



Research Article

ASSESSMENT OF SOIL MICROBIAL POPULATION IN THORN FOREST AND MOIST DECIDUOUS FOREST, WESTERN GHATS, TAMIL NADU

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Abstract- The study was carried out to assess the microbial populations in the Western Ghats. The soil samples were collected from tropical thorn and moist deciduous forest at the depth of 15 cm. The bacterial, fungal and actinomycetes population was assessed using serial dilution and plating technique. Among microbes, the fungal population was observed to be highest in thorn forest (60.07×10^3 cfu's g⁻¹ of soil) and moist deciduous forest (112.60×10^3 cfu's g⁻¹ of soil). The comparative study between this two forest types, showed the results of lowest bacterial (27.60×10^5 cfu's g⁻¹), actinomycetes (35.13×10^4 cfu's g⁻¹) and fungi (60.07×10^3 cfu's g⁻¹) population in tropical thorn forest

Keywords- Bacteria, Fungi, Actinomycetes, Tropical thorn forest, Tropical moist deciduous forest

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Introduction

Microbial diversity plays a dominant role in the maintenance of ecosystem. Soil microorganisms are the major organisms responsible for controlling the amount of nutrient cycling and for controlling the amount of nutrient available to plants [1]. The soil microbes decompose the plant and animal residues entering the soil and convert them into soil organic matter, which influences on soil physical, chemical and biological properties and on creating a complimentary medium for biological reactions and life support in the soil environment [2]. Soil fertility status is dependent upon soil microbial component and their mediated processes [3]. Microorganisms are everywhere in nature and form crucial components of all known ecosystems on earth. Their omnipresence is attributed mainly to the small size, ability to stay alive and multiply in different habitats, as well as anaerobic and other extreme conditions, their metabolic adaptability and flexibility to utilize wide substrates as nutrient source. Bacteria, actinomycetes and fungi are three major groups of soil inhabiting microorganisms. Interpreting the range of native microbial populations represents one challenge of modern soil ecology. In this situation, the study has been taken to assess, microbial diversity in different forest types present in the Western Ghats namely, tropical thorn forest and tropical moist deciduous forest.

Materials and Methods

Study area

The Western Ghats comprises of substantial unspoilt areas of natural vegetation ranging from Tropical thorn forest to evergreen forests and swamps thus contributing to highest biodiversity. The important forest types present in foot hills of Western Ghats which are Tropical thorn forest and tropical moist deciduous forest taken for a study. These forest types located in Mettupalayam and Sirumugai forest range, Coimbatore forest division, Tamil Nadu.

Tropical thorn forest

Tropical thorn forest occurs in the areas where dry season is hot and very long. The vegetation is of open type consisting of small trees and thorny or spiny shrubs of stunted growth. The forests remain leafless for most part of the year, so they are called as thorn scrub or scrub jungles. The species that dominate in the sites are *Acacia chundra* (Roxb. ex Rottl.), *Acacia leucophloea* (Roxb.), *Acacia mearnsii* de Wild. *Acacia nilotica* (Linn.), *Atalantia monophylla* (L.) Correa, *Bauhinia racemosa* Lam, *Cordia gharaf* (Forssk.) Ehren, *Dalbergia paniculata* Roxb., *Euphorbia tirucalli* L., *Hardwickia binata* Roxb., *Prosopis juliflora* DC and *Ziziphus jujuba* Mill.

Tropical moist deciduous forest

These cover an extensive area of the country receiving sufficiently high rainfall (100 to 200 cm) spread over most of the year. The dry periods are of short duration. Many plants of such forests show leaf-fall in hot summer. The forests are dominated by *Tectona grandis* Linn, *Terminalia paniculata* Roth, *Terminalia bellerica* Roxb, *Grewia tiliifolia* Vahl, *Dalbergia latifolia* Roxb, *Lagerstroemia lanceolata* Wall, *Adina cordifolia* Roxb. etc. Some other common associates are *Terminalia tomentosa* Roxb. *Dillenia pentagyna* Roxb, *Boswellia serrata* Roxb. These forests produce some of the most important timbers of India.

