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Acarine species associated with subterranean termites (Blattodea, Termitidae)

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ABSTRACT: Ten species of mites were found associated with three species of termites, *viz*, *Odontotermes obesus* Rambur, 1842, *O. feae* Wasmann, 1896 and *Nasutitermes gardneri* Snyder, 1933. The collected mite species conformed to nine genera, four families and two orders. Among the ten species collected, nine of them were from the order Sarcoptiformes and cohort Astigmatina, while only one belonged to the order Trombidiformes. Seven species collected conformed to the family Acaridae. All mite species exhibited a phoretic relationship with their respective host insects. One adult mite, *Premicrodispus paramaevi* Hosseininaveh and Hajiqanbar, 2015 and nine deutonymphs were collected and described.

KEY WORDS: Acaridae, Microdispidae, Suidasiidae, mite, deutonymphs, phoresy

Eusociality in termites converges along many lines with colony organization and highly social behaviour in the phylogenetically distinct insect order Hymenoptera. Termites have the potential to destroy the agriculture of tropical farmers and even make their way to our home to destroy the household materials (Korb, 2007). Termites are found associated with many organisms with which they share different types of associations like phoresy, parasitism, mutualism and commensalism (Wang *et al.*, 2002). Acarine associates of termites are a least explored area (Eickwort, 1990). Majority of the termite associated mites are from the cohort Astigmatina and the deutonymphal hypopi are the more frequently reported groups (Phillipsen and Coppel, 1977; Eraky 1998, 1999a, b, 2000, 2003; Fakeer *et al.,* 2014). O'Connor (2001) reviewed the various genera of the family Acaridae exhibiting termite association which are *Australhypopus, Machadoglyphus, Mahunkallinia, Mahunkaglyphus*, *Cosmoglyphus, Sancassania, Schweibea* and one unnamed genus. About 25 species of Mesostigmata has been reported in association with termites and termite nests (Hunter and Rosario, 1988). Records of heterostigmatic mites phoretic on termites are limited to some families like Scutacaridae, Pygmephoridae, Microdispidae, Dolichocybidae (Khaustov *et al.*, 2016, 2017, 2018a, b; Baumann and Ferragut, 2019).

Termites were collected from the termitarium from the agricultural fields of Thrissur, Palakkad and Malappuram districts of Kerala. The termites were collected in aerated plastic bottles either by using a moistened camel hairbrush or otherwise a part of termitarium containing the termites was carefully placed inside the bottle. Mites were carefully removed from the host insects and permanent slides

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Table 1. Mite species collected from the termites (Blattodea, Termitidae) with phoretic relationship

Termite species	Mite species	Family/Order of mite species	part preferred by the mite
Odontotermes feae Wasmann, 1896 Worker and soldier	1. *Premicrodispus paramaevi* (Hosseininaveh & Hajiqanbar, 2015)	Microdispidae: Trombidiformes	Sternal region
	2. *Rhizoglyphus vicantus* Manson, 1977	Acaridae: Sarcoptiformes	Dorsal head
	3. *Schweibea* sp.	Acaridae: Sarcoptiformes	Dorsal head
	4. *Caloglyphus subterraneousi* Fakeer *et al*., 2014	Acaridae: Sarcoptiformes	Dorsal head
O. obesus Rambur, 1842Worker and soldier	1. *Rhizoglyphus vicantus* Manson, 1977	Acaridae: Sarcoptiformes	Dorsal head
	2. *Sancassania boharti* (Cross, 1968)	Acaridae: Sarcoptiformes	Dorsal head
	3. *Histiostoma herbali* Eraky 2017	Histiostomatidae: Sarcoptiformes	Dorsal head
Nasutitermes gardneri Snyder, 1933 Worker and soldier	1. *Acarus solimani* Eraky 1999	Acaridae: Sarcoptiformes	Dorsal head
	2. *Acotyledon tariqi* Ashfaq *et al.,*1987	Acaridae: Sarcoptiformes	Dorsal head
	3. *Caloglyphus manuri* Negm, 2007	Acaridae: Sarcoptiformes	Dorsal head
	4. *Sapracarus* sp.	Suidasiidae: Sarcoptiformes	Dorsal head

