*Advances in Research*

*17(6): 1-8, 2018; Article no.AIR.43338*
*ISSN: 2348-0394, NLM ID: 101666096*

# Diversity of Ant Species (Hymenoptera: Formicidae) Nesting Beneath Different Trees in Periyanaickenpalyam, Coimbatore District, Tamil Nadu

**J. Sornapriya[1] and K. Varunprasath[1*]**

*[1]Department of Zoology, PSG College of Arts and Science, Coimbatore, Tamil Nadu, India.*

***Authors' contributions***

*This work was carried out in collaboration between both authors. Author KV designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author JS managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/AIR/2018/43338
Editor(s):
(1) Dr. Farzana Khan Perveen, Founder Chairperson & Associate Professor, Department of Zoology, Shaheed Benazir Bhutto University (SBBU), Main Campus, Pakistan.
Reviewers:
(1) Manoel Fernando Demétrio, Universidade Federal da Grande Dourados, Brazil.
(2) Márcio da Silva Araújo, Universidade Estadual de Goiás, Brasil.
(3) Moses Olotu, Mkwawa University College of Education, University of Dar es Salaam, Tanzania.
Complete Peer review History: http://www.sdiarticle3.com/review-history/43338

***Original Research Article***

***Received 16 July 2018***
***Accepted 03 October 2018***
***Published 18 January 2019***

## ABSTRACT

Ants (Formicidae: Hymenoptera) are one of the most successful organisms of the tropics and have survived many geological changes in the past and play crucial roles in ecosystem functioning. The present study examined ants nesting beneath different trees in Periyanaickenpalyam village, from November 2017 to February 2018. The study observed that 384 ants nests associated with 27 floral species at different locations in Periyanaickenpalyam were recorded. Based on floral ants nest association maximum of 18% ants nest in the *Prosopis juliflora* species followed by 15% of *Azadirachta indica, Ficus religiosa* contain 12%, *Mangifera indica* cover 9%, S*horea robusta* (6%) and *Toona ciliata* equally contain (6%) and rest of floral species *Cocos nucifera, Ficus benghalensis, Santalum album, Gmelina arborea, Bambuseae, carica papaya, Thespepsia populnea, Delonix, Tamarinds indica, Cassia fistula, Musa acuminate* each contain (3%) were

**Corresponding author: E-mail: varunkrishnaraj@gmail.com;*

observed. According to nest wise, fifty four nest below the *Prosopis juliflora* followed by fifty two nests in A*zadirachta indica,* (49) nests engaged in *ficus religiosa,* forty nests in *Mangifera indica* and twenty three nests beneath the S*horea robusta, Ficus benghalensis each* and in *Toona ciliata*, *Bambuseae* both contain twenty two nests, *reset of species contain less than 15 ants in Gmelina arborea, Carica papaya, Delonix*, *Cocos nucifera*, S*antalum album*, *Musa acuminate*, *Tamarinds indica, Cassia fistula* and *Thespepsia populnea tree*s were observed from the study. It can be concluded that this study provides clue information on ants nesting association with floral species.

*Keywords: Ants diversity; nests; mutualism; Azradica indica.*

## 1. INTRODUCTION

Ants are ubiquitous in distribution and occupy almost all terrestrial ecosystems. Ants are one of the ideal model organisms for measuring and monitoring biodiversity for many reasons. Ant belongs to a single large family Formicidae, largest of order Hymenoptera. It is represented by 26 extant subfamilies with 14,711 valid species and 428 valid genera [1] out of these, and 10 subfamilies were reported in India, which is represented by 100 genera with 828 species. Abundance and diversity of ants species is also greater neighbouring areas, for example, In India, Himalaya and the Western Ghats harbour a large number of ant species, 656 species from 88 genera were recorded in Himalaya, and 455 species from 75 genera were recorded in the Western Ghats, especially in Tamil Nadu, 184 species from 51 genera were recorded [2,3]. Ants in India, occupy a variety of habitats such as leaf litter, trees, soil and dead logs, while tramp species prefer human-modified habitats. Some species even form a symbiotic association with a particular group of plants, which produce suitable preformed nest sites to attract the ants to take up residence [4]. The design and architecture of nest are distinctly purposeful and constructed with patience. They construct nests in various types of habitats, some nest in plant cavities, but the majority of ants make nests in the ground. The same colony of ants may adopt very different methods of nest building at different periods during the growth and development [5]. The ability of ants to build its nests ranges from subterranean (i.e. terrestrial and/or intertidal habitats) [6], to lignicolous, lithophilic, and arboreal [7,8], with nests constructed of various combinations [9]. Ants play an important role in terrestrial ecosystems such as pollinators, seed dispersal, predators of harmful insects, good soil turners and as a food source for other animals. The plants and produce make suitable preformed nest sites to attract the ants to take up residence.

