AGRICULTURE · C4S COURSES

Smart Seed Coating Technology

23 June 2026

Source: The Hindu

Context

The **ICAR–Indian Institute of Oilseeds Research (ICAR-IIOR), Hyderabad**, has developed an **innovative, Indian-patented, biodegradable biopolymer-based Smart Seed Coating Technology** that **improves crop establishment** and **resilience against climate stress**, announced through a **PIB release on 18 June 2026**. The technology replaces **conventional single-purpose seed treatments** with a **multifunctional protective shield** that integrates **beneficial microorganisms, primary nutrients, micronutrients, crop protection agents, and plant growth-promoting compounds** in a **single application**. **Multi-location AICRP-Seed trials** across **seven crops** (**soybean, maize, groundnut, chickpea, cotton, mustard, pigeon pea**) showed **productivity gains ranging from 12 to 37 per cent** over **untreated controls**. **Field demonstrations in Telangana** recorded **nearly 30 per cent yield improvements** in **groundnut and soybean** compared to **conventional farmer practices**. The technology is **particularly suited to rainfed agriculture**, which covers about **52 per cent of India's net sown area**. ICAR-IIOR is seeking partnerships with **State Seed Development Corporations, National Seed Corporation, Farmer Producer Organisations (FPOs), seed processing units, seed entrepreneurs, and private seed companies** for **large-scale adoption**.

The Announcement

- **Announced by**: **Ministry of Agriculture & Farmers Welfare**.
- **Developed by**: **ICAR-Indian Institute of Oilseeds Research (ICAR-IIOR)**, **Hyderabad**.
- **Patent status**: **Indian patent granted**.
- **Type**: **Biopolymer-based, biodegradable seed enhancement platform**.

What is the Smart Seed Coating Technology?

- A **multifunctional protective shield** that:
  - **Coats raw seeds** with **biodegradable biopolymers**.
  - **Carries** beneficial inputs **directly to the seed-soil interface**.
  - **Improves seed performance** during the **early, vulnerable stages** of crop growth.

How It Works

Step 1: Layered Encapsulation

- Raw seed is **coated** with **eco-friendly, biodegradable biopolymers**.
- Forms a **customised shell** around the seed.

Step 2: Input Integration

- The biopolymer layer acts as a **local carrier**, packing:
  - **Beneficial microorganisms** (bacteria, fungi, plant growth-promoting microbes).
  - **Primary nutrients** (NPK).
  - **Micronutrients** (zinc, iron, boron, etc.).
  - **Crop protection agents** (fungicides, insecticides).
  - **Plant growth-promoting compounds**.

Step 3: Microenvironment Activation

- Once sown, the coating **reacts with soil moisture**.
- Creates a **protective microenvironment** at the **seed-soil interface**.

Step 4: Targeted Release

- **Embedded biologicals and nutrients** release **directly into the root zone** during germination.
- **Drives**:
  - **Rapid root development**.
  - **Immediate nutrition access** for the seedling.
  - **Stress tolerance**.

Key Features

Patented Biopolymer Base

- **Entirely biodegradable** polymer-based **carrier system**.
- **Breaks down naturally**.
- **No soil degradation** or **chemical pollution**.

All-in-One Input Delivery

- Unlike **traditional single-purpose treatments**, this **integrates**:
  - **Protection** (against pests and diseases).
  - **Nutrition** (NPK + micronutrients).
  - **Biological support** (microorganisms).
- In a **single application**.

Highly Customisable Design

- Can be **tailored** for:
  - **Cereals** (rice, wheat, maize).
  - **Millets** (jowar, bajra, ragi).
  - **Pulses** (chickpea, pigeon pea, urad, moong, masoor).
  - **Oilseeds** (soybean, groundnut, mustard, sunflower).
  - **Fibre crops** (cotton, jute).
  - **Fodder crops**.
  - **Vegetables**.
  - **Spices**.
  - **Horticultural varieties**.

