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Olive cultivars adaptability in Southern Italy in present and future climate

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The intra-specific biodiversity of agricultural crops is very significant and likely to provide the single major opportunity to cope with the effects of the changing climate on agricultural ecosystems. Assessment of adaptive capacity must rely on quantitative descriptions of plant responses to environmental factors (e.g. soil water availability, temperature). Moreover climate scenario needs to be downscaled to the spatial scale relevant to crop and farm management. Distributed models of crop response to environmental forcing might be used for this purpose, but severely constrained by the very scarce knowledge on variety-specific values of model parameters, thus limiting the potential exploitation of intra-specific biodiversity towards adaptation.

We have developed an approach towards this objective that relies on two complementary elements:
a)a distributed model of the soil [U+FFFD] plant [U+FFFD] atmosphere system to downscale climate scenarios to landscape units, where generic model parameters for each species are used;
b)a data base on climatic requirements of as many varieties as feasible for each species relevant to the agricultural production system of a given region.

By means of this approach, the adaptability of some olive cultivars was evaluated in a composite (hills and plains) area of Southern Italy (Valle Telesina, Campania Region, about 20.000 ha). The yearly average temperature is 22.5 [U+FFFD]C and rainfall ranges between 600 and 900 mm.
Two different climate scenarios were considered: current climate (1961-1990) and future climate (2021-2050). Future climate scenarios at low spatial resolution were generated with general circulation models (AOGCM) and down-scaled by means of a statistical model (Tomozeiu et al., 2007). The climate was represented by daily observations of minimum, maximum temperature and precipitation on a regular grid with a spatial resolution of 35 km; 50 realizations were used for future climate.
The soil water regime of 45 soil units was described for the two climate scenarios by using an hydrological distributed model (SWAP). For 11 olive cultivars, the yield response function to soil water regime was determined through the re-analysis of experimental data (unpublished or derived from scientific literature). According to these responses, cultivar-specific threshold values of soil water (or evapotranspiration) deficit were defined. The soil water regime calculated by the distributed model was compared with the threshold values to identify cultivars compatible with present and expected climates. The operation is repeated for a set of realizations of each climate scenario. This analysis is performed in a distributed manner, i.e. using the time series for each model grid to assess possible variations in the extent and spatial distribution of cultivated area of olive cultivars.
In the study area future climate scenarios predict an increase of monthly minimum and maximum air temperature of about 2 [U+FFFD]C during the summer (June, July and August) and a reduction of rainfall in autumn.
Spatial pattern of cultivars[U+FFFD] distribution, according their threshold values and soil water regime, was determined in the present and future climate scenarios, thus assessing variations in cultivars[U+FFFD] adaptability to future climate with respect to the present.

Key words: climate change, biodiversity, water availability, yield response.

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