



Alternative Dwarfing Genes in Wheat

Why in News

Recently, scientists at Pune based **Agharkar Research Institute (ARI)**, have mapped **two alternative dwarfing genes *Rht14* and *Rht18*** in wheat that can help in reducing rice crop residue burning i.e. [stubble burning](#).

- ARI is an autonomous institute of the **Department of Science and Technology**.

Background

- In India, close to **twenty-three million tonnes** of leftover rice residues are annually burnt by farmers to get rid of the straw and prepare their fields for sowing wheat, which is the next crop, resulting in air pollution.
- Also, dry environments pose a challenge for the **germination of wheat varieties** with **short coleoptile**.
 - **Coleoptile** is a sheath which protects the young shoot tip in a grass or cereal.
 - Short coleoptiles are generally less adapted for the deeper sowing conditions.
- The presently available semi-dwarf wheat varieties, which were explored during the [Green Revolution](#), carry conventional *Rht1* dwarfing alleles.
 - **Alleles** are the variant form of a given gene.
 - The Reduced Height (*Rht*) genes decreased plant height and increased productive tillers (sprouts).
- The present variety produces optimum yields under high-fertility irrigated conditions.
- However, they are **not well adapted for deeper sowing conditions in dry environments** due to **shorter coleoptiles**, and **low early vigor (measure of increase in plant growth)** often results in reduced seedling emergence.

Key Points

- **Alternative Dwarfing Genes:**
 - ARI mapped the dwarfing genes *Rht14* and *Rht18* on chromosome 6A in a **durum variety of wheat**, and DNA-based markers were developed for a better selection of these genes in wheat breeding lines.
 - **Genetic/DNA marker** is any alteration in a sequence of nucleic acids or other genetic traits that can be readily detected and used to identify individuals, populations, or species or to identify genes involved in inherited disease.
 - The DNA-based markers will help wheat breeders to precisely select wheat lines carrying these alternative dwarfing genes from a massive pool of wheat breeding lines. These genes are associated with better seedling vigour and longer coleoptiles.
 - **Breeding line** is a group of genetically identical homozygous individuals that, when intercrossed, produce only offspring that are identical to their parents.

- It has been found that dwarfing genes *Rht14* and *Rht18* in wheat conferred a **plant height reduction** comparable to the *Rht1* alleles **while retaining early vigour in wheat seedlings**, but do not affect coleoptile length and seedling shoot length.
 - Therefore, these can be utilized as an alternative dwarfing genes to *Rht1* for deep sowing conditions or in fields with retained stubble.
 - The DNA based markers are being used at the Institute for marker-assisted transfer of these genes in Indian wheat varieties, so as to make them suitable for sowing under rice stubble-retained conditions and dry environments.
- **Marker-assisted transfer:** It is an **indirect selection process** where a trait of interest is selected based on a **marker (morphological, biochemical or DNA/RNA variation)** linked to a trait of interest, e.g. productivity, disease resistance, abiotic stress tolerance, and quality.

▪ Advantages:

- The wheat lines with these alternative dwarfing genes will help in **reducing stubble burning incidences** under the rice-wheat cropping system.
- The improved lines will make it possible for **farmers to sow wheat under rice stubble-retained conditions**.
 - It means farmers won't have to resort to stubble burning for preparing their ground for the sowing of the next crop.
- These lines will also **allow deeper sowing of wheat seeds** to avail advantage of residual moisture in the soil, therefore, saving valuable water resources and reducing the cost of cultivation to farmers.

Way Forward

- Burning of leftover rice crop residue (stubble burning) has serious implications for the environment, soil, and human health. Therefore, there is a need to include alternative dwarfing genes in wheat improvement programs.
- Also, only two dwarfing alleles of *Rht1* are predominant in Indian wheat varieties; therefore, it is required to **diversify the genetic base of dwarfing** genes considering diverse wheat growing zones in India.
- Also there is a need for rigorous Research and Development related to the gene varieties of crops so that productivity of the crops can be enhanced.

Source: PIB

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