were made by following standard procedure. (Walter and Krantz, 2009). The microscopic examination of termites revealed that mites are frequently associated with both the workers and soldiers of termites. A total of ten species belonging to nine genera, four families and two orders were collected from different body parts like dorsal head (Fig. 1) and sternal region of three termite species, *viz, Odontotermes feae* Wasmann, 1896, *O. obesus* Rambur, 1842 and *Nasutitermes gardneri* Snyder, 1933 (Table 1). Among the ten species collected, nine of them were from the order Sarcoptiformes and cohort Astigmatina while only one of them belonged to the order Trombidiformes. Seven among the ten species collected conformed to the family Acaridae. The acarine families like Microdispidae, Histiostomatidae and Suidasiidae were represented by single species. The mite

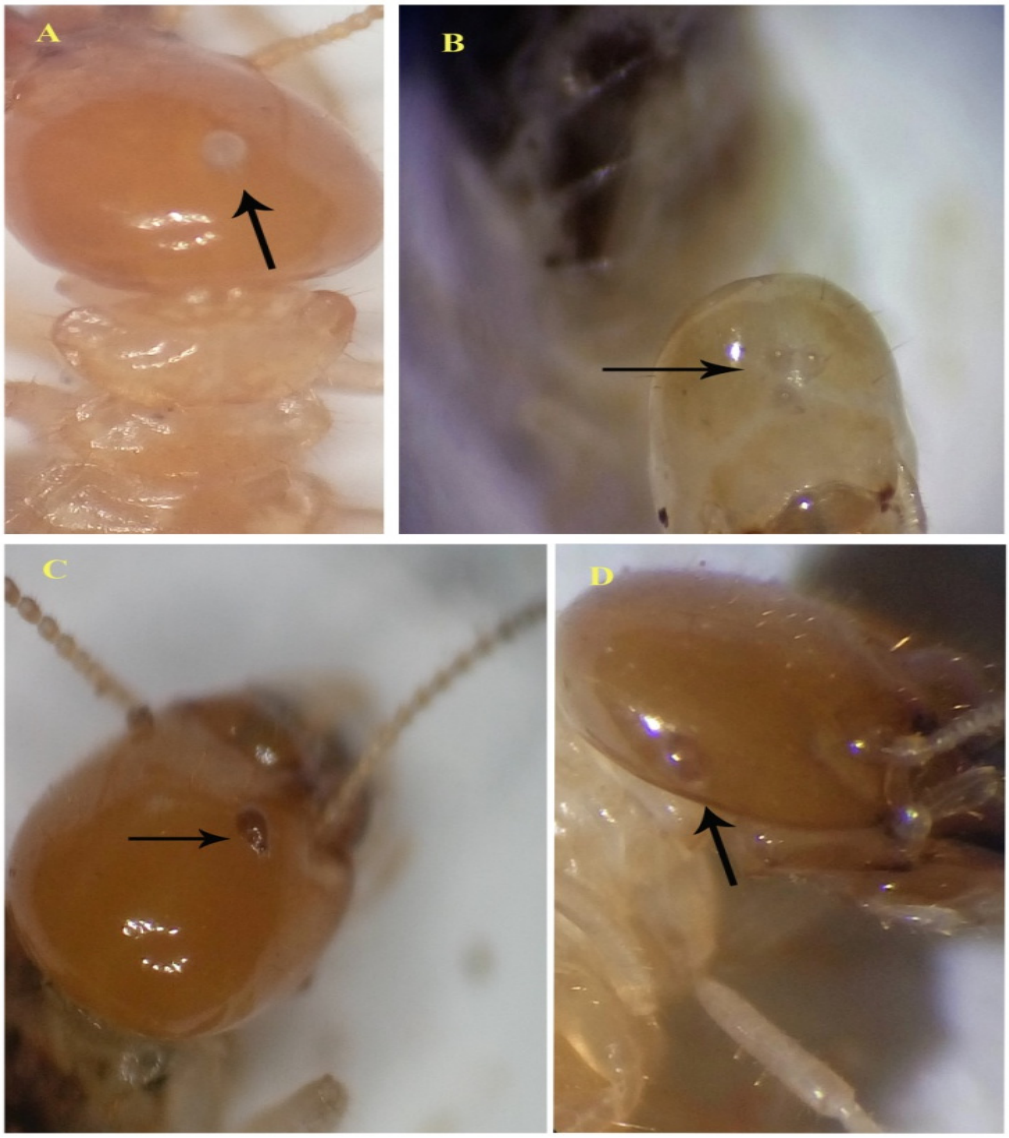

Fig. 1 A. *Histiostoma herbali* on *Odontotermes obesus*, *B. Acarus solimani* on *Nasutitermes gardneri*, *C. Caloglyphus subterraaneousi* on *Odontotermes feae*, *D. Sancassania boharti* on *Odontotermes obesus*

species were exclusively recovered in their deutonymphal stage except for one species, *Premicrodispus paramaevi* whose adult female was collected. All of the collected mite species except one species, *Rhizoglyphus vicantus* exhibited preference to a single host termite. Majority of the species preferred to attach on the dorsal head capsule of the host insect. The average number of mites collected from a single species was very low ranging from 1-2.

The present study reports 10 species of mites associated with three species of termites, all of which forms new host records. *Premicrodispus paramaevi* Hosseininaveh & Hajiqanbar, 2015 was recorded from *O. feae* is a new record and was earlier reported from the beetle *Lucanus ibericus* Motschulsky, 1845 (Hosseininaveh *et al*., 2015). The above finding concludes the wide host range of *P. paramaevi* ranging from Coleoptera to Blattodea. The mite, *Rhizoglyphus vicantus*

Manson, 1977 reported from *O. feae* and *O. obesus* in the present study has previous records from soil litter and plant materials (Barbosa and De Moraes, 2020). Likewise, *Histiostoma herbali* Eraky *et al.*, 2017, found phoretic on *O. obesus* in the present study has been previously reported from soil (Eraky *et al.*, 2017). The above two records help to draw the conclusion that mites present in the soil litter might have loaded on the termites for transport and hence phoretic in association. The report of *Acarus solimani* Eraky 1999 from *N. gardneri* in the present study is in agreement with the finding of Eraky (1999), where the author discovered *A. solimani* associated with an undetermined species of termite. The genus *Schweibea*, *Acotyledon, Caloglyphus, Sancassania* were found in association with other species of termites (O'Connor, 2001; Eraky *et al.*, 2015), which suggests that the above genera are constantly associated with termites.

