Separating soil chemical and biological effects of legume-rotation induced cereal growth increases on West African soils

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Hypothesis

The higher nutrient concentrations in rotation soils, especially N and P, are responsible for the yield increases in cereals following a leguminous crop.

Materials and Methods

- Differences in P and N concentrations of continuous cereal (CC) and legume-rotation (R) soils of Fada (Burkina Faso, F) and Koukombo (Togo, K) were determined and taken as the basis for nutrient application rates.
- Fada soils were planted with sorghum (*Sorghum bicolor* Moench) and Koukombo soils with maize (*Zea mays* L.).
- Treatments for CC soils consisted of five times the difference in N (N5), five times the difference of P (P5) and five times the difference of both nutrients (P5N5).
- Treatments for R soils consisted of four times the difference in N (N4), four times the difference of P (P4) and four times the difference of both nutrients (P4N4).

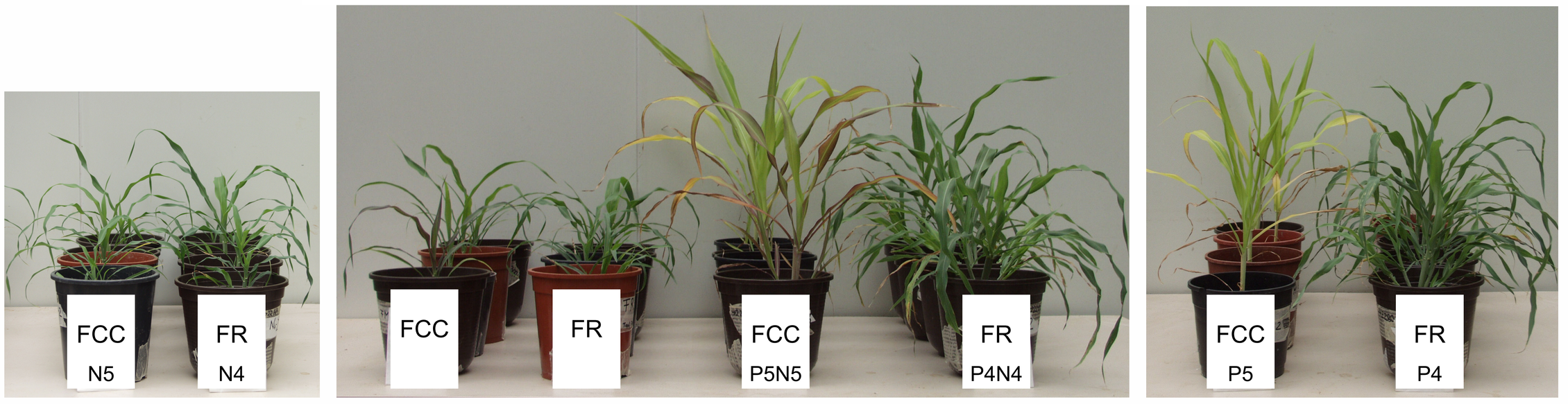

Figure 1-3. Sorghum (*Sorghum bicolor* Moench) grown on soils from Fada (Burkina Faso, F). Treatments for continuous cereal soil were five times the difference of N (N5), five times the differnce of P (P5), five times the difference of both nutrients (P5N5) and an unamended control (FCC). The treatments for rotation soils were four times the difference of the respective nutrients (N4, P4 and P4N4) and an unamended control (FR).

Results

- The application of the P only and the combined nutrients increased plant height significantly compared to N application only and to unamended soils (Fig. 1-3). Irrespective of the P and N level applied, shoot dry matter was significantly higher for the same nutrient input on rotation soils than on continuous soils (Fig. 4).
- Phosphorus, K and Na concentrations were higher in sorghum shoots for all CC-treatments compared to the respective rotation treatments. In contrast shoot N was higher in FN4 (18.5 mg g^{-1}) and FR (18.8 mg g^{-1}) compared to the respective CC treatments (9.6 mg g^{-1} and 6.7 mg g^{-1}).
- Mycorrhizal infection was higher on rotation soils even though this difference was only significant for FN4 compared to FP5 and FP5N5 (Fig. 5).
- Overall numbers of nematodes were higher in CC soils with a significant difference for FP5 and FN5 compared to FP4 and FP4N4 (Fig. 6).

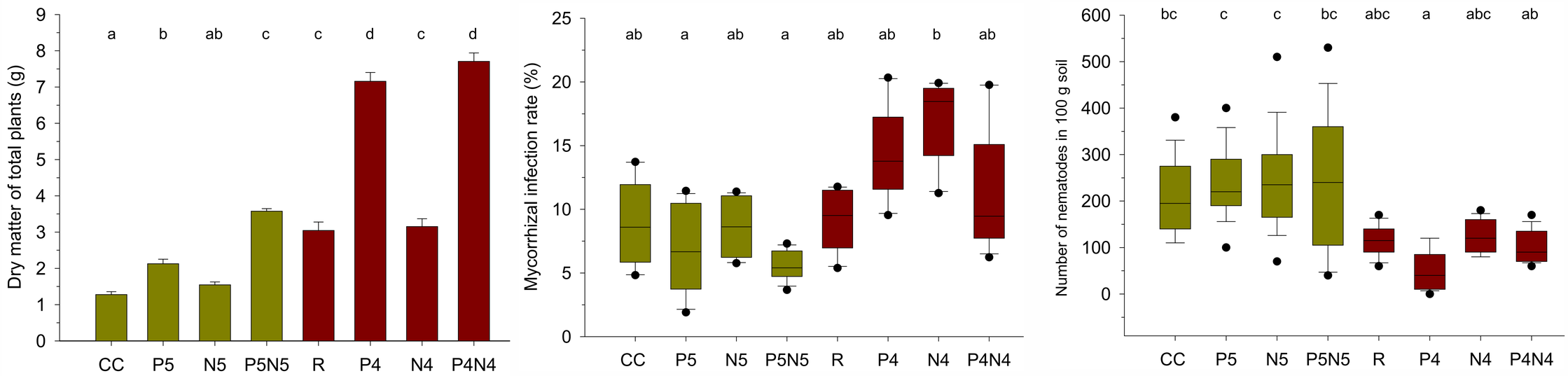

Figure 4-6. Dry matter of total plants (left) and mycorrhizal infection rate (middle) measured in sorghum (*Sorghum bicolor* Moench) grown on soils from Fada Kouaré (Burkina Faso, F); and numbers of nematodes found in 100 g soil of Fada (right). Treatments for continuous cereal soil (dark yellow) were five times the difference of N (N5), five times the differnce of P (P5), five times the difference of both nutrients (P5N5) and an unamended control (CC). The treatments for rotation soils (dark red) were four times the difference of the respective nutrients (N4, P4 and P4N4) and an unamended control (R). Different letters indicate singificant differences at the level $p < 0.05$ with Tukey HSD for dry matter and mycorrhiza and with Scheffé for transformed data (sqrt) for nematodes.

Conclusions

- Phosphorus seems to be more important than N for an increase of plant growth on nutrient-poor West African soils.
- Nevertheless healthier appearance of the plants, higher dry matter production, higher mycorrhizal infection rate and decreased numbers of nematodes on rotation soils indicate that a higher nutrient availability following a leguminous crop is not the only reason for yield increases of the following cereal.

Acknowledgements

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