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Microbial C, N, and P Relationships in Moisture Stressed Soils of Potohar, Pakistan

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Abstract

At present, information regarding the role of the microbial biomass as sink and source of plant nutrients in sub-tropical soils under rain-fed dry farming is generally lacking. This is particularly true for the moisture stressed soils of the Potohar plateau in Pakistan. In 11 typical soil series of this region, microbial biomass C, biomass N, and biomass P were analysed and related to their element-specific total storage compartment, i.e. soil organic C, total N and total P. The quotient microbial biomass C-to-soil organic C indicates the availability of organic substrates to soil microorganisms. Similarly, the quotients microbial biomass N-to-total N and microbial biomass P-to-total P indicate the availability of organic N and P components to soil microorganisms. Also the elemental ratios within the microbial biomass, i.e. the quotients microbial biomass C/N and microbial biomass C/P have been demonstrated to give valuable information on the availability of nutrients to soil microorganisms, especially on that of phosphorus. The effects of climatic conditions and soil physico-chemical properties on these relationships were highlighted with special respect to crop yield levels. Average contents of soil organic C, total N, and total P were 3.9, 0.32, and 0.61 mg g^{-1} soil, respectively. Less than 1 % of total P was extractable with 0.5 M $NaHCO_3$. Mean contents of microbial biomass C, biomass N, and biomass P were 118.4, 12.0, and 3.9 μg g^{-1} soil. Microbial biomass C, biomass N, biomass P, soil organic C and total N were all highly significantly interrelated. The mean crop yield level was closely connected with all soil organic matter and microbial biomass related properties, but showed also some influence by the amount of precipitation from September to June. Also the fraction of $NaHCO_3$ extractable P was closely related to soil organic matter, soil microbial biomass and crop yield level. This reveals the overwhelming importance of biological processes for P turnover in alkaline soils.

Keywords: Crop yield level, microbial biomass, precipitation, soil organic C, total N

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