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Physiological and anatomical responses of wheat to induced dehydration and rehydration

Research Article

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Abstract: Hydroponically grown wheat seedlings of two prominent Bulgarian cultivars (Katya and Prelom) were subjected to 48 h osmotic stress with PEG 8000 and were then rehydrated. The degree of stress was evaluated by monitoring relative water content, lipid peroxidation level, and accumulation of free proline and hydrogen peroxide in the leaves. Anatomy and ultrastructure of leaf tissue were observed under light microscopy. After imposition of stress, drought tolerant cultivar Katya displayed higher free proline content and significantly lower malondialdehyde and peroxide concentration in leaves than in the leaves of susceptible cultivar Prelom. After 24 h of rehydration Katya showed better ability to restore leaf water status and an apparent tendency towards recovery, whereas Prelom sustained higher levels of hydrogen peroxide, lipid peroxidation products and free proline and markedly low relative water content. Here, we have uncovered some of the characteristics displayed by cultivar Katya that enable it to survive and recover from severe osmotic stress. Interestingly, there was congruence between our results and the high level of cultivar Katya drought tolerance observed in the field.

Keywords: *Hydrogen peroxide • Lipid peroxidation • Osmotic stress • PEG • Proline • Rehydration*

Abbreviations:

MDA – malondialdehyde;
PEG – polyethylene glycol;
ROS – reactive oxygen species;
RWC – relative water content.

1. Introduction

The ability to survive periods with low water supply is of great importance to all land plants. Possession of such a trait would be of practical use regarding crop plants and cereals in particular for they are main food resource worldwide. The preservation of plant functions at low plant water potential, and the recovery after water stress are the major physiological processes that contribute to the maintenance of high yield under drought periods [1]. In order to understand the mechanisms that enable plants to survive stress it is appropriate to study the reaction of tolerant species and compare it to other non-tolerant ones [2]. Drought causes various morphological, physiological and biochemical changes in plants. Among its harmful effects is the generation of highly reactive oxygen species (ROS). Some of them, hydrogen peroxide in particular, are also formed as products of normal cellular metabolism but when present at high concentrations may cause serious damage to biological molecules including lipid peroxidation, protein degradation and DNA nicking [3,4]. Free proline accumulates in many living organisms in response to a wide range of stresses such as water shortage, salinity, extreme temperatures, and high light intensity [5]. It participates in the complex cellular process of osmotic adjustment and is generally recognized as a stress marker [6]. The aptitude of some species to accumulate proline in high concentrations is often viewed as an adaptive trait towards dehydration [7,8]. The aim of the present work was to evaluate the reaction of two widespread

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