

Report on mission to Senegal
From November 30 to December 4, 2009

Rabah Lahmar
URSCA
CIRAD, 01BP 596
Ouagadougou, Burkina Faso
Rabah.lahmar@cirad.fr

December 15, 2009

Mission Objectives

- To consolidate the science behind the design and the assessment of innovative and ecologically intensive smallholder cropping systems in Western and Central Africa ;
- To initiate scientific partnerships in order to address relevant questions.

Sahelian native shrubs in ecologically intensive cropping systems

The project SCAP (Smallholder Conservation Agriculture Promotion in West and Central Africa) aims to design and disseminate innovative cropping systems that are based on conservation agriculture (CA) or related principles. SCAP is funded by an IFAD small grant and it is implemented through four IFAD loan development projects: two in Burkina Faso (North and East), one in Guinea (North, Coastal) and one in Niger (Southeast). In terms of opportunities and constraints for CA development, the four projects areas offer a sequence of situations ranging from the wettest and less populated to the most arid and populated context (see EBICS .ppt file in appendix). The Sahelian region is the most challenging for the development of « classical » CA, where the soil is covered by crop residues or by grown cover crops. The soil is often degraded and the phytomass produced is under the pressure of local and transhumant livestock. In this area, SCAP envisages making the ligneous strata contribute to the production of the soil cover since farmers' plots always contain trees and shrubs. Traditionally, Agroforestry privileges trees on farms whereas the SCAP project focuses on shrubs, which is actually the originality of the project. Field observations, screening of farmers' practices as well as exchanges with farmers in Niger and Burkina Faso reveals the interest in two native shrubs traditionally maintained and managed within the plots: *Piliostigma reticulatum* (*Caesalpiniaceae*, nonnodulating legume) et *Guiera senegalensis* (*Combretaceae*) (see EBICS .ppt file in appendix).

Building on smallholders' practices in Burkina Faso and Niger, it seems possible to design CA-based cropping systems, where soil cover is provided by the pruning of these shrubs. Moreover, it is technically possible to increase their population within plots in order to obtain sufficient biomass. For this purpose, however, there is a need for knowledge on how these shrubs function and notably to understand the direct and indirect (via fauna and flora) relationships and mechanisms that involve the resources of the system (water, nutrients, light, manpower), and that may impact mature stands (facilitation, competition bio-aggression etc.).

Literature review reveals notably a series of publications dating between 2000 and 2009, resulting from research on these two species, carried out in the Senegal's Peanut Basin by a mixed team of researchers from ISRA/CERAAS and the Universities of Oregon, Ohio and Davis-California. This was done within the framework program (2001-2008) funded by the *National Science Foundation* (USA)¹. All published results tend to confirm the interest of the integration of the two shrubs into the cropping systems. However, there are still some aspects that deserve to be investigated.

In order to better elucidate certain research questions and to initiate scientific partnerships for this, contact was made with colleagues in Senegal. The first contact made, which was facilitated by Bertrand Muller (CIRAD BIOS, UR AIVA in post at CERAAS), was with Dr Ibrahima Diédhiou in July, 2009, during a mission in Ouagadougou. This was followed by the contact of other colleagues, which turned out to be very positive. A five days mission was organized, which was facilitated by Dr Ibrahima Diédhiou, who kindly accepted to organize meetings in Thiès and Dakar. During this mission two half days consisted of working visits to IRD Dakar and CORAF/WECARD.

Preliminary results of the mission

Four research scientists of the former ISRA/CERAAS team², of the NSF program were met: Dr Aminata Niane Badiane (USAID Senegal), Dr Ibrahima Diédhiou (University of Thiès, CERAAS), Dr Mamadou Khouma (Private Bureau) and Dr Samba Arona Ndiaye (University of Thiès). Discussions led to an e-mail exchange with Professor Richard Dick (Professor of Soil Microbial Ecology, Ohio State University Columbus).

At CORAF/WECARD headquarters, important discussion around EBICS ppt file were held with Dr Harold Roy-Macauley (Director of Programs, CORAF/WECARD); Dr Bruce Pengelly (Assistant Chief, CSIRO) and Sara Webb (Consultant Aus-AID).

At IRD, important exchanges were held around EBICS with Dr Lydie Lardy, Dr Komi Assigbetse, Dr Saidou Sall and Dr Moussa Ndienor.

