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Morpho-physiological and biochemical responses of finger millet (*Eleusine coracana* (L.) Gaertn.) genotypes to PEG-induced osmotic stress

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ABSTRACT

The effect of PEG-induced (0–25%) osmotic stress was studied in twelve diverse indigenous finger millet genotypes under various levels. With the increasing PEG concentration germination percentage, shoot length, root length, and biomass production decreased in all the genotypes. Among all the genotypes evaluated, reduction in germination percentage, seedling growth, and biomass production was more in FM/RT/01 and less in FM/ST/01. Principal component analysis (PCA) resulted in the formation of three distinct clusters, stress-sensitive (FM/RT/01, FM/RT/03, FM/SD/01, and FM/ST/02), stress-tolerant (FM/ST/01, FM/ST/03, and FM/KP/02) and moderately tolerant/sensitive (FM/KP/01, FM/RT/02, FM/RT/04, FM/RT/05, and FM/RG/01). Based on the germination percentage and growth parameters, FM/RT/01 was considered as PEG-induced osmotic stress-sensitive, and FM/ST/01 as stress-tolerant genotype. PEG-induced stress increases membrane damage (MDA content) and osmolyte accumulation (free proline, glycine betaine, and total soluble sugars) in both the genotypes. Damage to the membrane was found more in the stress-sensitive genotype (FM/RT/01) compared to stress-tolerant (FM/ST/01). The magnitude of increase in osmolyte accumulation was more in FM/ST/01 than FM/RT/01. Antioxidative enzyme activities (SOD, CAT, APX, and GPX) significantly increased with increasing PEG 6000 concentration up to 15% PEG but decreased at higher concentrations (20 and 25%) in both the genotypes. Our findings suggests, genotype FM/ST/01 genotype can be exploited for different crop improvement programs.

1. Introduction

Among abiotic stresses, the availability of water is the vital factor in shaping the evolution of the plants (Zhu, 2002). Drought is one of the most crucial issues faced by the agriculture today. In many countries, 70% of the total freshwater has been used for agriculture. To meet the requirements of the increasing population, we have to produce more food with less water (Moumeni et al., 2011). Among the abiotic stresses, drought, salinity, and cold stress-induced oxidative stress are often unified, and these conditions alone or in combination persuade various cellular damages. Such stress stimuli inducing osmotic stress in plants are complex in nature (Huang et al., 2012). Almost all the abiotic stresses including osmotic stress lead to oxidative damage and involve the formation of reactive oxygen species (ROS) in plant cells (Upadhyaya et al., 2013). However, plants developed an array of tolerance mechanisms to cope up with the oxidative damage. Activation of antioxidant enzymes and the accumulation of compatible solutes that effectively scavenge ROS are among them (Upadhyaya et al., 2013). Plant cells perceive stress stimuli via various sensors that in turn activate signaling pathways involving secondary messengers, plant hormones, signal transducers and transcriptional regulators (Cvikrová et al., 2013; Danquah et al., 2014; Gilroy et al., 2014). Multiple signals therefore unite to regulate stress-inducible genes that encode proteins and enzymes directly involved in stress metabolism, contributing to the specificity of the acclimation response to a given stress stimuli (Casaretto et al., 2016).

These environmental stresses are inter-dependent and affect almost every aspect of plant growth and development; this includes morphological, biochemical, physiological, and molecular changes. Osmotic stresses disturb the water homeostasis at the cellular level resulting in

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