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Mycoflora study of rice plant's root soil from Gondia district

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Abstract

Gondia district is one of the main rice (Oryza sativa L.) cultivating district in Maharashtra state. Paddy is the main staple food crop of Gondia district, Maharashtra, India. Gondia city is popularly known as rice city due to large number of rice mills. The district is divided into 4 subdivisions namely Gondia, Deori, Tiroda and Morgaon Arjuni. Every plant has its own associated microorganism which are beneficial or detrimental to the plant. The recent study is aimed to isolate, identifying and calculate the percentage of fungal species associated with the rice plant grown in this area. This study shown eight fungal genera and total twelve fungal taxa found to be associated with rice plant roots, they are Aspergillus, Penicillium, Cladosporium, fusarium, Rhizopus, Curvularia, Trichoderma and Mucor.

Key word: Rice, Fungi, Mycoflora, Root, Soil, Czapek–Dox

Introduction:

China stands in first place followed by India who rank second in rice production in world. Over 46 million hectares of land in India were planted with rice by the conclusion of the 2022 fiscal year. Around 165 million hectares of rice were planted worldwide in 2022, with India producing the most, reaping roughly 48 million hectares of the crop. Millions of people around the world are sustained on rice, a crucial staple crop (Statista,2023). According to recent blog published online by Junction, T. 2023, Maharashtra doesn't even stand in top ten Indian states, but play a vital role in ensuring a steady supply of rice for nation. The Gondia district, which is in the middle of Maharashtra in India, is a tribute to the agrarian wealth that the region possesses. Gondia has become an important centre for rice farming since it is renowned for having the most fertile areas and the most favourable climate conditions. Rice, which is a staple meal in India, carries a great deal of cultural and economic significance. The cultivation of rice is intricately connected to the livelihoods of millions of people within the country.

In the fiscal year 2022-23, the state of Maharashtra produced a staggering 1357.55 lakh tonnes of rice, setting a record. This astonishing statistic surpasses the rice production of the previous year, which was 1294.71 Lakh tonnes, by 62.84 Lakh tonnes, and it also beats the average production of the past five years (2017-2021) by 153.65 Lakh tonnes. (pib.gov.in).Paddy crop grown in kharif as well as rabi season. According to GOM Government of India Department Of Agriculture Government Of Maharashtra During year 2022-23 kharif rice production area of rice of Gondia district was 1911.40 ha, production 3673.80 tonnes and Productivity 1922.04 Kg /ha. And according to Directorate of Economics and Statistics Department of Agriculture and Farmers Welfare Ministry of Agriculture and Farmers Welfare, Govt. of India during kharif season of 2022-23 Area 190841.17 (Hectare) Production 489692.62 (Tonne) and Yield 2.57 (Tonne/Hectare)

The soil is a complicated system. Several biological activities take place in soil, and these processes dictate the functions that provide diverse services to ecosystems. These functions include the turnover of organic matter, the fixation of nitrogen in the atmosphere, both symbiotic and non-symbiotic, denitrification, and aggregation, among other things (Chenu and Stotzky, 2002). In particular, the microorganisms that are found in soil are an extremely important component. According to Tisdall and Oades (1982) and Feller and Beare (1997), soil is a medium that contains solids, liquids, and gases.

Within this medium, mineral and organic components aggregate into agreegates of varying sizes, which serve to delimitate spores. According to Chotte et al. (1997), this organisation is responsible for the creation of microenvironments that are suitable for microbial activity to variable degrees. Rcent research have pointed out the need of taking into consideration the distribision within soil matrix of microbial activity hot spots (Gaillard et al., 1999). The presence of microorganisms in soil is advantageous for increasing the fertility of the soil and the growth of plants since these organisms are involved in a number of biochemical

transformations and mineralization activities in the soil. Agronomic practices impact critical interactions within the plant microbiome (Wipf et al.). According to Manickam et al. (1972), the use of chemical fertilisers on a consistent basis over an extended period of time can lead to an imbalance in the mycoflora of the soil, which in turn can have an indirect impact on the biological features of the soil, ultimately resulting in soil deterioration.

According to Warcup (1950), fungi are critically important to the functioning of the soil ecosystem. According to Christensen et al. (1989), organisms play a significant part in a variety of critical processes, particularly in agricultural and forest soils. These processes include the breakdown of organic matter and the release of elements through mineralization. The rate of biodegradation is dependent on environmental factors, the number and types of microorganisms that are present, and the enzymatic processes that lead to the loss of the parent molecular structure and the production of smaller organic species. According to Gaddeyya G et al. (2012), microorganisms, in general, exhibit a capacity that is considered to be comparable for the metabolism of a large number of pesticides that are present.

