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Zeolite and attapulgite foliar applications improve the photosynthetic performance of ‘Muscat Hamburg’ grapevines

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INTRODUCTION & AIM

Climate change has significantly altered weather patterns, with elevated temperatures and heatwaves emerging as major environmental challenges for viticulture. High temperatures can negatively affect grapevine growth, maturity, and overall quality. In response to these challenges, there is an increasing interest in sustainable, cost-effective mitigation strategies that reduce reliance on chemical inputs. The aim of the study was to evaluate the effects of foliar applications of zeolite and attapulgite on the ‘Muscat Hamburg’ cultivar.

METHOD

An open-field experiment was conducted to assess the effects of foliar applications of zeolite and attapulgite on the grapevine cultivar ‘Muscat Hamburg’ under the Mediterranean conditions in Central Greece, particularly in Tyrnavos Region. The experiment was performed in the growing season 2023 - 2024 with three treatments (control, zeolite applied at 4% w/v, and attapulgite applied at 4% w/v) and five replications.The chemically inert mineral particles were applied as foliar sprays on 10/06/2024, 08/07/2024 και 11/08/2024 (Figure 1). Analysis of variance was conducted for all data and differences between means were separated using Duncan test at p<0.05.

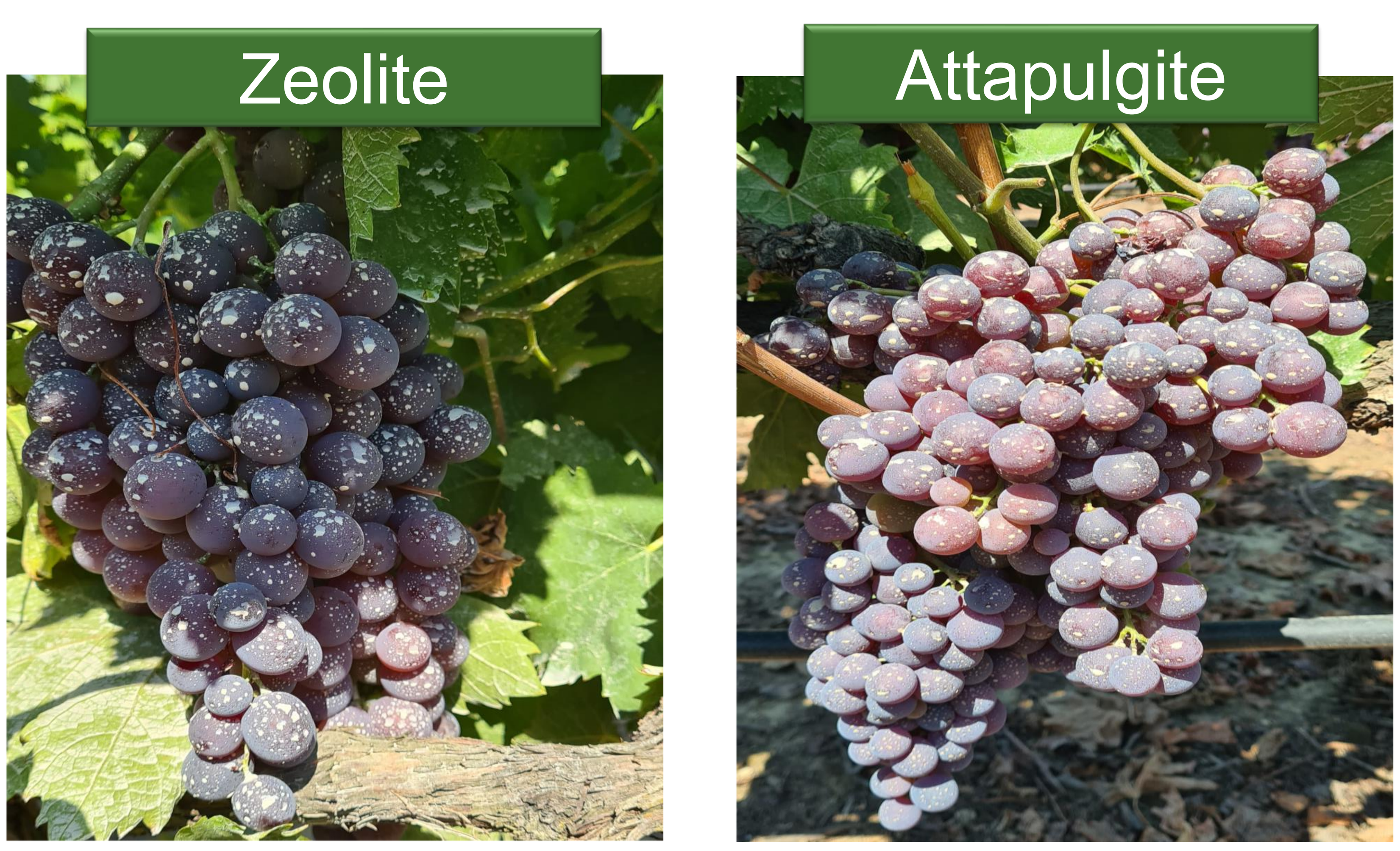

Figure 1. Foliar applications of zeolite and attapulgite.

RESULTS & DISCUSSION

The application of chemically inert mineral particles significantly decreased leaf temperature and enhanced physiological performance in veraison and maturity stages, particularly during the midday. Specifically, stomatal conductance (gs), transpiration rate (E), and net photosynthetic rate (A) were significantly increased compared to the control (Figures 2 and 3).

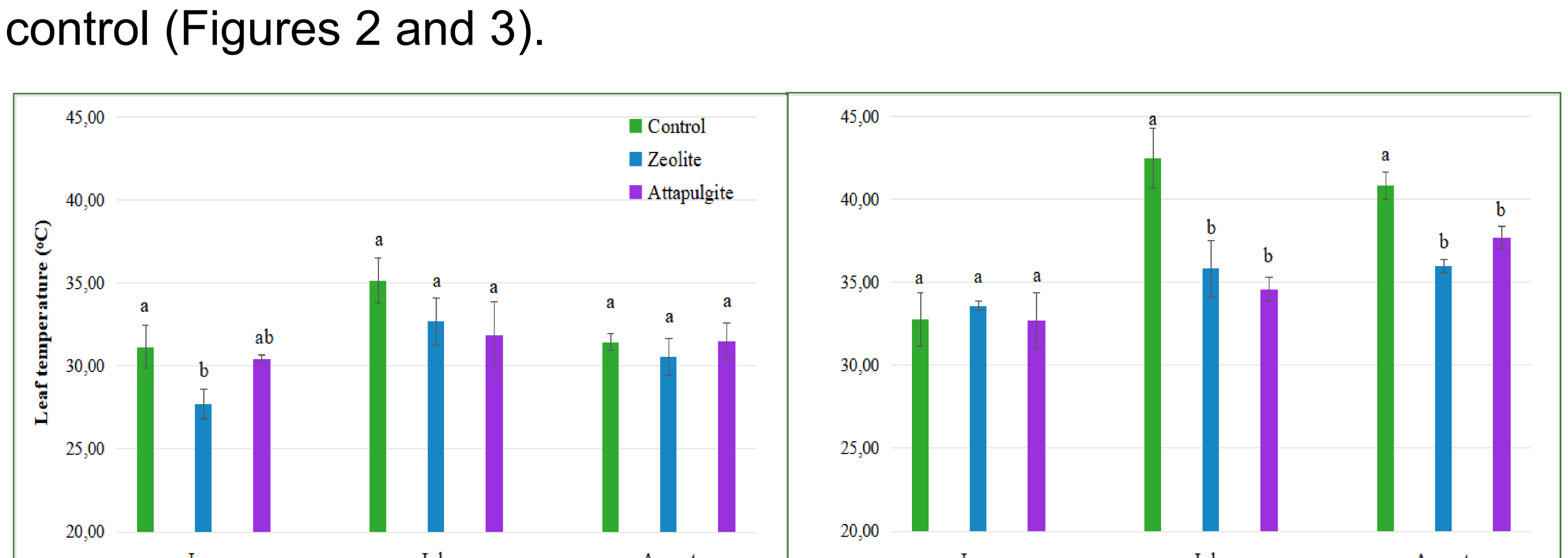

Figure 2.Effect of foliar applications (Control, Zeolite, Attapulgite) on leaf temperature in morning (a) and midday (b) measurements.

