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Sunflower adaptations and resilience to embolism in drought conditions

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Abstract.

Our research delves into the physiological impacts of drought on plants, considering the intricate biological processes underlying photosynthesis and transpiration. Water transport in plants, crucial for functions like CO2 assimilation and turgor maintenance, occurs through xylem conduits under significant negative pressure. However, under drought conditions, embolism formation in xylem tissues can impede water transport to sites of photosynthesis, affecting plant productivity and survival. Climate change-induced extreme environments pose significant risks to crop yield and survival. Sunflowers, a staple in the diets of numerous cultures and renowned for their high oil content, serve as an ideal subject as they vary markedly across, as well as within, genotypes, enabling them to thrive in different environments. Our interdisciplinary approach combines anatomical, physiological, and genomic analyses to study how sunflowers respond to drought stress and the potential for adaptation to extreme environments. Through trait scoring and genomic bioinformatics, we aim to identify genetic markers associated with adaptive traits for embolism resistance or refilling and predict plant responses to drought and varying levels of stress. Additionally, our research uses non-destructive assessments, including turgor loss analysis, continuous leaf imaging, and μ-CT scans of xylem tissues to detect embolism formation. By correlating genetic and physiological data, we seek to uncover genes and alleles associated with plant responses to environmental stressors. This integrated approach will deepen our understanding of sunflower resilience to drought and aid in the development or screening of crop varieties suitable for different conditions, contributing to global food security initiatives.