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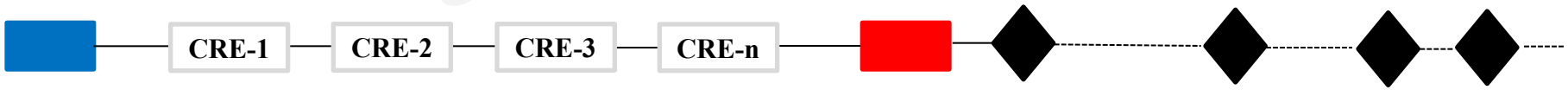
Gene editing: an instrument for practical application of gene biology to plant breeding

Key words: **Gene editing, Expression regulation, Novel allele, Trait development, Plant breeding**

Research Summary

This review mainly focused on the gene biology and propose different editing strategies for coding and non-coding genes. The strategies were summarized in the following aspects:

- **Gene editing for transcription and post-transcription regulation**
- **Gene editing for translation, post-translation modification, and protein localization**
- **Protoplast editing**



Innovation points

- **Introduction** of the progress and perspectives of genomic editing in plant breeding.

- **Summary** of the current state of plant gene biology research, from gene structure to transcription and post-transcription regulation, to translation and post-translation modification, and propose how to use gene editing as a mechanism to commercialize gene biology in plant breeding.

- **Emphasis** of a scheme of protoplast editing to make gene editing more applicable in plant breeding.

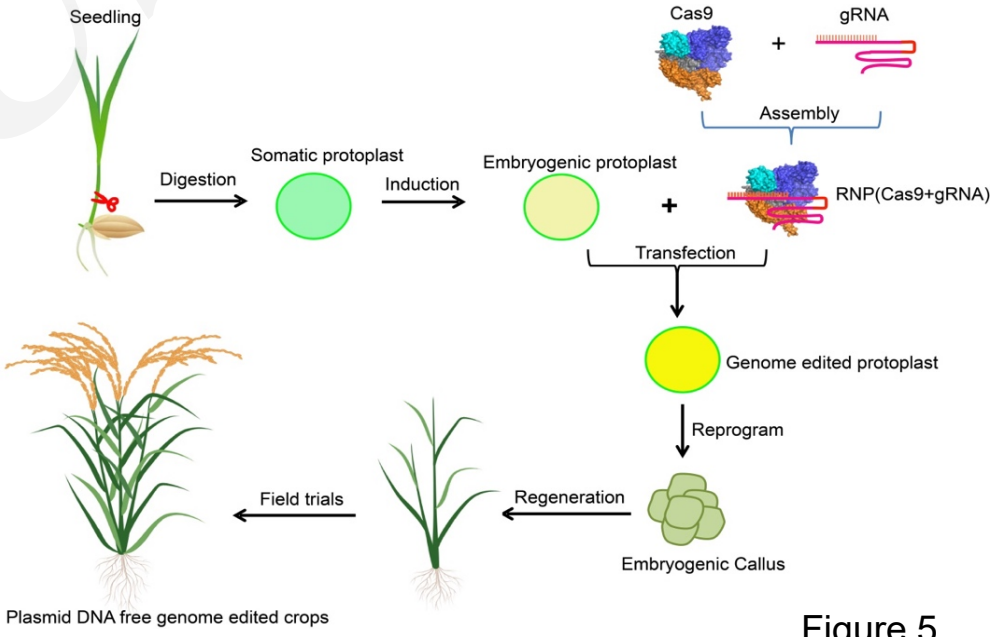


Figure 5

Innovation points

A series of comprehensive figures were generated to summarize the current state of plant gene biology research and propose various gene editing strategies to generate novel alleles of a given gene in plant breeding.

Figure 1 | A schematic presentation of a gene and its transcription, and important targets on the promoter or coding region of a gene directly confers a trait (Gene B) and its transcription factor (Gene A) for transcription editing.

Figure 2 | Schematic overview of post-transcriptional gene regulation events that can be theoretically controlled by CRISPR/cas9 technology in plants, including alternative splicing (AS), miRNA-mediated mRNA cleavage, RNA editing and Alternative poly adenylation (APA).

Figure 3 | Generation of gain- or loss- function mutations by using genome-editing tools.

Figure 4 | Potential post-translationally modified sites involved in phosphorylation and ubiquitination process using genome editing.

Figure 5 | The workflow of potential protoplast-based gene editing and regeneration for plant breeding (rice as a model).