REGULATED DEFICIT IRRIGATION IN PEACH AND NECTARINE AT THE FARM LEVEL

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INTRODUCTION

Regulated Deficit Irrigation (RDI) consists on the application of water below the full crop-water requirements during periods of crop growth that are less sensitive to water deficit (Chalmers *et al.*, 1986), and is a viable strategy during periods of water shortage (Fereres and Soriano, 2007). For stone fruits, such as peach and nectarine, the least sensitive stage to water stress is stage II of fruit development, characterized by a slow fruit growth rate and rapid vegetative growth. On-farm experiments in peach have shown that RDI scheduling based on stem water potential was a viable strategy that reduced applied irrigation water by 33%, relative to full requirements, without reducing yield or crop value. At present, there is a need for upscaling these results from experimental plots to commercial farms. This leap in space scale must be accompanied by adapting new tools that enable the early detection of water stress with higher spatial resolution thermal and narrow-band multispectral remote sensing imagery. Airborne thermal and multispectral imagery can provide pre-visual indicators of water stress (Berni *et al.*, 2008; Suarez *et al.*, 2008). In order to do this upscaling, a 5-years program (RIDECO-CONSOLIDER) started on 2006, funded by the Spanish Ministry of Education and Science, to study several aspects of the deficit irrigation practices in Spanish horticulture. In this work, full irrigation and RDI scheduling in two demonstration plots are compared, in peach and nectarine, and focus is done on the early assessment of water stress with airborne thermal and narrow-band multispectral imagery.

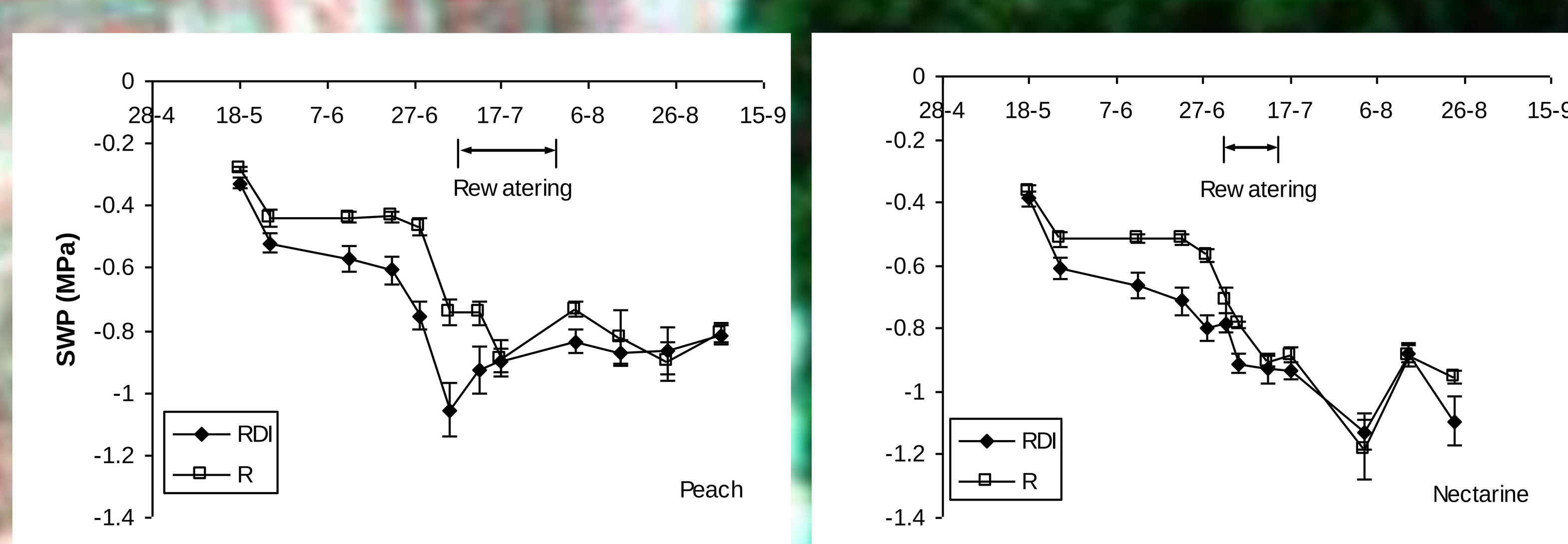

Figure 1: Evolution of stem water potential (MPa) for peach and nectarine trees under regulated deficit irrigation (RDI) and control (R) treatments.

