Physiological and Digital Phenotyping of Drought Tolerance in Brassica Crops

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Abstract

Climate change poses a significant threat to agricultural systems, with drought becoming increasingly prevalent in the Canadian prairies. This study addresses the urgent need to enhance crop resilience, focusing on *Brassica carinata*, a promising industrial feedstock crop used for the production of biofuels. Our research aims to comprehensively evaluate drought adaptive capacity in *B. carinata* through a combination of physiological and digital phenotyping methods. Under controlled conditions, we utilized a high-throughput phenotyping platform, the Plantarray system, to screen *B. carinata* germplasm. This system facilitated precise measurements of physiological traits, soil conditions, and atmospheric parameters, enabling the assessment of drought response. Concurrently, we conducted a field phenotyping experiment with 47 *B. carinata* Nested Association Mapping (NAM) founder lines and two *B. napus* checks, under irrigated and non-irrigated conditions. Aerial imagery obtained through Unmanned Aerial Vehicles (UAVs), complemented by phenological observations and manually recorded phenotypic data, was systematically gathered. Digital phenotypes extracted from aerial images are analyzed to identify a digital phenotype(s) for drought tolerance. Our study also explores the correlation between indoor physiological data and field performance of *B. carinata* lines, in an effort to identify parameters that can serve as reliable predictors of seed yield under drought stress. Overall, we believe this research provides valuable insights for enhancing crop resilience to drought.

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Climate change poses a significant threat to agricultural systems, with drought becoming increasingly prevalent in the Canadian prairies. This study addresses the urgent need to enhance crop resilience, focusing on *Brassica carinata*, a promising industrial feedstock crop used for the production of biofuels. Our research aims to comprehensively evaluate drought adaptive capacity in *B. carinata* through a combination of physiological and digital phenotyping methods. Under controlled conditions, we utilized a high-throughput phenotyping platform, the Plantarray system, to screen *B. carinata* germplasm. This system facilitated precise measurements of physiological traits, soil conditions, and atmospheric parameters, enabling the assessment of drought response. Concurrently, we conducted a field phenotyping experiment with 47 *B. carinata* Nested Association Mapping (NAM) founder lines and two *B. napus* checks, under irrigated and non-irrigated conditions. Aerial imagery obtained through Unmanned Aerial Vehicles (UAVs), complemented by phenological observations and manually recorded phenotypic data, was systematically gathered. Digital phenotypes extracted from aerial images are analyzed to identify a digital phenotype(s) for drought tolerance. Our study also explores the correlation between indoor physiological data and field performance of *B. carinata* lines, in an effort to identify parameters that can serve as reliable predictors of seed yield under drought stress. Overall, we believe this research provides valuable insights for enhancing crop resilience to drought.