

## What triggers the decision to ripen?

Sara Zenoni<sup>1\*</sup>, Chiara Foresti<sup>1</sup>, Alessandra Amato<sup>1</sup>, Erica D'Incà<sup>1</sup>, Nicola Vitulo<sup>1</sup>, Mario Pezzotti<sup>1</sup>, Tomas Matus<sup>2</sup>, Giovanni Battista Torielli<sup>3</sup>, Marianna Fasoli<sup>1</sup>

<sup>1</sup> Department of Biotechnology, University of Verona, Strada Le Grazie 15, 37134, Verona, Italy

<sup>2</sup> Institute for Integrative Systems Biology, I<sup>2</sup>SysBio (Universitat de València - CSIC), 46908, Paterna, Valencia, Spain

<sup>3</sup> Department of Agronomy, Food, Natural Resources, Animals and the Environment, University of Padova, Viale dell'Università 16, 35020, Legnaro (PD), Italy

\*Corresponding author: [sara.zenoni@univr.it](mailto:sara.zenoni@univr.it)

### Abstract

The decision for grape berries to ripen involves a complex interplay of genetic regulation and environmental cues. This review explores the molecular mechanisms underlying the transition from vegetative growth to ripening, focusing on transcriptomic studies and the role of the NAC gene family. Transcriptomic analyses reveal a significant rearrangement of gene expression patterns during this transition, with up-regulation of ripening-related genes and down-regulation of those associated with vegetative growth. A molecular phenology scale providing a high-precision map of berry transcriptomic development, indicates that key molecular changes occur well before the onset of ripening. Our recent investigations highlight the involvement of NAC genes in regulating berry ripening. Among these, NAC33 is implicated in terminating photosynthetic activity and organ growth, NAC60 orchestrates both ripening and senescence processes, and NAC61 regulates berry late- and post-ripening processes. Furthermore, coexpression, DAP-seq and physical interaction analyses, revealed the existence of a transcriptional hierarchy among NACs governing ripening decisions. This abstract provides insights into the molecular events driving grape berry ripening and sets the stage for further exploration of NAC-mediated regulatory mechanisms.

**Keywords:** Ripening, Berry, Transcriptomic, Regulation, NAC.