DISCUSSION...

V - Discussion and Conclusions

I) Distribution of soil fungi :-

It is evident from the table No.1 a large number of genera and species of fungi are common to Sugarcane, Banana fields, in clay and black soils. Of the 40 species isolated 13 are common to the four soils, a few fungi being restricted in their distribution. According to Rao (1988) it is of interest to note that a number of soil borne plant pathogens are isolated such as Alternaria fasiculata, Fusarium oxysporum, Fusarium culmorum, Rhizoctonia solani, Sclerotium rolfsi, Helminthosporium nodulosum, Curvularia lunata, Cladosporium oxysporum, Cladosporium cladosporioides, Penicillium sp., Geotrictum candidum, Drechslera halodes, Phoma humicola, Rhizopus stolonifer, Nigrospora sphaerica, Aspergillus flavus, A. fumigatus, A.terreus, A.versicolor, and A.candidus. Some species are appeared only sporodically, while others are predominant and were recorded more frequently in all the seasons.

They include Rhizopus stolonifer, Rhizopus oryzae, Aspergillus fumigatus, Aspergillus niger, Aspergillus phoenicus, Aspergillus candidus, Cladosporium cladosporioides, C.oxysporum and white mycelium.

Despite the efforts by earlier workers it has not been possible to classify the various fungi into distinct

ecological groups. However, Garrett (1951) defined an ecological group of soil fungi as an assemblage of species characterized by some peculiar advantage for pioneer colonization of a peculiar substrate and divided them into a few larger groups, i.e. the root inhibiting fungi, the saprophytic sugar fungi, the lignin decomposing fungi, the coprophilous fungi and the predaceous fungi. Park (1957-a,b) studied the behaviour of soil fungi in the presence of bacterial and fungal antagonists and classified them based on their ecological relationships.which are well adapted to continued vegetative activity in the soil substratum and exochthonous fungi for those, which are ill-adapted.

According to Garrett's (1951) ecological classification, saprophytic sugar fungi are phycomycetes, Cellulose decomposing fungi mainly belong to Ascomycetes and fungi Imperfecti and lignin decomposing fungi comprise of Basidiomycetes. In the present work, 40 species belonging to 21 genera, were isolated from soils, of these 5 species belong to Phycomycetes, 3 species are Ascomycetes and 32 species belong to fungi Imperfecti. No Basidiomycetes number was obtained in any type of soil.

While the general nature of the soil mycoflora has become recognised, there exist considerable differences of opinion regarding the species of fungi occuring in different soils. Which is not surprising, considering the diversity of soils, Werknthin (1916) and Brierley (1923) found no difference between the fungi from cultivated and uncultivated soils. Jensen (1931) reported that Penicillia and Trichoderma were common in acid soils. Mucorales were abundant in field and garden soil and Fusarium and Phoma were characteristic of cultivated soils. Campell (1938) observed more species of Mucorales in cultivated than in moor and peat bog soils and stated that there was no specific distribution of Mucorales in different soil types. Nicot (1953) found a widely represented fungus flora consisting essentially of Mucorineae associated with soils rich in organic matter, Penicillium and Aspergillus sp., Trichoderma viride, Cladosporium herbarum and Gliocladium roseum in some soils under large scale cultivation in tropical Africa and Madagascar. Ordin (1957) showed that black soil from uncultivated land and forests were characterised by a large number of Penicillia and fewer of Tricoderma sp. while Mucor, Rhizopus Fusarium, Cladosporium, Phoma and Chaetomium were abundant in the steppe soil. Miller et al., (1957)

demonstrated that Penicillium was dominant in forest soils, while Aspergillus was the chief genus in cultivated fields. Singh (1947) disproved the earlier belief, that species of Dictyostelium were dung organisms, by isolating two species of the same genus from soils at Rothamsted, where no fertilizers or only artificial ones had been applied for over hundred years. According Misra (1986) species of Aspergillus followed by Penicillium were dominant in mud. Dubey and Dwivedi (1988) fungi were screened from root region of Soyabean and reported that Aspergilli were dominant followed by Penicillium. Chesters (1949) and Burges (1958) who observed that Aspergilli occured more frequently than penicillium in soils of warm climate. As has been reported by various workers (Stover, 1959 Ghosh and Dutta, 1960; Das, 1963; Agnihotri, 1964; Dutta and Ghosh, 1965; and Kamal and Bhargava, 1970), Aspergillus and Penicillium are found to dominate.

