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Accuracy and Efficiency of Root Biomass Estimation Methods in Oil Palm (*Elaeis guineensis* Jacq.) Plantations

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Abstract

Root biomass is one of the most used parameter to characterise root development and distribution within soil. However, different methods exist with regards to plant root system architecture, soil sampling volume and planting design but no standard protocol were set up for Monocotyledonous trees in an equilateral triangle planting design and comparing different ages of plantation. The purpose of this work was to identify the most efficient method to estimate root biomass for young and adult oil palm trees *in situ*. Three methods based on the sampling excavation volume were compared on the same sampled tree. Working time and manpower required for each operation were recorded. We compared two large excavation techniques based on the Voronoi tessellation procedure (full and half trench) with root auger coring method. Two industrial plantations of oil palm trees, of the same genetic material, aged 2- and 16-year old, were studied in Benin, West Africa. Oil palm root biomass was estimated to $0.84 \pm 0.03 \text{ t.ha}^{-1}$ and $22.23 \pm 0.81 \text{ t.ha}^{-1}$ for 2 and 16-year-old plantations, respectively. Even if no significant differences were found between simplified and full Voronoi trench methods for both plantations ($p > 0.05$), root biomass were slightly overestimated (+ 4.8 %) and under-estimated (- 17.1 %) by the simplified Voronoi trench, when compared to full Voronoi trench method, for 2 and 16-year-old palms, respectively. However, a significant difference between simplified Voronoi method and auger method was found ($p < 0.01$). Auger method underestimated the stock of oil palm root biomass of 2 and 16-year-old by (- 23 %) and (- 53 %), respectively. In terms of efficiency, auger method was the quickest, but underestimated twice, the amount of root biomass in adult oil palm plantation. Half and full Voronoi trench method need twice and thrice more time to perform respectively, but provided better root biomass estimates. Simplified Voronoi method is the most efficient method to estimate oil palm root biomass, especially at young age. Auger method was the least efficient at any oil palm age.

Keywords: Auger, root sampling methods, root typology, Voronoi trench