RESPONSES TO REGULATED DEFICIT IRRIGATION OF A NECTARINE ORCHARD IN SOUTHERN SPAIN (S15.215)

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ABSTRACT

Irrigated agriculture is facing restrictions due to water scarcity. Regulated deficit irrigation (RDI) is a technique that has been shown to reduce irrigation water use in fruit orchards and vines. In RDI, water is applied below crop requirements during certain developmental stages that are less sensitive to water stress. The objective of this study was to test the RDI strategy in a nectarine commercial orchard (*Prunus persica* (L.) Batsch cv. "Sweet Lady") in Southern Spain. The experiment was conducted in 2007 and 2008 and RDI was compared to the orchardist's irrigation schedule. In RDI treatment, water was withheld from the start of the irrigation period (end May) until the start of the rapid fruit growth period (stage III). The strategy was to recover, as fast as possible, the water status of trees in order to avoid any water stress during the stage III. Neither yield nor any measured parameter was altered by the RDI relative to the farm schedule. In 2008, yield was slightly increased compared to 2007. There was a good relationship between the water status during the stage III, fruit diameter, and total soluble sugars. These results demonstrate that water deficit must be avoided during this very sensitive period if the goal is to achieve large fruit size.

INTRODUCTION

Irrigated agriculture in many world areas, such as Southern Spain, is facing restrictions due to water scarcity. The value of irrigated production is over 45%, while it represents only 18% of cultivated lands, highlighting the importance that irrigated agriculture has for feeding the world population (Molden, 2007). The increase in water demand from other users coupled with water scarcity is leading to the reduction in the amount of water diverted for agriculture. The optimization of the use of water diverted in agriculture is a primary challenge for agronomists.

Regulated deficit irrigation (RDI) is a technique that has been shown to reduce irrigation water use in fruit orchards and vines. Originally, it was developed to reduce vegetative growth (Chalmers et al., 1981). In RDI, water is applied below crop requirements during certain developmental stages that are less sensitive to water stress. For stone fruit trees, it has been demonstrated that the appropriate stages to apply RDI are the stage II or pit hardening period, and the post-harvest stage (Goodwin and Boland, 2002). On the contrary, the rapid fruit growth period (stage III) has demonstrated very sensitive to water stress (Torrecillas et al., 2000). Hence, it is essential to manage irrigation accurately in order to achieve a water status recovery at the start of the stage III. The objective of this study was to test the RDI strategy during the stage II in a nectarine commercial orchard (*Prunus persica* (L.) Batsch cv. "Sweet Lady") in Southern Spain as well as the analysis of the sensitivity of the stage III. RDI was compared to the orchardist's irrigation scheduling for two consecutive years, in 2007 and 2008.

MATERIALS AND METHODS

An experiment was conducted in 2007 and 2008 where RDI was compared to the orchardist's irrigation schedule (Control treatment) in two large plots of 3,600 m^2 each. The orchard was planted in 1999 at 6 x 3.3 m (500 tree ha^{-1}). Trees were irrigated using an automated drip system with 3 pressure-compensated emitters (4 l h^{-1}) per tree. In RDI treatment, water was withheld from the start of the irrigation period (end May) until the start of the rapid fruit growth period (stage III). The strategy was to recover, as fast as possible, the water status of trees in order to avoid any water stress during the stage III. To do so, irrigation was applied over crop needs during one week. From that date, it was scheduled as Control treatment. Water applied is shown in Table 1. The calculated Crop ET for C treatment (according to ETo*kc; kc=0.9), as an estimation of the evaporative demand within the orchard, is also shown in Table 1. Stem water potential and fruit growth were measured weekly during the whole season. Harvest passes were scheduled according to farmer' criteria. Four passes were made on 2007 and six passes on 2008. At harvest, yield, fruit volume and fruit quality parameters (total soluble solids and acidity) were assessed.

RESULTS AND DISCUSSION

Water potential was significantly different during the stage II, when water was withheld for RDI treatment (Fig. 1). Neither yield nor any measured parameter was altered by the RDI relative to the farm schedule (Table 2). In 2008, yield was slightly increased compared to 2007. Mean fruit volume was better correlated with tree water status during the stage III (measured as the time integral of stem water potential during this stage) compared to the stage II, corroborating that water stress during the stage III caused a severe reduction on fruit growth (Fig. 2). These results demonstrate that water deficit must be avoided during this very sensitive period if the goal is to achieve large fruit size. Total soluble solids content increased with water stress in 2008 (Fig. 3). Differences between both years should be ascribed to harvest time, as the timing for harvest was determined by the market demand and not by the physiological maturity.

CONCLUSIONS

Regulated deficit irrigation is a valuable technique to save water in nectarine orchards in the Mediterranean region. In this study, net savings of applied water were about 17-35%, compared to the orchardist irrigation scheduling. A correct water status during the stage III is critical to maintain fruit size, although fruit quality is enhanced by water stress. Recovery from water shortage applied during SII should be made as fast as possible in order to reduce yield losses.