Among the 10 species of mites collected, nine were found attached to the head capsule of the termite which is similar to the observation made by Wang *et al.* (2002), Myles (2002) and Silva *et al.* (2016) but the authors does not provide any particular reason for the high preference of mites towards head capsule. A similar observation was made by Behura (1956) where the hypopi of *Histiostoma polypori* (Oudemans 1914) exhibited high preference towards smooth cuticle of its host earwig and the author justified this finding that the hypopi clinging to the smooth surface of the host body is difficult to be detached. The above justification can be applied to the present observation since all the mites obtained from the head capsule was in the hypopus stage. The head capsule in the termite body offers a very smooth substratum for the hypopi to attach and can ensure a safe transport. A high incidence of astigmatid deutonymphal stage on termites implies that the mite embark on the termite body merely for transport, ie, phoresy. Members of Cohort Astigmatina exhibit heteromorphic stage called hypopus to aid in their phoretic dispersal (O'Connor, 2009), phoresy being three types; accidental, facultative and obligate as observed by Camerik (2009). The type of phoresy seen here is possibly facultative phoresy since facultative phoresy occur in relatively transient environments as observed by Camerik (2009) and termitarium offers more or less a transient habitat. The hypopus stage thus offers a free ride for the mite deutonymphs enabling them to explore different habitats where the soldiers and workers let them. Majority of mites were recovered from the family Acaridae and this observation further supports the observation that the phoresy here is not accidental since the acarid mites can be a constant associate of the fungal garden found in the termitarium and can utilise the ride offered by workers and soldiers in the termitarium as workers and soldiers are members which move out the colony for foraging and defence respectively. The constant association of acarid mites with fungus and decaying materials was observed by Zhang (2003) which again support the present observation of high incidence of acarid mites on the termite body.

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