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Biochar to Enhance Nutrient Availability in T.cacao Systems: A Greenhouse Trial

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Abstract

The agricultural sector with its strong dependencies on natural resources is inherently vulnerable to -and affected by climate change and, at the same time affects the climate system as a considerable contributor to greenhouse gas emissions. The application of biochar-based fertilisers (BBF) in a tropical agronomic context posses the potential of mobilising native soil-nutrients, enhancing the nutrient uptake of mineral fertilisers in conjunction with high carbon sequestration. Dominating, perennial agricultural systems, such as *Theobroma cacao*, are characterised by high production potentials of underutilised biochar feedstock. Yet nexus research targeting biochar application in *T. cacao* systems is limited. In 2020 greenhouse experiments were caried out to investigate the potential of BBFs to alleviate nutrient stress and sustainably intensify system productivity. Within the framework of a pot-trial the impact of BBFs onto T.cacao seedlings, planted in an Oxisol with critically low phosphorus (P) levels (slightly acidic, high aluminium), was investigated. 16 g of milled biochar were applied per pot - representing a 2 t ha^{-1} application rate. Four different soil amendments including BBFs, were deployed at three-placement levels (i.a. topsoil- and rootzone- application). The topsoil application of mineral fertiliser, i.e. farmer practice, served as the reference point for comparisons. The rootzone application of biochar, charged with mineral fertiliser increased the aboveground biomass, total leaf area and chlorophyll content index by 56 %, 222 % and 140 % respectively. To explain this observations mechanistically, the foliar stoichiometry was analysed as a proxy for soil-nutrient availability. The seedlings having received a rootzone application of nutrient charged biochar had significantly higher level of foliar P levels (+ 53 %) compared to farmer practice. The N:P ratio of the foliar tissue was optimised indicating the potential of BBF to alleviate P availability constrains as the systems limiting factor. A strategy of large scale BBF application to tropical perennial systems can contribute to achieving a range of sustainable development goals (SDGs). In the first place, by providing more income and higher yields to farmers in conjunction with high carbon sequestration while reducing the fossil-fuel dependence on industrial fertiliser production.

Keywords: Biochar, Climate Change Mitigation, Cocoa-Agroforestry, Nutrient-Availability, Phosphorus

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