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Water constraints in a hazelnut (Corylus avellana) orchard in NSW-Australia: a physiological approach for assessing the reduction of the potential productivity.

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Orchards productivity and thus nut yield is strictly dependent on plant growth (Baldwin, 2010), which is in turn influenced directly by water availability. Nevertheless, when introducing productive species in a new environment, it is necessary to assess all potential limitations.
The main objective of the study was to assess the water requirements of the orchard and the main controls over the transpiration dynamics. Therefore, we set a project in Dellapool, Sandigo, NSW, Australia that lasted for two growing seasons from February 2015 to April 2017, including an initial period for instrument testing in the field. The continuous monitoring of sap flow, soil water content and stem growth together with meteorological parameters allowed to assess the water related ecology of C. avellana and its response to the local environment. The sap flow was branch based monitored with Granier's sensors while allometric relations between plant tissues allowed for the scaling up of water volume from the branch to the whole tree and orchard. The record of multiple growing seasons under continuous monitoring provided a trustable dataset on which we estimated the growing season length (around 200 days of positive sap flow) and the maximum tree conductance. Results from the leaf gas analyzer (Lci) reported a tight correlation between stomatal conductance and carbon assimilation, suggesting that early stomatal closure in C. avellana leads to productive inefficiency.
The limitation exerted by the evaporative demand of the atmosphere (VPD) revealed to be the strongest. At comparable average soil water content, the tree conductance (Grel) was severely depressed by high frequency of VPD>15hPa, which kept the Grel six times lower the first growing season respect to the second. Accordingly, the tree daily water loss resulted to be 0.27mm day-1 in 2015-2016 and 0.56mm day-1 in 2016-2017. Whether water exploitation diminishes in case of high VPD, the potential productivity of the orchard is compromised. In the first growing season, trees reached 80% of the maximum performance only 0.8% of the time while in the second this value increased to 6.7%. In conclusion, it must be taken in serious consideration that that hazelnut is a drought-avoider species with high stomatal closure sensitivity. Additional ground water inputs must be limited to avoid water resource overexploitation in dry and windy climates, while an increased attention must be on microclimate mitigation. Closing the canopies and favoring a higher canopy resistance would limit soil evaporation, while introducing trees either as wind breaks or as a companion species in the orchard will result in a decrease of VPD and keep the cultivated surface cooler.