There are many workers who have expressed their views regarding the occurence of Fusarium species. Waksman (1916) placed Fusarium sp. in last number, but Bisby et al. (1935) put it in second number in order of preference. Swift (1929) reported that species of Fusarium were abundant in soil. Miller et al., (1957) found it to be very common in

cultivated soil and rare in forest soil. Christensen et al; (1962) found it to be prominent in population from Wisconsin soil. The most notable observation by Thornton (1956) was the absence of Fusarium sp. from Oak wood forest and heath acid soil. Jeffery et al·,(1953) did not record it from heath acid soil, although Mclennon and Ducker (1954) did. Park (1963) frequently isolated Fusarium oxysporum from grassland but failed to record its presence in the forest soil. Chou and Stephen (1968) isolated Fusarium sp. from Hongkong but as a rare one. Christenson et al; (1962) observed cladosporium sp. very frequently in all seasons.

The present study confirms the generally accepted view that the commonest soil fungi are representatives of Aspergillus, Rhizopus, Cladosporium, Fusarium, Trichoderma, Thielavia, Humicola. It also confirms that Aspergilli dominate in tropical soils. The order of occurence of the chief genera was Aspergillus, Rhizopus, Cladosporium, Fusarium, Trichoderma, Thielavia, Humicola sp.

The sugarcane and banana field soils harboured a greater variety of genera and species. Although no ecologically significant distribution of particular genera and species was exhibited, some were found to be restricted to a particular soil, while others showed an irregular

distribution which might be due to the progressive appearence or disappearence of a few genera and species from one soil to the other.

II) Soil type :-

Singh (1937) observed a direct correlation between soil fertility and number of fungi. Jasevoli (1924) reported that the fungal numbers were dependent on the nature of the soil. Nath and Banerjee (1989) recorded the number of fungi was higher in the surface soils and decreased down the depth. While Deka and Mishra (1984) studied distribution of soil microflora in Jhum follows and reported soil depth did not seem to have any influence on composition of fungal species. According Cooke (1948, 1953) the correlation between the fungus flora of a soil and soil type seems to be valuable in the understanding of the ecology of the indigenous soil microflora.

Mujumdar and Deoray (1968) studied microorganisms count in black soil from grassland of Baramati, red soil from the vicinity pneumatophores of Rhizophora mucronata, from the coastal region of Ratnagiri. They observed maximum number of microorganisms in black soil and minimum in saline soil. Rao (1970) in his investigation reported

the garden soil was the most fertile, dark brown in colour, had strikingly greater number of fungi. The next best was seen in maize field soil because of its good tillage and better aeration soil was black in colour. The uncultivated soil was least fertile dark brown in colour had the lowest number of fungi. The forest soil supported luxurient vegetation and the decaying vegetables matter added fertility to the soil. Hence the difference in fungal counts between the forest and maize field soils was not significant, while a marked difference exhibited between the garden and uncultivated soil.

Results of Ismail and Abdullah (1977) indicated that soil fungus flora is poor both with regards to the number of species and their total number in desert soils. But in soils under active cultivation there is marked increase both in the number of species and their total number. Behra and Mukerji (1984) reported river bed soil exhibited the lowest population and highest was in forest soils. Sawant (1984) in her investigation reported the garden soil was most fertile and so large number of fungi were found in it. Guava field soil was also fertile with the help of ploughing, weeds are constantly removed. Among Guava field soil, red soil contains more fungal numbers than the

black soil. The uncultivated soil was least fertile and had the lowest number of fungal population. The difference in fungal counts between two cultivated soils (Garden soil and Guava field soil) was not significant while marked difference was existed between cultivated and uncultivated soil.

