

Transgenic peanut overexpressing *mtlD* gene confers enhanced salinity stress tolerance via mannitol accumulation and differential antioxidative responses

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Abstract Globally, peanut is an important oilseed crop, which is cultivated under different agro-climatic zones. Soil salinity is one of the major constraints in peanut cultivation. Therefore, to understand the physio-biochemical mechanisms imparting salinity stress, four transgenic peanut lines (cv. GG20) already developed and confirmed by our lab, having bacterial mannitol dehydrogenase gene (*mtlD*), were subjected to different levels of salinity stresses (1, 2 and 3 dS m⁻¹) in pots under containment facility. Further, these lines were also characterized for various physio-biochemical parameters at flowering, pegging and pod formation stages. All the transgenic lines recorded significantly higher mannitol dehydrogenase (MTD) activity and mannitol accumulation than the wild type (WT). Under salinity stress, significantly higher levels of superoxide dismutase, catalase, guaiacol peroxidase, ascorbate peroxidase, glutathione reductase activities, while significantly lower levels of H₂O₂ and malondialdehyde contents, were recorded in the transgenics compared to WT. Similarly, significantly higher ascorbic acid and relative water content (RWC) were recorded in transgenic lines. The MTD activity showed positive correlation with various antioxidant enzymes, growth parameters and RWC, while negative correlation was recorded with H₂O₂

and malondialdehyde content at most of the plant growth stages. The *mtlD* transgenic peanut lines under pot conditions were found maintaining lower oxidative injuries, indicating amelioration of salinity-induced oxidative stress by enhanced protection mechanisms via mannitol accumulation and antioxidative responses. The best lines identified (MTD1 and MTD4) may be used further as pre-breeding source for imparting salinity stress tolerance in peanut. Besides, these lines may also be tested under open-field trials for release as salt-tolerant variety.

Keywords Antioxidant enzymes · Groundnut · Mannitol dehydrogenase · Oxidative injury · Soil salinity

Abbreviations

APX	Ascorbate peroxidase
CAT	Catalase
GR	Glutathione reductase
MTD	Mannitol-1-phosphate dehydrogenase
POD	Guaiacol peroxidase
SOD	Superoxide dismutase

Introduction

Peanut or groundnut (*Arachis hypogaea* L.) is one of the principal oilseed crop, which is cultivated in around 22–24 M ha area in about 120 countries. It is grown under different agro-climatic zones of tropical and subtropical regions of Asia, Africa and North and South America (Mishra et al. 2015). The worldwide peanut production is over 45.6 million tons with an average yield of 1.79 tons per hectare (FAOSTAT 2014). Among oilseeds, peanut is unique since it can be consumed directly as a foodstuff. In

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