Combining soil water balance models and water stress indicators for irrigation scheduling - case study in Portuguese conditions and its context

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Abstract

Distribution of irrigated areas in Portugal is presented, according to irrigation systems, water delivery management (irrigation districts, private irrigation companies, individual irrigators) and irrigated crops. Main institutions and services linked to irrigation management, experimentation and research are named. Examples are given on measured and modelled crop water requirements for the country, aiming at using inter-regions and inter-crops comparison to emphasise the large range of expected variation. Expected consumption is generally high, as a consequence of the mediterranean features of the observed climate subtypes (temperate, Csa and Csb). Water savings, crucial in the present context, require improved skills in water transport and application at different scales. This contribution focuses on management at plot scale (irrigation scheduling, how much water and when).

Irrigation scheduling modes on use are briefly described, discussing some limitations and advantages. It is advocated that none of them is fully satisfactory without the combination of two distinct approaches: (1) modelling based on the estimation of crop water requirements, with water balance, to get the irrigation water requirements and (2) water stress indicators, based on direct measurements of plant and/or soil water status, or crop water status (appropriate remote sensing tools). The first approach informs first how much to irrigate (irrigation depths) and, secondly, when to irrigate based on parameters of the system (mainly soil, with some impact of ET rates and crop). The second approach informs when to irrigate and, based on trial and error, possibly also how much to irrigate. Notwithstanding, the combination of both gives a more complete answer, possibly bringing the user to a self-learning process. It is especially necessary for woody crops, for the reasons here summarized, but requiring careful adaptation.

Two examples are presented, with different aims. The first concerns a deep rooted woody crop, considered very resilient to water stress. Results published showed that young, drip irrigated, olive trees can use more water than the amount given by irrigation, providing experimental evidence of the exploitation of deep soil layers, suggesting that (1) local measurements in upper soil layers are only indicative and (2) usual modelling approaches alone can severely fail, in case of the generally applied deficit irrigation, when evapotranspiration is reduced by stress. The second example is a case-study for a horticultural crop, where water balance estimations can easily be compared with local measurements, thanks to relatively shallow roots. Such comparison is used to adjust model parameters, as shown, emphasizing the mutual benefit of the two approaches above described.

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