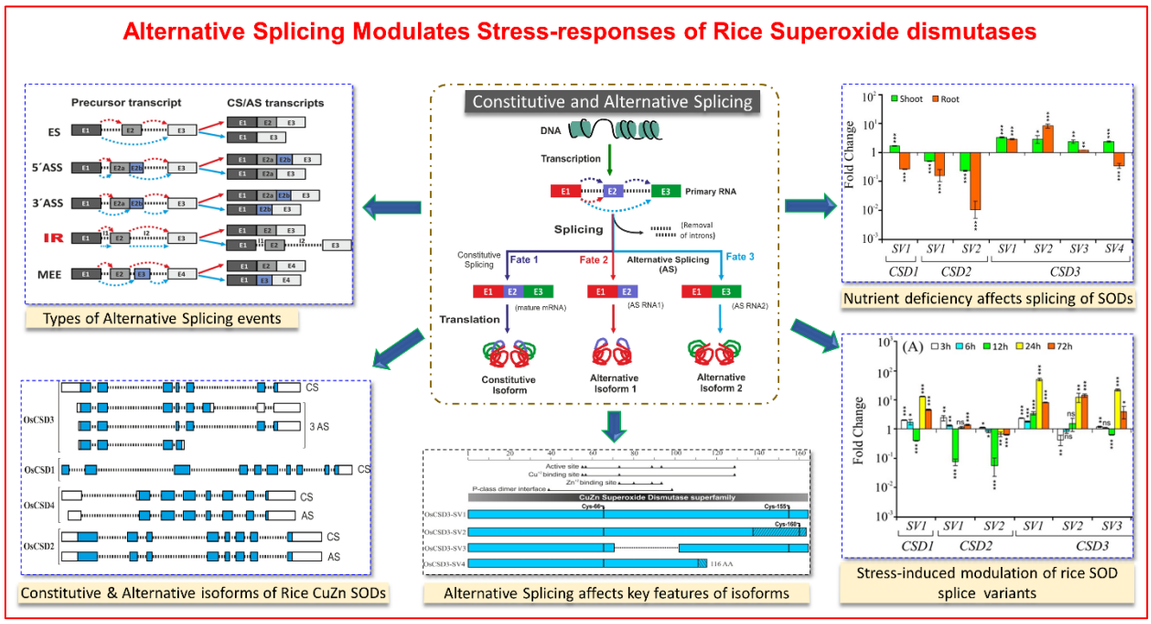
Alternative Splicing Modulates Stress-responses of Rice Superoxide dismutases

Alternative splicing (AS), a post-transcriptional regulatory mechanism, contributes significantly in enhancement of transcriptome/proteome diversity. AS via generating multiple transcripts by various types of AS events that may also encode alternative protein isoforms with novel characteristics. Copper-Zinc Superoxide dismutases (CSDs) in rice display extensive alternative splicing events leading to varying levels of constitutive and alternative transcripts under environmental stress conditions, in different tissues. Furthermore, alternative splicing also targets the coding regions of the SOD genes, affecting key sites/regions crucial for structure and function of the alternatively spliced protein isoforms.



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Article

Splice Variants of Superoxide Dismutases in Rice and Their Expression Profiles under Abiotic Stresses

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Abstract: The superoxide dismutases (SODs) play vital roles in controlling cellular reactive oxygen species (ROS) that are generated both under optimal as well as stress conditions in plants. The rice genome harbors seven SOD genes (*CSD1*, *CSD2*, *CSD3*, *CSD4*, *FSD1*, *FSD2*, and *MSD*) that encode seven constitutive transcripts. Of these, five (*CSD2*, *CSD3*, *CSD4*, *FSD1*, and *MSD*) utilizes an alternative splicing (AS) strategy and generate seven additional splice variants (*SVs*) or mRNA variants, i.e., three for *CSD3*, and one each for *CSD2*, *CSD4*, *FSD1*, and *MSD*. The exon-intron organization of these *SVs* revealed variations in the number and length of exons and/or untranslated regions (UTRs). We determined the expression patterns of *SVs* along with their constitutive forms of *SODs* in rice seedlings exposed to salt, osmotic, cold, heavy metal (Cu^{+2}) stresses, as well as copper-deprivation. The results revealed that all seven *SVs* were transcriptionally active in both roots and shoots. When compared to their corresponding constitutive transcripts, the profiles of five *SVs* were almost similar, while two specific *SVs* (*CSD3-SV4* and *MSD-SV2*) differed significantly, and the differences were also apparent between shoots and roots suggesting that the specific SVs are likely to play important roles in a tissue-specific and stress-specific manner. Overall, the present study has provided a comprehensive analysis of the SVs of SODs and their responses to stress conditions in shoots and roots of rice seedlings.

Keywords: abiotic stress; alternative splicing; rice; splice variants; SODs; superoxide dismutases

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Insight

Heat-stress priming and alternative splicing-linked memory

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Stress-induced priming and associated memory is an intriguing adaptive response in plants, and one with important implications for crop development. Ling *et al.* (2018) carried out a comprehensive RNA-Seq analysis of gene expression and splicing events in heat-stress primed and non-primed plants, revealing alternative splicing as a novel and vital component of heat-stress priming induced memory. The splicing-linked memory programmed during the priming phase is important for ensuring the availability of correctly spliced transcripts/proteins critical for enhanced tolerance.

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