Leaf water potential and sap flow as indicators of water stress in Crimson 'seedless' grapevines under different irrigation strategies

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Abstract

Season long plant-based measurement of water stress and transpiration were studied under field conditions for *Crimson* grapevine subject to two irrigation regimes with two sub-treatments consisting of normal irrigation throughout the growing season and a short irrigation induced stress period between *veraison* and harvest aimed at accelerating fruit maturity and thus increasing fruit market value. Leaf water potential measurements coherently signaled crop-available water variations caused by different irrigation treatments, suggesting that this plant-based method can be reliably used to identify water-stress conditions. The use of sap flow density data to establish a ratio based on a reference 'well irrigated vine' and less irrigated vines showed the ability to signal differences in the transpiration rates, which may be suitable for use in automated irrigation systems to improve irrigation management strategies while preventing undesirable levels of water stress. The impacts of the four different irrigation strategies on post-harvest grape quality attributes was studied, and although all implemented irrigation strategies guaranteed the production of quality table grapes, significant differences ($p \leq 0.05$) were found in both berry weight and sugar content between the

grower's normal irrigation and reduced irrigation treatments. Reduced irrigation increased the average berry size as well as sugar content and technical maturity index. The short irrigation stress period had a negative effect on these parameters.

Keywords: *Sap flow, Granier, Crimson seedless, table grapes, transpiration, leaf water potential, stomatal conductance, total soluble solids.*

Introduction

Grapevine (*Vitis vinifera L.)* is the most widely cultivated and economically important fruit crop in the world (Cunha *et al.*, 2005). Grapevines are well adapted to the Mediterranean climate which has a long growing season, high summer temperatures, low humidity, a ripening season free of rainfall, and mild winter temperatures (Mencarelli *et al.*, 2005). Table grape vineyards generally require more intensive irrigation than wine grapes due to the use of training systems designed to accommodate large leaf areas for higher production (Silva-Contreras *et al.*, 2012), thus resulting in higher canopy water loss. Given the importance of irrigation management as a key factor for the successful cultivation of table grapevines, research into new approaches to improve water management aiming not only at sustainable environmental and agricultural practices but also at restraining water-related production costs are required (Martinez *et al.*, 2010).

The *'Crimson Seedless*' cultivar, is a late-season red table grape developed in 1989 by scientists at the USDA Fruit Genetics and Breeding Research Unit in Fresno, California producing medium to large cylindrical seedless berries. The organoleptic quality of table grapes depends mainly on the sugar content, organic acid content and the balance between them (Muñoz-Robredo *et al.*, 2011). Total soluble solids, TSS, and total