

**CHAPTER- 2**

**REVIEW**

**OF**

**LITERATURE**

Soil is considered as a complex system containing biotic (living) and abiotic (non-living) components. The biotic components include microorganisms, like Bacteria, Fungi and Actinomycetes. Bacteria and Actinomycetes play dynamic role. Besides fungi play a main role as decomposers. Generally they are active in humus and mineral horizons of the soil. In decomposable organic matter, this horizon exploits the material that contains energy and releases the nutrients that are present in nutrient matter. Because of this the importance of study of soil mycoflora is widely recognized. Many workers have studied different types of soils for the mycoflora. The first person who studied the mycoflora of two soils was Adametz (1886). He isolated 11 species of fungi from experimental fields that is from soils of Germany. The fungal flora and biochemical activities of soil were studied by Reinitzer (1900). 45 species of fungi from Holland soils were isolated and identified by Oudemans and Koning (1902).

#### **International status of the study**

The soil microflora including Bacteria, Actinomycetes and fungi are studied by earlier workers. Special attention to soil fungi was given after 1916. From cultivated and virgin soils of Texas, Warkenthin (1916) isolated 16 species of fungi. He did not find any difference in the cultivated and virgin soils. *Aspergilli* was found to be predominant in the South and *Penicilli* and *Mucorales* were more extensive in the Northern soils. Like Warkenthin, Waksman (1916) could not find much variation in mycoflora of soil of cultivated and virgin soils. He stated that more fungi in both number and species are present in more fertile soil than in low fertile soils. The species of *Trichoderma* were found more in number in acidic and water-logged soils, than the normal agricultural soils. Waksman (1922) observed that the growth of microorganisms was stimulated by potassium salt and phosphate and the growth of microorganisms is more in presence of lime than in its absence. The number of fungi decreases and the number of bacteria and Actinomycetes increases with addition of lime. Swift (1929) studied the mycoflora of coastal and agricultural soils of Illinois and isolated 39 species. 8 species from that were reported first time from soil. Le Clerg (1931) observed 13 soils of different physical conditions supporting different crops and observed that fungal flora is reduced by alkali salts. But *Fusarium* species were found abundant in this type of soil.

Jensen (1931) made a study on the mycoflora of different types of Danish soils and of reactions varying from  $P^H$  3.34 to 8.35 and could not observe any clear relationship to the type of soil except, that, very heavy clay soils show poor mycoflora. The application of lime to acid soil could not depress the number of fungi but the microbial population was increased by the addition of farmyard manure. Timonin (1935) found the highest count of each group of microorganisms in A- horizon of Virgin Manitoba soils. While lowest number was observed in C-horizon. Chester (1940) suggested different techniques of isolation of fungi directly from soil insitu on sterile agar. Ellis (1940) studied Pine wood soil fungi. The isolation of soil fungi by immersion tube method was described by Chester (1948). Martin (1950) studied the comparative use of streptomycin and acid rose Bengal in the plate method, which was used for the estimation of soil fungi. Farrow (1954) observed that a large number of *Aspergillus* and *Chaetomium* were found in the soils of Costa Rica and Panama, while in this tropical region; *Mucor* and *Rhizopus* were rarely observed.

Miller et al (1957) found that the forest soils shows greater number of bacteria and actinomycetes as compared to cultivated soils of Georgia and secondly observed that the number varied more with soil types than with geographical region. Genus *Penicillium* was found dominant in forest soils and *Aspergillus* was chief genus in cultivated soils. In general the climatic factors are responsible for the distribution of microorganisms. Stevenson and Chase (1957) studied seasonal distribution of microorganisms of soil from different parts of the world and observed the seasonal distribution of soil microorganisms. The fungal component of soil organisms is influenced by various seasons by bringing variation in temperature and moisture and the food supply. Mekhtiew (1959) studied that the bottom land meadow soils shows richest microflora, which is followed by Chernozem soils and gray forest soil in descending order.

