Enhancing soil fertility and polyphenol composition in highland arabica coffee through agricultural biochar application

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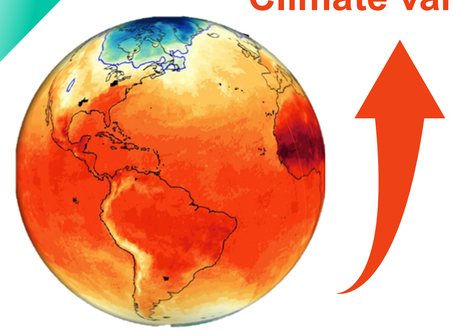
Introduction

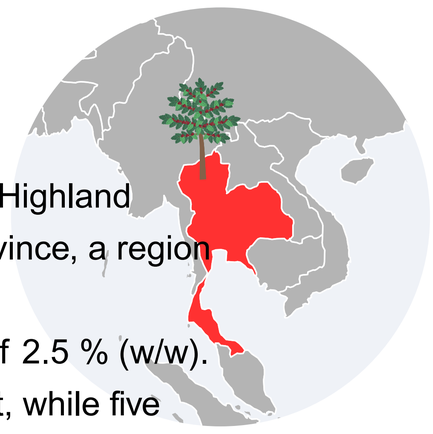


- The rising temperature limits Coffea arabica growth and yield.
- Biochar application can enhance soil water-holding capacity and nutrient retention, thereby improving plant productivity.
- However, its direct influence on the final quality attributes of coffee beans remains a critical knowledge gap requiring further academic investigation.

Objectives

- This study investigated the influence of biochar derived from highland agricultural residues on soil physicochemical properties and the polyphenolic profile of *Coffea arabica* beans during the harvest season in northern Thailand.

Methods



- The experiment was conducted at the Nong Hoi Highland Agricultural Research Station in Chiang Mai Province, a region renowned for Arabica coffee cultivation.
- Biochar was incorporated into the soil at a rate of 2.5 % (w/w).
- Five coffee plants received the biochar treatment, while five untreated plants served as controls.
- Soil, plant and coffee beans were analyzed for its properties.

Results

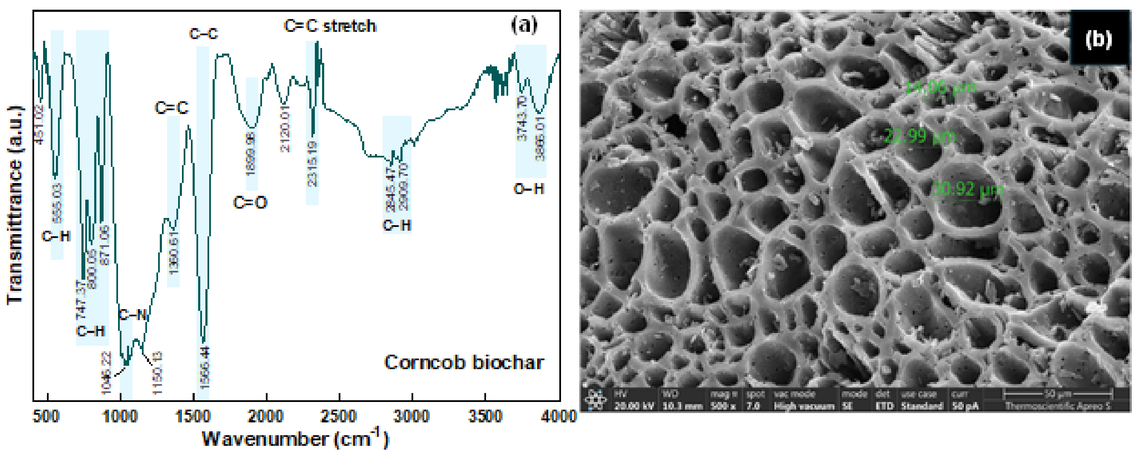


Fig. 1 FTIR spectrum of corncob biochar (a). Surface morphology and pore size analysis of corncob biochar at magnification of 500x (b).

