Geophysical Research Abstracts
Vol. 21, EGU2019-6086, 2019
EGU General Assembly 2019

Evaluating the effect of a biostimulant on growth performance and productivity of Vitis vinifera 'Aglianico' through a multidisciplinary approach tracing functional traits in the continuum soil-plant-atmosphere

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Grapevine is the most widely cultivated fruit crop in the world and Italy is one of the world's leading wine-producing countries whose vineyards are facing environmental constraints due to climate-change-driven rising temperatures, changes in precipitation frequency and occurrence of extreme events.
In this scenario, the use of biostimulants to improve vines' capacity to cope with biotic and abiotic stressors is considered a promising practice in vineyards. Indeed, specific products can be a useful tool to improve the vineyard resource use efficiency, enhancing the tolerance to water scarcity and excess solar radiation. Moreover, by strengthening plant tissues and improving resistance to diseases, they can complement the utilization of chemicals in the pest control for a more sustainable crop management.
In this study, we tested four different combinations of a biostimulant and conventional chemicals for pest control on growth performance and berry quality in Vitis vinifera L. subsp. vinifera 'Aglianico'. The study was conducted in a vineyard (Fonzone-Caccese) located in southern Italy (Avellino), where vines, trained to cordon spur pruned system, were planted with E-W row orientation and 2.2 $\times$ 1 m spacing (about 4545 vines/ha) in 2006.
The vineyard performance was monitored over two years characterized by different climatic conditions, especially concerning precipitation. Vines subjected to the different treatments were compared on the basis of several morphological and eco-physiological parameters, measured in the main phenological phases, including: plant architecture, fertility, leaf anatomical traits, photosynthetic efficiency (by determination of quantum yield of PSII electron transport, maximal photochemical efficiency and pigment content), leaf gas exchanges, stem water potentials, etc. The nutritional status was characterized by analyzing minerals (anions, cations) and organic acids in leaves and berries. Water use efficiency was estimated through the analysis of stable isotopes in plant and must. Berry quality was evaluated by measuring soluble solids, pH, acidity, phenolics, anthocyanins, etc. Geomorphology and pedological analyses allowed to interpret the data about plant performance also considering the spatial variability of soil properties and real water availability for the plants. Finally, a retrospective analysis through satellite images was realized, to further validate data on plant performance over the two years field monitoring at a larger scale.
The overall results showed that the expected differences in growth performance and productivity in vines were consequent to different eco-physiological and structural properties induced by the various treatments, suggesting a different capability to modulate gas-exchanges and resource use efficiency. Plants' response was also strictly linked to soil variability especially when the growth season is characterized by long drought periods.
The applied multidisciplinary approach proved to be promising to achieve a comprehensive understanding of the vine response in the continuum soil-plant-atmosphere, thus furnishing information about structural and physiological plant behavior as valuable inputs to manage terroirs in the sight of climate change.