A Few Minutes Series

Subject – Science

Date – 10th April 2023

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Top Gene Editing Techniques

Topics- Part I

- Gene vs Genome
- Gene editing
- Gene editing vs GMO
- Govt regulation changes
- Gene editing technologies
- SDN1 SDN2 SDN3

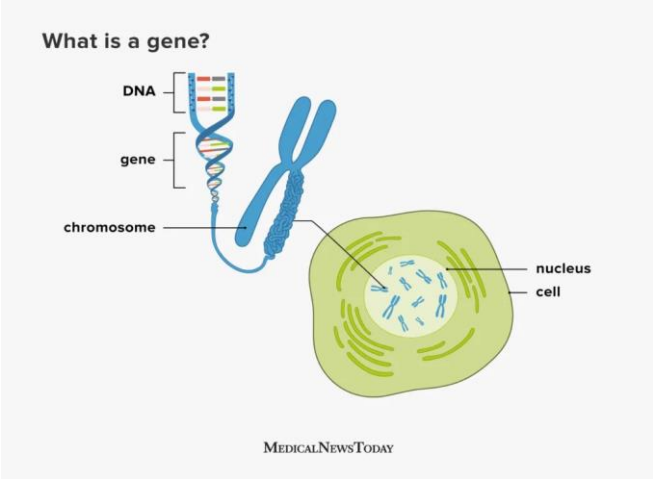
Gene editing Techniques-Part II	
1.	Zinc finger nucleases (ZFN)
2.	Transcription activator-like effector nucleases (TALENs)
3.	Meganucleases
4.	CRISPR-Cas9
5.	Base editing
6.	Prime editing
7.	PASTE: 'Drag-and-Drop' Editing for Large Insertions

- Recently, the Government has **allowed genome-edited plants without the cumbersome GMO (Genetically Modified Organisms) regulation** at the Genetic Engineering Appraisal Committee (GEAC).

About

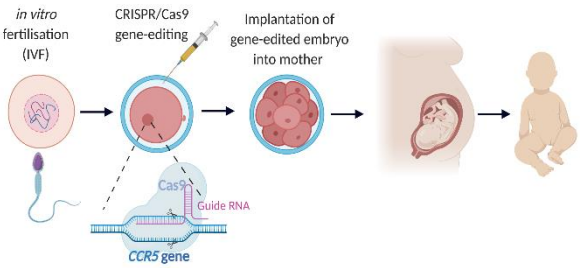
- The government has **exempted Site Directed Nuclease (SDN) 1 and 2 genomes** from Rules 7-11 of the **Environment Protection Act**, thus allowing it to avoid a long process for approval of GM crops through the Genetic Engineering Appraisal Committee (GEAC).
- The **Institutional BioSafety Committee (IBSC)** under the Environment Protection Act would now be entrusted to certify that the genome edited crop is devoid of any foreign DNA.
- While **SDN 1 and 2** do not involve the introduction of foreign DNA, SDN3 involves the introduction of foreign DNA making it typical of GMO development.
- In **SDN-3**, the newly developed plant falls under GMO legislation only if foreign DNA exceeding 20 base pairs is inserted.

What is Gene ?



- 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.
- However, many genes do not code for proteins. In humans, genes vary in size from a few hundred DNA bases to more than 2 million bases.

What is Genome editing ?



- Genome editing technologies enable scientists to make changes to DNA, leading to changes in physical traits, like eye color, and disease risk. Scientists use different technologies to do this. These technologies act like scissors, cutting the DNA at a specific spot. Then scientists can remove, add, or replace the DNA where it was cut.
- The first genome editing technologies were developed in the late 1900s. More recently, a new genome editing tool called CRISPR, invented in 2009, has made it easier than ever to edit DNA. CRISPR is simpler, faster, cheaper, and more accurate than older genome editing methods. Many scientists who perform genome editing now use CRISPR.

Gene editing Techniques	
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Site-Directed Nuclease (SDN) genome editing

- **It** involves the use of different DNA-cutting enzymes (nucleases) that are directed to cut the DNA at a predetermined location by a range of different DNA binding systems.
- After the cut is made, the cell's own DNA repair mechanism recognizes the break and repairs the damage, using one of two pathways that are naturally present in cells

Non-homologous end-joining (NHEJ)	Homology-directed repair (HDR)
The cut DNA is rejoined, but while doing this a few base pairs may be eaten away or added resulting in random small deletions (up to 20) or additions (a few base pairs) of nucleotides at the cut site.	A donor DNA that carries the desired change and has homology with the target site is used to introduce this change at the cut site. In this way you can introduce specific intentional insertions, changes or deletions