Interdisciplinary Journal of Information, Knowledge, and Management
An Official Publication of the Informing Science Institute InformingScience.org
Vol. : 21,Issue 1,Jan-June 2026
ISSN: (E) 1555-1237

TAXONOMIC DIVERSITY AND ECOLOGICAL ROLES OF BASIDIOMYCETES IN THE TERRESTRIAL ECOSYSTEMS OF DHULE REGION, MAHARASHTRA, INDIA

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1.1 Abstract

1.2 The present study investigates the taxonomic diversity and ecological roles of Basidiomycetes in the terrestrial ecosystems of the Dhule region, Maharashtra, India. Systematic field surveys were conducted during the monsoon and post-monsoon seasons (2024–2025) across diverse microhabitats, including forest floor, decaying wood, leaf litter, and soil. Fungal specimens were documented, photographed, and identified based on macroscopic morphological characteristics.

The study recorded representative Basidiomycetes belonging to different ecological groups such as lignicolous, saprophytic, and symbiotic forms. Identified species included *Termitomyces clypeatus*, *Sarcomyxa serotina*, *Amanita virgineoides*, and *Ganoderma lucidum*. The distribution of these fungi was strongly influenced by substrate type, moisture availability, and seasonal rainfall patterns, with higher occurrence observed during the monsoon period.

Basidiomycetes play a crucial role in ecosystem functioning through the decomposition of lignocellulosic materials, nutrient cycling, and soil enrichment. Variations in rainfall significantly affected fungal abundance, indicating that moisture is a key factor regulating fungal growth in semi-arid ecosystems.

The findings provide baseline information on fungal diversity in an underexplored region. The study also emphasizes the need for further taxonomic and molecular investigations and highlights the importance of conserving habitats that support macrofungal diversity.

Keywords: Basidiomycetes, macrofungi, taxonomic diversity, nutrient cycling, lignicolous fungi, semi-arid ecosystem

1. Introduction

Basidiomycetes represent one of the most diverse and ecologically significant groups within the Kingdom Fungi, comprising a wide range of macrofungi such as mushrooms, bracket fungi, puffballs, and stinkhorns. These fungi are characterized by the production of basidiospores on specialized structures known as basidia and are widely distributed across terrestrial ecosystems (Alexopoulos et al., 1996; Webster & Weber, 2007). They occur on forest floors, decaying wood, leaf litter, and soil substrates, where they play a crucial role in maintaining key ecosystem processes.

A major ecological function of Basidiomycetes is their role as primary decomposers of lignocellulosic materials. Through the secretion of extracellular enzymes, including lignin peroxidase, manganese peroxidase, and cellulases, these fungi degrade complex plant polymers such as lignin and cellulose, which are otherwise resistant to decomposition (Kirk & Farrell, 1987; Baldrian, 2008). This process facilitates nutrient cycling by releasing essential elements such as carbon, nitrogen, and phosphorus into the soil, thereby enhancing soil fertility and supporting plant productivity. In addition, Basidiomycetes contribute significantly to global carbon cycling and ecosystem sustainability (Dighton, 2003; Lindahl & Tunlid, 2015).

India is recognized for its rich fungal biodiversity due to its diverse climatic and ecological conditions. However, despite this diversity, macrofungi remain underexplored, particularly in semi-arid regions such as the Dhule region of Maharashtra (Manoharachary et al., 2005; Hawksworth, 2001). This region is characterized by fluctuating environmental conditions, including irregular rainfall, high temperatures, and variable organic matter availability, which create unique ecological niches for fungal communities. The distribution and occurrence of Basidiomycetes in such environments are influenced by multiple environmental factors, including substrate type, moisture availability, and microhabitat variability.

