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Ecology of micromycetes in forest soils of Delhi

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The present paper describes the mycoecology of three different forest soils of Delhi and suggests the effects of various edaphic variables on the composition of microfungal populations.

INTRODUCTION

Presence of fungi, both pathogenic and saprophytic, in soil as influenced by the ecological factors has drawn considerable attention with regard to their pathogenicity and soil fertility. Occurrence of microfungi both in forest and cultivated soils has been extensively studied by various workers (Bhatt 1977; Christensen et al. 1962; Thornton 1965) but little attention has been paid o uderstanding the ecological factors governing their occurrence and distribution in different soils (Saksena 1955; Moubasher and Abdel--Hafez 1978b; Behera, Mukerji 1979).

MATERIALS AND METHODS

Three localities, Green park, Wood park and Delhi University Ridge designated as Soil-A, Soil-B and Soil-C respectively, situated at about 20 - 25 Km from each other in Delhi, were selected for the study. Soil samples at three different depths (3, 15 and 30 cm) of each locality were collected at monthly intervals and the samples were labelled as SA 1, SA 2 and SA 3 (similarly in other cases also) from surface downwards. Samples for microbial analysis obtained from one face of the profile pit at selected points were processed using the soil dilution and soil plate

techniques. Czapek's Dox Yeast Extract Agar and Potato Dextrose Agar were used for isolation and culture of fungi. Statistical analyses were done for:

i) Total population of fungi per gram dry soil =

$$= \frac{\text{Mean number of fungal propagules} \times \text{Dilution factor}}{\text{Weight of dry soil}}$$

ii) Percentage frequency =

$$= \frac{\text{Number of soil samples from which fungi were recorded}}{\text{Total number of soils sampled}} \times 100$$

and for

$$\text{iii) Similarity coefficient} = \frac{2W}{a+b} \times 100$$

where W is the number of shared species, a is the total number of species in other soil.

Soil factors such as temperature, moisture content, pH, organic matter and total nitrogen were determined as described by Piper (1944), available phosphorus by the Olsen blue method (Jackson 1967) and Calcium by EDTA titration (Cheng, Bray 1951).

RESULTS

The soils were sandy-loam to sandy and the percentage content of the soils were more influenced by the climatic conditions of different seasons. The surface layer was recorded with slightly higher temperature compared to other two layers. Maximum temperature was noted in summer (V, VI) and minimum in winter (XII, I) months. Presence of water in soils mostly corresponded with the temperature of respective dates, the higher the temperature the lower was the water content except in the months of August and September (Table 1). Although a difference in pH at various depths was not appreciable it decreased with increasing depth. Carbon, nitrogen, phosphorus and calcium contents were higher in the surface layer and lower at 30 cm depth (Table 1).

The total number of fungal propagules per gram dry soil of monthly samples collected from various localities and depths is shown in Fig. 1. The surface layer was noted with maximum numbers of isolates which gradually declined with increasing depth. The lowest depth (30 cm) was recorded with population counts 5 - 7 times lower than the surface population. Significant variation in fungal counts was noted in different seasons of the year, the months August and September always presented maximal populations and the minimum was noted in May and June. Fungal population of soil-C during the months of January to July was comparatively higher than the population of soil-A but in rest of the

Table 1

Physico-Chemical characteristic of soils /SA, SB, SC/

	SA 1	SA 2	SA 3	SB 1	SB 2	SB 3	SC 1	SC 2	SC 3
Temperature /°C/	22.5±9.5	19 ± 10	18 ± 10	24 ± 11	19 ± 11	18 ± 10	22.5±10.5	20 ± 8	19± 8
Moisture content /%/	13 ± 8.5	8.7±6.5	8.3±4.5	12.5±7.6	9.5±5.5	7.8± 5	12 ± 9	9.5± 4	7.5±4.9
pH	8.1	7.9	7.7	8.4	7.6	7.9	9.0	8.3	7.9
Total organic carbon /g/100 g/	2.1	1.1	0.7	2.1	0.9	0.6	2.6	1.3	0.7
Total organic matter /g/100 g/	4.7	1.9	1.2	3.7	1.5	1.1	4.6	2.3	1.2
Total nitrogen /g/100 g/	0.5	0.12	0.08	0.45	0.11	0.06	0.5	0.17	0.07
Available phosphorus /mg/100 g/	3.8	2.0	1.3	3.6	2.1	1.1	3.9	1.9	0.7
Calcium /mg/100 g/	447.7	390.0	170.3	517.4	399.0	169.4	522.0	401.0	190.0

