Alternative dwarfing genes in wheat can eliminate rice crop residue burning

- 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**.
- To overcome these problems, Scientists at Pune based Agharkar Research Institute (ARI), an autonomous institute of the Department of Science and Technology, have mapped two **alternative dwarfing genes Rht14 and Rht18 in wheat**.
- These genes are associated with better **seedling vigour and longer coleoptiles** (sheath protecting the young shoot tip).
- ARI **have mapped the dwarfing genes on chromosome 6A in durum wheat**, and **DNA-based markers** were developed for a better selection of these genes in wheat breeding lines.
- 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 **DNA based markers** are being used at ARI 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**.
- Wheat breeding lines with these alternative dwarfing genes are presently at an advanced stage.

**Issues with Rht dwarfing varieties**

- The presently available **semi-dwarf wheat varieties**, which were explored during the Green Revolution, **carry conventional Rht1 dwarfing alleles** (variant form of a given gene) and produce **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** often results into reduced seedling emergence.
- Moreover, **crop stands of Rht1 wheat** also remain **poor** where previous crop residues pose a barrier for seedling emergence due to the short coleoptiles.
- Burning of leftover rice crop residue 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, there is a need to **diversify the genetic base** of dwarfing genes considering diverse wheat growing zones in India.

**Advantages of Rht14 and Rht18**

- In genetic studies conducted at ARI, **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.
- These can, therefore, be utilized as an alternative dwarfing gene to Rht1 for deep sowing conditions or in fields with retained stubble.
- It will help **reducing stubble burning** incidences under the rice-wheat cropping system.
• 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 reduce the cost of cultivation to farmers.