The Torch
Vol. 1 (9)

Genome editing using CRISPR-Cas9

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Recently, biotechnology has witnessed unprecedented technological changes. Advances in high-throughput sequencing techniques have provided insight into the location and structure of functional elements within the DNA. At the same time, advances in genome engineering tools have enabled unprecedented control over genetic material. Genome editing can precisely and efficiently modify the DNA, leading to changes in the characteristics of a cell or organism. CRISPR-Cas9 (clustered regularly interspaced short palindromic repeats/CRISPR associated protein 9) is a potent genome editing tool that precisely alters DNA virtually at any location. It consists of a CRISPR guide RNA (gRNA) and Cas9 protein. The process starts with the formation of gRNA and Cas9 protein complex; the gRNA complements to target DNA and Cas9 cleaves; further, repair by insertion, deletion, substitution, non-homologous end joining (NHEJ)/ homology-directed repair (HDR) occurs. Through CRISPR-Cas9, we can study and understand biological systems, treat cancers, AIDS, infections and genetic conditions, make genetically modified crops and animals for desired performance, etc. CRISPR-Cas9 is extensively researched as an application to treat sickle cell anaemia, which is a single base mutant genetic disease and successful outcomes are found. Also, recently a human trial has been performed to treat Leber congenital amaurosis, a retinal disorder causing blindness, effectively restoring normal vision. In rice, CRISPR-Cas9 is tremendously applied for improved varieties with high yield, biotic or abiotic stress tolerance and disease resistance essentially having an ideal rice crop. In the future, it might be standard to tweak or design genes, after all, CRISPR-Cas9 is not an expensive and inaccessible technology. CRISPR-Cas9 will make its significant impact in society by benefitting the researchers, doctors and farmers.

Keywords: CRISPR-Cas9, Genome editing, Genetic diseases, Sickle cell anaemia, Improved crop varieties, Biotic, Abiotic stress tolerance

Citation:
Dhanyashree R. Genome editing using CRISPR-Cas9. The Torch. 2020. 1(9). Available from: https://www.styvalley.com/pub/magazines/torch/read/genome-editing-using-crispr-cas9.