At Thiès discussions were held with:

- Other researchers such as Dr. Papa Madiallacke Diédhiou, (phytopathologist, University of Thiès) and Roger Bayala (PhD student, Soil Science, CERAAS);
- Vice chancellor of the University of Thiès, Professor Papa Ibra Samb;
- Leaders of NGOs addressing Sustainable Agricultural Development issues: Mr Souleymane Bassoum Director NGO AGRECOL-AFRIQUE (*Agriculture Ecologique*), Mr Fabien Loch, Regional Coordinator for Western Africa of NGO ADG (*Aide au Développement Gembloux, Belgium*) and President for the Platform of European NGOs in Senegal.

Lectures made at CERAAS on the SCAP project attracted the interest of a number of other colleagues as well as Masters and PhD students and raised some relevant and interesting debates.

All exchanges with partners were fruitful and very promising for the future. As far as preliminary results are concerned, it should be particularly mentioned that:

¹ Program led by Professor Richard Dick. There have been previous works, see dissertation of Professor Mateugue Diack (ISRA, 1998) on "*Piliostigma reticulatum* dans un parc à *Cordyla pinnata* dans la région de Kaolack".

² E.L. Dossa is at IFDC, Ghana; A. Lafufa is at the World Bank, Washington. M. Sène is at CERAAS, but he was on vacation as it was Tabaski time.

From the research point of view: Interesting results on *Piliostigma reticulatum* et *Guiera senegalensis* have been obtained in the Senegal Peanut Basin, notably regarding water, organic matter, nutrients, carbon storage, microbiology etc. These results, however, need to be consolidated, deepened and even confronted using systems approach on other soil types and with other crops. Other critical aspects remain to be investigated, especially (i)-the relationship between shrubs and fauna, and particularly termites that seem to induce mechanisms of bioremediation/facilitation that provide benefit to crops and, (ii)-the relationship between shrubs and bio-agressors that may present significant risks to crops notably because work will be initiated with monospecies population of *Piliostigma* or *Guiera*. It should be noted that a valuable on-field research experience has been gained on these two shrubs in the context of smallholders' plots which are always heterogeneous regarding the shrubs population density and spatial distribution.

From the partnership point of view: All researchers and leaders met during this mission favor the development of a scientific partnership to address the scientific questions raised (and/or that could be raised in the future) by the integration of these two ligneous species within CA-based cropping systems. Professor Richard Dick confirmed his interest and that of his University through an e-mail.

CIRAD thinks, therefore, that there would be a nucleus of 10 partners as follows, on which the hope of developing a regional research platform could be based, and which will be able to face the challenges of an ecologically based intensification of the cropping systems in West and Central Africa:

University de Thiès
ISRA/CERAAS
CORAF/WECARD
IRD
CSIRO, Australia
USAID Senegal
Ohio State University Columbus
AGRECOL (NGO)
ADG (NGO)

