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Consequence of Soil pH on the Fungal and Bacterial Community

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ABSTRACT

The influence of pH on the relative importance of the two principal decomposer groups in soil, fungi and bacteria, was investigated along a continuous soil pH gradient at Hoosfield acid strip.This experimental location provides a uniform pH gradient, ranging from pH 8.5 to 4.0, within 180 m in a silty loam soil on which barley has been continuously grown for more than 100 years. We estimated the importance of fungi and bacteria directly by measuring acetate incorporation into ergosterol to measure fungal growth and leucine and thymidine incorporation to measure bacterial growth. The growthbased measurements revealed a fivefold decrease in bacterial growth and a fivefold increase in fungal growth with lower pH. This resulted in an approximately 30-fold increase in fungal importance, as indicated by the fungal growth/bacterial growth ratio, from pH 8.3 to pH 4.5.

Key Words: Fungi, Bacteria, soil pH.

I. INTRODUCTION

An inherent problem in studying soil pH effects is its varied influence on multiple parameters. The soil microbial community is responsible for most nutrient transformations in soil, regenerating minerals that limit plant productivity. Fungi and bacteria are the two groups that dominate the microbial decomposer community, and, crudely defined, they share the function of decomposing organic matter in soil, indicating that there is a strong potential for interaction. This resulted in a 30-fold increase in the relative importance of fungi and bacteria the influence of pH on fungal growth has been investigated previously. Baath and Arnebrant reported that treatment of forest soils with lime and ash, which resulted in pH changes from about pH 4 to 7 and increased fungal growth about fivefold a Similar study that included 100 different soils sample from areas Mahagaon Land uses has also been reported.

However, one limitation of these observational studies is that it is impossible to determine whether the communities are structured directly or indirectly by pH. In other words, we do not know whether pH itself is the factor shaping these communities, or whether pH may be indirectly related to the observed community changes through many environmental factors (for example, nutrient availability, organic C characteristics, soil moisture regime and vegetation type), which often co-vary with changes in soil pH.[4] Similarly, we do not know whether soil pH is also correlated with the community composition of fungi, another dominant microbial group in soil.[5] Our objectives for this study were observe the effect of soil pH on the fungal community across the 100-m distance of the Mahagaon Dist. Yavatmal.

II. MATERIAL AND METHODS

Soil sample were collected from across the Mahagaon taluka Yavatmal district to investigate the direct influence of soil pH on the abundance, taxonomic diversity and composition of the major soil microbial fungi. We sampled along the first 100m of the strip taking 5 cm diameter, 0–23cm depth cores at each sampling position along the gradient. The gradient was sampled every 15m between 0–40 m, and every 5m between 40 and 60m and, then every 10m between the final 60–100m of the gradient. One fifty soil samples were sieved (2.8mm) in the laboratory, removing apparent roots and stones, and pH was measured using an electronic pH meter.

III. RESULT AND DISCUSSION

Spanning a pH range from 4 to 8, showed that there was an increase in bacterial growth with decreased fungal growth was found at higher pH. Thus, suggesting decrease in fungal dominance of decomposition at higher soil pH. The close correlation between the declines in fungal growth as soil pH declines requires explanation. One potential explanation could be independent physiological limitations by pH of the separate decomposer groups; i.e., low hydrogen ion concentrations limit fungal growth. Recent study has demonstrated that changes in soil microbial communities across space are often strongly correlated with differences in soil chemistry. In particular, it has been shown that the composition, and in some cases diversity, of soil fungal communities is often strongly correlated with soil pH. However, bacterial and fungal growth revealed dramatic differences in the activity of these microbial decomposer communities. In contrast, fungal growth was maximal at pH 4.5, and decreased by a factor of more than 5 toward the high pH end.[6]

Sam.No.	pH	Sam.No.	pH	Sam.No.	pH	Sam.No.	pH	Sam.No.	pH
1	7.1	5	7.8	9	7	13	6	17	7.1
2	4.3	6	6	10	7	14	8.3	18	7.6
3	4.8	7	8.2	11	7.1	15	7.8	19	6
4	8.1	8	8.5	12	8.4	16	7.8	20	5.2

Throughout the Mahagaon taluka the measured pH of the soil sample found to be lying in between 4.1 to 8.5. The value of observed soil pH is given in table below. The mainly all soil sample shows basic in nature and some soil sample shows neutral pH. The fungal growth in this range of pH hardly survives. Out of the collected sample the sample collected from river area shows 4.1 pH. This indicates that there is better survival of fungi. From above diagram it clearly shown that the majority of the sample having pH is greater than 6 pH. Irrespective of the mechanism, it is clear that the general inhibitory effects below pH 4.5 in the Hoosfield acid strip are very different from the pH effects above pH 4.5. For this reason, the analyses of the results and the remainder of the discussion concerning the influence of pH on microbial parameters focus exclusively on the pH range above pH 4.5.

IV. CONCLUSION

This study showed that neutral or slightly alkaline conditions favored bacterial growth. Conversely, an acid pH favored fungal growth. This resulted in an increase in the relative importance of fungi by a factor of 30 from pH 8.3 to pH 4.5. The drastic shift in fungal and bacterial growth affected basal respiration in the same pH range to a relatively minor extent, possibly suggesting functional redundancy in C mineralization. It was not possible to reconcile bacterial and fungal biomass measurements with growth measurements, which compromises the reliability of biomass-based methods to properly assess the relative importance of fungi and bacteria in soil. The use of growth-based measurements proved to be a sensitive way to compare the relative importance of the two major decomposer groups in soil, fungi and acteria.

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