Most previous studies on fungal diversity in India have focused on humid and forested ecosystems, whereas semi-arid ecosystems have received comparatively less attention (Mueller et al., 2004; Tedersoo et al., 2014). Consequently, there is limited information on the taxonomic diversity, ecological distribution, and functional roles of Basidiomycetes in regions like Dhule. Understanding fungal diversity in such habitats is essential for assessing ecosystem health, biodiversity conservation, and sustainable resource management.

The present study aims to document the taxonomic diversity of Basidiomycetes in selected terrestrial ecosystems of the Dhule region, Maharashtra, India, and to evaluate their ecological roles, particularly in relation to decomposition processes and nutrient cycling. The study also examines the influence of environmental factors on their distribution patterns. By generating region-specific baseline data, this research contributes to the existing knowledge of fungal biodiversity and the ecological importance of Basidiomycetes in maintaining the functional integrity of semi-arid ecosystems.

2. Review of Literature

Basidiomycetes represent a major group of macrofungi that play essential roles in terrestrial ecosystems, particularly in decomposition and nutrient cycling. According to Alexopoulos et al. (1996) and Webster and Weber (2007), Basidiomycetes are widely distributed and include ecologically important forms such as mushrooms, bracket fungi, and puffballs. Their ability to produce ligninolytic enzymes enables them to degrade complex plant polymers, making them key contributors to ecosystem functioning.

The role of Basidiomycetes in lignocellulosic degradation has been extensively studied. Kirk and Farrell (1987) reported that these fungi possess unique enzymatic systems capable of breaking down lignin, a highly resistant component of plant cell walls. Similarly, Baldrian (2008) highlighted the importance of extracellular enzymes such as lignin peroxidase and manganese peroxidase in wood decomposition. These processes are fundamental for nutrient recycling and carbon turnover in forest ecosystems (Dighton, 2003; Lindahl & Tunlid, 2015).

Fungal biodiversity has been recognized as a critical component of global biodiversity. Hawksworth (2001) estimated that millions of fungal species exist worldwide, although only a fraction has been described. In India, Manoharachary et al. (2005) documented significant fungal diversity; however, studies have largely focused on humid and forest ecosystems. Mueller et al. (2004) and Tedersoo et al. (2014) emphasized that fungal diversity varies significantly across ecosystems and is influenced by environmental factors such as climate, substrate availability, and soil conditions.

Several studies have highlighted the ecological importance of macrofungi in different habitats. Boddy (2001) discussed the role of fungi in wood decomposition and ecosystem dynamics, while Osono (2007) emphasized their involvement in litter decomposition and nutrient cycling. Recent studies by He et al. (2022) and Debeljak and Baltar (2023) further confirmed that Basidiomycetes exhibit high diversity and functional specialization across different ecological niches.

Vol. : 21,Issue 1,Jan-June 2026
ISSN: (E) 1555-1237

Although their ecological importance, macrofungi remain underexplored in semi-arid regions. Environmental constraints such as low moisture availability and high temperature fluctuations limit fungal growth and distribution in such areas. However, seasonal rainfall has been identified as a key factor influencing fungal fruiting and diversity patterns. Studies indicate that fungal abundance increases significantly during the monsoon season due to favourable moisture conditions (Tedersoo et al., 2014).

Generally, previous research highlights the ecological significance of Basidiomycetes and the need for region-specific studies. However, there is limited information on fungal diversity in semi-arid regions such as the Dhule region of Maharashtra. Therefore, the present study aims to fill this gap by documenting the taxonomic diversity and ecological roles of Basidiomycetes in this underexplored area.

3. Material & Methods

3.1 Study Area

The present study was conducted in selected terrestrial ecosystems of the Dhule region, Maharashtra, India. The region is characterized by a semi-arid climate, with high temperatures and seasonal rainfall occurring primarily during the monsoon period (June–September). Vegetation in the study area includes scattered trees, shrubs, grasses, and agricultural fields, contributing to the accumulation of organic matter in the form of leaf litter and deadwood. These environmental conditions provide suitable microhabitats for the growth and development of Basidiomycetes, particularly those associated with lignocellulosic substrates.

