STABLE OR DYNAMIC?
HOW PHENOTYPIC PLASTICITY COULD BE KEY TO SELECT FOR GRAPEVINE ADAPTATION?

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Abstract:

Context and purpose of the study – Climate change will require the adaptation of agricultural systems and among the different means of adaptation, changing plant material is a promising strategy. In viticulture, different levels of diversity are currently exploited: clonal and varietal diversity for rootstocks and scions. A huge quantity of research aims to evaluate different genotypes in different environmental conditions to identify which ones are the best adapted and the most tolerant to future environmental conditions. In general, traits are usually analyzed independently in each environmental condition. Far less research effort has been devoted to studying phenotypic plasticity (PP), i.e. characterizing the variation of a trait in two or more different environments. Our work aims to address the question: can PP be leveraged to select genotypes better adapted to adverse environmental conditions.

Material and methods - Phenotypic plasticity was studied in response to environmental conditions (different climatic or soil conditions) and in response to the scion genotype. Spatial variations were studied with multisite experiments in one research project and in a network of experiments in another project. Phenotypic plasticity was calculated in different ways: differences between the values obtained in two different environments, the variance within the different environments or the slope of a response curve between an environmental variable and a trait (which are not necessarily linear).

Results – Different examples will be presented: root related traits measured in different environmental conditions, rootstock conferred vigor-related traits measured with different scions, and rootstock control of transpiration responses under increasing water deficit. In some cases, genotypes showed the absence of significant differences in a given environment, but these genotypes could have differences in PP, highlighting the interest of studying the response of traits to environmental conditions and not just absolute values. The tradeoffs between PP and fitness (evaluated as vigor or yield) will be discussed. A stable response across different environments could be an indicator of higher levels of adaptation in some cases, whereas a plastic behavior could related with a better adaptation to situations of adverse abiotic environmental conditions.

Significance of the study - Our work highlights the interest in evaluating and understanding PP in plant breeding programs and genetic selection.

Keywords: Grapevine, Transpiration, Growth, rootstock × scion interactions, genotype × environment interactions