Using native shrubs to design agroecological production systems in semi-arid Burkina Faso

Georges Félix, Zangtinda Marcel Ouédraogo, Jean-Marie Douzet, Rabah Lahmar, Bruno Ouédraogo, Blaise Ouédraogo, Patrice Djamen, Edmond Hien, Cathy Clermont-Dauphin, Bernard Barthès, Raphaël Manlay, Johannes Scholberg, Pablo Tittonell, Laurent Cournac

georges.felix@wur.nl / www.wassa-eu.org

Background

Population growth in West Africa has intensified **pressure on land resources** for subsistence farming. This hampers the use of traditional fallows to **restore soil** productive capacity via **organic matter** accruement. In this context, crop productivity may be enhanced through the application of **agroecological techniques** such as crop association and mulching with locally-available material. Crop residues are often used for soil protection. However, there are competing claims since crop residues are also used as livestock forage during the dry season, thereby limiting the availability of mulches to restore soils in low external input systems. Experience from semi-arid Burkina Faso shows that **farmers** have developed **innovative** temporal and spatial arrangements using native evergreen woody shrubs (i.e. *Piliostigma reticulatum*) to provide in-situ organic mulching material.

Figure 1. *Piliostigma reticulatum* shrubs occur spontaneously in farmer fields (Photo: G. Félix)

Figure 2. Woody shrub fresh biomass applied as mulch before sowing (Photo: G. Félix)

Figure 3. Woody shrub mulch produces organic matter, retains soil humidity and favours biological activity (Photo: G. Félix)

Use of shrub fallows in farmer fields have been documented since the 1970's but only recently have **shrub-crop associations** been proposed as a support mechanism for agroecological systems in semi-arid West Africa (Lahmar *et al*. 2012). The presence of these woody shrubs in the landscape **reduces erosion** and intercepts wind-driven residues, surface soil sediments and nutrients (Dossa *et al.,* 2013). Shrubs are pruned prior to onset of the rainy season and fresh matter is applied on soils before main crop is sown - **sorghum** or millet, **usually inter-cropped with cowpea**. When crops are harvested at the end of the rainy season, shrubs re-gain biomass and restore root reserves that carry them through the dry season. Farming families use woody branches >2 cm diameter as firewood. Hence, most of the woody organic matter applied on the fields consists of **leaves and small-diameter branches.**

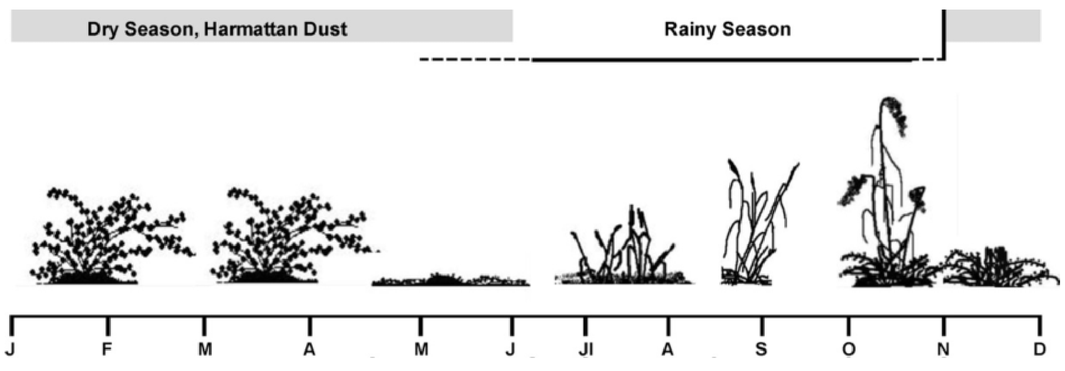


Figure 4. Shrub-crop temporal arrangement observed on some fields of innovative farmers in Yilou, Burkina Faso. During the dry season, *Piliostigma reticulatum* shrubs grow spontaneously on farmer fields. At the beginning of the cropping season, these shrubs are pruned and applied as mulch on the fields to maintain/enhance soil organic matter. Source: Lahmar et al., 2012.

