# Investigation of biochar and pig slurry effects on aggregate stability as an index of soil erosion using X-ray computed tomography

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## Introduction

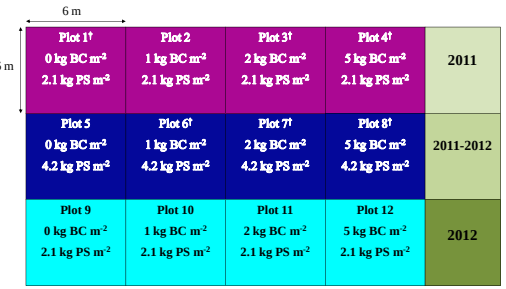
- Sustainable land use and management is one of the main challenge all over the world
- Biochar is a carbon-rich compound with high porosity produced by the pyrolysis process of biomass. Biochar application into the soil can be an approach to improve soil properties.

## Objectives

- Investigation the effects of biochar in different doses on stability, clay dispersibility and strength of soil aggregates
- Evaluation the aging effects of biochar on soil aggregates

## Materials and Methods

- **Study site:** Kalundborg, Denmark
- Experimental field with 12 plots with different applications of biochar (BC) and pig slurry (PS)
- **Measured parameters**
  - Aggregate stability
  - Clay dispersibility
  - Tensile strength (TS)
  - Specific rupture energy (SRE)
  - X-ray CT scanning of 18 selected aggregates



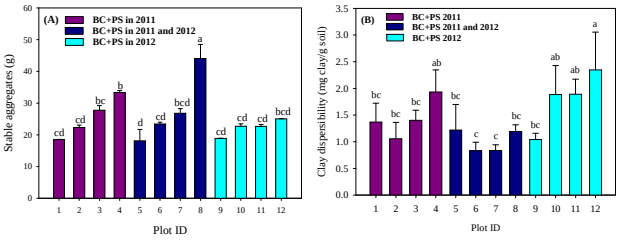

**Experimental field**

†CT scanned aggregates (3 aggregates per each selected plot)

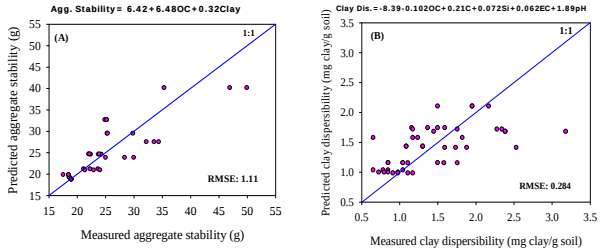
**Soil properties of studied plots**

| Plot ID | Bulk density | Clay | Silt | Sand | Organic carbon | pH | EC |
|---|---|---|---|---|---|---|---|
| - | g cm$^{-3}$ | | | % | | - | (µS/cm) |
| 1 | 1.21 | 8.0 | 22.5 | 69.5 | 1.59 | 6.48 | 43.0 |
| 2 | 1.31 | 9.4 | 24.3 | 66.3 | 1.81 | 6.63 | 40.5 |
| 3 | 1.34 | 10.0 | 25.4 | 64.6 | 2.19 | 6.70 | 45.5 |
| 4 | 1.24 | 10.9 | 26.5 | 62.5 | 2.71 | 6.33 | 44.5 |
| 5 | 1.28 | 8.6 | 22.0 | 69.4 | 1.64 | 6.56 | 48.0 |
| 6 | 1.11 | 8.7 | 22.0 | 69.2 | 2.37 | 6.69 | 47.0 |
| 7 | 1.14 | 8.4 | 23.8 | 67.7 | 3.14 | 6.57 | 45.0 |
| 8 | 1.09 | 8.9 | 22.2 | 68.9 | 4.76 | 6.83 | 47.5 |
| 9 | 1.31 | 8.6 | 23.9 | 67.6 | 1.48 | 6.68 | 52.5 |
| 10 | 1.35 | 10.0 | 26.6 | 63.5 | 1.74 | 6.73 | 43.5 |
| 11 | 1.37 | 11.3 | 27.1 | 61.5 | 2.25 | 6.98 | 48.0 |
| 12 | 1.24 | 11.0 | 26.9 | 62.1 | 3.50 | 6.72 | 44.0 |

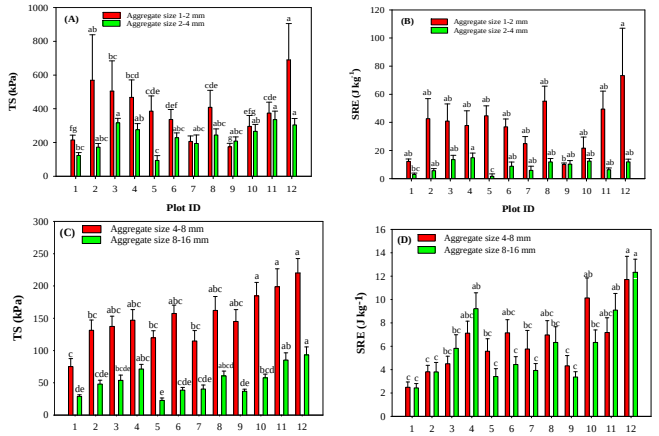
## Results

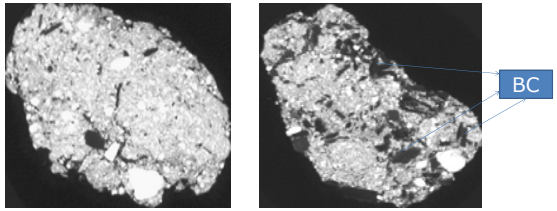



**(A) Stable aggregates and (B) Clay dispersibility of different studied plots**




**(A) Measured vs. predicted aggregate stability and (B) Measured vs. predicted clay dispersibility of different studied plots**




**X-ray CT gray images of soil aggregates (plot 3 (left) and plot 8 (right)).**

## Conclusions

- Plots having the highest application of biochar and pig slurry showed the highest aggregate stability and lowest clay dispersibility.
- The increase in biochar and pig slurry applications led to increase in TS (kPa) and SRE (J kg$^{-1}$) for large size aggregates (4-8 and 8-16 mm), whereas for small aggregates (1-2 and 2-4 mm) the effect was less pronounced.
- Based on CT scanning, the aggregates with large amount of biochar led to enhance in TS and SRE ($R^2$ = 0.6, $P < 0.001$).
- Our results indicate, that the biochar application has a positive affect on aggregates physical and mechanical properties. This can be used to improve and sustain an overall high soil quality.

### Acknowledgements

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