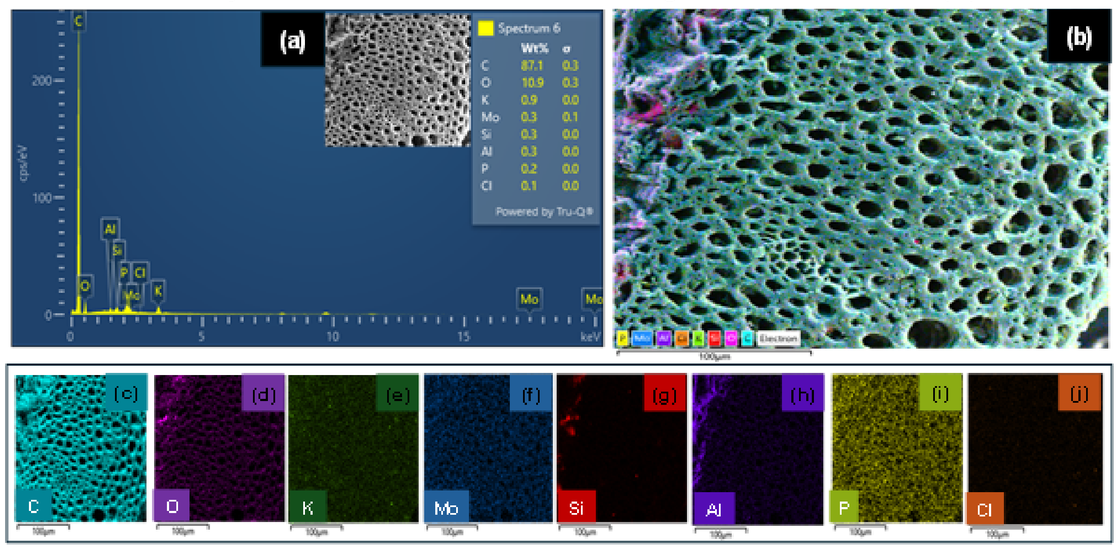


Fig. 2 The EDS spectrum of corncob biochar (a). The selected area for EDS analysis (b)

Results (Cont.)

