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Biodiversity of Phoretic Mites in and Around Baramati Tehsil (MS) India

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ABSTRACT:
The study of mites is essential due to their significant roles in ecosystems, including processes such as decomposition and pollination. Despite their ecological importance, mite collections are often overlooked in entomological and acarological studies. The purpose of this research was to investigate the biodiversity of mites in various regions of Baramati, located in the state of Maharashtra, India. The findings of the present study significantly enhance our understanding of mite biology and will facilitate future research in the field of acarology. The study was conducted between October 2024 and March 2025. It revealed the presence of three species of phoretic mites belonging to the order Mesostigmata, family Diplogyniidae, Macrochelidae and Parasitidae belonging to three genera: *Diplogynium*, *Macrochilus* and *Parasitus*. These findings indicate a diverse acarine fauna within a relatively short timeframe. This research highlights the importance of systematic collection and identification of mites to gain insights into their diversity across different habitats. It encompasses a range of species, from common to rare, thereby serving as a valuable resource for the exploration of mite diversity, ecology, and evolution.

Keywords: Ecology, Morphotaxonomy, Mite diversity

Introduction:

Mites, which are an essential component of the microarthropod community, play crucial roles in ecosystems, contributing to processes such as pollination, decomposition, and the regulation of other invertebrate populations. Despite their significance, they are frequently neglected in research efforts. Mites are classified under the phylum Arthropoda and class Arachnida, specifically within the Acari group, which distinguishes them from insects due to their lack of mandibles and antennae. Their body structure consists of a gnathosoma (the mouthpart area) and an idiosoma (the fused segment that bears legs and the posterior region). Typically, mites possess legs divided into five segments that end in claws and primarily reproduce by laying eggs, often producing several generations within a year. The behaviour of mites ranges from basic predation to parasitism and herbivory. They can be found in nearly all types of environments, including terrestrial, freshwater, and marine ecosystems, and they provide benefits to humans by preying on pests and breaking down organic matter. In India, a variety of parasitic mites are identified across numerous families, including Astigmata (like Analgidae and Sarcoptidae), Prostigmata (such as Trombiculidae and Cheyletidae), and Mesostigmata (for example, Dermanyssidae and Myonyssidae) (Sonyal & Bhattacharya, 2005). Dung beetles (Scarabaeidae), which consume dung from herbivores, serve as hosts for many mite species, particularly phoretic mites that depend on beetles

for transportation between dung sources. This interaction necessitates the coordination of their life cycles and behaviours. Mites travel on beetles to new dung locations, where they disembark to feed on fly eggs, thereby decreasing maggot populations and benefitting both species (Costa, 1969; Krantz, 1983; Bartlow & Agosta, 2021; Noriega et al., 2022). The Macrochelidae family is the most prevalent group of phoretic mites, comprising over 280 species (Krantz, 1983), and they uniquely remain phoretic as adult females (Krantz & Royce, 1994). These mites feed on nematodes, springtails, and fly eggs (de Azevedo et al., 2015). Coprinae dung beetles exhibit brood care behaviour, where the parents tend to their young underground, providing mites with enhanced opportunities for dispersal and reproduction (Halffter & Edmonds, 1982). A study was scheduled from October 2024 to March 2025 in Baramati, Maharashtra to investigate mesostigmatic mites associated with dung beetles, emphasizing their diversity, ecological significance, and the necessity for thorough taxonomic research.

Material and methods:

Mites were gathered from diverse environments due to their widespread presence, although their small size posed challenges for isolation. Samples, which included mites associated with insects, were collected from different areas within the Baramati tehsil, Maharashtra (India), in clean, labelled containers that recorded the collector's details, date, time, location, and were then transported to the laboratory for further analysis. Mites were separated using the pickup technique outlined by Jogdand (1988), and mites associated with beetles were moved to sterilized petri dishes for examination under a stereo binocular dissecting microscope. To prepare the mounting medium, glycerine jelly was made by boiling 300 mL of distilled water, gradually incorporating 350 mL of glycerine and 50 gm of gelatin powder with continuous stirring to prevent clumping, followed by the addition of 1 gm of phenol. The mixture was allowed to cool to room temperature to solidify. Isolated mites were cleared in 4% lactic acid for 2–3 days with frequent checks to avoid excessive clearing, and afterward, they were mounted with the ventral side facing up on clean glass slides using a drop of melted glycerine jelly. Excess jelly was wiped away with filter paper, and the slides were air-dried, labelled with pertinent information, and preserved as permanent specimens. Morphometric measurements were conducted using ImageJ software, and the identification of the mites was carried out using visual keys established by Hughes (1976) and Vishnupriya & Mohanasundaram (1988).

