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Impact of Legume Versus Cereal Roots on Chemical and Biological Properties of West African Soils

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Abstract

To investigate whether root residues of legumes and their specific decomposition are responsible for the yield increases on the subsequent cereal in a rotation, 2 g kg⁻¹ soil of dry roots of cowpea (*Vigna unguiculata* Walp.; CP), groundnut (*Arachis hypogaea* L.; G), pearl millet (*Pennisetum glaucum* L.; PM), maize (*Zea mays* L.; M) and sorghum (*Sorghum bicolor* Moench; SO) were applied to pre-incubated monoculture soils from Fada (Burkina Faso, F) and Koukombo (Togo, K). Other treatments comprised mineral phosphorus (P) application in an amount equal to the applied P through legume root residues and a control (Con). At 5 sampling times over a period of 189 days (0, 7, 21, 63 and 189 days after incubation) microbial biomass C (Cmic) and N (Nmic) were determined and the soil respiration was measured initially every two days and later weekly. During the first 3 weeks Cmic concentrations were almost 41 % higher in FG and 38 % higher in FCP compared to FCon. In the Koukombo soils 43 % higher Cmic concentrations were measured in KPM than in KP. Significantly higher Nmic concentrations were determined in FG (11.6 µg g⁻¹) and FSO (10.5 µg g⁻¹) compared to FCon (6.2 µg g⁻¹). Nmic concentrations measured in KPM (7.0 µg g⁻¹) were significantly higher compared to KP (4.7 µg g⁻¹) and KCon (3.7 µg g⁻¹) and soil respiration was up to 11-fold higher in FG than in FCon, whereas it was up to 16 fold higher in KP compared to KCon. Even if no legume-specific effects on microorganisms were observed in Koukombo soils, the system-specific effects in the Fada soils indicate that influences of legume root residues and their decomposition on the microbial population might contribute to the yield-enhancing effect of legume rotations. A subsequent experiment with analyses of adenylates, microbial P, ergosterol, pH, and POM finalized by September 2006 will allow more insights into soil biological and biochemical factors.

Keywords: Legume-rotation, microbial biomass, root residues, sahel