Predicting hydrological affinities of herbaceous species from their functional traits – Linking physiological and morpho-anatomical traits

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Abstract

Soil water availability is an important mechanism filtering plant species. Since the functional basis of this filtering in herbaceous dicots is poorly studied, we investigated the relationship between physiological "hard" traits, morpho-anatomical "soft" traits and the ability to predict species' habitat affinities of 25 herbaceous dicots related to a gradient of water availability. We conducted a drought experiment in controlled conditions, for which the field distributions of these species span a gradient of soil moisture from wetlands to dry soils. We measured a large set of physiological "hard" traits of drought tolerance on stressed plants and a large set of morpho-anatomical "soft" traits on well-watered plants. We built a mechanistic model that allowed us to predict species habitat affinities to soil wetness based on physiological "hard" traits of drought tolerance measured on stress plants (R2 = 0.62). We also found that we could predict those "hard" traits using morpho-anatomical "soft" traits. The strength of the predictions are much more robust when using an indirect path (from "soft" traits to "hard" traits to habitat) than using a direct path (from "soft" traits to habitat without using "hard" traits). This study is a first step in investigating the abiotic component of environmental filtering of species and functional traits.

Keywords: species distribution, habitat affinities, drought, water stress, leaf wilting, leaf water potential, leaf dry matter content, photosynthesis, stomatal conductance, stomatal area, root/leaf mass ratio

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