

Indigenous Gene Editing Technology to Make GE Crops Cheaper in India

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Gene Editing Tech Latest News

- Indian scientists have created a homegrown, “miniature” alternative to the globally patented **CRISPR-Cas** system for precise genome editing in plants.
 - CRISPR-Cas is a natural bacterial defense system adapted for genome editing.
 - It uses a guide RNA to lead a Cas enzyme, such as Cas9, to a specific DNA sequence.
 - The Cas enzyme cuts the DNA at that exact spot, and the cell’s repair machinery is then used to insert, delete, or modify genes with precision.
- The new technology, recently patented by the Indian Council of Agricultural Research (ICAR), uses **TnpB** — transposon-associated proteins — to cut and modify plant DNA.
- This development strengthens India’s ability to produce genome-edited (GE) crops at lower cost while reducing dependence on foreign proprietary tools.

Gene Modification Vs Gene Editing

- **Gene Modification** – GM introduces foreign DNA from a different species into an organism.
 - Process: A new gene from another organism is inserted into the target organism's genome.
 - Outcome: Produces a genetically modified organism (GMO) containing genetic material from multiple species.
 - Analogy: Like inserting a new chapter from another author into a book.
 - Example: Adding a gene from another plant species to make a crop disease-resistant.
- **Gene Editing** – Gene editing makes precise, targeted changes to an organism's existing DNA without adding foreign genes.
 - Process: Small changes—such as deletions, corrections, or replacements—are made at specific DNA sites. It uses **Molecular scissors** (Cas/TnpB) and **Guides RNA** to direct cuts at precise DNA locations.
 - Outcome: Produces a genetically edited organism (GEO) with modified original DNA.
 - Analogy: Like correcting or deleting a word in a document.
 - Example: Removing a gene to stop an unwanted protein or correcting a mutation causing a genetic disorder.

India's First GE Rice Varieties

- ICAR announced two CRISPR-edited rice varieties:
 - **Samba Mahsuri (IIRR)** – Edited *cytokinin oxidase 2* gene using CRISPR-Cas12a → higher yield.
 - **MTU-1010 (IARI)** – Edited *DST* gene using CRISPR-Cas9 → drought & salinity tolerance.
- These varieties face **commercialisation hurdles** due to CRISPR patent restrictions.

Indigenous Breakthrough in Genome Editing

- Indian scientists have developed a “miniature alternative” to CRISPR-Cas technologies using **TnpB proteins**, offering a fully indigenous genome-editing (GE) tool for plants.
- The technology, recently patented by ICAR, enables precise DNA cutting and modification to improve crop traits.

What Makes TnpB Technology Different

- The new tool uses Transposon-associated TnpB proteins that function like Cas9/Cas12a as molecular scissors.
- **Key advantages:**
 - Much smaller size (400–500 amino acids) compared to Cas9 (1,000–1,400) and Cas12a (1,300).
 - Compact size allows easy delivery via viral vectors, avoiding tissue-culture-based delivery.
 - Uses *Deinococcus radiodurans*-derived TnpB, enabling efficient gene editing.
 - *Deinococcus radiodurans* is a bacterium that can survive in extremely harsh conditions.
 - The bacterium is harmless to humans. It is useful in bioremediation and can help clean up radioactive waste.

Why TnpB-Based Editing Is a Game Changer

- The indigenous tool allows:

- Freedom from foreign IP control
- Lower costs for GE crop development
- Easier DNA delivery due to the protein's small size
- Potential to address NGO concerns about foreign companies dominance

Why India Needed an Alternative to CRISPR

- CRISPR-Cas technologies are controlled globally by:
 - **Broad Institute** – patents for CRISPR-Cas12a
 - **Corteva Agriscience** – joint licensing for CRISPR-Cas9 in agriculture
- Indian scientists can use CRISPR for research but commercial release of GE varieties requires licensing fees.
- Indigenous TnpB systems eliminate such **IP restrictions**, making GE crop development affordable and scalable.
- ICAR has been negotiating with Broad Institute and Corteva since July 2025. They permit research use but may charge licensing fees for commercial GE crop cultivation.
 - India has requested fee waivers for small and marginal farmers.

Source: **IE** | **AFS**

Source: <https://vajiramandravi.com/current-affairs/indigenous-gene-editing-technology-to-make-ge-crops-cheaper-in-india/>

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