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Improvement of water use efficiency in an Italian vineyard through variable rate drip irrigation

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In precision irrigation, optimal water management is realized by supplying proper water amounts to different parts of the field according to the within-field variability in soil and crop properties (Variable Rate Irrigation, VRI), and this is obviously expected to improve water use efficiency. Drip irrigation is the most common method adopted in viticulture. Nevertheless, to date, very few studies are attempting to apply Variable Rate Drip Irrigation (VRDI) concepts in viticulture as well as in all other agricultural production sectors, and the authors are not aware of any commercial application.
During the cropping season 2018, the effectiveness of implementing a VRDI system was investigated in a vineyard of about one hectare located in the Morainic Hills south of Lake Garda (NUTRIPRECISO project; RDP-EU, Lombardy Region). An Electro-Magnetic Induction sensor (EMI) dragged by a quad was used to produce maps of soil electrical conductivity, which were elaborated by applying statistical techniques to identify two homogeneous management zones (MZs) corresponding to the two main soil types in the field. The reliability of the within-field zonation was validated through multispectral and thermal imagery acquired by sensors mounted on a UAV in one survey during the agricultural season. For each MZ, a soil profile was opened and analyzed, and soil samples were collected from the different soil horizons in order to measure in laboratory the soil water content at the field capacity and at the wilting point. From these values, considering the depth reached by the crop roots, the available water content (AWC) was calculated over the rooting depth. The computed AWC values for each MZ were used to obtain an irrigation prescription map (IPM). On the basis of the IPM, a VRDI system characterized by three sectors, each one controlled by independent electrovalves was designed and realized. The first two sectors deliver water to the two MZs with different rates depending on soil type, while the third one, whose function is to show the ‘reference irrigation management’, was realized in a narrow strip of field where both types of soil are present. Drip lines in the first two sectors are different in terms of spacing between drippers and dripper flow rates, based on the type of soil. In the third sector, the drip lines most commonly used in vineyards were installed, regardless of soil type. A wireless sensor network including one soil water content probe for each sector was used to fine-tune the frequency and duration of irrigation events in the first two sectors; in the third sector, irrigation was provided on the basis of the farmer’s decisions.
VRDI showed to cut water use of about 25% compared to the ‘reference irrigation management’, without losses in yield and product quality, which proved to be more uniform in the vineyard compared to previous years. The investigation will continue in the agricultural season 2019 using a soil water balance model calibrated with the 2018 dataset as a DSS to support the irrigation scheduling.