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Comparative Analysis of Microbial Diversity in Soil and Decaying Leaf Litter within *Tectona grandis* Plantations in Ede and Ibadan Sites.

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ABSTRACT- *This study explores "Home Field Advantage" in leaf litter decomposition, a phenomenon which reveals that leaves tend to undergo a significantly swifter decomposition process within their native environment as compared to foreign locales This intriguing observation has prompted a leading hypothesis suggesting that local soil communities adapt over time to optimize the decomposition of litter originating from the plant species they regularly interact with. This adaptation is believed to entail specific microorganisms relocating to strategic soil locations, where they can more efficiently access the energy and nutrients locked within the decaying litter. The research focuses on identifying species of Fungi and Bacteria in two distinct Tectona grandis monoculture plantations in southwest Nigeria: Idi Ayunre, Ibadan, Oyo state, and Ara junction-Osogbo expressway, Ede, Osun state. Collected samples of decaying leaf litter and soil from both locations underwent rigorous analysis such as; serial dilution, isolation, colony counting, morphology assessment, biochemical tests, and sugar fermentation to effectively identify the various species present in the sample. Results revealed diverse bacterial species in both locations, including Bacillus spp, Azotobacter spp, Pseudomonas aeruginosa, and Acinetobacter spp shared by both sites. Ibadan soil featured specific species like Staphylococcus aureus, Streptomycetes spp, Clostridium spp, Micrococcus spp, and Bacteroides fragilis, absent in Ede. Fungal communities showed common and unique species, with Fusarium and Fonsecaea in both. Ede had unique species like Chrysosporium spp, Pithomyces, and Verruconis, possibly due to local soil characteristics. Ibadan presented distinct species: Cladosporium spp, Nigrospora, Arthrographis kalrae, Phialemonium, and Aphanoascus fulvescens. This is a pointer to the fact that the bacterial and fungal communities found in distinct locations tasked with decomposing Tectona grandis litter may exhibit dissimilarities. This dissimilarity arises from the fact that the composition of specific bacterial and fungal species at these locations can fluctuate due to environmental factors, soil composition, and other local conditions.*

Keywords: *Home field advantage, leaf litter decomposition, microbial communities, bacterial diversity, fungal diversity*

Introduction

In recent years, the concept of "Home Field Advantage" (HFA) has gained attention in the field of leaf litter decomposition. HFA posits that leaves tend to decompose more rapidly in their native environment (home) than in non-native (away) settings, as observed in various studies (Ayres *et al.*, 2009; Chommel *et al.*, 2015; Lyu *et al.*, 2019). This phenomenon is thought to arise from specialized microorganisms that localize in specific soil areas, where they can more effectively extract energy and nutrients from decomposing litter (Schoebitz *et al.*, 2016). The implications of HFA suggest that soil biota and leaf litter from a particular plant species in different locations may host similar microbial communities, particularly with respect to certain functional groups (Heinze *et al.*, 2015).

Motivated by this intriguing concept, the aim of this study is to investigate the microbial diversity, with a focus on fungi and bacteria, in two distinct sites located in southwest Nigeria. By assessing these communities, we seek to deepen our understanding of how HFA influences decomposition processes across geographically separated environments.

Materials and Methods

Study Site:

This study was conducted across two *Tectona grandis* (Teak) monoculture plantation sites in southwest Nigeria. The first site is located in Idi-Ayunre, Ibadan (IB), with coordinates 7°13'3" N and 3°52'38" E (Larinde and Olasupo, 2011), and the second site is near Egbedi town along the Iwo-Osogbo expressway, Ede (Ede), with coordinates 7°77'89" N and 4°45'32" E.

Sample Collection and Analysis:

Soil and leaf samples were collected from three different points (A, B, and C) within each plantation site (IB and Ede) to ensure representative coverage of the soil biota in each location. Samples were placed in sterile polythene bags, labeled accordingly, and transported to the laboratory for microbial analysis.

