

ICAR Launches World's First Genome-Edited Rice: Kamala & Pusa DST Rice 1

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Genome-Edited Rice Latest News

- **ICAR** has developed the **world's first genome-edited rice varieties** featuring higher yields, drought and salinity tolerance, and improved nitrogen-use efficiency, making them climate-resilient and water-conserving.

Genome Editing (GE) in Plants and GM Crops

- Genome editing in plants refers to making precise, targeted changes to a plant's DNA without introducing foreign genetic material.
 - It uses technologies like **CRISPR-Cas9** to edit specific DNA sequences within a plant's existing genome.
 - This can involve deleting, inserting, or modifying DNA at precise locations.
- On the other hand, GM crops involve inserting genes from other organisms into the plant's genome.
- In essence, genome editing modifies existing DNA, while GM crops introduce new DNA.
- India has exempted GE crops from biosafety regulations under the Environment (Protection) Act of 1986.
 - These regulations govern both field trials and release for commercial cultivation in the case of GM crops.

ICAR Develops Two Genome-Edited Rice Varieties

- ICAR has developed the world's first genome-edited rice varieties—**DRR Dhan 100 (Kamala)** and **Pusa DST Rice 1**—to enhance yield, drought and salinity tolerance, and nitrogen-use efficiency, without using any foreign DNA.

DRR Dhan 100 (Kamala)

- **Developed by:** ICAR-Indian Institute of Rice Research (ICAR-IIRR), Hyderabad
- **Parent Variety:** Samba Mahsuri (BPT 5204)
- **Gene Targeted:** *Cytokinin Oxidase 2 (CKX2 or Gn1a)*
- **Technology Used:** Site Directed Nuclease 1 (SDN1) genome editing
 - SDN1 uses DNA-cutting enzymes (nucleases) to create a targeted break in the DNA at a specific location.
- **Key Traits:**
 - Early maturity (~130 days; 20 days earlier than parent)
 - Drought tolerance
 - High nitrogen-use efficiency
- **Superior yield:**
 - **5.37 tonnes/ha** (vs. 4.5 t/ha for parent) – 19% increase
 - **Up to 9 t/ha** under optimal conditions
 - Retains the grain and cooking quality of Samba Mahsuri
- **Recommended Zones:** Andhra Pradesh, Telangana, Karnataka, Tamil Nadu, Puducherry, Kerala (Zone VII), Chhattisgarh, Maharashtra, Madhya Pradesh (Zone V), Odisha, Jharkhand, Bihar, Uttar Pradesh, West Bengal (Zone III).

Pusa DST Rice 1

- **Developed by:** ICAR-Indian Agricultural Research Institute (ICAR-IARI), New Delhi
- **Parent Variety:** MTU1010

- **Gene Targeted:** *Drought and Salt Tolerance (DST)* gene
- **Technology Used:** SDN1 genome editing
- **Key Traits:**
 - Drought and salinity tolerance
 - Enhanced yield under stress conditions:
 - **Inland salinity:** 3,508 kg/ha (9.66% higher than MTU1010)
 - **Alkaline soils:** 3,731 kg/ha (14.66% higher)
 - **Coastal salinity:** 2,493 kg/ha (30.4% higher)
 - Contains no foreign DNA, comparable to conventional varieties
- **Recommended Zones:** Same as Kamala – major rice-growing states across India

Practical Benefits of ICAR's New Genome-Edited Rice Varieties

- **Higher Yields, Lower Emissions**
 - Cultivating **DRR Dhan 100 (Kamala)** and **Pusa DST Rice 1** over 5 million hectares can:
 - Increase paddy production by 4.5 million tonnes
 - Reduce greenhouse gas emissions by 32,000 tonnes (approx. 20%)
- **Significant Water Savings**
 - **Kamala's shorter maturity period** allows for:
 - Three fewer irrigations
 - Savings of 7,500 million cubic metres of irrigation water, which can benefit other crops
- **Use of Safe and Award-Winning Technology**
 - Developed using **CRISPR-Cas9** genome-editing technology, awarded the **2020 Nobel Prize in Chemistry**
 - No foreign DNA used; only native gene edits to enhance traits
 - Follows **Site Directed Nuclease 1 (SDN1)** and **SDN2** methods — considered equivalent to natural mutations
- **Exempt from Stringent GMO Regulations**
 - Under India's Environment (Protection) Act, 1986, SDN1 and SDN2 crops are:
 - Exempt from strict GMO rules (**Rules 7-11**)
 - Classified as genome-edited, not genetically modified
- **Regulatory Clearances Granted**
 - Institutional Biosafety Committees (IBC) of ICAR approved the lines
 - Review Committee on Genetic Manipulation (RCGM) cleared them in May 2023
 - Declared safe under India's **simplified regulatory framework** for genome-edited crops
- **IPR Concerns Being Addressed**
 - Some concerns exist about the **Intellectual Property Rights** of the genome-editing technology, but ICAR has assured they are being looked into and will be resolved in due course

Significance of the Breakthrough in Genome-Edited Paddy

- **Paddy: India's Most Critical Foodgrain Crop**

- Paddy is the main kharif crop and occupies **one-third of India's foodgrain cultivation area**.
- It contributes about **40% to the total foodgrain basket**, making it essential for national food security.
- **Major paddy-growing states include:** West Bengal, Uttar Pradesh, Punjab, Odisha, Andhra Pradesh, Telangana, Tamil Nadu, Chhattisgarh, Bihar, and Assam.

• India's Paddy Production Paradox

- India had the **largest area under paddy cultivation (45 million ha)** globally in 2020.
- But in production, India **ranked second** (186.5 million tonnes) after **China** (211 million tonnes).
- The gap is due to **lower yield** in India:
 - **India:** 4,138 kg/ha
 - **World average:** 4,717 kg/ha
 - **China:** 7,043 kg/ha
 - **Indonesia:** 5,128 kg/ha
 - **Bangladesh:** 4,809 kg/ha

India's Push for Genome Editing in Agriculture

• Beyond Rice: Genome Editing in Other Crops

- Genome-editing research is underway for **oilseeds and pulses**.
- The University of Delhi has already developed a genome-edited mustard variety.

• Government Support and Funding

- The Indian government has allocated **₹500 crore** for **genome-editing research** in agricultural crops to boost yield and climate resilience.

Genome-Edited Rice FAQs

Q1. What is genome-edited rice?

Ans. Genome-edited rice involves precise gene changes using CRISPR, improving traits without introducing foreign DNA.

Q2. Which are ICAR's new genome-edited rice varieties?

Ans. DRR Dhan 100 (Kamala) and Pusa DST Rice 1 are ICAR's newly developed genome-edited rice varieties.

Q3. What traits do Kamala and Pusa DST Rice 1 offer?

Ans. They offer higher yield, drought and salinity tolerance, and better nitrogen-use efficiency.

Q4. How is genome editing different from GM crops?

Ans. Genome editing modifies native DNA; GM crops insert foreign genes from other organisms.

Q5. Are genome-edited rice varieties regulated like GMOs in India?

Ans. No, they are exempt from GMO regulations under India's Environment (Protection) Act, 1986.

Source: <https://vajiramandravi.com/current-affairs/icar-launches-worlds-first-genome-edited-rice/>

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