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Induction of cold tolerance by priming and stress memory in crops

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Cold is one of the major environmental factors limiting plant growth and development. The increased climatic variability and more frequent episodes of extreme conditions also result in plants being exposed to not only one single cold event but also multiple abiotic stresses at different periods. Although the abiotic stresses occurring at different stages result in a higher risk of injury, earlier stress events may prime the plant to protect it against later stresses. A large body of evidence has shown that a previous exposure to different types of stress can affect the subsequent responses and eventually prepare the plants to more quickly or actively respond to future stresses. Cold stress tolerance in plants involves diverse and multiple physiological and molecular mechanisms. Priming and stress memory are key processes, by which plant may increase the tolerance to subsequent drought events. Stress memory involves multiple modifications at physiological, proteomic, transcriptional levels and epigenetic mechanisms. We summarized recent advancements in physiological, biochemical, and molecular studies related to drought priming and its effect on drought tolerance in plants. The mechanisms of drought stress memory and the possible priming induced cross-tolerance to other abiotic stresses are discussed. As one of main focuses in plant-abiotic stress research, studies on plant drought priming and stress memory is still rare. To date, most of results on plant drought priming were obtained in controlled lab experiments, which might be different from the natural conditions. Thus, in future studies, a combination of experiments from controlled lab evaluations with observations and simulation under field conditions should be performed. Collectively, to further understanding the processes and mechanisms of priming effects, eco-physiologists and molecular biologists should work together in order to reveal the complete regulation network at different levels and scales, such that management strategies could be developed to sustain crop productivity under future climate changes scenarios.

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