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New methods of measuring and modeling biomass partitioning in winter wheat under field conditions.

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Partitioning of biomass between roots and the above ground organs of crops is a key plant physiological processes that is closely linked to root growth and, thus, water and nutrient uptake. This makes investigations and knowledge about the partitioning of carbon between below and above ground plant organs important for accurately simulating water and carbon fluxes from croplands. Previous experiments have shown that carbon partitioning between root and shoot of crops could be altered by drought. However, most crop models do not explicitly consider the alteration of carbon partitioning caused by drought. This might partly be due to the difficulties in measuring the complete root biomass under field conditions and, thus, a lack of data on the field scale. Current methodologies such as soil coring and shovelomics are time-consuming and limited with regards to the measured depth, they do not necessarily capture the whole root biomass of deep rooting winter crops like winter wheat.

The overall aim of the study is to improve our understanding of responses of below and above ground growth processes to different soil water availability. A field experiment has been conducted to investigate how drought stress affects the root: shoot ratio of different winter wheat cultivars under field conditions. A carbon partitioning subroutine, based on the sink strength principle and considering the direct effects of drought stress on carbon allocation, is implemented in the crop model SIMPLACE<LintulCC2>. The experimental data was used to test whether this newly developed model could successfully represent the effects of drought stress on biomass partitioning for different wheat cultivars.

In the experiment, tubes with a diameter of 11 cm and a length of 1 m, filled with a sandy substrate and closed on the bottom with a fine mesh fleece that allows water to flow through but stops roots from growing through, were buried in 1m deep holes. Winter wheat was sown inside the tubes and the field around them to catch the whole plant biomass under canopy conditions. Half of the tubes were watered during the growth period, the other half were sheltered from rain during early growth stages. Root biomass and traits were investigated after harvesting the tubes. The data from this experiment was used to calibrate the carbon partitioning subroutine in the crop model under non-stressed and water-stressed conditions. The carbon partitioning subroutine calculates organ-specific potential daily growth rates. These growth rates are used to calculate the

organ-specific sink strength, which can be affected by water stress and is used to define the amount of carbon distributed to each organ per day.

The first experimental results show that water stress did affect the carbon partitioning between root and shoot biomass of winter wheat. The implemented model improved the simulation of biomass partitioning between root and above ground plant organs under drought conditions.