Adaptation of European cultivars to severe drought and moisture-favourable conditions

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A6: Breeding for abiotic stress and climate change

The changing climate emphasizes the importance of breeding soybean cultivars with greater drought tolerance. This study assessed grain yield (GY) and other agronomic and physiological traits of 72 early-maturing (MG 000/0+) and 72 intermediate-maturity (MG I-/II) European cultivars under managed drought stress and moisture-favourable conditions during the reproductive phase, to highlight opportunities and optimal selection strategies for drought tolerance improvement. The material was grown in a phenotyping platform composed of eight large (24.0 m x 1.6 m x 0.8 deep), bottomless containers filled with sandy loam soil, equipped with a rainout shelter and a double-rail irrigation bloom. We adopted an alpha-lattice design with four replications per condition, with plant density of 42 plants m-2. Stress and favourable conditions implied soil moisture kept at 80% and within 10-30% of the available water, respectively. On average, drought stress reduced GY by 66% (0.94t ha^{-1} vs. 2.76t ha^{-1}). Both early and intermediate maturity groups revealed large genotype × environment interaction across conditions ($P < 0.01$), with fairly modest genetic correlation for cultivar GY responses across environments (rg = 0.59 and 0.53 for early and intermediate cultivars, respectively). Both maturity groups revealed greater genetic variation for yielding ability (expressed as genetic coefficient of variation, CVg) under favourable conditions than under stress (21.8% vs. 16.3%, averaged across groups), probably due to limited historical effort in terms of selection environments and useful genetic resources that was paid to selection for drought tolerance in soybean. Our results highlighted the crucial importance of selecting under drought stress (given the modest rg value across conditions) and carefully identifying suitable parental germplasm by thorough screening of commercial cultivars and exotic or less conventional genetic resources, when targeting drought stress environments. Additional information on phenology, plant biomass and physiological traits contributed to define a breeding strategy for stress environment.

Keywords: Drought tolerance, maturity group, genotype × environment interaction, genetic correlation, yielding ability

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