Apinis was given another dimension of the study of soil mycoflora. In certain alluvial soils Apinis (1962) studied the occurrence of thermophilous microfungi and isolated 22 species of microfungi near Nottingham from U.K. Various techniques for isolation of cellulose decomposing fungi from soil was mentioned by Pugh (1962). 121 species were isolated by Hodges (1962) by using Rose Bengal Streptomycin medium from Southern forest tree nursery soils of U.S.A. Kendrick (1962) isolated 31 species

from cupiferous peat and studied soil fungi of copper swamp. Pugh (1962) studied coastal soil fungi and ecology of fungi in developing salt marsh. The methods for isolation of soil Basidiomycotina member was given by Warcup and Talbot (1962). Griffin (1963 a & b) studied physical factors of soil and their influence on soil fungi. The mycoflora of continuously cropped soil in Israel was investigated with special reference to efforts of manuring and fertilizing by Joffe (1963), who also observed that the soil shows rich mycoflora supplied with NPK than non supplied soil. Apinis (1964) isolated 92 species of Phycomycotina from alluvial soils of certain pastures, marshes and swamps from Attenborough.

Medina De Wernil (1968) investigated that volcanic ash soils of the southern region and recorded large number of bacteria than actinomycetes and fungi, on the other hand because of decrease in soil moisture content the bacterial population increased with depth in the profiles of Zululand. He observed in the lower horizons that increase in the colonies and the species with increase in carbon content.

The methods for observation of soil microorganisms with other natural habitats were suggested by Casida (1969). This was followed by many other workers. 112 species were isolated from surface soils of forest communities in Zululand by Eicker (1969). *Penicillium* was found as a dominant genus. The spatial and seasonal distribution of microfungi of aerable soils of Germany was studied by Gams and Domsch (1969) for comparison between soil and root surface mycoflora. Lim (1969) studied 6 localities from Singapore and found that the mycoflora of soil and root surface was different. Bhatt (1970) isolated 184 species from soils by studying the fungal populations of neutral to alkaline soils at Ontario from Canada. In 1970 many other workers like Eicker, Gochenaur, Moubasher and Dohlab and Oner studied soil microfungi from Zululand, Peru, Egypt and Turkey respectively.

Apinis (1972) isolated 70 species of thermophilous fungi in certain grasslands of Britain. Widden and Parkinson (1973) observed soil fungi from four Pine forests from Canada and observed no seasonal pattern in these fungi. Eicker (1974) used soil plate, dilution plate and soil washing technique for isolation of fungi and he isolated 127 species from alkaline soils of open Savannah of the Transvaal South Africa. 53 species of micro fungi were first time reported by Singh (1976) from the soils of Newfoundland

Canada. Tansey and Jack (1976) reported the diversity in population of thermophilic and thermotolerant fungi in temperate soils present throughout the year and reported that the species present at greater frequency in sun heated soils than shadeable soils from South Central Indiana U.S.A. Bissett and Parkinson (1979 a, b & c) studied the distribution of fungi, fungal community, structural and functional relationship between soil fungi and environment in the different type of soil that is alpine Tundra soils. Fungal flora of rubber plantation soils from Sirrea in relation to  $P^H$  and water are studied by Gando and Kapooria (1979) and they isolated 32 species of fungi. They observed that the mycoflora is rich in wet season than dry season. They found a dominant genus, *Penicillium*.

Clarke and Christensen (1981) studied the microfungi of soil of grassland of South Dakota. They concluded that soil microfungi communities of U.S. grasslands show closer similarities with the microfungal communities of British or New Zealand grasslands. Ogbonna and Pugh (1983) isolated soil fungi of Nigeria and stated that mesophilic fungi were isolated more often in rainy season and dematiaceous species were most frequent in dry season. 63 species of fungi from two localities of Southern desert of Iraq by Abdullah et al (1986) from which, he encountered 6 thermotolerant and thermophilic species. Edinborough, Foley and Deacon (1986) isolated *Pythium oligandrum* and other necrotrophic parasites. An aggressive mycoparasite, *Pythium mycoparasiticum* Sp. Nov. was reported from British by Deacon et al (1991). From Bolivian soil, Guarro et al (1992) isolated a new keratinophilic *Gymnoascus*. Three noteworthy soil borne Ascomycotina were isolated by Horie et al (1993) from Shandong Japan. The soil fungi and their diversity and variability were studied by Persiani et al (1998) from disturbed tropical rain forests of South Africa and isolated 519 species of fungi. Greenę et al (2000) made a study on *Coccidioides immitis* from California and also concentrated on isolation of soil. Stchigel et al (2000) isolated and described a new species *Ascotricha canariensis* Sp. nov. belongs to ascomycotina isolated from soils of Canary Islands of Spain. Weinstein et al (2000) isolated fungi from field soil in the marine Antarctic for the study of influence of growth temperature on lipid and soluble carbohydrate synthesis.

