

# GLIMPSES OF

# ICAR-IIOR TECHNOLOGIES



INDUSTRY MEET, NAIF PROJECT



भाकृअनुप-भारतीय तिलहन अनुसंधान संस्थान  
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## ICAR-IIOR Technologies –At a glance

The Indian Institute of Oilseeds Research (IIOR) is a premier agricultural research institute located in Hyderabad, Telangana, India. It operates under the Indian Council of Agricultural Research (ICAR) and focuses on research and development of oilseed crops to enhance productivity and sustainability. The Key Activities being, Development of high-yield and disease-resistant oilseed varieties, Promotion of improved agronomic practices, Transfer of technology to farmers through training programs and Biotechnology and genomic research in oilseeds. IIOR plays a crucial role in India's efforts to reduce dependence on edible oil imports and achieve self-sufficiency in oilseed production.

Since, 1977, IIOR is playing vital role in development of several high yielding varieties and hybrids of oilseeds as well as development of notable sustainable pest and disease management technologies viz; bt and *Trichoderma* based bio pesticides, to name some.

### Varieties and Hybrids of ICAR-IIOR, Hyderabad:

ICAR-IIOR, Hyderabad is involved in research and development of varieties and hybrids of castor, sunflower, safflower, sesame, linseed and Niger. Varieties and hybrids developed from ICAR-IIOR have high yield potential along with high oil content.

Castor is a rainfed oilseed crop with high industrial value. Castor hybrids released from ICAR-IIOR are **ICH-5, ICH-6 and ICH-66**. The yield potential of these hybrids is 1700kg to 1900kg per hectare with high oil content of 46% to 49%. Resistant to wilt and moderately resistant to root rot and leafhopper are special features of these hybrids. These castor hybrids are mostly suitable for all castor growing areas of our country.

Sunflower is a versatile crop due to its photo and thermo insensitive nature it can grow throughout years. Hybrids are mostly preferred by farmers over open pollinated populations due to high yielding potential, quality, uniformity and resistance /tolerance to major biotic and abiotic stresses. Two hybrids namely **TilhanTec-SUNH-1 and TilhanTec-SUNH-2** have been developed and released from the ICAR-IIOR, Hyderabad. TilhanTec-SUNH-1 is a medium duration (95-100 days) hybrid. Average seed yield of 18-20 q/ha is expected under normal conditions, however under better management or irrigated situations, yield up to 20-26 q/ha is possible. It is recommended for cultivation for all sunflower growing states. TilhanTec-SUNH-2 is an early hybrid with 85-89 days maturity. Average seed yield is 15-18 q/ha under rainfed conditions. Oil content is 37-40%. It is recommended for rainfed areas of all sunflower growing states of India. Both the hybrids are resistant to downy mildew and moderately resistance to leafhoppers.



Safflower is a traditional oil seed crop in India. Considering the growing domestic demand for edible oils, a high oil content (38.2%) safflower variety ISF-300 is developed through conventional breeding. It recorded a potential oil yield up to 788 kg/ha. The mean seed yield of ISF 300 is 1796 kg/ha. ISF-300 is a normal duration variety (days to 50% flowering: 87; days to maturity: 134). ISF-300 is found to be resistant to *Fusarium* wilt. It is recommended for all safflower cultivating regions in India. The safflower variety ISF-123-sel-15 is recommended for rainfed areas of safflower cultivating regions in India. It is a high oil, high seed yielding coupled with *Fusarium* wilt resistant variety. It recorded 16.31 q/ha seed yield under rainfed conditions (The potential yield recorded was 32.92 q/ha).

Sesame is an ancient oilseed crop with a long history of cultivation in India. It is a high value oilseed crop cultivated for its high-quality edible oil and direct confectionery uses. In ICAR-Indian Institute of Oilseeds Research, Hyderabad efforts were made to develop superior plant type of sesame suitable for cultivation during *rabi*-summer season under irrigated conditions for cultivation across the country. **TilhanTec Til-1** is a white seeded variety developed by ICAR-IIOR. It was released for cultivation during *rabi*-summer in Karnataka, Maharashtra, Telangana, Odisha, West Bengal and Tamil Nadu. This variety is highly suitable for export purpose.

Research work is going on in linseed and niger to develop varieties with high oil and yield potential.

### Microbe based technologies for Insect Pest and Plant Disease Management

ICAR-IIOR is a forerunner in the area of microbial biopesticide technologies development, commercialization and HRD in the country. Biopesticide technologies based on *Bacillus thuringiensis*, *Beauveria* and *Trichoderma* have been developed. We have licensed first indigenous Bt WP technology to 50 private firms, *Beauveria bassiana* SC formulation to 3 private firms and *T. harzianum* Th4d SC formulation to 7 companies. One new liquid formulation of DOR Bt-127 SC is ready for commercialization. Furthermore, technologies like Bt + *Beauveria bassiana* combination formulation for lepidopteran pest management and a novel biopolymer based *Trichoderma* liquid formulation for disease management are in the pipeline.

### Biopolymer based seed pelleting technology for introducing multiple crop specific inputs

Film coating technology is a sophisticated process of applying precise amount of active ingredients along with a liquid material directly on to the seed surface without obscuring its shape. Seed coating provides an opportunity to package effective quantities of materials so that they can improve the germination and seedling growth. The polymer film coating may act as physical

barrier, which has been reported to reduce the leaching of inhibitors from the seed coverings and may restrict oxygen diffusion to the embryo

### Patented Biopolymer film coating technology

A number of potential endophytic *Trichoderma* species possessing salt and high temperature tolerant traits with broad spectrum activity have been identified, formulated and field evaluated against important fungal pathogens. These products have been commercialized as well. Our group has initiated research on identifying and optimizing suitable natural biopolymers as a carrier for *Trichoderma* in seed coating applications. We have developed a process for conversion on natural polysaccharide like chitosan, cellulose into a stable film former for seed coating applications and the process has been patented (Indian Patent No. 202141015658A). Initial research efforts have established the film forming and seed coating ability of chitosan and cellulose polymers, enhancement of seed germination and vigor, persistence and sustained release of active ingredient from films, viability of biocontrol agents in the carrier for longer period (Chandrika *et al.*, 2019).

### Multilayer Seed Coating Technology

Multi-layer seed coating approach with components like *Trichoderma* and chemical seed protectant entrapment in layer-by-layer strategy without much intervention to each other can be further explored as a novel strategy to enhance productivity of crops under field condition even during biotic and abiotic stresses. IIOR also has developed an innovative multilayer seed coating process (Provisional patent no. 202341006282) to introduce crop specific inputs like microbial biopesticides, chemical pesticides and nutrients and the proof of concept has been tested in groundnut and soybean crops.