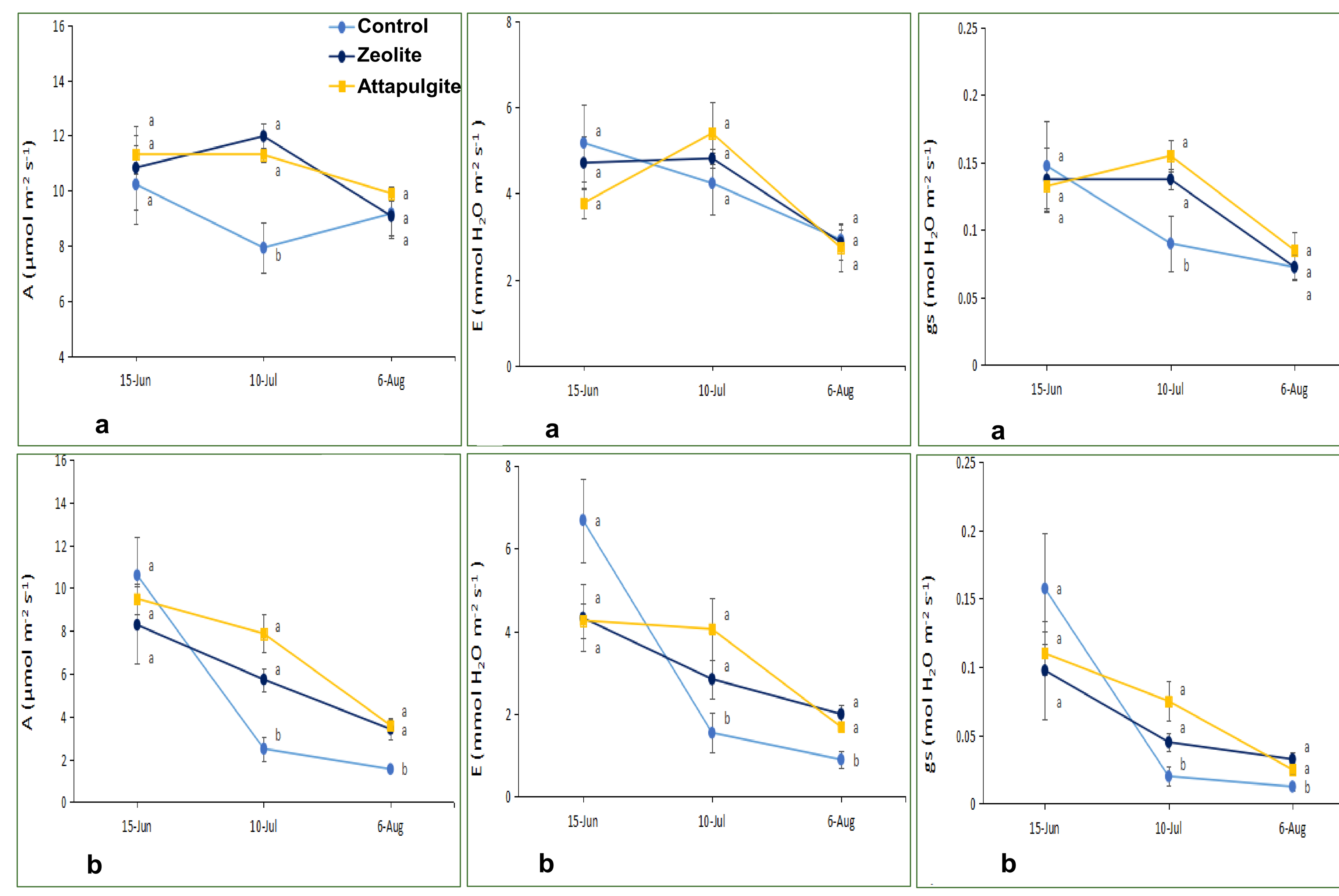

Figure 3.Effect of foliar applications (Control, Zeolite, Attapulgite) on leaf photosynthseis (A), transpiration (E), and stomatal conductance in morning (a) and midday (b) measurements.