### **National status of the study**

Many Indian workers simultaneously carried out investigation on soil fungi. The fungal flora of Varanasi was studied by Dwivedi (1958). Gangnani and Lal (1962) studied fungal flora of Banaras. Haware and Pavagi (1970) isolated soil fungi from Utar Pradesh. They described 6 species of fungi. Kamal and Bhargava (1970) made a comparison between fungal flora of earthworm casts, a termitarium and surrounding soil from a teak stand. They concluded that the population of mycoflora was more in surrounding as compared to the other.

Mehrotra and Kakkar (1972) studied ecology of soil fungi of agricultural fields. In those fields Sugacane was grown for many years. They isolated 55 fungal species. Mishra and Kanaujia (1972) selected eight different localities for their study of certain ecological aspects of soil fungi. These localities were cultivated garden, virgin and wasteland soil. They isolated 52 forms. Behra et al (1973) studied fungi of Dehli. They isolated 22 species from soil, rhizosphere and leaf litter.

Manoharachary and Rama Rao (1975) made a survey of microfungi from ponds, muds and soils of Hyderabad district and reported *Phoma fimeti* Brum and *Sphaaeronema allahabadensis*. Manoharachary (1976 a) gave distribution of *Aspergilli* and *Penicillia*, that is 9 species of *Aspergilli* and 9 species of *Penicilli* from different types of soils such as mud, paddy field, scrub jungle, dry wasteland and Coastal soils of Andhra Pradesh. Jabbar Miah and Sarbhoy (1977) isolated 251 species for which they investigated about three hundred and fifty field soil samples from South India. They also described 3 new species. Further Manoharachary studied microbial ecology of scrub jungle and dry wasteland in 1977 from Hyderabad and isolated 112 species from three different localities of Andhra Pradesh. Tulsi Reddy and Manoharachary (1977) selected cultivated and riverbank soil. They isolated 24 fungal species and stated that riverbank soil shows maximum number of fungi, which is followed by cultivated soil. Manoharachary et al (1978) studied an influence of P<sup>H</sup> and moisture content of soil of higher altitude of about 5600- 8600 ft above sea level.

Behra and Dash (1979) studied the ecology of microfungi of rice fields of Sambalpur. They isolated 28 species and shown the positive correlation of soil organic matter contents, soil moisture and fungal colonies. Chauhan (1980) selected a new habitat

for study of mycoflora of soil and isolated 69 species of fungi around the pneumatophores of mangrove in Andaman Islands. Jabbar Miah et al (1980) discussed the distribution of mycoflora of South Indian soils with special reference to C/N ratio and isolated 251 fungal species from cultivated soils. Myco-ecology of two pond muds and forest soils of Andhra Pradesh were studied by Madhusudan Rao and Manoharachary (1981) and isolated 57 species. Sharma (1981) made a survey on cellulose decomposing fungi from soils of Sagar and many thermophilic fungal species were isolated from these soils. Agarwal and Chauhan (1983) recorded new soil microfungi of Madhya Pradesh from rhizosphere soils of Bhagalpur. From different soils of Andhra Pradesh, Manoharachary (1983) isolated 12 species of *Fusarium*. Manoharachary and Murty (1987) recorded 45 species by studying fungal ecology of mud and soil habitats. Manoharachary et al (1989) studied population and phenology of fungi in scrub jungle forest soils. Fungi and bacteria in relation to physico-chemical complexes from three semi and tropical soils were studied by Tulsi Reddy et al (1990). They stated that the thicker forest possessing soil shows greater microbial number.

