RESPONSE OF DIFFERENT GRAPEVINE CULTIVARS TO WATER STRESS USING A HYDROSCAPE APPROACH

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Abstract:

Context and purpose of the study – Viticulture worldwide is currently affected by the effects of climate change. This set of adverse phenomena lead to a deterioration of functional vine mechanisms, affecting growth, physiology and grape ripening, which may cause severe losses with respect to yield and quality. To prevent water stress and other abiotic factors from severely affecting its physiology, the vine's response is to reduce transpiration and photosynthesis rates. This response varies depending on the cultivar and its ability to adapt to the environment. The hydroscape method is based on the internal regulation of water status in the plant. It has been recently used to classify grapevine genotypes according to their iso/anisohydric behavior when they are subjected to water stress conditions. The present study was aimed to classify different grapevine genotypes according to their behaviour under drought stress using a hydroscape approach.

Material and methods – The study was conducted from 2020 to 2022 in a multivarietal vineyard. Eight cultivars were selected: Albilla Dorada, Bobal, Macabeo, Mizancho, Moscatel Serrano, Riesling, Tinto Fragoso, and Tinto Velasco. Predawn leaf water potential (Ψ_{pd}) and stem water potential (Ψ_{stem}) were monitored during the summer season. Stomatal conductance, net assimilation and transpiration measurements were recorded. Using measurements of water potentials, hydroscape area and six metrics related with iso/anisohydric behavior were calculated.

Results – In all cultivars the stress slope was lower than the non-stress slope meaning that when water stress increased, they became more isohydric. Macabeo (1.33) and Albilla Dorada (0.41) exhibited the steepest and least non-stress slope, respectively, whereas for stress slope were Tinto Fragoso (0.42) and Albilla Dorada y Riesling (both 0.02). The largest hydroscape areas were recorded for cultivars Tinto Velasco and Tinto Fragoso (1.26 MPa^2 and 1.25 MPa^2, respectively). Conversely, Albilla Dorada showed the smallest area (0.95 MPa^2), which agrees with a severe control over its stomatal conductance (σ = – 0.57) and thus it can be considered as a cultivar with isohydric behavior. Under non-limiting water availability, the lowest Ψ_{stem} value was recorded for Tinto Velasco (– 1.23 MPa) and the highest for Bobal (– 0.67 MPa). Regarding the Ψ_{pd} at which the transition point is reached, the extreme values were for the varieties Mizancho and Tinto Fragoso (Ψ_{pd} = – 0.82 MPa and – 0.39 MPa, respectively). There were also differences in the range of Ψ_{pd} at which the cultivars are able to extract soil water. Albilla Dorada works in a small range (– 1.46 MPa < Ψ_{pd} < 0 MPa) whereas Tinto Fragoso and Mizancho operate in a higher range (– 2.1 MPa < Ψ_{pd} < 0 MPa).

Keywords: Grapevine, Hydroscape, Stomatal conductance, Transpiration, Water potential, Water use efficiency.