

What is genome editing technology?

April 1, 2022

In news- Recently, the Central government has paved the way for easy introduction of genome edited crops

Key updates-

- The Environment Ministry has **notified fresh guidelines related to genome editing.**
- The notification has exempted SDN 1 and SDN 2 genome and instead it would rely on reports of the Institutional Biosafety Committee to exclude exogenous genetic material.
- The **institutional biosafety committees** are expert committees constituted to deal with research and release of GM material.
- **Such committees would now be entrusted to certify that the genome edited crop is devoid of any foreign DNA.**
- **In India, the introduction of GM crops is a laborious process which involves multiple levels of checks.**
- **The Genetic Engineering Appraisal Committee (GEAC), a high power committee under the Ministry of Environment, Forest and Climate Change, is the regulator for introduction of any GM material** and in case of agriculture multiple field trials, data about biosafety and other information is necessary for getting the nod before commercial release of any GM crop.
- **Till date the only crop which has crossed the regulatory red tape is Bt cotton.**
- Now this would be a less cumbersome and time consuming process for commercial release of genome edited crops.

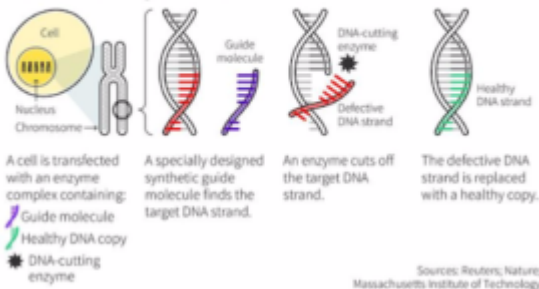
What is genome editing technology?

- **Genome editing (also called gene editing) is a group of technologies** that lets scientists change the DNA of many organisms, including plants, bacteria, and animals.
- A decade ago, scientists in Germany and the US discovered a technique which allowed them to 'cut' DNA strands and edit genes.
- For agriculture scientists **this process allowed them to bring about desired changes in the genome by using site directed nuclease (SDN) or sequence specific nuclease (SSN).**
- Nuclease is an enzyme which cleaves through nucleic acid – the building block of genetic material.
- Advanced research has allowed scientists to develop the highly effective clustered regularly interspaced palindromic repeat (CRISPR) -associated proteins based systems.
- This system allows for targeted intervention at the genome sequence.
- Using this tool, agricultural scientists can now edit the genome to insert specific traits in the gene sequence.
- **Depending on the nature of the edit that is carried out, the process is divided into three categories – SDN 1, SDN 2 and SDN 3.**
 - **SDN1 introduces changes in the host genome's DNA through small insertions/deletions** without introduction of foreign genetic material.
 - In the case of **SDN 2, the edit involves using a small DNA template to generate specific changes.** Both these processes do not involve alien genetic material and the end result is indistinguishable from conventionally bred crop varieties.
 - On the other hand, **SDN3 process involves larger DNA elements or full length genes of foreign origin** which makes it similar to Genetically modified organisms (GMO) development.

DNA editing

A DNA editing technique, called CRISPR/Cas9, works like a biological version of a word-processing programme's "find and replace" function.

HOW THE TECHNIQUE WORKS



How is gene editing different from GMO development?

- Genetically modified organisms (GMO) involves modification of the genetic material of the host by introduction of a foreign genetic material.
- In the case of agriculture, soil bacteria is the best mining source for such genes which are then inserted into the host genome using genetic engineering.
- For example, in case of cotton, introduction of genes cry1Ac and cry2Ab mined from the soil bacterium *Bacillus Thuringiensis* (BT) allow the native cotton plant to generate endotoxins to fight pink bollworm naturally.
- BT Cotton uses this advantage to help farmers naturally fight pink bollworm which is the most common pest for cotton farmers.
- **The basic difference between genome editing and genetic engineering is that while the former does not involve the introduction of foreign genetic material, the latter does.**
- In the case of agriculture, **both the techniques aim to generate variants which are better yielding** and more resistant to biotic and abiotic stress.
- Before the advent of genetic engineering, such variety improvement was done through **selective breeding** which involved carefully crossing plants with specific traits to produce the desired trait in the offspring.
- Globally, European Union countries have bracketed genome

edited crops with GM crops. Countries like Argentina, Israel, US, Canada, etc have liberal regulations for genome edited crops.