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► To cite this version:

Markus Rienth, Laurent Torregrosa, Mary Kelly, Nathalie Luchaire, Ratthaphon Chatbanyong, et al.. The night transcriptome of grapevine berries reveals new insights in developmental pattern and heat stress response. 11. International Conference on Grapevine Breeding and Genetics, Jul 2014, Beijing, China. hal-01601505

HAL Id: hal-01601505

<https://hal.science/hal-01601505>

Submitted on 3 Jun 2020

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The night transcriptome of grapevine berries reveals new insights in developmental pattern and heat stress response

Markus Rienth^(1,2), Laurent Torregrosa⁽²⁾, Mary Kelly⁽³⁾, Nathalie Luchaire^(2,4), Rattaphon Chatbanyong⁽²⁾, Morgane Ardisson⁽²⁾, Gautier Sarah⁽²⁾, Agnès Agorges⁽³⁾, Angélique Adivèze⁽²⁾, Catherine Roux⁽²⁾, Valérie Miralès⁽²⁾, Gilbert Lopez⁽²⁾, Mark Farnos⁽²⁾, Frederico Novelli^(2, INSTITUT Brasil), Clea Houel⁽²⁾, Anne Pellegrino⁽⁴⁾, Jérôme Grimplet⁽⁵⁾, Charles Romieu⁽²⁾ *

¹*Fondation Jean Poupelain – Javrezac, France*

²*Montpellier SupAgro-INRA, UMR AGAP, 2 place Pierre Viala, 34060 Montpellier, France*

³*INRA, UMR 1083 SPO, 2 place Pierre Viala, 34060 Montpellier, France*

⁴*INRA, UMR LEPSE, 2 place Pierre Viala, 34060 Montpellier, France*

⁵*ICVV (CSIC, Universidad de La Rioja, Gobierno de La Rioja), Logroño, 26006, Spain*

**Corresponding author: romieu@supagro.inra.fr*

Keywords: berry development, day-night transcriptome, RNA-seq, heat stress, microvine

Global climate change impacts grapevine fruit and consequently wine quality in all growing regions. This is mainly due to increasing temperatures altering vegetative and reproductive development of plants. A better understanding of the molecular mechanisms involved in the response of the grapevine to temperature will be essential in order to develop new breeding strategies and adapt to changing environments. However, most processes occurring during normal berry development are not fully understood yet, even less so, the regulation that is at the basis of its response to abiotic stress. In addition, while plant gene expression is known to be highly dependent on diurnal patterns, there is no detailed study on the relevance of this factor on fleshy fruit, including the grapevine berry.

In the present study, gene expression along berry development was investigated during the day and at night under “normal” and heat stress conditions using microvines (**Dwarf Rapid Cycling** and **Flowering** mutant) grown under fully controlled conditions. Whole genome transcriptomic approaches were carried out using either Nimbelgen[®] 12X, 30K microarrays or illumina RNA-seq technology.

Results on berry development revealed significant differences between day and night where many developmentally regulated transcripts exhibited a more distinct pattern at night than during the day. Furthermore, critical pathways were differently day – night modulated depending on the stage of berry development. Cell wall-related processes were found to be highly active during the night in green berries, while in ripening berries secondary metabolism, notably the phenylpropanoid pathway was night activated.

These new insights in the day - night regulation of the transcriptome were used for the design of further experiments where heat stress periods of differing duration (2h up to 4 weeks) and intensity were applied to berries at different developmental stages (green, onset of ripening, ripening and maturity) during the day and at night. Results revealed significant differences in the plasticity of fruit response to heat stress as a function of time and developmental stages.