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Stress-Controlled Senescence and Development in Arabidopsis thaliana by Root Associated Factor (RAF), a NAC Transcription Regulator

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Abstract : Adverse environmental conditions such as salinity stress, high temperature and drought limit plant growth and typically lead to precocious tissue degeneration and leaf senescence, a process by which nutrients from photosynthetic organs are recycled for the formation of flowers and seeds to secure reaching the next generation under such harmful conditions. In addition, abiotic stress affects developmental patterns that help the plant to withstand unfavourable environmental conditions. We discovered an NAC (for NAM, ATAF1, 2, and CUC2) transcription factor (TF), called RAF in the following, which plays a central role in abiotic drought stress-triggered senescence and the control of developmental adaptations to stressful environments. RAF is an ABA-responsive TF; RAF overexpressors are hypersensitive to abscisic acid (ABA) and exhibit precocious senescence while knock-out mutants show delayed senescence. To explore the RAF gene regulatory network (GRN), we determined its preferred DNA binding sites by binding site selection assay (BSSA) and performed microarray-based expression profiling using inducible RAF overexpression lines and chromatin immunoprecipitation (ChIP)-PCR. Our studies identified several direct target genes, including those encoding for catabolic enzymes acting during stress-induced senescence. Furthermore, we identified various genes controlling drought stress-related developmental changes. Based on our results, we conclude that RAF functions as a central transcriptional regulator that coordinates developmental programs with stress-related inputs from the environment. To explore the potential agricultural applications of our findings, we are currently extending our studies towards crop species.

Keywords : abiotic stress, Arabidopsis, development, transcription factor
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