Microbial Analysis:

The analysis included the following procedures: isolation, serial dilution, incubation, colony counting, morphological characterization, biochemical tests, and sugar fermentation. For bacterial identification, resources such as Bergey's Manual, Microbiology Resource Online (microrao.com), and TGW Bacterial Identification (tgw1916.net/bacteria_abis.html) were consulted. Fungal identification was performed using Lactophenol Cotton Blue (LPCB) staining, as well as the "Clinical Laboratory Handbook of Descriptions of Medical Fungi and Identifying Fungi." All analyses followed established standard procedures.

Results

		IBADAN SOIL (IS) SAMPLE						
		Serial Dilution 2 (Triplicates)				Serial Dilution 4 (Triplicates)		
BACTERIA	CODES	IS (2) 1	IS (2) 2	IS (2) 3		IS (4) 1	IS (4) 2	IS (4) 3
	COLONY COUNTS	100	94	131		52	45	48
FUNGI	CODES	IS (2) 1	IS (2) 2	IS (2) 3		IS (4) 1	IS (4) 2	IS (4) 3
	COLONY COUNTS	5	5	6		3	2	1
		EDE SOIL (ES) SAMPLE						
		Serial Dilution 2 (Triplicates)				Serial Dilution 4 (Triplicates)		
BACTERIA	CODES	ES (2) 1	ES (2) 2	ES (2) 3		ES (4) 1	ES (4) 2	ES (4) 3
	COLONY COUNTS	77	82	149		38	42	30
FUNGI	CODES	ES (2) 1	ES (2) 2	ES (2) 3		ES (4) 1	ES (4) 2	ES (4) 3
	COLONY COUNTS	8	5	3		4	3	4

Fig 1: Colony counts of bacteria and fungi in the soil of Ibadan and Ede samples, during serial dilutions

		IBADAN DECAYED LEAF (IL) SAMPLE						
		Serial Dilution 2 (Triplicates)				Serial Dilution 4 (Triplicates)		
BACTERIA	CODES	IL (2) 1	IL (2) 2	IL (2) 3		IL (4) 1	IL (4) 2	IL (4) 3
	COLONY COUNTS	29	36	28		14	20	17
FUNGI	CODES	IL (2) 1	IL (2) 2	IL (2) 3		IL (4) 1	IL (4) 2	IL (4) 3
	COLONY COUNTS	7	5	4		2	4	4

		EDE DECAYED LEAF (EL) SAMPLE						
		Serial Dilution 2 (Triplicates)				Serial Dilution 4 (Triplicates)		
BACTERIA	CODES	EL (2) 1	EL (2) 2	EL (2) 3		EL (4) 1	EL (4) 2	EL (4) 3
	COLONY COUNTS	42	38	32		15	12	10
FUNGI	CODES	EL (2) 1	EL (2) 2	EL (2) 3		EL (4) 1	EL (4) 2	EL (4) 3
	COLONY COUNTS	5	7	5		3	3	2

Fig 2: Colony counts of bacteria and fungi in the decayed leaf of Ibadan and Ede samples, during serial dilutions

Table 1: Bacteria species in Ibadan soil samples

Ibadan soil samples (Bacteria)	**Dilution 2**	**Macconkey**	**Identification**
	Dilution 4	Pink	*Acinetobacter spp*
		Light Pink	*Staphylococcus aureus*
		Purplish	*Streptomycetes spp.*
		Nil	*Clostridium spp*
		Red	*Micrococcus spp*
		Nil	*Bacteroides fragilis*
		Nil	*Clostridium spp*
		Nil	*Bacteroides fragilis*
		Purplish	*Streptomycetes spp.*
		Pink	*Acinetobacter spp*

Table 2: Bacteria species in Ibadan decayed leaf samples

Samples	Dillutions	Macconkey	Identification
Ibadan decayed leaf samples bacteria	Dilution 2		
		Nil	*Bacteroidesfragilis*
		Pink	*Acinetobacterspp*
		Greenish (dark)	*Pseudomonas aeruginosa*
		Purplish	*Streptomycetes spp.*
		Pink	*Escherichia coli*
	Dilutions 4		
		Nil	*Bacteroidesfragilis*
		Greenish (dark)	*Pseudomonas aeruginosa*
		Purplish	*Streptomycetes spp.*
		Pink	*Escherichia coli*

