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The GREASE project: Sustainable cultivation of Greco grapevine - Reconstruction of the vines ecophysiological behaviour

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The increasing irregularity in precipitation patterns and frequency of extreme drought events in the Mediterranean area is challenging the sustainability of grapevine production, especially in some areas of southern Italy. Here, being the grapevine mostly rainfed-cultivated, there is a strong demand for cultivation techniques aiming to improve water use efficiency and water stress tolerance.

Pruning techniques and training system can have an effect on the hydraulic architecture of vines, thus on their hydraulic behavior that is strictly coordinated with photosynthetic efficiency and ultimately contribute to determine yield and grape quality.

In this study, we aimed to evaluate whether and to what extent a change in pruning technique can influence the efficiency and safety of water flow in vines. In order to pursue this objective, we combined the dendro-sciences approach, analysing tree-ring width and anatomical features of vines subjected to an abrupt change in the pruning technique. The study was conducted within the GREASE project, funded by the Campania Region through the Rural Development Programme 2014-2020, within the framework of the optimization of agricultural practices for improving grapevine resources-use efficiency for the sustainable management of vineyards.

The study was conducted in a vineyard of Vitis vinifera L. subsp. vinifera ‘Greco’ (Feudi di San Gregorio farm) located in southern Italy (Avellino) at a site where the pruning technique was changed in 2004 following the method by Simonit & Sirch (Simonit 2014 Manuale di potatura della vite Ed IA; Sun et al 2008 Am J Bot 95:1498-1505). This method applies pruning cuts oriented in a way to drive vine natural tendency in the branching, to reduce injuries stress, in order to modulate the hydraulic pathway to reduce resistances to flow. Wood cores were extracted by the vines trunk, tree-rings were dated and widths were measured according to dendro-chronological techniques using WinDENDRO software. Then the cores were subjected to thin sectioning to obtain tree-ring series that were analysed through microscopy and subjected to digital image

analysis. Wood anatomical traits, linked with hydraulic conductivity and vulnerability, were quantified in each year. The tree-ring series were then annually separated and $d^{13}C$ was measured in each year, in order to obtain information on intrinsic water use efficiency. The overall wood anatomical and stable isotope parameters were integrated to reconstruct and interpret past eco-physiological vine behaviour in response to the change in pruning technique also taking into account the inter-annual environmental variability.

The analysis of wood anatomical functional traits linked with carbon stable isotopes of grapevine tree-ring series confirmed that vineyard management technique can severely affect the vine water use, thus affecting plant growth, productivity and ultimately plant ability to adapt to changing environmental conditions.

All these interactions and their effects on water use should be taken into account when designing management practices in vineyards for sustainable production.