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Climate stressors' interplays modulating interannual olive and grapevine yields in Italy: a composite index approach

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Even though a large part of the Italian peninsula is characterized by a Mediterranean climate intrinsically highly suitable for olive and grapevine cultivation, farmers may experience variable agronomic and management costs due to interannual yield variability. A synoptic picture of major climate stressors and their ongoing impacts on olive and grapevine yield variability at a broad spatio-temporal scale are scarce, but, if identified, could enhance the development of actionable services to alert stakeholders of potential climate risks. We analyzed Italian olive and grapevine yield data from the Italian National Statistics Institute (ISTAT), aggregated at the provincial level, during 2006-2021, and several climatic variables from Reanalysis v5 (ERA5) of the European Centre for Medium-Range Weather Forecasts (ECMWR) to *i*) explore yields trends and inter-annual variations over the whole peninsula; *ii*) identify major climate stressors likely responsible for the largest drops in yield; *iii*) build a composite index that summarizes the risk of having exceptionally low yields due to the occurrence of multiple climate stressors. To this end, we defined two major classes of yield, namely exceptionally low and high yields (^{L}Y and ^{H}Y, respectively), and explored the climatic variables, aggregated on a monthly (grapevine) and bimonthly (olive) time scale, determining yield in outcomes. It is worth noting that the use of monthly or bimonthly periods provides a means of examining the seasonal effects of stressors while providing the basis for near-real-time forecasting. Selected years, characterized by a conspicuous number of both ^{L}Y and ^{H}Y, were focused to examine whether the composite risk index has application at more local scales. Results are discussed and some possible explanations based on the current knowledge of olive and grapevine physiological developmental. We suggest our approach as a promising yet still in-progress work that could pave the way to an integrated meteorological seasonal forecast system to provide timely insight on factors affecting within-season yield development.