Changes in Inorganic and Microbial P Fractions Over Time Following Goat Manure and Inorganic Phosphate Addition to a High P Fixing Soil

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Abstract

Phosphorus transformations in untreated and manure treated soils at varying inorganic P application rates were assessed in controlled laboratory incubation experiments using a sequential fractionation procedure. Phosphorus was added at rates of 0, 45, 90, 135 and 180 mg P kg$^{-1}$ as triple super phosphate with or without 20 t ha$^{-1}$ of goat manure (dry weight) and incubated moist for 12 weeks. Resin P, soil microbial biomass P, 0.5 M NaHCO$_3$ extractable inorganic P (NaHCO$_3$-Pi) and 0.1 M NaOH extractable inorganic P (NaOH-Pi) concentrations were determined on days 1, 7, 14, 28, 56 and 84. Addition of inorganic P increased all P fractions but the increases were greater when goat manure was co-applied. The control treatments had only 17.2 and 27.5 mg P kg$^{-1}$ of resin extractable P in the un-amended and manure amended treatments, respectively which increased to 118.2 and 122.7 mg P kg$^{-1}$ at the highest rate of P application (180 mg P kg$^{-1}$) on day 28 of incubation. NaOH-Pi was the largest extractable Pi fraction and ranged from 144 to 251 mg P kg$^{-1}$ and 108 to 213 mg P kg$^{-1}$ in the unamended and manure amended treatments, respectively. Inorganic P addition increased the microbial biomass P concentration from 17 to 44 mg P kg$^{-1}$ in P alone treatments but the fraction was greatly enhanced with manure addition, increasing it from 32.6 to 97.7 mg P kg$^{-1}$. The largest improvement in microbial biomass P due to manure occurred at low rates of added P indicating the potential of goat manure to enhance the fertiliser use efficiency of low doses of P fertilisers. This increase in microbial biomass P following goat manure addition implies that the presence of goat manure increased the proportion of added P immobilised in microbial cells that would be subsequently released into the soil solution and be available for plant uptake following microbial turnover.

Keywords: P fractionation, goat manure, microbial biomass, resin-P

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