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Assessing physiological responses in different leaf positions of wheat genotypes under water deficit

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Abstract

Heading and grain-filling are the most susceptible stages to water deficit. At these stages, the flag leaf is the most metabolically active leaf, providing the largest fraction of the carbohydrates needed for grain filling. However, lower leaves can also contribute to final yield through current photosynthesis and translocation of previously assimilated carbon. However, little is known about the physiological status of lower leaves and how it is affected by water deficit. This study investigates the physiological changes in both flag and third leaves of 24 elite genotypes from CIMMYT's Best PT panel grown in the field under well-watered and water deficit conditions. Trials were carried out in Cd. Obregón, Mexico, during the season 2023–2024. The water deficit treatment was irrigated at sowing, and the well-watered environment was irrigated at the sowing stage and every 15 days and later reduced to every 10 days during late grain filling. Transpiration rate, stomatal conductance, and quantum yield of photosystem II were measured at the booting, heading, and grain-filling stages using the LICOR LI-600 porometer, the SPAD 502 Plus was used to estimate chlorophyll concentration. Results showed differences in transpiration rates, stomatal conductance, and SPAD values at different leaf positions in water-stressed plants and irrigated plants. SPAD values, stomatal conductance, and transpiration rates were higher in irrigated than droughted plants. The quantum yield of photosystem II varied among the genotypes and leaf positions. A decline of quantum yield of PS II was observed under drought compared to irrigated conditions, possibly due to reduced photosynthetic rate. Flag leaves showed higher stomatal conductance, quantum yield, transpiration rates, and relative chlorophyll content than the third leaves. The SPAD values gradually increased as the growth stages progressed from heading to physiological maturity stage. However, the transpiration rates and stomatal conductance showed a decreasing trend at later growth stages. Further analysis will be performed to relate the physiological parameters presented here to plant biomass and grain yield.

Keywords: Canopy levels, climate change, physiology, stomatal conductance, transpiration, wheat

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