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MICROFLORA POPULATION AND PHENOL CONTENT IN THE ROOT-ZONE SOIL OF RICE CULTIVARS UNDER PROBLEM SOILS

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ABSTRACT

A potculture experiment was conducted to study the influence of rice root system on microbial population and biochemical changes, grown in acid and alkali soils under two population levels and three stages. The microbial (bacteria, fungi and actinomycetes) population was high in root-zone soil when compared to unplanted soil. Bacteria and fungi population were high under acidic condition whereas actinomycetes population was high under alkali soil and also in post harvest stage. Phenolic content was more in root-zone alkali soil and less in acid soil when compared to the respective unplanted soil.

Keywords: *Rice rhizosphere, Problem soil, Microbial population, Phenolic content.*

INTRODUCTION

The plant growth and its microbial harbours have a place in influencing the transformation, availability and uptake of nutrients and also establishing eco condition for the better establishment of plants. The root surface secreted significant quantities of organic compounds and the organic acids secreted by micro-organisms, can solubilize the plant nutrients. The number of organisms in the root-zone/rhizosphere region (soil adhering to the root) is greater than that of the unplanted soil. Thus root-zone soil differs biologically, chemically and physically from bulk soil. To increase the nutrient use efficiency, reduce the loss of nutrients and reduce cost of inputs, understand the population of microflora in rhizosphere region is important.

MATERIALS AND METHODS

Bulk samples of acid soil was collected from Rice Research Station, Ambasamudram and alkali soil was collected from the Agrl. College and Research Institute, Killikulam. These soils were classified as Typic Ustropepts and Typic Rhodustalfs respectively. Five gram processed soil was transferred to specially designed tubular pots of 30 cm height and 20 cm diameter. The soil was hand puddled and the water level was

maintained at 5 cm level throughout the experimental period. Twenty-three days old seedlings of the rice varieties ASD 18 and IET 1444 were planted in pots at two population levels equivalent to 66 hill s/m^2 (P_1) and 115 hill s/m^2 (P_2). Ten pots were maintained (unplanted soil) without any plant under similar above said conditions. In other pots gap filling was done after a week of transplanting to ensure uniform population levels. Fertilizer was applied at the rate of 100-50-50 NPK kg ha^{-1}. Half of the nitrogen, entire phosphorus and potassium were applied as basal. The remaining 50 % of the nitrogen were applied in two splits: one at maximum tillering stage and the other at flowering stage. Adequate plant protection measures were given depending upon the requirement. At the time of collecting the soil samples from pot, the flood water in the pots were drained, and the pots were turned upside-down and the soil core was allowed to slide down on a polythene sheet spread on the table.

The soil volume permeated by the root system (Rhizosphere soil) and unplanted soil was collected and analysed for phenolic content by folin ciocalteau reagent method (Bray and Thrope, 1954), the total population of bacteria, fungi and actinomycetes. For this one gram wet soil sample was transferred to test tube with 10 ml of distilled water. It was further diluted up to 10^{-6} dilution. From 10^{-3}, 10^{-4} and 10^{-6} dilution, 1 ml was taken and poured to petridish. Tthen RBA, Soil extract agar and Munaier's agar medium was added for the estimation of fungi, bacteria and actinomycetes respectively.

RESULTS AND DISCUSSION

The microbial population was high in planted condition when compared to unplanted soil. Bennett and Lynch (1981) and Klopper et al. (1985) suggested that the number of bacteria in the root-zone soil depend on the substrate supply from the root. Acid soil recovered higher population of bacterial and fungal colonies per gram of soil than that of alkali soil condition (Tables 1 & 2). As the actinomycetes required pH more than 8, its population was high under alkali condition (Table 3). Bacterial and fungal population was high in maximum tillering stage which was followed by flowering and post harvest stage where as actinomycetes population was high in post harvest stage and was less in maximum tillering stage. Microbial population promotes nutrient transformation and enhances the yield and uptake of nutrients. It was reflected in Table 4. As the microbial population was high in acid soil, the DMP, grain yield and uptake of nitrogen was high under acidic condition.

Table 1. **Changes in bacterial population (population x 10^6 cells g^{-1} of soil on oven dry basis) in the root-zone and unplanted soil.**

Stages	Unplanted soil		Root - zone soil	
	Acid	Alkali	Acid	Alkali
Maximum tillering	65	49	136	69
Flowering	58	41	103	67
Post harvest	53	36	90	59

The root-zone soils of rice planted in acid soil recorded low quantities of phenolic substances compared to unplanted soil (Fig. 1). It indicates that the major sources of phenolic substances are microbial synthases and not root metabolites.