Soil Collection

Fifteen soil samples in each forest types totally thirty soil samples were collected from two forest types namely, Tropical thorn forest and Tropical moist deciduous forest at the depth of 15 cm. soils are kept under 0°-20°C for the microbial analysis. The geo referenced location of soil samples collected were presented in [Table-1].

Enumeration of microbial population

Isolation and enumeration of organism during decomposition, namely bacteria,

fungi, actinomycetes were done by using Parkinson serial dilution and plating technique [4].

Table-1 Geo referenced location of the soil sampled collected

| Tropical thorn forest | | | | Tropical moist deciduous forest | | | |
|-----------------------|------------------|-------------------|----------|---------------------------------|------------------|---------------------|----------|
| Plot | Latitude | Longitude | Altitude | Plot No | Latitude | Longitude | Altitude |
| 1 | N 11° 20' 09.9" | E 076° 56' 17.4" | 343 | 1 | N 11° 21' 38.61" | E 076° 55' 53.575" | 1026 |
| 2 | N 11° 20' 11.6" | E 076° 56' 24.9 " | 340 | 2 | N 11° 21' 4.28" | E 076° 56' 21.61 " | 921 |
| 3 | N 11° 20' 27.4" | E 076° 56' 53.4 " | 330 | 3 | N 11° 21' 45.88" | E 076° 56' 29.18" | 1090 |
| 4 | N 11° 20' 44.4" | E 076° 57' 02.1 " | 337 | 4 | N 11° 22' 1.03" | E 076° 55' 33.35" | 1002 |
| 5 | N 11° 20' 47.2" | E 076° 56' 55.6 " | 346 | 5 | N 11° 21' 43.46" | E 076° 56' 13.11 " | 1037 |
| 6 | N 11° 20' 16.4" | E 076° 56' 09.3 " | 363 | 6 | N 11° 21' 56.18" | E 076° 57' 12.3.3 " | 992 |
| 7 | N 11° 20' 16.0" | E 076° 56' 01.3 " | 360 | 7 | N 11° 21' 21.34" | E 076° 55' 18.8 " | 1005 |
| 8 | N 11° 20' 16.1" | E 076° 56' 54.2 " | 358 | 8 | N 11° 22' 15.98" | E 076° 56' 55.6 " | 968 |
| 9 | N 11° 20' 16.4" | E 076° 55' 42.2 " | 374 | 9 | N 11° 21' 53.45" | E 076° 55' 23.9 " | 1026 |
| 10 | N 11° 20' 17.4" | E 076° 55' 34.2 " | 366 | 10 | N 11° 22' 15.4" | E 076° 55' 49.8 " | 1015 |
| 11 | N 11° 20' 15.7" | E 076° 55' 25.5 " | 360 | 11 | N 11° 23' 27.56" | E 076° 57' 25.3" | 1018 |
| 12 | N 11° 20' 25.4" | E 076° 55' 27.3" | 380 | 12 | N 11° 23' 9.41" | E 076° 57' 16.7" | 1008 |
| 13 | N 11° 20' 13.18" | E 076° 55' 30.4 " | 336 | 13 | N 11° 22' 70.5" | E 076° 56' 22.4" | 1010 |
| 14 | N 11° 21' 14.9" | E 076° 57' 30.4 " | 364 | 14 | N 11° 23' 67.1" | E 076° 56' 49.3" | 1028 |
| 15 | N 11° 21' 23.4" | E 076° 57' 50.8 " | 344 | 15 | N 11° 24' 23.4" | E 076° 56' 63.1 " | 1052 |

Enumeration of bacteria

The bacteria were enumerated by plating one ml of 10^{-5} dilution in the sterile petri dishes using Nutrient Agar medium. The colonies appearing on the plate after 48 hours of incubation at 30°C were counted and expressed as number of CFU.g⁻¹ soil.

