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Partial rootzone drying irrigation modulates transpiration of olive trees

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Abstract: Water scarcity and the increasing water demand for irrigation in olive orchards are leading to adopt
deficit irrigation approaches to save water. The partial rootzone drying (PRD) irrigation technique has been proposed for woody crops as an agronomic practice to improve water productivity. This study was conducted to evaluate the effect of this irrigation strategy on water relations and transpiration of olive tree (cv. Cobrançosa) under climate conditions of the Northeast of Portugal, during the season of 2014. To irrigation treatments were used: control (FI), irrigated with 100% of the estimated crop evapotranspiration (ET) and PRD_{50}, irrigated with 50% of the control (FI) on one side switching every two weeks. Whole tree transpiration (T) was quantified by sap flow, that was monitored within the trunk of both the control (FI) and deficit irrigated (PRD_{50}) trees using the compensation heath-pulse technique. Foliage gas exchange and water potentials were determined throughout the experimental period. During summer, daily transpiration reached roughly 27 and 43 L d^{-1} for PRD_{50} and FI olive trees, respectively, with a clear reduction of 37% in PRD_{50} olives trees. PRD_{50} showed statistically comparable values of water potentials to the Control which seemed to prevent an excessive drop in tree water status by modulating stomatal closure.

Keywords: *Olea europaea* L., deficit irrigation, water relations, sap flow, heat pulse

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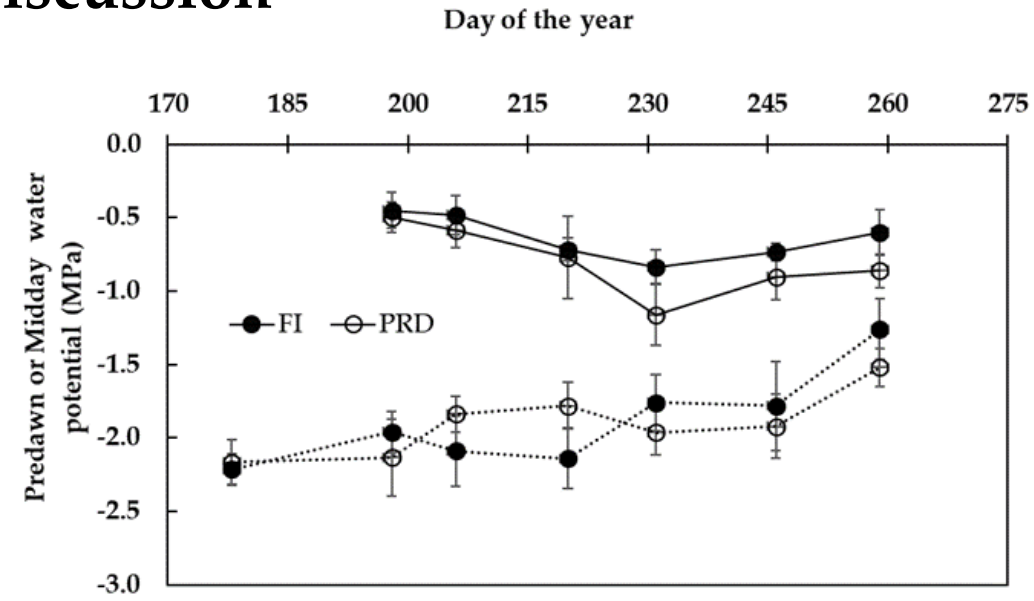
Results and Discussion



Predawn values of water potential showed slight differences between FI and PRD treatments only in DOY 231 in which Ψ_{PD} of PRDI plants attained a minimum of -1.16 MPa (Figure 3). For FI trees values were higher of -0.65 MPa whereas for PRD plants they were usually higher than -0.80 MPa. Stem water potential was not significantly affected by PRD that had values similar to FI plants, in general higher than -2.0 MPa.

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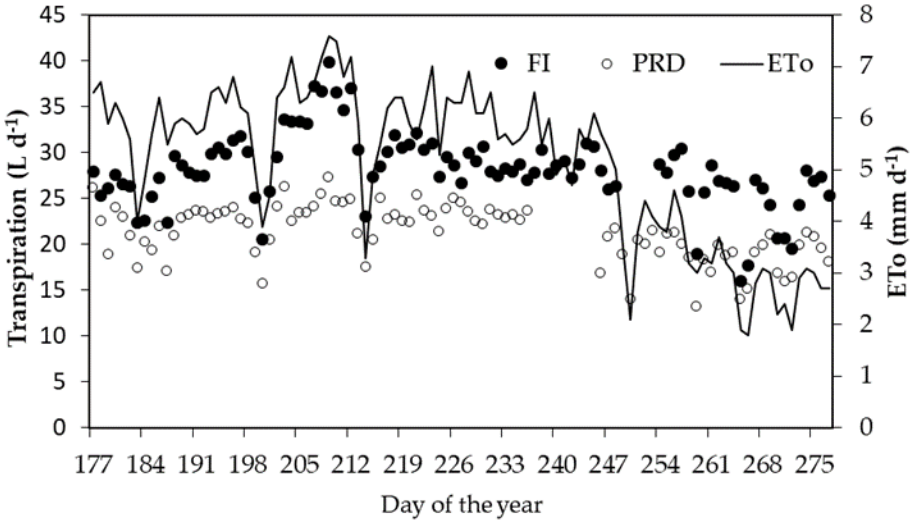

Averaged daily transpiration showed with maximum values at the end of daily reference evapotranspiration wa similar between treatments. Howeve showed invariably lower daytime sap flow rates than full irrigated plants. Values of transpiration in FI plants ranged from 16 to 39.9 L d^{-1} respectively at DOY 265 (ETo = 1.9 mm d^{-1}) and 209 (ETo = 7.6 mm d^{-1}), while in PRD plants a minimum of 13.1 L d^{-1} and a maximum of 27.3 L d^{-1} was attained in the same dates. A good agreement between measures daily water use and daily reference evapotranspiration was observed for both treatments ($P<0.05$) with a coefficient of determination (r^2) of 0.74 for FI and 0.68 for PRD, thought the slope of the regression was significantly higher in FI plants compared to PRD trees

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Conclusions

Preliminary results of this study done in field grown olive trees showed that partial rootzone drying irrigation did no affect plant water relations, as expressed by bulk leaf water potential, when the total amount of water supplied to these adult olive trees was 50% of to that supplied to Control plants. Stomatal closure observed in PRD plants effects water use in PRD_{50} plants showed by a clear reduction of sap flow and transpiration of mature olive trees. The coordinated adjustment in stomatal responses may represent an adaptive advantage in conditions of water deficit induced by PRD irrigation. Further research is need to understand the long term yield and water use efficiency response of Cv. Cobrançosa to this irrigation strategy.

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