...State-of-the-Art in CRISPR Technology and Engineering Drought, Salinity, and Thermo-tolerant crop plants

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Abstract

Our review has described principles and functional importance of CRISPR-Cas9 with emphasis on the recent advancements, such as CRISPR-Cpf1, base editing (BE), prime editing (PE), epigenome editing, tissue-specific (CRISPR-TSKO), and inducible genome editing and their potential applications in generating stress-tolerant plants. Improved agricultural practices and enhanced food crop production using innovative crop breeding technology is essential for increasing access to nutritious foods across

the planet. The crop plants play a pivotal role in energy and nutrient supply to humans. The abiotic stress factors, such as drought, heat, and salinity cause a substantial yield loss in crop plants and threaten food security. The most sustainable and eco-friendly way to overcome these challenges are the breeding of crop cultivars with improved tolerance against abiotic stress factors. The conventional plant breeding methods have been highly successful in developing abiotic stress-tolerant crop varieties, but usually cumbersome and time-consuming. Alternatively, the CRISPR/Cas genome editing has emerged as a revolutionary tool for making efficient and precise genetic manipulations in plant genomes. Here, we provide a comprehensive review of the CRISPR/Cas genome editing (GE) technology with an emphasis on recent advances in the plant genome editing, including base editing (BE), prime editing (PE), epigenome editing, tissue-specific (CRISPR-TSKO), and inducible genome editing (CRISPR-IGE), which can be used for obtaining cultivars with enhanced tolerance to various abiotic stress factors. We also describe tissue culture-free, DNA-free GE technology, and some of the CRISPR-based tools that can be modified for their use in crop plants.

Keywords: Abiotic stress; Base editing; CRISPR-IGE; CRISPR-TSKO; DNA-free GE; Epigenome editing; Prime editing; Tissue culture-free GE.