CHAPTER-VI

IMPACT OF COMPOSTS ON RHIZOSPHERE
MYCOFLORA OF MAIZE

"With respect to the boys I never till lately doubted but that I should be able to give them a competence as comfortable farmers and no station is more honorable or happy than that".

- Thomas Mann Randolph

Introduction

The term ‘rhizosphere’ was introduced by Hiltner (1904) to designate the zone of soil in which the mycoflora is influenced by plant root, and classical researcher of Starkey (1929) as well as those of Lochhead et al. (1948) opened a new field of research in microbiology.

A more detailed and systematic study of root region mycoflora began in the 1930s. Richter and Werner (1931) observed that the roots of plants have a considerable influence on the accumulation of micro-organisms in the soil. These micro-organisms have direct and indirect impacts in morphology and development of the roots, nutrient uptake and a number of physiological and developmental processes in plants (Ghosh et al., 2005). According to his observation, the number of micro-organisms in the rhizosphere is several times higher than that in ordinary soil (non-rhizosphere). For example, in the rhizosphere of beets 427 million bacteria per gram were found while in the control soil it was only 8.2 million.

A very complex and interesting type of relationship exists between the plants, microbes and soil. A major part of this microbial activity is yet a mystery, because the various factors governing relationship can not be provided under controlled conditions. However, the data collected
Chapter 6  
Rhizosphere Mycoflora Of Maize

(Katelson et al., 1948; Rovira, 1956; Parkinson, 1967; Gopal Reddy, 2007) on the subject reveal that the soil micro organism population in the rhizosphere region undergoes considerable fluctuations during different stages of plant life. Several workers (Starkey, 1931; Rovira, 1956; Chesters and Parkinson, 1959) have extensively studied the rhizosphere and rhizoplane mycoflora and the factors responsible for rhizosphere effect.

Rhizosphere

Work on rhizosphere mycoflora of different crop plants is now receiving considerable attention. Soil is the ‘reaction vessel’ in which the activities of the primary and secondary producers are connected with each other (Ulrich, 1987). Plants as most biological entities are living in relation with numerous micro-organisms. The relation between the plants and micro-organisms are intimate and permanent. The presence of other microorganisms may be detrimental to the plant (e.g. plant pathogens) while other may promote and favour the growth of the plant (e.g. plant growth promoting rhizobacteria, biological control agents, symbiotic, nitrogen-fixing bacteria etc.).

The role of roots in the life of micro-organisms is not only limited to the supply of nutrient substances but also around the roots more favorable physico-chemical and biological conditions for the existence of microbes as well as for the plants themselves are created. The rhizosphere is that portion of the soil under the direct influence of the roots of higher plants (Tate, 1995). However, for the cause of practical investigation, the rhizosphere is most often defined as the soil adhering to plant roots when they are vigorously shaken, throughout which the rhizosphere effect must be observed to some extent (Kang and Mills, 2004).

In addition to the classical roles of providing mechanical support and allowing water / nutrient uptake, roots also perform certain
specialized roles including the ability to synthesize, accumulate and secrete a diverse array of compounds (Flores et al., 1999). Rather, the compounds secreted by plant roots serve important roles as chemical attractants and repellants in the rhizosphere (Estabrook and Yoder, 1998; Bias et al., 2001).

The chemicals secreted into the soil by roots are broadly referred as root exudates. Through the exudation, roots may regulate the soil microbial community in their immediate vicinity, cope with herbivores, encourage beneficial symbioses, change the chemical and physical properties of the soil and inhibit the growth of competing plant species (Nardi et al., 2000). These exudates consists of a wide variety of compounds and simple substrates from low molecular weight (sugars, phenolics, amino acids, organic acids and other secondary metabolites) to higher molecular weight (proteins and mucilage) which supports the rhizosphere mycoflora of bacteria, fungi and actinomycetes (Garrett, 1981). The exact composition of the exudates is determined by many factors including species and nutritional status of the plant, soil structure and micronutrient status (Marschner, 1995). In fact, most rhizosphere bacteria and fungi are highly dependent on associations with plants that are clearly regulated by root exudates (Bias et al., 2004) and in the rhizosphere number of micro-organisms can reach upto $10^{10}$ to $10^{12}$ organisms g$^{-1}$ soil (Foster, 1988).

