No shift to a deeper water uptake depth in response to summer drought of two lowland and sub-alpine CČ-grasslands in Switzerland

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Temperate C3-grasslands are of high agricultural and ecological importance in Central Europe. Plant growth and consequently grassland yields depend strongly on water supply during the growing season, which is projected to change in the future. We therefore investigated the effect of summer drought on the water uptake of an intensively managed lowland and an extensively managed sub-alpine grassland in Switzerland. Summer drought was simulated by using transparent shelters. Standing above- and belowground biomass was sampled during three growing seasons. Soil and plant xylem waters were analyzed for oxygen (and hydrogen) stable isotope ratios, and the depths of plant water uptake were estimated by two different approaches: (1) linear interpolation method and (2) Bayesian calibrated mixing model. Relative to the control, aboveground biomass was reduced under drought conditions. In contrast to our expectations, lowland grassland plants subjected to summer drought were more likely (43-68%) to rely on water in the topsoil (0-10 cm), whereas control plants relied less on the topsoil (4-37%) and shifted to deeper soil layers (20-35 cm) during the drought period (29-48%). Sub-alpine grassland plants did not differ significantly in uptake depth between drought and control plots during the drought period. Both approaches yielded similar results and showed that the drought treatment in the two grasslands did not induce a shift to deeper uptake depths, but rather continued or shifted water uptake to even more shallower soil depths. These findings illustrate the importance of shallow soil depths for plant performance under drought conditions.

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