Topography of Gondia district:

The Gondia district in Maharashtra, India, is characterized by a complex topography with fertile plains and undulating plateaus. The Satpura Range, spanning central India, influences the southern portion of the district. The district is surrounded by rivers and their tributaries, including the Bagh, Bawanthadi, and Wainganga rivers, which provide essential water supplies for agriculture. Deep woods, including parts of the Tadoba-Andhari Tiger Reserve and Navegaon National Park, enhance biodiversity and provide habitats for various flora and fauna. Steep terrain, particularly in the southern and eastern parts, is present on the Satpura foothills.

The district also has wetland areas and bodies of water, which preserve local biodiversity and aid in water storage, rehabilitation, and flood prevention. The Gondia district is located between the latitudes of 20.39 and 21.38 degrees north and the longitudes of 79.27 and 80.42 degrees east. The most important river in the district is the Wainganga, also known as the bawanthadi.

It shares a border with the district of Balaghat and Bhandara on the west, the district of Rajnandgaon in Madhya Pradesh on the east, and Gadchiroli on the south. One of its borders is on the north. Approximately 1.83% of the entire land area of the state of Maharashtra is comprised by the district, which has a total size of 5641 square kilometers. The distance between Gondia and Mumbai, the capital, is 1006 kilometers. Rail and national highway no. 6 provide excellent connections to the region of Gondia. (Brief Industrial Profile of Gondia District, MSME Nagpur, GOI)

Material and method:

Gondia district comprises the following tehsils:Gondia, Tirora, Amgaon, Goregaon, Salekasa, Deori and Arjuni Morgaon. From each tehsil three samples were collected. Further soil samples for fungi isolation requires careful planning and execution to ensure the preservation and viability of fungal species. To minimise errors sample of same variety rice plant were selected i.e. HMT (National Innovation Foundation, India) variety of rice commonly grown in Gondia district. Sterile equipments and plastic bags was used for collecting soil surrounding the root environment. Plant were selected must be free of contamination and other weed growth. Collect soil samples from different depths to capture the vertical distribution of fungi. Typically, samples are collected from the surface layer (0-10 cm depth) and subsurface layers (10-20 cm depth).Collect approximately 100-200 grams of soil per sample, depending on the specific requirements of your study. Each soil sample were stored into a sterile container (plastic bag or vial).

Label each container with a unique identifier, including information such as sample location, depth, and date of collection. Use a permanent marker to ensure labels remain intact. Record Sampling Metadata: Record detailed information about each sampling site, soil type, vegetation cover, land use history, and any other relevant environmental parameters. Transport the soil samples to the laboratory as soon as possible after collection to minimize changes in fungal community composition.

Once in the laboratory, process the soil samples according to your specific fungal isolation protocol, which may include techniques such as dilution plating, selective media culture. The current research follows the fungus isolation medium recipe proposed by J. H. Warcup in 1950. The media used was Czapek–Dox supplemented with 0.5% yeast extract agar, which was acidified to pH 4.0 with phosphoric acid. Numerous soil fungi found in paddy soil can grow and sporulate in this medium, as demonstrated. Based on cultural, texture colour and morphology the fungi were identified using literatures Available online and offline.

Collection sites	Name of tehsil	Name of village	No. of fungal Genera observed
	Gondia	Gangazari	6
		Dongargaon	7
		Kamtha	6
	Tirora	Wadegaon	6
		Mundikota	4
		Vihirgaon	5
	Amgaon	Malhi	8
		Sakritola	7
		Amgaon	8
	Goregaon	Goregaon	6
		Dawwa	6
		Ghoti	7
	Salekasa	Salekassa	6
		Rondha	3
		Darekassa	6
	Deori	Deori	8
		Navegaon	8
		Gothangaon	4
	Arjuni Morgaon	Arjuni	6
		Morgaon	4
		Pathari	7

Table 1: Collection sites along with tehsil and observed genera of respective site.

Observation:

Isolated fungi which are grown on the culture plate after serial dilution are identified with the help of monographs and literature available online as well as offline. The identified genera were recorded and enlisted in table as following

.

