doi 10.18699/PlantGen-2025-262

Assessment of genetic divergence of *Brassica juncea* breeding lines for yield traits under rainfed conditions

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Motivation and aim: This study investigates the genetic divergence in *Brassica juncea* (Indian mustard) for yield-related traits under rainfed conditions. The rationale behind the study was to assess the magnitude of genetic diversity among the breeding lines concerning improvement in yield potential, particularly under water-scarcity conditions.
Materials and methods: Field experiments were conducted at the Barani Agricultural Research Institute (BARI), Chakwal, Pakistan, during two consecutive Rabi seasons 2022–23 and 2023–24. Twenty-seven genotypes, including two checks, were evaluated in a randomized complete block design with three replications. The study investigated phenological and morphological characteristics like days to germination, flowering, maturity, plant height, branch count, seed pod numbers, and grain yield.
Results: In most of the traits studied, the genetic variance was significant, indicating presence of high genetic diversity among the studied brassica genotypes. It also showed significant variation among genotypes for days to germination, days to flowering, and number of seed pods. The study also revealed that some traits, such as pods per plant, showed increased genetic variation over the two seasons, demonstrating the dynamic nature of genetic traits in response to environmental conditions. Such variation confirms the possibility of selecting high-yielding lines suitable for rainfed conditions. Furthermore, correlation analysis further established crucial relationships among key traits, particularly the inverse relationship between early flowering and maturity, which can be leveraged to develop faster-maturing crops. The research demonstrated that identifying traits with high heritability, such as plant population and secondary branches, is vital for breeding programs targeting rainfed environments.
Conclusions: The results provided a basis for climate-resilient, high-yielding *Brassica juncea* cultivars that could thrive well under rainfed conditions to enhance agricultural productivity under deteriorating climatic conditions.