



Tropentag, October 9-11, 2007, Witzenhausen

“Utilisation of diversity in land use systems:
Sustainable and organic approaches to meet human needs”

Separating Soil Chemical and Biological Effects of Legume Rotation-Induced Cereal Growth Increases on West African Soils

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Abstract

Numerous reports have shown legume-rotation induced increases in cereals on nutrient-poor West African soils, however, their mechanisms are still debated. In this study differences in P and mineral N concentrations between continuous cereal (CC) and legume rotation (R) soils from the two West African sites Fada (Burkina Faso, F) and Koukombo (Togo, K) were determined and taken as the basis for nutrient application rates for a growth chamber experiment. Sorghum (*Sorghum bicolor* Moench) was planted on Fada soils and maize (*Zea mays* L.) on Koukombo soils. Treatments for CC soils consisted of five times the difference of N (N5), five times the difference of P (P5), and five times the difference of both nutrients (N5P5). Treatments for rotation soils consisted of four times the difference of the respective nutrient concentrations (N4, P4 and N4P4). These variants were compared to the unamended soils (CC and R). Shoot length was measured daily. After harvest shoots and roots were analysed for their nutrient concentrations and total root length and mycorrhizal infection determined.

The combined application of P and N increased plant height significantly (FCC-P5N5 = 65 cm; FR-P4N4 = 59 cm; both FCC-P5 and FR-P4 = 55 cm) compared to N application only and to the unamended soil (FCC-N5 = 35 cm; FR-N4 = 40 cm; F-CC = 42 cm; F-R = 41 cm). Irrespective of the N and P level applied, for the same nutrient input shoot dry matter was significantly higher on rotation soils than on continuous soils (FR-P4N4 = 7.4 g; FCC-P5N5 = 4.7 g). Sorghum shoots had higher concentrations of P, K and Na for all CC treatments compared to the respective rotation treatments. In contrast shoot N concentrations were significantly higher for FR-N4 (18.5 mg g⁻¹) and FR (18.8 mg g⁻¹) compared to FCC-N5 (9.6 mg g⁻¹) and FCC (6.7 mg g⁻¹).

Mycorrhizal infection rates were higher on FR soils even if this difference was only significant for FR-N4 (17%) compared to FCC-P5 (7%) and FCC-P5N5 (6%). Nematode counts are conducted and will be presented in the final version of the abstract.

Keywords: Mineral N, mycorrhiza, phosphorus, root length, Sahel