In the present study sugarcane field soil more fertile than Banana field soil. So large number of fungi were found in sugarcane field soil. Amongs sugarcane and banana field soils, deposited clay soil consist of higher fungal numbers than the black cotton soil.

III) Plant cover :-

The importance of plant cover influencing the fungal population in soil was reported by many workers (Bisby et al., 1933; Jasevoli, 1924; Deyl, 1938; Thornton, 1958). Since Warcup's paper in (1951) a number of investigations of soil fungi have been carefully related to prior detailed studies of the associated higher plants. Thus major difference in communities of soil fungi from soils supporting different vegetation have been revealed. Prominent in such studies have been a group of workers in Wisconsin, Christensen et al., (1962); Orput and Curtis (1957), Tresner et al., (1954) concluded that soil microfungi in

that state do not form discrete communities, but rather continua. Similar to those of higher plants described by Curtis (1957). The continua consists of series of progressively changing species combinations among the sites sampled, the microfungal continua appear to be correlated with the vegetational continua . Suggesting at the least that vegetation influence its associated soil microflora.

Rao (1970) studied four soils differed in their plant cover. He observed that deciduous forest had a good growth of large trees and perennial shrubs throughout the year. The cultivated soil had a crop of maize during the mansoon, viz. from July to November and a good growth of annual weeds during the fallow period, and the crop residue, while the garden soil had some flowering plants throughout the year, the uncultivated soil supported good number of seasonal weeds along with some small shrubs. It is significant from the data that the months showing higher number of fungi, correspond with the maize crop in cultivated soil, and with the luxurient growth of vegetation in forest and uncultivated soils . However, although the garden soil supported some flowering plants such as Zinnia sp. in the summer, the fungal counts showed a steep

fall during the hot months. Ismail and Abdullah (1977) observed maximum number of species which are isolated from cultivated soils from Zubair and Abdul Khasib, while the minimum number of species was from date palm plantation. Megharaj et al., (1987) reported the maximum number of fungi from uncultivated soil and minimum numbers from Subabul field. Sawant (1984) observed difference in the fungal flora from garden soil, Guava field soil and uncultivated soil due to difference in their plant cover.

In the present study two soils differed in their plant cover. Sugarcane field soil was had a good growth of different weeds and crop residue. While banana is a perennial plant, there were annual and perennial weeds growing constantly. The soil types under study slightly differed with their plant cover due to which there was a variation in the fungal flora.

IV) Soil moisture :-

Moisture content and fungal numbers in soils were directly correlated by a number of investigators (Dixon, 1928; Jasevoli, 1924; Tresner et al., 1954; Waksman, 1944). But in some other soils, such a clear correlation was not observed, Cobb (1932) and Ramakrishnan (1955). Stover (1953) after studies on the effect of soil moisture on

Fusarium species summerised that their population might be greatly reduced by maintaining the soil in a saturated condition in the absence of hosts. Menon and Williams (1957) stated that the effect of moisture had been over-emphasized in the past, and they found greater numbers of fungi, at low than at high moisture level.

Orpurt and Curtis (1957) carried out an interesting investigation on the fungal populations of some prairies in Wisconsin, U.S.A. These prairies ranged from very wet to very dry. They found that there were no essential differences in the fungal flora, but at different moisture levels of the prairies, different fungi tended to be more abundant and others were less frequents. They concluded that most species of fungi exhibited broad amplitudes of environmental tolerence. Rao (1970) observed a general correlation between the abundance of fungi in the soil and the soil moisture. The garden soil had the maximum moisture average, the maize field coming second, the forest soil third, and the uncultivated soil having the minimum. The fungal number also followed the same descending order. The correlation between moisture and fungal numbers within each soil was clearly seen in the case of garden and forest soils, while the maize field and uncultivated soils failed to exhibit