Sr no	Name of tehsil	*Aspergillu*	*Aspergillu*	*Aspergillu*	*Penicilliu*	*Cladosporium*	*Fusarium*	*Fusarium*	*Rhizopus*	*Rhizopus*	*Curvularia*	*Trichoder*	*Mucor spp.*
	Gondia	+	+	-	+	-	+	+	-	+	+	+	+
	Tirora	+	+	+	+	+	+			+	-	-	+
	Amgaon	+	+	+	+	+	+	-	+	+	+	+	+
	Goregaon	+	+	+	+	-	+	+	+	-	+	+	+
	Deori	+	+	+	+	+	+	+	+	+	+	+	+
	Salekassa	+	+	+	+	-	+	+	+	+	+	+	-
	Morgaon Arjuni	+	+	+	+	+	+	+	-	-	+	+	+

Table 2: Tehsil wise observed taxa of fungi found associated with paddy root soil.

Result :

The mycoflora study conducted on the root soil of rice plants in Gondia district yielded insightful results, providing significant implications for agriculture and environmental management. There are total 12 taxa and 8 genera of fungi found to be associated with rice/ paddy plant root soil all were isolated from different locations within Gondia district. Aspergillus niger, Aspergillus flavus and Penicillium notatum were found to be dominant in all sites.

Discussion:

The study revealed a diverse array of fungal species inhabiting the root soil of rice plants in Gondia district. This diversity underscores the complex ecological interactions occurring within the rhizosphere, which can have profound effects on plant health and productivity.

Among the fungal species identified, several were found to be potential pathogens known to cause diseases in rice plants. These findings highlight the importance of understanding the composition of the rhizosphere microbiome for disease management strategies.

In addition to pathogenic species, the study identified a number of beneficial fungi known for their symbiotic relationships with plants. These fungi play crucial roles in nutrient cycling, stress tolerance, and disease suppression, thereby

enhancing the resilience of rice plants to environmental challenges.

The study observed variations in fungal species composition and abundance based on environmental factors such as soil type, moisture levels, and agricultural practices. Understanding these environmental influences is essential for designing site-specific management practices to optimize crop productivity and minimize disease incidence.

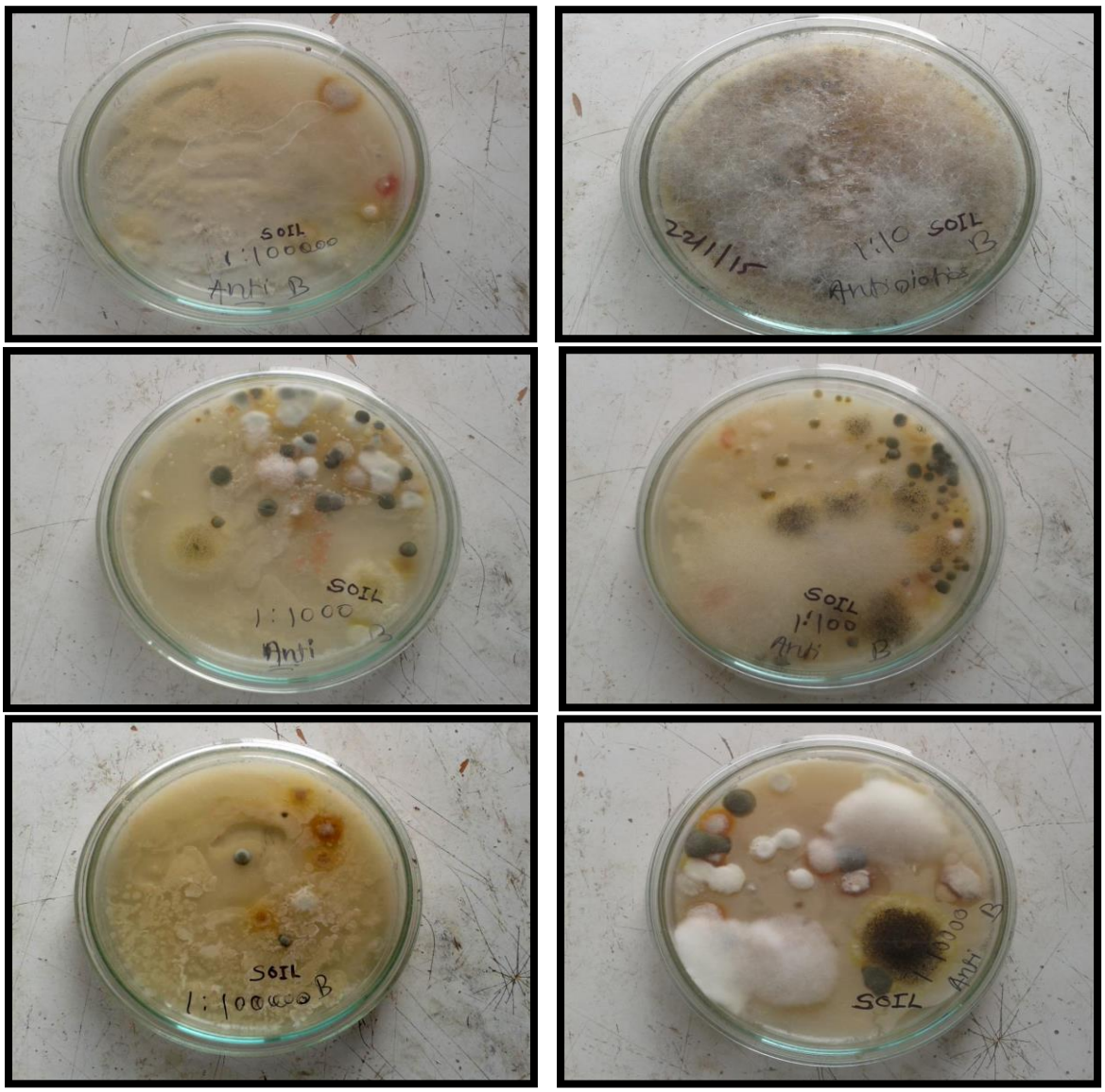
Further research is warranted to explore the functional roles of specific fungal taxa within the rhizosphere microbiome and their interactions with rice plants. Longitudinal studies can provide insights into the dynamics of fungal communities over time and their responses to changing environmental conditions and agricultural practices.