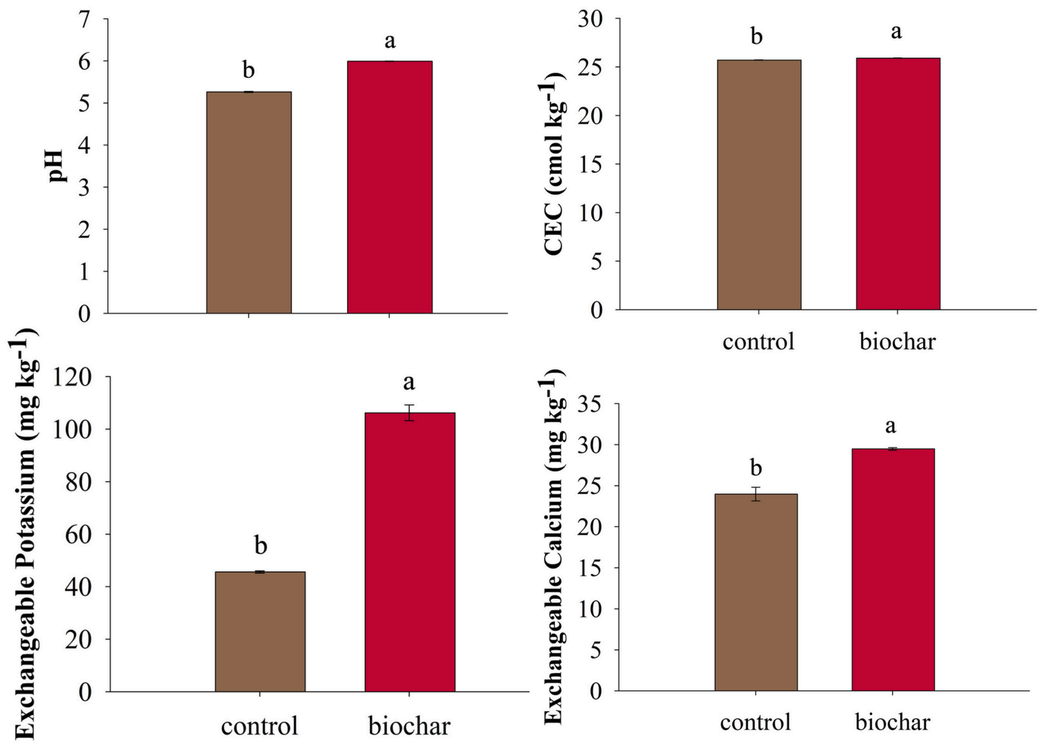
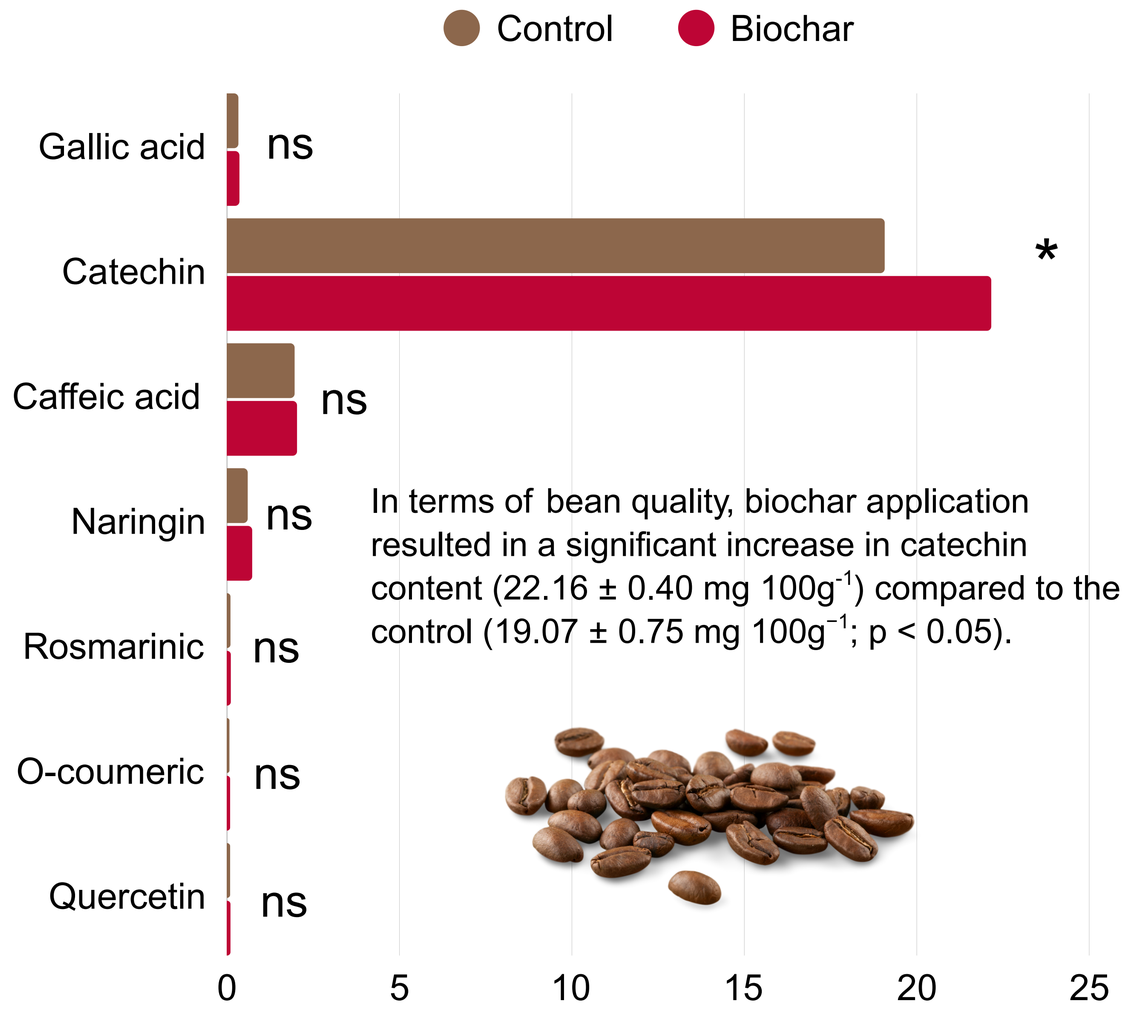


Fig. 3 The soil pH (a), CEC (b), Exchangeable Potassium (c), and Exchangeable Calcium (d) on Coffea arabica.



In terms of bean quality, biochar application resulted in a significant increase in catechin content (22.16 ± 0.40 mg $100g^{-1}$) compared to the control (19.07 ± 0.75 mg $100g^{-1}$; $p < 0.05$).

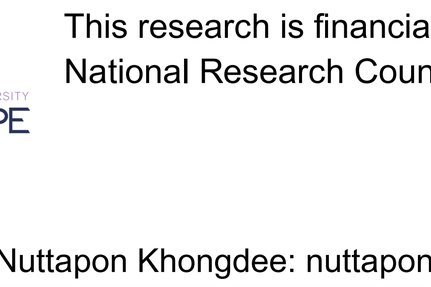


Fig. 4 Analysis of Coffea arabica beans quality (mg $100g^{-1}$)

Conclusion

The application of biochar not only enhanced soil fertility but also contributed to the improvement of health-promoting compounds in Arabica coffee beans. These findings support the use of biochar as a sustainable soil amendment for enhancing both soil health and bean quality in highland coffee production systems.

Acknowledgement

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