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Development of a semi-controlled setup for manipulating drought and heat stress in open field trials

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Abstract

Drought and heat stress will pose challenges for the future of viticulture and wine quality, as grapevine biological processes are pushed beyond their optimum conditions. Efforts are increasing to study and predict the effects of drought spells and heatwaves on grapevine physiology and resulting harvest quality. This calls for the development of adequate systems to induce and manipulate the required stress, especially in open field trials where conditions are more difficult to control. We present a semi-controlled system for studying drought and heat stress in grapevine in the field. The system uses automatic weighing mini-lysimeters to record whole-plant evapotranspiration throughout the growing season and manage deficit irrigation programs for drought trials, as well as infrared lamps to heat the cluster zone above ambient temperature. Drought stress was imposed at 25% soil field capacity for 9 days, during which a heat stress of 5 days was induced with infrared lamps set to 800W at 30cm from the fruiting cane. Grapevine ecophysiology was monitored throughout the experimental period. The system successfully allowed us to control grapevine evapotranspiration, lowering both leaf stomatal conductance (g_{sw}) and midday stem water potential (Ψ_{stem}), as well as increase berry surface temperatures, with a mean increment of 3.6°C. These results provided insight into the efficacy of the system in imposing stress in the field, as well as into possible further improvements for the setup, taking into consideration the constraints of the system as well as undesired effects of changing weather during the experiment.

Keywords: abiotic stress, climate change, heatwaves, phenotyping, method development.