GM Mustard

For Prelims: Dhara Mustard Hybrid (DMH-11), Barnase/Barstar System, Bronchitis, Genetic Engineering Appraisal Committee (GEAC), Bt cotton,

For Mains: The importance and significance of GM Crops and Dhara Mustard Hybrid (DMH-11)

Why in News?

Recently, the **Genetically Modified (GM) mustard Dhara Mustard Hybrid (DMH-11)** was tested in the field and shown to be **more productive.**

- Production of the **DMH-11** variety is not interfering with **honey bees' natural pollination practices.**

What are Genetically Modified (GM) Crops?

- **GM crops** are derived from plants whose **genes are artificially modified,** usually by inserting **genetic material** from another organism, in order to give it new properties, such as **increased yield, tolerance** to a **herbicide**, **resistance** to **disease** or **drought,** or **improved nutritional value.**
    - Earlier, India approved the commercial cultivation of only one GM crop, **Bt cotton**, but **Genetic Engineering Appraisal Committee (GEAC)** has recommended GM Mustard for commercial use.

What is GM Mustard?

- **DMH-11** is an indigenously developed **transgenic mustard**. It is a **genetically modified variant of Herbicide Tolerant (HT) mustard.**
- **DMH-11** is a result of a cross between **Indian mustard variety 'Varuna'** and **East European 'Early Heera-2'** mustard.
- It contains **two alien genes ('barnase' and 'barstar')** isolated from a **soil bacterium** called **Bacillus amyloliquefaciens** that enable breeding of **high-yielding commercial mustard hybrids.**
- **Barnase in Varuna induces a temporary sterility** because of which it can't naturally self-pollinate. Barstar in Heera **blocks the effect of barnase allowing seeds to be produced.**
- **DMH-11** has shown approximately **28% more yield** than the **national check** and **37 %** more than the **zonal checks** and its use has been claimed and approved by the **GEAC.**
    - **"Bar gene"** maintains the **genetic purity of hybrid seed.**

Why is the Barnase/Barstar System Required?

- The **hybrid seed production** requires an **efficient male sterility and fertility restoration system.**
- The currently available conventional **cytoplasmic-genetic male sterility system** in mustard has

limitations of **breakdown of sterility** under certain environmental conditions leading to **lowering of seed purity.**

- The **genetically engineered barnase/barstar system** provides an **efficient and robust alternative method** for **hybrid seed production in mustard.**
- In India, the **Centre for Genetic Manipulation of Crop Plants (CGMCP)** has made a **successful attempt** with some alterations in the **barnase/ barstar system** which culminated in the development of **GM mustard hybrid MH11** which has undergone the required regulatory testing processes during **2008-2016.**

Why GM Mustard is Necessary?

- India's **import of edible oils is on continuous rise** to meet the domestic demand. It ultimately led reduction forex. GM Mustard is **essential to reduce the forex drain on Agri-import.**
- **Productivity of oilseed crops** viz., soybean, rapeseed mustard, groundnut, sesame, sunflower, safflower and linseed in India is **much lower than the global productivity of these crops.**
- Crossing of genetically diverse parents results in hybrids with **increased yield and adaptation**

What are the Safety Concerns associated with DMH-11?

- The safety of **three genes** used in the creation of the technique **Barnase, Barstar and Bar** is being questioned.
- Field trials for **three years (two years of BRL-I and one year of BRL-II)** have been conducted to assess the impact on **human health and environment** as per the stipulated guidelines and applicable rules.
- It is important to note that comprehensive research on the toxicity, allergenicity, compositional analysis, field trials, and environmental safety studies of GM mustard has shown that **they are safe for food and feed usage as well as for production.**
- **DMH-11** has **"Bar gene"** which is responsible for herbicide tolerance. Effectiveness of **"Bar Gene"** is under question as per herbicide tolerance is concerned.

What is the Significance of Genetically Modified Crops?

- Crossing of **genetically diverse plants** results in **hybrids** with **increased yield** and **adaptation**, a phenomenon known as **hybrid vigor heterosis** which has been widely exploited in crops like rice, maize, pearl millet, sunflower and many vegetables.
- It has been convincingly demonstrated that hybrids in general show **20-25% higher yield** over the **conventional varieties** across the crops.
- **Hybrid technology** can play an important role in **enhancing the productivity** of **rapeseed mustard** in the country.

UPSC Civil Services Examination Previous Year Question (PYQ)

Prelims

Q1. Other than resistance to pests, what are the prospects for which genetically engineered plants have been created? (2012)

1. To enable them to withstand drought
2. To increase the nutritive value of the produce
3. To enable them to grow and do photosynthesis in spaceships and space stations
4. To increase their shelf life

Select the correct answer using the codes given below:

(a) 1 and 2 only
(b) 3 and 4 only
(c) 1, 2 and 4 only

(d) 1, 2, 3 and 4

Ans: (c)

- **Genetically modified crops (GM crops or biotech crops) are plants used in agriculture, the DNA of which has been modified using genetic engineering methods.** In most cases, the aim is to introduce a new trait to the plant which does not occur naturally in the species. Examples of traits in food crops include resistance to certain pests, diseases, environmental conditions, reduction of spoilage, resistance to chemical treatments (e.g., resistance to a herbicide), or improving the nutrient profile of the crop.
- Some potential applications of GM crop technology are:
    - Nutritional enhancement – Higher vitamin content, more healthful fatty acid profiles, **Hence, 2 is correct.**
    - Stress Tolerance – Tolerance to high and low temperatures, salinity, and drought, **Hence, 1 is correct.**
    - There is no such prospect that enables GM crops to grow and do photosynthesis in spaceships and space stations. **Hence, 3 is not correct.**
    - Scientists have been able to create certain genetically modified crops which stay fresh for a month longer than usual. **Hence, 4 is correct. Therefore, option (c) is the correct answer.**

Q2. Bollgard I and Bollgard II technologies are mentioned in the context of

(a) clonal propagation of crop plants
(b) developing genetically modified crop plants
(c) production of plant growth substances
(d) production of biofertilizers

Ans: (b)

- **Bollgard I Bt cotton (single-gene technology) is first biotech crop technology approved for commercialization in India in 2002**, followed by Bollgard II- double-gene technology in mid-2006, by the Genetic Engineering Approval Committee, the Indian regulatory body for biotech crops.
- Bollgard I cotton is an insect-resistant transgenic crop designed to combat the bollworm. It was created by genetically altering the cotton genome to express a microbial protein from the bacterium Bacillus thuringiensis.
- Bollgard II technology contains a superior doublegene technology - Cry1Ac and Cry2Ab, which provides protection against bollworms and Spodoptera caterpillar, leading to better boll retention, maximum yield, lower pesticides costs, and protection against insect resistance.
- Both Bollgard I and Bollgard II insect-protected cotton is widely planted around the world as an environmentally friendly way of controlling bollworms. **Therefore, option (b) is the correct answer.**

Mains

Q. How can biotechnology help to improve the living standards of farmers? **(2019)**

Source: PIB