Reduced plant water use can explain higher soil moisture in organic compared to conventional farming systems

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Conventional high-input farming systems in Europe are often regarded as unsustainable with severe environmental impacts on biodiversity, soils, water and climate. Low-input farming approaches, such as organic farming, have been proposed to reduce environmental impacts while further improving soil properties such as soil organic matter content and aggregate stability. Whether these changes also influence ecohydrological properties and improve the water relations of organically grown crops remains unclear. In this study we assessed the long-term effects of conventional and organic farming systems on the water relations of soils and crops in the ”DOK” (bioDynamic, bio-Organic & ’Konventionell’ = conventional) trial. In particular, we tested if organic and conventional farming lead to marked differences in soil moisture, soil water evaporation, as well as root water uptake depth and stomatal conductance of winter wheat and soybean during the growing seasons 2017 and 2018. Stable isotope analyses and ecophysiological measurements revealed that organic compared to conventional farming did not affect soil water evaporation or root water uptake depths. Instead, we found higher soil moisture in the rooting zone and reduced stomatal conductance (gs) in organically grown wheat. Treatment effects on soil moisture and gs of soybean were smaller but showed similar tendencies as observed in wheat. Also, leaf area, and grain and straw yield of wheat decreased under organic farming while yields of soybean were not affected by the treatments. Based on our data we suggest that reduced plant water use observed under organically managed farming lead to the observed higher soil moisture in organically compared to conventionally managed farming systems in the DOK trial. These results suggest advantages of organic farming regarding agronomic water use as well as for the resistance of farming systems to current or future drought scenarios.

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