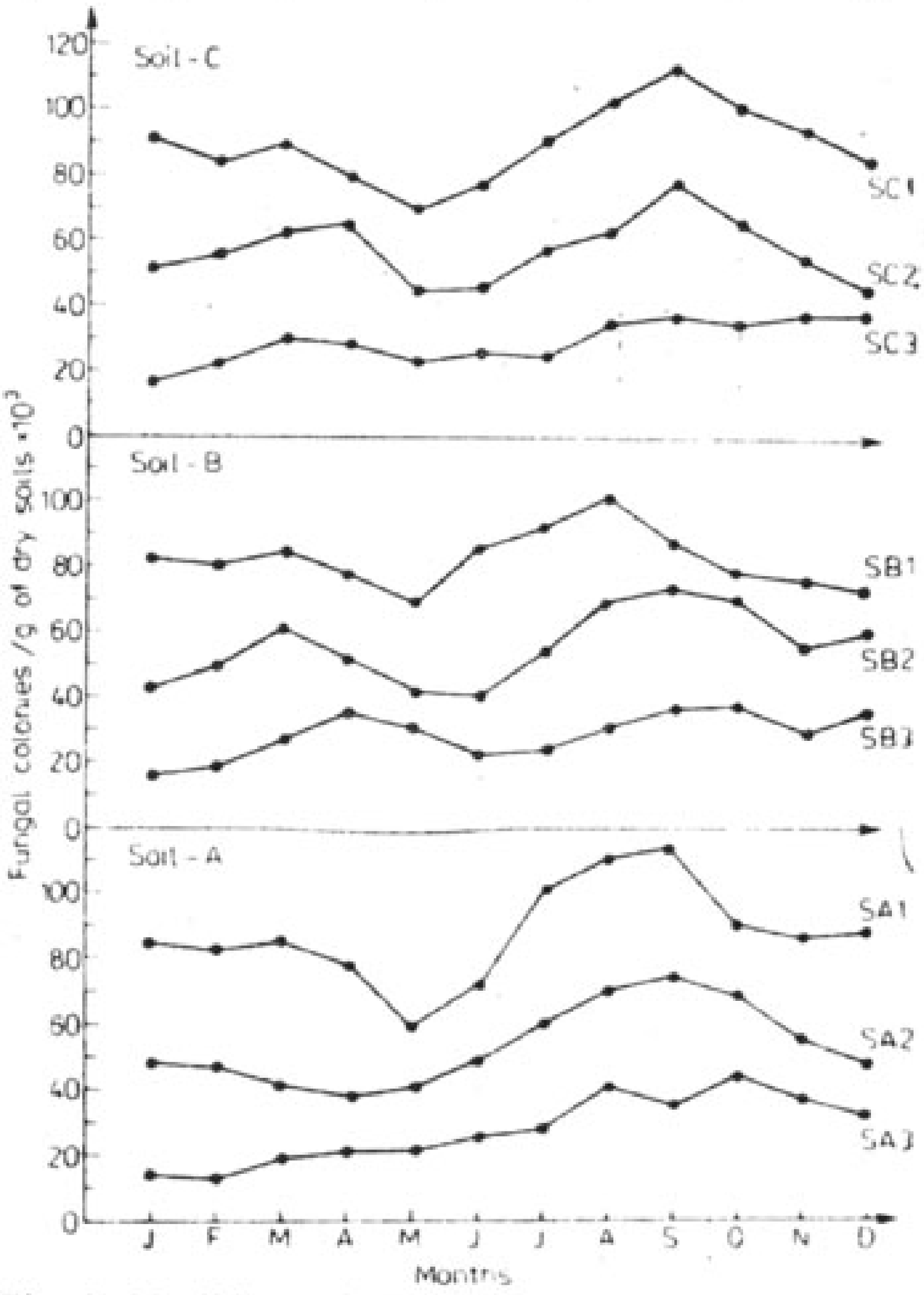

Fig. 1. Monthly variation in total number of fungal propagules per gram dry soil isolated from different depth of soils

Table 2
Distribution of different classes of fungi in soils /A, B, C/

	A		B		C	
	No. of species	% of total	No. of species	% of total	No. of species	% of total
Phycomycetes	11	15.7	9	13.9	11	13.6
Ascomycetes	7	10	6	9.2	8	9.9
Deuteromycetes	52	74.3	50	77	62	76.5
Aspergilli	13	18.6	15	23.1	17	21
Penicilli	8	11.4	7	10.8	11	13.5
Fusaria	5	7.1	5	7.7	6	7.4
Dematiaceae	14	20	13	20	12	14.8
Other fungi	12	17.1	10	15.4	16	19.7

Table 3
Number of species per frequency class in different soils /SA, SB, SC/

Frequency class /%/	SA 1	SA 2	SA 3	SB 1	SB 2	SB 3	SC 1	SC 2	SC 3
0-20	27	21	7	23	13	6	33	26	9
21-40	18	11	6	19	11	5	21	15	5
41-60	11	6	4	9	7	4	11	9	2
61-80	9	3	1	8	4	-	9	1	2
81-100	5	2	-	6	-	-	7	-	-

Table 4
Matrix showing number of species /bold face/, number of shared species /above the line/ and similarity coefficient for each soil with every other soil /below the line/

Soil	A	B	C
A	70		
B	40 59.24	65	
C	48 63.57	36 49.31	81

months the opposite situation was observed. However, soil-B always harboured population numbers intermediate between the two soils.