We have to address the multiple stresses in an integrated manner to find sustainable or continued biotic and abiotic stress management solutions. The inherent merits of input delivery through polymer seed coating *viz.*, multiple input delivery, reduction of wastage of active ingredient while application, slow release and reduction in application costs etc., provides an opportunity to be exploited under integrated pest management and sustainable crop protection programs in oilseed crops.




Seed treatments in the present context are produced, formulated and marketed by few international companies with more utilization of chemical pesticides alone as a success story from the countryside. And there is a need for involvement of public sector for utilizing these multilayer polymer-based seed coating that is laden with crop inputs like biofertilizers, biocontrol agents and pesticides.

# *Improved varieties/Hybrids of Oilseeds*

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## 1. Sunflower

- i. **Sunflower hybrid: TilhanTech-SUNH-1 centrally notified vide S.O. 8 (E), dated 24.12.2021**

<b>Year of release:</b>	<b>2021</b>	  
<b>Salient features</b>	Average seed yield (kg/ha) under rainfed: 2000 Medium Maturity: 90-100 days Plant height (cm): 180-200 Seed characteristics: Black, medium in size and ovoid elongated in shape Resistant to: Downy mildew First hybrid found moderately resistant to leafhopper Oil content (%) 38-41	
<b>Recommended area (states)</b>	Uttarakhand and Jammu & Kashmir, Gujarat, Maharashtra and Northern Karnataka, Andhra Pradesh, Southern Karnataka, Tamil Nadu and Telangana State	
<b>Suitability</b>	Rainfed/timely sown	

### Proposed licensing terms and conditions

<b>A</b>	<b>Nature of License: Exclusive/non-exclusive</b>	<b>Non-exclusive</b>
<b>B</b>	Duration of the License	5 years
<b>C</b>	Licensee fee	15 lakhs
<b>D</b>	Royalty	4-5%
<b>E</b>	Licensed territory: India/other countries	India
<b>F</b>	Raw material to be transferred. If any	Breeder seeds of parental lines of the hybrid (3.75 kg ARM-243A and 1.25 kg RGP-100)
<b>G</b>	Cost to be charged for raw material. If any	Yes (Rs 1000/kg seeds of A line (ARM-243A) and Rs 500/kg seeds of R line)
<b>H</b>	Time line for transfer of the raw material	Immediately/5-6 months from the date of issue of license
<b>I</b>	Handholding and training support required	Training in maintenance and multiplication of parental lines and quality hybrid seed production
<b>J</b>	Cost for handholding and training	Rs 1,00,000/-per year to be incurred by seed company securing licence
<b>K</b>	Any other specific requirements	Sunflower is a cross pollinated crop and requires at least 400 m isolation distance for quality hybrid seed production Proper packages and practices (PoP) should be implemented

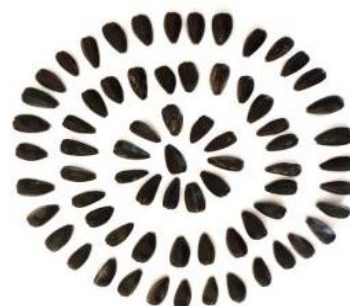


**ii. Sunflower hybrid: TilhanTec-SUNH-2 Centrally Notified on 21.11.2023**

<b>Year of release:</b>	<b>2023</b>
<b>Salient features</b>	Average seed yield (kg/ha) under rainfed: 1600 Early Maturity: 85-88 days Plant height (cm): 160-180 Seed characteristics: Black, medium in size and ovoid elongated in shape Resistant to: Downy mildew 8 moderately resistant to leafhopper Oil content (%) 37-40
<b>Recommended area (states)</b>	Gujarat, Maharashtra and Northern Karnataka, Andhr Pradesh, Southern Karnataka, Tamil Nadu an Telangana State
<b>Suitability</b>	Rainfed/timely sown


**Proposed licensing terms and conditions**

<b>A</b>	<b>Nature of License: Exclusive/non-exclusive</b>	<b>Non-exclusive</b>
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<b>D</b>	Royalty	4-5%
<b>E</b>	Licensed territory: India/other countries	India
<b>F</b>	Raw material to be transferred. If any	Breeder seeds of parental lines of the hybrid (3.75 kg ARM-243A and 1.25 kg RGP-100)
<b>G</b>	Cost to be charged for raw material. If any	Yes (Rs 1000/kg seeds of A line (ARM-243A) and Rs 500/kg seeds of R line
<b>H</b>	Time line for transfer of the raw material	Immediately/5-6 months from the date of issue of license
<b>I</b>	Handholding and training support required	Training in maintenance and multiplication of parental lines and quality hybrid seed production
<b>J</b>	Cost for handholding and training	Rs 1,00,000/-per year to be incurred by seed company securing licence
<b>K</b>	Any other specific requirements	Sunflower is a cross pollinated crop and requires at least 400 m isolation distance for quality hybrid seed production Proper packages and practices (PoP) should be implemented




## 2. Castor


### i. Castor Hybrid: Tilhan Tec ICH-6

Seed yield : Rainfed - 1000-1500 kg/ha	Rainfed - 1000-1500 kg/ha	
Maturity : 100 - 110 days	1000-1500 kg/ha Maturity : 100 - 110 days	
Oil content :	47 - 49%	
Recommended for	Andhra Pradesh, Telangana, Tamil Nadu, Karnataka, Odisha,	
Resistant to : Wilt, tolerance to sucking pests	Resistant to : Wilt, tolerance to sucking pests	

### ii. Castor Hybrid: ICH-5 (Centrally Notified Vide S.O.8 (E), DATED 24.12.2021)

Seed yield	Rainfed - 1670 kg/ha	
Maturity	1st picking 100-110 days	
Oil content	48%	
Recommended for	Rainfed regions of Andhra Pradesh, Telangana, Tamil Nadu,	
Resistant to	Wilt, root rot and leafhopper	

### iii. Castor Hybrid: ICH-66 (Centrally Notified Vide S.O. No. & date: 3220 (E), date 05.19.2019)



Seed yield	Rainfed - 1500 kg/ha	
Maturity	1st picking - 95-100 days	
Oil content	48%	
Recommended for	Rainfed regions of Andhra Pradesh, Telangana, Tamil Nadu, Karnataka and Odisha	
Resistant to	Wilt, root rot and leafhopper	

