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# A Study of some Micro-Organic Contents of a Dwaba Soil

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## Introduction

Studies on soil fungi have received much more attention since the problem of soil mycological investigation was probed in by Adametz (1886). In India, investigation on the problems of soil fungi was initiated by Butler in 1907. This work was followed by Galloway in 1936 and since then a lot of work has been done in this field by Indian workers. The main contributions came from Shetye (1954), Saksena (1955), Bakshi and Singh (1957), Dwivedi (1959), Mishra (1963), Srivastava (1966), Saksena *et al.* (1967) and Kamal (1968). Dwaba, a belt in between rivers Ganges and Ghagra, could not receive any attention so far. In the present investigation, however, an attempt has been made to isolate fungi, bacteria and actinomycetes from a Dwaba soil and to study in detail the distribution of fungal species in different soil depths.

## Materials and Methods

The area from which the collection of different soil samples was made is a belt in between rivers Ganges and Ghagra in District Ballia of Uttar Pradesh. This region is characterised by the deposition of a layer of soil brought by these rivers annually when the area is flooded over.

The colour of the soil was black and it was clayey in texture. The samples were collected from different localities from three different depths (0—6″, 7—12″ and 13—18″). Practically five samples were taken from each horizon and were mixed together. The composite soil samples were kept in sterile containers and brought to the laboratory for isolation of fungi, bacteria and actinomycetes. The moisture content and the soil reaction were determined on the day of collection.

The soil samples were plated by dilution plate mehod of Warcup (1950). 1 gram. of soil was suspended in thousand ml. of sterilized distilled water resulting in the initial dilution of 1 : 1000. 1 ml. of the suspension was poured in each plate containing sterilized and cooled agarmedium. Martin's medium for fungi, Yeast glucose chalk agar medium for bacteria and Egg albumen agar medium for actiomycetes

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were employed. The plates were encubated at 25° C. and were observed regularly for the assesment of fungi, bacteria and actinomycetes.

The data regarding the total number of colony present in a plate and the number of species of different genera were kept. The total number of colonies only was recorded in the case of actinomycetes and bacteria and detail study could be made only of fungi. The total number of fungi/mg. dry soil was calculated by multiplying the ever-

Table I. Percentage occurrence of fungi at different depths

| Organisms | Depths | | |
|---|---|---|---|
| | 0—6″ | 7—12″ | 13—18″ |
| *Absidia ramosa* | 0.64 | 4,90 | 22.41 |
| *A. spinosa* | 1.92 | — | — |
| *Aspergillus niger* | 25.0 | 4.90 | — |
| *A. flavipes* | 18.0 | 32.51 | 5.17 |
| *A. sydowi* | 1.28 | 1.84 | 2.58 |
| *A. versicolor* | 0.64 | 0.61 | 0.86 |
| *A. versicolor* I | — | 3.06 | 3.44 |
| *A. lanosus* | 1.28 | — | 2.58 |
| *A. terreus* | 6.41 | 3.68 | 6.81 |
| *A. niveus* | 10.28 | 4.90 | — |
| *A. nidulans* | 0.64 | 3.06 | — |
| *A. variecolor* | 1.28 | — | 5.17 |
| *A. variecolor* I | 0,64 | — | — |
| *A. tamarii* | 0.64 | — | — |
| *A. flavus* | — | — | 1.72 |
| *A. fumigatus* | — | 1.22 | — |
| *A. sclerotiorum* | 0.63 | 1.84 | 1.72 |
| *Alternaria tenuis* | — | 3.68 | 0.86 |
| *Cladosporium epiphyllum* | 1.28 | 1.22 | — |
| *C. herbarum* | 1.28 | 0,81 | — |
| *Cladosporium* species | — | 0.62 | 0.86 |
| *Cunninghamella bertholettiae* | 0.64 | — | 0.87 |
| *Curvularia lunata* | 1.92 | 1.22 | — |
| *Fusarium chlamydosporum* | 6.41 | 6.74 | 9.48 |
| *F. oxysporum* | 3.20 | 1.22 | 6.03 |
| *Fusarium* Sp. | 4.48 | 1.84 | — |
| *Monocilium indicum* | 0.64 | 3.68 | — |
| *Mucor hiemalis* | — | — | 4.31 |
| *Paecilomyces fusisporus* | — | — | 2.58 |
| *P. punctonii* | — | 1.22 | 4.32 |
| *Penicillium digitatum* | 3.20 | — | — |
| *P. funiculosum* | 1.28 | 1.22 | — |
| *P. humocola* | — | — | 4.31 |
| *P. luteum* | — | 1.84 | — |
| *P. nigricans* | — | 4.90 | — |
| *Rhizopus stolonifer* | 1.28 | 1.84 | — |
| *Syncephalastrum racemosum* | 1.28 | — | 1.72 |
| *Stysanus medius* | 1.28 | 1.84 | — |
| *Trichoderma viride* | — | — | 1.72 |

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Table 2. Physico-chemical properties of soil samples

| Factors | Soil samples | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| Moisture content % | 6.11 | 11.32 | 13.28 |
| Organic matter % | 7.48 | 5.48 | 3.31 |
| Organic carbon % | 3.96 | 2.31 | 1.75 |
| Total soluble salts % | 0.500 | 0.360 | 0.253 |
| Soil reaction (pH) | 6.8 | 7.0 | 7.6 |
| Total Nitrogen % | 0.083 | 0.075 | 0.032 |
| Available Phosphorus % | 0.190 | 0.152 | 0.123 |
| Potassium % | 1.82 | 1.78 | 1.00 |

1 = 0–6″, 2 = 7–12″ and 3 = 13–18″

Table 3. Number of fungi, actinomycetes and bacteria/gmofdry soil at different dephths

| Organisms | Soil samples | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| Fungi | 61613 | 53215 | 34000 |
| Actinomycetes | 501000 | 435000 | 367622 |
| Bacteria | 886600 | 784300 | 704600 |

1 = 0.6″, 2 = 7–12″ and 3 = 13–18″

age number of colonies perplate by dilution factor. A correction factor, on the basis of moisture present, was applied.