significant correlation. Moubasher and El-dohlob (1970) observed in Egypt the richest period in the fungal number and spectrum were those between November and April and between September and October, where the temperature and water content were relatively moderate. On the other hand in summer when the soil was rather dry, the soil fungal flora is subject to unfavourable conditions. Ismail and Abdullah (1977) observed direct correlation between number of fungi in the soil and soil moisture. Behera and Mukerji (1984) suggested that soil moisture contents was responsible for the distribution of fungi in various seasons. Moisture content is maximum during rainy months which indicates greater number of fungal flora during those months.

In the present investigation, amongs the sugarcane and banana fields, black cotton soils contains more water than the deposited clay soils. But the deposited clay soils contains more fungal numbers than the black cotton soils.

Thus it can be said that the present study indicates that even though the moisture plays an important role in determining the abundance of fungi in soils its effect is not clearly seen to the some extent in all the soils.

V) Soil reaction :-

Regarding the reaction of the soil the statement, that fungi prevail in acid soils, and bacteria in neutral and alkaline soils (Ramann et al.,1899) was supported by Leclerg (1931); Shetye (1954); and Waksman (1944); while Cobb (1932); Eggleton (1938) differed. Jensen (1931) reported fungi were common in acid soil because of the elimination of the competition with bacteria to a great extent. While Warcup (1950) found that there is a distinct increase in the number of fungi per gram of soil when condition changes from alkalinity to acidity.

Saksena (1955) stated that the change in number of fungi is not affected considerably by the P^H of the soil alone, but other factors such as moisture content and organic acids also play an important role in microbial population.

Rao (1970) observed the highest average number of fungi in the garden soil, which was definately alkaline. While the uncultivated soil comparatively less alkaline, had the least number of fungi. On the other hand, the maize field soil having the lowest P^H recorded the highest number of fungi in September. From this data it is clear that the P^H of the soil is not a limiting factor and that

there is a possibility of other nutrients exerting a positive influence. However, an inverse correlation was observed in the soils under study between the variation in P^H and fluctuations in fungal numbers. This was clearly seen in the case of garden soil. He concludes that acid as well as alkaline soil support large numbers of fungi and the small fluctuations in P^H within each soil exert an inverse influence on the abundance of fungi. Menon and Williams (1957), Ismail and Abdullah (1977), Moubasher and Abdel-Hafez (1978) confirmed that the P^H in soils was not a factor influencing the mycoflora. Kale (1981) studied soil mycoflora of Bombay-Pune tract and observed that there is a distinct increase in the fungal population per gram of soil as the condition changes from alkalinity to acidity. The alkaline soils of Bombay and Panvel have shown less number of fungi per gram as compared to the acidic soils of the ghats and the plains of Maharashtra eg. soils of Rajmachi point, Khandala. Salvi (1983), Sawant (1984) observed that P^H of the soil has no effect on fungal flora as it remains constant.

Dubey and Dwivedi (1988) observed a negative correlation between total number of fungal and soil P^H. In the present study P^H of four soils is between 7.4 and 8.9. There is no effect on the fungal flora according to P^H of soil.

VI) Total nitrogen, phosphorus and potassium :-

The stinulatory effect of nitrogen, phosphrus and potassium on the development of soil fungi was confirmed by many soil mycologists (Guillemat and Montegat, 1958; Saksena, S.B. 1955; Waksman and Starkey, 1924). Ramkrishnan (1955) found that the changes in nitrate nitrogen and phosphorus had a positive effect on fungal numbers while it was not the case with regard to potassium in vandalur soils. In the Rao's (1970) investigation the garden soil was the richest in nitrogen, phosphorus and potassium and it recorded the greatest average of the fungal counts. While the other three soils differed considerably. Kamal et al., (1979) studied four soils of Gorakpur (forest, cultivated, grassland and usar soil). He observed that available phosphorus, exchangeable calcium, total nitrogen was maximum in cultivated soil and minimum in the usar soil. The forest soil was characterised with maximum number of fungi followed by grassland, cultivated and usar soil. Sawant (1984) observed in her investigation that garden soil and Guava field soil was richest in the nitrogen, but only garden soil was richest in available phosphorus and exchangeable potassium and they had greatest average of fungal counts. According Joshi (1986) Nitrogen content of

soil showed a significant positive correlation with fungal population, whereas potassium and phosphorus failed to exhibit any significant correlation with fungal population.

