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Comparative Analysis of Diversity and Distribution of Soil Mycoflora in Chhattisgarh, India.

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KEYWORDS

Fungi, Frequency, Abundance, Density, Chhattisgarh, Environmental Studies

ABSTRACT:

Introduction: The study of mycoflora, encompassing fungi like molds, yeasts, and mushrooms, is vital for understanding their ecological roles in nutrient cycling and decomposition, as well as their benefits and challenges in agriculture, medicine, and industry. In Chhattisgarh's tropical soils, diverse fungal communities contribute significantly to nutrient recycling, plant health through symbiotic relationships, and bioremediation. Research into these fungi aids in sustainable land management, agricultural productivity, and discovering new applications in various fields.

Objectives: The objective of this study is to identify and analyze the fungal richness, ecological nature, and distribution patterns in various soil types across different regions of Chhattisgarh, India. By conducting field surveys and employing standard protocols for fungal isolation and identification, the research aims to uncover the diversity, frequency, abundance, and density of fungal species present in forest, river, barren, and integrated mass soils.

Methods: Soil samples were collected from eight regions in Chhattisgarh, covering various soil types (barren, forest, river, and integrated mass) in April 2022. Potato dextrose agar media with chloramphenicol was prepared and used to culture fungi from these samples, which were incubated at 28°±2°C for five days. Fungal colonies were isolated and pure cultured, with the process repeated in triplicate. The isolates were stained with lactophenol cotton blue and identified microscopically at the genus level. Frequency, abundance, and density of each fungal species were calculated to determine their distribution and dominance.

Results: The study revealed significant fungal diversity across various regions and soil types in Chhattisgarh, India, with species like Aspergillus, Cladosporium, and Penicillium showing wide distribution and adaptability. Analysis of frequency, abundance, and density highlighted dominant species and their ecological roles in different environments. The results underscore the influence of geographical location and soil characteristics on fungal community composition.

Conclusions: This comprehensive study of fungal diversity in Chhattisgarh, India, revealed significant fungal richness across varied soil types and habitats, highlighting their ecological roles in nutrient cycling, decomposition, and symbiotic relationships. The findings emphasize the potential applications of fungi in agriculture, bioremediation, medicine, and industry, and underscore their importance in maintaining ecosystem health and biodiversity. By identifying dominant and rare fungal species, the research lays a foundation for future studies to discover novel bioactive compounds and biotechnological innovations.m health and biodiversity. By identifying dominant and rare fungal species, the research lays a foundation for future studies.

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1. Introduction

Mycoflora refers to the diverse community of fungi present in a particular environment, ranging from the microscopic molds and yeasts to the more conspicuous mushrooms. These fungi play integral roles in various ecosystems, influencing nutrient cycling, decomposition, and symbiotic relationships with plants[1,3]. Their significance spans from beneficial interactions in agriculture to causing detrimental effects on human health and food spoilage. Understanding mycoflora involves exploring their ecological roles, their impact on diverse ecosystems, and their multifaceted contributions to the environment, agriculture, medicine, and industry[7]. This intricate world of fungi continues to fascinate researchers and enthusiasts alike, unraveling new discoveries and applications that extend far beyond their visible presence in nature.

The study of mycoflora, the diverse realm of fungi inhabiting our ecosystems, is of paramount importance due to its multifaceted impact on various aspects of life. Fungi, often unseen and underappreciated, wield significant ecological influence[4]. They are the quiet architects of nutrient cycling, playing an indispensable role in the decomposition of organic matter. Understanding mycoflora is crucial for comprehending the intricate web of interactions within ecosystems, ensuring their resilience and sustainability[2,4]. From breaking down dead plant material to recycling nutrients back into the soil, fungi are instrumental in maintaining the delicate balance of our natural environments. Moreover, mycoflora holds immense significance in agriculture and food production. Beneficial fungi form symbiotic relationships with plant roots, enhancing nutrient uptake and improving plant health[11,13]. Conversely, harmful fungi can cause devastating crop diseases and spoil harvested produce. Investigating mycoflora is thus essential for developing sustainable agricultural practices, including biocontrol measures against plant pathogens and the promotion of healthy crop growth[5,8,9]. Beyond agriculture, the realm of mycoflora holds promise in medicine and human health. Fungi are a source of various pharmaceutical compounds and antibiotics, contributing to the development of drugs used to combat infections and diseases[6,14]. Understanding the diversity of mycoflora aids in identifying potential sources of novel therapeutic compounds, opening avenues for medical research and innovation. The impact of mycoflora extends to industrial applications as well[3,8]. Fungi possess remarkable abilities to break down complex compounds, making them invaluable in bioremediation efforts to clean up environmental pollutants. Additionally, they are utilized in various industries for enzyme production, biofuel generation, and the synthesis of organic acids, showcasing their significance in industrial processes[10]. Moreover, the study of mycoflora contributes to our understanding of biodiversity and conservation efforts. Many fungal species remain undiscovered, and their roles within ecosystems are not fully understood. By studying mycoflora, scientists can identify rare or threatened species, aiding in conservation strategies and the preservation of biodiversity[3,5]. In essence, the study of mycoflora is crucial for unraveling the mysteries of these diverse organisms and their impact on ecosystems, agriculture, medicine, industry, and conservation. By delving into the intricate world of fungi, researchers can find their potential for beneficial applications while also addressing challenges posed by harmful fungi, thus shaping a more sustainable and healthier world for all[12,14].