Despite the importance of ants in different ecosystems, there is little information on abundance and diversity of ants nesting beneath different trees in Periyanaickenpalyam, TamilNadu. The present study, therefore, investigated the abundance and diversity of ant species nesting beneath different trees in Periyanaickenpalyam.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

The fieldwork was conducted in the Periyanaickenpalyam village, Coimbatore district, TamilNadu. Coimbatore, which is located between Latitude 11°1′6″N and Longitude 76°58′21″E, in south India at 411 m.a.s.l on the banks of the Noyyal River, in southwestern Tamil Nadu. The average annual rainfall is around 700 mm (27.6 in) with the northeast and the southwest monsoons contributing to 47% and 28%, respectively, to the total rainfall. Periyanaickenpalayam is a neighbourhood in Coimbatore in the Indian state of Tami Nadu. It is located along National Highway NH 67, Mettupalayam road, an arterial road in Coimbatore.

#### 2.1.1 All out search method

The village was divided into 8 equal size zones. Ants were collected twice a day, each of two hours duration. (6-8 and 16-18 h Indian Standard Time (IST). One day was devoted to each zone from November 2017 to February 2018. Ants were collected using a brush and forceps during daytime in between 11 am to 16 h IST twice in every month. Collected ants were transferred into 70% ethanol in plastic vials at the Department of Zoology, PSG College of arts and science and same time maintained for all zones while ants collection. The stored ant specimens were then counted and identified up to genus level (some to species level) using microscope. Species identification was carried out under the help of

the keys of "Ants identification guide" [10] collected ants were identified up to the genus level by the user based on literature [11,4,12,13,14]. Identified specimens will be kept in the airtight insect wooden box. Ant species were listed, and each species was counted to calculate and compared composition, richness, species diversity, trees association, habitat type and identification of ants.

## 3. RESULTS

The study observed that 384 ants nests associated with 27 floral species at different locations in Periyanaickenpalyam Village, TamilNadu state were recorded (Table 1). The study recorded the approximate height (H) of the tree, diameter (D) of tree and ants nest entrance size (NES). Based on floral ants nest association, eighteen percentage of ants species associated with *Prosopis juliflora* tree with the height of (14-16 ft), diameter (14-21 cm) and nest entrance size ranges in between (0.8-1.2 cm) followed by fifteen percentage of ants species allied in *Azadirachta indica* with (9-16 ft) in height, diameter of (60-70 cm) and nest size of (1-1.5 cm)*, Ficus religiosa* species contain twelve percentage of ants species with the distinctive features of trees height (40-66 ft) with diameter (40-50 cm) and nest size (0.9-1.5 cm), *Mangifera indica* species contain nine percentage of ants species with the height of (19-22 ft) and the diameter of (23-28 cm) with the nest size (0.9-1.5 cm), S*horea robusta* contain six percentage of ants species with (H: 19-23 ft, D:40- 55 cm and NES: 1-12 cm) and six percentage of species associated with T*oona trees* with the height of (9-12 ft), including the diameter of (20-30 cm) and nest size of (1-1.5 cm) were recorded. The rest of floral species of *Cocos nucifera species* with the height of (20 ft) and the diameter of (30 cm) and nest size of (0-7-1.2 cm), *Ficus benghalensis with* height (9-16 ft) and diameter of (60 cm) with nest size of (1-1.7 cm), *Santalum album* with the height of twenty five feet with the diameter of sixteen centimeter and the nest size of (1-2 cm)*, Gmelina arborea* with height and diameter of (H: 13 ft, D:12 cm, NS: 0.5-1 cm)*, Bambuseae with* height and diameter of (5 ft, 5 cm), and nest size of opening of (1-1.5 cm)*, Carica papaya* approximate height of five feet with the diameter of (10 cm) and Nest size of (1.3-1.5 cm), *Thespepsia populnea with* height of sixteen feet and diameter of (44cm) with the nest size of (1-1.2 cm)*, Delonix with* height of eight feet and diameter of (41 cm) with the nest size of (0.8-1.4 cm), *Tamarinds indica* height of thirty two feet and the (26 cm) diameter with the nest size of (1-1.6 cm), *Cassia fistula with* height of sixteen feet and diameter of (54 cm) with nest size of (1-1.5 cm)*, Musa acuminate* floral species with height of fifteen feet with the diameter of (10 cm) and the nest size (0.4-.7 cm), *Prosopisjuli flora* tree species with height of sixteen feet and diameter of (20-33 cm) along with the nest size (0.7-1.1 cm) were observed from the study.

