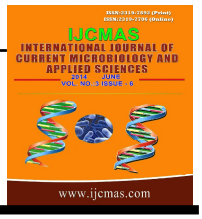
International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 3 Number 6 (2014) pp. 454-458**
http://www.ijcmas.com



Original Research Article

Assessment of Microbial diversity in non-rhizosphere soil of forest nurseries in Southern Tamil Nadu, India

E.Mohan* and K.Rajendran

Centre for Research and P.G. Department of Botany, Thiagarajar College, Madurai-625009, Tamil Nadu, India
**Corresponding author*

A B S T R A C T

Keywords

Microbial population, Non-rhizosphere soil, Forest nursery

The study was undertaken to know the microbial diversity and population in non-rhizosphere soil of state government forest nurseries in southern part of Tamil Nadu (Madurai). The analysis of non-rhizosphere soil samples showed that all the nurseries soil samples contain representative groups of microbial population such as bacteria and fungi Among the bacteria the five dominant bacterial species isolated and identified were *Micrococcus sp, Bacillus sp, Cellulomonas sp, Pseudomonas sp* and *Azospirillum sp*. Among the fungi the six dominant fungal species such as *Rhizopus sp, Curvularia sp, Penicillium sp*, Asperigillus *sp, Fusarium sp* and AM fungal spores were isolated and identified. In general bacterial population was higher in the nursery soil followed by fungal population.

Introduction

Soil is an appropriate substrate for the growth and multiplication of microorganisms. The nature and activity of microbes in the soil influences the growth and yield of plants significantly. The increased microbial activity in the soil leads to an increased competition between the component species for mineral nutrition and space and these may distress the plants either adversely or favorably.

The nature and activity of microflora in the soil influences the growth and yield of plants significantly. The complexity of soil system is determined by the numerous and diverse interactions among the physical, chemical and biological components as modulated by the prevalent environmental conditions (Buscot, 2005). Various types of microorganisms inhabit the soil. Many microbial interactions, which are regulated by specific molecules (Pace, 1997) are responsible for key environmental processes, such as the bio-geo chemical cycling of nutrients, organic matter and maintenance of plant health and soil quality (Barea et al., 2004).

Microorganisms are universally present in air, soil and water. They play an important role in restoring the physical, chemical and biological properties of soils. Their role in

agriculture is vital for nitrogen fixation, phosphate solubilization and mobilization of nutrients. Such beneficial microbes are called biofertilizers, which include both free living and symbiotic forms.

Long term application of synthetic chemical fertilizers will damage the physico-chemical and biological properties of soil. At present the pinch on fertilizer consumption is being felt more in India, since the country cannot afford either to import the required fertilizer at high cost or to subsidize the sale to the farmers or build new fertilizer plants at formidable cost. However, extensive use of chemical fertilizers in long term causes declining in productivity and also environmental quality.

Plant Growth Promoting Rhizobacteria (PGPR) (Arshad and Frankenberger, 1998) improves plant growth in two different ways, directly or indirectly. The direct promotion of plant growth by PGPR is through production of plant-promoting substances (Patten and Glick, 1996), or facilitation of uptake of certain nutrients from the soil (Glick and Ibid, 1995).

Materials and Methods

Study site

The study area selected was in Madurai, Tamil Nadu located at10^0 05' N latitude and 78^0 16' E longitude. The elevation of the study area ranges from 100-132 M above mean sea level. The temperature ranges from 21^0 C during winter and about 39^0 C during summer. The study area of Madurai received the annual rain fall of about 750 and 850 mm. The climate is sub-humid to semi-arid.

The soil type is sandy clay loam (sand 61%: silt 20%: clay 19%) with a pH 7.8. moisture content 32.71(%), electrical conductivity 0.23 (dsm^{-1}) and organic carbon 1.48%. The nitrogen, phosphorus and potassium level was 43Kg/ha, 36Kg/ha and 118Kg/ha. Similarly, the iron (5.44 mg/g), manganese (8.94mg/g), zinc (0.84mg/g), copper (0.52mg/g), calcium (1.22mg/g) and the sodium level are 1.20 (mg/g).

Soil collection

Soil samples (Non-Rhizosphere) were collected from the forest nurseries located in different regions in Madurai district, Tamil Nadu.

Soil physico-chemical analysis

The soil pH was determined in soil water suspension (1:2:5) using a pH meter (Jackson, 1973), Electrical conductivity was determined 1:2 ratio of soil water suspension by conductivity meter (Jackson, 1973), nitrogen by kjeldahl method using Kjeltech autoanalyser 1030 (Piper, 1966) and phosphorus by calorimetrically employing vanado-molybdate method. Potassium was estimated by using flame photometer with determined with neutral normal ammonium acetate solution (Stanford and English, 1949). Calcium, magnesium, iron, zinc, sodium and copper were determined with neutral normal ammonium acetate solution by versenate method (Jackson, 1973). Organic carbon was estimated by Walkey and Black wet digestion method (Piper, 1966).

Quantitative estimation of the microorganisms

Dilution plating method was employed for the enumeration of microbial population in the soil samples. N-free semi solid malate

medium was used for Azospirillum (Dobereiner et al., 1960), Pikovaskaya's medium was used for Phosphobacteria (Sundara Rao and Sinha, 1963), Kings B medium was used for Pseudomonas (Kings et al., 1954), Kuster's Agar medium was used for Actinomycetes (Subba rao, 1986) and total bacteria (Allen, 1957) and total fungi (Martin, 1950) in the soil samples.

