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Nutrient Analysis and Microbial Diversity In Rhizosphere Soil Of Medicinal Plants In Kolli Hills

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Abstract
The bacteria present in the rhizosphere region of the plant are called rhizobacteria. Rhizobacteria produces antibiotic substances protecting toxic effects of plant parasites. The rhizosphere soil of 14 different medicinal plants was collected from the Kolli Hills. The soil samples were analyzed and the physicochemical characteristics such as pH, EC, nitrogen, organic carbon, phosphorous, potassium, sulphur, zinc and boron was estimated. The microbial colonies were counted according to the colony forming unit.
Key Words: *rhizosphere, soil, microbes*

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I. Introduction

Soil is the complex heterogeneous mixture of various elements due to its diverse interaction with physical, chemical and biological components under different environmental conditions (Buscot, 2005). Most important region of the soil is rhizosphere where the roots of the soil closely interact with microbes which actively participated in metabolic process for nutrient uptake, the plant growth and maintain the plant health. The microbial community present in rhizosphere soil includes bacteria, fungi, oomycetes, nematodes, algae, protozoa, viruses, archaea and arthropods (Lynch, 1990; Meeting, 1992; Bonkowski *et al.,* 2009; Buee *et al.,* 2009; Raaijmakers *et al.,* 2009). Rhizosphere microbiome facilitates the conversion of nutrients, minerals and trace elements in active manner in the soil and also reduces the risk of plant pathogens.

The highest population of microbes present near the rhizosphere region and these microbes are maintaining the commensalic, mutualistic and symbiotic relationship with plants through their root colonization hence the nutrient availability also varies the microbial diversity in rhizosphere (Chowdhury *et al.,* 2009; Paul and Clark, 1996; Shukla *et al.,* 2013). Some of the bacteria can produce positive effects to the plants by releasing their metabolic products in soil which are known as plant growth promoting rhizobacteria (PGPR). The role of PGPR may be indirect through antagonistic activity against pathogens or direct by producing phytohormones (Glick, 2012).

Most of the micro organisms present in rhizosphere soil of some medicinal plants can produce the secondary metabolites which were used to treat various diseases like cancer, tumors, eye disorders, nerve disorders and paralysis. In the light of the above the present study focused on nutrient analysis and bacterial diversity in rhizosphere soil of 14 different medicinal plants from Kolli hills.

II. Methodology

Rhizosphere Soil Collection

Rhizosphere soil were collected from 14 different medicinal plants such as *Schinus molle, Millettia pinnata, Azadirachta indica, Calotropis gigantea, Leucas aspera, Ocimum sactum, Musa acuminata, Solanum nigrum, Phyllanthus amarus, Lawsonia inermis, Pergularia daemia, Centella asiatica, Cryptolepis dubia, Acorus calamus* from Kolli hills. 250 gram of each rhizosphere soil sample were collected aseptically and stored in sterile bags until their use.

Soil sample analysis

Soil sample were analysed for pH (Davis *et al.,* 1970), EC, Organic Carbon (Walkly Black Method) (Singh *et al.,* 1999), Nitrogen by Kjeldahl Method (Black, 1965), Phosporous (Singh *et al.,* 1999), Potassium (Ghosh *et al.,* 1983), Sulphur (Barrow, 1968), Zinc (Relic *et al.,* 2013), and Boron (Wolf, 1971; Gupta, 1979).

Microorganism Isolation and Colony Count

Dried rhizosphere soil samples were used for the isolation of microorganism by soil suspension method (Oskay *et al.*, 2004).

