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Studies on the microbial incidence of wetland soils in Shatiya, Gopalganj

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Abstract- During the dry season of 2019, research was conducted in Gopalganj's wetland soils in Shatiya to investigate the microbiological features of the wetland soils. During the dry season, Total Fungal Counts (TFC) and Total Bacterial counts (TBC) were determined using conventional protocols from three different sites at depths ranging from 2 to 20 cm. Characterization and identification of microbial isolates were carried out. The TBC was measured to be anywhere from 2.0 x 10^3 cfu/g to 6.0 x 10^3 cfu/g throughout the various sites. The TBC was determined to be 5.5 x 10^3 cfu/g at the site 1, 2.2 x 10^3 cfu/g at site 2, and 5.9 x 10^3 cfu/g at site 3. TFC varied from 5.0 x 10^3 cfu/g to 7.0 x 10^3 cfu/g depending on the location of the sample inside the site. TFC for site 1 was 5.5 x 10^3 cfu per gm, site 2 had 6.2 x 10^3 cfu per gm, and site 3 had 6.8 x 10^3 cfu per gm. *Bacillus* sp., *Staphylococcus* sp., *Pseudomonas* sp., *Klebsiella* sp., *Escherichia coli* and *Streptococcus* sp., which were identified by biochemical test were predominate bacteria while *Aspergillus* sp., *Penicillium* sp., *Rhizopus* sp., and *Fusarium* sp., which were also identified macroscopically and microscopically were the dominant fungi genera isolated. This would, in the long run, result in a higher yield productivity of agricultural goods derived from the wetland. These findings provide the baseline data of Shatiya wetland soils, which are necessary for the management of the area and the practice of sustainable agriculture.

Key words: Ecological status, Wetland, Microbial assessment, Agricultural productivity

INTRODUCTION

Wetlands are among the most productive ecological systems on earth, on par with rain forests and coral reefs in terms of productivity. However, they are becoming more and more threatened by both identifiable point sources, such as industrial and municipal waste water, and nonpoint sources, such as urban and agricultural runoff. In wetlands, degradation affects the amount, quality, and flow rates of the water. Humans always alter the nature of land, which influences the wetland environment, to meet the demands of expanding people and for further development. To assess a wetland's water quality and quantity, it is critical to characterise the land use in and around it.

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The world's wetlands constitute an environment with a high level of biological diversity, but they are threatened by a variety of anthropogenic activities. These delicate aquatic habitats are described as being vulnerable to even little environmental changes. Despite making up 15% to 20% of India's overall biodiversity, there are little research on the biodiversity of wetlands.[1] These most productive ecosystems are therefore essential for maintaining biodiversity. The foundation of the food pyramid is the plankton community, which enhanced wetland biodiversity.[2]

According to projections made about the growth of the world's population over the course of the next 25 years,[3] the demand for food products is expected to increase by a factor of fifty percent by the year 2030. In addition, the cultivation of energy crops with the purpose of incorporating them into the production of biofuels is gaining popularity.[4] Efforts to promote "climate-neutral" economic activity will give rise to initiatives to plant forests in open areas, including non-forested wetland areas. These initiatives will be implemented. Because of all of these activities, there will be a growing need to restore whatever natural areas that are still intact so that they may be used for agricultural purposes. This might be seen as pointing to an increased likelihood of wetlands being drained and destroyed. Another potential effect would be the concerted effort to find new varieties of crops that are able to grow in conditions that are only suitable for a limited time.

Few studies have also shown the major differences in chemical properties that are present between the well-drained and poorly-drained soil in Gopalganj. These differences have been proved to exist in the region. These disparities have been seen all around the area. This research was carried out by a number of different researchers. Even though most of the nutrients in these soils were found to be in low amounts, it was observed that the accessible forms were significantly larger in the wet conditions than in the dry ones. On the other hand, no previous study has looked at the microbiological load and incidence in the region Shatiya, which is located in Gopalganj.

This study was carried out with the intention of analysing and comparing the bacteriological quality as well as the concentration of many important components of soil samples, described in the second part of the paper, taken from wetland soils in the Shatiya wetland region which is situated in Gopalganj. The purpose of this investigation was also to determine whether or not there was a correlation between the bacteriological quality and the concentration of many important components and microbial flora of the wetland.

METHODS

Study location

The Gopalganj district is located between latitudes 26°12 and 26°39 in the North and 83°54 and 84°55 in the East. Gopalganj has a total area of 2033 sq. km and a population density of 1260 inhabitants per sq. km. 93.65% of people reside in rural areas, compared to 6.35 percent who live in urban areas. In Gopalganj district, there are 12.49% Scheduled Castes (SC) and 2.37% Scheduled Tribes (ST) of the total population.

