BIOCHAR TO MITIGATE GHGs EMISSION FROM ACIDIC SANDY LOAM SOILS OF ASSAM: ROLE OF FEEDSTOCK AND PRODUCTION TECHNIQUE

A *thesis submitted in partial fulfilment of the requirements*

for award of the degree of

Doctor of Philosophy

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April, 2023

Physicochemical properties of biochars produced from tea pruning litters and mixed wood chips using conventional (using kilns), pyrolysis, and gasification methods were investigated. Laboratory analyses were carried out to determine the influence of produced biochars on germination performance of mustard (*Brassica juncea* L., variety TS 38) and french bean (*Phaseolus vulgaris* L., variety Arka Anoop) seeds. Additionally, field studies were conducted to explore the impact of tested biochars on soil quality, crop health and emission of N_2O and CO_2 from mustard and french bean fields.

Objective 1

- Conventional method of biochar production is more efficient as it yielded highest biochar for both the tested feedstocks.
- Specific surface area, pH and adsorption capacity of the biochar are positively correlated with its production temperature. Higher value for these parameters were documented in pyrolyzed and gasified biochars than conventionally made biochars.
- Biochars produced from mixed wood chips revealed higher yield, fixed carbon content, specific surface area, calorific value, and water holding capacity compared to biochars made from tea pruning litter.
- Produced biochars can be categorized as most recalcitrant (except the conventionally prepared tea pruning litter biochar). Whereas, tea pruning litter biochar has higher nutrient content.
- Tea pruning litter biochars documented presence of four EPA enlisted PAHs against only naphthalene in mixed wood chips biochars.
- High CV and absence of sulphur in the produced biochars make them a potential source of clean energy.

Objective 2:

- Properties of the applied biochars, application dose and seed size have significant influence on germination performance of the experimented seeds with the addition of biochars.

- Germination percentage of both mustard and french bean was highest on application of tea pruning litter biochars at 10 t ha^{-1}. Whereas, increasing the application dose (20 t ha^{-1}) of same biochar decreased the germination.
- Application of biochar significantly increased the soil pH, EC, micronutrients, and SOC than control and inorganically fertilized plots.
- As a soil amendment, biochar showed positive impact on soil health, growth and yield of mustard and french bean crops as compared to farmyard manure.
- Significant positive effect on soil health and crop yield were recorded when co-application of FYM with biochar or inorganic NPK fertilizer with biochar were applied.

Objective 3:

- Statistical analysis showed positive correlation of N_2O and CO_2 flux with soil biological activities, soil available carbon and nitrogen, plant transpiration and plant fresh biomass of both the crops.
- Application of conventionally made tea pruning litter (TLC) biochar at a rate of 10 t ha^{-1} (treatment TLC10) significantly reduced (up to 45.44% in mustard and 51.96% in french bean field) soil N_2O flux compared to control.
- However, compared to control, application of inorganic NPK fertilizers at recommended dose (treatment NPKR) increased N_2O emission upto 21.31% from mustard and 12.78% of the same from french bean field.
- Application of mixed wood chips gasified biochar (WCG) at rate of 10 t ha^{-1} dose (treatment WCG10) reduced the soil CO_2 efflux upto 30.28% from mustard and 33.26% from french bean fields compared to control.
- Whereas, greater (4.12% from mustard and 5.36% from french bean field) CO_2 efflux was noted under application of FYM at 10 t ha^{-1} (treatment FYM10) as compared to control.
- Combined application of FYM and biochar or inorganic NPK fertilizer with biochar reduced emission of both the GHGs from the mustard and french bean field. This open up the likelihood of using biochar with other soil amendment and inorganic fertilizers to earn more benefits.
- Long term field studies are necessary before final recommendation.

Future prospects:

- Study on influence of biochar on germination of various crop seeds is required before it is used as soil amendment.
- Detailed study on presence of PAHs and other harmful compounds on biochars and their removal technology is important to harness its maximum benefit.
- Long-term, regional crop specific studies on application doses of biochars and their impact on soil biota is needed to screen out the sustainable dose of biochar as soil amendment.
- Study on impact of waterlogged agricultural ecosystems on the applied biochar is important for its application as agricultural soil amendment.