Objective

Evaluate the effects of **native woody shrub** *Piliostigma reticulatum* as a **mulch alternative** to increase sorghum yields **in farmer fields** of semi-arid Burkina Faso, in West Africa.

Materials & Methods

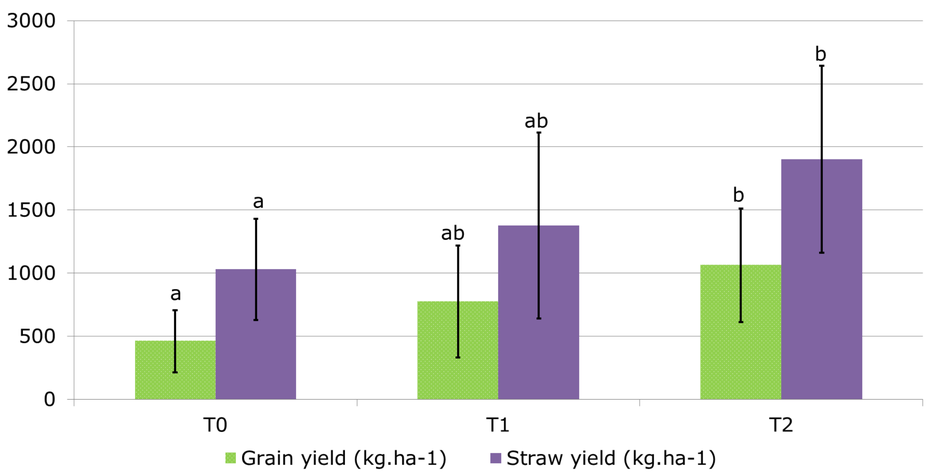
Shrub-crop associations were monitored in farmer fields in Yilou, Burkina Faso (13°01' N, 01°32' W), based on the description of local field crop operations. In June 2013, **four on-farm trials** of 300-900 m^2 plots were established in areas with homogeneous distribution of vegetation. Each plot was divided in **three equivalent sections** where standing woody shrub biomass was cleared and fresh matter was applied as three mulch treatments (Fig. 5). Sorghum (0.80 x 0.40 m) was intercropped with cowpea (0.80 x 0.40 m) using reduced tillage techniques and fertilizer application 21 days after sowing at 100 $kg.ha^{-1}$ NPK (23-10-5). Sorghum yields were measured for three 8 m^2 sized sub-plots for each treatment. **Grains and straw were measured** at harvest (November 2013) to calculate yield per hectare. Planting dates varied from mid-June to mid-July 2013.

Figure 5. Experimental treatments in farmer study. T1: standing *Piliostigma* biomass applied at 1 $t.ha^{-1}$ mulch; T2: standing *Piliostigma* biomass applied at 2 $t.ha^{-1}$ mulch; T0 (control): standing biomass cut and applied on T2. (n=4)

T0	T1	T2
0 $t.ha^{-1}$ woody mulch	1 $t.ha^{-1}$ woody mulch	2 $t.ha^{-1}$ woody mulch

Results

Based on results from on-farm trials, yield differences were slightly significant (Tukey test, $p<0.10$) among treatments (Graph 1). When no woody mulch was applied, average sorghum grain yields were 460 $kg.ha^{-1}$ while **yields increased** to 1063 $kg.ha^{-1}$ when 2 $t.ha^{-1}$ of fresh woody mulch was applied. Similar trends occurred for straw biomass production.



Graph 1. Grain and straw sorghum yields under three woody shrub mulch treatments in four farmer fields. Experiment was carried out in 2013 in Yilou, Burkina Faso. (Tukey test, $p<0.10$) Source: Ouédraogo (2014)

The way forward…

- **Initial results** show that woody mulch **may contribute** to increased crop yields (T2>T1>T0) as related to reduced fertility and water losses, resulting in more **efficient use of local resources**.
- Further research will assess the contribution of **biological activity** (*i.e.* termites, fungi, bacteria) to enhance soil productive capacity and nutrient retention as drivers for chemical soil fertility increases.
- **Companion modelling platforms** will support the analysis and design of agroecological systems through farmer knowledge mobilization for maximisation of local resource-use and nutrient flows.

Acknowledgements

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