Molecular perspectives into seed priming. The seed repair response as a key player in the pre-germinative metabolism

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Abstract

High-quality seeds are a proxy of crop establishment in view of sustainable agricultural practices. The need for increased seed quality has become a priority for facing the current demand for high standards in the agricultural market. Within this context, seed priming, a pre-sowing technique used to increase seed vigor, has become a valuable tool due to its potential to enhance germination and stress resilience under changing environments. Successful priming protocols result from the ability to properly act on the seed pre-germinative metabolism and stimulate central events. The pre-germinative metabolism, or early seed germination phase, is among the most fascinating aspects of seed biology, as it is characterized by a series of dynamic physiological, biochemical, and molecular events triggered by the rapid water uptake during imbibition. Additionally, the so-called rehydration-dehydration cycle, often associated with priming treatments, can be also described in terms of metabolic pathways that are set in motion, modulated, or turned off, depending on the seed physiological stage. Among the triggered events, DNA damage response (DDR) pathways are necessary to mitigate the mutational and growth-inhibitory effects of DNA damage which can accumulate in seeds during maturation, storage, and early germination phase when rapid water uptake can lead to ROS overproduction. High DDR activity is necessary during the pre-germinative metabolism to ensure DNA repair prior to cell division to minimize damaging effects on seedling growth and development. Understanding the ways seed priming affects (positively or negatively) such pathways and impacts gene expression represents an important step toward the identification of novel seed quality indicators. The need to expand the basic knowledge on the molecular mechanisms ruling the seed response to priming will be underlined along with the strong potential for applied research. Considering that these techniques require constant optimization, several open questions (e.g., how to identify the correct time point to stop the treatment? how to tackle inter- and intraspecific variability? how to enhance the potential of

underutilized germplasm resources?) still need to be addressed to overcome some of its drawbacks. Some of these questions and putative solutions will be discussed during this webinar, along with providing general insights into the molecular mechanisms at the base of seed priming, with a focus on the seed repair response.