ACKNOWLEDGEMENTS

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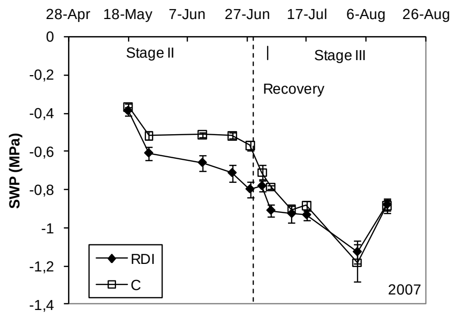
- Figures



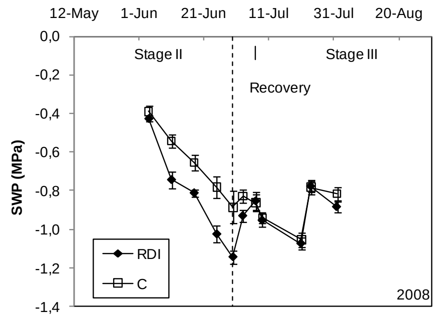
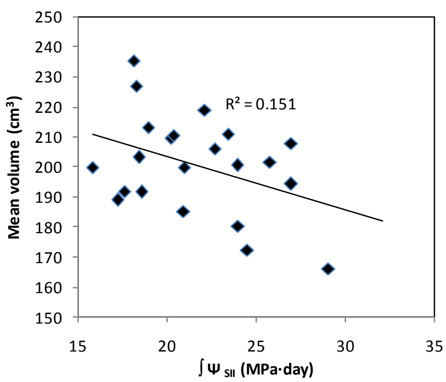


Fig. 1: Time course of the stem water potential (SWP; MPa) on 2007 and 2008. Vertical bars showed the standard error (n=6).



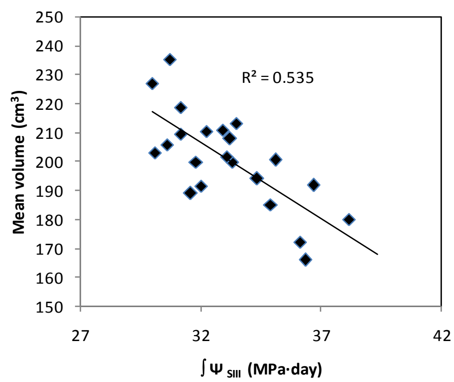


Fig. 2: Relationship between the time integral of stem water potential during the SII and SIII and fruit volume. Each point is an individual tree. Both treatments and years are represented.

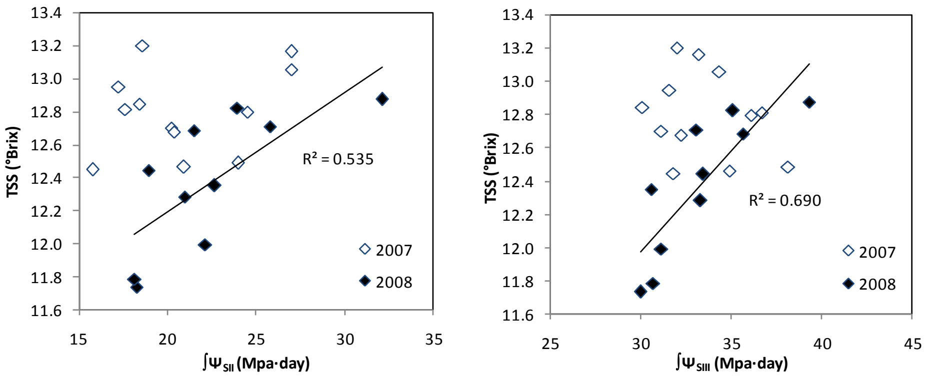


Fig. 3: Relationship between the time integral of stem water potential during the SII and SIII and total soluble solids. Each point is an individual tree. Regression line corresponded to 2008 data.

Tables

Table 1: Water applied for RDI and Control (mm) and calculated ETc (mm)

	2007			2008		
	StageII	StageIII	Total	StageII	StageIII	Total
Water applied RDI (mm)	0	204	204	0	266	266
Water applied C (mm)	89	223	312	94	226	320
Calculated ETc (C) (mm)	168	285	453	208	287	495

Table 2: Yield (kg/tree), Total Soluble Solids (°Brix) and Tritatable Acidity (%) for Control and RDI treatments on 2007 and 2008.

	2007			2008		
Treat	Yield (kg/tree)	TSS (°Brix)	TA (%)	Yield (kg/tree)	TSS (°Brix)	TA (%)
C	45.2 (2.9)	12.9 (0.1)	1.10 (0.02)	50.6 (2.8)	12.1 (0.1)	1.15 (0.01)
RDI	44.5 (3.9)	12.7 (0.1)	1.07 (0.02)	47.6 (3.0)	12.3 (0.2)	1.09 (0.01)