Table 3: Bacteria species in Ede soil samples

Samples	Dilutions	Macconkey	Identification
Ede soil samples bacteria	Dilution 2		
		Creamy	*Bacillus spp*
		Dark brown	*Azotobacter spp*
		Pink	*Enterobacter aerogenes*
		Greenish (dark)	*Pseudomonas aeruginosa*
		Pink	*Acinetobacter spp*
		Pink	*Enterobacter aerogenes*
	Dilution 4		
		Greenish (dark)	*Pseudomonas aeruginosa*
		Pink	*Escherichia coli*
		Creamy	*Bacillus spp*

Table 4: Bacteria species in Ede decayed leaf samples

Samples	Dillutions	Macconkey	Identification
Ede decayed leaf samples bacteria	Dilution 2		
		Greenish (dark)	*Pseudomonas aeruginosa*
		Creamy	*Bacillus spp*
		Dark brown	*Azotobacter spp*
	Dilution 4	Light blue	*Pseudomonas spp*
		Creamy	*Bacillus spp*
		Dark brown	*Azotobacter spp*

Table 5: Fungi species in Ede and Ibadan soil samples

Samples	Fungi found
Ede soil sample	*Chrysosporium spp*
	Fusarium spp
	Pithomyces spp
	Verruconis species
Ibadan soil sample	*Cladosporium spp*
	Nigrospora spp
	Arthrographis kalrae
	Cladophialophora spp
	Fonsecaea spp

Table 6: Fungi species in Ede and Ibadan decayed leaf samples

Samples	Fungi found
Ede decayed leaf sample	*Cladophialophora spp*
	Neoscytalidium spp
	Alternaria spp
Ibadan decayed leaf sample	*Fusarium spp*
	Fonsecaea spp
	Phialemonium spp
	Aphanoascus fulvescens

Discussion

The findings revealed that Ede soil exhibits a broader range of bacterial species, including common soil bacteria like *Bacillus, Azotobacter*, and *Pseudomonas,* which are known for their roles in organic matter decomposition. In contrast, Ibadan soil harbors a more specialized set of species, with *Streptomycetes* playing a prominent role. The presence of *Streptomycetes* in Ibadan is particularly noteworthy, as these bacteria are efficient decomposers of complex organic compounds, such as cellulose and lignin, suggesting that Ibadan soil may have an enhanced ability to break down tougher organic materials.

Additionally, the occurrence of *Pseudomonas aeruginosa* in the decaying leaf litter at both sites underscores its ecological importance, as this species is capable of degrading a variety of organic compounds, contributing to the overall decomposition process in both locations. Notably, both Ibadan soil and its decayed leaf litter samples exhibited a higher diversity of fungal species compared to Ede. This greater fungal diversity in Ibadan may enhance decomposition efficiency and resilience, as a more diverse fungal community can support the breakdown of a broader range of organic substrates, contributing to a more robust nutrient cycling process.

Overall, these findings suggest that while Ede soil possesses a rich variety of bacterial species that may support rapid decomposition, the specialized microbial community in Ibadan soil, particularly its diversity in fungal species and presence of *Streptomycetes*, might provide an advantage in breaking down complex organic matter. This microbial differentiation between sites points to potential ecological adaptations that could influence nutrient cycling and organic matter decomposition across these plantation environments.

Conclusion

The greater diversity observed in Ibadan suggests a more complex and potentially more efficient decomposition process, likely due to a broader array of microbial interactions and metabolic capabilities. In contrast, Ede's soil supports a more limited set of microbial species, which may affect its decomposition dynamics. These disparities underscore the influence of environmental factors, soil characteristics, and local conditions on the composition of microbial communities. Understanding these variations provides valuable insights into the ecological processes governing

decomposition and nutrient cycling in distinct plantation environments, with potential implications for soil management and ecosystem health

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