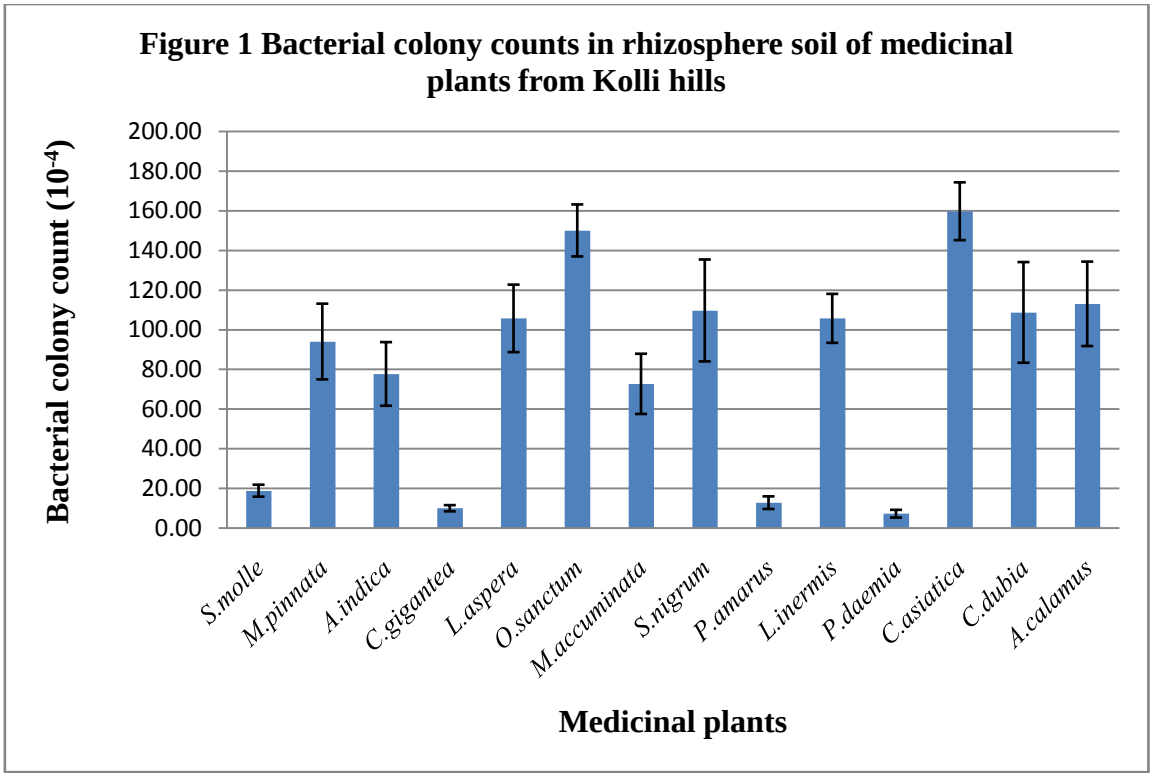
III. Results

Characterization of soil type in rhizosphere soil of medicinal plants from Kolli hills showed out of 14 soil samples, 12 soil samples were red soil and 2 soil samples like *C. dubia* and *A. calamus* were black soil. Characterization of Soil texture and lime status in rhizosphere soil of medicinal plants from Kolli hills showed sandy loam and non calcareous for all the 14 soil samples.

The rhizosphere soil sample of different medicinal plants pH ranged from 6.07 to 6.93, EC ranged from 0.04 to 0.24 ds m^{-1}, Organic carbon ranged from 0.64 to 1.05%, nitrogen ranged from 28.82 to 48.67 Kg ha^{-1}, phosphorous ranged from 12.43 to 20.56 Kg ha $^{-1}$, potassium ranged from 6.82 to 91.05 Kg ha $^{-1}$, sulphur ranged from 6.92 to 29.77 mg kg $^{-1}$, zinc ranged from 0.46 to 1.44 mg kg $^{-1}$, boron ranged from 1.70 to 4.78 mg kg $^{-1}$.

Bacterial colony count in rhizosphere soil of medicinal plants from Kolli hills showed that high number colonies was observed in *C. asiatica*, followed by *O. sanctum* and low number colonies was observed in *P. daemia*.