Agarwal and Chauhan (1988) reported nitrogen and exchangeable potassium do not shows any effect on fungal population. Nath and Banerjee (1989) the proliferation of fungal community was found to be highly influenced by mineral nitrogen.

In the present investigation the sugarcane field deposited clay soil was the richest in total nitrogen, available phosphorus and exchangeable potassium content and it recorded the greatest average of fungal counts. In the four soils under study, deposited clay soils amongs sugarcane and banana fields was richest in nitrogen, phosphorus, potassium content and they had highest fungal count than Black cotton soils.

VII) Calcium and sodium :-

Saksena S. B. (1955) concluded that soil fungi were favourably affected by exchangeable calcium content of the soil. Rao (1970) observed the variations in exchangeable calcium and fungal numbers were directly correlated in the case of forest and uncultivated soils, while the maize field and garden soils, the correlation was not clear.

Joshi (1986) observed calcium content failed to exhibit any significant correlation with fungal population. Agarwal and Chauhan (1988) described a positive effect of calcium on fungal population in forest soil. According to Nath and Banerjee (1989) the proliferation of fungal community was found to be highly influenced by exchangeable calcium.

Salvi (1983) studied that variations in calcium and sodium were directly correlated with fungal numbers. Sawant (1984) showed a direct correlation between calcium and sodium content in the garden soil, Guava field soil and uncultivated soil with fungal number. In the present study sugarcane field soils shows a inverse correlation while banana field soils having a direct correlation between the calcium content and fungal flora. There is a direct correlation between the sodium content and fungal flora in selected soils. It shows greatest count of fungal flora and high content of sodium and gradually decreasing in fungal counts and sodium content.

VIII) Iorn and Magnesium :-

Rao (1970) observed a direct correlation existed between exchangeable iorn and fungal numbers in all the four soils studied. Similarly Sawant (1984) showed a

direct correlation between exchangeable iron and fungal numbers in the garden soil, Guava field soil and uncultivated soil.

In the present investigation a direct correlation existed between exchangeable iron and magnesium with fungal numbers in all the four soils studied. It shows gradually increase in fungal numbers during rainy season, winter season and decrease during summer season.

IX) Manganese, Copper and Zinc :-

Rao (1970) observed a inverse correlation with regards to manganese and fungal numbers in maize field, garden and uncultivated soils. The forest soil, however showed a positive correlation between exchangeable manganese and fungal count. Marsh and Bollen (1943) observed that the application of manganese sulphate at the rate of 40 pounds double the number of moulds in Williamette silty clay loam in five days, while by the 100 pound treatment, moulds definitely decreased in Newbery loamy sand, especially after 30 days. Thus they concluded that response of microflora was roughly in inverse proportion to available manganese. Sawant (1984) observed a inverse correlation with regards to manganese and fungal number in garden soil, Guava field and uncultivated soils.

In the present investigation the correlation between manganese, copper and zinc was inverse with regards to fungal number in all selected soils. It shows gradually increase in manganese, copper, zinc content and decrease in fungal number in all selected soils.

Several workers like Griffin (1963), Davis (1968), Pugh and Methison (1962) have made critical studies on the effect of ecological factors on the distribution of fungi. According to Domasch and Gams (1972) the survey shows more and more soil fungi to be ubiquitons with a virtually worldwise distribution. Hence the geographical distribution is important only in the isolated cases. Sharma and Mishra (1977) showed that soil factor did not play any significant role in distribution of fungi. The principle factors which are responsible for the distribution of fungi may be microhabitat under the influence of modifying environmental factors.

