GM crops in India

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Manifest Pedagogy

GM crops related issues can be asked both at the prelims and mains stage. At the prelims especially technology related like genes of which bacteria etc could be asked. At the mains the debate between increasing food production/productivity/nutritional improvement versus environmental issues involved would be important area of preparation. Current developments related to Gm crops should be kept track for preparation at both stages of exam.

In news

GM seed use has surged in India

Placing it in the syllabus

Agriculture- and Food security

Static dimensions

1. GM crops and its technology
2. Pros and cons of GM crops

Current dimensions

1. GM crops approval mechanism in India
2. Scenarios across the world and examples of GM crops

Content

Technology about GM crops

Organisms that have new genes inserted into them are called

transgenic or genetically modified organisms (GMOs).

GM is a technology that involves inserting DNA into the genome of an organism. To produce a GM plant, new DNA is transferred into plant cells. Usually, the cells are then grown in tissue culture where they develop into plants. The seeds produced by these plants will inherit the new DNA.

Genetic modification of plants involves adding a specific stretch of DNA into the plant's genome, giving it new or different characteristics. This could include changing the way the plant grows, or making it resistant to a particular disease. The new DNA becomes part of the GM plant's genome which the seeds produced by these plants will contain.

Scenarios across the world and examples of GM crops

GMO crops are grown around the world by approximately 18 million farmers, most of them in developing countries. In total, more than 75 countries import, grow and/or research GMOs, and in 2016, 26 countries (seven industrial and 19 developing) planted biotech crops. As of 2016**, the top five countries growing GMOs in terms of crop area are the United States, Brazil, Argentina, Canada and India.**

Cultivating GMO crops has provided significant benefits to farmers globally, including increased yield and lower production costs. Importantly, GMOs also help to alleviate poverty for the millions of resource-poor farmers and farm families around the world (equaling approximately 65 million people total).

Following are some of the list of the countries that grow GM crops

Countries	Crops
United States of America	Cotton, Alfalfa, Canola, Maize, Papaya, Soybean, Sugar beet

South Africa	Cotton, Maize, Soybean
China	Cotton, Papaya, Poplar, Sweet pepper, Tomato
Canada	Canola, Maize, Papaya, Soybean, Sugar beet
Mexico	Cotton, Soybean
Myanmar	Cotton
Argentina	Cotton, Maize, Soybean
Brazil	Cotton, Maize, Soybean
Australia	Canola, Carnation, Cotton

Golden Rice– Golden rice is the collective name of rice varieties that are genetically modified to counter vitamin A deficiency in developing countries. Golden rice is a variety of rice (Oryza sativa) produced through genetic engineering to biosynthesize beta-carotene, a precursor of vitamin A, in the edible parts of rice. European scientists developed the first strain of Golden Rice towards the end of the 1990s. Golden rice differs from standard rice in that it contains extra genes. These were added through genetic modification and ensure the production of provitamin A in the rice grains. Provitamin A colors the grains yellow-orange, hence the name 'Golden Rice'. Once absorbed into the body, provitamin A is converted into vitamin A.

GM crops in India

India has the world's fifth largest cultivated area under genetically modified (GM) crops, at 11.4 million hectares (mh) in 2017. But unlike other big growers, its entire GM crop area is under a single crop – **cotton** – incorporating genes from the Bacillus thuringiensis or Bt soil bacterium coding for resistance against heliothis bollworm insect pests.

Bt Brinjal

The GEAC in 2007, recommended the commercial release of Bt

Brinjal, which was developed by Mahyco (Maharashtra Hybrid Seeds Company) in collaboration with the Dharwad University of Agricultural sciences and the Tamil Nadu Agricultural University. But the initiative was blocked in 2010.

GM-mustard

Dhara Mustard Hybrid-11 or DMH-11 is a genetically modified variety of mustard developed by the Delhi University's Centre for Genetic Manipulation of Crop Plants. The researchers at Delhi University have created hybridised mustard DMH-11 using "barnase / barstar" technology for genetic modification(Soil bacterium, *Bacillus amyloliquefaciens*,). It is Herbicide Tolerant (HT) crop. If approved by the Centre, this will be the second GM crop, after Bt Cotton, and the first transgenic food crop to be allowed for cultivation in the country.

