Overexpression of TaCOMT Improves Melatonin Production and Enhances Drought Tolerance in Transgenic Arabidopsis

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Abstract: Melatonin (N-acetyl-5-methoxytryptamine) is involved in many developmental processes and responses to various abiotic stresses in plants. Most of the studies on melatonin focus on its functions and physiological responses in plants, while its regulation mechanism remains unknown. Caffeic acid 3-O-methyltransferase (COMT) functions at a key step of the biosynthesis process of melatonin. In this study, a COMT-like gene, TaCOMT (Traes\_1AL\_D9035D5E0.1) was identified in common wheat (Triticum aestivum L.). Transient transformation in wheat protoplasts determined that TaCOMT is localized in cytoplasm. TaCOMT in wheat was induced by drought stress, gibberellin (GA)3 and 3-Indoleacetic acid (IAA), but not by ABA. In TaCOMT transgenic Arabidopsis, melatonin contents were higher than that in wild type (WT) plants. Under D-Mannitol treatment, the fresh weight of the transgenic Arabidopsis was significantly higher than WT, and transgenic lines had a stronger root system compared to WT. Drought tolerance assays in pots showed that the survival rate of TaCOMT-overexpression lines was significantly higher than that of WT lines. this phenotype was similar to that the WT lines treated with melatonin under drought condition. In addition, the TaCOMT transgenic lines had higher proline content and lower malondialdehyde (MDA) content compared to WT lines after drought treatment. These results indicated that overexpression of the wheat TaCOMT gene enhances drought tolerance and increases the content of melatonin in transgenic Arabidopsis. It could be one of the potential genes for agricultural applications.