DIVERSITY IN GRAPE COMPOSITION FOR SUGARS AND ACIDITY OPENS OPTIONS TO MITIGATE THE EFFECT OF WARMING DURING RIPENING

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Abstract:

Context and purpose of the study - The marked climate change impact on vine and grape development (phenology, sugar content, acidity …) is one of the manifestations of Genotype X Environment X Management interactions importance in viticulture. Some practices, such as irrigation, can mitigate the effect of water deficit on grape development, but warming is much more difficult to challenge. High temperatures tend to alter the acid balance of the fruit with a parallel increase in sugar concentration. In the long term, genetic improvement to select varieties better coping with temperature elevation appear as a good option to support sustainable viticulture. Nevertheless, the existing phenotypic diversity for grape quality components that are influenced by temperature is poorly understood, which jeopardizes breeding strategies. The purpose of this study was to characterize the phenotypic diversity present in the genetic resources of Vitis vinifera or that could be implemented by breeding.

Material and methods - Two critical grape development stages were characterized comparing 33 genotypes, including 12 wine grape varieties and 21 microvine lines. Berry softening and growth were precisely monitored to target the onset of ripening and physiological ripening. Main primary metabolites and cations were analysed in order to assess the genotypic differences in fruit sugars/organic balance and titratable acidity.

Results - The phenotypic diversity observed in this study was higher than initially expected. In the mature stage, the weight of the berries varied from 1.04 to 5.25 g and the sugar concentration from 751 to 1353 mmol.L-1. The organic acid composition varied both in concentration (from 80 to 250 meq.L-1) and in composition with a malate / tartrate ratio of between 0.13 to 3.62. A correlation between this ratio and the weight of berries was found. Moreover, a great diversity of cation content has been observed. The potassium content, which is the major cation in the grape, varied between 28 and 57 mmol.L-1 at physiological maturity. This combined with variations in organic acid contents, led to a range of titration acidity from 38 to 215 meq.L-1. This experiment showed that the phenotypic diversity already present in V. vinifera varieties or to be obtained by crossing opens up new perspectives for mitigating the effects of climate change on the composition of berries, notably the rise in temperature.

Keywords: Grapevine, climate changes, warming, breeding, grape composition, sugar/acidity balance.

1. Introduction.

Diversity in grape composition for sugars and acidity opens options to mitigate the effect of warming during ripening

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Purpose - In the long term, genetic improvement to select varieties better coping with temperature elevation appear as a good option to support sustainable viticulture. The purpose of this study was to study the phenotypic diversity available in Vitis vinifera for grape primary metabolites and main determinants of the must acidity.

Material & methods – During 2 years, 2 critical grape development stages were characterized for 33 genotypes, including 12 wine varieties and 21 microvine lines. Berry softening and growth were monitored to target the onset of ripening and physiological ripening. Main primary metabolites and cations were analysed in order to assess the genotypic differences in fruit sugars/organic balance and titratable acidity.

Main results - Berry weight at ripening varied from 1.04 to 5.25 g and sugar concentration from 751 to 1353 mmol.L^{-1}. The organic acid composition varied both in concentration (80 to 250 meq.L^{-1}) and in composition with a malate / tartrate ratio of between 0.13 to 3.62. The potassium content, which is the major cation in the grape, varied between 28 and 57 mmol.L^{-1} at physiological ripening. This, combined with the variation in organic acid contents, led to a range of titration acidity from 38 to 215 meq.L^{-1} at grape physiological ripening.

Fig. 1* - **Sugar** concentrations in varieties and microvine fruits

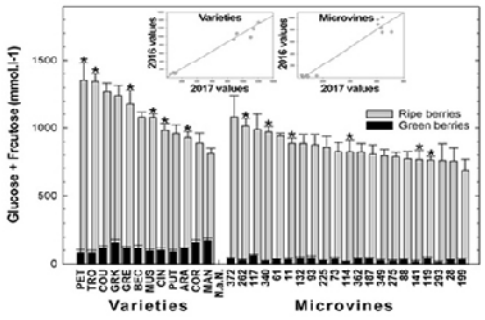


Fig. 2* - **Malic/tartaric** acid ratio in varieties and microvine fruits

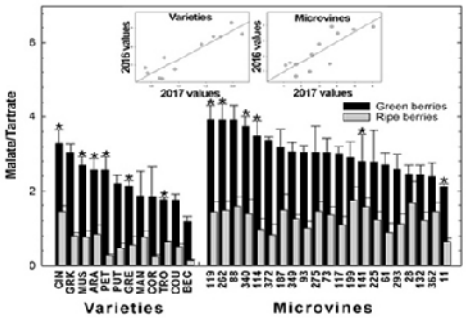


Fig. 3 - **Potassium** concentrations in varieties and microvine fruits

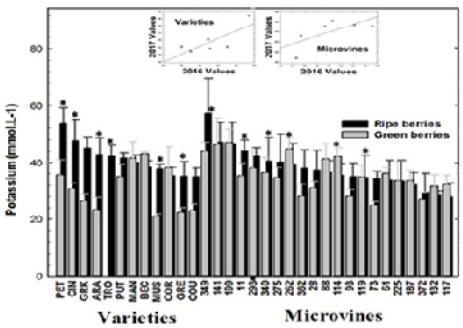
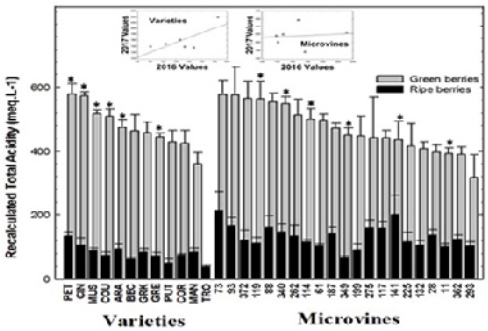


Fig. 4 - Recalculated **Total Acidity** in varieties and microvine fruits



Conclusion - The phenotypic **diversity in *V. vinifera*** varieties or to be obtained by crossing opens new perspectives to **mitigate the effects of climate warming** on grapevine fruit composition.