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Local-based circularity of biomass to improve soil quality in Estarreja: biochar as a driver

Carolina Morim, Márcia Santos, Pollyanna Mendoza, Luís Tarelho, Flávio Silva*

CESAM – Centre for Environmental and Marine Studies; DAO – Department of Environment and Planning, University of Aveiro, Portugal

Introduction

Population growth has raised the pressures in soil due to intensive agriculture and contamination from industrial activities, hence creating a need to improve its properties and quality while using sustainable and cost-effective materials [1-4]. Biochar (pyrolysed biomass) is an example that has been studied, since it can both improve the soil physicochemical properties and reduce bioavailability of contaminants. It allows increasing the soil organic matter content (SOM), pH, and water and nutrient retention, while providing wise biomass management [5-10]. Thus, the **MOSAIC** project “Application of microbial-laden biochar as a proxy for long-term sustainability of contaminated soils” has as a main goal the valorization of available biomass into biochar for adding quality to Estarreja soils.



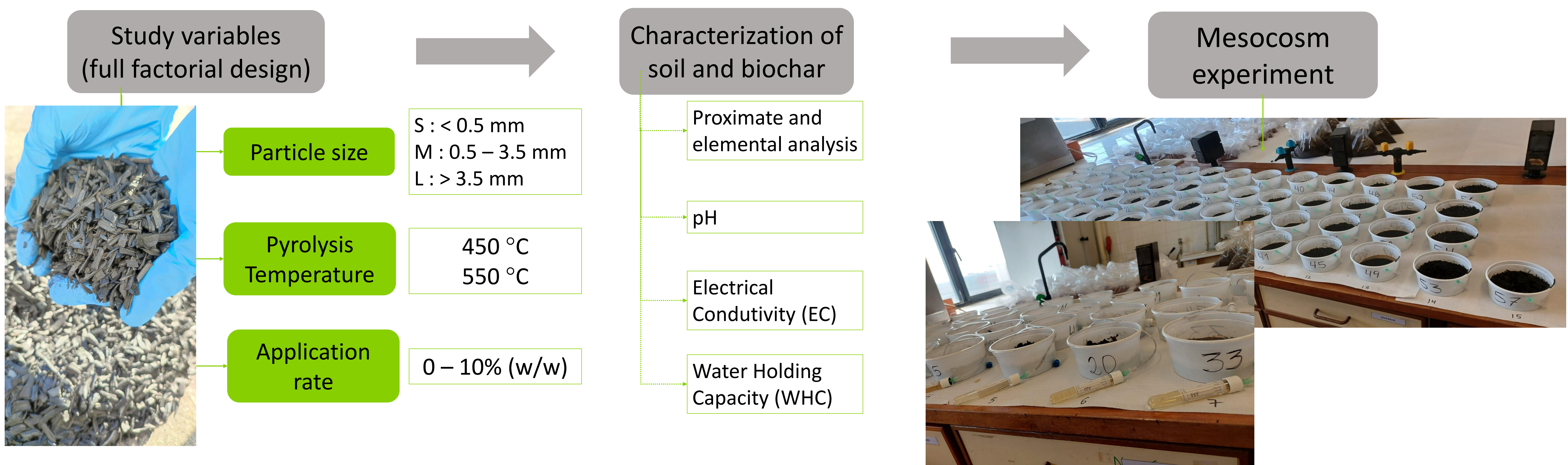
Objectives

MOSAIC project’s main purpose is the valorization of local available biomass for the bioremediation and fertilization of Estarreja soil, to promote its long-term quality.

To accomplish this goal, several objectives are being addressed in this study:

- Continuous pyrolysis of residual biomass (acacia) available in Estarreja at 450 and 550 °C in an auger reactor;
- Characterization of Estarreja soil biochemical and physicochemical properties upon addition of biochar;
- Germination and growth of plant species in the biochar-amended soil;

Approach – soil incubation experiment with biochar



Key results

- Estarreja sandy soil presented poor physicochemical properties: pH = 3.4, EC = 6.27 $\mu\text{S}/\text{cm}$, SOM = 1 %, WHC = 16 %.

