WONDER TECHNOLOGY

Biopolymer based film forming polymers: Sustainable Innovation from Crop Waste

DR. RK MATHUR

DIRECTOR, ICAR-IIOR, HYDERABAD

भाकृअनुप-भारतीय तिलहन अनुसंधान संस्थान

ICAR-Indian Institute of Oilseeds Research

राजेंद्रनगर, हैदराबाद-500 030, तेलंगाना राज्य, भारत

Rajendranagar, Hyderabad-500 030, Telangana State, India

Fax: +91-040-24017969 Web: http://www.icar-iior.org.in

ISO 9001:2008 Certified Institute

Oilseed Production Scenario in Indian Context

India is one of the largest oilseed producers globally, cultivating crops like **soybean, groundnut, rapeseed-mustard, sunflower, and sesame**.

Contributes 20% of global area but only 6–8% of global production.

Despite area expansion, **domestic edible oil demand far exceeds production**, leading to heavy import dependence (60%).

Government initiatives: **National Mission on Edible Oils (NMEO)**, **NFSM–Oilseeds & Oil Palm**, and state-level programs to boost self-sufficiency.

Key Productivity Challenges

- 🌧️ **Rainfed cultivation:** 70–75% area under rainfed conditions; high climatic vulnerability.
- 🌾 **Low yield potential:** Yields (1.0–1.3 t/ha) far below global averages (2.0–2.5 t/ha).
- 🌱 **Poor seed replacement & varietal adoption.**
- 🐛 **Biotic/abiotic stresses:** Pests, drought, and temperature extremes.
- ⚙️ **Low mechanization & input use.**
- 💰 **Market and policy limitations:** Price volatility, import competition, and poor value-chain integration.

Multilayer seed coating using layer-by-layer strategy with biopolymeric films and crop inputs (microbes, insecticides, fungicides)

Biotic and abiotic stresses

Drought
Nutrients
Salinity
Pathogens

Direct seed treatment with multiple inputs

Constraints

- Physical incompatibility
- Environmental pollution
- Change in chemical characteristics
- Antagonistic interactions
- Wastage
- Improper adherence
- Toxicity and adverse effects

Seed quality and germination issues resulting in less plant stand and establishment

Multilayer seed coating with different inputs

Advantages

Multilayer seed coating

- Delivery of multiple inputs
- Seed size can be increased
- Incompatible combinations can also be considered
- Proper adherence
- Precision application
- Controlled release

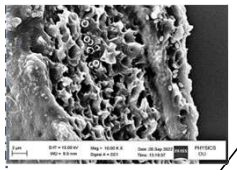
Patent Commercialization- Biopolymers developed as stable, tailored and crosslinked film coating polymers as a carrier and seed coating applications in agriculture

Incotec, Bayer, BASF, Syngenta are major players for adhesive purpose; This technology is compatible to microbes as a delivery carrier

Biopolyme r Film

Biopolymer + *Trichoderma* film

Biopolymer + *Trichoderma* seed treatment



10 Publications
NAAS rating 10 to 14.0

Groundnut, Sunflower
Seed coated with biopolymer + *Trichoderma*

Groundnut, Sunflower
Seeds coated with *Trichoderma* powder

International Journal of Biological Macromolecules 126 (2019) 282–290

Contents lists available at ScienceDirect

International Journal of Biological Macromolecules

journal homepage: http://www.elsevier.com/locate/ijbiomac

Biopolymer-2 - *Trichoderma* 1% w/v

Antioxidative enzymes ^ in biopolymer - *Trichoderma* treated plants

Persistence

log 2.1 CFUs/g soil 90 DAA

Seed load

1000 to 2000 CFUs/ g seed

Shelf life

log 8.4 CFU (24 months)

Entrapment Efficiency

87 %

Lab studies

Increase in germination > 13-36%
Disease reduction - 65 - 75 %

Crop	Disease
Groundnut	*Aspergillus* collar rot
Soybean	*Macrophomina* root rot
Safflower	*Macrophomina* root rot

