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MICRO FUNGAL DIVERSITY IN FOREST AND DEGRADED LAND SOILS

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Fungal population of forest and degraded land soil was estimated for a period of one year. A total number of 34 and 32 species were isolated from forest and degraded land soil respectively. Numbers of fungal propagules were higher in surface soil, which decreased with increasing soil depth. *Acremonium rutilum, Absidia heterospora, Aspergillus flavus, Cladosporium cladosporiodes, Humicola fuscoatra, Mucor hiemalis, Necteria ventricosa* and *Penicillium chrysogenum* were dominant fungi in both the field soils.

INTRODUCTION

Microorganisms occupy a unique position in biological cycles in terrestrial habitats, as they are essential for maintenance of soil fertility and plant growth. Thus soil is impregnated with a variety of heterotrophic microorganisms. Fungi and bacteria are responsible for breakdown of organic mattter and release of nutrients. They are also considered responsible for nutrient transformation, particularly in case of nitrogenous and phosphate minerals. Fungi are most important primary consumers of decomposable materials of soil. Clark and Paul (1970) reported about twice as much fungal biomass as bacterial biomass. The plant species growing on the soil also exert an influence on the population and species composition of fungi (Mishra and Sharma, 1977).

A perusal of literature reveals that our knowledge on fungal and bacterial population is largely based on forest and grassland soils (Mishra, 1966; Christensen, 1969) or agricultural soils (Mishra and Kanaujia, 1973; Shukla and Mishra, 1992). Microbiological studies of degraded and forest soils have not been carried out concerning to the fungal and bacterial population and therefore, an attempt was made to study the bacterial and fungal population of forest and degraded land soils.

MATERIALS AND METHODS

The study was carried out near University Campus on Rono Hills (altitude 340 msl, latitude 27° 9" N and longitude 93° 46" E. Two types of lands *i.e.*, forest and degraded are situated adjacent to each other. Soil sample were collected from the forest and degraded land at the depth of 0-15 cm and 15-30 cm on three months interval for a period of one year. Before digging of soil upper surface was scraped to remove the litter contamination especially in case of forest soil. After collection, soil samples were brought to laboratory for analysis of microbiological parameters. Soil is sandy loam in characteristic. The average minimum and maximum ambient temperature of the study site was 8 °C and 28 °C during the study period in the month of February and April respectively.

Soil plate method was used to assess fungal populations developing on Martin's rose Bengal agar medium (Johnson and Curl, 1972). The inoculated agar plates were incubated at 25°C and

colonies were counted after 5 days. Dilution plate method was used to estimate bacterial populations on nutrient agar medium (Johnson and Curl, 1972). The patriplates were incubated at 30°C and colonies were counted after 24 hrs. For identification of fungi the monographs consulted were those of Barnett and Hunter (1972), Subramanian (1971) and Domsch *et al.* (1980). No attempt was made to identify bacteria.

RESULTS

Depth-wise variation in the fungal and bacterial population of forest and degraded land soils are given in table 1 and 2. Fungal population and bacterial population were always highest in surface soil and decreased along with soil depth. In both the land soils maximum fungal population was harboured from forest land soil in the month of September from 0-15 cm depth and minimum from degraded land soil in the month of June from 15-30 cm depth. Similarly bacterial population was maximum in forest soil at 0-15 cm depth in September month and minimum number was in degraded land soil at 15-30 cm depth in the month of June.

A total number of 34 fungal species were isolated from forest soil. Fungal species, *Bispora catenula, Clavariopsis aquatica, Gonatorrhodiella highlei, Haplosporangium parvum, Heterocephalum auranticum, Oidiodendron echinulatum, Phialomyces macrosporus* were isolated only from surface soil (0-15 cm) and *Aureobasidium* sp., *Arthrobotryum melanospora, Bipolaris* sp., *Cercospora rosicola, Cunninghamella elegans, Discosia maculicila, Gonatobotryum apiculatum, Gonatobotrys simplex, Harpographium fasciculatum* and *Sympodilla acicola* were isolated from 15-30 cm soil depth of forest land. *Acremonium rutilum, Absidia heterospora, Aspergillus flavus, Botrytis cinera, Cladosporium cladosporiodes, Cladobotryum* sp., *Fusarium oxysporum, Geoderma* sp., *Geotrichum albidum, Gilmaniella* sp., *Humicola fuscoatra, Mucor hiemalis, Necteria ventricosa, Penicillium chrysogenum* and *Stephanoma tetracoccum* were common fungi in both depth of forest soil (table 3).

Thirty-two species were isolated from degraded land soil. *Aspergillus flavus, Botrytis cinera, Botryotrichum piluliferum, Cercospora rosicola, Cladosporium cladosporiodes, Dendrophoma obscurans, Monilia americana, Oidium moniliodes* and *Streptothirx* sp. were restricted to surface (0-15 cm) soil. *Absidia heterospora, Aureobasidium* sp., *Arthobotrys oligospora, Arthrobotryum melanospora, Bispora punctata, Cercosporella persica, Chaetophoma confluens, Curvularia lunata, Chalaropsis* sp. and *Torula herbarum* were isolated only from 15–30 cm depth soil. *Acremonium rutilum, Chrysosporium* sp., *Clasterosporium caricinum, Cunninghamella elegans, Gilmaniella* sp., *Geotrichum albidum, Humicola fuscoatra, Mucor hiemalis, Necteria ventricosa, Paecilomyces* sp., *Penicillium chrysogenum* and *Trichoderma viride* were common fungi in both the depths of degraded soil.

