

Identification of Fungi from the Rhizosphere of Bamboo Plants (*Bambusa Vulgaris*) In Gorontalo City and Bone Bolango Regency

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ABSTRAK

Rhizosfer merupakan zona tanah di sekitar akar tumbuhan yang memiliki aktivitas mikroorganisme tinggi, termasuk jamur tanah yang berperan penting dalam dinamika ekosistem dan kesehatan tanaman. Tumbuhan bambu (*Bambusa vulgaris*) memiliki sistem perakaran yang luas dan padat sehingga berpotensi mendukung keberadaan jamur rhizosfer dengan fungsi ekologis yang beragam. Penelitian ini bertujuan untuk mengidentifikasi jamur yang terdapat pada rhizosfer bambu (*Bambusa vulgaris*) di Kota Gorontalo dan Kabupaten Bone Bolango. Penelitian dilakukan melalui pengambilan sampel tanah rhizosfer pada dua lokasi dengan karakteristik lingkungan yang berbeda, dilanjutkan dengan isolasi jamur menggunakan metode kultur pada media Potato Dextrose Agar (PDA). Identifikasi jamur dilakukan berdasarkan karakter morfologi makroskopis koloni, meliputi warna dan tekstur permukaan koloni. Hasil penelitian menunjukkan bahwa rhizosfer bambu di kedua lokasi mengandung jamur dari tiga genus utama, yaitu *Trichoderma*, *Penicillium*, dan *Fusarium*. Kabupaten Bone Bolango menunjukkan jumlah isolat jamur yang lebih tinggi dibandingkan Kota Gorontalo, khususnya dari genus *Trichoderma*. Perbedaan jenis dan jumlah isolat jamur antara kedua lokasi diduga dipengaruhi oleh faktor lingkungan lokal, seperti pH tanah, kelembapan, serta karakteristik mikrohabitat. Penelitian ini memberikan informasi awal mengenai keanekaragaman jamur rhizosfer bambu di wilayah Gorontalo dan Kabupaten Bone Bolango, serta diharapkan dapat menjadi dasar bagi penelitian lanjutan terkait identifikasi spesies secara lebih mendalam dan pemanfaatan jamur rhizosfer dalam pengelolaan tanah dan tanaman secara berkelanjutan.

ABSTRACT

The rhizosphere is a soil zone surrounding plant roots that exhibits high microbial activity, including soil fungi that play important roles in ecosystem dynamics and plant health. Bamboo (*Bambusa vulgaris*) has an extensive and dense root system that potentially supports a diverse array of rhizospheric fungi, each with various ecological functions. This study aimed to identify fungi associated with the rhizosphere of bamboo (*Bambusa vulgaris*) in Gorontalo City and Bone Bolango Regency. The research was conducted by collecting rhizospheric soil samples from two locations with different environmental characteristics, followed by fungal isolation using culture methods on Potato Dextrose Agar (PDA) medium. Fungal identification was conducted based on the macroscopic morphological characteristics of the colonies, including colony color and surface texture. The results showed that the bamboo rhizosphere at both locations contained fungi belonging to three main genera, namely *Trichoderma*, *Penicillium*, and *Fusarium*. Bone Bolango Regency exhibited a higher number of fungal isolates compared to Gorontalo City, particularly those belonging to the genus *Trichoderma*. Differences in the type and number of fungal isolates between the two locations were presumably influenced by local environmental factors such as soil pH, moisture, and microhabitat characteristics. This study provides preliminary information on the diversity of bamboo rhizospheric fungi in Gorontalo City and Bone Bolango Regency and is expected to serve as a basis for further studies focusing on more detailed species identification and the potential utilization of rhizospheric fungi in sustainable soil and plant management.

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1. INTRODUCTION

Soil is a highly complex ecosystem that serves as a home for various microorganisms that are important for maintaining environmental integrity. Soil microorganisms are involved in the decomposition of organic matter, nutrient cycling, and soil fertility enhancement (Brady & Weil, 2016). In addition, the presence of microorganisms contributes to soil structure stability and terrestrial ecosystem productivity (Paul, 2015). Among these microorganisms, fungi play an important ecological role in nutrient mineralization (Sylvia et al., 2005). Furthermore, soil fungal diversity is closely related to soil health and ecosystem health (Van der Heijden et al., 2008). This is very important because it makes soil fungi a relevant object of study in soil ecology.

Soil fungi are usually found in the rhizosphere, which is the area around plant roots. According to Hinsinger et al. (2009), the rhizosphere is associated with high levels of microorganism activity because root exudates are rich in organic compounds. The interaction between plant roots and microorganisms in the rhizosphere affects the composition and activity of fungal communities (Lynch & Whipps, 1990). According to Hartmann et al. (2008), the presence of fungi in the rhizosphere is effective in increasing nutrient availability and promoting plant growth. According to Philippot et al. (2013), the rhizosphere community also contributes to soil microbiological development. Therefore, the rhizosphere is a strategic location for the study of soil fungi species.

