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Soil Fungal Diversity of Agriculture Area of Neem Ka Thana District in Rajasthan, India

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ABSTRACT

Soil is the most important and complex bio-reservoir in the terrestrial ecosystems. Soil microorganisms include different types of bacteria and fungi which together help in improving the soil fertility and promoting plant growth. Soil also harbours one of the most important undiscovered microbial biodiversity. Soil samples of agriculture fields of Neemkathana area of Rajasthan were investigated for soil fungal diversity. A total of 51 species in 15 genera of fungi are documented from the agricultural soils, following standard soil dilution techniques. Fungi were identified and characterised based on morphological characters, using standard identification manuals. Current study indicates that temperature, pH, alkalinity, moisture, and physical, chemical, and biological factors influence the soil fungal diversity.

***Key words**: Soil mycoflora, Soil, Terrestrial ecosystem, Soil fertility, Biodiversity, Soil pH, Soil temperature, Soil alkalinity.*

Introduction

Soil is the major component of the earth's ecosystem and it comprises of organic matter, minerals, and a large number of macro and microorganisms (Shi *et al*., 2002). The soil ecosystem is supported by physical, chemical, and biological interaction of the microorganism within the soil (Bhattacharyya and Jha, 2011). Many biological processes that take place in the soil determine the various functions in the soil, which together is responsible for the characteristic properties of the soil of a particular area (Buscat and Verma, 2005; Satish *et al*., 2007).

Agricultural field is the zone of the soil, surrounded by the roots of the plants (trees, shrubs, herbs), wherein the microbial population is activated by the different types of secretion of the roots which include amino acids, growth factors and sugars (Sharma *et al*., 2015). Agricultural zone of any field in soil is known to be the hotspot of microbial activities (Buckova *et al.,* 2000). Soil mycoflora plays a significant role in the productivity of the soil and thereby the vegetation (Wicklow and Whittingham, 1974; Delgedo *et al*., 2021). Microorganisms in the soil are beneficial in increasing soil fertility and plant growth as they are involved in several biochemical transformation and mineralization activities (Waksman, 1944; Raviraja *et al*., 1998).

Types of cultivation and agriculture practices determine the soil microbial taxa (Tejesvi *et al*., 2005; Devi *et al*., 2012) Fungi are important members of the soil microbiota and they are in abundance than bacteria depending on the soil depth and nutrient conditions (Christensen, 1984; Subha *et al*., 2013; Yang *et al*., 2022).

For the functioning of soil ecosystem, fungi are important contributors (Strickland and Rousk, 2010). Especially in forest and agriculture ecosystems, they play a key role in essential processes such as organic matter decomposition and elemental releases by the mineralization in the soil (Slavikova and Vadkertiova, 2000). It is estimated that of the 1.5 million fungal species present in the natural ecosystem, only 5 to 10 percent so far have been described (Pandey *et al.*, 2006; Oyeyiola, 2009; Osono and Hirose, 2009).

The aim of present investigation is to determine the fungal diversity of agriculture area. The study involves the isolation, identification, and enumeration of the fungi of the agriculture area in and around the Neem ka thana of Rajasthan.

Material and Methods

Study area: Neem ka thana is a district 73 km away from the Sikar district in Rajasthan. It is 119 km away from Jaipur and there are several agriculture fields existing in the area. From literature survey it has been found that very less effort has been done for the study of the soil fungi in the area, although a large potential agriculture field is present which can be a good source for research in several aspects of agriculture and plant sciences.

The soil of the area is litho-soil, consisting chiefly of unweathered or partly weathered rock fragments, usually found on steep slopes and many types of agricultural crops are grown here.

Collection of soil samples and isolation of fungi: Soil samples near the agricultural areas were collected, randomly from five different sites from 0 to 15 cm depth, after removing 2-3cm below soil from the surface. Samples were collected in polyethylene bags and soil samples were brought into the laboratory for the testing of the physical, and chemical analysis, as well as isolation of the fungi. Serial dilution method (Waksman, 1944) was followed using PDA medium. One percent Streptomycin antibiotic was added into the culture medium to prevent the growth of the bacteria. The Petri dishes were incubated at 28 ^{o}C for 5-7 days. The colony forming units (CFU) of the fungi isolated were studied.

Identification of the fungi: Fungal morphology was studied macroscopically by observing the colony features (texture, size and colour) and microscopically by making slide mounts in lactophenol and cotton blue stains. The slides were observed under a compound microscope for fungal structure such as conidiophores and conidia and arrangement of the spores. The isolated fungi were identified by the relevant literature (Gilman, 1998: Naganami *et al.*, 2006).

Results and Discussion

During the investigation, we were able to obtained isolates belonging to 51 species in 15 genera of fungi which belonged to Ascomycetes, Zygomycetes and Deuteromycetes.

Physico-chemical parameters such as the soil pH, temperature, moisture, sulphur, potassium, phosphorus, and copper were tested with the standard protocols, soil pH is slightly acidic and moisture content of the soil is also favourable to the growth of the soil fungi in the agriculture fields, several fungi can be observed, during the rainy season the soil moisture content increases and this enhances the growth of the fungi and other microorganism (Osono and Hirose, 2009).

