A 3-years PhD position on grapevine physiology at Montpellier

Physiological and Transcriptional Determinism of the *LowSugarBerry* Trait and its Impacts on the Performance of the Vine under Soil-Air Water Deficits (Acronym: *LoSuBe*)

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Context: In Mediterranean regions, the rise in temperature and drought hampers the grape yield and quality potential while increasing production costs (due to increased irrigation and pesticide use). In addition to these **environmental and economic constraints**, there is a high societal demand for reducing input usage (water, fertilizers and pesticides). Therefore, the **sustainability of viticulture** requires exploring news practices to reduce the use of input while maintaining acceptable yields and quality levels. **New grapevine varieties** displaying **low sugar contents in berries** (**L**ow**S**ugar**B**erry, LSB) and **resistant to mildews** could make smarter vineyards both more resilient to climate change (global warming, drought) and less reliant on chemicals (Bigard et al., 2022). Indeed the lower sugar concentration helps mitigating wine alcohol content (Ojeda et al., 2017), while decreasing the sensitivity of these varieties to summer drought during ripening. However, current selection programs inadequately address the adaptation criteria to climatic constraints (Wilhelm et al., 2021, 2023). Notably, the **acclimation properties of these varieties** in terms of water and carbon (C) management, together with the **causal mechanisms of the LSB trai**t and their impacts on water (W) and C fluxes at the leaf-fruit interface, in response to soil and/or air water stresses have not been precisely studied.

Objectives: To compare the C metabolism and W balance responses of LSB and non-LSB genotypes grown under several levels of soil and/or air W deficit, and to dissect the origin of the LSB trait through detailed analyses of berry tissue structure and composition and fruit transcriptome. This corresponds to **three questions** based on **two hypotheses**:

Q1. *Are there specific characteristics related to the LSB trait in the* ***management of W loss and C gain*** *established at the leaf and whole plant scales?*
Q2. *How does the LSB trait affect the intensity and dynamics of* ***W and C fluxes to the fruits*** *during cellular expansion, green growth, and maturity phases?*
Q3. *Which are the* ***structural and functional properties of fruit cells*** *(skin, pulp) associated with the LSB trait?*

H1 *(Q1, Q2):* ***The lower sugar accumulation in fruits*** *of LSB varieties could, at equivalent fruit yield, confer* ***greater C status homeostasis*** *at the vine-grape interface under soil-air W constraints;*
H2 *(Q3): The anatomy and biochemical composition of the skin and/or pulp cell walls in LSB varieties may favor their expansion capacities,* ***decoupling W and solute imports during fruit development****.*

Working plan: The program will be organized around **three main tasks** conducted in the field and under controlled environments using a panel of grapevine and microvine genotypes resistant to fungal diseases and displaying the LSB trait. **First,** the variations in water demand and carbon gain induced by the LSB trait under soil/air W constraints will be quantified. Leaf photosynthetic functions and carbon and water balances at organ (leaf, fruit) to whole plant scales, with equivalent water demand (same yield) or carbon allocation (same amountof berry sugar demand), will be compared between LSB and non-LSB varieties subjected to different soil and/or air water regimes. **Secondly,** the structural and functional origin of the LSB trait in berries during the three berry development phases will be studied. The goal here is to identify a link between the structure and/or composition of skin and/or flesh cells in the variations of water and carbon fluxes to berries and their consequences on fruit rheology. The evolution of berry firmness will be analyzed in collaboration with UMR SPO (Dr. F. Mabille), who is currently developing a dedicated clamp for non-destructive study of berry mechanic properties. The biochemical characteristics of flesh and skin cell walls of the fruit will be determined in collaboration with the UR BIA Nantes (Dr. Lahaye, AL Chataignier-Boutin, who are experts in fleshy fruit cell wall composition; Lahaye et al 2020, 2021) and/or the University of Stellenbosch (Dr. Moore, expert in grape cell wall structure; Gao et al., 2015, 2020) and/or the UMR BFP Bordeaux that developed specific probes to target in fleshy fruits (Musseaux et al., 2020). **Thirdly,** after monitoring single berry growth, berries will be collected at specific physiological stages (Savoi et al., 2021) to identify differentially expressed genes (DEGs) linked to functional categories and (iso)genes co-regulated with the LSB trait.

Student skills to be acquired during the project: Experimental and analytical skills in ecophysiology and fruit biology by interacting internally and through planned collaborations with biochemists, ecophysiologists, and specialists in fruit cell wall structure. Methods and communication skills through oral presentations (seminars, participation in an international conference) and scientific document writing (thesis and articles). Critical thinking and mentoring abilities (co-supervising interns with thesis supervisors).

Required skills of the candidate: student with a confirmed knowledge and interest in ecophysiology and/or molecular physiology. A good knowledge in statistical analyses (with R software) applied to large dataset is also required. Open minded student able to communicate with researchers belonging to different research units.

Education: Master in degree in agronomy, in plant biology or molecular physiology.

Gross salary: 2 200 € / month (including social security contributions)

Literature:

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Wilhelm L., Pellegrino A., Ojeda H., Torregrosa L. (2021) Caractériser la tolérance à la sécheresse des nouvelles variétés résistantes aux maladies fongiques : complexité des processus physiologiques sous-jacents de l'adaptation aux contraintes hydriques. Revue des Oenologues 181 : 1-4.

Wilhelm L., Pellegrino A., Fontez B., Torregrosa L., Ojeda H. (2023) Short and long-term acclimation to water status at leaf and plant level of fungus-tolerant genotypes. OenoOne, https://doi.org/10.20870/oeno-one.2023.57.2.7431.