Genome Editing- ISDra2TnpB

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Context:

A recent breakthrough in plant genome editing comes from a collaborative effort between the ICAR-National Rice Research Institute in Cuttack, India, and Pennsylvania State University, USA.

About Genome editing:

? Genome editing is a powerful tool that allows scientists to make precise changes to the Deoxy-Ribonucleic Acid (DNA) sequence of living organisms.

? This technology has vast applications in agriculture, where it can be used to enhance crop yields, improve resistance to pests and diseases, and introduce desirable traits like drought tolerance.

? The most commonly known genome-editing tool is CRISPR, which has revolutionised genetic research due to its precision and efficiency.

CRISPR and its limitations in plant genome editing:

? CRISPR technology, particularly using proteins like Cas9 and Cas12, has been widely used in genome editing.

? These proteins work by cutting DNA at specific locations, allowing scientists to remove, add, or replace genetic material.

? However, a major limitation in plant genome editing has been the size of these proteins, which are often too large to be efficiently accommodated by plant cells.

? This has created a need for smaller, more efficient genome-editing tools that can work effectively in plant systems.

The ISDra2TnpB genome editor:

? Researchers have developed a new genome-editing tool called ISDra2TnpB, derived from the bacteria Deinococcus radiodurans.

? This tool is significantly smaller than the traditional CRISPR-associated proteins like Cas9 and Cas12, making it more suitable for use in plant cells.

Key Features of ISDra2TnpB:

? Size advantage: ISDra2TnpB is less than half the size of Cas9 and Cas12, allowing for more efficient delivery and function within plant cells.

? High editing efficiency: The tool has demonstrated a 33.58% editing efficiency in average plant genomes, making it a promising option for various crops.

? Versatility: The researchers showed that ISDra2TnpB is effective in editing both monocot plants (like rice) and dicot plants (like Arabidopsis).

? Base editing capabilities: The team further enhanced the tool by creating a hybrid base editor that can swap single nucleotides in the DNA sequence, opening up new possibilities for precise genetic modifications.

Potential applications in agriculture: The development of ISDra2TnpB has significant implications for agriculture, particularly in improving crop resilience and productivity. For example, this tool could be used to:

? Reduce crop susceptibility to pests: By editing genes that make crops vulnerable to pests, ISDra2TnpB could help develop more pest-resistant varieties.

? Enhance nutritional value: The tool could be used to remove anti-nutrient factors from crops, improving their nutritional content.

Increase crop resilience to environmental stress: ISDra2TnpB could help create shorter rice crops that are less prone to damage during cyclones, a common problem in cyclone-prone regions. A genome is the complete set of genetic information in an organism, stored in DNA molecules called chromosomes. It includes genes that code for RNA and proteins, with eukaryotes containing their genomes in the nucleus and prokaryotes in the nucleoid.