MATERIALS AND METHODS

Two demonstration plots were established in a peach (*Prunus persica* (L.) Batsch cv. 'Baby Gold 8') and nectarine (*Prunus persica* (L.) Batsch cv. 'Sweet Lady') orchards in a commercial farm on deep alluvial soil located near Cordoba (Spain), with the same experimental design for both plots. Two large subplots (3150 m^2) with 6 lines each and about 30 trees/line (3.3 × 5 m grid) were chosen to compare the two irrigation schedules. In well-irrigated subplot (R), water was applied according to the crop water requirements in every stage. In RDI subplot, water was withheld from the beginning of the irrigation season until the beginning of the stage III according to Fereres and Soriano (2007). To determine water status, midday stem water potential was measured weekly in 6 trees/treatment. At harvest, water applied, yield, fruit diameter and fruit number was determined. Thermal and multispectral cameras were installed in an unmanned aerial vehicle (UAV) flying at 150 m altitude. The images yielded 40 cm spatial resolution (320x240 pixels with 16-bits) in the thermal, and 20 cm pixel size in the visible and near-infrared multispectral camera. For more information concerning calibration, image capture and analysis, see Berni *et al.* (2008) and Suarez *et al.* (2008).

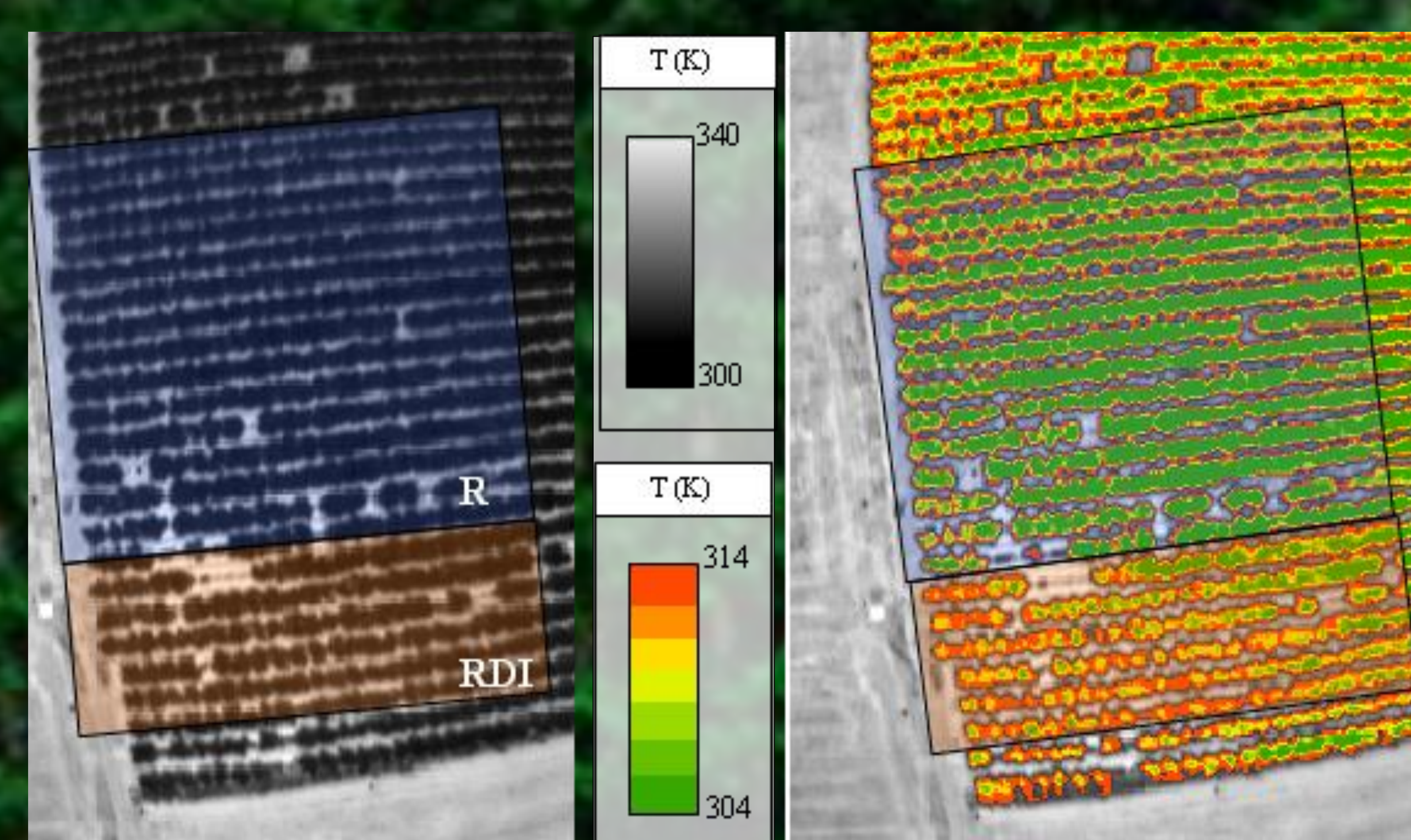

Figure 2: Original image and map of temperature of the experiment plots, acquired with the thermal camera.

RESULTS AND DISCUSSION