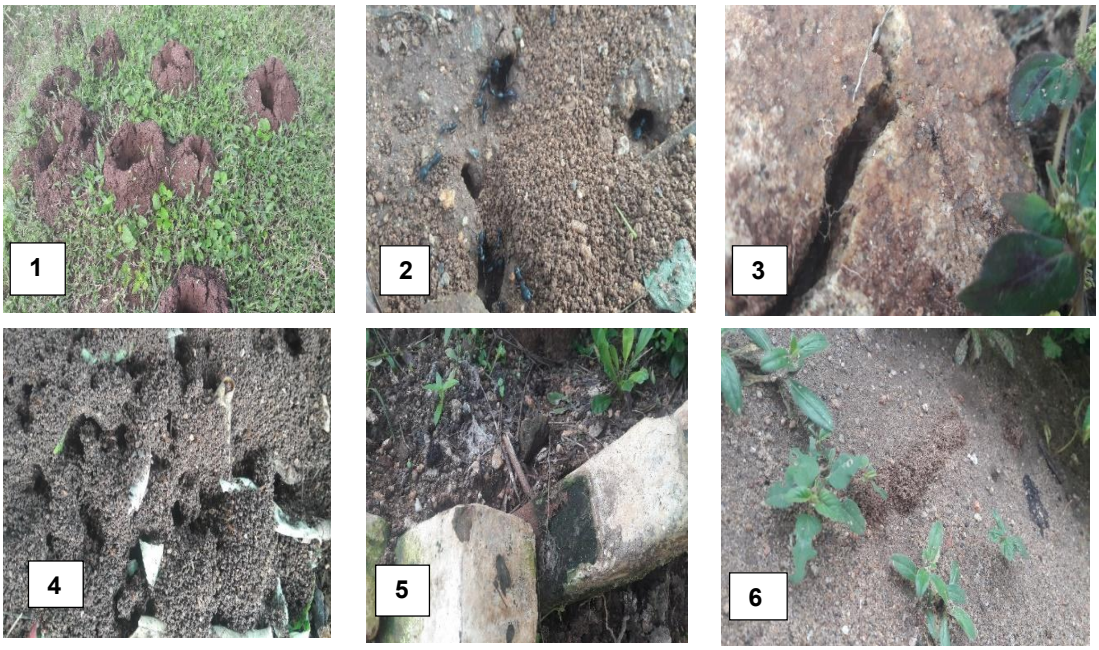


**Plate 1.**

*1 Camponotus spp, 2 Componotus compressus, 3 Camponotus sericeus, 4 Camponotus fabricus, 5 Monomorium destructor, 6 Crematogaster subnuda, 7 Componotus spp, 8 Camponotus compressus, 9 Componotus spp, 10 Monomorium pharaonis, 11 Oecophylla smaragidina, 12 Paratrechina longicornis*

According to nest wise, out of 384 ant's nests, fifty-four nests (14%) in *Prosopis juliflora* floral species under three subfamilies of ants were observed. Twenty-seven nests (50%) in Myrmicinae, twenty-two nests (41%) in Pseudomyrmicinae and five nests (9%) in Dolichodeni species were recorded. In A*zadirachta indica* (13.5%) species which contain fifty-two nests. Out of 52 nests, subfamily Myrmicinae has twenty-nine nests (56%), thirteen nest in Pseudomyrmicinae (25%) and ten Formicinae nests consist of (19%) were observed.

