COMPARING VINEYARD IRRIGATION MANAGEMENT BASED IN TWO DIFFERENT APPROACHES: VEGETATION INDICES AND SIMDUALKC MODEL.

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Abstract:

Context and purpose of the study – Water scarcity, high air temperatures, high vapor pressure deficit, and increasing frequency and intensity of extreme climatic events, namely heat waves, exert huge pressure on viticulture, as is the case of Mediterranean climates. Therefore, farmers rely more and more on irrigation to overcome these constraints. Deficit irrigation is a proved strategy to optimize irrigation efficiency and wine quality. The present study intends to demonstrate the application of precision techniques, namely remote sensing derived vegetation indices (VI) and an open source software, SIMDualKc, to compute crop evapotranspiration using the dual crop coefficient approach (Kcb + Ke), for deficit irrigation management.

Material and methods – The present work focuses on the irrigation management, during the 2018 growing season, of a vineyard submitted to regulated deficit irrigation, located in Reguengos de Monsaraz, Alentejo, Portugal, the hottest and driest Portuguese region. VI were calculated from Sentinel 2 imagery (revisiting time: 5 days, spatial resolution: 10 m), and crop coefficients (Kcb, Ks) were estimated from existing functions for vineyards. The SIMDualKc model was fed with local meteorological data, observed dates of main developmental stages and total available soil water in the root zone (TAW, mm), estimated from the difference between the water content at field capacity (θFC $m^3.m^{-3}$) and at wilting point (θWP $m^3.m^{-3}$), multiplied by the rooting depth [m]. The plant water stress intensity was monitored with predawn leaf water potentials. Results were validated against soil water balance and transpiration estimates (thermal dissipation sap flow gauges).

Results – Accumulated Reference Evapotranspiration during the vegetative cycle was around 980 mm, a relatively low value compared to a normal year, due to the rainfall that occurred during spring (320 mm). In consequence, the soil was at field capacity until the end of May, delaying the first irrigation event. Regarding vegetation indices, considerable variability between and within sectors was found. Crop coefficients VI derived functions found in the bibliography may need a local adjustment, however, they present the advantage of being more spatially representative since they use the average of the whole sector's vegetative expression. The main limitation of SimDualKc is the representativeness of soil properties (measured in one point per sector). However, SimdualKc presented a good estimation of Ks, comparing with stress functions, and enabled the estimations of transpiration and soil evaporation, allowing the evaluation of irrigation management performance. In conclusion, the use of VI approach proved to be a cohesive tool for precise irrigation as it considers the irrigation sector's variability. This approach presented the potential to save, on average, around 13% of irrigation water, when compared with the farmer's irrigation scheduling. These results were corroborated by soil and plant water stress indicators.

Keywords: Deficit irrigation, Remote sensing, Water stress, Evapotranspiration modelling.