To sum up, it can be stated that, total nitrogen, available phosphorus, exchangeable potassium, sodium, calcium, magnesium, and iron content of soil affect the fungal numbers favourably. While the moisture, manganese, copper and zinc contents have an adverse effect on fungal numbers. The richest periods in the fungal population

were those, where the temperature and the water content were relatively moderate. In summer on tne other hand, the soil fungus flora is subject to unfavourable conditions. However, it could be concluded that the fungal numbers in soil are controlled by the cumulative effect of all the factors discussed above.

X) Seasonal variation in fungal numbers :-

Ma (1933), Cobb (1932) and Stevenson and Chase (1957) recorded seasonal variations in fungal numbers. Singh (1937) and Sewell (1959) failed to observe definite seasonal changes. Seasonal fluctuation of fungi have been also studied by Brierley (1923); England and Rice (1957), Pugh (1957), Witkamp (1960), Reddy (1962), Fincher (1963), Suprun (1963), Gams and Domsch (1969) and several others. They all reported periodicity in the composition of the fungal flora. Timonin (1935) recorded more fungi in September. Tresner et al.,(1954) found greater number of soil microorganisms during winter and spring.

According to Warcup (1957) during early period of summer with low soil moisture the fungal counts were also less with the advent of rainy season. During the summer the fungal colonies are less in number than during rainy season or winter observed by Saksena and Sarbhoy (1962).

According to Saksena persistent drought and high temperature are responsible for bringing down the number of fungal colonies in summer.

Mujumdar (1966) observed that the cultivated soils contains the fungal colonies are sufficiently large in number even during the summer on account of irrigation and addition of fertilizers. Moubasher and El-dohlob (1970) studied the seasonal fluctuations of soil fungi of nineteen months. They observed that the richest periods in the fungal population and spectrum were those between November and April and between September and October, where the temperature and the water contents were relatively moderate. During these periods the monthly average maximum temperature ranged between 19° and 35° and the average minimum temperature between 7° and 22°. A similar observations was reported by Brierly (1923), England and Rice (1957), Warcup (1957), and Witkamp (1960). Moubasher and El-dohlob (1970) also showed that the soil fungus flora is subjected to unfavourable conditions. The soil dries up quickly and the temperature becomes so high as to affect the inhabitants of the soil severely. The range of fungal genera is affected also by the conditions of the soil, the broadest range (10-14 genera per sample) was recorded in the periods between November and April and between September

and November, while the narrowest range (4-7) was recorded in the summer periods. This indicates that severe conditions of the summer not only reduce the total count of the fungal flora of the soil but also narrow the range of genera per sample.

Moubsher and El-dohlob (1970) observed sixteen genera during the experiment in addition to members of mucoraceae. Aspergillus, Penicillium and Fusarium were isolated all through the year. Aspergillus showed that its highest frequency of occurence was shown during the summer season. The least frequency of occurance was shown during the cold winter months and when the field left unplanted and dry it seriously affected the frequency of Aspergillus. On the contrary during the summer, the soil conditions were milder as the field was cultivated with cotton and irrigated periodically. Penicillium showed its highest frequency and its least frequency during the summer months. Reddy (1962) in this respect, observed that Aspergillus tended to be supressed at the high altitudes of the Nilgiri forest in India. During observation of Moubasher and El-dohlob (1970) Fusarium did not show regular response to fluctuation of seasonal condition but it showed striking predominance over all the soil fungi

during June-July, which were the severest months of their experimental period. It was isolated in moderate frequency during the summer months. This observation may show that Fusarium is thermotolerant. Tolba (1952) and Tolba and Moubasher (1957) recorded a high prevalence of Fusarium during the summer months among the fungi recovered from damped off seedlings of letuce and cotton.