3.2 Field Survey and Sampling

Systematic field surveys were conducted during the monsoon and post-monsoon seasons (June to October 2024–2025), when fungal fruiting bodies are most abundant. Sampling sites included forest patches, grasslands, agricultural margins, and areas rich in organic debris.

Fungal specimens were observed in situ and documented using GPS-enabled devices to record geographic coordinates and spatial distribution. Ecological parameters such as habitat type, substrate (soil, leaf litter, deadwood, decaying logs), moisture conditions, and growth pattern (solitary or clustered) were recorded for each specimen. Representative specimens were carefully collected using sterile techniques to avoid contamination and were transported to the laboratory in labelled containers. Field photographs were taken to capture diagnostic macroscopic features. Monthly rainfall data for the study period were recorded and used for analysis of environmental influence on fungal distribution."

3.3 Morphological Identification

Collected specimens were identified based on macroscopic morphological characteristics using standard taxonomic keys and literature (Alexopoulos et al., 1996; Webster & Weber, 2007). Observations included pileus shape, size, colour, surface texture, hymenial configuration (gills, pores, or gleba), stipe characteristics, and mode of attachment to the substrate.

Identification was carried out up to genus or species level wherever possible by comparing field observations with published descriptions and available fungal databases. Microscopic observations were not included in the present study and represent a limitation of the identification process.

3.4 Ecological Classification

The recorded Basidiomycetes were classified based on their ecological roles and substrate preference. Fungi growing on deadwood were categorized as lignicolous (wood-decaying), whereas those occurring on soil and leaf litter were classified as saprophytic soil fungi. Species exhibiting specialized ecological associations, such as termite-associated fungi (*Termitomyces*), were recorded separately due to their ecological significance.

3.5 Data Analysis

Species diversity was analysed using Shannon–Wiener (H′) and Simpson's (D) indices to evaluate species richness, evenness, and dominance across different habitats in the Dhule region.

4. Results and Discussion

4.1 Taxonomic Diversity of Basidiomycetes

The present study documented a diverse assemblage of Basidiomycetes from terrestrial ecosystems of the Dhule region, Maharashtra. The recorded taxa represented major morphological groups, including polypores, bracket fungi, agaricoid (gilled) mushrooms, and stinkhorn fungi.

The identified species included *Termitomyces clypeatus*, *Sarcomyxa serotina*, *Amanita virgineoides*, and *Ganoderma lucidum*, representing distinct ecological strategies such as symbiotic, saprophytic, and lignicolous (wood-decaying) forms. The occurrence of these taxa indicates considerable taxonomic diversity within the study area and reflects the adaptability of Basidiomycetes to semi-arid environmental conditions. However, the diversity recorded represents a preliminary assessment due to limited sampling.

4.2 Morphological Diversity

The collected specimens exhibited significant morphological variation corresponding to their ecological functions. *Ganoderma lucidum* showed a hard, woody, bracket-shaped basidiocarp with a characteristic varnished surface, typical of polypores adapted for long-term persistence on woody substrates. *Sarcomyxa serotina* displayed a soft, laterally attached fruiting body, reflecting adaptation to lignicolous habitats. In difference, *Termitomyces clypeatus* and *Amanita virgineoides* exhibited umbrella-shaped pilei with well-developed stipes and lamellae, facilitating efficient basidiospore production and wind-mediated dispersal. These morphological differences highlight functional adaptations that enable species to exploit diverse ecological niches.

4.3 Ecological Distribution

The distribution of Basidiomycetes was strongly influenced by substrate type and environmental conditions. *Ganoderma lucidum* and *Sarcomyxa serotina* were predominantly observed on decaying wood, indicating their lignicolous and saprophytic nature.

Termitomyces clypeatus was recorded in soil associated with termite activity, demonstrating a symbiotic relationship, whereas *Amanita virgineoides* was found in soil habitats, indicating probable mycorrhizal associations with plant roots. Most species were recorded during the monsoon season, particularly in moist and shaded microhabitats, which favour fungal growth and fruiting body development.