Soil factors were determined by the standard methods described by Piper (1942) and Jackson (1962). Soil reaction was obtained by Leeds Northrup electric pH meter.

## Observations and Results

Percentage occurrence of fungi is presented in table 1. Physico-chemical properties of soils are given in table 2 and the number of colony of fungi, bacteria and actinomycetes/gm. dry soil are given in table 3.

It is evident from table 1 that the number of fungi isolated decreases from surface downwards. The highest number of fungi/gm of dry soil was recorded from the samples representing surface to 6″ soil profile. The total number of fungi isolated from the samples 1 and 2 were 27 and 25 respectively, while only 21 species could be isolated from the deepest soil investigated (3). *Aspergillus niger* and *A. flavus* were dominant in the surface soil and the other codominant were *Aspergillus terreus*, *A. niveus*, and *Fusarium chlamydosporum*. Comming to the next soil depth (2) it was found that *Aspergillus niger* which was most dominant in the upper most soil profile, lefts the scene and the most dominant in this region were *Aspergillus flavipes* followed by *A. niger*. *Aspergillus niveus*, *Syncephalastrum recemosum*,

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*Monocilium indicum* and *Fusarium oxysporum* were the codominant. In the third horizon *Aspergillus niger* again reaches the peak being most dominant. *Fusarium chlamydosporum*, *F. oxysporum*, *Aspergillus lanosus* and *A. versicolor* came in the next series.

It is clear that Fusaria are equally common in all the three horizons. Aspergilli and Penicillia are common in the surface as well as lower most horizon. Species of Paecilomyces are absent from the surface layer (1). Members of Mucorales though not recorded in good numbers are present in all the horizons studied. It is interesting to note that the whole scene is dominated by Aspergilli and Penicillia.

As regards the distributional pattern of Actinomycetes and Bacteria, they are always present in more numbers as compared to these of fungi. The colony counts of these organisms were always found to be more in a particular soil horizon as compared to that in the suceeding lower one. The number of Bacteria/g dry soil was higher than that of Actinomycetes in same soil sample (Table 3).

Data on the physico-chemical properties (Table 2) reveal that the-re was gradual drease in the moisture content from surface downwards. The soil reaction was found to be highest in the third horizon of soil profile (3). Other chemical constituents viz. Organic matter, Organic carbon. Total soluble salts, Total nitrogen, Available phosphorus and Potassium were always found maximum in the upper layer with a gradual decrease towards the lower horizons.

## Discussion

That the microbial population of soil is dominated by Bacteria and Actinomycetes, has well been emphasised. The fungi, next only to the Bacteria and Actinomycetes constitute the bulk of the soil micro-cosm. The preponderance of Aspergilli in the warmer regions and that of Penicillia in the colder regions of the world has been worked out by Waksman (1927) and Garrett (1956). Presence of Aspergilli in poorer number as compared to that of Penicillia conforms with the findings of Waksman (1932), Warcup (1955) and Saksena *et al.* (1967). Presence of Fusaria in the deeper levels of soil may be attributed to deep going plant roots which harbour these organisms as parasites.

Comparatively higher number of fungi, actinomycetes and bacteria in the upper horizons may actually be attributed to different soil factors governing their distribution. Organic matter which is one of the most important factors for the soil microbes is highest in the surface soil conciding with the highest number of organisms in this region. Importance of this factor for soil fungi has well been emphasised by the Dwivedi (1959), Williams and Schmithenner (1960), Kaufman and Williams (1963) and Saksena *et al.* (1967). Other soil factors like organic carbon, available phos-

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phorus, soluble salts, potassium, nitrogen also tend to decrease from the surface downwards with the decreasing tendency in the microbial population. Moisture content, in the soil, has a pronounced effect on microbial population. Ofcourse, moisture requirements and ability to face desiccation or water logging differs from species to species. Waid (1960) found that there is a great reduction in the active growth of fungi when the moisture content is sufficiently high so as to reduce aeration. Griffin (1963) is of the opinion that the actual volume of water, taken as a factor in itself, has no marked effect on fungal ecology and the growth of fungi is dependent upon moisture content, presumably, acting through an aeration effect.

In the present investigation, however, the moisture content is highest in the lower most (3) horizon though the fungi, actinomycetes and bacteria are highest in the upper most horizon (1) It seems possible that the amount of water present in the uppermost region (in the present study) is not below the optimum point. Moreover, the micro-population is the product of several factors operating together. In the present study there was not much variation in the soil reaction of different horizons in question. Workers like Waksman (1927), Jensan (1934) and Saksena (1955) have also emphasized that slight variation in soil reaction has no marked effect on myco-population. They asserted that fungi thrive well both in the acidic as well as in alkaline soils.

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