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Summer drought alters dynamics of carbon allocation to roots and root respiration in mountain grassland

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Meteorological extreme events like summer droughts are expected to occur more frequently in a future climate and exert a major impact on the carbon (C) balance of terrestrial ecosystems. Drought impairs the activity of C source (photosynthesis) and sinks (growth, respiration, storage) as well as C partitioning between aboveground and belowground plant organs. To date, little is known about effects of drought on the allocation dynamics of recently assimilated C in intact ecosystems. Combining experimental rain exclusion with $13CO_2$ pulse labelling in a mountain meadow in the Austrian Central Alps, we investigated how summer drought impacts the translocation of fresh photosynthates to roots and the partitioning of this C input among root carbohydrate pools and respiration. Severe soil drying slowed down and decreased the amount of recent C allocated to the root system by ca. 50%, reflecting similar reductions in C uptake. However, interestingly, the proportion of 13C translocated belowground (relative to the amount of 13C assimilated by the plants) increased under drought, reflecting a change in C allocation patterns. Overall, relatively more C was allocated to root starch and to osmotically active compounds (sugars), whose concentrations were doubled under drought. In contrast, drought reduced the proportional allocation of recent assimilates to root respiration, whose rates were diminished by ca. 26%. These results suggest that while summer drought reduced the supply of recently assimilated C to roots, it increased its proportional allocation to osmotically active sugars and to storage while decreasing its allocation to root respiration.