**iv. M-574 Castor female (pistillate) line (Developed through mutation breeding**



Registration details:	M-574 is protected by PPV & FRA as an extant variety (VCK) with registration no. 143 of 2020 dated 8-06-2020
Salient features:	Highly resistant to wilt, leafhopper Good combiner for high seed yield
Plant characters:	Triple Bloom Condensed Internode type Pistillate flowers on spikes Spiny capsule
Hybrid developed using M-574 :	DCH-519

### 3. Safflower

**i. Variety: ISF-764 (Lakshmipriya) Centrally notified vide S.O.99 (E), Dated 06/01/2020**



Salient features	<ul style="list-style-type: none"> <li>● High seed yielding variety</li> <li>● Average seed yield (kg/ha) <ul style="list-style-type: none"> <li>- 1583 (Rainfed)</li> <li>- 2274 (Irrigated)</li> </ul> </li> <li>● Seed oil content (%): 30.6</li> <li>● Days to 50% flowering: 80-85</li> <li>● Maturity days: 125-130</li> <li>● Petal color: Lemmon yellow-light Pinkish</li> <li>● Moderately resistant to Fusarium wilt and Alternaria</li> </ul>	 
Recommended area (states)	Maharashtra, Karnataka, Telangana, Andhra Pradesh, Madhya Pradesh, Chhattisgarh, Bihar, Uttar Pradesh, Rajasthan	

**ii. Variety: ISF-1 (Pride) Centrally notified vide S.O.99 (E), dated 06/01/2020**


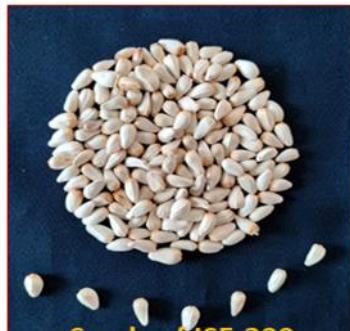
Salient features	<ul style="list-style-type: none"> <li>● First high oleic content variety</li> <li>● Average seed yield (kg/ha) <ul style="list-style-type: none"> <li>- 1236 (Rainfed)</li> <li>- 1864 (Irrigated)</li> </ul> </li> <li>● High oleic acid content (76%)</li> <li>● Average oleic acid yield (kg/ha):441</li> <li>● Oil content: 30.5%</li> <li>● Petal color: Yellow-orange</li> <li>● Days to Maturity: 125-130</li> </ul>	 
Recommended area (states)	Maharashtra, Karnataka, Telangana, Andhra Pradesh, Madhya Pradesh, Chhattisgarh, Bihar, Uttar Pradesh, Rajasthan	



**iii. Hybrid: ISH-402 centrally notified vide S.O.1050 (E), dated 06/01/2020**

Salient features	<ul style="list-style-type: none"> <li>● High seed and oil-yielding hybrid</li> <li>● CGMS-based hybrid (A-133-1x ISF-855)</li> <li>● Average seed yield (kg/ha) <ul style="list-style-type: none"> <li>- 2003 (Rainfed)</li> <li>- 3008 (Irrigated)</li> </ul> </li> <li>● Average oil yield (kg/ha): 723</li> <li>● Seed oil content (%): 30.8</li> <li>● Petal color: Yellow-orange</li> <li>● Days to 50% maturity: 80-82</li> <li>● Days to Maturity: 125-129</li> </ul>	 
Recommended area (states)	Maharashtra, Karnataka, Telangana, Andhra Pradesh, Madhya Pradesh and Chhattisgarh	

**iv. Variety: ISF-300 (High oil content) identified by varietal dated 05/09/2023**

Salient features	<ul style="list-style-type: none"> <li>● Average seed yield (kg/ha): 1796</li> <li>● Average oil yield (kg/ha): 694</li> <li>● Seed oil content (%): 38.2</li> <li>● Petal color: Yellow-orange</li> <li>● Resistant to Fusarium wilt</li> <li>● Hull content (%): 45</li> <li>● 100 seed weight (g): 4.5</li> <li>● Days to Maturity: 125-129</li> </ul>	 
Recommended area (states)	Maharashtra, Karnataka, Telangana, Andhra Pradesh, Madhya Pradesh and Chhattisgarh	

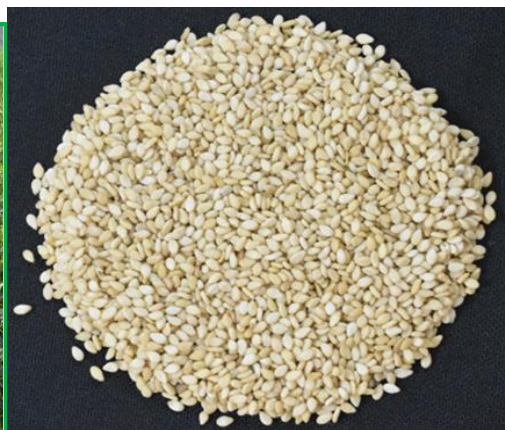
#### 4. **Sesame**

##### i. **Sesame variety: TilhanTec Til-1**

Seed yield	Seed yield : 900-960 kg/ha
Oil content	Oil content : 45%
Duration	Duration : 90-92 days
Seed colour	Seed colour : White seeded
Recommended for	Recommended for : Karnataka, Maharashtra, Telangana, Odisha, West Bengal and Tamil Nadu

##### ii. **Sesame variety: JCS-2454**

Seed yield	970-1030 kg/ha
Oil content	46-49 %
Duration	Summer 90-95 days
Seed colour	White seeded
Recommended for	Telangana



**TilhanTec Til-1**

# *Microbial based Bio-pesticides*

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## II. Microbial based bio pesticides:

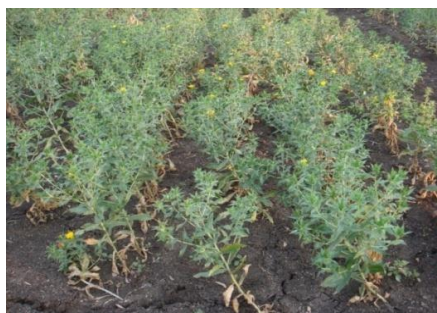
### 5. *Trichoderma harzianum* Th4d SC (Triguard Th-L)