Regarding yield components, foliar applications did not significantly affect yield per vine, number of clusters per vine, cluster width and length, and berries weight (Table 1). However, attapulgite application led to a significant increase in cluster weight, cluster density, and number of berries per cluster. Additionally, both zeolite and attapulgite significantly increased the relative skin mass.

Table 1.Effect of foliar applications on yield, cluster and berries characteristics

Parameter	Control	Zeolite	Attapulgite
Yield (Kg/vine)	4.77 a	4.71 a	5.58 a
Cluster width (cm)	14.80 a	15.40 a	15.20 a
Cluster length (cm)	20.75 a	18.80 a	21.70 a
Cluster weight (g)	259.02 b	255.81 b	327.31a
Density (berries/cm)	3.62 b	4.09 ab	4.62 a
Berries per cluster	78.00 ab	71.20 b	94.00 a
Berry weight (g)	3.32 a	3.61 a	3.50 a
Relative skin mass (%)	7.68 b	10.20 a	9.43 a

In terms of grape quality traits, total acidity (TA) was not affected by foliar applications, although attapulgite significantly increased must pH, while zeolite application led to a reduction in total soluble solids (TSS) (Figure 4).

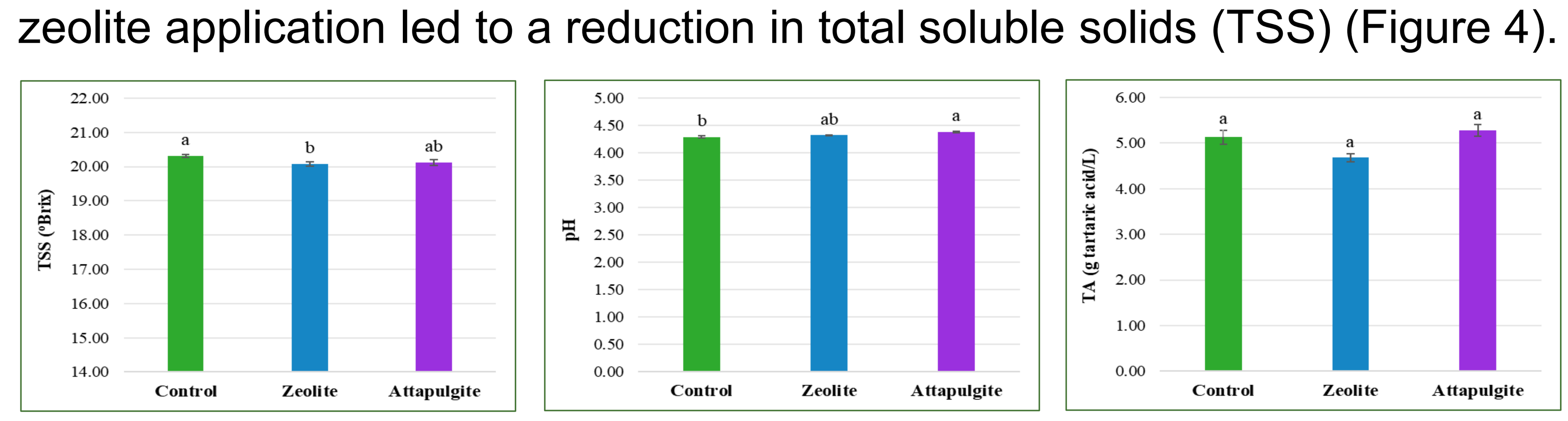

Figure 4.Effect of foliar applications (Control, Zeolite, Attapulgite) on quality traits.

CONCLUSION

Foliar applications of zeolite and attapulgite can be integrated into sustainable viticultural practices to mitigate the adverse effects of high temperatures. By reducing leaf temperature and improving physiological performance, these treatments contribute to the protection of grapevines under heat stress conditions.