Forty-nine ants' nest's species present in *Ficus religiosa* trees which restrain (12.7%) and further undergoes into thirty-nine nests (80%) in subfamily Formicinae and ten nests (20%) in Myrmicinae subfamilies were recorded. Forty nests occupied in M*angifera indica* contain (10.5%) nests which were further undergoing into thirty (75%) nest in subfamily Formicinae, and ten nests (25%) in Myrmicinae nest were recorded.

Twenty-three nests present in S*horea robusta* species which comprise of 6% ants nests further undergoes twenty-three ants nests (100%) in subfamily *Formicinae* nests. Twenty-two nests present in *Toona ciliata* species enclose (5.8%) nests under subfamily Formicinae contain twelve nests (55%) and ten nests (45%) in *Pseudomyrmicinae* species were observed. The other faunal varieties like twenty-three nests in *Ficus benghalensis species* contain 5.8%, *twenty two Bambuseae* nest comprise of 5.7%, *nineteen nest in gmelina arborea* contain 4.9%, *fifteen nests in Carica papaya* enclose 3.9%, *thirteen nests in Delonix* contain 3.4%, *eleven nests in Cocos nucifera species c*ontain 2.8% nests, eleven nests in S*antalum album* includes 2.8%, *ten nests in Musa acuminate* include 2.6%, seven nests in *Tamarinds indica* contain1.9%, seven nests in *cassia fistula species* enclose 9% and six nests in *Thespepsia populnea* comprise of 1.6% of nests were observed from the study.

**Table 1. Showing the ant nests with the floral association on Periyanaichenpalayam village**

| Common name | Scientific name | Number of nests | Subfamily | Genera | Species |
|---|---|---|---|---|---|
| Neem tree | *Azadirachta indica* | 10 | Formicinae | Camponotus | radiatus |
| sacred fig | *Ficus religiosa* | 20 | Formicinae | Camponotus | compressus |
| Sal | *Shorea robusta* | 16 | Formicinae | Camponotus | irritans |
| Coconut | *Cocos nucifera* | 11 | Formicinae | Camponotus | parius |
| Banyan | *Ficus benghalensis* | 23 | Formicinae | Camponotus | sericeus |
| Sacred fig | *Ficus religiosa* | 19 | Formicinae | Camponotus | fabricus |
| Sandal wood | *Santalum album* | 11 | Formicinae | Camponotus | maculatus |
| Mango | *Mangifera indica* | 23 | Formicinae | Oecophylla | smaragidina |
| Toona | *Toona ciliata* | 12 | Formicinae | Anoplolepsis | gracillipes |
| White teak | *Gmelina arborea* | 19 | Formicinae | Paratrechina | Longicorns |
| Neem tree | *Azadirachta indica* | 18 | Myrmicinae | Monomorium | Minimum |
| Bamboo | *Bambuseae* | 22 | Myrmicinae | Monomorium | Destructor |
| Papaya | *carica papaya* | 15 | Myrmicinae | Monomorium | Pharaonis |
| Karuva | *Prosopis juliflora* | 11 | Myrmicinae | Crematogaster | Species |
| Porita tree | *Thespepsia populnea* | 6 | Myrmicinae | Crematogaster | Subnuda |
| Gulmohar | *Delonix* | 13 | Myrmicinae | Solenopsis | Invicta |
| Mango | *Mangifera indica* | 10 | Myrmicinae | Solenopsis | Germinata |
| Neem tree | *Azadirachta indica* | 11 | Myrmicinae | Solenopsis | Diplorhoptom |
| Sacred fig | *Ficus religiosa* | 4 | Myrmicinae | Phediole | Spp |
| Tamarind | *Tamarinds indica* | 7 | Myrmicinae | Phediole | Megacephala |
| Indian laburnum | *Cassia fistula* | 7 | Ponerinae | Lepitogenys | Processionalis |
| Banana tree | *Musa acuminate* | 10 | Dolichoderinae | Tapinoma | Indicum |
| Karuva | *Cinnamoumverum* | 5 | Dolichoderinae | Tapinoma | Sessile |
| Karuva | *Cinnamoumverum* | 13 | Pseudomyrmicinae | Tetraponera | Species |
| Neem tree | *Azadirachta indica* | 7 | Pseudomyrmicinae | Tetraponera | Nigra |
| Toona | *Toona ciliata* | 10 | Pseudomyrmicinae | Tetraponera | Rufonigra |
| Karuva | *Cinnamoumverum* | 9 | Pseudomyrmicinae | Tetraponera | Allaborans |
| Sal | *Shorea robusta* | 7 | Formicinae | Camponotus | flying ants |
| Karuva | *Cinnamoumverum* | 9 | Myrmicinae | Solenopsis | Germinata |
| Neem tree | *Azadirachta indica* | 6 | Pseudomyrmicinae | Tetraponera | nigra(flying) |
| Mango | *Mangifera indica* | 7 | Formicinae | Camponotus | Species |
| Sacred fig | *Ficus religiosa* | 6 | Myrmicinae | Tetramorium | Species |
| Karuva | *Prosopis juliflora* | 7 | Myrmicinae | Crematogaster | Species |