In total 48 genera comprising 95 species were isolated from all the three localities of which the *Deuteromycetes* were represented by 74 species, the *Phycomycetes* by 11 species, the *Ascomycetes* by 8 species, and the *Basidiomycetes* and *Myxomycetes* were represented by single species each, *Corticium solani* and *Physarum* sp. respectively (Table 2). On the basis of percentage frequencies of different fungi, five different frequency classes have been recognised (Table 3). Infrequently occurring ones are considered within 1 - 40%, moderately occurring ones are

within 41 - 60% and frequently occurring ones are within 60 - 100% frequencies. Tables 3 represents the species numbers occurring under different frequency categories. It is evident from the data that infrequently occuring species (1 - 40% frequency) were more in numbers than moderately (41 - 60% frequency) and frequently (61 - 100% frequency) occurring species. Table 4 indicates the total number of species in each soil, number of shared species and the similarity coefficient for each pair of soils.

DISCUSSION

Forest soils comprise a heterogenous group of microorganisms in which fungi, bacteria and *Actinomycetes* play a major role in soil fertility. Fungi of all closses are found in soils. Saprophytic sugar fungi are mostly members of *Phycomycetes* (Garrett 1951). In the present study 11 species of *Phycomycetes* were isolated of which seven members were common to all the three soils and others were shared by two soils. *Chlamydoabsidia dasgupti* was isolated from Soil-A only. Certain members like *Absidia glauca, A. ramosa, Mucor mucedo* and *Rhizopus nigricans* were recorded from all the collections, but others were isolated mostly either in rainy or in winter seasons. Members of the *Ascomycetes* and the *Deuteromycetes* were 82 in numbers of which 74 isolates comprised the latter group. *Aspergillus*, the dominant fungus, was recorded with 30 - 35 percent followed by *Penicillium* with 10 - 25 percent of the total population. Others in the sequence were *Rhizopus*, *Mucor*, *Trichoderma*, *Fusarium* and white sterile mycelium.

Moubasher and Abdel-Hafez (1978a) reported that *Aspergilli*, *Penicilli*, *Fusaria* and *Mucor* were of high occurrence in Egyptian soils. *A. niger, A. fumigatus, M. racemosus, P. notatum, P. chrysogenium* and *A. flavus* were the dominant species. *Aspergillus* was reported to be the dominant fungus in soils of Georgia (Miller et al. 1957) grassland soils of Varanasi (Dwivedi 1965; Misra 1965), forest soils of Saugar (Saksena 1955) and various soils of Andhra Pradesh (Rama Rao 1979) whereas *Penicillium* was isolated as dominant from soils of Wiken Fen (Stenton 1953), Manitoba (Bisby et al. 1933) and many other soils. Appreciable difference in total population and species numbers was boticed in different seasons of the year, the maximum being recorded between July to September and the minimum in May and June. Pady and Kelly (1953) reported that seasonal variation in fungal flora depended on the nature of the substrate, factors operating inside the soil and the immediate environment above it. Rama Rao (1970) recorded lowest fungal population in May and June and

highest in September. Lowest population of fungi in summer and highest in the rainy seasons has also been reported in Egyptian soil (Moubasher and Abdel-Hafez 1978b).

A large number of fungi was isolated from surface layer and 15 cm depth, but only few members which had wider adaptability to the conditions prevailing in the lower depth were recorded at 30 cm depth. *Acrophialophora nianiana* was isolated more in numbers from 15 cm depth and *Cladosporium* almost equally from all the depths. This was in agreement with the findings of Eicker (1970) except in the case of *Penicillium casei* which had the tendency to increase up to 30 cm depth. Moisture content exerted greater influence on the occurrence and distribution of fungi in different seasons and depths, the higher was the water content the more was the fungal population and the fungal species. Although similar findings were recorded by various workers (Waksman 1944; Tresner et al. 1954), Menon and William (1957) reported a greater number of fungi at lower than at higher moisture levels.

All the soils investigated in the present study were alkaline in nature and none of them exhibited a pH less than 7 irrespective of the day and depth from which samples were collected. Soil-B had a pH level intermediate between Soil-A and Soil-C exhibited the lowest population and minimum numbers of fungi species. But in general, the lover the pH was the more fungal species and population were present. The present investigation reports a direct correlation between the fungal population and the total carbon content. Soil-A which exhibited the highest carbon content harboured the maximum population followed by Soil-C and Soil-B. Decrease in population at various depths directly corresponded with the carbon contents. In addition to the organic carbon other soil butrients viz., nitrogen, phosphorus and calcium also had a stimulating effect on the occurrence and distribution of microfungi at various depths. Saksena (1955) reported that soil fungi are more affected by the presence of calcium in soil.

The present study concludes that temperature and moisture content of the soils, which directly correspond to the climatic conditions and rainfall of different seasons, are the two important parameters that govern the occurrence of various fungi in different periods of the year and their population density depends upon the soil nutrients. In an ecosystem, particularly in soil, a single parameter as cannot be assigned as sole regulator of such microbial activities, it is the coordinated effort of all the edaphic parameters that regulates the dynamics of microbial population in soils.

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