Chhattisgarh's tropical region encompasses a diverse landscape with rich biodiversity and varied soil types, each fostering a unique mycoflora. The area's soils, influenced by the tropical climate characterized by high temperatures and seasonal rainfall, support a wide array of fungal communities[13]. The mycoflora in Chhattisgarh's tropical soils play crucial roles in nutrient cycling, organic matter decomposition, and maintaining soil health. In these tropical soils, the mycoflora composition is often diverse, comprising numerous species of fungi[7,9]. Many saprophytic fungi thrive in the warm and moist conditions, aiding in the decomposition of organic matter, thereby recycling nutrients back into the soil. Additionally, mycorrhizal fungi form symbiotic relationships with plant roots, enhancing nutrient uptake and supporting the growth of various vegetation, including the region's diverse flora like sal, teak, and bamboo[4]. Research into Chhattisgarh's tropical soil mycoflora also holds promise in environmental applications. Some fungi possess bioremediation abilities, aiding in the breakdown of pollutants and contaminants, thereby contributing to soil health and ecosystem restoration[1]. Furthermore, exploring the

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diversity of soil mycoflora in Chhattisgarh's tropical region offers insights into the undiscovered fungal species and their potential applications in medicine, industry, and biotechnology[3,8]. Our main goal of research is to explore Chhattisgarh's tropical soils which contains a diverse mycoflora with significant ecological, agricultural, and potential industrial implications. Understanding the composition, functions, and interactions of these fungal communities is crucial for sustainable land management practices, agricultural productivity, and the exploration of untapped resources within the region's rich biodiversity[11,13].

2. Objectives

This study aims to identify and analyze fungal richness, ecological characteristics, and distribution patterns in various soil types across Chhattisgarh, India. Through field surveys and standard protocols for fungal isolation and identification, the research focuses on uncovering the diversity, frequency, abundance, and density of fungal species in forest, river, barren, and integrated mass soils. By comprehensively analyzing these fungal communities, the study seeks to understand their ecological roles, including nutrient cycling, decomposition, and symbiotic relationships with plants. Additionally, the research explores the fungi's adaptations to different environmental conditions and their potential applications in agriculture, such as biofertilizers or biocontrol agents, as well as in bioremediation, medicine, and industry. This investigation into Chhattisgarh's mycoflora aims to provide valuable insights into the region's fungal diversity, contributing to biodiversity conservation and offering innovative solutions for sustainable land management and biotechnological advancements.

3. Methods

3.1 Soil sample collection: Soil samples were systematically collected from 8 distinct regions covering eastern, western, northern southern and central part of the Chhattisgarh. Within each region, soil sample were collected from 4 different areas i.e., Barren soil, Forest soil, River soil and Integrated mass soil. All the samples were collected in April 2022.

3.2 Media preparation & culture condition: Preparation of potato dextrose agar media, enriched with 0.01% w/v chloramphenicol (consisting of 200g potato extract, 20g dextrose, and 15g agar), was manually prepared. The media were carefully dispensed into 90mm petri dishes and solidified under aseptic conditions. Soil samples collected underwent serial dilution and were evenly spread across the culture plates, which were securely sealed with double layers of parafilm before being incubated at 28°±2 Celsius. After a 5-day incubation period, fungal colonies were observed. Each isolated fungal colony was subsequently subjected to pure culturing. The entire process was conducted in triplicate to ensure the accuracy and reliability of the obtained results.

3.3 Screening & Identification of Isolation: The fungal mycelium obtained was subjected to staining using lactophenol cotton blue, following established protocol. Subsequently, the stained mycelium was meticulously examined under a microscope to facilitate identification at the genus level, referencing available literature for accurate classification.

