Spatial and temporal variability of nodulation of cowpea intercropped with sorghum in a Sudano-Sahelian agro-ecosystem in Burkina Faso

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ABSTRACT

Sorghum-cowpea intercropping is the most frequent cropping system, generally under practise of stone-strips or zaï associated to manure in the soudano-sahelian region of Burkina Faso, where low soil N and P contents impact negatively the yields. In order to better understand the level of nitrogen fixation by cowpea intercropped with sorghum, this study analyzes the nodulation and biomass production of cowpea, and their relations, in 12 agronomic trials during years 2012 and 2013 in 3 villages in the north of Burkina. The results show that the nodules number (NN) and shoot dry weight (SDW) per plant of cowpea varied among trial sites and years. Both parameters were higher under zaï with manure (ZF) than simple zaï (ZS), whatever the year. The correlation between the means of NN and SDW per individual site was significant for both ZF and ZS with all sites in 2012, with one nodule producing a mean of 4.0 and 1.4 g SDW respectively to ZS and ZF in 2012. By contrast in 2013, the correlation between the NN and SDW was significant with 4 sites only. It is concluded that the difference between the two years would be due to higher rainfall in 2012 than in 2013. More work is needed on N and P contents of soils and manure, and soil granulometry, in order to assess their contributions to the observed variations of nodulation and the subsequent growth of cowpea under intercropping with sorghum in Northern Burkina.

INTRODUCTION

In the soudano-sahelian region sorghum-cowpea intercropping (mixed cropping) is the most frequent cropping system practiced in farms. Thus, in this area, cereals intercropping benefit of nitrogen fixed by legumes only if they are used in combination because the crop residues are exported from the fields. Despite the benefits of this cultivation system, farmers' yields remain low. This is due to low rainfall and low soils content of nutrients, especially N and P (Bationo and *al*., 2000; Pallo, 2008). Maintaining or even increasing, the soil fertility is a major issue (Smaling et *al*., 1997; Sanchez, 2002). In order to optimize this system in these

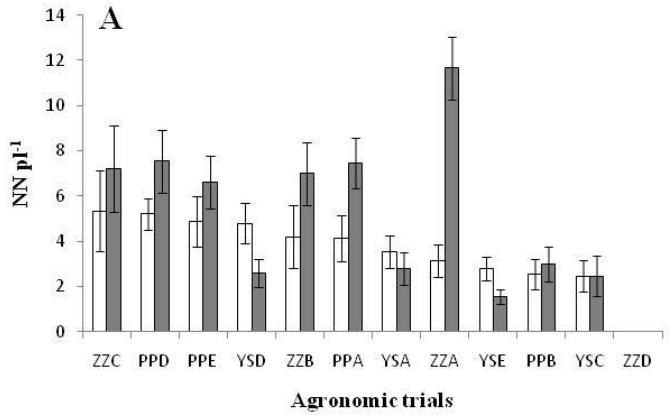
areas, it is necessary to investigate the level of nitrogen fixation by cowpea through nodulation and biomass production in various sites. This study analyzes the spatial and temporal variability of nodulation, and its relationship with biomass of cowpea intercropped with sorghum.

MATERIALS AND METHODS

The study was conducted during 2012 and 2013 in 4 villages of the northen region of Burkina localized 12°38' and 14°18' north, and 1°33' and 2°55' west, with four agronomic trials in completely randomized blocks in each village, coresponding to a total of twelve (trials throughout the region). Trial sites were PPA, PPB, PPC, PPD in Pougyango, ZZA, ZZB, ZZC ZZD in Zindiguéssé and YSA, YSB, YSE, YSD in Soumyaga. Trial treatments were zaï+manure+urea (ZFN), zaï+manure (ZF) as the most widespread local practice and simple zaï (ZS). Each treatment was repeated five times. Fifteen plants (3 plants x 5 replicates) per treatment were collected at flowering stage. Measurements were the nodules number (NN), shoot dry weight (SDW) and root dry weight (RDW) per plant of cowpea. Statistical analysis and graphics and standard error were performed with Excel 2007.

RESULTS AND DICUSSION

The results show that the mean NN and SDW per plant of cowpea varied among trial sites and years (fig.1A&1B). Both parameters were higher under ZF than ZS, whatever the year. The differences between years would be due to higher rainfall in 2012 than in 2013 (data no shown).



