Tropentag, September 15-17, 2021, hybrid conference

"Towards shifting paradigms in agriculture
for a healthy and sustainable future"

Leaf Wettability and Leaf Angle Affect Air-Moisture Deposition in Wheat for Self-Irrigation

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Abstract

Climate change and the ever-increasing world population affect the water sources and reduce irrigation water supply. Means of translating scarce water sources like air moisture has gained attention to be utilised for crop irrigation. The present study was designed to explore and architect the wheat plant for self-irrigation through exploiting the leaf surface structures like leaf hydrophilicity, leaf-stem angle supported by optimum leaf rolling. For this purpose, a set of 30 wheat genotypes and four local cultivars with all possible combinations of leaf angle (droopy >90°, semi-droopy; 60–90°, semi-erect; 30–60° and erect; <30°) and leaf rolling (abaxially, adaxially, and spirally rolled) was selected from diverse germplasm (1796 genotypes). The germplasm was characterised for the leaf traits, physiological traits (stomatal conductance, net photosynthesis, water use efficiency, transpiration rate), and soil moisture content at the tillering, booting, and the anthesis stage. The yield traits like spikelets per spike, ear weight, seed weight, and plot yield were also recorded. The climate parameters including soil and air temperature, solar radiation, rainfall, wind speed, and relative humidity were recorded by the sensors installed in an automatic weather station at the study site. The core set of 10 wheat genotypes was evaluated for the interception and water channeling by the measurement of water through stem flow and leaf wettability. The biplot, heat map, and correlation analysis indicated wide diversity and traits association. The soil moisture content and collected water through stem flow showed a substantial amount of moisture in the root zone (2–3.5 ml). The genotypes coded as 1, 7, and 18 with characteristics semi-erect to erect leaf angle, spiral rolling, and hydrophilic leaf surface provided that contact angle hysteresis less than 10° had higher soil moisture content (6–8 %) and moisture harvesting efficiency (3.5 ml). These findings can provide the basis for in-depth anatomical and molecular studies to develop self-irrigating and drought-tolerant wheat cultivars as an adaptation to climate change.

Keywords: Climate change, contact angle, hydrophilicity, leaf angle, leaf rolling

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