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Rhizosphere fungi play a variety of roles, ranging from decomposers to plant symbionts. Saprophytic fungi function in the decomposition of organic matter, thereby increasing the availability of nutrients for plants (Dugan, 2011). Some fungi also form symbiotic associations such as mycorrhizae, which aid in the absorption of phosphorus and water by plants (Smith & Read, 2008). In addition, certain rhizosphere fungi are able to suppress the growth of soil pathogens through antagonistic mechanisms (Bonfante & Anca, 2009). This diversity of functions shows that the composition of rhizosphere fungi is greatly influenced by the type of host plant (Rillig et al., 2015). One plant that has great potential in forming a distinctive rhizosphere fungal community is bamboo.

Rhizosphere fungi have various functions, from decomposers to symbiotic plants. They are used in the production of organic materials to increase nutrient availability for plants (Dugan, 2011). According to Smith and Dan (2008), some fungi also form symbiotic relationships, such as mycorrhiza, which facilitate the absorption of air and fossil fuels by plants. Read (2008) states that some fungi also form symbiotic relationships, such as mycorrhiza, which

facilitate the absorption of air and fossil fuels by plants. According to Bonfante and Anca (2009), rhizosphere fungi also have the ability to increase soil pathogens through antagonistic mechanisms. The function shows that this type of host plant significantly influences the composition of the rhizosphere (Rillig et al., 2015). Bamboo is one type of plant with significant potential to create a unique fungal rhizosphere community.

Bamboo is a member of the Poaceae family, which has a fibrous system and rhizomes. This fibrous system creates a rhizosphere environment that encourages the growth of microorganisms, including fungi (Liese & Köhl, 2015). *Bambusa vulgaris* is one of the bamboo species commonly found in Indonesia (Dransfield & Widjaja, 1995). This species has a high level of adaptation to various environmental conditions (Widjaja et al., 2014). *Bambusa vulgaris* has important economic and conservation value in addition to its ecological value (Clark et al., 2015). However, information about fungi associated with the rhizosphere of this bamboo is still scarce, especially in Gorontalo City and Gorontalo Regency.

Gorontalo City and Bone Bolango Regency are two areas with tropical climates that support bamboo growth. According to Hardjowigeno (2010), factors such as climate, humidity, and soil characteristics in this region likely influence the diversity of rhizosphere fungi. The presence of naturally cultivated bamboo has the potential to create a unique fungal soil community (Whitten et al., 2002). However, research on the identification of *Bambusa vulgaris* rhizosphere fungi in Gorontalo and Bone Bolango is still in its early stages (BPS Provinsi Gorontalo, 2023). This data is problematic because the ecological potential of rhizosphere fungi has not been fully utilized (Garbeva et al., 2004). This situation highlights the need for more in-depth scientific study.

Based on these issues, research is needed to identify fungi found in the rhizosphere of bamboo plants (*Bambusa vulgaris*). Fungal identification is the first step in determining the diversity and characteristics of soil fungi (Watanabe, 2010). The information obtained from the identification can be used as a basis for the sustainable management of soil biological resources (Mueller et al., 2007). In addition, data on rhizosphere fungal diversity can be utilized in the development of biological agents and environmental conservation (Kirk et al., 2008). Thus, this study is expected to contribute scientifically to the fields of soil microbiology and plant ecology (Hawksworth & Lücking, 2017).

2. METHOD

This research was conducted from November 20 to December 13, 2025. Bamboo (*Bambusa vulgaris*) rhizosphere samples were taken in 3 locations in Gorontalo City and 3 locations in Bone Bolango Regency, using a purposive sampling method. Isolation and identification of fungi were carried out at the Gorontalo Province Agricultural Plant Protection Laboratory. The tools used in this research were Sample Plastic, Soil Tester, Laminar Air Flow, Oven, Incubator, Incubator shaker, Bunsen Lamp, Hot Plate Stirrer, Erlenmeyer, Beaker, Ose Needle, Petri Dish, Analytical Scale, and Stirring Rod, mortar and pestle. The materials used were samples of Bamboo (*Bambusa vulgaris*) rhizosphere, Alcohol, Aquades, PDA Media (*Potato Dextrose Agar*) and Rose Bengal Agar Media.

