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The power of PDH45 gene in developing extraordinary GM crops with high salinity stress tolerance and improved yield

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Environmental stresses, including climate change and global warming, are the major concerns especially with regard to crop productivity in relation to the increasing global population. These stresses ultimately lead to reduction in crop yield and threaten food security. Therefore, there is an urgent need to develop extraordinary stress-tolerant crops which have negligible loss in productivity even under stress. Helicase genes are now being reported as powerful gene for developing stress tolerant crops. Most helicases are members of DEAD-box protein super-family and play essential roles in basic cellular processes such as replication, repair, recombination, transcription, ribosome biogenesis and translation initiation. Earlier, we have reported the isolation of a pea DNA helicase 45 (PDH45) and its novel role in abiotic stress tolerance in model plant tobacco. The exact mechanism of helicase-mediated salt tolerance is not yet understood. After observing the proof of concept in model plants, the PDH45 has been used to transform the bacteria and to different varieties of rice and groundnut crops. The results show that PDH45 also provide the salt tolerance in bacteria, rice and groundnut. Interestingly, there was no yield loss. In case of groundnut the yield was much improved even in the stress condition. The T1 transgenic rice plants exhibited higher glutathione (GSH) and ascorbate (AsA) contents under salt stress. The activities of antioxidant enzymes viz. superoxide dismutase (SOD), ascorbate peroxidase (APX), guaicol peroxidase (GPX) and glutathione reductase (GR) were significantly higher in transgenics; suggesting existence of efficient antioxidant defense system to cope up with salinity induced-oxidative damages. Furthermore, the T2 transgenic rice plants were also able to grow, flower, and set viable seeds under continuous salinity stress of 200 mM NaCl. Furthermore, the transgenic plants were found to have no negative impact on the properties and microbial communities of rhizosphere soil. This study provides insights into the mechanism of PDH45 mediated salinity stress tolerance by controlling the generation of stress induced reactive oxygen species (ROS) and also by protecting the photosynthetic machinery through strengthened antioxidant system. Overall, the PDH45 is a powerful gene which can be exploited in developing other crops of interest with stress tolerance and improved yield.

Biography

Narendra Tuteja is a Group Leader & Senior Scientist at International Centre for Genetic Engineering & Biotechnology (ICGEB), New Delhi, India. He has done his education (M.Sc., Ph.D. & D.Sc. all in Biochemistry) from University of Lucknow and postdoc at NIH, Bethesda & UCLA, Los Angeles. He is an elected fellow of all the major science academies (FNA, FNASc., FASc., FNESA; FNAAS, FTWAS). His research interest is in the development of GM crops resistant/tolerant to stresses and to understand its mechanism. He has reported the first DNA helicase from plant and human systems and discovered novel roles of Helicases, G-proteins, Ca2+-binding proteins & LecRLK in abiotic stress tolerance in plants; developed salinity/drought stress tolerant rice and groundnut. His results indicate the potential for improving crop production at sub-optimal conditions. He has Publications: ~205 and Books Edited: 7.

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