India and to elucidate its ecological significance within plant–pollinator networks in the Indian context.

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