ZEOWINE: the synergy between zeolite and compost. Effects on vine physiology and grape quality

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ABSTRACT

Climate change has a relevant impact on the vines maturation. The consequences are directly reflected in the quantitative and qualitative characteristics of the grapes. There is an imbalance of maturation: the sugar content is in excess compared to anthocyanins content. This work aimed to evaluate the effects of Zeowine (organic compost added zeolite) on ecophysiology, technological maturity and phenolic maturity of Vitis vinifera L. cv Sangiovese. 3 treatments have been established: Zeowine, Zeolite and Compost. During the season, measurements were made of single-leaf gas exchange and midday water potential. In addition, the parameters of technological maturity (° brix, acidity and weight of berries) and the anthocyanins content were analyzed. Zeowine treatment showed less negative water potential, a higher rate of photosynthesis, and higher levels of anthocyanins.

Article extracted from Eleonora Cataldo's presentation in occasion of Enoforum Web Conference (23-25 February 2021)

Introduction.

Identification of zeolite as a mineral goes back to 1756, when a Swedish mineralogist, Fredrich Cronstet, began collecting some well-formed crystals from a copper mine in Sweden. They were named “Zeolite” from the Greek words meaning “boiling stones”, that is, because of ability to froth when heated (Kaduk and Faber, 1995).

Zeolites are hydrated aluminosilicates, characterised by three-dimensional networks of SiO4 and AlO4 tetrahedra, linked by the sharing of all oxygen atoms. The partial substitution of Si4+ by Al3+ results in an excess of negative charge which is compensated by alkali and earth alkaline cations (Schöllhorn, 1984).

Zeolites have many important tasks such as ion exchange, filtering, odour removal, chemical sieve, water softener and gas absorption (Colella and Mumpton, 2000).

In agriculture the natural zeolites are widely used as slow releasing carriers of fertilizers as well as other agrochemicals such as insecticides, pesticides, antibacterial agents, growth stimulators, for improving the fertility and biological activity of the soil, recultivation and increasing the production capacity of acid and devastated soils, increasing the nitrogen balance especially in light and sandy soils. They are also useful from the ecological point of view for removing harmful wastes from the soil such as sorption of heavy metals and other toxic compounds (Flanigen and Mumpton, 1981; Janjgava et al., 2003).

In the light of current climate change, improving farming practices is more than ever a necessity and all these aspects suggest the possible positive contribution of zeolite in reducing the doses of fertilizers to be distributed, while maintaining/increasing the quality of the product, reducing production costs and limiting the risks of environmental pollution. The aim of this study was to evaluate the synergistic impact of compost and zeolite (Zeowine) on physiological activity, yield and quality parameters of Sangiovese grapes (Vitis vinifera), with particular interest in achieving the balance between technological maturity and phenolic.

Material and Method

The experimentation was set up in the San Miniato area (Pisa, Tuscany) in Central Italy. The climate is Mediterranean, semi-arid, with a mean annual precipitation of 830 mm and a mean annual temperature of 15°C.

Using the experimental randomized block design with 5 repetitions per treatment, the comparison was set between: Zeowine (30 tons per hectare), Zeolite (10 tons per hectare) and Compost (20 tons per hectare). During the 2020 season, reliefs of leaf gas exchanges were carried out with Ciras 3 (PP Systems). From the beginning of September until the harvest, 150 grapes were taken from each repetition for the determination of soluble sugars (°Brix), titrable acidity (g/L of tartaric acid) and the berries weight (g). Analyses of the potential content of total and extractable anthocyanins (mg/L) were carried out on a similar sample using glories' proposed method. The collected data was subjected to variance analysis with SPSS Data Editor. For multiple comparisons between treatments, Fisher's significant minimum difference (DMS) was reported and statistically significant differences were taken with $P<0.05$.

Results and discussion.

The 2020 growing season in which the experimentation took place was characterized by the following meteorological trend: the average temperatures of the summer period stood at 25-30 °C, accompanied by poor rainy events in June and July. The soil's water reserves only reintegrated with september rains after harvest.