4.4 Influence of Rainfall

Fungal diversity and abundance exhibited a strong relationship with rainfall patterns during the study period.

Table 1. Monthly Rainfall Percentage (%) in Dhule Taluka (2024)

Taluka	June	July	August	September	October
Dhule	157.7	137.5	156.1	95.5	275.7

Table 2. Monthly Rainfall Percentage (%) in Dhule Taluka (2025)

Taluka	June	July	August	September	October
Dhule	107.7	98.5	186.7	184.9	10.3

Fungal diversity and abundance were strongly influenced by rainfall patterns. Higher fungal occurrence was observed during the monsoon months (June–September) due to increased moisture, which favors the development of fruiting bodies. The very high rainfall in October 2024 (275.7%) likely supported extended fungal growth, whereas the low rainfall in October 2025 (10.3%) resulted in reduced fungal presence. Overall, rainfall plays a key role in regulating the distribution and seasonal occurrence of Basidiomycetes in the Dhule region.

4.5. Taxonomic account

A) *Termitomyces clypeatus* R. Heim

Taxonomic Classification:
Domain: Eukaryota
Kingdom: Fungi
Phylum: Basidiomycota
Class: Agaricomycetes
Order: Agaricales
Family: Lyophyllaceae
Genus: *Termitomyces*
Species: *Termitomyces clypeatus*

The specimen was recorded from moist soil rich in organic matter, often in association with termite activity. *Termitomyces clypeatus* is a symbiotic fungus forming mutualistic associations with termites. It plays a crucial ecological role in the decomposition of lignocellulosic material within termite mounds, thereby contributing to nutrient cycling and soil enrichment. Species-level identification is based on macroscopic characteristics; however, further microscopic and molecular analyses are required for confirmation

B) *Sarcomyxa serotina* (Pers.) P. Karst.

Taxonomic Classification:
Domain: Eukaryota
Kingdom: Fungi
Phylum: Basidiomycota
Class: Agaricomycetes
Order: Agaricales
Family: Sarcomyxaceae
Genus: *Sarcomyxa*
Species: *Sarcomyxa serotina*

This species was observed growing on decaying hardwood, indicating a lignicolous and saprophytic mode of life. *Sarcomyxa serotina* plays an important role in wood decomposition by degrading complex organic polymers such as lignin and cellulose. It is typically found during cooler seasons and contributes to nutrient recycling in forest ecosystems. Identification is based on macroscopic characters; confirmation at the species level requires detailed microscopic and molecular analysis.

C) *Amanita virgineoides* Bas

Taxonomic Classification:
Domain: Eukaryota
Kingdom: Fungi
Phylum: Basidiomycota

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Class: Agaricomycetes
Order: Agaricales
Family: Amanitaceae
Genus: *Amanita*
Species: *Amanita virgineoides*

The specimen was found growing on soil in association with plant roots, suggesting a mycorrhizal relationship. Amanita virgineoides belongs to a genus known for forming symbiotic associations with higher plants, facilitating nutrient exchange between soil and host plants. Members of Amanita are ecologically significant; however, some species are toxic and require careful identification. Identification is based on macroscopic features and requires microscopic and molecular confirmation.

D) *Ganoderma lucidum* (Curtis) P. Karst.

Taxonomic Classification:
Domain: Eukaryota
Kingdom: Fungi
Phylum: Basidiomycota
Class: Agaricomycetes
Order: Polyporales
Family: Ganodermataceae
Genus: Ganoderma
Species: Ganoderma lucidum

The specimen was observed on decaying wood, exhibiting a bracket-shaped, woody basidiocarp with a characteristic varnished appearance. *Ganoderma lucidum* is a well-known wood-decaying fungus that plays a vital role in lignin degradation and nutrient cycling. It is also recognized for its medicinal properties and ecological importance in forest ecosystems. Species identification is based on macroscopic characters and requires further microscopic and molecular confirmation.