The findings of this study have implications beyond the realm of academia, extending to farmers and agricultural extension services in Gondia district. Outreach efforts should focus on disseminating knowledge about the importance of soil microbial diversity and promoting practices that enhance beneficial fungal associations for sustainable rice production

.**Conclusion:-**

In conclusion, the mycoflora study of rice plant root soil in Gondia district offers valuable insights into the complex interactions between fungi and plants in agricultural ecosystems. By understanding and harnessing the potential of these microbial communities, stakeholders can work towards promoting sustainable agriculture practices that optimize crop productivity while preserving environmental integrity.

Figure 1: Growth of fungal colonies on PDA solod media after inoculating with root soil of rice plant



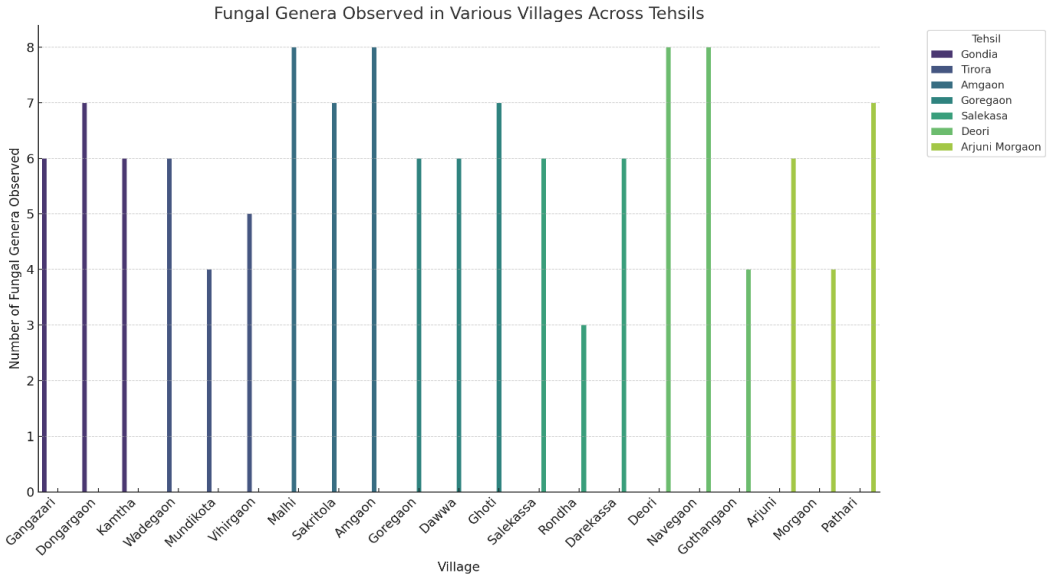


Figure 2 :
Here's a bar chart depicting the number of fungal genera observed in each village, categorized by tehsil. Each bar represents a village, and the height of the bar indicates the number of fungal genera observed there**.**

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