Green house

Increase in germination > %
Disease reduction - 90- 96 %

Crop	Disease
Groundnut	*Aspergillus* collar rot
Soybean	*Macrophomina* root rot
Safflower	*Macrophomina* root rot

Field Trials

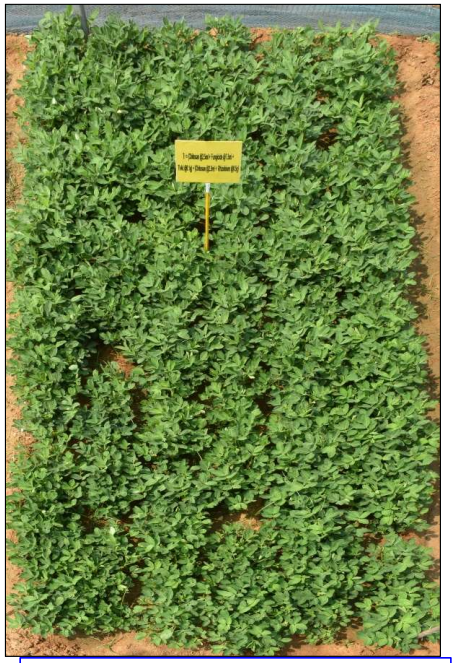
Increase in germination >14- 30%
Disease reduction - 68 to 75%

Crop	Disease
Groundnut	*Aspergillus* collar rot
Soybean	*Macrophomina* root rot
Safflower	*Macrophomina* root rot and *Fusarium* wilt

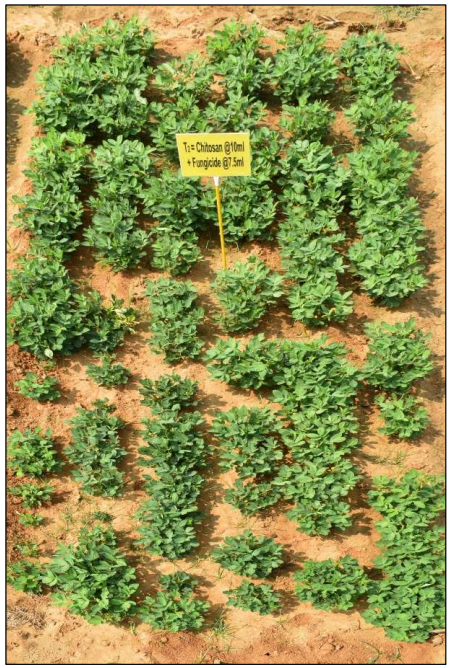
Prasad, R.D., Poorna Chandrika, K. S. V., Varsha G., 2020. *Microbiol. Res.* 237:126487. *(NAAS rating - 9.9)*

Effect of multilayer seed coating on the germination and disease incidence under field conditions

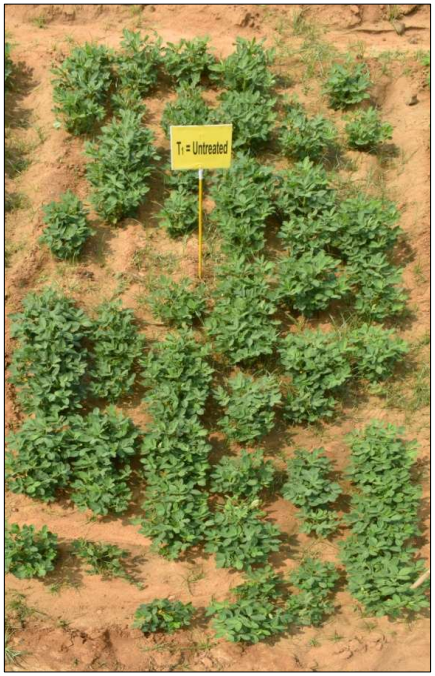
T_5 ML



T_7 -DL



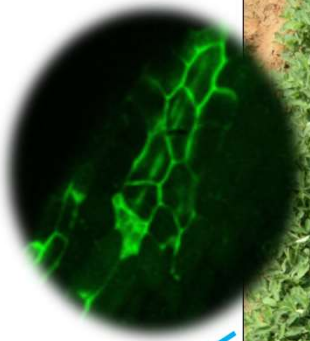
T_2 - SL



Untreated control

<u>Treatment ML and DL</u> has shown better germination and less disease incidence over control and other treatments.