Quantitative estimation of AM spore

AM spore density in each soil samples was estimated by a modified wet sieving and decanting technique as described by Gerdemann and Nicolson (1963).

Statistical analysis

The data were statistically analyzed by analysis of variance (ANOVA) and treatment means were separated using Duncan's Multiple Range Test ($P<0.05$) (Duncan, 1955).

Results and Discussion

The soil type, pH and temperature play an important role in affecting the microbial population in the soil. Besides, factors such as soil nutrient status and organic matter content also often affect the soil microbial population. The non-rhizosphere population of microorganisms is dynamic and governs by several factors (Katznelson, 1965).

The present investigation of the analysis of nursery soil samples showed that all the soil samples contain representative groups of microbial population such as total bacteria and fungi. In general bacterial population and fungal population were lesser in the non-rhizosphere soil (Table 1).

Total Bacteria

There are five different bacterial populations were found in the soil. The lowest bacterial population was found in the nursery soil. Among them, the highest population of bacterium was *Cellulomonas* followed by *Bacillus* and *Micrococcus* sps. The least population of bacterium found was *Azospirillum* and *Pseudomonas* sps.

Total Fungi

Fungal population diversity varies and low in the non-rhizosphere nursery soil (Table-2). The highest fungal population recorded in the soil was *Aspergillus* followed by *Rhizopus, Curvularia, Fusarium, Penicillium* sp.

AM spore population

The occurrence of AM spores depends upon the environmental conditions, plant species and soil type. During the present study, there are two different types of AM spores such as *Acaulospora* and *Glomus* were observed in non-rhizosphere soil. Among the two different AM spore, *Glomus* was the dominant one. Spore density was very low (8 spore/100 gram of soil). Occurrence of arbuscular mycorrhizal fungus in nursery and plantation has been studied by Mohan et al (1995). The present study is also corroborating with the above studies.

The present study clearly shows presence of bacterial and fungal populations in the nursery soil samples from non-rhizosphere of all the different sites of Madurai district. Among the microbial population, both beneficial and harmful bacteria as well as fungal species were found, but the population was low compared to rhizosphere soil.

Table.1 Physical and Chemical properties of nursery soil

Sl. No	Soil Parameters	Measurements
1	Soil pH	7.8
2	Moisture content (%)	32.71
3	Electrical conductivity (dSm^{-1})	0.23
4	Organic carbon (%)	1.48
5	Nitrogen (Kg/ha)	43
6	Phosphorus (Kg/ha)	36
7	Potassium (Kg/ha)	118
8	Iron (mg/g)	5.44
9	Manganese (mg/g)	8.94
10	Zinc (mg/g)	0.84
11	Copper (mg/g)	0.52
12	Calcium (mg/g)	1.22
13	Sodium (mg/g)	1.20

Table.2 Microbial population of non-rhizosphere nursery soil

Sl. No	**Bacterial and fungal species**	CFU (10^6/g) dry soil
1	*Micrococcus roseus*	7^c
2	*Bacillus cereus*	8^d
3	*Cellulomonas terrae*	10^e
4	*Pseudomonas fluorescens*	3^b
5	*Azospirillum brasilense*	2^a
6	*Rhizopus microsporus*	6^c
7	*Aspergillus niger*	8^d
8	*Curvularia clavata*	3^b
9	*Fusarium oxysporum*	2^a
10	*Penicillium chrysogenum*	2^a
11	AM Spore	08/100 gram soil

These microbes especially beneficial one can be isolated for mass multiplication and may be used for the growth and development of seedlings in nursery as well as plantation.

References

Arshad, M. and Frankerberger, W. T. 1998. Plant growth-promoting substances in the rhizosphere: microbial production and functions. *Adv. Agron*. 62: 145-151.

Barea, J.M., Aczon, R and Azcon-Aguilar, C. 2004. Mycorrhizal fungi and plant growth promoting rhizobacteria. In: Varma, A, Abbott, L, Werner, D, Hampp, R. eds. Plant surface microbiology. Heideberg. Germany: Springer-Verlag. 351-371.

Buscot, F. 2005. What are soils. In: Buscot, F, Varma, S, eds. Microorganisms in soils: roles in genesis and functions. Heidelberg, Germany: Springer-Verlag, 3-18.

Glick, B.R. and Ibid, G. 1995. Genotyping of antifungal compounds producing PGPR *Pseudomonas*. *Can. J. Microbiol*. 41: 107-109.

Jackson, M. L. 1973. Soil chemical analysis. Printice hall of India (Pvt) Ltd., New Delhi.

King, E.O. Ward, M.K and Raney, D.E. 1954. Two simple media for the demonstration of Pyocianin and fluorescein. *J. Lab. Clin. Med*. 44: 301-307.

Mohan, V., Verma Neelam and Singh Y.P. 1995. Distribution of VAM fungi in nurseries and plantation of Neem tree (*Azadirachta indica*) in arid zone of Rajasthan. Indian For, 121: 1069-1076.

Pace, N.R. 1997. A molecular view of microbial diversity in the biosphere. Science, 276: 734-740.

Patten, C and Glick, B. 1996. Bacterial biosynthesis of indole 3-acetic acid. *Can. J. Microbiol*. 42: 207-220.

Piper, C.S. 1966. Soil and Plant Analysis. Hans Publications. Bombay.

Stanford, S and English, L. 1949. Use of flame photometer in rapid soil tests of K and Ca. Agron, 41: 446-447.

Sundara Rao, W. V. B. and Sinha, M. K. 1963. Phosphate dissolving organisms in the soil and rhizosphere. *Indian Journal of AgriculturalScience*, 33: 272 – 278.