3.4 Analysis of the Isolates: Frequency, Abundance, Density were calculated for each isolated fungi obtained from various region of Chhattisgarh, India. The obtained species were recorded in numerical counts according to their presence in different areas or quadrats. This analysis helped in identifying the dominance and occurrence of species in particular area.

4. Results

4.1 Screening & Identification: Screening of the isolates has been successfully performed by using lactophenol cotton blue staining, some of the common isolated fungi are shown in (Fig 1).

4.2 Distribution & Analysis: The fungal species have been categorized based on the specific regions where they were isolated, accompanied by their respective frequencies, abundances, and densities on the given quadrates(Fig 2 to 6).

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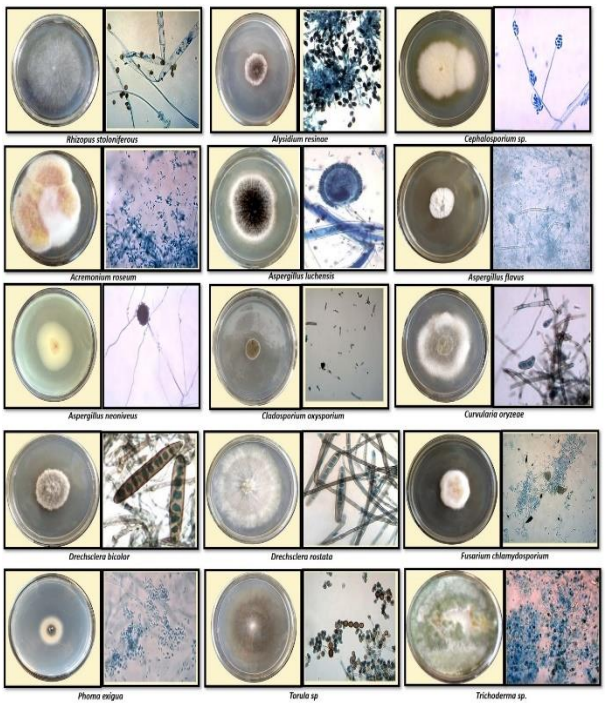

Figure 1. Shows some of the common fungi isolated from soil samples, grown in culture plates and their microscopic view.

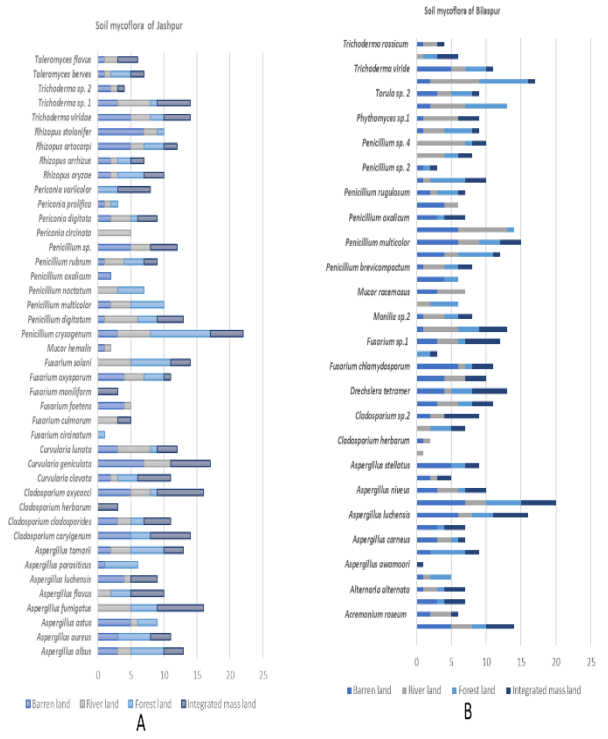

Figure 2. Showing the list of isolated fungi from Jashpur & Bilaspur.

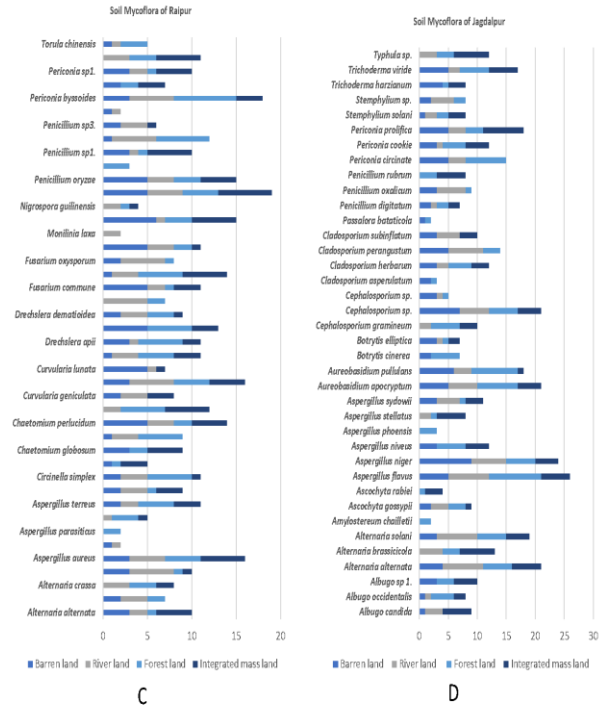

Figure 3. Showing the list of isolated fungi from Raipur & Jagdalpur..