Activity: Field evaluation of multilayer seed coating in groundnut



- Double layer coating

Untreated

Field validation of double layer seed coating technology in groundnut, green gram, red gram and castor

- ❖ Germination percentage was increased by 12.1 %
- ❖ Plant vigour was Increased by 21.6 %

Untreated groundnut

Double layer seed coating groundnut

Significant increase in Nodulation

Effectively controlled the Aspergillus rot

Parameter	Untreated	Double layer seed coating
Aspergillus rot Incidence	10-15 %	0
Leaf spot incidence	5-10 %	< 10 %
Peanut bud necrosis incidence	15-20 %	< 10 %
Aphid incidence	1-2 scale	0-1 scale
Thrips incidence (no.)	6.7	2.7

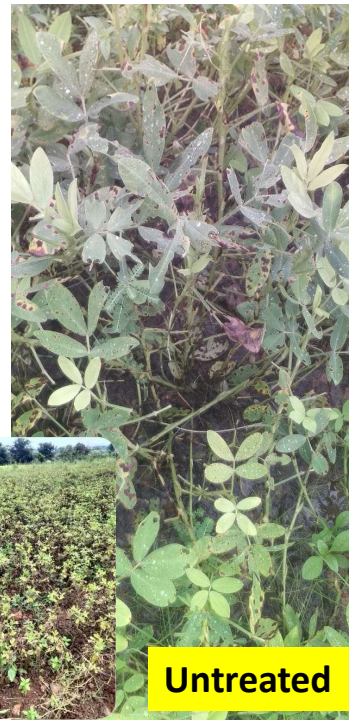
Field evaluations were conducted on castor, groundnut, red gram, and green gram crops each around 3000 sq. mt.

Success story at tribal farmers village with biopolymer-based seed treatment

	Yield (q)/ ac	Yield Increase (%)	
Treated field	**13**	**30**	***Rabi* 2024- 2 ac**
Farmers practice	10	-	
Treated field	**7**	**40**	***Kharif* 2025- 25 ac.**
Farmers practice	5	-	

Farmer's Practice
Yield -10 q/ acre

Biopolymeric multilayer seed coating
Yield- 13 q/ acre



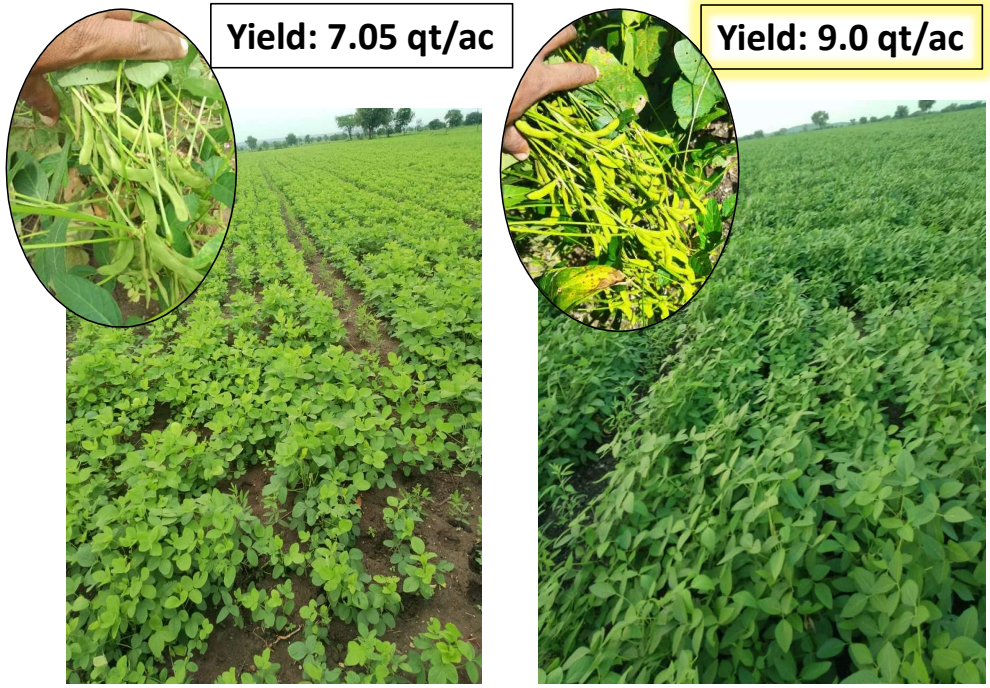
Validation of Biopolymer Technology in Farmers fields