The soil is proved to be a great reservoir from which new and interesting micro-organisms are being discovered every moment (Gilman, 1945). Soil microorganisms play an important role in the improvement of soil quality. The importance of soil mycoflora (chemosynthetic, autotrophic bacteria, cyanobacteria, and fungi) in view of soil fertility is well known (Atlas and Bartha, 1998). The decomposition of animal and plant wastes, formation of humus and humic
acid, ammonification, nitrification, denitrification, degradation of cellulose and hemicellulose not only provide a bed for plant growth but also balances the physical and chemical properties of the soil.

Organic manures considerably alter the number of individuals or microbial community in the rhizosphere. Introduction of organic manures and inorganic fertilizers increase rhizosphere mycoflora of Sorghum-wheat cropping sequence (Malwar et al., 1999). So many workers also concluded that manuring causes changes in rhizosphere mycoflora of the crop plants. Therefore, the main objective of this study was to evaluate the effect of manures prepared by various methods on rhizosphere mycoflora population in case of maize crop.

MATERIAL AND METHODS

Soil sampling

The soil samples were taken from top of the soil (10 - 15 cm) at four to five randomly selected regions of each plot and collected in sealed polythene bags from before sowing and after harvesting of maize plots. Approximately 100 g of each sample was stored at 5 - 10°C until use and subsequently used for fungal flora analyses.

Mycoflora assay

The rhizosphere mycoflora was studied by soil dilution plate technique as described by Johnson et al. (1959). This method was originally developed by soil bacteriologists for enumeration and isolation of soil micro-organisms. For this purpose, appropriate soil dilutions are plated on suitable solid media. To suppress bacteria from appearing on plates and to encourage fungal growth, Smith and Dawson (1944) incorporated rose Bengal into the media. Rose Bengal has the further advantage that it slows down growth of fungal colonies and reduces the tendency of fast growing fungi to spread quickly over the whole plate before more slowly growing fungi have an opportunity to form colonies.
For the determination of mycoflora, 1 g of soil sample was dissolved in 100 ml of distilled sterile water. From the dilution flasks, 1 ml of soil suspension was placed in sterilized petridishes and dispersed with approximately 15 ml molten rose Bengal agar medium by gently rotating the plate in clockwise and anticlockwise direction before medium solidifies. These plates were incubated at room temperature (27 - 29°C) in the dark for 96 h. After the desired incubation, observations were recorded. Identification of fungi was done as per Gilman (1945) and Mukadam (1997).

**Results and discussion**

In order to know the effect of various types of composts on rhizosphere mycoflora of maize, the experiments were conducted in the experimental field of botanical garden of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. Results are summarized in table 1 and 2.

Rhizosphere mycoflora was analyzed i.e. soil fungi before sowing of maize and after harvesting of maize. Results presented in table 1, clearly indicates that in all total 14 fungi were isolated namely *Aspergillus niger*, *A. flavus*, *Rhizopus oryzae*, *Penicillium notatum*, *Trichoderma viride*, *T. harzianum*, *Fusarium oxysporum*, *F. roseum*, *Curvularia lunata*, *Alternaria alternata*, *Alternaria spp.* *Rhizoctonia solani*, *Rhizoctonia spp.* and *Phytophthora spp.*

Results indicate that in vermicompost; *Fusarium roseum*, *Curvularia lunata* and *Phytophthora* fungi were totally absent but they were present in remaining types of composts. Similarly, only *Rhizoctonia* spp. was absent in DLM remaining all fungi were present. It means maximum frequency of fungi was found in DLM. Fungal population as well as frequency of fungi varied in all types of composts including
control. All types of composts showed maximum population of fungi as compared to control.

The results presented in Table 2 clearly suggest that there was decrease in fungal population of all types of composts including control after harvesting of maize crop. This change may be due to the root exudates released by maize crop to the soil. But, this variation in mycoflora of all types of composts was not that much of significant or it was not considerably significant.

The presence of different fungi in different types of composts was also variable viz. *Rhizopus oryzae* was absent in compost but was present in remaining all types of composts including the control.

It was also observed that within different types of compost treatments rhizosphere mycoflora varies. All composts treatments show higher fungal population as compared to control. High density of fungi was observed after harvesting of maize crop in the plot having the treatment of green manure followed by vermicompost, compost, dry leaf manure, and finally fertilizer.

**Conclusion**

From the above results, it can be concluded that treatment of composts affected qualitative and quantative population of fungi in the rhizosphere of maize crop. Application of different types of composts not only increased microbial population but also improved fertility of soil.