As regards gaseous exchanges on single leaf, there are significantly higher values in net photosynthesis for the thesis treated with Zeowine (Fig. 1).

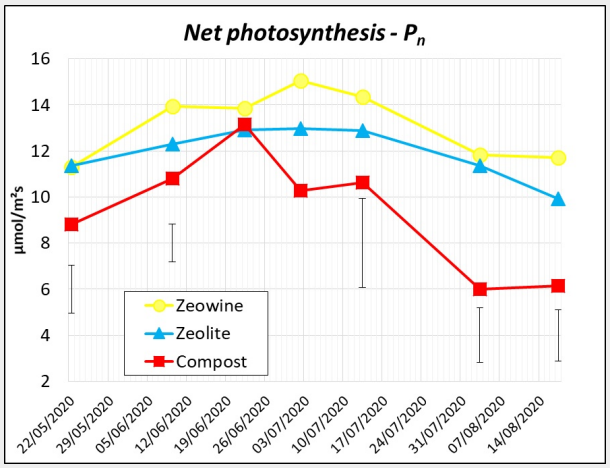

Fig. 1 - Seasonal net photosynthesis values (µmol/m2s). Bars are LSD (P<0.05).

The stomatic conductance in zeowine and zeolite thesis has never fallen below 100mmol/m2s, a threshold that is taken as a reference in the assessment of the plant's water stress. As can be seen from the results of the midday water potential Zeowine and Zeolite have reduced water stress (Fig. 2).

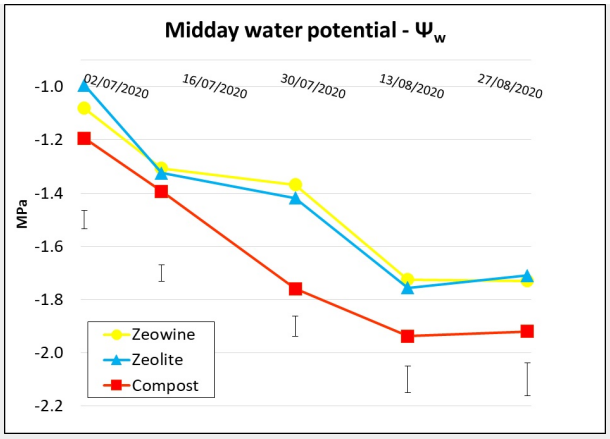

Fig. 2 - Seasonal midday water potential values (MPa). Bars are LSD (P<0.05).

There are significant differences in the parameters of the technological maturation of the grapes and in the coloring substances that are superior in the grapes of the theses treated with Zeowine and Zeolite (Fig. 3).

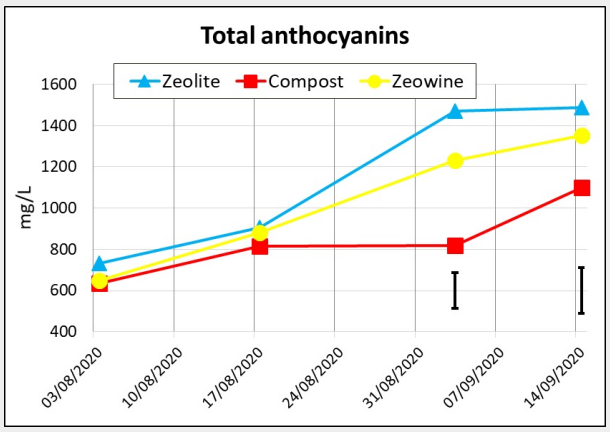

Fig. 3 – Total anthocyanins values (mg/l). Bars are LSD (P<0.05).

Conclusion. With a view to reducing the phenomena of imbalance between technological maturity and phenolic maturity caused by the interactions between current global warming and the changed techniques of soil management, Zeowine treatment can represent a valid agronomic management. In general, it can be hypothesized that this product, improving the efficiency of water use and minimizing water stress, addresses the activity of the plant to maximize photosynthesis and accumulation of substances of secondary metabolism.

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