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Impacts of technically modified plant pits on water balance dynamics and tree vitality in urban environments

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Trees as essential components of green urban structures are of crucial importance for the regulation of the urban climate and human wellbeing. Despite this, the currently rising demand for living space and infrastructure causes an increase in the share of sealed and compacted soils. These trends directly affect soil-plant interactions in urban environments. The synergy of the increasing land use pressure and changing climatic conditions worsen the site and growth conditions and thus the vitality for young and mature trees. A possible adaptation strategy is the transformation of plant pits into water reservoirs combining the discharge of excess water with impermeable sole materials and substrates that optimise the water conductivity and storage capacity. The corresponding aim of this study is the quantification of the effects of the water balance dynamic in the rooting zone on the vitality of young trees at highly sealed sites in the city of Hamburg. The two main questions are 1) Do technically modified plant pits reduce summerly drought stress inside the rooting zone and thus improve the root water uptake and tree vitality?, and 2) Does excess water after high rainfall limit the gas exchange and thus the root growth? To answer these questions, we selected two different sites, one residential area and one pedestrian zone, which differ regarding the type of excess water discharge. Overall, two technically modified plant pit variants will be compared with generally constructed variants. Each site will be characterized by soil physical and chemical parameters. Additionally, each plant pit is equipped with TDR- and water tension probes for a continuous monitoring of the soil water balance and O_2 as well as CO_2 probes for monitoring the gas household. Rhizotrones and dendrometers in combination with Δ13C isotope analysis and stomatal resistance will help to investigate the tree vitality. The data will be used for modelling local water balance dynamics under expected climatic scenarios and for evaluating the different plant pit variants. Development as well as dimensioning recommendations for prospective plant pit constructions, improving the soil-plant interaction, will be derived.