Enumeration of actinomycetes

One ml of 10^{-4} dilution was transferred to sterilized petri dishes and plated in Ken knight's Agar medium and incubated. The colonies of actinomycetes that came out after 10-14 days were counted and explicated as number of CFU. g⁻¹ soil.

Enumeration of fungi

Fungi was enumerated by plating one ml of 10^{-3} dilution in the sterile petri dishes using Martin's Rose Bengal Agar medium. The colonies appearing on the plate after 2-3 days of incubation were counted and expressed as number of CFU. g⁻¹ soil.

Results

The entire viable bacteria, actinomycetes and fungi of the soils were incurred at 10^{-5} , 10^{-4} and 10^{-3} dilutions respectively. The microbial populations in the tropical thorn forest soils were measured and exhibited in [Table-2]

Table-2 Soil microbial population (cfu) in tropical thorn forest ecosystem

| Soil sample | Bacteria (×105) | Actinomycetes (×104) | Fungi (×103) |
|-------------|-----------------|----------------------|--------------|
| 1 | 25 | 38 | 58 |
| 2. | 13 | 23 | 32 |
| 3 | 13 | 25 | 40 |
| 4. | 24 | 33 | 51 |
| 5. | 18 | 30 | 46 |
| 6. | 49 | 53 | 89 |
| 7. | 36 | 45 | 75 |
| 8. | 35 | 38 | 74 |
| 9. | 30 | 39 | 70 |
| 10. | 44 | 46 | 90 |
| 11. | 21 | 26 | 47 |
| 12. | 14 | 22 | 40 |
| 13. | 28 | 36 | 65 |
| 14. | 43 | 45 | 77 |
| 15. | 21 | 28 | 47 |
| Mean | 27.60 | 35.13 | 60.07 |

Microbial population in tropical thorn forest

In tropical thorn forest, the total viable bacteria count ranged from 13×10^5 cfu g⁻¹ to

45×10^5 cfu g⁻¹ of soil. Actinomycetes population ranged from 22×10^4 to 53×10^4 cfu g⁻¹ of soil [Fig-1]. However the fungal population was enumerated from 32×10^3 to 90×10^3 cfu g⁻¹ of soil. This result indicated that in tropical thorn forest soil, fungal population was predominantly thrived followed by actinomycetes and bacteria.

**Fig-1** Microbial population in the tropical thorn forest soils**Microbial population in the tropical moist deciduous forest**

The microbial population in the tropical moist deciduous forest was estimated and presented in [Table-3]. In tropical moist deciduous forest, microbial population was observed to be the highest in soil sample 2 and was lowest in sample 14. The population of bacteria, actinomycetes and fungi ranged from $45-73 \times 10^5$ cfu's g⁻¹ of soil, $41-91 \times 10^4$ cfu's g⁻¹ of soil and $85-136 \times 10^3$ cfu's g⁻¹ of soil [Fig-2].

Table-3 Soil microbial population in the tropical moist deciduous forest

| Soil sample | Bacteria (×105) | Actinomycetes (×104) | Fungi (×103) |
|-------------|-----------------|----------------------|--------------|
| 1 | 58 | 69 | 103 |
| 2. | 73 | 91 | 136 |
| 3 | 71 | 90 | 133 |
| 4. | 70 | 86 | 131 |
| 5. | 65 | 83 | 127 |
| 6. | 67 | 85 | 129 |
| 7. | 63 | 86 | 120 |
| 8. | 51 | 67 | 95 |
| 9. | 56 | 73 | 108 |
| 10. | 49 | 68 | 104 |
| 11. | 61 | 79 | 116 |
| 12. | 53 | 56 | 88 |
| 13. | 49 | 65 | 90 |
| 14. | 45 | 41 | 85 |
| 15. | 64 | 84 | 124 |
| Mean | 59.67 | 74.87 | 112.60 |

