Evaluating the potential of sap flow measurements for scheduling irrigation in olive, grape and apple

J.E. Fernández[1], *S.R. Green*[2], *H.W. Caspari*[3], *A. Diaz-Espejo*[1] *and M.V. Cuevas*[1]

1 Instituto de Recursos Naturales y Agrobiología, PO Box 1052, 41080-Sevilla, Spain
2 HortResearch Palmerston North, Tennent Drive, Private Bag 11030, Palmerston North, New Zealand
3 Department of Horticulture and Landscape Architecture, Colorado State University, 3168 B ½ Rd., Grand Junction, Colorado, USA

Abstract. In this work we try to explore the potential of sap flow measurements for scheduling irrigation in olive and apple trees, and in grape vines. For olive, experiments were carried out from May to October 2006 in an olive orchard (40-year-old 'Manzanilla' trees at 7 m x 5 m) at La Hampa, an experimental farm close to Seville, southwest Spain. Trees were irrigated daily from May to October, by a localised irrigation system. Some trees were overirrigated (130% of ETc determined form the crop coefficient approach), while neighbour trees were under deficit irrigation, with decreasing irrigation doses until the soil relative water content was about 50%; then, the soil water profile was replenished by 10 days recovery irrigation. Sap flow measurements were made in the trunk of three representative trees of both treatments, all throughout the irrigation season. We used the Tz method (Green et al., 2003), which was calibrated for olive by Fernández et al. (2006).

The grape experiment was made in spring 2003, on a commercial vineyard (Nautilus Estate) near Renwick, Marlborough. Control vines received 100% of ETc determined form the crop coefficient approach, while a water-stressed treatment received 30% of ETc only. Sap flow measurements were carried out in grape vines of each treatment, from January to mid March, with the Tmax method (Green et al., 2003).

Experiments with apple trees were made in the summer of 1998/99 in a commercial orchard near Blenheim, Marlborough, and in the summer of 1999 in a commercial orchard near Prosser, WA, USA. Control trees received 100% of ETc determined form the crop coefficient approach, while deficit-irrigated trees received 50% (Marlborough) or 70% (WA) of ETc only. Sap flow measurements were carried out in both trunks and large structural roots for about 100 days using the Tz method (Green et al., 2003).

We have explored the potential of two possible indicators for scheduling irrigation: 1) the shape of sap profiles under conditions of water stress, and 2) sap flow in a stressed plant relative to a non-stressed plant. Despite of some evidences in the literature suggesting the potential of radial profile changes caused by water stress as an indicator for irrigation control, our results were not consistent, for any of the three studied species. By comparing the control treatment vs. the deficit irrigation treatment sap flow ratio with soil water, stomatal conductance and stem water potential measurements, we got reasonable evidences of such ratio being useful for irrigation control, at least for olives and grapes.

Fernández et al., 2006. Tree Physiology, 26:719-728. Green et al., 2003. Agronomy Journal, 95:1371-1379.