- **Name of the technology and its microbial constituent:** Suspension Concentrate (SC) formulation of *Trichoderma harzianum* Th4d (NAIMCC-F- 02188) which is first of its kind in the country with shelf life of more than 24 months and production process for improved yield of *Trichoderma* biomass (Patented process, Indian Patent No. 316651). The SC formulation will have a minimum of  $2 \times 10^6$  cfu/ml even at 18<sup>th</sup> month after storage in room temperature.
- **Target diseases, crops and delivery system:** The technology has been validated against Phytophthora seedling blight, Macrophomina root rot and Fusarium wilt of safflower and castor, Botryotinia gray mold of castor and Alternariaster leaf blight and powdery mildew of sunflower. The formulations can be used for seed treatment @ 1ml/kg seed or 500 ml in 500 litre of water/ha and foliar spray.
- **Target agroecological zones/states (if any):** Telangana, Tamilnadu, Maharashtra
- **Validation and commercialization:** Technology validated over 5 years in multi-location field trials conducted under AICRP on Castor, Sunflower and Safflower revealed its effectiveness against Phytophthora seedling blight, Macrophomina root rot and Fusarium wilt of safflower, Botryotinia gray mold of castor, Alternariaster blight and powdery mildew of sunflower.
- **Whether licensed to private companies, If yes, details thereof:** The technology has been licensed (2015-2018) to 4 private companies between viz., 1. M/s Dhampur Sugars Pvt. Ltd., Dhampur, UP, 2. M/s Shri Ram Bioorganics, Jaspur, UK, 3. M/s Vidarbha Biotech, Yavatmal, MS, 4. M/s Agricos Pvt. Ltd., Yavatmal, MS, 5. M/s Siddaganga Oil & Bio Industries LLP., Tumkur.
- **Benefits:** *Trichoderma* formulation has longer shelf life (more than 24 months), dosage required is very low (1 or 2 ml/kg seed/L water), the strain is effective against many plant diseases (broad host range), symbiotic root colonizer, induces defense response in plants against pathogen and promotes plant growth. The production process supports high yield and desiccation tolerant viable propagules. *Trichoderma harzianum* Th4d SC liquid formulation can be produced at a low cost.

#### Field Trial at Parbhani (MS) in safflower crop during 2015-16, (Var. PBNS 12)



**Triguard Th-L**



**Triguard Th-L treated**



**Control**



## 6. *Trichoderma harzianum* Th4d WP (Triguard Th-P)

- **Name of the technology and its microbial constituent:** The technology offered is the biocontrol agent *Trichoderma harzianum* Th4d 1.5% WP formulation with shelf life of more than 18 months and production process for improved yield of *Trichoderma* biomass (patented process, Indian Patent No. 316651). The formulation will have a minimum of  $2 \times 10^6$  cfu/gm even at 18<sup>th</sup> month after storage in room temperature.
- **Target disease, crops and delivery system:** The technology has been validated against Phytophthora seedling blight, Macrophomina root rot and Fusarium wilt of safflower and castor, Aspergillus root rot in groundnut. The formulation can be used for seed treatment @ 10g/kg.
- **Target agroecological zones (if any):** Telangana, Tamilnadu, Maharashtra
- **Validation and commercialization:** Technology validated over 8 years in multi-location field trials conducted under AICRP on Castor and Safflower revealed its effectiveness against Phytophthora seedling blight, Macrophomina root rot and Fusarium wilt diseases.
- The technology is ready for commercialization.
- **Whether licensed to private companies, if yes, details thereof:** LOI has been obtained from two private firms and the technology will be licensed after completing technology transfer formalities
- **Benefits:** *Trichoderma* WP formulation has longer shelf life (more than 18 months), effective against many plant diseases (broad host range), *Trichoderma* strain is symbiotic root colonizer, induces defense response in plants against pathogen and promotes plant growth. The production process supports high yield and desiccation tolerant viable propagules. *Trichoderma harzianum* Th4d WP formulation can be produced at a low cost.



Triguard Th-P



Triguard Th-P



Control

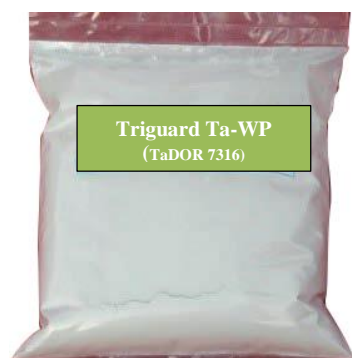


Control  
Treated

Field Trial at Palem (TS) in groundnut crop during 2018-19, (Var. K-6)

## 7. *Trichoderma asperellum* TaDOR 7316 WP (Triguard Ta-WP)

- **Name of the technology and its microbial constituent:** The technology offered is wettable powder formulation of thermotolerant strain of *Trichoderma asperellum* Tv 7316 5% WP. *Trichoderma asperellum* TaDOR7316 (MTCC 5623) at its hyphal stage was also able to tolerate high temperature (patented process, Indian Patent No. 359123) due to accumulation of more quantities of osmoprotectants. *T. asperellum* 7316 able to colonize root cortex and induce defense response in treated plants. *Trichoderma asperellum* Ta DOR 7316 WP formulation retains shelf life of more than 18 months. The formulation will have a minimum of  $2 \times 10^6$  cfu/gm even at 18<sup>th</sup> month after storage in room temperature.
- **Target diseases, crops and delivery system:** The technology has been validated against Phytophthora seedling blight, Macrophomina root rot and Fusarium wilt of safflower. The formulation can be used for seed treatment @ 10 g/kg.
- **Target agroecological zones (if any):** Telangana, Tamilnadu, Maharashtra
- **Validation and commercialization:** Technology validated over 5 years in multi-location field trials conducted under AICRP on Safflower revealed its effectiveness against Phytophthora seedling blight, Macrophomina root rot and Fusarium wilt diseases.
- **Whether licensed to private companies, If yes, details thereof:** Technology ready for transfer.
- **Benefits:** The wettable powder of thermotolerant strain of *Trichoderma asperellum* TaDOR7316 when applied as seed treatment in safflower under drought condition able to control soilborne diseases in safflower and gave high seed yield.



