Larger field than variety effect on belowground maize biomass and root system architecture

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Over the past decade analysis of multiple field experiments has proven that belowground biomass contributes twice more than aboveground biomass to build-up and preservation of soil organic matter (SOM). Alongside, a consensus has emerged that model based predictions are particularly ill-parameterized for amount and degradability of belowground biomass. Root system architecture (RSA), the spatial organization of the root system, affects the uptake of mineral nutrient and water from the soil. Thus, RSA plays an important role in crop performance thanks to the potential to boost or stabilize yield, enhance the disease resistance and lower the need for fertilizer. However, the changes of RSA in response to soil properties are poorly understood. Our objective was to evaluate the effects of maize variety versus field (as affected by soil texture and field management history) on RSA. Three experimental fields, representative of sandy, sandy loam and clay texture were cultivated with eight commercial maize varieties according to common agricultural practice. Soil blocks ($10\times30\times30cm^3$) with the intact topsoil rooting systems were collected at harvest time. Roots were washed, sieved, weighed and further C content was measured. Root traits were quantified by 2D and 3D analysis. For 2D analysis, images of dried roots were analyzed by the software of "Root Estimator for Shovelomic Traits" (REST) to determine several root traits. X-ray µCT was used on intact soil blocks ($10\times20\times20cm^3$) to perform a detailed 3D model to capture the root-soil interface in situ. A novel segmentation procedure had to be developed to extract maize rooting systems from pre-processed CT-volumes as existing software failed to do so. First results indicate only field to impact belowground biomass, although both maize variety and field significantly affected aboveground biomass. Field also significantly determined convex hull area and depth of rooting systems assessed on 2D images, and convex hull volume, depth, total volume and root diameter distribution in the 3D model. No significant variety effect on root traits could be observed, neither in the 2D nor 3D models. Therefore, maize root biomass and RSA to some extent depend on soil type and field history and is not necessarily in line with aboveground biomass. Maize cultivar only holds an insignificant control.