Title: Trehalose-mediated drought tolerance in bread wheat: Integrating biochemical and physiological insights for resilience in arid environments

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Drought stress remains one of the most critical constraints to wheat productivity in arid and semi-arid regions such as Oman, where limited water resources and high temperatures threaten crop sustainability and food security. This study investigates the role of trehalose, a protective non-reducing disaccharide, in enhancing drought tolerance among 20 bread wheat (Triticum aestivum L.) genotypes. Plants were subjected to three soil moisture regimes—80%, 60%, and 40% of field capacity—to represent mild, moderate, and severe drought conditions. Physiological, biochemical, and growth-related parameters were assessed at the flowering stage, the most drought-sensitive phase of wheat development. Results demonstrated marked genotypic variation in response to water deficit. Genotypes exhibiting higher endogenous trehalose accumulation maintained superior leaf relative water content, chlorophyll stability, and membrane integrity, while showing reduced oxidative injury. Elevated antioxidant enzyme activities (SOD, CAT, POD) in these genotypes effectively mitigated reactive oxygen species accumulation, contributing to enhanced cellular protection. Consequently, high-trehalose genotypes sustained greater shoot biomass and leaf area even under severe stress. Overall, the findings identify trehalose as a key biochemical marker and potential driver of drought resilience in wheat. The study provides valuable insights into the integrated physiological and biochemical mechanisms underlying stress adaptation, offering practical guidance for breeding climate-resilient wheat varieties tailored to the arid conditions of Oman and similar environments.

Biography

Marwa Sulaiman Mohsin Al-Hinai is a PhD candidate in Plant Sciences at Sultan Qaboos University, Oman. She also works as a researcher at the Biotechnology Research Section, Ministry of Agriculture, Fisheries and Water Resources. Her research focuses on nanotechnology-enabled strategies to enhance drought tolerance in wheat using nano-trehalose formulations. She has published and presented her work in several national and international scientific forums and is actively engaged in advancing sustainable agriculture and climate resilience through biotechnology-driven innovations.

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