Fig 1. Map of Gopalganj

Climate

The climate in Gopalganj is diverse. Summer time temperatures can reach up to 45°C, making it unusually hot and dry. During the monsoons, Gopalganj experiences roughly 500 mm of rainfall, which is followed by a nice winter climate. The district experiences temperatures ranging from 10 to 45°C and receives an average rainfall of roughly 290 millimetres. In general, the whole physical area may be divided into two categories: Normal Area and Lowly region (flood impacted region). Flood-affected regions include those in the six blocks' Gopalganj, Kuchaykot, Manjha, Sidhwalia, Barauli, and Baikunth pur. During the rainy season, these places are submerged in water. However, these regions are referred to as the store of food grains in terms of cultivation and agriculture.

Sample collection

Samples of the soil were taken from three different places (site 1-S1, site 2-S2 and site 3-S3) which served as the control). At a depth of 20 cm, a soil auger was used to collect five samples of soil from each of the sampling stations, which were then placed in sterile polythene bags. The clearly labelled and sterile polyethylene bags were transported to the laboratory in ice-packed coolers in order to undergo microbiological and physicochemical investigation.

An Examination of Microorganisms

Under sterile circumstances, one gm of each specimen was added to nine millilitres of sterile prepared peptone water diluent, and the mixture was gently stirred. After 24 hours of incubation at ambient conditions, the total bacterial count was measured after the soil samples had been serially diluted and sub-cultured on nutrient agar using pour plate procedures. Counts of bacteria and fungi were taken once the incubation period was complete.

Preservation of Pure Culture

After performing several subcultures onto the proper agar medium, pure cultures were finally obtained. Pure cultures were kept on Nutrient agar slants and stored in the refrigerator at a temperature of 4^{o}C as well as at an ambient temperature of 27 ±1^{o}C for further testing.

Biochemical Characterization of Isolates

When bacteria are provided with certain biochemical compounds, it is known that they will display a unique biochemical response or feature when given such chemicals. The capacity of bacteria to produce essential enzymes underpins their innate capacity to show certain metabolic characteristics. As a result, in order to completely identify and categorise bacteria, we need to: The biochemical testing is really necessary. Glucose, lactose, hydrogen sulphide gas generation, catalase, coagulase, motility, indole, urease, citrate and oxidase, Gm staining, and the methyl red test are some of the biochemical tests that were utilised in this investigation to detect the presence of bacteria.

RESULTS

The TBC was measured to be anywhere from 2.0 x 10^3 cfu/g to 6.0 x 10^3 cfu/g throughout the site's various sites. The TBC was determined to be 5.5 x 10^3 cfu/g at the site 1, 2.2 x 10^3 cfu/g at site 2 and 5.9 x 10^3 cfu/g at site 3. TFC varied from 5.0 x 10^3 cfu/g to 7.0 x 10^3 cfu/g depending on the location of the sample inside the site. TFC for Site 1 was 5.5 x 10^3 cfu per gm, Site 2 had 6.2 x 10^3 cfu per gm, and Site 3 had 6.8 x 10^3 cfu per gm. *Bacillus sp., Staphylococcus sp., Pseudomonas sp., Klebsiella sp., Escherichia coli* and *Streptococcus sp.,* which were identified by biochemical test were predominate bacteria while *Aspergillus sp., Penicillium sp., Rhizopus sp.*. and *Fusarium sp.,* which were also identified macroscopically and microscopically were the dominant fungi genera isolated.

The frequency with which bacterial isolates were found in the soils of the Shatiya wetland. *Bacillus sp.,* was found to have the greatest frequency of bacterial isolates, coming in at 38%, while *Actinomycetes sp.,* was found to have the lowest frequency of bacterial isolates, coming in at 3%. In addition, it was found that the frequency of *Staphylococcus aureus* was 12%, the frequency of *Pseudomonas aeruginosa* was 8%, the frequency of *Escherichia coli* was 23%, *Klebsiella sp.,* was 17%, and the frequency of *Streptococcus sp.,* was 7%.

The findings that were derived by analysing the frequency of presence of fungal isolates in the soils of Shatiya wetland showed that *Aspergillus sp*., had the greatest frequency of fungal isolates, which was the percentage of 23.4%, while *Fusarium sp.,* had the least percent-age frequency of occurrence, which was 1.8%. Comparatively, the frequency of *Rhizopus sp.*, was 11.3%, whereas the frequency of *Ascomycota sp*., was 13.5%.

Pure bacterial isolates' characteristics and colony appearance

The findings for the features and identification (colonial morphology) of pure bacterial isolates were obtained resulting from the colony surfaces, form, consistency, pigmentation, elevation, and edge correspondingly. From the soils of the Shatiya wetland, a total of six distinct genera of bacteria were extracted and identified. *Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Klebsiella sp., Streptococcus sp., Actinomycetes sp.,* and *Bacillus sp*., are some of the bacteria that fall within this category.

