"Impacts of soil conductivity loss on plant transpiration regulation under drought"

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ABSTRACT

Between 60 and 90% of terrestrial precipitations go back to the atmosphere through plant transpiration stream and this huge flux is controlled by plant stomata. Yet, stomatal functioning is not fully understood and there is no consensus on a universal model for stomatal regulation. Recent studies have hypothesized that there is an intimate relationship between the hydraulics of the soil-plant continuum and the stomatal response to drought. It has been shown in silico that it is the drop in rhizosphere hydraulic conductance that is the main driver of leaf water potential decrease that leads to stomatal closure to protect the plant against cavitation. The soil conductance would be one of the first factors limiting the transfer of water to the plant under conditions of water deficit. On the other hand, physiologists have demonstrated that the stomatal regulation could differ between plant species and genotypes due to different sensitivities of stomata to chemical or hydraulic signals and have classified plant stomatal regulation into iso- or anisohydric regulation classes. In this project, we hypothesize that the degree of anisohydricity will be a function of the environment. The objective of this research is to elucidate the impact of soil hydraulics on plant transpiration regulation under drought. Two main experiments will be conducted on two genotypes of Zea mays L. with contrasted stomatal behavior. First, we will use small pressure ecotron to characterize the relationship between leaf potential, soil potential and transpiration from different combinations of vapor press...

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The objective of this research is to elucidate the impact of soil hydraulics on plant transpiration regulation under drought. Two main experiments will be conducted on two genotypes of Zea mays L. with contrasted stomatal behavior. First, we will use small pressure ecotron to characterize the relationship between leaf potential, soil potential and transpiration from different combinations of vapor pressure deficit and soil hydric status (without any stomatal control). Then, we will perform a series of pot experiments with similar combinations of VPD and soil conditions to characterize the stomatal control and link it with the shape of the soil-plant conductance obtained from pressure ecotron. Finally, we will aim to validate our hypothesis that the degree of iso/anisohydricity is a function of the environment. The second experiment will be performed in a rhizotron in order to decipher how soil water potential spatial distribution will affect the stomatal regulation under drought. The last step will consist in comparing the collected data to ones obtained from larger scales and/or modelling approaches. A first experiment with sunflower (i.e. an anisohydric plant) already showed that transpiration regulation is influenced by the substrate. It also questions the anisohydricity of the sunflower as the observed stomatal behavior was dependent on the environmental conditions.