**Triguard Ta-WP**



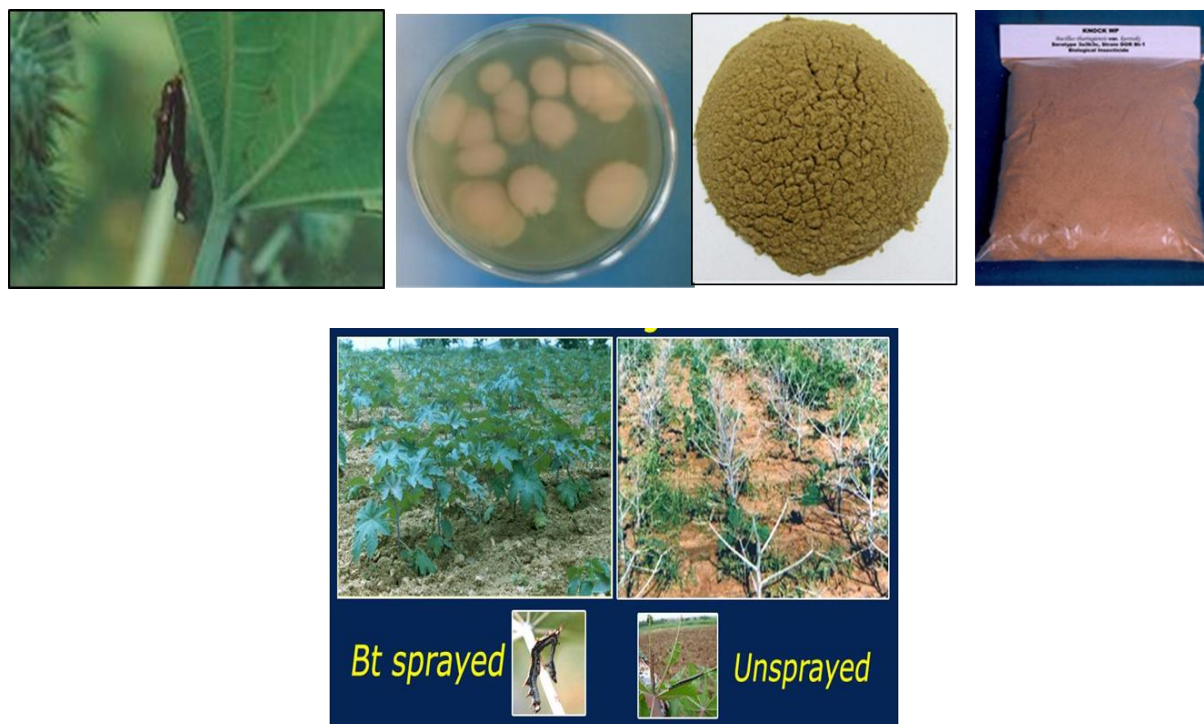
**Triguard Ta-P**

**Control**

**Field Trial at Solapur (MS) in safflower crop during 2013-14 (var. *Phule Kusum*)**

## 8. *Bacillus thuringiensis* var. *kurstaki* DOR Bt-1 W.P. (Knock Bt-WP)

- **Name of the technology and its microbial constituent:** Wettable powder (W.P.) formulation of *Bacillus thuringiensis* var. *kurstaki* Strain - DOR Bt-1, Serotype 3a3b3c (NAIMCC-B-01118)
- **Target pests, crops and delivery system:** Pod borer, *Helicoverpa armigera* on pigeon pea (polyphagous pest) and semilooper (*Achaea janata*) on castor
- **Target agroecological zones/states (if any):** All pigeon pea growing areas of India
- **Validation and commercialization:** Registered in 2005 under 9(3b) section with CIBRC vide registration no. CIR-511/2005(256). Generated data on Toxicity, Chemistry, Bio-efficacy, Container Content Compatibility & Ecotoxicity for 9(3) registration (Permanent)
- **Whether licensed to private companies, If yes, details thereof:** Technology licensed to more than 50 companies. Technology license fee: Rs. 6 lakhs + 18% GST.
- **Benefits:** Target specific & efficacious; Ecologically safe with no toxicity to humans, animals, non-targets including beneficial insects; Causes immediate feeding cessation & brings larval mortality within 2-4 days; Not phytotoxic, biodegradable and does not pollute the environment.



*Bacillus thuringiensis* var. *kurstaki* DOR Bt-1 W.P. (Knock Bt-WP)



## 9. *Bacillus thuringiensis* var. *kurstaki* DOR Bt-127 SC

- **Name of the technology and its microbial constituent:** Suspension Concentrate (SC) formulation of *Bacillus thuringiensis* var. *kurstaki* strain DOR Bt 127 (MTCC 5976/NAIMCC-B-01463); Suspension Concentrate formulation with mineral oil as carrier.
- **Target pests, crops and delivery system:** *Spodoptera litura*, *Helicoverpa armigera*, *Thysanoplusia orichalcea*, *Achaea janata*. Can be extended to other lepidopteran pests viz., *H. armigera* on pigeon pea, *Cnaphalocrocis medinalis* on rice, *Plutella xylostella* on cauliflower and cabbage etc.
- **Target agroecological zones/states (if any):** All oilseed crops growing areas of India. It can be extended to other pulses and horticultural crops also against lepidopteran pests.
- **Validation and commercialization:** Evaluated under AICRP on soybean, sunflower, castor, groundnut and cotton against *Spodoptera litura* and other defoliators for 3 years. Studies for determination of potency completed. Safety to natural enemies and phytotoxicity studies completed. Shelf-life studies for formulation stored at 2 locations (Hyderabad & Akola) completed for 24 months. Analytical test report for physicochemical and biological parameters generated including endotoxin quantification. Eco-toxicity data generated (mother culture & formulation) as per CIBRC 9(3) registration.
- **Whether licensed to private companies, If yes, details thereof:** Technology ready for transfer.
- **Benefits:** DOR Bt-127 strain is effective at high temperatures (till 40°C), hence will be very useful in the context of climate change. It was found to have a broad host range with potencies of 34833 IU/mg, 50200 IU/mg, 46205 SU/mg and 71,722 SU/ mg against *Helicoverpa armigera*, *Achaea janata*, *Spodoptera exigua* and *S. litura* respectively.



Bt-127 SC

Control

Suspension Concentrate (SC) formulation of DOR Bt-127



## 10. *Beauveria bassiana* SC

- **Name of the technology and its microbial constituent:** Suspension Concentrate (SC) formulation of entomopathogenic fungi (EPF), *Beauveria bassiana*; 30% Suspension Concentrate formulation with mineral oil as carrier
- **Target pests, crops and delivery system:** Pod borer, *Helicoverpa armigera* on pigeon pea (polyphagous pest)
- **Target agroecological zones/states (if any):** All pigeon pea growing areas of India.
- **Validation and commercialization:** Evaluated for efficacy against pod borer, *Helicoverpa armigera* and other lepidopteran pests on pigeon pea under AICRP (Pigeon pea). Data for provisional registration under section 9(3b) generated. Eco-toxicity data needs to be generated as per registration guidelines to enable licensing data for complete registration.
- **Whether licensed to private companies, If yes, details thereof:** Technology ready for transfer.
- **Benefits:** The formulation is not phytotoxic, eco-friendly and safe to non-target organisms and beneficial insects. Shelf-life 24 months when stored in HDPE bottles at room temperature.



