Gene Editing using CRISPR

Prelims: *Science and Technology | Current events of national and international importance*

Why in News?

Recently, India has developed the world's first-ever genome-edited rice varieties.

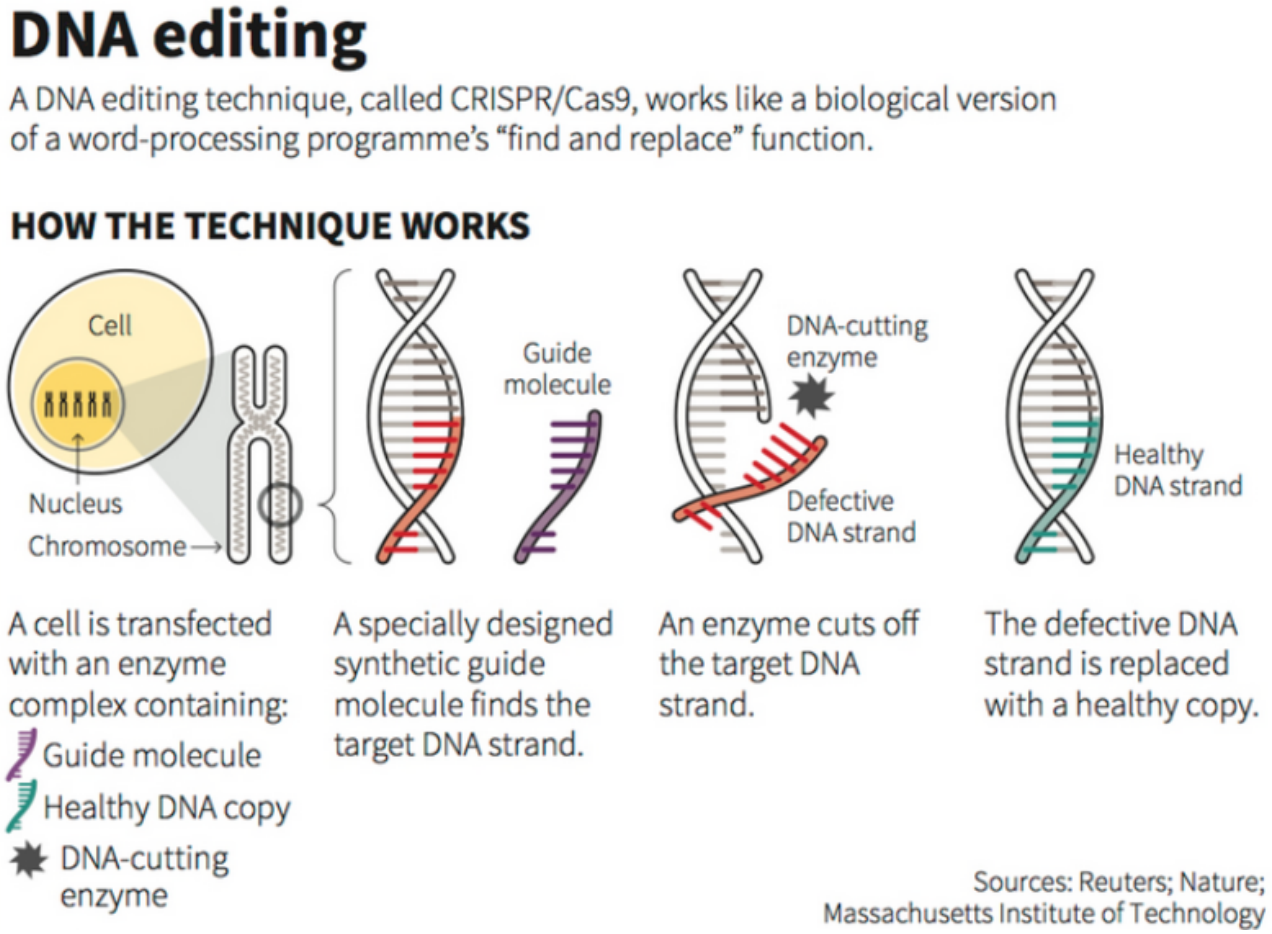
- **Gene editing** – It entails mere ***"editing" of genes naturally present in the host species***, leading to mutation or changes in their DNA sequence.
- *No foreign genes or DNA* are incorporated.

> *A **gene** is the basic physical and functional unit of heredity. Genes are made up of DNA. Some genes act as instructions to make molecules called proteins, which are needed for the body to function. However, many genes do not code for proteins, instead they help control other genes.*

- **Recent technology** – Targeted genome editing using "CRISPR/Cas9" (Clustered regularly interspaced short palindromic repeats/***CRISPR-associated protein 9***).
- It was originally identified and adapted from a naturally-occurring immunity mechanism *in bacteria*, which is employed against invading viruses.

Gene Editing by Bacteria
• The bacteria basically capture snippets of DNA from the viruses and use them to ***create CRISPR arrays***. • These DNA segments allow the bacteria to "*remember" the viruses*. • In the event of the viruses attacking, the bacteria *produce RNA* (messenger that carries genetic information from the DNA) from the CRISPR arrays. • The bacteria then use ***Cas9 enzyme, which acts as a pair of "molecular scissors",*** to cut the DNA apart and disabling the virus.

- **Working** – Technology involves to *produce RNA complementary to a specific target DNA sequence* in the genome of an organism.
- This ***"guide" RNA*** binds itself only to that target sequence and no other regions of the genome.
- The Cas9 enzyme will, in turn, follow the guide RNA and cut the 2 strands of DNA at the targeted location.
- At this stage, the cell knows that the DNA is damaged and tries to repair it.



- Such genome editing using CRISPR/Cas9 is possible through 3 different approaches - **Site-Directed Nuclease (SDN) 1, 2 and 3.**
- The researchers can now use the natural DNA repair machinery to introduce changes, including by adding or deleting genetic material.

Gene Modification

- It is different from Gene Editing.
- It involves ***introduction of genes from unrelated species*** into host plants.
    - For example, be genes from Bacillus thuringiensis, a soil bacterium, that code for the production of proteins toxic to various insect pests in cotton.

Reference

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