RNA decay plays an essential role in the regulation of gene expression during plant development and response to environmental stimuli. The protein DXO is a 5' to 3' exonuclease that functions in RNA degradation and RNA quality control that has been studied in animals. It has not yet been identified in plants. The gene locus At4g17620 in *Arabidopsis thaliana* encodes a protein homolog of the mammalian DXO, termed *AtDXO*. Recombinantly expressed *AtDXO* possesses a 5'-3' RNA exonuclease activity *in vitro*. Loss-of-function of *AtDXO* in *Arabidopsis* generates multiple growth defects, including curled and yellowish leaves, growth retardation and limited fertility, whereas overexpression show no obvious growth phenotype. The development defect of *atdxo* might be attributed to aberrant RNAs, which are not degraded when *AtDXO* is dysfunctioning. From the RNA-Seq analysis, the transcriptome pattern of *atdxo* mutants shows significant disparity from wild-type. Among the differences, the defense response genes are elevated in *atdxo* while photosynthesis-related and plastid genesis-related genes are downregulated. The constitutive expression of defense response genes causes the autoimmune phenotypes of *atdxo*. This could be modulated by temperature and is partially dependent on the master immunity regulators *EDS1* or *NPR1*. Reactive oxygen species (ROS) accumulation was also detected in the *atdxo* mutant, and *atdxo* showed insensitivity to oxidative stress imposed by paraquat. Moreover, the
atdxo mutant is hypersensitive to salt stress but not sensitive to general osmotic stress. In Arabidopsis, the 5'-3' RNA decay pathway could act as a repressor of endogenous post-transcriptional gene silencing (PTGS), which is regulated by small RNAs (sRNA). The mutation of AtDXO caused productions of 24- and 25-nucleotide endogenous sRNAs. The growth defect phenotype of atdxo could not be repressed by dysfunction of the RDR6 (RNA-DEPENDENT RNA POLYMERASE 6)-dependent sRNA biogenesis pathway. These findings demonstrate that AtDXO functions as a 5'-3' exoribonuclease both in vitro and in vivo to regulate plant development and to mediate the response to environmental stresses.
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