Suspension Concentrate (SC) formulation of *Beauveria bassiana*

## 11. *Bacillus thuringiensis* + *Metarhizium rileyi* / *Beauveria bassiana* (Combination formulation)

- **Name of the technology and its microbial constituent:** Oil based Suspension concentrate (SC) formulations of Bt-127 in combination with the entomofungal pathogens, *Metarhizium* (*Nomuraea*) *rileyi* and *Beauveria bassiana*. First report of storable combination formulation of Bt with fungus (Indian Patent No. 315134 dt. 28.6.2019).
- **Target pests, crops and delivery system:** Effective against polyphagous lepidopteran pests viz., *Spodoptera litura*, *Helicoverpa armigera*, *Thysanoplusia orichalcea*, *Achaea janata*. The formulation can be used against lepidopteran pests in several agricultural and horticultural crops.
- **Target agroecological zones/states (if any):** All oilseed crops growing areas of India. It can be extended to other agricultural and horticultural crops also against lepidopteran pests.
- **Validation and commercialization:** Formulations effective against lepidopteran pests on sunflower (RARS-Nandyal and ORS-Latur) and on castor (RARS, Palem and TCRS, Yethapur). Data generation for CIB registration is under way (CIBRC guidelines 23.5.2022 for Registration of Consortium of Bio-pesticides).
- **Whether licensed to private companies, if yes, details thereof:** The patent can be licensed to interested firms.
- **Benefits:** The formulation is not phytotoxic, eco-friendly and safe to non-target organisms and beneficial insects. Shelf-life 24 months when stored in HDPE bottles at room temperature.



**Combination SC formulations of Bt with entomopathogenic fungi (*Metarhizium rileyi* / *Beauveria bassiana*)**

**12. *Bacillus thuringiensis* var. *kurstaki* strain DOR Bt-127 WDG (under pipeline)**

- **Name of Microorganisms:** *Bacillus thuringiensis* var. *kurstaki* strain DOR Bt-127 (MTCC 5976/NAIMCC-B-01463)
- **Type of formulation developed:** 67% WDG with starch as carrier (low volume formulation)
- **Shelf-life:** 12 months at room temperature
- **Target pests:** *Spodoptera litura*, *Helicoverpa armigera*, *Achaea Janata*. Can be extended to other lepidopteran pests viz., *H. armigera* on pigeon pea, *Cnaphalocrocis medinalis* on rice, *Plutella xylostella* on cauliflower and cabbage etc.
- **Status of evaluation:** Lab bioassays, potency determination, pot culture studies and preliminary field trials completed.
- **Status of commercialization:** Data is to be generated for toxicology, container content compatibility as well as bio-efficacy (AICRPs for castor, sunflower, soybean, pigeon pea, rice). Hence commercialization would take place after 3-4 years
- **Any other:** DOR Bt-127 strain is effective at high temperatures (till 400C), hence will be very useful in the context of climate change



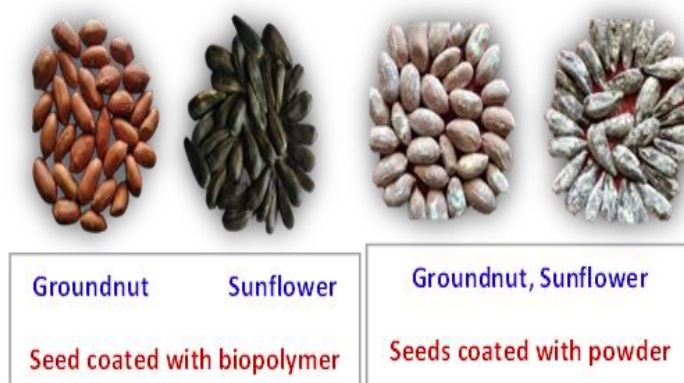
# *Biopolymer based input delivery systems*

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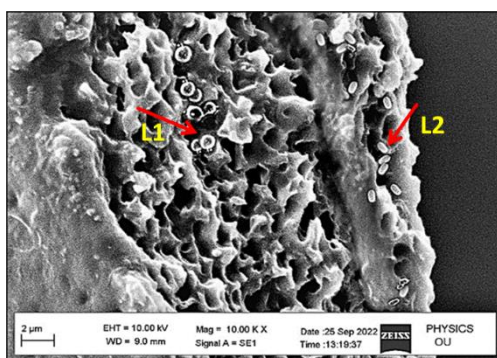
### 13. Biopolymeric film composition:

- **Name of the product/technology:** Preparation of biopolymeric film composition for seed coating
- **Background:** Modern agriculture faces challenges from biotic and abiotic stresses, with conventional agrochemicals posing environmental risks. Biocontrol agents like *Trichoderma* and *Pseudomonas* have limitations under harsh conditions. To overcome these issues, biodegradable polymers are emerging as sustainable carriers for agrochemicals, enabling controlled release and reducing environmental impact. At IIOR, efforts focus on synthesizing tailor-made biopolymer-based seed coatings to deliver pesticides and beneficial microbes efficiently, enhancing crop protection and sustainability.
- **Salient Features:**
  - Can able to form thin films after seed coating
  - Has ability for water vapour transmission and water absorption capacity
  - Has optimum tensile strength without affecting seed germination
  - Synthesis involves easy, eco-friendly and cheap raw materials
  - Crop inputs can be releases in controlled and sustained release manner
  - Can have high entrapment efficiency of crop inputs
  - Easy application
- **Business and commercial potential:** This technology holds potential for widespread commercialization across all agricultural crops and regions in India. Particularly beneficial for seed companies, it can be seamlessly integrated into seed treatment techniques as an advanced seed coating technology.
- **8. Technology licensing:** With ITMU, ICAR-IIOR

