Can biochar improve tuber yield and soil fertility in yam systems?

Helena Ström[1], Valérie K. Hgaza[2], Johan Six[3], Emmanuel Frossard[1]

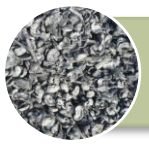
[1]Group of Plant Nutrition, ETH Zurich; [2]Département Recherche et Développement, Centre Suisse de Recherches Scientifique, Abidjan; [3]Group of Sustainable Agroecosystem , ETH Zurich

Introduction

Yam *Dioscorea* sp. is an important tuber crop for the livelihoods of many people in West Africa.

Yams are usually grown on light textured soils, generally of low fertility.

Current cultivation practices could result in decreased soil organic matter stocks and further decline of soil fertility.



The addition of biochar could be a strategy to maintain soil organic matter and soil fertility.

Biochar

- Biochar is carbonized biomass made through pyrolysis.
- Biochar can act as a long-term carbon storage in the soil due to its large proportion of aromatic carbon.
- Biochar can provide similar functions in the soil as soil organic matter and may thereby mitigate certain soil fertility constraints and increase crop productivity.

Fig. 1: Biomass (left), biochar (centre), biochar applied to field (right). Cotton gin trash (upper row); cashew nut shell (lower row).

Conclusions

- After two cropping seasons we did not observe a significant biochar-induced effect on tuber yield.
- Carbon stocks were significantly increased in most biochar treatments at both sites.
- Long-term field trials are needed to evaluate the effect of biochar on soil fertility and crop productivity over time.

Field experiment

Field experiments installed at two sites of different soil fertility levels in Côte d'Ivoire:

- Tiéningboué:
  High soil fertility
- Kouassi Kouassikro:
  Low soil fertility

Two biochars applied at 5 or 10 t ha^{-1}, as sole applications or in combination with manure or mineral fertilisers.

Results

Tuber yields

- No significant biochar-induced effect on tuber yields was observed after two years.
- Site difference in tuber yields during first year, but not during second year.
- Tuber yields of 20-25 t ha^{-1} are high compared to conventional yields. The yields of the control treatment are already high and thus the potential effect of any treatment is relatively small.

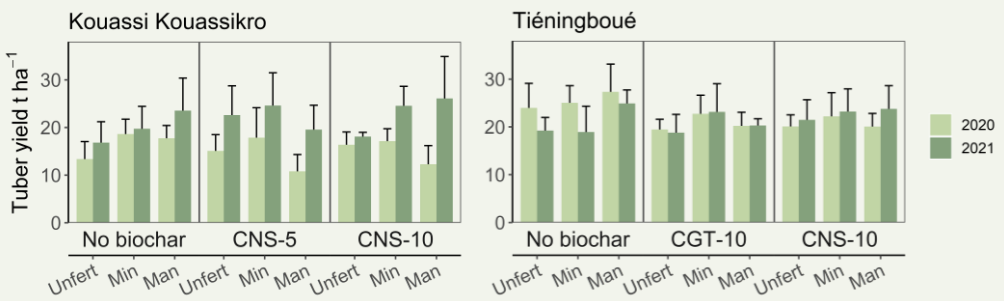


Fig. 2. Fresh tuber yield from two cropping seasons. Unfert: unfertilised control, Min: mineral fertilisers, Man: manure, CGT: cotton gin trash-derived biochar, CNS: cashew nut-derived biochar. Error bars represent standard deviations.

Soil carbon stocks

- Carbon stocks increased significantly in most treatments at both sites, however not in the treatment receiving only mineral fertilisers.

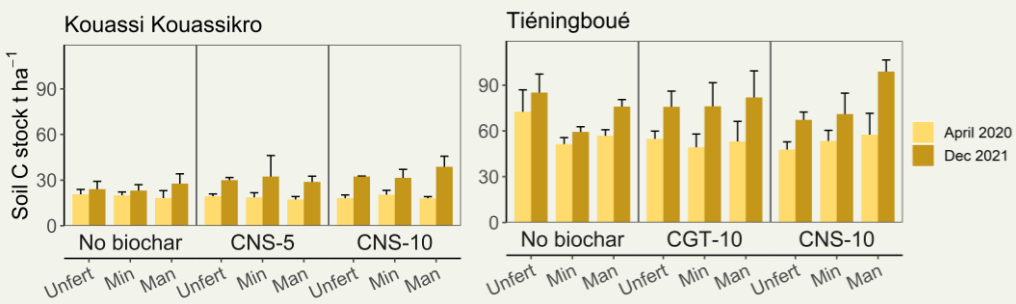


Fig. 3. Changes in carbon stock (0-30 cm) before the set up of the field experiment (April 2020) and after the second cropping season (Dec 2021). Error bars represent standard deviations.

helena.stroem@usys.ethz.ch

CSRS Centre Suisse de Recherches Scientifiques en Côte d'Ivoire

YAMSYS

مؤسسة ساويرس للتنمية الاجتماعية
Sawiris Foundation For Social Development