Effects of legume *versus* cereal roots on plant growth and biological properties of West African soils

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Introduction

Legume rotations with groundnut and cowpea have been reported to cause several changes in soil chemical and biological properties on West African soils (Bagayoko et al., 2000; Avley et al., 2001; Marschner et al., 2004). Therefore this work aimed in investigating whether root residues of legumes and their specific decomposition are responsible for the yield increases of the subsequent cereal in rotation.

Materials and Methods

- Pre-incubated monoculture soils of Fada (Burkina Faso) and Koukombo (Togo).
- Per kg of soil 2 g of dry roots from previously grown cowpea (*Vigna unguiculata* Walp.), groundnut (*Arachis hypogaea* L.), pearl millet (*Pennisetum glaucum* L.), maize (*Zea mays* L.), and sorghum (*Sorghum bicolor* Moench) were applied.
- At five sampling times microbial biomass C (C_{mic}) and N (N_{mic}) and adenylate concentrations were measured to determine changes in the microbial biomass and their activity.

Results

Figure 1: *Sorghum bicolor* grown on a monoculture soil from Fada (Burkina Faso) with (+) and without (-) application of groundnut root residues.

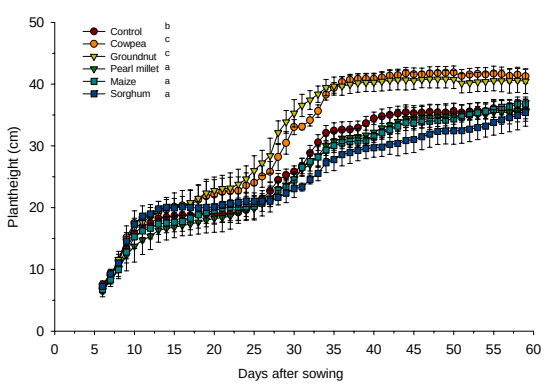

Figure 2: *Sorghum bicolor* planted on a monoculture soil of Koukombo (Togo) without and with application of legume and cereal root residues. Treatments with different letters are significantly different at $p < 0.05$ (Tukey-HSD).

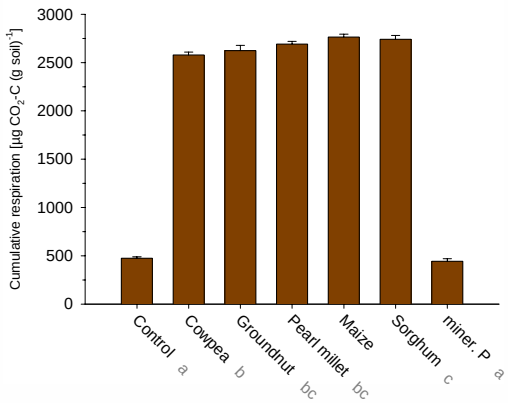

Figure 3: Cumulative respiration measured over 189 days of incubation of a monoculture soil from Fada (Burkina Faso) with application of legume and cereal root residues. Treatments with different letters are significantly different at $p < 0.05$ (Tukey-HSD).

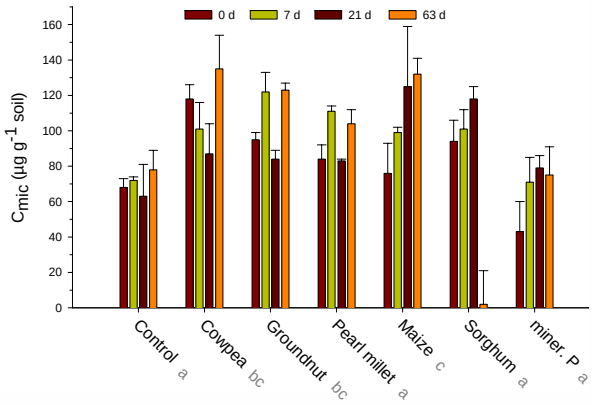

Figure 4: Microbial biomass C measured at 0, 7 21 and 63 days of incubation of a monoculture soil from Fada (Burkina Faso) with application of legume and cereal root residues and mineral P. Treatments with different letters are significantly different at $p < 0.05$ (Tukey-HSD).

- Biomass production of *Sorghum bicolor* Moench was increased by 20 and 40 % on both soils by applied root residues of legumes (Fig.1). Plant growth (Fig. 2) was up to 28 and 37 % greater on the Koukombo soil with applied root residues of groundnut and cowpea, respectively. Applied mineral P and mineral P+N increased biomass production by up to 340 %, while plant growth was up to 200 % greater than the control.
- Cumulative respiration measured over 189 days was significantly increased by applying of root residues compared to the control in both soils and to mineral P application on the Fada soil (Fig. 3).
- C_{mic} in the Fada soil was significantly increased by root residues of groundnut and cowpea compared to the control, and to the application of root residues of pearl millet and sorghum and mineral P (Fig. 4).
- N_{mic} was increased by legume root residues compared to applied mineral P in both soils and to the control in the Koukombo soils, except for sorghum on the Fada soil, even if these differences were not all significant.
- ATP and ADP concentrations were slightly increased by groundnut root residues but no significant differences in adenylate concentrations were found in both soils.

Conclusions

The specific effects of legume residues on plant growth and on soil microbial population at least in the Fada soil indicate that influences of legume root residues and their decomposition contribute to the yield-enhancing effect of legume rotations.

Additional analyses of P_{mic}, ergosterol, pH, N_{min} and amino sugars will allow more insights and will be published soon.

Acknowledgements

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References

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