Result and Discussion:

The current research illustrates the diversity (Table 1) and morphometric differences (Table 2) of mesostigmatic mites found in association with dung beetles in Baramati, Maharashtra. Three mite families—Diplogyniidae, Macrochelidae, and Parasitidae—were observed, with species such as *Diplogynium sp*., *Macrochilus limue*, and *Parasituss sp*. (Plate 1) The most commonly found host beetle species was *Oryctes rhinoceros*, followed closely by *Heliocopris Midas*. Interestingly, both male and female beetles harboured *Diplogynium sp*. and *Macrochilus limue*, showing no apparent sex specificity among hosts. The morphometric analysis (Table 2) indicated notable distinctions among species. Female *Diplogynium sp*. displayed the largest body measurements (613.652 µm in length and 405.100 µm in width), while male *Macrochilus limue* was the smallest recorded (264.357 µm in length and 130.129 µm in width), possibly indicating juvenile stages or concealed morphological variations. *Parasituss sp*. had the longest Leg I (462.944 µm), potentially representing adaptations for phoresy—where mites utilize

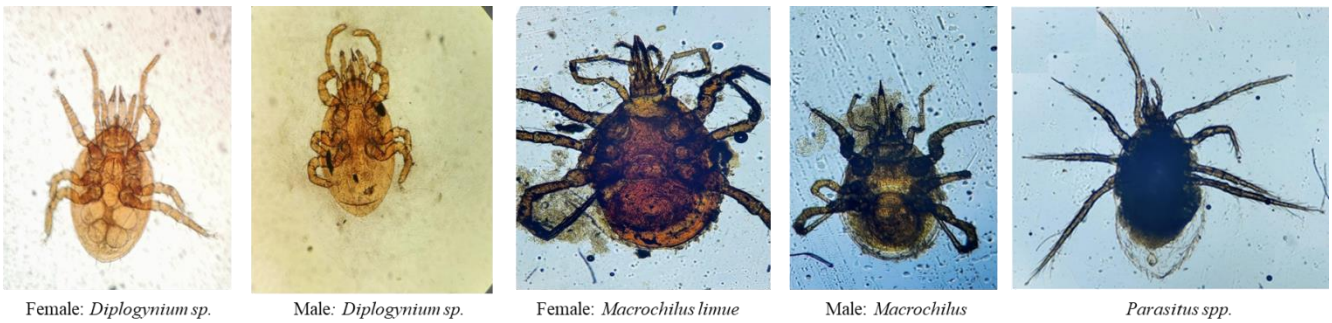
dung beetles for transportation to new environments. Differences in cheliceral and pedipalpal lengths across the species (e.g., chelicera of female *Diplogynium sp.*: 174.233 µm compared to *Parasituss sp.*: 82.976 µm) may relate to their distinct feeding strategies, such as preying on nematodes or fly eggs. The morphometric variations observed within *Macrochilus limue* (male versus female) further indicate possible intraspecific variability or hidden speciation. The steady occurrence of macrochelid mites like *Macrochilus limue*, which possess specialized structural features, highlights their ecological significance in dung decomposition and pest control by curbing populations of fly larvae. These results underscore the essential role of dung beetle-mite associations in ecosystem dynamics and stress the necessity for more thorough taxonomic, ecological, and behavioural research on these often-overlooked micro-arthropods.

Order	**Family**	**Species**	**Habitat**
Mesostigmata	Diplogyniidae	*Diplogynium sp.*	*Oryctes rhinoceros*
	Macrochelidae	*Macrochilus limue*	
	Parasitidae	*Parasitus sp.*	*Heliocopris midas*

Table 1: List of mites along with their habitats and taxonomic position

Species	**Length**	**Width**	**Leg I**	**Leg II**	**Leg III**	**Leg IV**	**Chelicera**	**Pedipalp**
Female: *Diplogynium sp.*	613.652	405.100	425.376	369.439	331.388	495.327	174.233	179.725
Male: *Diplogynium sp.*	603.269	384.047	336.054	252.161	248.620	288.780	147.733	192.982
Male: *Macrochilus limue*	264.357	130.129	225.669	132.852	126.692	190.420	144.074	122.102
Female: *Macrochilus limue*	569.706	375.492	248.645	206.021	237.132	255.089	148.388	129.137
Parasitus sp.	534.135	280.030	462.944	335.598	324.014	456.247	82.976	107.079

Table 2: Measurements of body length and width (in µm) of mites



Female: *Diplogynium sp.* Male: *Diplogynium sp.* Female: *Macrochilus limue* Male: *Macrochilus* *Parasitus spp.*

Plate 1: Mite Diversity

Conclusion:

The current research focuses on the variety and unique morphometric traits of mesostigmatic mites linked to dung beetles in Baramati, Maharashtra. The discovery of three primary mite families, Diplogyniidae, Macrochelidae, and Parasitidae, alongside their host specificity and morphological adaptations, illustrates the ecological intricacies of dung beetle–mite relationships. Significant differences in body size, leg length, and feeding structures indicate functional adaptations for dispersal and predation, highlighting their contributions to nutrient recycling and pest management. The stable occurrence of these mites across various beetle sexes and species demonstrates their ecological resilience and adaptability. These results stress the importance of conducting more in-depth taxonomic and environmental research to enhance our understanding of the biodiversity, behaviour, and ecosystem services offered by these often-overlooked micro-arthropods.

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