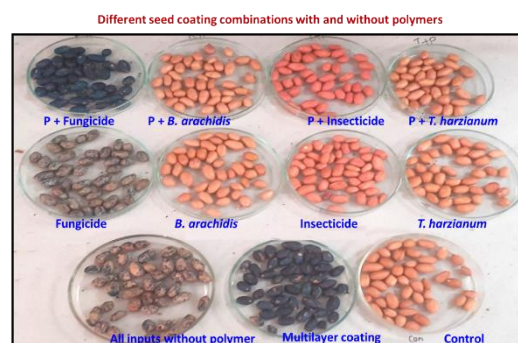


## 14. Biopolymer based multilayer seed coating composition for multi crop input delivery

- **Name of the product/technology:** Multilayer seed coating composition in a layer-by-layer strategy
- **Background:** Seed quality is crucial for agricultural productivity, and seed treatment enhances resilience against biotic and abiotic stresses. Seed coating, integrating biopolymers with pesticides, nutrients, and bioagents, offers a novel approach to improving productivity. While existing single-layer coatings are effective, they lack a comprehensive multi-stress management strategy. The unregulated mixing of crop inputs without understanding compatibility poses challenges. A synchronized approach is needed to develop integrated solutions for effective biotic and abiotic stress management.
- **Salient Features:**
  - Entrapment efficiency of crop inputs was 89-97%
  - Reduced the dose of active ingredient for seed treatment
  - Reducing wastage of multiple active ingredients during application for synchronized manner of biotic and abiotic stress management
  - Efficient use of multiple crop inputs by precision management
  - Microclimate of seed can be managed
  - Low cost of production
  - Raw materials used are eco-friendly which are origin of natural derivatives
  - Less laborious
  - Desired manner of stress management
- **Business and commercial potential:** This technology has the potential for widespread commercialization in all agricultural crops and regions across India, for biotic and abiotic stress management which pose significant challenges. It serves as an effective seed coating solution to address these multiple issues using multi crop inputs.
- **Technology licensing:** With ITMU, ICAR-IIOR



SEM image of Multilayer seed coating



Different types of seed coatings

## 15. Biopolymer MUP based *Trichoderma* delivery (under pipeline)

### ➤ Name of the product/technology:

- Biopolymer based *Trichoderma* MUP blend for seed coating
- Biopolymer based *Trichoderma* MUP films for seed coating
- Biocomposite based *Trichoderma* microcapsules for seed coating
- Biocomposite based *Trichoderma* microcapsules for foliar application

➤ **Background:** Sustainable agriculture requires innovative strategies to manage biotic stresses while minimizing environmental impact. *Trichoderma* spp., a beneficial fungal bioagent, plays a crucial role in plant disease suppression, growth promotion, and stress tolerance. However, its efficacy is often compromised by environmental factors such as desiccation, UV exposure, and inconsistent field application. To enhance its stability and performance, biopolymer and biocomposite-based delivery systems are being explored for seed coating and foliar applications.

### ➤ Salient Features:

- High entrapment efficiency (96%) of active ingredient for seed coating
- Reducing wastage of active ingredient during application for effective kill of pathogen
- Efficient use of beneficial microbes by precision management
- Raw materials used are eco-friendly which are origin of natural derivatives
- Good shelf life
- Less laborious



