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Short talk

Genetic architecture of water use efficiency in grapevine: a key role for night transpiration

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Improving water use efficiency (WUE, the balance between biomass production and water costs) in crops becomes crucial to match increasing needs for food in a context of global change. Reduction of water loss at night could be a good strategy to limit waste of water without altering photosynthesis rate in the daytime. However, genetic and physiological bases of night transpiration and its contribution to WUE remain poorly documented. This study first aimed at deciphering the genetic determinants of WUE in grapevine, a woody crop of economic importance in drought prone areas. It further explored a possible role for night transpiration in WUE variability. A four-year experiment was run on a F1 progeny from a cross between Shiraz and Grenache. A greenhouse phenotyping facility (PhenoArch, Montpellier) was used to dissect determinants of WUE in potted plants and results were compared to those obtained in vineyard conditions under two soil water regimes. In PhenoArch, a high genetic variability was found and QTLs were detected for whole plant WUE under both watering regimes. Interestingly, these QTLs co-localized with those found for proxys of WUE ($\Delta 13C$ in musts) measured in the field, highlighting the promising avenues offered by phenotyping facilities. Furthermore, a genetic control of water losses at night was detected and supported for the first time by QTL detection. Night transpiration could reach 30% of daytime one depending on genotype and conditions. Furthermore, we found common QTLs to WUE and night transpiration. This, together with significant negative correlations between both traits, strongly suggested that lower WUE relies, at least partly, on higher water losses at night. Through further physiological characterization of the determinants of night transpiration, we showed that both residual stomatal aperture and cuticle losses are genetically controlled. These results open new avenues to breed grapevine for lower water losses at night.

Keywords: Water use efficiency, night transpiration, QTL, stomata, cuticle