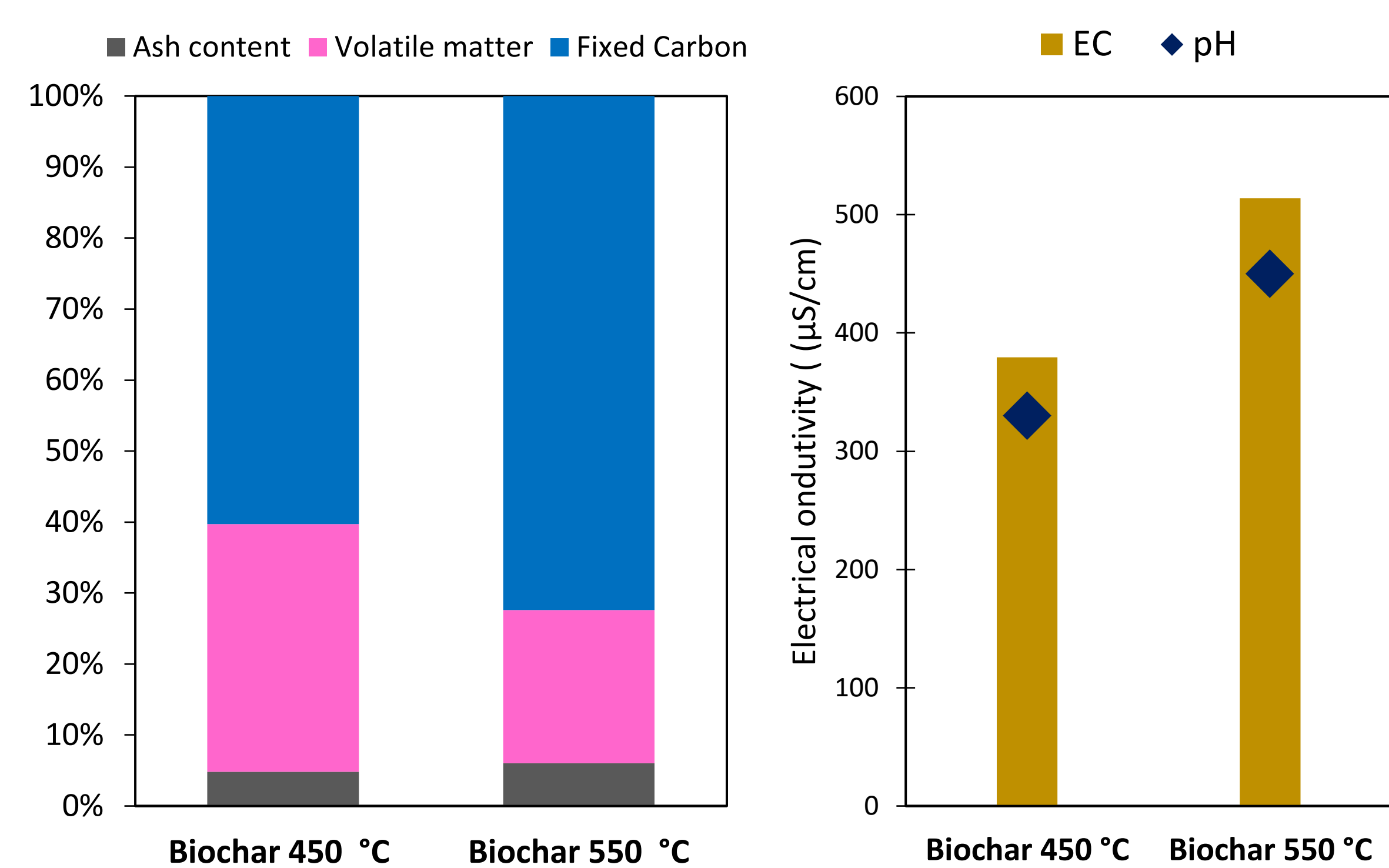


Figure 2- Proximate analysis, electrical conductivity and pH of biochar

- Biochar produced at different temperatures presented different properties. The volatiles content is higher in the lowest temperature biochar, while the fixed carbon present in biochar produced at 550 °C is higher.
- The pH of both biochars is neutral and the EC is higher than observed in soil. The EC of the biochar 550 °C is also higher than the biochar 450 °C, possible due to a higher ash content.