**Biocomposite for  
seed coating**



**Biocomposite for foliar use**



**Treated**

**Untreated**

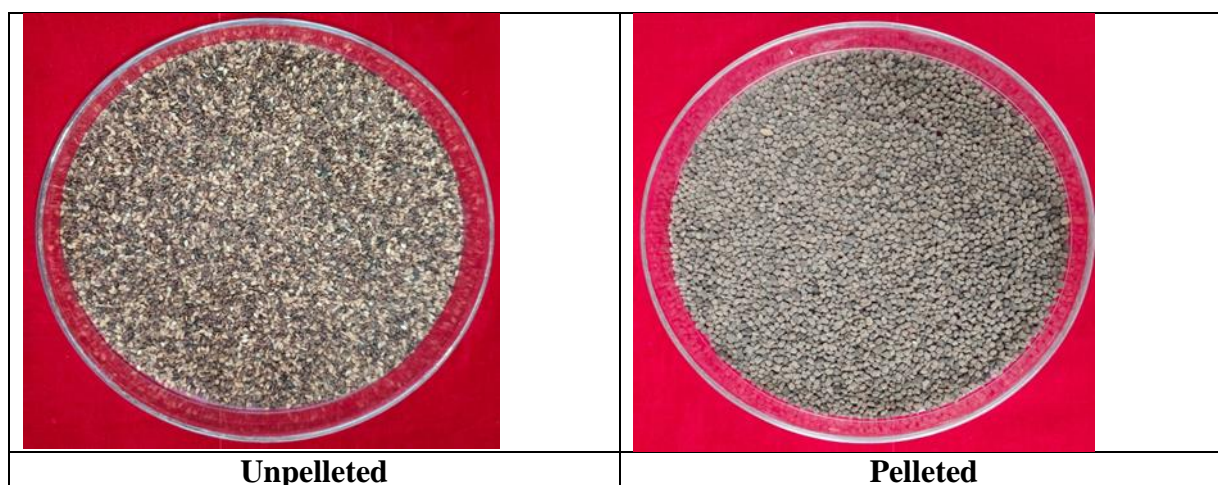


**Traeted**

**Untreated**

## 16. Multi-input delivery through seed pelleting (*under pipeline*)

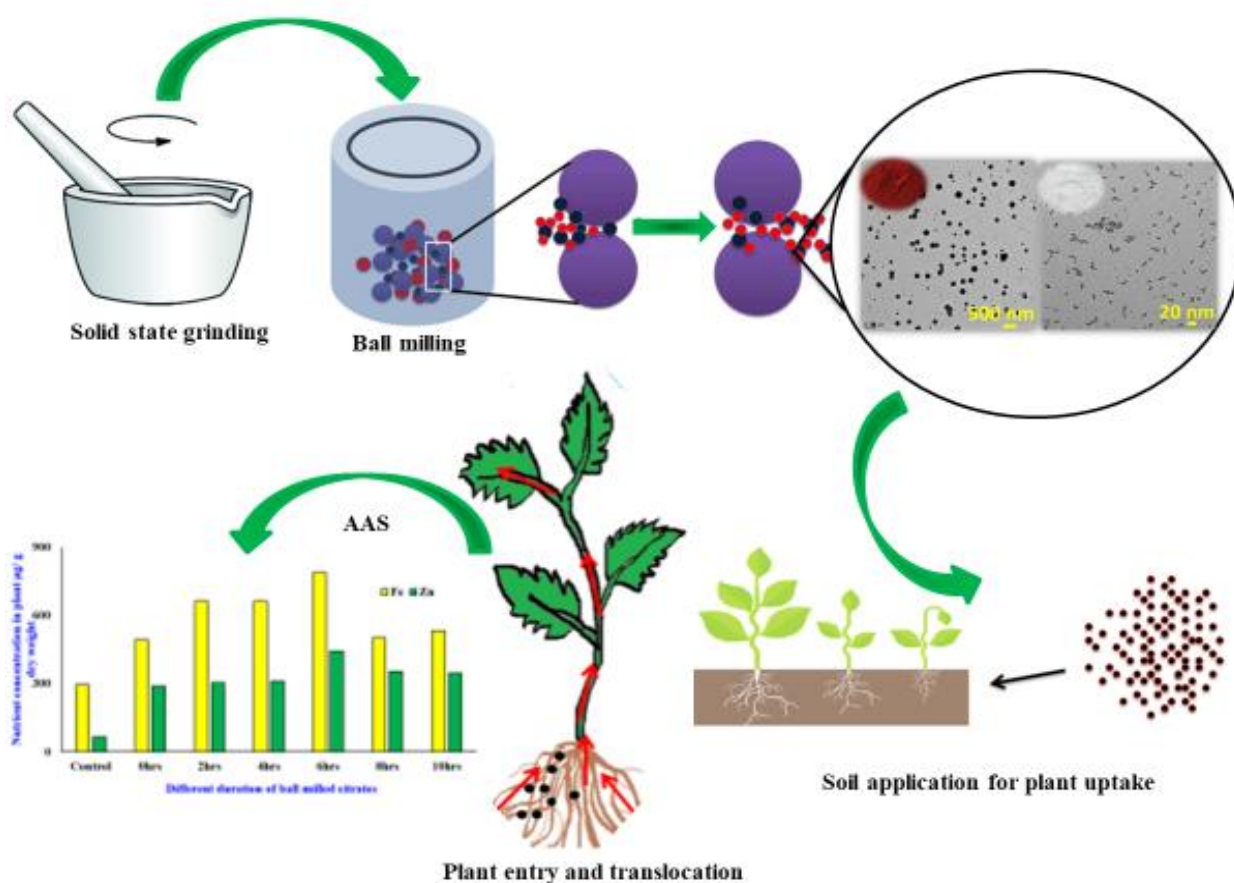
- **Name of the product/technology:** Biopolymeric based seed pelleting for sesame and linseed.
- **Target crops and delivery system:** Low-volume oilseed crops like sesame and mustard face difficulties in modern farming due to their small size seeds, leading to non-uniform plant stands and labour-intensive thinning operations. Traditional sowing methods contribute to seed wastage, weed dominance, and pest infestations, particularly affecting smallholder farmers. To overcome these challenges and achieve sustainable production, there is a need for research on precision planting techniques, such as seed pelleting, integrated with site-specific sowing and plant protection measures. This approach aims to ensure uniform plant stands, efficient resource use, and improved overall crop output.
- **Benefits:** Seed pelleting serves as a beneficial practice for both low-volume crops and vegetable crops, offering advantages to the seed industry by promoting uniform plant growth, reducing wastage, and enhancing overall crop yield. Using this technology, low volume seed crops can be utilized for precision and mechanized sowing, seed rate can be reduced and labour cost can be decreased.





## 17. Nanochelators as plant nutrients (*under pipeline*)

- **Name of the process/product/technology:** Fe and Zn based nanocitrates
- **Target crops and delivery system:** This technology has the potential in all agricultural crops.
- **Benefits:** Crop nutrition is an integral component of modern agriculture and fertilizers comprise a major agro-input in this context. However, the real potential of fertilizers being applied remains unutilized primarily due to bottlenecks of leaching, runoff, fixation and reactivity in the soil leading to less plant use efficiency. Hence, the developed nanocitrates reduces soil application losses due to environmental conditions, slow-release behaviour, less leaching and more availability, less toxic effects on microflora in soil and reduces number of applications.







### Fe and Zn based nanocitrates

## *Crop Production & Value Addition*

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## 18. Short duration castor for mechanized harvesting

- **Name of the product/technology:** Short duration castor for mechanized harvesting
- **Background:** Castor's long duration and perennial nature hinder second cropping and mechanical harvesting. Research on growth regulation and harvest aids is essential to reduce cultivation costs and expand castor acreage. Plant growth regulators can control excessive vegetative growth without affecting yield, while desiccants promote uniform maturity, facilitating machine harvesting. Developing these strategies will enhance efficiency and productivity in castor cultivation.
- **Salient Features:**
  - Significant reduction in plant height facilitating machine harvesting
  - Yield was on par as that of normal unsprayed castor crop
  - Increasing plant population with closer spacing along with retardant (Paclobutrazol) spray
  - Crop duration is reduced by 2-3 months there by allowing castor farmers to take second crop
  - Use of Paraquat 1 ml/litre (Paraquat dichloride), a contact herbicide for complete crop desiccation facilitates machine harvesting as the crop needs to be dried completely to run a machine.
  - Crop management is easy due to height reduction
  - On par seed yield with reduced duration
  - Raw materials are easily available in market and not expensive
  - Crop amenable for mechanical harvesting, farmer can take castor as commercial crop and there is scope for taking up second crop also due to reduction in crop duration.

	
	
<p><b>Paclobutrazol spray</b></p>	<p><b>Control</b></p>

## 19. Value added products of oilseeds

- **Name of the product/technology:** Protein hydrolylates and hydrolysates from oilseed meal
- **Background:** Oilseed cakes, rich in proteins, can be transformed into high-value protein isolates and hydrolysates instead of being limited to animal feed or fertilizer. These proteins have excellent nutritional and functional properties, making them valuable for food, pharmaceutical, and nutraceutical applications. Safflower seed protein isolates and hydrolysates prepared at ICAR-IIOR were tested at ICMR–NIN and showed potential effects on WNIN rats growth, blood parameters, Organs and histopathology. This validation highlights their potential for human health applications. This technology promotes the efficient and sustainable utilization of oilseed cakes/meals for diverse applications ICAR-Indian Institute of Oilseeds Research (ICAR-IIOR) provides technologies for extraction of high-purity protein isolates and production of bioactive protein hydrolysates from oilseed meal
- **Salient features:**
  - Simple, Cost-Effective, and Eco-Friendly Process
  - Conversion of Low-Cost Oilseed Meal into High-Value Products
  - Scientifically Validated for Efficacy by ICMR - National Institute of Nutrition