Figure 1 Bacterial colony counts in rhizosphere soil of medicinal plants from Kolli hills



IV. Discussion

Soil is the diverse environment which provides shelter for wide range of micro organisms like bacteria, fungi, protozoan etc. It contains various macro nutrients, micro nutrients and heavy metals include carbon, nitrogen, phosphorous, lead, cadmium, chromium and nickel (Khan *et al*., 2012; Asghar *et al.*, 2013). Soil microbes involved in the various physiological and metabolic activities which influences the microhabitat. These organisms interact with soil and supports plant nutrition, soil structure, soil fertility, nutrients cycling, inhibition of soil borne pathogens and removal of toxins while decomposing organic matter (Prescott *et al.*, 2005; Kozdroj and Van Elsas, 2000). Generally rhizosphere soil comprises low pH, low water potential, low oxygen pressure and increased levels of carbon dioxide when compare to the bulk soil (Suresh and Bagyaraj, 2002). Metabolic activities of microorganisms were found to be increased in the rhizosphere region which results in higher concentration of carbon. pH is an important factor in the soil that determine the mobility of nutrients to plant through their roots which are known as rhizosphere. In general electrical conductivity (Ec) is the measure of the soil salinity, thus the electrical movement of ions through solution is high when compared to water conductivity. Historically decomposition of soil organic matter leads to mineralization of organic carbon as a rhizo deposits in plant roots through various microorganisms found in rhizosphere region (Kuzyakov *et al.*, 2000), in the present study organic carbon ranged from 0.64 to 1.05%. Nitrogen is the major nutrient required by

plants and it is key component of chlorophyll, amino acids and protein synthesis for the plant growth (Good and Beatty, 2011), in the present study nitrogen ranged from 28.82 to 48.67Kg ha^{-1}. Generally amount of phosphorous present in the soil is high but they are unavailable to the plants due to absorption, precipitation or conversion into organic forms. The availability of phosphate would be low when the acidification of rhizosphere takes place by proton extrusion (Hinsinger *et al.,* 2003), in the present study phosphorous ranged from 12.43 to 20.56 Kg ha $^{-1}$. Potassium is one of the important macronutrient to maintain the plant growth and metabolism which are absorbed through abundant cations in the soil by their root hairs (Jungk, 2001), in the present study potassium ranged from 6.82 to 91.05 Kg ha $^{-1}$. Sulphur (S) is a major nutrient needed by plant as inorganic (sulphate) but mostly the soil S is in the form of organic (elemental sulphur) in nature and exists in 3 different forms such as ester bonded S, carbon bonded S and residual S (Tabatabai, 1982), in the present study sulphur ranged from 6.92 to 29.77 mg kg $^{-1}$. Zinc is one of the important metals required for plant metabolism, phyto hormone activity, photo synthesis, regeneration of reactive oxygen species and membrane integrity (Cakmak, 2002), in the present study zinc quantity ranged from 0.46 to 1.44 mg kg $^{-1}$. Boron is an important micronutrient in oil seed crops and deficiency of boron affects the crop yield, fruit production and seed production etc (Dell and Huang, 1997) in the present study amount of boron ranged from 1.70 to 4.78 mg kg $^{-1}$x10. In recent times researchers are most interested in isolation and identification of rhizosphere microorganisms due to their diverse beneficial roles in plant growth promotion, enzyme production, phyto hormone production, solublization of nutrients and increasing resistance against pathogens (Bhattacharyya and Jha, 2012). However, in the present study also the microbial colony count found in the range of 7.20 $x10^{-4}$ to 159.67 $x10^{-4}$. Bacterial colony counts in rhizosphere soil of medicinal plants from Kolli hills found to be higher in *O. sanctum* and *C. asiatica* where as lower in *S. molle, C. gigentea*, *P. amarus* and *P. daemia*. The variation found in this bacterial population may be due to the effect of chemical composition of root exudates present in the individual plants on microorganisms.

V. Conclusion

In recent times researchers are most interested in isolation and identification of rhizosphere microorganisms due to their diverse beneficial roles in plant growth promotion, enzyme production, phyto hormone production, solublization of nutrients and increasing resistance against pathogens. The diversity of microorganisms found in the rhizosphere soil mainly depends on plant species, microbial interactions, soil type and other environmental factors.

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