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Applicability of optical scanner method for fine root dynamics

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Fine root dynamics is one of the important components in forest carbon cycling, as ∼60 % of tree photosynthetic production can be allocated to root growth and metabolic activities. Various techniques have been developed for monitoring [U+FB01]ne root biomass, production, mortality in order to understand carbon pools and fluxes resulting from fine roots dynamics. The minirhizotron method is now a widely used technique, in which a transparent tube is inserted into the soil and researchers count an increase and decrease of roots along the tube using images taken by a minirhizotron camera or minirhizotron video camera inside the tube. This method allows us to observe root behavior directly without destruction, but has several weaknesses; e.g., the difficulty of scaling up the results to stand level because of the small observation windows. Also, most of the image analysis are performed manually, which may yield insufficient quantitative and objective data. Recently, scanner method has been proposed, which can produce much bigger-size images (A4-size) with lower cost than those of the minirhizotron methods. However, laborious and time-consuming image analysis still limits the applicability of this method. In this study, therefore, we aimed to develop a new protocol for scanner image analysis to extract root behavior in soil. We evaluated applicability of this method in two ways; 1) the impact of different observers including root-study professionals, semi- and non-professionals on the detected results of root dynamics such as abundance, growth, and decomposition, and 2) the impact of window size on the results using a random sampling basis exercise. We applied our new protocol to analyze temporal changes of root behavior from sequential scanner images derived from a Bornean tropical forests. The results detected by the six observers showed considerable concordance in temporal changes in the abundance and the growth of fine roots but less in the decomposition. We also examined potential errors due to window size in the temporal changes in abundance and growth using the detected results, suggesting high applicability of the scanner methods with wide observation windows.