As soil was near field capacity, stem water potential did not show any difference for the first 20 days in both, peaches and nectarines (Figure 1). Differences were maxima just before rewatering, reaching 0.3 and 0.2 MPa, for peach and nectarine, respectively. The day before the rewatering period, the temperature map showed differences near 10ºC between both treatments (Figure 2). After rewatering, both treatments followed a similar evolution until harvest. At the end of the season, the total water saved in RDI was equal to 63 and 108 mm for peach and nectarine respectively (Table 1). No differences were found in yield (Table 1) or quality parameters, such as total soluble sugars or total acidity (*data not shown*). RDI treatments resulted in a large number of smaller fruits (Table 1; Figure 3). No difference in fruit size or number was found in nectarine, and both treatments exhibited similar distribution (*data not shown*).

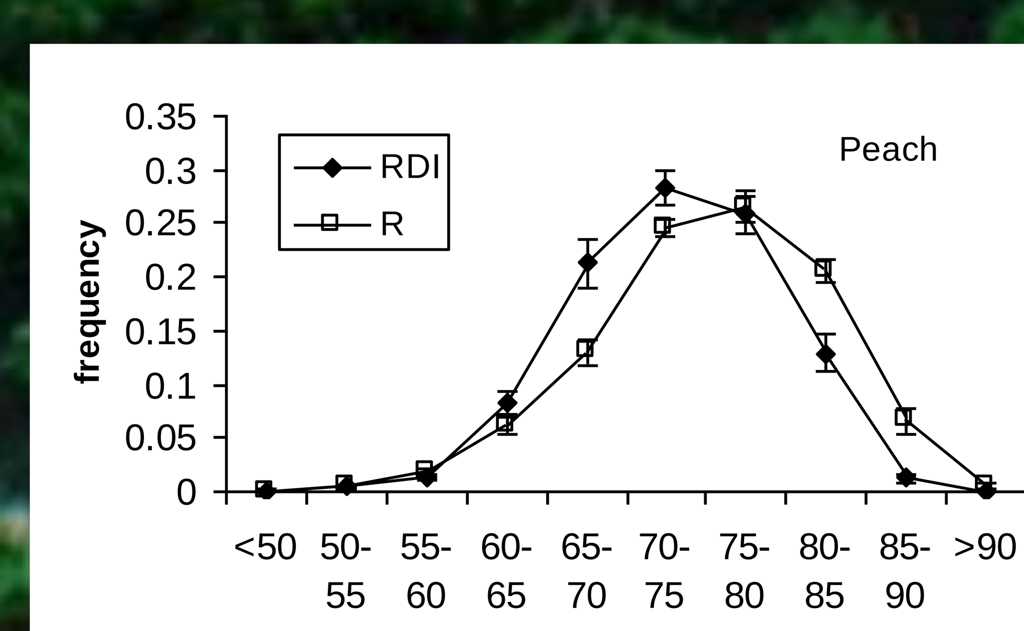

Figure 3: Distribution of fruit diameter at harvest.

Table 1: Water applied (mm), fruit number (n/tree) and yield (kg/tree)

Species	Treatment	Water applied (mm)	Fruit number (n/tree)	Yield (kg/tree)
Peach	R	465	170	42,4
Peach	RDI	402	195	40,8
Nectarine	R	312	256	44,5
Nectarine	RDI	204	253	45,2

CONCLUSION

RDI techniques are suitable for irrigation scheduling in commercial farms. Water savings will depend on the contribution from soil water storage. Thermal imagery is a valuable tool for farmers to quantitatively monitor the plant water status in order to control water deficit levels and schedule the irrigation events.

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