Double layer seed treatment

YIELD

- ✓ **Untreated-** 10 qt/ac
- ✓ **Double layer seed treatment-** 13 qt/ac

Validation of Double layer seed coating technology in groundnut in Vikarabad district

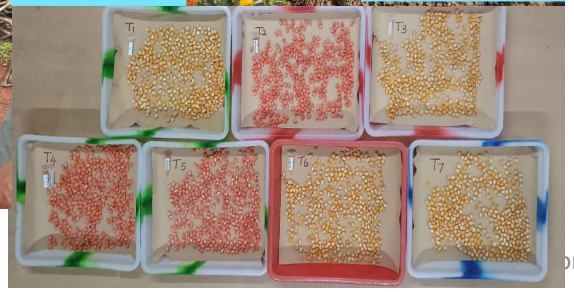


Untreated | **Multilayer seed treatment**

Validation of multilayer seed coating technology in soybean in Nizamabad district

Evaluation of Biopolymer Seed coatings in AICRP trails in different crops

Class	Crops
Cereals	Maize, Pearl millet, Small millets, Paddy
Pulses	Pigeon pea, chick pea
Oilseeds	Castor, soybean, groundnut, cotton, mustard, safflower, sesame, linseed
Vegetables	Potato, Chilli, Ginger



Milestone of ICAR-IIOR through Biopolymer Seed coatings in soybean

Despite facing drastic and erratic rainfall conditions during the kharif season 2025 — which normally lead to poor germination, resowing needs, and wide plant gaps — the coated soybean seeds showed: Excellent plant stand establishment right from emergence. No requirement of resowing or gap filling, even under stress conditions. Uniform and vigorous growth, ensuring better early crop coverage.

OTHER MILESTONES IN PPP..

Technology has been successfully transferred to three companies along with first hand set training:

1) Srikar Pvt Ltd (one batch evaluated in maize, cotton, paddy) market sent biopolymer seed treatment- **1 Ton maize seed**
2) Yaduka Agritech Ltd (first batch of production was done). Ready for marketing with other seed companies
3) Kurnool seeds Ltd- **7 MT paddy seed**

Biopolymer based seed treatments	Quantity
Multilayer seed coating for groundnut	1000 kgs
Biocoat for safflower	200 kgs
Multilayer seed coating /biocoat sesamum	10 kgs
Biocoat for castor	25 kgs
Biocoat to other crops	150 kgs

Looking for collaborations; scaling this innovation; technology transfer, or pilot testing in new regions as a per part of sustainable agriculture

Contact details: Director, ICAR-IIOR, Hyderabad;
director.iior@icar.org.in ; directoriior2025@gmail.com

Important

A warm invitation to attend "Smart Seeds for Sustainable Productivity" (Seed Industry-Farmer-Academia Interface on Biopolymer-Based Multilayer Seed Coating for Multi-Input Delivery)

📍 **Venue: ICAR–IIOR, Hyderabad** 🗓️ **Date: Oct 27, 2025**

Thank You