Irrigazione e stress idrici I

Monitoring water stress in grapevine: a multiple index approach

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Grapevine first strategy to prevent the negative effects of water limitation is the reduction of the leaf transpiration. A precise monitoring of the changes in the transpiration rate of grapevine exposed to drought is needed for the application of any strategy of controlled deficit irrigation. Despite the available literature on grapevine and drought stress, comprehensive studies considering simultaneous measurements of different physiological indexes at different level of water stress intensity and different time of the day are scarce. We aimed to investigate the onset and the development of water stress in grapevine by integrating the information provided by different physiological indicators. Under a glass roof shelter, the experiment was performed on potted vines, exposed to 2 progressive drought cycles (C1, C2) of 10 days each. Irrigation was presumed when a threshold value of midday stem water potential (mSWP) was reached (-1.5 MPa). Vines were hung on a suspended weighting lysimeter structure equipped with individual load cells (LC). Sap Flow (SF) sensors were installed in each vine's trunk to monitor transpiration. The results showed a synchronization of SF and LC indications to describe the gradual reduction of transpiration under progressive water deficit. Drought effect became evident when SF showed lower flows in diurnal courses from the 7th day of each cycle (> 75% of reduction). The transpiration losses correlate to the mSWP, which agrees with the transpiration trend. The occurrence of stress followed by drastic transpiration reduction was detected when mSWP reached -0.8 MPa. Drought led to leaf gas exchange decreases throughout both cycles with significant rate reductions during C2, mainly when measured in the morning and at midday. Chlorophyll fluorescence parameters response presented sensibility to PAR light incidence. The light curve parameters were fitted with non-linear models, the coefficients and p-values were statistically analyzed. The electron transfer rate (ETR) and the effective PSII quantum yield (Y(II)) were fitted with a logarithmic model, the coefficient of photochemical quenching (qP) with the exponential decay model, and the coefficient of nonphotochemical quenching (qN) with the 2-parameters-Michaelis-Menten equation. The obtained coefficients showed significant differences for qP (C1) and qN (C1 and C2). Under the current experimental conditions, results show that qN and qP are potentially responsive to early water stress (mSWP>-0.8 MPa). In conclusion, this study suggests the chlorophyll fluorescence light curve (qP and qN) as a potential for early detection of water stress in grapevine.

Keywords: sap flow, drought, early stress detection, chlorophyll fluorescence light curve, leaf gas exchange.