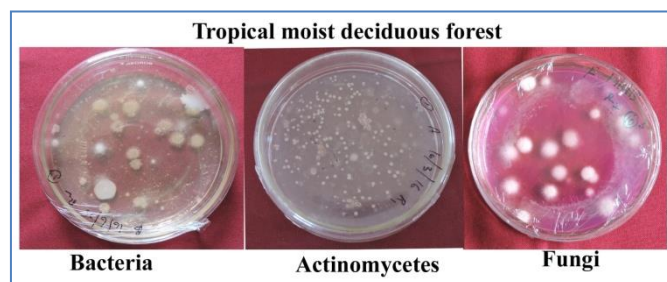


Fig-2 Microbial population in tropical moist deciduous forest soils

Discussion

Microbial population in different forest ecosystem

Soil microorganisms play an important role in soil processes that determine plant productivity. Soil fungi make a very important part of the ecosystem along with other microbes in turnover of the biomass [5]. Microbial diversity plays a dominant role in the maintenance of ecosystem. Soil microorganisms are the major organisms responsible for controlling the amount of nutrient cycling and for controlling the amount of nutrient available to plants [6]. This study deals with bacterial, actinomycetes, fungal populations in relation to the different forest types present in Western Ghats of Tamil Nadu. The bacterial populations in the forest are significantly enhanced decomposition process. High bacterial population was observed in the tropical moist forest with the mean value of $59.67 \times 10^5 \text{ g}^{-1}$ of soil. This is in line with the findings of [7].

The fungal population of the current study 60.07 to $112.60 \times 10^3 \text{ g}^{-1}$ of soil was similar to the finding of [8], who reported that it ranged from 46 to $110 \text{ cfu} \times 10^3 \text{ g}^{-1}$ of soil. The highest microbial counts were recorded in the top soil (0 - 10 cm) layer except during the summer season when the population was greater in the subsurface (10 - 20 cm) layer. Altogether, 26 soil micro-fungal forms were recorded from the sites. *Aspergillus* and *Penicillium* were the abundant genera in all sites. The population of fungal significantly exceeded than the bacterial population of rehabilitated and secondary forest in Malaysia [9]. However, microbial population was much higher in rehabilitated forest compared to that of secondary forest. In the present study it was observed that the bacteria population was in the order: tropical thorn forest < tropical moist deciduous forest with the mean population of $60.07 \times 10^3 \text{ g}^{-1}$ of soil and $112.60 \times 10^3 \text{ g}^{-1}$ of soil respectively. Soils of tropical forest ecosystems are important for the global carbon cycle, and the identification of active microbial decomposers is essential for understanding organic matter transformation in these ecosystems. Fungi quantitatively take over the microbial population in the litter perspective, while the organic horizon shows comparable amount of fungal and bacterial biomasses [9,1]. Though, the dispersion of soil microbial community is decided by a number of ecological factors like pH, moisture content and soil organic matter.

Conclusion

Considering the outcome of the present investigation, it was concluded that highest population of bacteria ($59.67 \times 10^5 \text{ cfu's g}^{-1}$), actinomycetes ($74.87 \times 10^4 \text{ cfu's g}^{-1}$) and fungi ($112.60 \times 10^3 \text{ cfu's g}^{-1}$ of soil) were found in moist deciduous forest compared to tropical thorn forest. Though, the accountability of macro and microclimatic seasonality and soil nutrient condition cannot be entirely ruled out. It is also understood that the quality of plant residues accumulating in these different forest sites are furthermore important and may play a vital role in soil microbial population. This microbial populations study at different forest types in the Western Ghats not proving information on microbial diversity, but also will provide information to explore the important microorganisms for various biotechnological applications.

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Author Contributions

All authors have contributed substantially in conception, designing of the study,

acquisition of data, analysis and interpretation of data.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of Interest: None declared

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