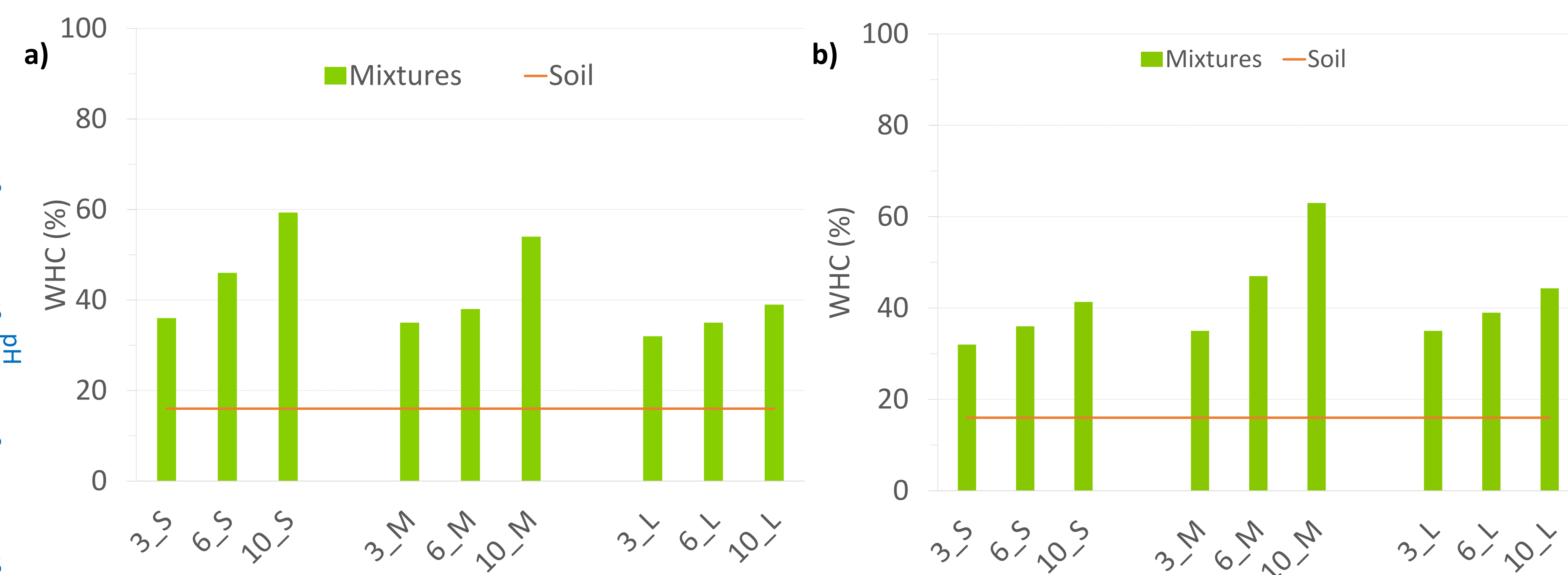


Figure 3- WHC of the soil and biochar mixtures at pyrolysis temperature (a) 450 °C, and (b) 550 °C. The application rates are represented as 3, 6 and 10 and the particle size as S, M and L.

- The WHC of the biochar-amended soil at several application rates presented a substantial increase from the value of the unamended soil up to 63 %.
- WHC is proportional to the biochar application rate, possibly due to a decrease in the bulk density of the soil, thus enhancing porosity and water retention.
- WHC decreased with the increase in the particle size, possibly explained by the inability to blend the larger particles of the biochar with the sandy soil.

Conclusions

References

The increase of the WHC of the soil with the application of biochar was substantial (at least two-fold and at most 63%) thus reinforcing the importance of biochar to retain water in soil and promote a better water use efficiency by plants. Follow-up of the pot experiment will provide further information regarding the changes in the physicochemical properties of the soil, such as the patterns of nutrient and metals retention/transfer. Follow-up includes sampling and analysis of pore water, ecotoxicological assessment, seed germination and growth, and cost-effectiveness assessment to provide information on the sustainability of biomass valorization into biochar for Estarreja soil amelioration.



* flavio.silva@ua.pt