Rao (1970) observed the lowest numbers of fungi were recorded during summer months, viz. March, April, May, June and the highest numbers in September, with the exception of the forest soil, which showed its maximum in October. The number fluctuated little from October to February. But a sudden fall was observed in all the soils with the advent of hot season in March. According to Ursekar (1975) an influence of season would appear to be reflected in isolation. During study the survey of Mahabaleshwar he observed that summer season was found to be the most favourable for fungal growth than winter. These results agreed with those of Eggleton (1938) and Miller et al.,(1957) observations who suggested that climatic factors (temperature, rainfall, humidity etc.) control the amount of energy material available from the soil. This ultimately reaches to the microorganisms

present in the soil. According to Ursekar (1975) along with these factors, moisture content of soil and organic material in soil, mainly formed by debris in this area are also responsible for decline in fungal population. After heavy rain, moisture content is higher and soil is also drained. Therefore, less organic content is available in soil and also aeration in soil may not be properly set in the winter season.

Moubsher and Abdel-Hafez (1978) studied seasonal fluctuation of soil fungi in 72 soil samples collected at 10 day intervals between January, 1972 and December, 1983. They observed the richest periods in the fungal population and spectrum were those during the periods January, March and September, December, 1972 and April, May, September, November and December, 1973, where the temperature was relatively moderate or low. The count in May was exceptionally high due to markedly high counts of Aspergillus. The poorest periods in fungal population were recorded during the summer months June and July, 1972 and 1973, and August, 1973. During summer, the temperature runs so high (average maximum temperature ranging between 34° and 38°c) and the soil dries up so quickly that severely affect the fungal inhibitants of soil. Thirty-nine genera were collected during this experiments, six genera

were of high seasonal occurence and these were Aspergillus, Penicillium, Fusarium, Mucor, Rhizopus, and Humicola. Moreover, it is fully accepted fact that Aspergillus predominates over Penicillium in soils of tropical and subtropical localities, whereas the reserve occurs in cold weather localities.

The seasonal variation were noted by Mishra (1980) and observed that in summer Deuteromycetes dominated over phycomycetes and Ascomycetes, whereas in winter Phycomycetes dominated over Deuteromycetes. Salvi (1983) studied soil fungi of coconut rhizosphere. She showed lowest number of fungi during winter months and highest in the rainy season. There was fluctuation in the summer months. Sadruddin (1984) observed higher number of Fusarium colonies in February, March and September. The peak decrease a little in October but fall is rapid from April to June and in December. Minimum number of colonies was found during June and July. Behera and Mukerji (1984) observed seasonal fluctuation of Aspergilli. They reported minimum count in May or June and maximum in August or September.

Sawant (1984) studied soil fungi of Kolhapur region. She has recorded lowest number of fungi during summer

months and highest numbers in September, 1980 in Guava field and uncultivated soils. The Botanical garden soil, showed maximum numbers in February, 1981. Agarwal and Chauhan (1988) during the ecological studies on sandy loam forest soil fungi of Chandpata, Shivpuri (M.P.). Observed high population of fungal species during rainy and winter season while low fungal count during summer season due to high temperature.

In the four soils under investigation the lowest number of fungi were recorded during summer months viz. March, April, May, June, 1989 and highest numbers in September and October 1989. The numbers fluctuated little in November, December, January and February, 1989. But sudden fall was observed in all the soils due to hot condition in May, 1989. The minor difference in seasonal variation in the four soils may be due to differences in the other factors which are peculiar to each soil.

Twenty one genera were isolated during this experiment. Three genera were of high seasonal occurance and these were Aspergillus, Rhizopus, Cladisporium. Aspergillus showed its lowest frequency of occurence in December, 1989 and highest frequency during January, February, March, April, May, 1989. Rhizopus showed their high frequency in

rainy season when humidity is high. Cladosporium showed its high frequency during January, August to December, 1989 and its least frequency during high temperature months viz. March, April, May, 1989. Three genera were of moderate seasonal occurence and these were Mucor, Fusarium and white mycelium. Other fifteen genera were of low and rare seasonal occurence.