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Response and adaptation of grapevine cultivars to hydrological conditions forced by a changing climate in a complex landscape

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Soil water availability is one of the main components of the terroir concept, influencing crop yield and fruit composition in grapes. The aim of this work is to analyze some elements of the "natural environment" of terroir (climate and soil) in combination with the intra-specific biodiversity of yield responses of grapevine to water availability. From a reference (1961-90) to a future (2021-50) climate case, the effects of climate evolution on soil water availability are assessed and, regarding soil water regime as a predictor variable, the potential spatial distribution of wine-producing cultivars is determined.
In a region of Southern Italy (Valle Telesina, 20,000 ha), where a terroir classification has been produced (Bonfante et al., 2011), we applied an agro-hydrological model to determine water availability indicators. Simulations were performed in 60 soil typological units, over the entire study area, and water availability (= hydrological) indicators were determined. Two climate cases were considered: reference (1961-90) and future (2021-2050), the former from climatic statistics on observed variables, and the latter from statistical downscaling of predictions by general circulation models (AOGCM) under A1B SRES scenario. Climatic data consist of daily time series of maximum and minimum temperature, and daily rainfall on a grid with a spatial resolution of 35 km.
Spatial and temporal variability of hydrological indicators was addressed. With respect to temporal variability, both inter-annual and intra-annual (i.e. at different stages of crop cycle) variability were analyzed. Some cultivar-specific relations between hydrological indicators and characteristics of must quality were established.
Moreover, for several wine-producing cultivars, hydrological requirements were determined by means of yield response functions to soil water availability, through the re-analysis of experimental data derived from scientific literature. The standard errors of estimated requirements were determined.
To assess cultivars adaptability, hydrological requirements were evaluated against hydrological indicators. A probabilistic assessment of adaptability was performed, and the inaccuracy of estimated hydrological requirements was accounted for by the error of estimate and its distribution.
Maps of cultivars potential distribution, i.e. locations where each cultivar is expected to be compatible with climate, were derived and possible options for adaptation to climate change were defined.
The 2021 – 2050 climate scenario was characterized by higher temperatures throughout the year and by a significant decrease in precipitation during spring and autumn.
The results have shown the relevant variability of soils water regime and its effects on cultivars adaptability.
In the future climate scenario, a hydrological indicator (i.e. relative evapotranspiration deficit - RETD), averaged over the growing season, showed an average increase of 5-8 %, and more pronounced increases occurred in the phenological phases of berry formation and ripening. At the locations where soil hydrological conditions were favourable (like the ancient terraces), hydrological indicators were quite similar in both climate scenarios and the adaptability of the cultivars was high both in the reference and future climate case. The work was carried out within the Italian national project AGROSCENARI funded by the Ministry for Agricultural, Food and Forest Policies (MIPAAF, D.M. 8608/7303/2008)

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