Research Procedures

Fungi Isolation

Samples of rhizosphere of bamboo plants (*Bambusa vulgaris*) from Gorontalo City and Bone Bolango Regency were each composited and then ground using a mortar and pestle, then

weighed as much as 10 grams put in an Erlenmeyer flask and added with 90 ml of sterile distilled water and shaken for 30 minutes. Next, a multi-dilution was carried out up to 10⁻⁵ then isolated using Rose Bengal Agar media and incubated at room temperature for 2-4 days.

Fungi Purification

Purification is performed on every fungal colony that appears distinct according to its macroscopic morphology, which encompasses the colony's color and shape. Each microorganism was collected using an ose needle and subsequently cultured on a petri dish with PDA media (Ariyanto *et al.*, 2013).

Fungi Identification

The purified fungal isolates were then observed, both macroscopically or microscopic, which are then identified based on the Identification Guide Book Barnett and Hunter (1972).

Analisis Data

Macroscopic and microscopic data are presented in the form of images. The results of the isolation of each Identified fungal isolates are presented in the form of descriptions and images.

3. RESULT AND DISCUSSION

The Overview of the Research Location

The research samples were taken at two different locations, namely in Moutong Village, Tilongkabila District, Bone Bolango Regency and Padebuolo Village, Bone Bolango District East City, Gorontalo City. Both locations are areas covered with bamboo (*Bambusa vulgaris*) and has different environmental characteristics, both from in terms of soil conditions and humidity levels. Geographically, Moutong Village is located at coordinates 0.536745° N and 123.069971° E, while Padebuolo Village is located at coordinates 0.557231° N and 123.1341° E, which shows that both locations are still located in the same regional area of Gorontalo Province but has different conditions microhabitat.

Table 1. Environmental conditions for sampling

Location	Average pH			Average Moisture			Coordinate Points
	T 1	T 2	T 3	T 1	T 2	T 3	
Desa Moutong, Kec. Tilongkabila, Kabupaten Bone Bolango, Gorontalo	6,4	6,3	7	3,5	2,5	1	Lat 0.536745° Long 123.069971°
Kelurahan Padebuolo, Kec. Kota Tim., Kota Gorontalo, Indonesia, Kecamatan Kota Timur, Gorontalo,	6,1	6,4	6,2	3	3,5	1	Lat 0.557231° Long 123.1341°

Results of Fungal Identification from Bamboo Rhizosphere

Isolation of fungi from the rhizosphere of bamboo (*Bambusa vulgaris*) located in Gorontalo City successfully isolated two types of *Trichoderma* sp., *Fusarium* sp., and *Penicillium* sp. (Table 1). Meanwhile, the isolation of fungi from the bamboo rhizosphere located in the Regency was successful. isolated one type of *Trichoderma* sp., and *Penicillium* sp. (Table 2) From these isolates, two some of them are biological control agents, while one of them is a fungus pathogens.

Table 2. Morphological characteristics of fungi from the bamboo rhizosphere

No	Warna Koloni	Tekstur Permukaan koloni	Konidiofor	Konidia	Jenis	Lokasi ditemukan
a	Hijau keabu abuan hingga hijau tua dengan bagian tengah lebih pucat	bertepung	ada	ada	<i>Trichoderma</i> sp. (1)	Bone Bolango
b	abu abu gelap hingga coklat keabu abuan	halus agak bertepung	ada	ada	<i>Trichoderma</i> sp. (2)	Bone Bolango
c	hijau kebiruan (hijau tosca)	bertepung halus	ada	ada	<i>Trichoderma</i> sp. (3)	Kota Gorontalo
d	hijau tua dengan tepi putih	seperti beludru	ada	ada	<i>Penicillium</i> sp.	Bone Bolango
e	Putih keabuabuan	seperti kapas	ada	ada	<i>Fusarium</i> sp. (1)	Bone bolango
f	Merah muda dengan tepi putih	berbulu seperti kapas	ada	ada	<i>Fusarium</i> sp. (2)	Kota Gorontalo

