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Evaluation of a core sampling scheme to characterize root length density of maize

U. Buczko (1), R.O. Kuchenbuch (1), and H.H. Gerke (2)

(1) Chair of Plant Nutrition, Institute for Land Use, University of Rostock, Justus-von-Liebig-Weg 6, D-18059 Rostock, Germany, E-mail: Uwe.Buczko@uni-rostock.de, (2) Institute for Soil Landscape Research, Leibniz-Centre for Agricultural Landscape Research (ZALF), Eberswalder Strasse 84, D-15374 Müncheberg, Germany, E-mail: hgerke@zalf.de

Information about root distribution is important for characterization and modeling of water and nutrient uptake, biomass, and yield. Due to the heterogeneous distribution of roots in row crops, the reliability and representativeness of estimates of root length and root morphology using core sampling depend on the number of samples and their location. The objectives of this study were to evaluate errors when assessing root length density (RLD) and root morphology from auger core sampling schemes, to estimate 2D distributions of RLD by auger core sampling, and to assess the number of samples necessary for representative estimates of RLD and root diameter classes.
The reference dataset utilized in this study is based on completely sampled 3D soil monoliths under maize, taken at three different dates (55, 78, and 104 days after planting) and two different row spacings (75 and 37.5 cm).
A hypothetical auger core sampling scheme with one core within the row and another midway between rows mostly overpredicted total RLD. Bias was lower when using an 1:3 weighting scheme. Estimation of 2D vertical RLD distribution by calculating the ratio of RLD in the plant row to RLD midway between rows yielded reasonable estimates only when the average of 8 cores was used. An assessment of the proportions of RD classes yielded high bias values, even when using the average of 8 cores. An analysis of sampling errors using successively more cores revealed that for total RLD, to attain a bias < 20%, more than 10 samples would be necessary. This suggests that the number of core samples taken in many root studies could be too low. This bias was even higher when taking core samples for estimation of proportions of RD classes, where a reasonably low bias between estimated and “true” values could not be attained in this study even with 10 core samples. Consequently, when taking samples for measurement of root morphological parameters, more detailed and site-adapted sampling schemes have to be devised. For estimating total averaged RLD, two core samples (within-row and midway between rows) could be sufficient when using a 1:3 weighting scheme for calculating the average RLD. When samples are taken in a more random manner and no weighting is applied, the necessary number of samples would be at least 10.