Pros and cons of GM crops with special reference to India

Pros

Growing Genetically Modified Crops is supposed to help the farmer's to:

- Spend less money producing more crops, hence increases farmers income.
- Use fewer pesticides and herbicides: The amount of pesticide chemicals used on the plants are reduced, so their exposure to dangerous pesticides are also reduced.
- Do less tilling to remove weeds, thereby protecting the soil.
- Foods with better texture, flavor and nutritional value.
- Foods with a longer shelf life for easier shipping.
- It can help to feed the rapidly increasing population.
- It will help to produce more in small area of land.
- India imports edible oil from other countries. A higher yield will ensure price regulation of edible oil. It will also reduce dependency on imported food.
- For example, GM mustard is a self-pollinating plant and

is better suited to hybridisation compared to other methods.

Cons

- Creating “super weeds” that have evolved a resistance to glyphosate, a common herbicide in GMO food production.
- Allergic Reactions: It states that genetic modification often adds or mixes proteins that were not indigenous to the original animal or plant, which might cause new allergic reactions in our body.
- Raise of Super pest: The chance in evolution of pest is more.
- Cross-Pollination:Cross-pollination can cover quite large distances, where new genes can be included in the offspring of organic, traditional plants or crops that are miles away. This can result in difficulty in distinguishing which crop fields are organic and which are not, posing a problem to the task of properly labeling non-GMO food products.
- The impact of growing GMO crops like GM mustard on the health of the population, the environment (the soil on which it is grown), the food chain, the groundwater, etc., is still unknown.
- Some GMO foods have antibiotic features built into them to make them immune to diseases or viruses. These antibiotics can make actual antibiotic medicines less effective.

GM crops approval mechanism in India

The top biotech regulator in India is Genetic Engineering Appraisal Committee (GEAC). The committee functions as a statutory body under the Environment Protection Act 1986 of the Ministry of Environment & Forests (MoEF). It was earlier known as Genetic Engineering Approval Committee. Under the EPA 1986 “Rules for Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms/Genetically Engineered Organisms

or Cells 1989", GEAC is responsible for granting permits to conduct experimental and large-scale open field trials and also grant approval for commercial release of biotech crops.

The Rules 1989 also define the competent authorities and composition of such authorities for handling of various aspects of the Rules. Presently there are six committees. The mandate of the six Committees notified under Rules 1989 is as follows:

1. **Recombinant DNA Advisory Committee (RDAC):** The functions are of an advisory nature and involve review of developments in biotechnology at national and international levels and recommend suitable and appropriate safety regulations for India in recombinant research, use and applications from time to time.
2. **Review Committee on Genetic Manipulation (RCGM**) established under the Department of Biotechnology, ministry of Science and technology is to monitor the safety related aspects in respect of on-going research projects and activities (including small scale field trials) and bring out manuals and guidelines specifying procedure for regulatory process with respect to activities involving genetically engineered organisms in research, use and applications including industry with a view to ensure environmental safety.
3. **Genetic Engineering Appraisal Committee (GEAC)** established under MoEFCC is the apex body to accord notified under Rules 1989. For approval of activities involving large scale use of hazardous microorganisms and recombinants in research and industrial production from the environmental angle. The GEAC is also responsible for approval of proposals relating to release of genetically engineered organisms and products into the environment including experimental field trials (Biosafety Research Level trial-I and II known as BRL-I and BRL-II).

4. **State Biotechnology Coordination Committee** (SBCC's) have a major role in monitoring. It also has powers to inspect, investigate and take punitive action in case or violations of statutory provisions.
5. **District Level Committees (DLCs)** have a major role in monitoring the safety regulations in installations engaged in the use of genetically modified organisms/hazardous microorganisms and its applications in the environment.
6. **Institutional Biosafety Committee (IBSC)** is established under the institution engaged in GMO research to oversee such research and to interface with the RCGM in regulating it.