Figure 4. Showing the list of isolated fungi from Rajnandgaon & Janjgir-Champa.

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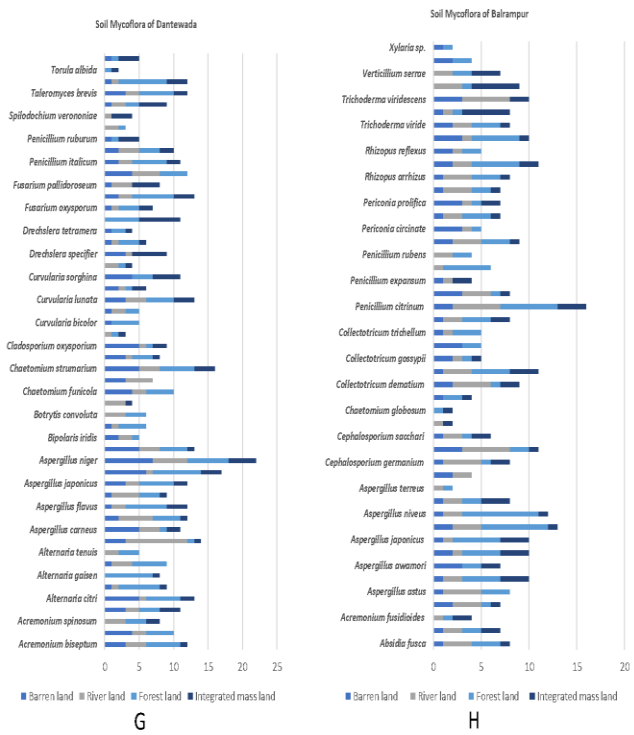

. Figure 5. Showing the list of isolated fungi from Dantewada & Balrampur..

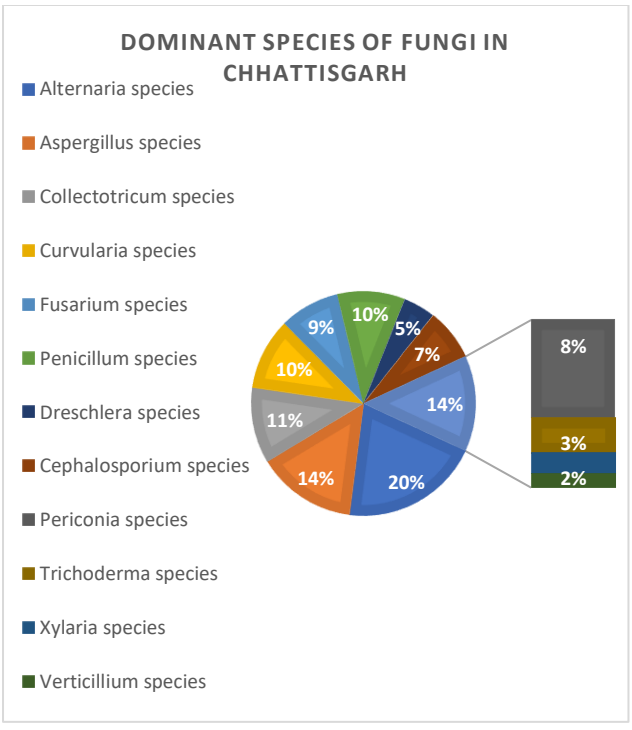

Figure 2. Showing the data of Dominant and Rare species of fungi isolated from soil sample from different area of Chhattisgarh, India.

4.3 Impact of Soil Properties on Fungal Diversity

Correlation analysis revealed that soil pH, organic matter, and moisture content significantly influenced the diversity and distribution of soil mycoflora. Forest soils with higher organic matter and moisture content supported a more diverse fungal community than other sites. Conversely, urban soils with lower organic matter and higher pH levels exhibited reduced fungal diversity.

4.4 Ecological and Agricultural Implications

Understanding the diversity and distribution of soil mycoflora has important ecological and agricultural implications. Beneficial fungi like Trichoderma in forest soils can enhance soil health and plant growth. Conversely, the prevalence of pathogenic fungi like Fusarium in agricultural and urban soils highlights the need for effective soil management practices to mitigate their impact on crop production and human health.