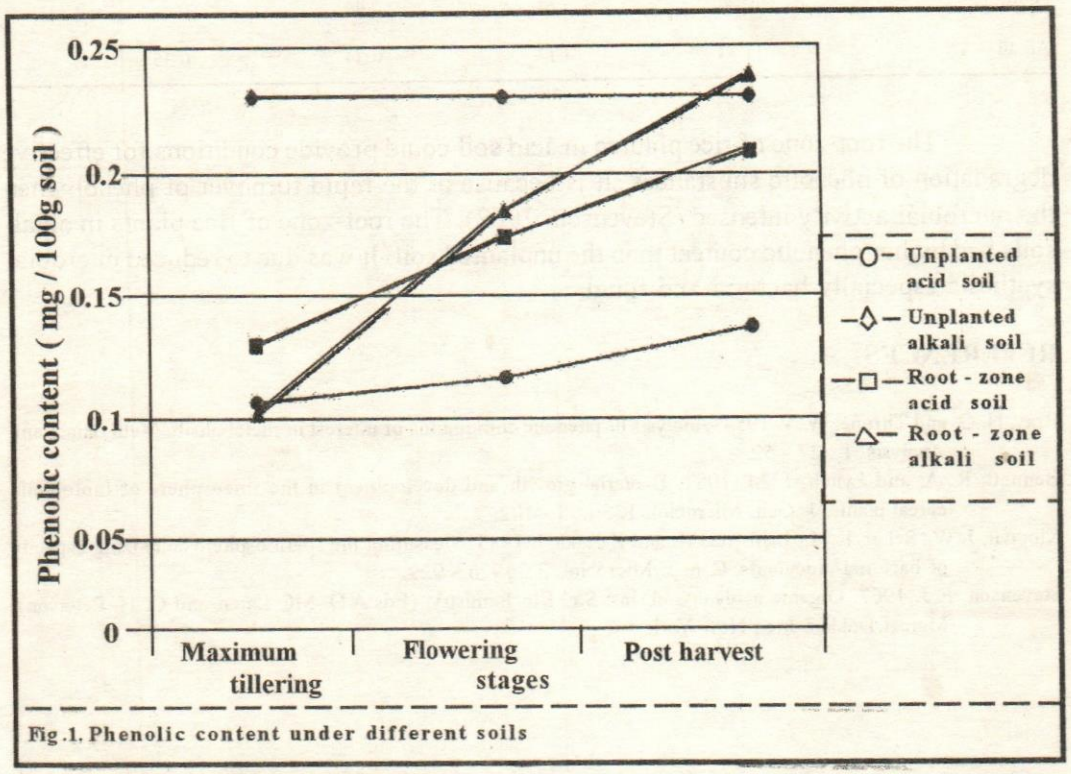

Fig.1. Phenolic content under different soils

Table 2. **Changes in fungal population (population x 10^3 CFU g^{-1} of soil oven dry basis) in the root-zone and unplanted soil.**

Stages	Unplanted soil		Root - zone soil	
	Acid	Alkali	Acid	Alkali
Maximum tillering	69	49	107	67
Flowering	67	46	87	62
Post harvest	63	43	77	46

Table 3. **Changes in Actinomycetes population (population x 10^4 CFU g^{-1} of soil oven dry basis) in the root-zone and unplanted soil.**

Stages	Unplanted soil		Root - zone soil	
	Acid	Alkali	Acid	Alkali
Maximum tillering	08	11	16	25
Flowering	09	13	29	38
Post harvest	08	17	33	56

Table 4. **Changes in yield and nitrogen uptake.**

Soil	DMP	Grain	Plant	Grain
Acid	15.11	3.81	0.44	0.67
Alkali	11.81	3.17	0.34	0.35

Thé root-zone of rice planted in acid soil could provide conditions for effective degradation of phenolic substances. It is because of the rapid turnover of phenol when the microbial activity intensed (Stevenson, 1967). The root-zone of rice plants in alkali soils had higher phenolic content than the unplanted soil. It was due to reduced microbial synthesis especially bacteria and fungi.

REFERENCES

Bray, H. G. and Thrope, W. V. 1954. Analysis of phenolic compounds of interest in metabolism. Meth. Biochem. Analysis. 1 : 27 - 52.

Bennett, R. A. and Lynch, J. M. 1981. Bacterial growth and development in the rhizosphere of Inotobiotic cereal plants. J. Gen. Microbiol. 125 : 95 - 102.

Klopper, J. W.; Scher, F. M.; Laliberte, M. and Zaleska, I. 1985. Measuring the spermosphere colonizing capacity of bacterial inoculants. Can. J. Microbiol. 31 : 926 - 929.

Stevenson, F. J. 1967. Organic acids in soil. In : Soil Biochemistry: (Eds.A.D. MC Laren and G. H. Peterson). Marcel Dekker. Inc., New York.