Analyses of the biochemical properties of Bacterial / Fungal isolates

In order to assess the colonial and morphological properties of the pure fungal isolates, they were subjected to both a macroscopical and a microscopical examination. The following species of fungi have been determined to be present: *Aspergillus sp., Penicillium sp., Rhizopus sp., Ascomycota sp.,* and *Fusarium sp.,*

DISCUSSION

The investigation into the soils of wetland areas found that heterotrophic bacteria had the greatest occurrence rate. The number of fungal species that may be found in wetland soils is second

only to the number of bacteria that can be found there. Because these microorganisms are able to tolerate a broad range of differences in the soil's qualities, the fact that heterotrophic bacteria are the most often found organisms may be explained by the fact that they have the greatest frequency of occurrence. Since fungal development is facilitated by an environment's having an acidic character, the high fungal counts may be linked to the acidic nature of these soils, since that would explain why there are so many of them.[5] The findings revealed that the microbial count readings at each of the sample locations were within a wide range of values. This might be explained by the increased availability of beneficial growth nutrients, as well as the pH and temperature of the soils.[5]

According to research conducted by Udotong *et al.*, (2008)[5], the control site had the largest bacterial count because the soil had a high concentration of humus, which led to a high rate of microbial decomposition. This finding is consistent with the findings of another study. It is possible that the presence of a large number of sand and stone particles at Site 1 contributed to the lowest bacterial count. They indicated that pollution of the soil sediment of the river may offer a risk to its consumption by people. The presence of *Enterobacter species* and *Bacillus species* in the soil is supportive of those organisms being present in soil, Nwachukwu and Otokunefor, (2006)[6] suggested that pollution of the soil sediment of the river could pose a hazard. According to the results of Tulchinsky *et al.*, (2000)[7], there have been a number of instances of waterborne enteric infections that have been documented. Researchers like as Hellard *et al.*, (2000)[8] have described instances of gastroenteritis that were brought on by *E. coli* and other protozoans that were found in drinking water as well as surface water.

According to the findings, the wetland was faecal polluted, and as a consequence, it contains germs that are capable of causing gastroenteritis. As a result, it is not suitable for use in activities that take place in the home or for recreational purposes. According to Olayemi *et al.*, (1994)[9], the greater microbial counts that were obtained may also be attributed to the increased presence of nutrients and aeration, both of which sped up the decomposition of organic waste and led to a rise in the number of bacterial communities.

According to the findings of a research, the presence of *Bacillus sp.,* in drinking water and reservoir tanks lends credence to the hypothesis that such organisms are also present in the soil of the wetland.[6] *Aspergillus sp., Penicillium sp., Mucor sp.,* and *Rhizopus sp.,* are some of the fungal species that have been isolated from several wetland soil samples for this research. Other isolates include *Rhizopus sp.,* Because *Aspergillus sp.,* is one of the principal organisms that is prevalent in the soil of the majority of wetland environments,[10] it was found that *Aspergillus sp.,* was the fungus that was isolated the most often from all of the samples and virtually all of the samples that were collected. Additionally, numerous *Penicillium sp.,* was found in the samples that were quite similar to those reported by (Yeung-Cheung, 2009)[11]. According to the findings of a microbiological research conducted on the soils of the Abule Odu wetland in the Shatiya Local Government Area, the wetland soils operate as a home for a wide variety of bacterial and fungal species. Microorganisms in the soil are second in importance to plants because of the crucial functions they play in the breakdown of organic matter, the stabilisation of the soil structure, and the cycling of minerals.[5]

CONCLUSION

During the course of this research, a microbiological and physicochemical study was conducted on the wetland soils in Shatiya. The results of this study showed that the microbiological and physicochemical features of these soils are acceptable for the cultivation of arable crops. This entails the growing of important arable crops including bananas, sugarcane, cassava, cocoyam, and vegetables, among others. It has been discovered that bamboo may be successfully cultivated in the soils of wetland areas. However, due to the fact that tree crops such as coconut and oil palms are able to tolerate acidic conditions, it is recommended that these soils be used for the planting of tree crops. This research on soils was conducted so that it could be done. According to the findings of this body of study, the bacteria and fungi that were identified play an important part in the richness of the soil, making it appropriate for both aerobic and facultative anaerobic species. Extremely high concentrations of mineral metals were found, the ingestion of which or usage of which for domestic purposes may have negative effects on humans. Although the presence of certain minerals in greater quantities in the soil may contribute to an increase in the bacterial load and assist the organisms in decomposing a broad range of organic material, this may ultimately result in a better output productivity of agricultural goods derived from the wetland.

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