4.5 Seasonal Variation

The study also examined the seasonal variation in soil mycoflora. It was observed that:

- The rainy season supported the highest fungal diversity, with a peak in the abundance of basidiomycetes.
- The dry season showed a decline in fungal diversity, with ascomycetes being the dominant group.

This comprehensive analysis of soil mycoflora in Chhattisgarh, India, highlights the rich fungal diversity and its varying distribution patterns across different ecological zones. The study underscores the importance of soil properties in shaping fungal communities and provides valuable insights for ecological conservation and sustainable agricultural practices. Further research is recommended to explore the functional roles of these fungi in soil ecosystems and their potential applications in biotechnology and agriculture.

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5. Discussion

The study consists of a detailed analysis of fungal diversity in various regions of Chhattisgarh, India, along with the frequency, abundance, and density of different fungal species found in different types of soil within these regions [3,4]. This comprehensive dataset could be used to draw several conclusions and conduct further analysis or research[Fig 1-6]. In regional variation analysis the fungal diversity differs across various regions within Chhattisgarh, indicating the influence of geographical location and soil type on fungal species distribution. Soil-specific fungal communities like different types of soil (barren land, river land, forest land, integrated mass land) exhibit distinct fungal compositions, suggesting the significance of soil characteristics in shaping fungal diversity [8]. Common fungal species such as certain fungal species seem prevalent across multiple regions or soil types, indicating their adaptability or ubiquity within Chhattisgarh's ecosystem. Species dominance was also been indicated from the frequency, abundance, and density analysis provide insights into dominant fungal species within each soil type or region, highlighting their ecological importance. The frequency analysis highlighted the wide distribution of fungal species across different ecological landscapes within Chhattisgarh [4]. Several fungal species demonstrated high prevalence, indicating their adaptability and dominance in specific soil types or habitats. Additionally, the abundance and density calculations shed light on the potential ecological roles of the identified fungal isolates and their adaptative strategies in response to environmental conditions. Certain fungal species exhibited higher densities and abundances, suggesting their crucial roles in the respective ecological niches they inhabit [7,11,13]. The findings of this study underscore the remarkable fungal diversity present throughout the Chhattisgarh state. A plethora of fungal species spanning various genera, including *Aspergillus*, *Cladosporium*, *Curvularia*, *Fusarium*, *Penicillium*, *Rhizopus*, *Trichoderma*, and others, were identified and quantitatively assessed across the surveyed regions. These fungi exhibited differential occurrence patterns, with some species prevalent in specific ecological niches while others displayed adaptability across various environments [4,9].

6. Conclusion

The comprehensive study conducted to explore fungal richness and diversity in the Chhattisgarh regions of India has provided valuable insights into the mycoflora thriving across varied ecological landscapes. The research encompassed eight distinct regions within Chhattisgarh, focusing on different soil types and habitats such as barren land, riverbanks, forested areas, and integrated mass lands. The analysis aimed to unravel the ecological patterns and distribution of fungal species, shedding light on their frequency, abundance, and density in response to diverse environmental conditions. The major impact of this ecological study is to investigate the ecological roles of dominant fungal species in nutrient cycling, decomposition, and symbiotic relationships within Chhattisgarh's ecosystems. Exploring the influence of these fungi on soil health, crop growth, and potential applications in agriculture, such as biofertilizers or biocontrol agents against plant pathogens. To Identify fungi with bioremediation potential for cleaning up environmental pollutants, contributing to ecosystem restoration. Study of these fungi with potential medicinal properties or industrial uses (e.g., antibiotic production, enzyme synthesis) for pharmaceutical or biotechnological purposes. For Biodiversity Conservation its important to assess the presence of rare or threatened fungal species to aid in biodiversity conservation efforts within the region. The research underscores the significance of mycoflora in maintaining ecosystem health, nutrient cycling, and their potential applications across multiple domains. Understanding the intricate interplay between fungal communities and their habitats holds promise for innovative uses in agriculture, medicine, industry, and environmental remediation. The study's comprehensive approach to exploring fungal communities provides a foundation for further research into these diverse organisms, potentially leading to the discovery of novel bioactive compounds, biotechnological applications, and improved land management practices. This study emphasizes the rich fungal diversity in Chhattisgarh's varied ecological regions, illuminating the intricate web of interactions between fungi and their environments. The findings contribute to our understanding of fungal ecology and pave the way for future studies aimed at finding the untapped potential of these organisms for

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sustainable and innovative applications across multiple fields.

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