

Siaya-Nyabeda-Kibugu (Kenya)

EXPERIMENT GOALS

Specific objectives were to analyse the effects of biochar input on:

- yield of maize and soybean without and with inorganic fertiliser,
- yield reliability, i.e. random variation among seasons and,
- soil C and N stocks, extractable phosphorus (P) and potassium (K) content, acidity, water-holding capacity and bulk density.

Plots without any plant cover (bare fallow) were also included in the experiment, to determine the effect of biochar addition on soil properties in the absence of other natural litter inputs.

10-years experiment



SITE DESCRIPTION

The field experiments were carried out in two sub-humid areas: two sites (Siaya, Nyabeda) in Siaya County in the Lake Victoria basin and two (Kibugu, Embu) in Embu County, located on the foothills of Mount Kenya.

All the sites have a bimodal annual precipitation pattern, with long rains (LR) and short rains (SR), during which maize and soybean, respectively, were grown. The crop rotation thereafter consisted of maize (*Zea mays*) grown during the long rains, followed by soybeans (*Glycine max*) grown during the short rains.

Table 1

Location of the Kibugu, Nyabeda and Siaya experimental sites, soil pH and soil texture (mean \pm stdev) measured at the start of the experiments in November 2006.

| | Kibugu | Nyabeda | Siaya |
|----------------------|-----------------|-----------------|-----------------|
| County | Embu | Siaya | Siaya |
| Latitude | 0° 30' S | 0° 07' 51" N | 0° 08' 01" N |
| Longitude | 37° 30' E | 34° 24' 11" E | 34° 24' 18" E |
| Altitude (m) | 1480 | 1333 | 1347 |
| pH(H ₂ O) | 5.01 | 5.96 | 5.25 |
| SOC (%; n = 9) | 2.01 \pm 0.17 | 1.66 \pm 0.12 | 1.56 \pm 0.16 |
| Sand (%; n = 3) | 21.7 \pm 2.3 | 23.0 \pm 4.2 | 22.4 \pm 2.0 |
| Clay (%; n = 3) | 43.5 \pm 1.1 | 60.1 \pm 5.3 | 60.1 \pm 2.0 |

BIOCHAR AND ITS APPLICATION IN THE FIELD

At each field site, a complete randomized block experiment was established with three replications and three main treatments; bare fallow (**Fa**l), unfertilised crop (**UC**) and fertilised crop (**FC**) and with the biochar (**BC**) addition as a split-plot treatment in all plots. Plots with main treatments measured 8m by 12m and were surrounded by a buffer strip of 0.75m or 1.0 m .

The biochar used was sourced from an artisanal charcoal maker and was produced mainly from *Acacia* spp. wood, through pyrolysis in brick kilns. The application rate was 100 Mg dry weight ha⁻¹, which was divided between two equal doses applied at the start of growing seasons SR2006 and LR2007. The biochar was spread by hand and then incorporated to around 20 cm depth using hoes.

Measured parameters

Field conditions: rainfall

Crop yield and nutritional status: 4.5m² at the centre of each subplot has been harvested and quantified for maize and soybean yield calculation

Soil analysis and interactions with biochar: soil analysis at T0, periodic soil analysis, pH, N, P, SOC, bulk density, K

Biochar dynamics and matrices: degradation of biochar, soil carbon contribution

Carbon dynamics: soil respiration

Plant-soil dynamics and interactions: carbon and nitrogen soil-plant dynamics

Key findings

1. The seasonal yield increase due to biochar application was in average around 1.2 Mg ha⁻¹ for maize and 0.4 Mg for soybean, independently of fertilisation, over seasons and sites.
2. The effect on maize and soybean yield of adding biochar to soil persisted over the whole 10-year period.
3. About 40% of biochar C was apparently lost through mineralization, erosion or vertical translocation.
4. Biochar application increased nitrogen mineralization from native soil organic matter

Planned activities or potential experimental activities

Intention to maintain the field plot active for future researches

PRESENTATION OF THE WORKING GROUP

The field trials were established and are maintained mainly supported by grants from the Swedish Research Council for Environment, Agricultural Sciences, and Spatial Planning (FORMAS), among others through [grant number 942-2015-1648].

Bibliography and publications of the experiment, online information material, websites

Kätterer, Thomas, Dries Roobroeck, Olof Andrén, Geoffrey Kimutai, Erik Karlton, Holger Kirchmann, Gert Nyberg, Bernard Vanlauwe, and Kristina Röing de Nowina. 2019. 'Biochar Addition Persistently Increased Soil Fertility and Yields in Maize-Soybean Rotations over 10 Years in Sub-Humid Regions of Kenya'. *Field Crops Research* 235 (April): 18–26. <https://doi.org/10.1016/j.fcr.2019.02.015>.

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