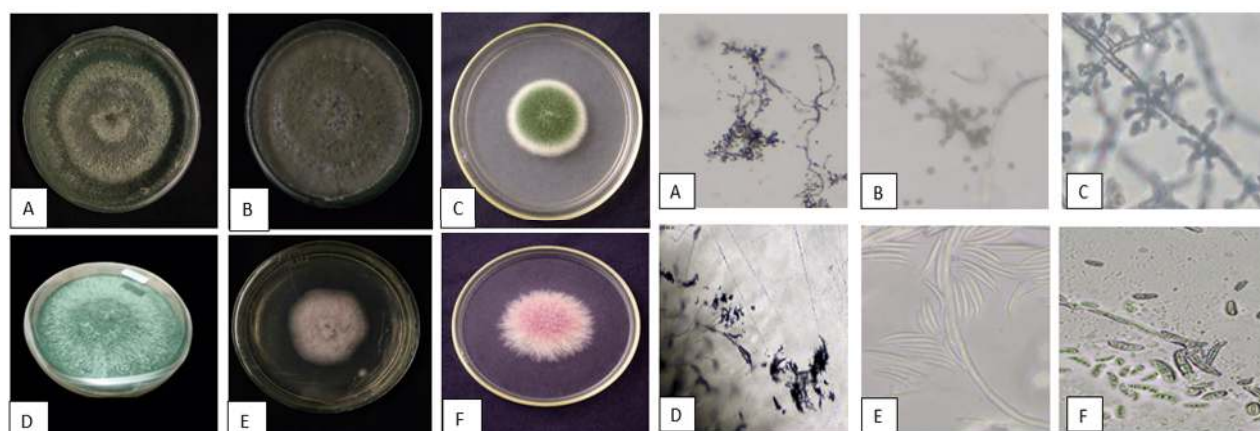


Figure 1. Morphology of fungal colonies macroscopically (left) and microscopically (right); (A) *Trichoderma* sp1, (B) *Trichoderma* sp2, (C) *Trichoderma* sp3, (D) *Penicillium* sp, (E) *Fusarium* sp1, (F) *Fusarium* sp2.

The results of fungal isolation from the rhizosphere of bamboo (*Bambusa vulgaris*) from Gorontalo City found two types of fungi, namely one isolate of *Trichoderma* sp. and one isolate of *Fusarium* sp. The identified *Trichoderma* sp. isolates have bluish-green colonies with a fine-powdery texture, indicating very high sporulation activity. Furthermore, *Fusarium* sp. was identified by its pink colonies and hairy texture, indicating the presence of potentially pathogenic fungi. The combination of fungal antagonists (*Trichoderma*), decomposers (*Penicillium*), and pathogens (*Fusarium*) suggests that the bamboo rhizosphere in Gorontalo is functional, but relatively so.

In Bone Bolango Regency, fungal isolation from bamboo rhizosphere yielded four types of fungi: two isolates of *Trichoderma* sp., one isolate of *Penicillium* sp., and one isolate of *Fusarium* sp. These isolates had a variety of colony colors from grayish to dark green and a powdery to slightly smooth texture, thus limiting the ability of *Trichoderma* to adapt to environmental conditions. *Penicillium* sp. found consistently showed soil saprophytic fungi and velvety dark green colony characteristics. The fact that the number of isolates in Bone Bolango Regency was higher indicates that this environment has a higher level of fungal diversity than in Gorontalo City.

Overall, the bamboo rhizosphere in Bone Bolango Regency exhibited a higher diversity of fungal isolates, particularly from the genus *Trichoderma*, compared to Gorontalo City. Meanwhile, Gorontalo City still exhibited the presence of fungi with a complete range of ecological functions, including antagonistic, decomposer, and pathogenic fungi. These differences indicate that local environmental conditions and microhabitat characteristics play a role in shaping the composition of the rhizosphere fungal community in bamboo plants.

Based on environmental measurements, the soil pH at both research locations ranged from slightly acidic to neutral. In Moutong Village, the soil pH ranged from 6.3–6.4, while in Padebuolo Village, the soil pH ranged from 6.1–7.0. This pH range is considered optimal for the growth of various types of soil fungi, particularly rhizosphere fungi, which generally thrive in slightly acidic to neutral soil conditions. These pH conditions indicate that both locations have the potential to support the presence and diversity of soil fungi.

Differences in fungal isolates between Gorontalo City and Bone Bolango Regency can be explained by variations in environmental factors, land cover, soil texture, and microhabitat conditions that influence the structure of soil fungal communities, thus forming bacterial and fungal communities simultaneously. The two different locations have the potential to produce different fungal community compositions (Labouyrie, 2024). Furthermore, natural moisture gradients are known to alter the diversity and composition of soil fungal communities (Li et al., 2021). Furthermore, changes in water regimes (e.g., drought/humidity) can also affect specific fungal groups and the ecosystem functions they provide (Buscardo, 2021). Therefore, the variation in isolates found in this study is ecologically reasonable and reinforces the importance of considering environmental conditions when interpreting rhizosphere fungal isolation data.

4. CONCLUSION

This study shows that *Trichoderma*, *Penicillium*, and *Fusarium* fungi, which have different ecological functions, were found in the rhizosphere of bamboo (*Bambusa vulgaris*) in Gorontalo City and Bone Bolango Regency. Differences in the quantity and type of fungal isolates between the two locations indicate that local environmental conditions, such as soil pH, humidity, and microhabitat characteristics, are important in the formation of fungal communities. rhizosphere. Compared to Gorontalo City, Bone Bolango Regency has a higher level of Reviews, higher isolation.

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