## 4. DISCUSSION

Domatia are internal plant structures that appear to be specifically adapted for habitation by ants [15]. These cavities are found primarily in the stems, leaves, and spines of plants. Many different genera of plants offer domatia. The study observed that 384 ants nests associated with 27 floral species at different locations in Periyanayakenpalayam were recorded based on our photos and searching method. Based on floral -ants nest association maximum 18% of *Prosopis juliflora* followed by 15% of *azadirachta indica,* Plants of the *Acacia* genus have some of the most widely recognised forms of domatia and offer some of the best examples of ant-plant obligate mutualism [15]. Different species of Acacia provide a variety of resources needed for their codependent counterparts. One of these resources is the need for shelter. Acacia has enlarged thorns on their stems that are excavated by ants for use as housing structures.

*Ficus religiosa* contains 12%, *Mangifera indica* contains 9%, *Shorea robusta* (6%) and *Toona ciliata* both contain (6%). The *Shorea robusta*, *Mangifera indica* are formed building up leaf domatia. The rolling pattern of leaf domatia in *Pterospermum sp* and the complete leaf domination a hemiparasitic angiosperm (*Lorenthus longifolia)* in Manikara plant species. In the interesting, hanging like leaf domatia found in Swetenia mahogany. Some plants produce food bodies for use by other organisms [16].

Floral species *Cocos nucifera, Ficus benghalensis, Santalum album, Gmelina arborea, Bambuseae, carica papaya, Thespepsia populnea, Delonix, Tamarinds indica, Cassia fistula, Musa acuminate* each contain (3%) were observed. Mutualism between plants and ants is widespread. Two of these mutualisms involving ants in protecting plants from herbivores, and in seed dispersal (myrmecochory), are well known and intensively studied [17,18,19,20].

Colony structure can be highly variable, with some species establishing nests through either single or multiple queens [21,22] or obligatory parasitic relationships with other species of ants [23]. Individual nests can contain numerous dimorphic queens, each of which has a full set of thoracics clerites and seemingly functional wings. Both queen morphs appear capable of reproduction, possessing apparently functional ovaries, and together present a typical bimodal but continuous size frequency distribution [24].