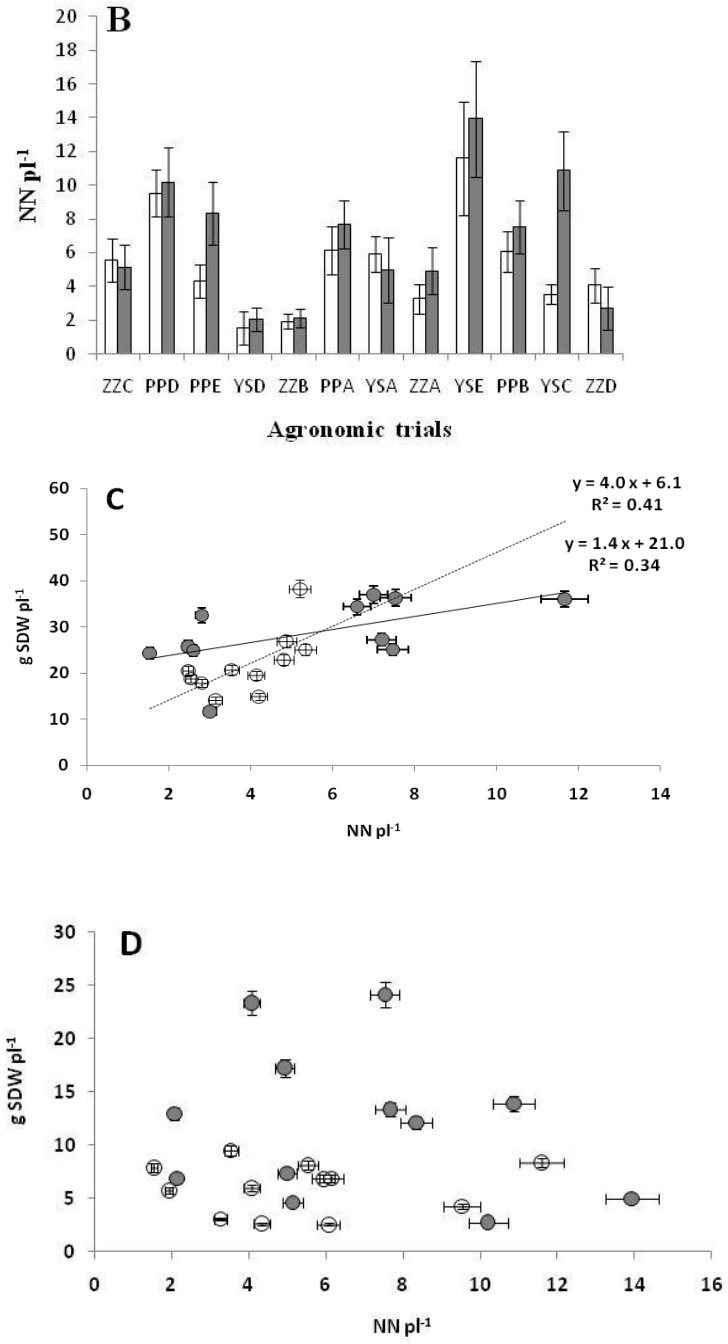


Figure 1. Nodules Numbers in 2012 (A) and 2013 (B) under ZS (□) and ZF (■) treatments per test. Correlation between nodules numbers and shoot dry weight under ZS (┈┈) and ZF (—) treatments in 2012 (C) and 2013 (D). Data are means and standard error of three plants of cowpea for five replicates by treatment and trial harvested at flowering stage

The correlation between the means of NN and SDW per individual site was significant for both ZF and ZS with all sites in 2012 (fig.1C), but only with 4 sites in 2013 (data not shown). In 2012, the efficiency of 1 nodule to produce SDW, i.e. the slope of the regression of SDW

as a function of NN, was lower under ZF than under ZS (1 nodule produced 4.0 and 1.4g SDW, respectively, fig.1**C**).

In conclusion the observed variations in NN and SDW would be due to pedological and rainfall factors. Thus, more work is needed on N and P contents of soils and manure, and soil granulometry, in order to assess their contributions to the variations of nodulation and the subsequent growth of cowpea under intercropping with sorghum in Northern Burkina-Faso.

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REFERENCES

Bationo A., Wani S.P., Bielders C.L., Vlek P.L.G. and Mokwunye U. 2000. Crop residue and fertilizer management to improve soil organic carbon content, soil quality, and productivity in the desert margins of West Africa. Pages 117–145 in Global climate change and tropical ecosystems, edited by R. Lal, J.M. Kimble, and B.A. Stewart. Advances in Soil Science. CRC Press, Washington DC, USA.

Pallo F. J. P., Sawadogo N., Sawadogo L. Sedogo M. P. et Assa A. 2008.Statut de la matière organique des sols dans la zone sud-soudanienne au Burkina Faso. Biotechnol. Agron. Soc. Environ. 12(3), 291-301.Sanchez P.A., 2002. Soil fertility and hunger in Africa. Science 295, 2019-2020.

Sanchez P.A., 2002. Soil fertility and hunger in Africa. Science 295, 2019-2020.

Smaling E.M.A., Nandwa S.M. and Janssen B.H. 1997. Soil Fertility Is at Stake. In: Replenishing Soil Fertility in Africa, Buresh R.J., Sanchez P.A. and Calhoun F. (Eds.). Soil Science Society of America and American Society of Agronomy, Madison, Wisconsin, USA., pp: 47.