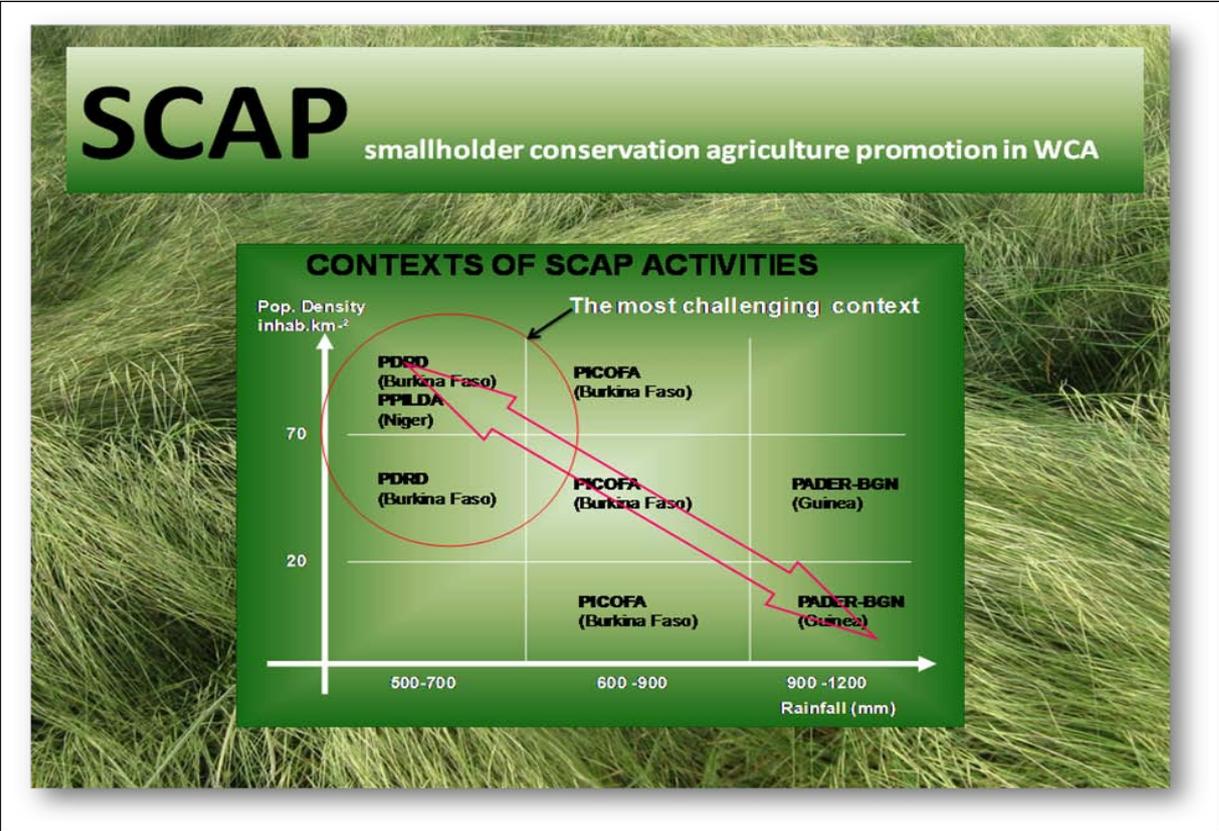
Perspectives

In early 2010, other partners such as IFDC (E. Dossa and A. Mando), WUR (L. Brussaard), CEAS (E. Ouédraogo), will be approached in order to complete the multidisciplinary character of the team.

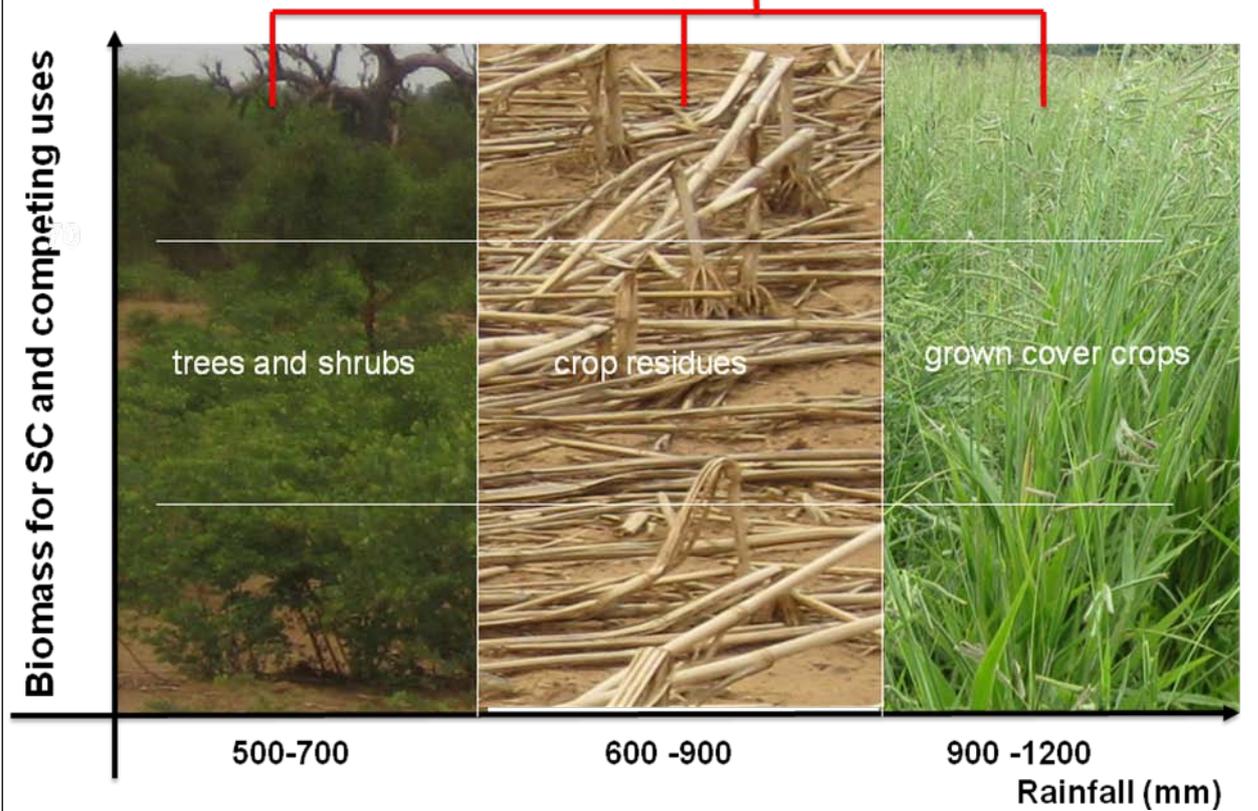
A reflexion is proposed to be held in 2010 on partnerships around EBICS and a concept note and research program developed with regards to mid- and long-term plans. With regards to resource mobilization, it might seem difficult to obtain funds very quickly given the deadlines fixed in January (EU) and March (ANR). The year 2011 will, therefore, be a realistic target.