Aim of the Smart Seed Coating Technology

- **Strengthen climate-resilient agriculture**.
- **Reduce production risks** in **rainfed farming systems**.
- **Enhance overall crop productivity**.
- **Safeguard** emerging seedlings against:
  - **Erratic monsoons**.
  - **Droughts**.
  - **Temperature spikes**.
  - **Soil degradation**.
  - **Pest pressures**.

About ICAR-IIOR (Indian Institute of Oilseeds Research)

- **Established**: **1977** as **National Research Centre for Oilseeds Crops**.
- **Upgraded**: To **Directorate of Oilseeds Research** in **1986**.
- **Renamed**: **Indian Institute of Oilseeds Research (IIOR)** in **2014**.
- **Located**: **Hyderabad, Telangana**.
- **Parent body**: **Indian Council of Agricultural Research (ICAR)**.
- **Mandate**:
  - **Research on oilseed crops**: Castor, safflower, sesame, niger, sunflower.
  - **AICRP-Seed** coordination.
  - **Biotechnology and genetic resources**.
  - **Crop protection** research.
  - **Technology transfer**.

About ICAR (Indian Council of Agricultural Research)

- **Founded**: **16 July 1929** as **Imperial Council of Agricultural Research**.
- **Renamed**: **1946** to ICAR.
- **Headquartered**: **Krishi Bhavan, New Delhi**.
- **Director General**: **Dr. Mangi Lal Jat** (since November 2024).
- **Functions**:
  - **Coordinate, guide, and manage** research and education in **agriculture, animal husbandry, fisheries**.
  - **Operates 113 ICAR Institutes** + **74 Agricultural Universities** + **731 KVKs** (Krishi Vigyan Kendras).
- **Under**: **Department of Agricultural Research and Education (DARE)**, **Ministry of Agriculture**.

About AICRP-Seed (All India Coordinated Research Project on Seeds)

- **Established**: As part of ICAR's **AICRP network**.
- **Function**: **Multi-location trials** for **seed research, technology validation, and dissemination**.
- **Network**: Across **State Agricultural Universities (SAUs)** and **ICAR institutes** in **diverse agro-climatic zones**.
- **Purpose**: Generate **location-specific recommendations** for **seed quality enhancement**.

About Biopolymers

- **Definition**: **Polymers produced by living organisms** or made from **biological/natural sources**.
- **Examples**: **Cellulose, starch, chitin, alginate, gelatin, pectin, agar**.
- **Properties**:
  - **Biodegradable**.
  - **Eco-friendly**.
  - **Renewable**.
  - **Non-toxic**.
- **Applications**: **Agriculture, biomedical, packaging, pharmaceuticals**.

About Seed Treatment Technology

Traditional Seed Treatment

- **Single-purpose** approach:
  - **Fungicide application**.
  - **Insecticide application**.

  - **Or growth promoter**.
- **Applied separately**.
- **Often uses chemical actives**.

Smart Seed Coating (New)

- **Multifunctional** approach.
- **All inputs in one shell**.
- **Biopolymer base** (biodegradable).
- **Targeted release**.

Related Government Initiatives

- **Mission for Aatmanirbharta in Pulses** (October 2025).
- **Mission for Aatmanirbharta in Oilseeds**.
- **National Mission on Oilseeds and Oil Palm (NMOOP)**.
- **National Mission on Sustainable Agriculture (NMSA)**.
- **Per Drop More Crop** under PMKSY.
- **Soil Health Card Scheme**.
- **Sub-Mission on Seeds and Planting Materials (SMSP)**.
- **Mission SEHAT** (May 2026): For nutritional convergence.

Practice MCQs

Q1. With reference to the Smart Seed Coating Technology, consider the following statements:

1. It was developed by the ICAR-Indian Institute of Oilseeds Research (ICAR-IIOR), Hyderabad.
2. The technology holds an Indian patent and uses biodegradable biopolymers.
3. It integrates protection, nutrition, and biological support in a single application.
4. The technology uses non-biodegradable synthetic polymers.

How many of the above statements are correct?

(a) Only one (b) Only two (c) **Only three** (d) All four (e) None

(Statement 4 is wrong; the **technology uses BIODEGRADABLE biopolymers**, NOT non-biodegradable synthetic polymers.)