Bipolaris catenula, Cladobotryum sp., *Clavariopsis aquatica, Discosia maculicila, Fusarium oxysporum, Geoderma* sp., *Gonatorrhodiella highlei, Haplosporangium parvum, Harpographium fasciculatum, Heterocephalum aurantiacum, Lacellina graminicola, Oidiodendron echinulatum, Phialomyces macrosporus, Stephanoma tetracoccum, Sympodilla acicola* were restricted to forest soil only. Whereas, *Arthrobotrys oligospora, Botryotrichum piluliferum, Cercosporella persica, Chaetophoma confluens, Chalaropses* sp., *Chrysosporium* sp., *Clasterosporium caricinum, Curvularia lunata, Dendrophoma obscurans, Monilia americana, Paecilomyces* sp., *Streptothrix* sp., *Torula herbarum* and *Trichoderma viride* fungi were restricted to degraded land soil only. Besides above cited fungi, remaining were common in both the land soils (table 3 and 4).

Table 1 : Number of fungal propagules (per gram dry soil x 10^2) in forest and degraded land soils.

Sampling period	Forest land		Degraded land	
	0–15 cm	15–30cm	0–15 cm	15–30 cm
March	21.95	20.00	20.80	17.07
June	22.22	20.00	21.68	12.19
September	34.56	28.20	30.58	25.88
December	30.12	25.10	27.20	22.00

Table 2 : Bacterial population (per gram dry soil x 10^4) in forest and degraded land soils.

Sampling period	Forest land		Degraded land	
	0–15 cm	15–30cm	0–15 cm	15–30 cm
March	17.07	11.25	10.00	5.12
June	17.03	8.50	4.57	3.90
September	20.24	13.23	8.23	4.00
December	19.10	12.80	8.15	4.22

DISCUSSION

The drop in number of fungi in lower depth could be attributed to the high moisture content of the deeper soil resulting into reduced aeration of soil (Shukla and Mishra, 1992). Surface soil usually provided with high organic matter content which in presence of adequate moisture supply is acted upon by the microorganisms to decompose the complex organic residue into simpler forms, hence the microorganisms are higher in upper layer of soil (Acea and Carballas, 1985). Generally in forestland soil amount of mineral nutrients found always higher than degraded land (Widden, 1979). It is the possible reason of higher bacterial and fungal population in forestland soil than degraded land soil. The major elements essential for germination of fungal propagules in soil are considered nitrogen, carbon and iron (Benson and Baker, 1970). The majority of the taxa showed change in quantity with soil depth. In general major changes in community structure take place at surface layer. Fungi like *Alternaria, Curvularia* and *Trichoderma* are occur commonly in tropical forest soils but in present study these fungi were not identified may be due to low temperature and unfavourable physico-chemical properties of the soil (Widden, 1979; Bissett and Parkinson, 1979). The genus *Aspergillus* is extremely common in subtropical soils (Saxena and Sarbhoy, 1963). Fungal taxa that were restricted to forest soil only seem to have affinity to grow in higher concentration of mineral nutrients.

For a given community, it is generally observed that one or a few species are numerically predominant and may strongly affect environmental conditions for other species are numerically (Wardle and Parkinson, 1991). In the present study, few species were regularly isolated at relatively high frequencies. These species also have the most widespread and least aggregated distributions. The low levels of aggregation observed for these species may reflect a relatively broad or diverse niche space that may be the result of successful adaptation to many dimensions in the system. From the present study it could be concluded that forest and degraded land soil consists diverse range of fungal taxa, among them some were common and some were restricted to particular land system. It also may be inferred that a number of species were capable of colonizing the soil up to 30 cm of depth.

Table 3 : Fungal genera (per gram dry soil x 10^2) in forest soil.

