# Herbicide-Tolerant Rice Varieties

## Why in News

Recently, the **Indian Agricultural Research Institute (IARI)** has developed the **country's first-ever non-GM (genetically modified) herbicide-tolerant rice varieties (Pusa Basmati 1979 and Pusa Basmati 1985).**

- These varieties **can be directly seeded** and significantly save water and labour **compared to conventional transplanting**.
- **ICAR-IARI** is a deemed university.

## Key Points

- **About the New Varieties of Rice:**
    - The new varieties contain a **mutated AcetoLactate Synthase (ALS) gene** making it possible for farmers to spray **Imazethapyr**, a broad-spectrum herbicide, to control weeds.
        - The **ALS gene** in rice codes for an enzyme (protein) that **synthesises amino acids for crop growth and development.**
        - The **herbicide sprayed on normal rice plants binds itself to the ALS enzymes, inhibiting their production of amino acids.**
    - **Imazethapyr**, effective against a range of broadleaf, grassy and sedge weeds, **can't be used on normal paddy**, as the chemical **does not distinguish between the crop and the invasive plants.**
    - However, the new basmati varieties contain a **mutated ALS** gene whose DNA sequence has been altered using **ethyl methanesulfonate, a chemical mutant.**
        - As a result, the ALS enzymes no longer have binding sites for Imazethapyr and amino acid synthesis isn't inhibited.
    - The plants can now **"tolerate" application of the herbicide**, and hence it kills only the weeds.
    - It is important to note that, as **there is no foreign gene involved in the process**, the herbicide-tolerance is through mutation breeding. **Thus, it is not a** Genetically modified organism**.**
- **Advantages of These Varieties:**
    - **Direct Seeding of Rice Activity:** The new varieties simply replace water with Imazethapyr and there's no need for nursery, puddling, transplanting and flooding of fields.
        - Water is a natural herbicide that takes care of weeds in the paddy crop's early-growth period.
        - The new varieties will help in Direct Seeding of Rice **(DSR) which has several advantages over paddy transplantation.**
    - **Cheaper Option:** DSR cultivation is currently based on two herbicides, Pendimethalin and Bispyribac-sodium.

        - However, Imazethapyr is cheaper than these two options.
    - **Safer Option:** Imazethapyr, moreover, has a wider weed-control range and is safer, as the ALS gene isn't present in humans and mammals.

## Paddy Transplantation vs Direct Seeding of Rice

- **Paddy Transplantation:**
    - The field where the seedlings are transplanted has to be **"puddled" or tilled in standing water.**
    - For the first three weeks or so after transplanting, the plants are irrigated almost daily to maintain a water depth of 4-5 cm.
    - Farmers continue giving water every two-three days even for the next four-five weeks when the crop is in **tillering (stem development) stage.**
    - Paddy transplantation is **both labour- and water-intensive.**
- **Direct Seeding of Rice (DSR):**
    - In DSR, the **pre-germinated seeds are directly drilled** into the field by a tractor-powered machine.
    - There is no nursery preparation or transplantation involved in this method.
    - Farmers have to only level their land and give one pre-sowing irrigation.
- **Advantages with Direct Seeding of Rice:**
    - Water savings.
    - Less numbers of labourers required.
    - Saves labour cost.
    - Reduce methane emissions due to a shorter flooding period and decreased soil disturbance compared to transplanting rice seedlings.
- **Drawbacks of Direct Seeding of Rice:**
    - The seed requirement for DSR is also high, 8-10 kg/acre, compared to 4-5 kg/acre in transplanting.
    - Further, laser land levelling is compulsory in DSR. This is not so in transplanting.
    - The sowing needs to be done timely so that the plants have come out properly before the monsoon rains arrive.

**Source: IE**

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