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

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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 accrualment. 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.

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-grow 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.

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 m² 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 m² 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.

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 fresh woody mulch was applied. Similar trends occurred for straw biomass production.

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 mobilisation for maximisation of local resource-use and nutrient flows.

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References