There is decrease reports of soil fungi after 90s. Seasonal variations of microfungal population was studied by Tiwari and Mishra (1991). They isolated 25 species from Pineapple orchard soils of Meghalaya. Murty and Manoharachary (1992) studied the mycology of muds and soils of Godavari river estuary from Andhra Pradesh. They isolated 45 species from Central Orissa and Eastern Ghat ranges. Basu et al (1993) selected five forest sites and studied the viability of microfungal hyphae in soils of tropical forests. The population of *Aspergillus flavus* in field and pod zone soil in groundnut fields of ICRISAT was studied by Nahdi (1996) and noted higher fungal populations in pod zone than in field soil. The survival of *Fusarium moniliformae* in soil containing different nutrients and their combinations were studied by Sunder and Satyavir (1997). Saha and Pan (1998) studied a highly antagonistic isolate of *Gliocladium virens*. They studied this with respect to the survival ability of it in soils of three different P<sup>H</sup> for longer survival of antagonist was 7.0 and 8.0 than 5.6. Roy and Pan (2004) studied comparatively, the rhizosphere colonization by some mutant and wild isolates of *Trichoderma* species. Mittal, Goswami and Chowdhary (2005) studied the

hyphomycetous fungi from rhizosphere and rhizoplane of root- knot nematode affected cucurbitaceous crops from trans- Yamuna river belt of delhi.

### **Status in Maharashtra**

Many workers did more work on soil fungi. The population study of soil mycoflora of Maharashtra was studied by Mujumdar (1968, 1967). Gangawane and Deshpande (1972) studied microbial ecology of some forest soils of Ajanta hills and made a comparative study on microfungi of rhizosphere of seventeen common trees. In 1973, they isolated and listed 59 species of fungi from soil of rhizosphere of groundnut and made comparison between them. The fungal flora of Pune soils was studied by Patil et al (1975 & 1976). They reported two new species and isolated 42 species from these soils. Ursekar (1977) investigated the fungal population of Western Ghats and Mahabaleshwar and 43 species of fungi were isolated from these soils. Seven species of *Chaetomium* from soils along Bombay- Pune tract were studied by Patil and Kale (1979). Patil and Pendse (1979 & 1981) studied nematophagous fungi of soils of Maharashtra. They made a survey on Nagpur soil mycoflora. For the first time from Indian soil, Wagh and Shankpal (1979) isolated and reported *Cephalosporium acremonium* responsible for production of Cephalosporin antibiotic. A consolidated list of 301 fungi from Mahabaleshwar was given by Patil and Thite (1980) from which some fungi were isolated from soil. A new species of *Circinella indica* was isolated and described from soils of Bombay-Pune tract. From lateric and neutral soils of Maharashtra, Ahmed (1982) isolated 55 genera with reference to cellulytic forms. Patil and Kale (1984) gave some allied genera from which 6 genera were new for Maharashtra and 2 new for India. They also gave the systematic occurrence of *Chaetomium*. Surange (1985) isolated 100 species by studying microflora of forest soils of Maharashtra and Goa and reported the absence of ascomycotina and basidiomycotina.

Mane (1990) studied soil fungi of Karad region. Four types of soils were selected from Sugarcane and Banana field and isolated 40 fungal species from 13 genera, which were common to four soils. Gouri Rane and Gandhe (2000) studied the mycoflora of Rabi *Sorghum* from Jalgaon District. They isolated 3 species of Zygomycotina. They isolated *Chaetomium reflexum* from Ascomycotina from both the rhizosphere and



nonrhizospheric soil and 16 species were isolated from Deuteromycotina from nonrhizospheric soil. Gauri Rane (2002) selected four types of soils. They were agricultural soils, river soils, uncultivated soils and forest soil for the study of diversity of soil fungi in Jalgaon district and found that extreme climatic changes are throughout the district which influence often directly with many other factors.