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Simultaneous decay of contact-angle and surface-tension during the rehydration of air-dried root mucilage

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Plants can extract or exude water and solutes at their root surface. Among the root exudates, the mucilage exhibits a surfactant like properties - depressing the surface-tension (ST, mN/m) at the water-air interface. The amphipathic nature of some of the mucilage molecules (e.g. lipids) is thought to be the reason for its surfactant like behavior. As the rhizosphere dries out, re-orientation and/or re-configuration of amphipathic molecules at the solid-air interface, may impart hydrophobic nature to the rhizosphere. Our current knowledge on the ST of natural and/or model root mucilage is based on measurements of the equilibrium ST. However, adsorption of amphipathic molecules at the water-air interface is not reached instantaneously. The hydrophobic nature of the rhizosphere was deduced from the initial advancing CA, commonly calculated from the first few milliseconds up to few seconds (depending on the method employed). We hypothesized that during the rehydration of the root mucilage; both quantities are dynamic. Processes such as water absorbance and dissolution, may vary the interfacial tensions as a function of time. Consequently, simultaneous reduction of both CA and ST as a function of time can be expected. The main objective of this study was to characterize and quantify the extent, persistency and dynamic of the CA and ST during rehydration of air-dried root mucilage. The study was involved with measurements of dynamic and equilibrium ST using the pedant drop or Wilhelmy plate method, respectively. Glass slides were coated with naturally occurring or model root mucilage and the CA of a sessile drop was measured optically, as a function of time. The results were analyzed based on the Young–Dupré and Young-Laplace equations, from which the simultaneous decay of CA and ST was deduced. The implication for the wettability and water flow in the rhizosphere will be discussed.