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Olive response to water availability: yield response functions, soil water content indicators and evaluation of adaptability to climate change

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Climate evolution, with the foreseen increase of temperature and frequency of drought events during the summer, could cause significant changes in the availability of water resources specially in the Mediterranean region. European countries need to encourage sustainable agriculture practices, reducing inputs, especially of water, and minimizing any negative impact on crop quantity and quality.
Olive is an important crop in the Mediterranean region that has traditionally been cultivated with no irrigation and is known to attain acceptable production under dry farming. Therefore this crop will not compete for foreseen reduced water resources. However, a good quantitative knowledge must be available about effects of reduced precipitation and water availability on yield.
Yield response functions, coupled with indicators of soil water availability, provide a quantitative description of the cultivar- specific behavior in relation to hydrological conditions.
Yield response functions of 11 olive cultivars, typical of Mediterranean environment, were determined using experimental data (unpublished or reported in scientific literature). The yield was expressed as relative yield (Yr); the soil water availability was described by means of different indicators: relative soil water deficit (RSWD), relative evapotranspiration (RED) and transpiration deficit (RTD).
Crops can respond nonlinearly to changes in their growing conditions and exhibit threshold responses, so for the yield functions of each olive cultivar both linear regression and threshold-slope models were considered to evaluate the best fit.
The level of relative yield attained in rain-fed conditions was identified and defined as the acceptable yield level (Yrrainfed). The value of the indicator (RSWD, RED and RTD) corresponding to Yrrainfed was determined for each cultivar and indicated as the critical value of water availability. The error in the determination of the critical value was estimated. By means of a simulation model of the water flow in the soil-plant-atmosphere system, the indicators of soil water availability were calculated for different soil units in an area of Southern Italy, traditionally cultivated with olive. Simulations were performed for two climate scenarios: reference (1961-90) and future climate (2021-50).
The potentiality of the indicators RSWD, RED and RTD to describe soil water availability was evaluated using simulated and experimental data. The analysis showed that RED values were correlated to RTD. The analysis demonstrated that RTD was more effective than RED in representing crop water availability RSWD is very well correlated to RTD and the degree of correlation depends of the period of deficit considered.
The probability of adaptation of each cultivar was calculated for both climatic periods by comparing the critical values (and their error distribution) with soil availability indicators.

Keywords: Olea europaea, soil water deficit, water availability critical value.

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