According to nest wise showed that out of 384 ants nests associated with 27 floral species at different locations in Periyanayakenpalayam were recorded. Ants nests maximum in (n=54) nest with the *Prosopis juliflora* species which undergoes three subfamily; 27(50%) nest of myrmicinae, 22(41%) nests in pseudomyrmicinae and 5(9%) dolichodeni nests followed by (n=52) nests in *azadirachta indica* which undergoes 29 (56%) in Myrmicinae, Pseudomyrmicinae 13(25%) and Formicinae consist of 10(19%) nests, (n=49) nests in *Ficus religiosa* contain 39(80%) Formicinae nests and 10(20%) Myrmicinae nest,(n=40) nests in *Mangifera indica* contain 30(75%) Formicinae nests and 10(25%) myrmicinae nest and (n=23) *Shorea robusta* contain nests under 23(100%) Formicinae nests and (n=22) *Toona ciliata* contain nests under formicinae 12 (55%) nests and 10 (45%) Pseudomyrmicinae. Worker size is strongly bimodal [25]: Smaller (minor) workers perform tasks within the nest while larger (major) workers carry out a range of tasks both within and outside the nest [26] reported that ant species richness generally increased with increase in vegetation. Tree hollow, tree holes and dead limbs are the most common nesting site for this species [27,28]. Many myrmecophytes are defended from both herbivores and other competing plants by their ant counterparts (Acacia cornigera, for example, is thoroughly guarded by its obligate ant partner, *Pseudomyrmex ferruginea*. A single colony of *P. ferruginea* may contain more than 30,000 ants, and can tend multiple Acacia trees. The soldier ants are incredibly aggressive, patrolling the trees twenty-four hours a day. Any disturbance to the tree alerts ants, who then recruit more workers from inside the horn domatia. These ants defend the Acacia by biting, violently stinging, and pruning any trespassers. The ants keep the plant free from other insects and vertebrate herbivores, but also from invading fungi and other plants [19].

Faunal varieties like *Ficus benghalensis* (n=23) contain 5.8%, *Bambuseae* (n=22) contain 5.7%, *Gmelina arborea* (n=19) contain 4.9%, *Carica papaya* (n=15) contain 3.9%, *delonix* (n=13) contain 3.4%, *Cocos nucifera* (n=11) contain 2.8% nests, *Santalum album* (n=11) contain 2.8%, *Musa acuminate* (n=10) contain 2.6%, *Tamarinds indica* (n=7) contain 1.9%, *cassia fistula* (n=7) contain 1.9% and *Thespepsia populnea* (n=6) contain 1.6%, nests were observed from the study. Nesting location within Polyrhachis species for example can vary from intertidal and subterranean to arboreal, the

presence of silk nests and/or larval cocoons is highly variable and disjunct, and even the source of silk within nests can vary from their own larvae to spiders silk.

Since the tree contains their nest, these aggressive ants react strongly to any disturbance of the tree, providing the myrmecophyte with defence from grazing herbivores and encroaching vines. The ants continuously patrol the surface of their host plant and protected it from depending on this protection and grow poorly in the absence of their ant partner.

Plants of the Acacia genus have some of the most widely recognised forms of domatia and offer some of the best examples of ant-plant obligate mutualism [15]. Different species of Acacia provide a variety of resources needed for their codependent counterparts. One of these resources is the need for shelter. Acacia has enlarged thorns on their stems that are excavated by ants for use as housing structures. Since the tree contains their nest, these aggressive ants react strongly to any disturbance of the tree, providing the myrmecophyte with defence from grazing herbivores and encroaching vines.

Recent work involving principally taxonomic and ecological studies indicates that nesting habits and ecology in the taxonomically extensive ant genus Polyrhachis are almost as diverse as that of all ants in general [29], offering the unique potential to explore the evolution of nest-weaving within a single genus.

## 5. CONCLUSION

A total of 33 floral species associated with ants nesting habitat have been recorded from Periyanakenpalayam village, Coimbatore district. During this study, out of thirty-three floral species, Karuva tree followed by Neem tree, Sacred fig, Mango tree, Sal and toona species accounted for contain 63% of ants nests was occupied. The present study will yield valuable information on ant species availability in this region. Finally, to sum up, this study provides a little information about ants nesting association with floral species. In a future study we developed to research soil developing and decomposing of soil during the nesting behavior.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES


