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Editorial

Climate-Resilient Agriculture: From Stress Management to Smart Breeding

Md. Daraj Uddin Prodhan*

Senior Researcher, Department of R&D, AR Malik Seeds Pvt. Ltd., Bangladesh

***Corresponding Author:** Md. Daraj Uddin Prodhan, Senior Researcher, Department of R&D, AR Malik Seeds Pvt. Ltd., Bangladesh.

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Climate change is no longer a distant concern for agriculture. Increasing temperatures, irregular rainfall, drought, flooding, salinity, and emerging pests and diseases are creating increasingly complex challenges for crop production. More importantly, these stresses often occur together, making conventional crop management less effective.

This changing scenario demands a shift from short-term stress management toward climate-resilient agriculture and smarter crop improvement. Conventional breeding remains essential, but recent advances in genomics, pangenomics, multi-omics, high-throughput phenotyping, and genome editing are providing new opportunities to accelerate the development of resilient crops.

Among these technologies, CRISPR-based genome editing has attracted particular attention. Recent studies have demonstrated its potential for improving drought, heat, salinity, and disease tolerance in crops such as wheat, rice, banana, and other major food crops. Newer approaches, including base editing and prime editing, are further expanding the possibilities for precise genetic improvement.

However, technology alone cannot make a crop climate resilient. A major challenge is that farmers rarely face a single stress. Heat may occur together with drought; excessive rainfall may increase disease pressure; and salinity may interact with nutrient and water stress.

Therefore, future breeding programs need to place greater emphasis on combined-stress screening, multi-location field evaluation, efficient phenotyping, and genotype × environment interactions.

The integration of molecular breeding with practical field research is particularly important for developing countries such as Bangladesh, where farmers work across highly diverse environments ranging from drought-prone northern areas to flood- and salinity-affected regions. Farmer-preferred traits, affordability, seed availability, and local adaptability must remain central to the breeding process.

The future of agricultural science should therefore move beyond simply developing "stress-tolerant" plants. The real objective is to develop stable, productive, nutritious, and economically viable varieties that perform reliably under real farming conditions. Connecting advanced breeding technologies with field-based research, sustainable crop management, and farmers' knowledge will be critical for building a more resilient food system in an increasingly unpredictable climate.