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"Reconcile land system changes
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Identification of drought-responsive wheat cultivars for climate change adaptation in Ethiopia

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Abstract

Drought is a significant threat to global food security. Wheat production in Ethiopia is vulnerable, as it faces high rainfall variability and relies entirely on rainfed farming. Climate-change-induced increases in the frequency and severity of droughts aggravate the risk to smallholder farmers, likely leading to higher yield losses and food insecurity. This study aimed to assess the drought response of four Ethiopian wheat cultivars suited to different agroecologies: two from the highlands (i.e., Varieties Dendea and Biftu) and two from the lowlands to midlands (i.e., Varieties Abay and Kingbird). Using the high-throughput (Plantarray) phenotyping platform, drought was imposed during the flowering stage, a critical period for wheat productivity, to observe how each cultivar adapts to water stress. Phenological, physiological, and yield traits data were recorded using. After 10 days of intermittent drought, i.e., the water content depleted to a level below 22 % for the lowland and nearly 10 % for the highland varieties, significant differences in drought response were observed among the cultivars from the two agroecological groups. Lowland varieties, Abay and Kingbird, exhibited a delayed transition to key phenological stages and exhibited water-conserving traits. These cultivars maintained higher soil moisture, had reduced transpiration rates, and showed a moderate to high reduction in photosynthetic activity (50–57 %). In contrast, highland varieties, such as Dendea, depleted soil moisture more rapidly, exhibited higher transpiration and stomatal conductance reductions, and experienced a severe decline in photosynthesis (86–89 %). The critical soil water content below which the transpiration was significantly reduced was higher for lowland cultivars (38 % for Abay and 36 % for Kingbird) than for highland varieties (16 % for Dendea), indicating that lowland varieties are better adapted to conserve water. Highland varieties gave significantly higher grain yield compared with lowland varieties under well-watered conditions ($p < 0.05$). Nevertheless, under drought stress, the performance of lowland genotypes was superior to that of the highland types, with a significant yield advantage. These results provide evidence that Abay and Kingbird are more tolerant of intermittent drought and thus more suitable for the future climate of Ethiopia. The new findings could help plant breeders and growers trying to improve drought tolerance in wheat.

Keywords: Agroecological conditions, drought, flowering stage, high-throughput phenotyping, water conserving

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