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# Impact of shade tree species and soil type on root traits in cocoa agroforestry system

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**Abstract**

Climate change is threatening agricultural systems worldwide, with tropical countries being most vulnerable to the impacts of altering precipitation and temperature patterns. In Ghana and other West African countries with over 70 % of global cocoa production, agroforestry has the potential to enhance climate resilience and crop yield stability. However, it remains difficult to determine decisive shade tree traits that affect productivity and climate resilience. In such a complex system, it is crucial to consider not only aboveground indicators but include information from belowground. Roots can provide valuable insights about a plant´s condition and its response strategies to environmental changes. This study aims to determine the extent to which shade trees and soil type influence root traits over both temporal and spatial scale. We determined whether root traits vary under a shade tree compared to those growing beyond the shade tree´s impact zone. On a smallholder cocoa farm in south-east Brong-Ahafo region, Ghana, two common shade tree species with contrasting leaf phenology were observed. *Terminalia superba* sheds and emerges leaves during the dry season while *ivorensis* sheds leaves only at the end of the dry season. This difference in timing could lead to different competition patterns and hence variable root development under those trees when water is limiting. To access root characteristics over the drought period, the CI-600 root imager was used to take scans in October 2023, December 2023 and February 2024 within the shade tree sub canopy and in full sun control plots. After analysing the images with the RootSnap software, root parameters such as average diameter and root length density will be related to hydrological soil conditions in loamy and sandy soils. Further, the question of whether *in situ* root scanning is a suitable technique for this specific research setting will be answered. By comparing the CI-600 *in situ* images to manually sampled roots, the accuracy of this time-saving method shall be quantified. Final results will provide for both a more detailed knowledge about influential shade tree parameters in a tropical agroforestry system and a first evaluation of suitability of *in situ* root imaging techniques in agroforestry systems research.

**Keywords:** Cocoa, leaf phenology, physiological traits, root parameters

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