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At the interface between atmosphere and deep sub-soil, the root zone plays a major role in regulating the flow of water between major compartments: groundwater / surface / atmosphere (drainage, runoff, evapotranspiration). This role of soil as regulator/control of water fluxes, but also as a supporting medium to plant growth, is strongly dependent on the hydric properties of the soil. In turn, the plant roots growing in the soil can change its structure; both in the plow layer and in the deeper horizons and, therefore, could change the soil properties, particularly hydric properties. Such root-related alteration of soil properties can be linked to direct effect of roots such as soil perforation during growth, aggregation of soil particles or indirect effects such as the release of exudates by roots that could modify the properties of water or of soil particles. On an another hand, the rhizosphere, the zone around roots influenced by the activity of root and associated microorganisms, could have a high influence on hydric properties, particularly the water retention.

To test if crops and plant roots rhizosphere may have a significant effect on water retention, we conducted various experiment from laboratory to field scales. In the lab, we tested different soil and species for rhizospheric effect on soil water retention. Variation in available water content (AWC) between bulk and rhizospheric soil varied from non-significant to a significant increase (to about 16% increase) depending on plant species and soil type. In the field, the alteration of water retention by root systems was tested in different pedological settings for a Maize crop inoculated or not with the bacteria Azospirillum spp., known to alter root structure, growth and morphology. Again, a range of variation in AWC was evidenced, with significant increase (∼30%) in some soil types, but more linked to innoculated/non-innoculated plants rather than to a difference between rhizospheric and bulk soil. Finally, in field condition, on a larger time scale, we investigated the effect of crop alternations on the Lusignan ACBB SOERE site. That site presents on the same soil type different crop alternation treatments: an old, continuous grassland, a 8-year continuous cereal rotation and an alternation of cereal/grassland (3-years cereals and 3 to 6 years grassland). Measurements of AWC in these different crop systems setting, 8 years after implementation of the SOERE, show that AWC was different in the cereal/grassland alternation compared to the continuous cereal or grassland cropping systems (∼15-20% increase). If such alteration of AWC may seem modest, modeling (in the case of ACBB SOERE) shows that this increase in AWC would increase the cereal yield but also decrease the water drainage out of the root zone, and the possible associated loss of nitrate and pesticides. As a conclusion, in line with some other literature data, roots can influence soil hydric properties and this opens a way to use plants as “soil engineers” to modulate the properties of the root zone, and thus the components of water balance, to mitigate effects of drought on crops… However, how and how much plants will modify the hydric properties, a question which mixes physics, biology, microbiology, crop system settings, is still in infancy and needs further research.