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Comparing root architecture efficiency for root water uptake with a 3-D water flow model

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Root architecture at a given time reflects the past interactions between the plant and its environment. In this study we compare the ability of plants with two contrasted root architecture to sustain water stress. Two realistic root structures with comparable density profiles but contrasted branching rules were generated with Roottyp. We used R-SWMS to predict the evolution of soil water uptake profiles, the xylem water potential time series, and the time for stress of the two systems. This model estimates the 3-D soil water flux distribution between soil and root xylem systems based on the water potential gradients. Root growth was based on the distribution of the soil water strength affected by the water content. The same boundary and initial conditions were imposed for root and soil systems. Different scenarios for the distribution of the root and soil hydraulic properties were used for the comparison. Scenarios with one and multiple plants were also compared to take into account interactions between plants. It is observed that optimal root architecture can be found to sustain water scarcity for long term depending on the distribution of the water input to the system.