Fungi	0–15 cm				15–30 cm			
	March	June	Sep.	Dec.	March	June	Sep.	Dec.
Acremonium rutilium	2.4	2.1	2.7	2.0	–	–	1.5	1.0
Absidia heterospora	0.4	0.7	1.7	2.0	2.5	0.5	–	0.5
Aspergillus flavus	1.4	2.5	3.3	3.0	1.7	0.2	–	–
Aureobasidium sp.	–	–	–	–	–	0.5	0.6	0.5
Arthrobotryum melanospora	–	–	–	–	–	0.5	0.6	0.5
Botrytis cinera	2.4	1.7	–	1.0	–	1.0	–	–
Bipolaris sp.	–	–	–	–	–	1.0	1.5	1.0
Bispora catenula	–	–	3.7	1.5	–	–	–	–
Cercospora rosicola	–	–	–	–	0.5	1.0	–	–
Cladosporium cladosporiodes	2.0	2.0	2.5	1.5	1.0	0.5	1.5	1.0
Cladobatryum sp.	–	–	0.5	0.5	–	–	0.5	–
Cunninghamella elegans	–	–	–	–	1.2	0.7	1.9	1.0
Clavariopsis aquatica	1.0	1.3	1.2	1.0	–	–	–	–
Discosia maculicila	–	–	–	–	–	–	1.2	–
Fusarium oxysporum	–	1.5	1.0	1.0	–	0.5	1.7	2.0
Geoderma sp.	–	1.3	1.3	0.5	–	–	–	–
Geotrichum albidum	–	1.5	1.5	0.5	–	1.7	0.5	0.7
Gonatobotryum apiculatum	–	–	–	–	–	–	1.5	1.0
Gonatobotrys simplex	–	–	–	–	–	–	1.0	0.5
Gilmaniella sp.	0.7	0.5	1.2	1.5	–	1.0	–	–
Gonatorrhodiella highlei	–	–	1.5	1.5	–	–	–	–
Haplosporangium parvum	2.4	1.0	–	–	–	–	–	–
Harpographium fasciculatum	–	–	–	–	0.5	1.0	2.5	0.9
Heterocephalum aurantiacum	2.4	–	–	–	–	–	–	–
Humicola fuscoatra	–	1.5	1.5	1.0	2.0	2.0	2.5	3.0
Lacellina graminicola	–	–	–	–	–	–	1.5	2.0
Mucor hiemalis	2.4	1.0	3.5	2.0	2.5	3.5	2.0	1.5
Necteria ventricosa	–	–	1.2	1.0	0.5	0.9	–	–
Oidiodendron echinulatum	2.4	1.0	1.7	2.0	–	–	–	–
Penicillium chrysogenum	2.4	1.5	1.2	1.5	1.2	0.5	2.0	1.5
Phialomyces macrosporus	–	0.5	–	–	–	–	–	–
Stephanoma tetracoccum	2.4	–	–	–	2.0	1.5	1.0	1.0
Sympodilla acicola	–	–	–	–	1.5	1.5	1.0	0.5
Sterile	1.0	1.5	2.5	2.5	3.0	–	1.2	1.5

Table 4 : Fungal genera (per gram dry soil x 10^2) in degraded soil.

Fungi	0–15 cm				15–30 cm			
	March	June	Sep.	Dec.	March	June	Sep.	Dec.
Acremonium rutilum	1.5	1.5	1.5	1.6	–	0.5	1.0	1.0
Absidia heterospora	–	–	–	–	–	0.5	0.5	0.5
Aspergillus flavus	–	1.5	0.5	2.0	–	–	–	–
Aureobasidium sp.	–	–	–	–	–	0.5	1.0	1.0
Arthrobotrys oligospora	–	–	–	–	–	1.0	0.5	1.0
Arthrobotryum melanoplace	–	–	–	–	–	1.0	1.3	0.5
Bispora punctata	–	–	–	–	–	1.5	1.2	0.5
Botrytis cinera	1.2	1.5	1.7	1.0	–	–	–	–
Botryotrichum piluliferum	1.7	1.8	2.0	2.5	–	–	–	–
Cercospora rosicola	2.2	2.4	2.5	2.0	–	–	–	–
Cercosporella persica	–	–	–	–	2.0	2.2	2.5	1.0
Cladosporium cladosporiodes	–	–	3.0	2.0	–	–	–	–
Chaetophoma confluens	–	–	–	–	3.0	1.5	1.9	1.0
Chrysosporium sp.	–	–	1.5	1.5	1.5	1.5	2.0	1.5
Clasterosporium caricinum	1.7	–	–	–	1.7	–	–	–
Cunninghamella elegans	1.0	–	–	–	1.5	–	–	–
Curvularia lunata	–	–	–	–	–	1.2	2.0	1.8
Chalaropsis sp.	–	–	–	–	1.5	–	–	–
Dendrophoma obscurans	1.2	2.5	–	–	–	–	–	–
Gilmaniella sp.	–	–	1.0	1.5	–	–	2.2	2.0
Geotrichum albidum	–	–	1.0	1.5	–	–	2.5	2.0
Humicola fuscoatra	–	1.5	1.2	1.0	1.5	2.0	–	–
Monilia americana	–	–	2.0	1.5	–	–	–	–
Mucor hiemalis	1.0	1.0	1.5	1.0	1.0	1.0	1.6	1.5
Necteria ventricosa	–	–	1.5	1.0	–	1.0	2.2	2.0
Oidium moniliodes	–	1.2	1.3	1.2	–	–	–	–
Paecilomyces sp.	2.1	1.5	1.2	1.2	2.0	–	–	–
Penicillium chrysogenum	3.0	1.5	1.0	1.0	1.0	–	–	–
Streptothrix sp.	2.0	1.0	–	–	–	–	–	–
Torula herbarum	–	–	–	–	1.5	1.5	2.5	2.0
Trichoderma viride	2.5	1.0	1.0	1.5	2.0	–	–	–
Sterile	1.5	1.0	1.3	1.5	2.5	–	1.0	1.0

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