	
Termitomyces clypeatus **R. Heim**	*Sarcomyxa serotina* **(Pers.) P. Karst.**

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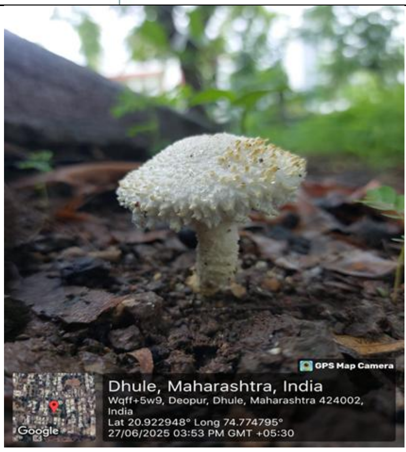	
Amanita virgineoides **Bas**	*Ganoderma lucidum* **(Curtis) P. Karst.**

Fig 1. Basidiomycete species recorded in the study area

5. Discussion

The present study taxonomic and ecological diversity of Basidiomycetes in the semi-arid ecosystems of the Dhule region. The occurrence of different fungal taxa across varied substrates indicates their ecological adaptability and niche specialization.

Wood-decaying fungi such as *Ganoderma lucidum* and *Sarcomyxa serotina* play a crucial role in the degradation of lignin and cellulose, thereby contributing significantly to carbon cycling and nutrient recycling. Soil-inhabiting fungi such as *Amanita virgineoides* form mycorrhizal associations, facilitating nutrient exchange between soil and host plants and enhancing soil fertility. The presence of *Termitomyces clypeatus* reflects specialized symbiotic interactions with termites, representing an efficient pathway for lignocellulosic decomposition. Such mutualistic associations enhance nutrient availability and contribute to ecosystem sustainability.

Morphological diversity among the recorded taxa reflects evolutionary adaptations for survival and reproduction. Bracket fungi are adapted for long-term persistence on woody substrates, whereas gilled mushrooms facilitate efficient spore dispersal through increased hymenial surface area. These findings are consistent with previous studies (Boddy, 2001; Osono, 2007), which highlight the role of environmental factors in regulating fungal diversity.

Environmental factors, particularly rainfall and substrate availability, strongly influence fungal distribution and diversity. The observed increase in fungal occurrence during the monsoon season checks that moisture is a key limiting factor in semi-arid ecosystems. These findings are consistent with previous studies on macrofungal ecology, which emphasize the role of climatic conditions in regulating fungal growth and distribution.

6. Conclusion

The present study demonstrates that Basidiomycetes in the Dhule region exhibit remarkable taxonomic, morphological, and ecological diversity across different terrestrial habitats. The recorded species-*Termitomyces clypeatus*, *Sarcomyxa serotina*, *Amanita virgineoides*, and *Ganoderma lucidum*-represent diverse ecological strategies, including symbiotic, saprophytic, and lignicolous forms. These fungi play a crucial role in ecosystem functioning through the decomposition of lignocellulosic materials, nutrient cycling, and soil enrichment, thereby contributing to ecosystem stability and productivity. The study also reveals that environmental factors, particularly rainfall and substrate availability, significantly influence fungal distribution and seasonal occurrence, with higher diversity observed during the monsoon period. This work provides baseline data on fungal diversity in an underexplored semi-arid region. However, the findings are based on macroscopic identification and limited sampling; therefore, further studies incorporating microscopic and molecular techniques, along with long-term monitoring, are essential for accurate identification and a more comprehensive understanding of fungal biodiversity.

7. Acknowledgment

The authors are grateful to the Principal of K.T.H.M. College, Nashik, for providing necessary facilities. We sincerely thank our research guide for valuable guidance and support. We also acknowledge the Department of Botany for their cooperation during the study.

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