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Water for Carbon, Carbon for Water

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Plant roots exude approximately 10% of the carbon assimilated through photosynthesis into the soil, a process referred to as rhizodeposition. Although this may look like a waste of energy, it has been shown that the carbon exuded into the soil helps roots to take up nutrients and promote positive interactions with microorganisms.

Here, we show that the mucilaginous fraction of the rhizodeposits, referred to as mucilage, plays also a crucial role on soil-plant water relations and triggers positive feedbacks between the water and carbon cycles. Mucilage is a gel that can absorb large volumes of water, altering the physical properties of the rhizosphere and maintaining the rhizosphere wet and conductive when the soil dries. Acting as a hydraulic bridge between roots and the soil, mucilage facilitates root water uptake and maintains transpiration and photosynthesis in dry soils.

By employing a simplified model of root water uptake coupled with mucilage dynamics, we found that indeed the carbon exuded in form of mucilage maintains photosynthesis in dry soils resulting a in a net gain of carbon.

In summary, by exuding mucilage, plants modify the physical soil environment, have a better access to water when water is scarce, and maintain photosynthesis for a prolonged time during drought. We propose that mucilage exudation is a plant trait conferring drought resistance. In other words: water for carbon, but also carbon for water.