To initiate the partnership, it is proposed that the first nucleus meets physically during 2010 in Ouagadougou and on the grounds of SCAP in order to finalize a research program and define mid- and long-term objectives and partnership modalities. For this purpose, financial and logistics support will be requested from CIRAD and SCAP.

Appendix



$$C_{\text{ons. Agr.}} = N_{\text{oTill}} + \text{SoilCover} + C_{\text{ropRotation}}$$

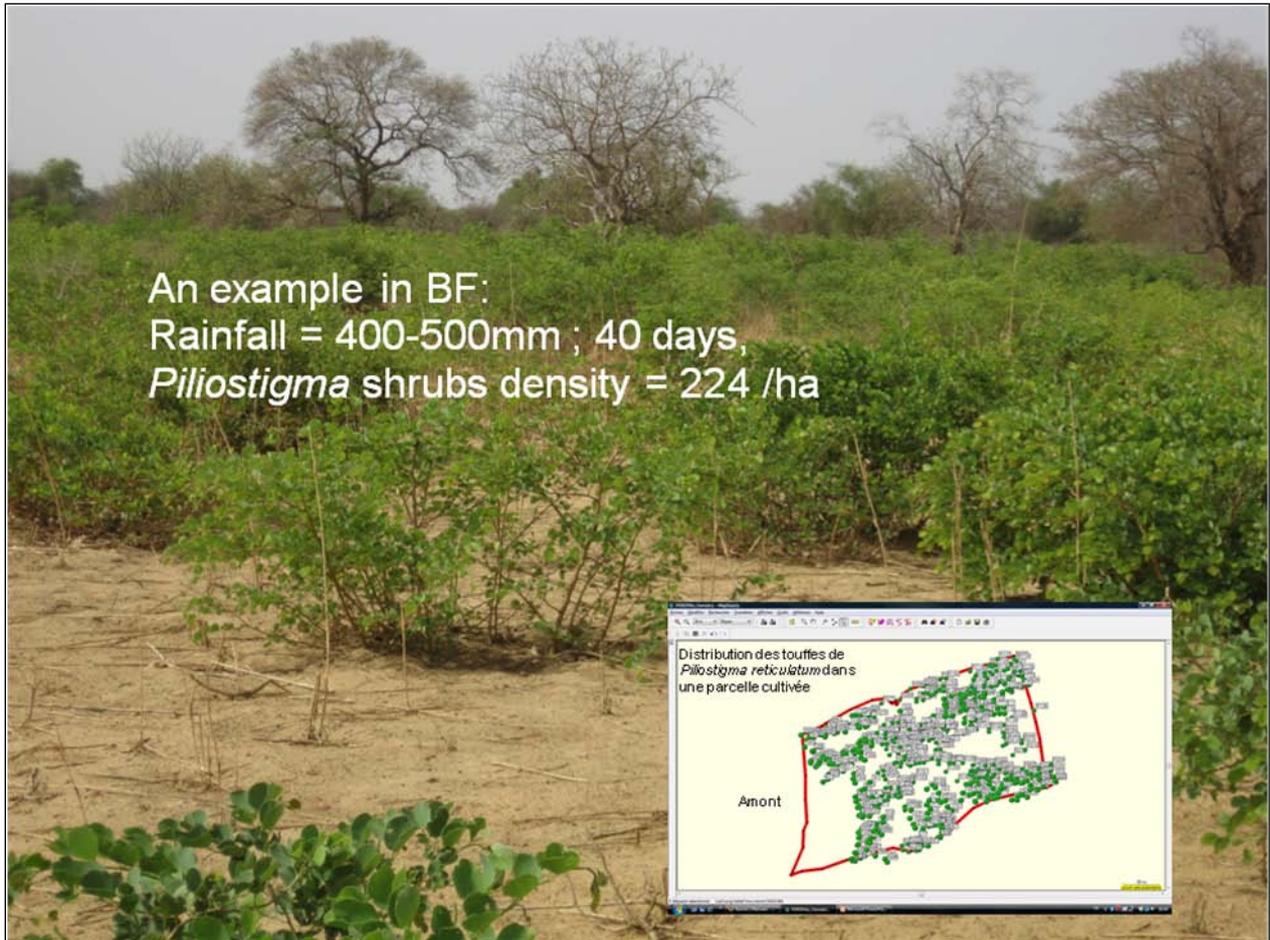


Opportunity for EBICS in Sahelian region

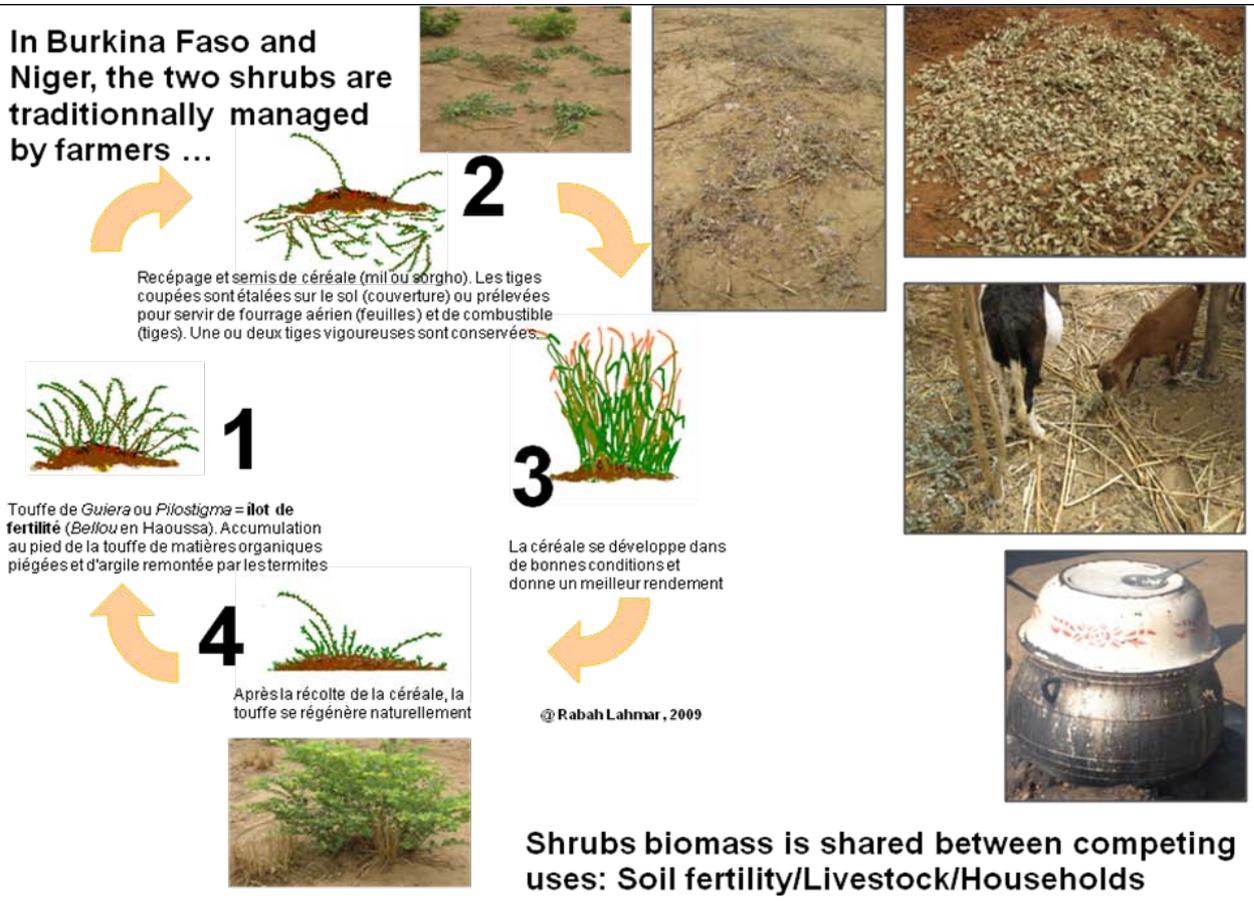
Two native shrubs, coexist with annual crops in the Sahelian belt



