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Yield and Physiological Evaluation of Coffee (Coffea arabica L.) in Response to Biochar Applications

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Abstract : Colombian coffee is recognized worldwide for its mild flavor and aroma. Its cultivation generates a large amount of waste, such as fresh pulp, which leads to environmental, health, and economic problems. Obtaining biochar (BC) by pyrolysis of coffee pulp and its incorporation to the soil can be a complement to the crop mineral nutrition. The objective was to evaluate the effect of the application of BC obtained from coffee pulp on the physiology and agronomic performance of the Castillo variety coffee crop (Coffea arabica L.). The research was developed in field condition experiment, using a three-year-old commercial coffee crop, carried out in Tolima. Four doses of BC (0, 4, 8 and 16 t ha-1) and four levels of chemical fertilization (CF) (0%, 33%, 66% and 100% of the nutritional requirements) were evaluated. Three groups of variables were recorded during the experiment: i) physiological parameters such as Gas exchange, the maximum quantum yield of PSII (Fv/Fm), biomass, and water status were measured; ii) physical and chemical characteristics of the soil in a commercial coffee crop, and iii) physiochemical and sensorial parameters of roasted beans and coffee beverages. The results indicated that a positive effect was found in plants with 8 t ha-1 BC and fertilization levels of 66 and 100%. Also, a positive effect was observed in coffee trees treated with 8 t ha-1 BC and 100%. In addition, the application of 16 t ha-1 BC increased the soil pHand microbial respiration; reduced the apparent density and state of aggregation of the soil compared to 0 t ha-1 BC. Applications of 8 and 16 t ha-1 BC and 66%-100% chemical fertilization registered greater sensitivity to the aromatic compounds of roasted coffee beans in the electronic nose. Amendments of BC between 8 and 16 t ha-1 and CF between 66% and 100% increased the content of total soluble solids (TSS), reduced the pH, and increased the titratable acidity in beverages of roasted coffee beans. In conclusion, 8 t ha-1 BC of the coffee pulp can be an alternative to supplement the nutrition of coffee seedlings and trees. Applications between 8 and 16 t ha-1 BC support coffee soil management strategies and help the use of solid waste. BC as a complement to chemical fertilization showed a positive effect on the aromatic profile obtained for roasted coffee beans and cup quality attributes.

Keywords : crop yield, cup quality, mineral nutrition, pyrolysis, soil amendment
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