Fungal diversity was observed in the PDA medium. *Absidia gluca* is presented by 5 colonies in the Petri dishes, *Absidiaspinosa* is presented by the five colonies. *Rhizopus* and *Mucor* are the common inhabitants of the soil, although in this soil they are repre-

Table 1. Distribution of fungal colonies in the study area

Name of the fungus	Total number of species
Zygomycetes	
Absidiagluca Hagem	05
Absidiaspinosa Lendn	05
Cunninghamella blakesleenam Lendn	01
Mucorplumbeus Naumov	02
Rhizopusmicrosporous Tiegh	02
Deuteromycetes	
Cladosporium spp. Link	05
Cladosporiumoxysporium Berk.	01
Cylian drocladium spp. Crous.	03
Fusarium japonicum Link.	05
Phoma spp. Boerema.	03
Trichoderma sp. Persoon.	01
Alternaria alternata (Fr.) Krisseler.	02
Ascomycetes	
Penicillium decumbens Thom.	02
Penicillum granulatum Bain	02
Aspergillus flavus Link.	03
Aspergillus japonicus Link.	02
Aspergillus niger Link.	02
Chaetomium globosum	02
Nectria spp. Tode	02
Nectriopsis sp. Schmidt	01

sented by only two colonies, *Aspergillus niger* and *A. flavus* also show the abundant growth in Petri plates, *Cladosporium* is also presented by the five colonies, members of the basidiomycetes are also in rich in growth, however they are presented by the less colonies. Bhattacharyya and Jha (2011) studied the seasonal and depth-wise variation in microfungal population. Numbers in Nameri forest soil, Assam, Northeast India, 21 fungal species belonging to the 14 genera were recovered from all depth throughout the season with the highest population and relative abundance of the *Aspergillus flavus* (8.4%) followed by the *Penicillium crysogenum* (8.0%) lowest by the *Rhizopusoryzae, Rhizopus nodosus, Trichophyton* sp. (2.8%). A total of 15 genera and 51 species of the fungi were found in agriculture area.In a similar work Buckova *et al*. (2000) studied the occurrence and abundance of microscopic fungi in floodplain forest soils +. Thirty-one genera of microscopic fungi were determined from Fluvi - eutricGleysol and Eutric Fluvisol (FAO). The most frequent genera are: *Penicillium*, *Trichoderma. Aspergillus, Aureobasidium, Verticillium*, *Humicola*. In the present research work we found that *A.niger, Rhizopus, Mucor* are the most common members of the Ascomycetes and Zygomycetes. Chandini (2016) analysed the soil fungal diversity in Seethaliyanagari hills of Chikkamagaluru, Karnataka. A total of 19 genera and 42 species with classes Deuteromycetes (50%) with highest percentage followed by Ascomycetes (23.8%) and Zygomycotina (21.4%) were recorded in the study site. In our work we found that members of the ascomycetes, deuteromycetes are most abundant than the members of the basidiomycetes in the soil of the Neemka than area of Rajasthan. Devi et al. (2012) worked on the diversity of culturablesoil micro-fungi along altitude in algradients of Eastern Himalayas, Species of *Penicillium* (D =1.44) and *Aspergillus* (D =1.288) were found to have highest diversity index followed by *Talaromyces* (D= 1.26) and *Fusarium* (D= 1.26) (Osono and Hirose, 2009). Altitudinal distribution of microfungi associated with *Betulaermanii* leaf litter on Mt. Rishiri, northern Japan. A total of 35 species were isolated from *Betula* leaf litter of which 12 occurred frequently and were regarded as dominant microfungi. Oyeyiola (2009) studied the mycoflora of okra (*Hibiscus esculentus)*.

Conclusion

Soil fungi are the best decomposers of organic matter and they increase the soil fertility. The diversity of soil fungi can be observed in the deep forest such as the tropical forests and Amazon forests. In addition, soil fungi are an integral part of several biogeochemical cycles of the earth. Seasonal variations can be seen in the fungi diversity in the agriculture fields. Some of the genera such as *Aspergillus, Mucor*, *Cladosporium,* and are also common in all the seasons. Soil fungi have important functions like nutrient cycling and water dynamics; in addition, they are important decomposers of organic matter. Soil fertility is considered an important term of the soil ecosystem. Fungi are the successful inhabitants of the soil, and due to their high plasticity and their capacity to adapt to various soil conditions, they are an important part of the soil ecosystem. Many species of fungi are important in bioremediation. They are the bio absorbent of several metals such as cadmium, copper, mercury, lead, and zink. The diversity of soil is affected by the several abiotic and biotic of the soil. Soil fungi diversity is strongly affected by the plant community structure and the ecosystem dynamics of the area, in addition, the fungal diversity also affects the pattern of the organic matter and the plant diversity. Fungi have several roles in the soil ecosystem, they fix the nitrogen, hormone production, biological control against root pathogens, and protection against drought, there are several multidisciplinary research effects of the soil fungal biodiversity, they are very important for the sustenance of the life forms in the soil ecosystem. In this research article we have tried to find out soil fungal diversity in agriculture area of the Neem ka thana district. Appropriate knowledge of fungal diversity leads to the better development of that area for agriculture crops.

Conflict of Interest: NA

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