Comparative Analysis of Physio-Biochemical Responses to Cold Stress in Tetraploid and Hexaploid Wheat

Leila Nejadsadeghi · Reza Maali-Amiri · Hassan Zeinali · Sanaz Ramezanpour · Behzad Sadeghzade

Abstract The cellular changes induced by cold stress (CS) include responses that lead to oxidative stress and limits plant growth, metabolism, and productivity. In this study, responses of physio-biochemical to CS phases were comparatively studied in three genotypes of bread and durum wheats differing in sensitivity, two of them (Norstar, bread wheat and Gerdish, durum wheat) were tolerant to CS and the other one, SRN (durum wheat) was sensitive to CS. 14-day-old seedlings were subjected to CS (12 and 24 h) with or without cold acclimation (CA) phase. During CS, the elevated levels of electrolyte leakage index, contents of hydrogen peroxide (H$_2$O$_2$), and malondialdehyde in Norstar and Gerdish were lower than that of SRN plants. Positive correlation and co-regulation of reactive oxygen species (ROS) scavenging systems, superoxide dismutase, catalase, ascorbate peroxidase, guaiacol peroxidase, and proline especially after CA phase suggested crucial role for holding back toxic ROS levels in CS phase. However, different activities of this system resulted in different intensities of oxidative stress in acclimated and non-acclimated plants. Our results showed that a CA phase induced oxidative stress tolerance by modulating antioxidative systems. These responses confirmed the existence of wide range of genetic capacity in durum wheat to increase cold tolerance particularly in Gerdish so that the sensitivity of SRN plants to CS was linearly correlated with the more decrease of antioxidant systems. These general responses may be a sign for associating other metabolites or enzymes activities to create partly tolerance against cold-induced oxidative stress. Eventually, assessing the dynamic of cell responses in short intervals after CS without CA phases profitably could be a novel path in plant stress response investigations in a short period of time.

Keywords Antioxidative systems · Damage index · Durum · Cold acclimation · Cold responses · Lipid peroxidation · Wheat

Abbreviations APX Ascorbate peroxidase · CA Cold acclimation · CAT Catalase · CS Cold stress · ELI Electrolyte leakage index · FM Fresh mass · GPX Guaiacol peroxidase · MDA Malondialdehyde · NBT Nitro blue tetrazolium · ROS Reactive oxygen species · SOD Superoxide dismutase

Introduction

The cold, as one of the major environmental stresses, induces oxidative processes in plant cells. These processes