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Belowground hydraulic resistance generates stomatal closure of grapevine in soil water-limited conditions

Louis Delval[1], François Jonard[2], and Mathieu Javaux[1]
[1]Earth & Life Institute, Université catholique de Louvain, Louvain-la-Neuve, Belgium (louis.delval@uclouvain.be)
[2]Earth Observation and Ecosystem Modelling Laboratory, ULiège, Liège, Belgium

Climate change will exacerbate drought events in many regions, increasing the demand on freshwater resources and creating major challenges for viticulture. In viticulture, the terroir governs the hydraulic behavior of the vine. The terroir is defined as the interactions between climate, soil, plant material (vine and rootstock varieties) and human management practices. The knowledge on grapevine drought stress physiology has increased significantly in recent years, but a holistic comprehension on how soil-plant hydraulic resistances develop and are regulated remains poorly understood. In particular, how different soil-rootstock combinations and their plasticity affect the vine hydraulic condition is still an open question.

The objective of this study is to understand the hydraulics of the soil-plant system in grapevines (*Vitis vinifera* cv. Chardonnay) *in situ*, for different soil-rootstock combinations in a temperate oceanic climate, and to investigate its influence on vine water status.

The concomitant and automatic monitoring of soil and collar water potentials, as well as sap flow, made it possible to characterize the evolution of the soil-vine hydraulics *in situ* in real-time, with hourly measurements for two months. In order to investigate the impact of the soil-rootstock combination, two Belgian vineyards with the same variety (cv. Chardonnay) were selected due to their intra-field heterogeneity of soil physico-chemical properties (two study areas per vineyard). The vines of the first vineyard are grafted on the rootstock 3309C and planted on sandy or loamy soils. Those of the second vineyard are associated to the rootstock 101-14Mgt and grow on loamy or silty-clay soils. In each vineyard the soil is therefore the only variable factor, for which hydraulic properties were measured to a depth of 2 m.

The measurements were collected between mid-July and mid-September, during a period of exceptional drought in Belgium leading to soil water-limited conditions (rainfall anomaly of -153,8 mm and -148,4 mm in the first and second vineyard respectively over this period). The mean soil-plant conductances observed over the season were respectively 0,54.10^{-5} cm.s^{-1}.MPa^{-1} and

$2{,}18.10^{-5}$ $cm.s^{-1}.MPa^{-1}$ in the sandy and loamy areas of the first vineyard, and $1{,}79.10^{-5}$ $cm.s^{-1}.MPa^{-1}$ and $2{,}97.10^{-5}$ $cm.s^{-1}.MPa^{-1}$ in the silty-clay and loamy areas of the second vineyard. Despite this extreme drought, the minimum observed stem water potential (Ψ_{stem}) was -1,47 MPa (sandy study area of the first vineyard). This is in line with other studies that have shown *in situ* vines typically work within a safe range of water potentials (Ψ_{stem} > -1,5 MPa) that do not lead to cavitation or turgor loss. These first observations validate the hypothesis that the increase of belowground hydraulic resistance triggers stomatal closure of vine.