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EXPLOITING GENETIC DIVERSITY IN TOMATO (*Lycopersicum esculentum*) FOR IMPROVED PHYSIOLOGICAL PERFORMANCE, YIELD, AND QUALITY UNDER ENVIRONMENTAL STRESS

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Efforts to conserve the genetic diversity of *Lycopersicum esculentum* L. and its wild relatives from their centers of origin are a research priority. Local tomato populations have been naturally selected and adapted to specific environmental conditions, representing valuable genetic resources with the potential to introduce desirable traits into future improved cultivars (Knapp and Peralta, 2016). Tomato breeding is a complex and demanding process that requires extensive collections of genetic resources, well-equipped research laboratories, protected cultivation facilities, experimental fields, and highly qualified personnel.

The relatively low tomato yield per unit area in Romania, particularly under organic production systems, can be attributed to the use of genotypes that are insufficiently adapted to the specific pedoclimatic conditions of the cultivation area and to production technologies that have not been fully optimized. Moreover, tomato breeding programs have traditionally focused primarily on increasing yield and improving tolerance to biotic stress, while comparatively less attention has been paid to fruit sensory characteristics (aroma, flavor, and taste) and nutritional quality (lycopene, vitamin C, β-carotene, and other bioactive compounds). The success of tomato breeding programs depends largely on the appropriate selection of parental genotypes, the identification of target traits, and the breeding strategy employed.

The main objective of this research was ex to explore genetic diversity, in order to identify useful germplasm to develop new tomato cultivars (*Lycopersicum esculentum* L.) with improved tolerance to environmental stress factors while maintaining exceptional sensory and nutritional quality.

The biological material used in this study originated from the germplasm collection of the Vegetable Research and Development Station Bacau and from a research collaboration with the Institute of Genetics, Physiology, and Plant Protection of the Republic of Moldova. This partnership provided the opportunity to evaluate tomato genotypes with diverse genetic backgrounds.

The specific objectives of the study were:

- the morphophysiological and agronomic characterization of the parental genotypes used in hybridization compared with the newly developed genotypes;
- the evaluation of fruit quality traits and their relationship with shelf life, aroma, flavor, and taste through the determination of lycopene, β-carotene, ascorbic acid, and total polyphenol contents.

At a time when breeding programs are predominantly aimed at developing cultivars and hybrids with maximum productivity and extended postharvest shelf life, this research sought to exploit additional valuable characteristics of tomatoes, particularly tolerance to environmental stress and superior sensory attributes (aroma, flavor, taste, and bioactive compounds). The initial breeding material consisted of seeds collected from home gardens, including traditional cultivars, local populations, and improved varieties.

The materials and methods employed were specific to plant physiology and plant breeding studies, with the objective of characterizing the initial genetic material and the cultivars obtained through genealogical selection and hybridization. More than thirty tomato genotypes were included in the experimental program; however, the present study focuses on ten cultivars, comprising five originating from the Republic of Moldova and five from Romania.

The results confirmed considerable genetic diversity within the evaluated germplasm regarding the variability of production traits and morphophysiological characteristics among the studied tomato genotypes. Furthermore, the analysis of photosynthetic parameters revealed significant physiological differences among the cultivars from the two countries, primarily attributable to their distinct genetic backgrounds.

Keywords: tomato breeding; genetic diversity; local germplasm; fruit quality; environmental stress tolerance.

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