1. Bolton B. Bolton's catalogue and synopsis, in Version: 1; 2011. Available:http://gap.entclub.org/
2. Bharti H. List of Indian ants (Hymenoptera: Formicidae). Halteres. 2011;3:79-87.
3. Bharti H, Guénard B, Bharti M, Economo EP. An updated checklist of the ants of India with their specific distributions in Indian States (Hymenoptera, Formicidae). ZooKeys. 2016;551:1-83.
4. Bolton B. Identification guide to the ant genera of the world. Cambridge, Mass: Harvard University Press. 1994;222.
5. Wheeler WM. Ants, their structure, development and behaviour. Colombia University Biological Series 9; 1913.
6. Nielsen MG. Nesting biology of the mangrove mud-nesting ant Polyrhachis sokolova Forel (Hymenoptera, Formicidae) in Northern Australia. Insect. Soc. 1997;44:15–21.
7. Liefke C, Dorow WHO, Hçlldobler B, Maschwitz U. Nesting and food resources of syntopic species of the ant genus Polyrhachis (Hymenoptera, Formicidae) in West-Malaysia. Insect. Soc. 1998;45:411–425.
8. Robson SK. Comparative nesting biology of two species of Australian lithocolous ants: Polyrhachis (Hedomyrma) turneri Forel and P. (Hagiomyrma) thusnelda Forel (Hymenoptera: Formicidae: Formicinae). Aust. J. Entomol. 2004;43:5–9.
9. Robson SKA, Kohout RJ. Evolution of nest-weaving behaviour in arboreal nesting ants of the genus Polyrhachis Fr. Smith (Hymenoptera: Formicidae). Aust. J. Entomol. 2005;44:164–169.
10. Bayer. Ant identification guide. Bayer Environmental Science; 2010.
11. Mathew R, Tiwari RN. Insecta: Hymenoptera: Formicidae. Zool. Surv. India. Fauna of Meghalaya. State Fauna Series. Part 7. 2000;4.
12. Bingham CT. The Fauna of British India, including Ceylon and Burma. Hymenoptera, Ants and Cuckoo-wasps London: Taylor and Francis (02). 1903;1-506.
13. Hölldobler B, Wilson EO. The ants. Cambridge, MA: Harvard University Press. 1990;732.
14. Krebs CJ, Addison S, Prasad P, Puyravaud BR, Ramesh KA. Ecological

methodology. Educational Publishers. California. 1999;581.
15. Janzen DH. Coevolution of mutualism between ants and acacias in Central America. Evolution. 1966;20:249–275.
16. Shilpa Dinda, Amal Kumar Mondal. Biodiversity of Myrmecophytes in Eastern India. 2015;6(4):625-631.
17. Herrera CM, Pellmyr O. Plant-animal interactions: An evolutionary approach. Blackwell Publishing, Malden; 2002.
18. Bronstein JL, Ruben AR, Geber M. Tansley review: The evolution of plant–insect mutualisms. New Phytol. 2006;172: 412–428.
19. Rico-Gray V, Oliveira PS. The ecology and evolution of antplant interactions. University of Chicago Press, Chicago; 2007.
20. Schaefer HM, Ruxton GD. Plant-animal communications. Oxford University Press, Oxford; 2011.
21. Sasaki K, Jibiki E, Satoh T, Obara Y. Queen phenotypeand behaviour during cooperative colony founding in *Polyrhachis moesta*. Insect. Soc. 2005;52:19–25.
22. Yamauchi K, It Y, Kinomura K, Takamine H. Polycalic colonies of the weaver ant *Polyrhachis dives*. Kontyu. 1987;55:410–420.
23. Maschwitz U, Go C, Dorow WHO, Buschinger A, Kohout RJ. Polyrhachis loweryi (Formicinae): A guest ant parasitizing Rhytidoponera sp. (Ponerinae) in Queensland, Australia. Insect. Soc. 2003;50:69–76.
24. Heinze J, Hçlldobler B. Queen polymorphism in an Australian weaver ant, Polyrhachis cf. doddi Psyche. 1993;100: 83–92.
25. Cole AC Jr, Jones JW. A study of the weaver ant, *Oecophylla smaragdina* (Fab.). American Midland Naturalist. 1948;39:641-651.
26. Sunil Kumar MKT, Nair P, Varghese T, Gadagkar R. Ant species richness at selected localities of Bangalore insect environment. 1997;3:3-5.
27. Robinson W. Urban entomology. Chapman Hall, London. 1996;262-284.
28. Holldobler B, Wilson EO. The superorganism: The beauty elegance, and strangeness of insect societies; 2009.
29. Robson SKA, Kohout RJ. A review of the nesting habits and socioecology of the ant genus Polyrhachis Fr. Smith. Asian Myrmecol. 2007;1:81–99.



*Peer-review history:*
*The peer review history for this paper can be accessed here:*
*http://www.sdiarticle3.com/review-history/43338*