

**Año:** 2022

**Título artículo:** Physiological basis to assess barley response to optimized regulated deficit irrigation for limited volumes of water (ORDIL)

**Revista, volumen, páginas:** Agricultural Water Management, Volume 274, 1 December 2022, 107917

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## RESUMEN:

Agriculture must improve the productivity of irrigation water due to several factors, such as global warming, the increasing water demand of other sectors or the protection of the environment. The “optimized regulated deficit irrigation for limited volumes of water” (ORDIL) methodology may contribute to reach this objective by optimizing the allocation of irrigation water during the growing cycle, when the available volume is lower than the crop irrigation requirements. ORDIL was applied to a barley crop in a 3-year (2015–2017) field test under the semiarid conditions of Albacete (Spain). The main aim was to assess the influence of ORDIL on the physiological response of barley. The specific objectives were: 1) Identify if stomatal conductance ( $g_s$ ), net assimilation rate ( $A_n$ ), intrinsic water use efficiency ( $WUE_i$ ) and total dry matter (TDM) evolution can be used as early and sensitive indicators of barley water status and crop performance; 2) Provide a mechanistic basis to understand barley physiological response to deficit irrigation at the most sensitive stages and; 3) Evaluate barley physiological response to ORDIL and its relation with yield. Thus, five irrigation treatments were performed. One without deficit (ND), and four with limited volumes of irrigation water (100%, 90%, 80% and 70% of typical irrigation needs). According to the results,  $g_s$  was a reliable variable to detect early water deficit in barley. Besides, critical thresholds for this variable were found to optimize irrigation and to avoid chronic physiological damages affecting the most sensitive and yield-related stages. In summary, the physiological approach applied in this study validates ORDIL methodology being useful for future irrigation scheduling and distribution improvements.

## Agradecimientos:

This paper was developed within the framework of the MEFLIS (Ref. AGL2017–82927-C3–3-R), TEMAER (Ref. AGL2014–59747-C2–1-R), PRODAGUA (Ref. SBPLY/19/180501/000144) projects (Spanish Ministry of Economy and Competitiveness, Government of Castilla-La Mancha and European Union FEDER funds) and the European project SUPROMED “GA-1813” funded by PRIMA – Partnership for Research and Innovation in the Mediterranean Area. Authors thank Centro Integral de Formación Profesional (Agua Nuevas) and Inter Malta S.A. their technical support in this work.