Q2. With reference to the AICRP-Seed multi-location trials, consider the following statements:

1. Trials were conducted across seven crops: soybean, maize, groundnut, chickpea, cotton, mustard, and pigeon pea.
2. Productivity gains ranged from 12 to 37 per cent over untreated controls.
3. Field demonstrations in Telangana recorded nearly 30 per cent yield improvement in groundnut and soybean.
4. The technology can be used only for oilseed crops, not for cereals or pulses.

How many of the above statements are correct?

(a) Only one (b) Only two (c) **Only three** (d) All four (e) None

(Statement 4 is wrong; the **technology can be customised for cereals, millets, pulses, oilseeds, fibre crops, fodder crops, vegetables, spices, and horticultural crops**.)

Q3. With reference to the working mechanism of the Smart Seed Coating Technology, consider the following statements:

1. The biopolymer layer acts as a carrier for beneficial microorganisms, nutrients, and crop protection

agents.
2. Once sown, the coating reacts with soil moisture to create a protective microenvironment at the seed-soil interface.
3. Targeted release delivers biologicals and nutrients directly to the root zone during germination.
4. The coating is permanent and does not biodegrade.

How many of the above statements are correct?

(a) Only one (b) Only two (c) **Only three** (d) All four (e) None

(Statement 4 is wrong; the **coating biodegrades naturally** without causing soil degradation.)

Q4. With reference to ICAR-IIOR and AICRP-Seed, consider the following statements:

1. ICAR-IIOR was established in 1977 as the National Research Centre for Oilseeds Crops.
2. It was renamed Indian Institute of Oilseeds Research (IIOR) in 2014.
3. AICRP-Seed is a multi-location research network of ICAR for seed technology validation.
4. ICAR-IIOR is located in New Delhi.

How many of the above statements are correct?

(a) Only one (b) Only two (c) **Only three** (d) All four (e) None

(Statement 4 is wrong; **ICAR-IIOR is located in Hyderabad**, NOT New Delhi.)

Q5. With reference to rainfed agriculture in India, consider the following statements:

1. Rainfed agriculture covers about 52 per cent of India's net sown area.
2. It accounts for about 89 per cent of millets, 88 per cent of pulses, and 70 per cent of oilseeds production.
3. It is highly vulnerable to erratic monsoons, drought, and pest pressures.
4. Rainfed agriculture is irrigated agriculture using groundwater wells.

How many of the above statements are correct?

(a) Only one (b) Only two (c) **Only three** (d) All four (e) None

(Statement 4 is wrong; **rainfed agriculture depends SOLELY on rainfall**, NOT on irrigation through wells.)

Q6. With reference to the institutional deployment strategy, consider the following statements:

1. ICAR-IIOR is seeking partnerships with State Seed Development Corporations for large-scale adoption.
2. Partnerships are being formed with Farmer Producer Organisations (FPOs).
3. Private seed companies are also being engaged for wider dissemination.
4. The technology will be exclusively sold by ICAR with no private participation.

How many of the above statements are correct?

(a) Only one (b) Only two (c) **Only three** (d) All four (e) None

(Statement 4 is wrong; the **deployment strategy explicitly includes private seed companies** for **wider dissemination**.)

Answer Key

1. (c), Statements 1, 2, 3 are correct; Statement 4 is wrong because the technology uses biodegradable biopolymers.
2. (c), Statements 1, 2, 3 are correct; Statement 4 is wrong because the technology can be used for multiple crop categories.
3. (c), Statements 1, 2, 3 are correct; Statement 4 is wrong because the coating is biodegradable.
4. (c), Statements 1, 2, 3 are correct; Statement 4 is wrong because ICAR-IIOR is in Hyderabad.

5. (c), Statements 1, 2, 3 are correct; Statement 4 is wrong because rainfed agriculture depends on rainfall, not wells.
6. (c), Statements 1, 2, 3 are correct; Statement 4 is wrong because private seed companies are involved.

Exam Relevance

NABARD Grade A	**Very high importance, agriculture, rural innovation, seed systems**

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