They grow during the dry season and, their density within the croplands may be significant.



In Burkina Faso and Niger, the two shrubs are traditionally managed by farmers ...



Building on farmers knowledge and practices to design, test and assess impacts of the cropping systems integrating these native shrubs.

**Sorghum / *Piliostigma* system, Yilou, Bam Province, BF
R: 400/500 mm, 2009.**



Recent scientific findings* tend to ascertain the benefit of these shrubs for soil fertility and water management, including nutrients cycling, SOM & SOC etc.

In a perspective of EBICS in WCA, we need to understand interactions of eco-bio-soil mechanisms in play, in order to better manage the systems i.e. to induce better mediations and efficient resources allocation (light, water, nutrients, manpower...) between annual crops and coexisting perennials, and to reduce risks.

* Main papers

- M. Diack. **1998**. *Piliostigma reticulatum* dans un parc à *Cordyla pinnata* : effet sur la régénération des sols dégradés du Sénégal. Mémoire Titularisation, ISRA CRA Kaolack, pp 48.
- M. Diack, M. Sene, A.N. Badiane, M. Diatta, and R.P. Dick. **2000**. Decomposition of a native shrub, *Piliostigma reticulatum*, litter in soils of semi-arid Senegal. *Arid Soil Research and Rehabilitation* 14, 205-218.
- F. Kizito, M. Draglia, M. Sène, A. Lafufa, I. Diédhiou, R.P. Dick, J.S. Selker, Diack, E. Dossa, M. Khouma, A.N., Badiane, S. Ndiaye. 2006. Seasonal soil water variation and root patters between two semi-arid shrubs co-existing with pearl millet in Senegal, West Africa. *Journ. Arid Environ.* 67, 436-455.
- F. Kizito, M. Sène, M. Draglia, A. Lafufa, I. Diédhiou, E. Dossa, R. Cuenca, J.S. Selker, R.P. Dick. **2007**. Soil water balance of annual crop-native shrub systems in Senegal's Peanut Basin : the missing link. *Agricultural water management* 90, 137-148.
- A. Lufafa, J. Bolte, D. Wright, M. Khouma, I. Diedhiou, R.R. Dick, F. Kizito, E. Dossa, J.S. Noller. **2008**. Regional carbon stocks and dynamics in native woody shrub communities of Senegal's Peanut Basin. *Agric. Ecosyst. Environ.* 128, 1-11.
- A. Lufafa, I. Diédhiou, S.A.N. Samba, M. Séné, M. Khouma, F. Kizito, R.P. Dick, E. Dossa, J.S. Noller. **2008**. Carbon stocks and patterns in native shrub communities of Senegal's Peanut Basin. *Geoderma* 146, 75-82.
- A. Lufafa, I. Diédhiou, N.A.S. Ndiaye, M. Séné, F. Kizito, R.P. Dick, J.S. Noller. **2009**. Allometric relationships and peak season community biomass stocks of native shrubs in Senegal's Peanut Basin. *Journ. Arid Environ.* 73, 260-266.
- S. Diédhiou, E.L. Dossa, A.N. Badiane, I. Diédhiou, M. Sène, R.P. Dick. **2009**. Decomposition and spatial microbial heterogeneity associated with native shrubs in soils of agroécosystèmes in semi-arid Senegal. *Pedobiologia* 52, 273-286.
- E.L. Dossa, M. Khouma, I. Diédhiou, M. Sene, F. Kizito, A.N. Badiane, S.A.N. Samba, R.P. Dock. **2009**. Carbon, Nitrogen and phosphorus mineralization potential of semi-arid Sahelian soils amended with native shrub residues. *Geoderma* 148, 251-260.