# 4. GMO Wheat - Environment

The global agricultural landscape is currently witnessing a pivotal shift as hybrid wheat becomes more accessible and Genetically Modified (GM) varieties move toward potential launches in major markets like the U.S. This technology represents a frontier in food security, designed to address the challenges of a growing population and a changing climate.

## 1. Background

### What are GM Crops?

Genetically Modified (GM) crops are plants used in agriculture whose DNA has been modified using genetic engineering techniques. Unlike traditional breeding, which involves crossing entire genomes, genetic engineering allows for the precise transfer of specific genes to introduce desirable traits.

### The Genetic Engineering Process

Creating a GM crop typically follows a four-step scientific protocol -

**Identification -** Pinpointing a specific trait (e.g., drought resistance) in another organism.

**Isolation -** Extracting the specific gene responsible for that trait.

**Insertion -** Integrating the gene into the target crop's genome using molecular tools.

**Expression -** Ensuring the plant successfully "reads" the new DNA and manifests the trait.

### Techniques and Modification Types

**Key Techniques -**

**Gene Guns -** Shooting microscopic gold particles coated with DNA into plant cells.

**Agrobacterium -** Using a natural soil bacterium as a "taxi" to carry new DNA into cells.

**Electroporation & Microinjection -** Using electrical pulses or physical needles to insert DNA.

### Types of Modification -

**Transgenic -** Genes from a non-related species (e.g., bacteria to plant).

**Cis-genic -** Genes from a closely related or same species.

**Subgenic -** Altering the plant's own genetic makeup without adding outside DNA.

**Stacked Traits -** Integrating multiple modifications (e.g., both pest and herbicide resistance).

## 2. The Indian Scenario - Progress and Regulation

India maintains a cautious yet evolving stance on biotechnology in agriculture.

### Current Status of GM Crops in India

**Bt Cotton -** The only GM crop officially approved for commercial cultivation (since 2002). It uses genes from the bacterium *Bacillus thuringiensis* to produce a protein toxic to the Pink Bollworm.

**Pipeline Projects -** Several crops are in advanced stages of testing or awaiting final clearance, most notably Bt Brinjal and DMH-11 Mustard (Hybrid Mustard).

### Regulatory Framework

The oversight of GM crops involves multiple ministries and stringent legal acts -

**Genetic Engineering Appraisal Committee (GEAC) -** Housed under the Ministry of Environment, Forest and Climate Change (MoEF&CC), it is the apex body for approving commercial releases and large-scale field trials.

**Key Legal Pillars -**

**Environment Protection Act, 1986 (EPA) -** The primary umbrella legislation.

**Biological Diversity Act, 2002 -** Protects native genetic resources.

**Food Safety and Standards Act, 2006 -** Regulates the safety of GM-derived food for human consumption.

**Plant Quarantine Order, 2003 -** Prevents the entry of exotic pests via GM seeds.

## 3. Comparison of Primary GM Trait Types

| Trait Type | Description | Primary Benefit |
|---|---|---|
| **Herbicide Tolerance (HT)** | Engineered to withstand specific chemical weed-killers (like Glyphosate). | Simplifies weed management for farmers. |

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| **Insect Resistance (IR)** | Plant produces its own pesticide (e.g., Bt toxin). | Reduces the need for external chemical sprays. |
| **Nutritional Enhancement** | Altered to provide more vitamins or minerals. | Combats "hidden hunger" (e.g., Golden Rice with Vitamin A). |
| **Climate Resilience** | Traits for drought, heat, or salt tolerance. | Ensures yield stability in erratic weather. |

## 4. Critical Concerns and Risks

The deployment of GM technology is met with significant resistance from environmentalists and health advocates.

**The Glyphosate Controversy -** Many GM crops are designed for "Herbicide Tolerance." This often leads to increased use of Glyphosate, a herbicide banned in states like Punjab due to suspected carcinogenic effects (non-Hodgkin lymphoma) and damage to soil health.

**Biodiversity & Gene Flow -** There is a risk of "super-weeds" emerging if GM genes jump to wild relatives. Furthermore, the dominance of GM seeds can lead to monocultures, wiping out diverse native varieties.

**Public Health & Superbugs -** Scientists worry about the use of antibiotic resistance markers during the engineering process. If these transfer to human gut bacteria, they could render life-saving antibiotics ineffective.

**Legal & Transparency Gaps -** Civil society groups, such as the *Coalition for a GM-Free India*, have criticized the lack of transparency in issuing No Objection Certificates (NOCs) for trials and the absence of robust public consultation.

## 5. Way Ahead - A Balanced Approach

To move forward, India must bridge the gap between technological ambition and public trust through the following steps -

**Scientific Transparency -** All trial data should be published in the public domain for independent, peer-reviewed assessment.

**Stringent Containment -** Use of "buffer zones" and strict containment strategies is necessary to prevent accidental cross-pollination with native varieties.

**Institutional Independence -** Empower biosafety and ethics committees with greater autonomy to ensure decisions are free from commercial or political pressure.

**Public Engagement -** Shift from a "top-down" implementation to a "consultative" model involving farmers, scientists, and civil society at every stage of the approval process.

Source - https -//epaper.thehindu.com/ccidist-ws/th/th_international/issues/177369/OPS/G7MFNU59F.1+GG1FOU5R7.1.html