Field study on multifunctional irrigation of vineyards

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**Abstract.** Due to climate change, grapevine is increasingly exposed to both thermic stress and water stress, that affect the physiological activity and the phenological stages of vine. In particular, high temperature can accelerate ripening, involving in excessive sugar accumulation and high alcohol in the wine, reducing the total acidity due to a faster degradation of organic acids. Beside the technological ripening, the temperature increase also affects the synthesis and the accumulation of polyphenols, vitamins, and aromatic compounds in berries. The effect of the warming conditions is aggravated by the increasing exposure of vines to water stress, due to decreasing trend of rainfall during spring and summer. Depending on the level and the phenological stage, water stress reduces the yield and affects the quality of grapes. The warming trend not only affects grape ripening, determining an impact on grape and wine quality, but also induces an anticipation in the sprouting phases of the vine, increasing the risks caused by late spring frosts. Low temperature during sprouting can involve to the loss of buds and shoots (Poling, 2008), reducing the production of grape.

Different adaptation strategies could be adopted in viticulture to counter the emerging problems related to climate change, including both long-term measures (e.g., changes in vineyard locations) and short-term ones (e.g., use of tolerant varieties, of shading systems, of wind machines, of delayed pruning). Smart irrigation strategies are also an option and in this study we explored a multifunctional approach to vineyard irrigation, capable to counter the negative effects of excessively high summer temperatures and of late spring frosts, as well to provide hydric nutrition when needed. The capacity of evaporating water to achieve the canopy and berry cooling has been well studied from 1970s. The first studies considered overhead cooling sprinkler systems, that mainly water the outer canopy layer and only partially the bunch zone. More recently micro-sprinkler cooling system inside the canopy at the bunch level were also applied. Overvine sprinklers have been widely applied also for protection from frosts, allowing to form a layer of ice over vines that keeps the temperature slightly above the critical values and preventing damages of buds and shoots.

Our study was conducted during the 2020 and 2021 agricultural seasons, in a commercial vineyard located in Cavriana, Italy, at 135 m a.s.l. in the viticultural area of Garda Colli Mantovani DOC. The grapevine variety is Chardonnay, grafted on rootstock 420A; the vines are trained using Guyot system. Soil between rows is grass-covered with periodic mowing. Eight plots were designed within the experimental vineyard to compare four different irrigation strategies The following strategies were considered: i) automated drip irrigation; ii) automated drip and sprinkler irrigation; iii) traditional drip irrigation, iv) no irrigation. Results obtained during the two seasons highlight the potential of automated, multifunctional irrigation for protecting from thermal stress and increasing water use efficiency in vineyards.