ICAR-IIPR At a Glance

Committed to Nutritional Security and Sustainable Agriculture





ICAR-Indian Institute of Pulses Research
Kanpur 208 024

ICAR-IIPR at a Glance

About the Institute

ICAR-Indian Institute of Pulses Research (IIPR) was established as national Institute by the Indian Council of Agricultural Research (ICAR) for basic, strategic and applied research on major pulse crops. The Institute is involved in generation of basic information, development of high yielding varieties and appropriate production and protection technologies, production of breeder seeds, demonstration and transfer of technologies, and strategic coordination of pulses research through wide network of testing centres across the country.

Timeline

1966 Establishment of All India Coordinated Pulses Improvement Project (AICPIP) with headquarters at Indian Agricultural Research Institute (IARI), New Delhi.

1978 Upgraded as Project Directorate (Pulses) and shifted from New Delhi to Regional Station of IARI at Kanpur.

1984 Attained independent status and rechristened as Directorate of Pulses Research(DPR) under the direct control of ICAR.

1993 DPR elevated to an Institute 'Indian Institute of Pulses Research' and three All India Coordinated Research Projects on Chickpea, Pigeonpea and MULLaRP (Mungbean, Urdbean, Lentil, Lathyrus, Rajmash, and Pea) created.

Organizational Structure of ICAR- IIPR Genesis

Pulses Research Network

ICAR-IIPR :
- Regional Center, Bikaner
- Regional Station, Bhopal
- Regional Station, Dharwad
- Regional Station, Odisha

AICRP's :
- *Kharif* Pulses
- *Rabi* Pulses
- Transgenics

Mandates

- Basic and strategic research on pulses
- Provide access to information, knowledge and genetic material to NARS partner
- Planning, coordination and monitoring of applied research through AICRP's
- Dissemination of technology and capacity building

Mandate Crops : Chickpea, Pigeonpea, Mungbean, Urdbean, Lentil, Lathyrus, Rajmash, Pea, Cowpea, Horsegram, Guar, Mothbean and Ricebean

Common Facilities

Six Specialized Divisions

- Crop Improvement (GPB & Seed)
- Crop Production (Agronomy, Soil Science, FMP & APE)
- Crop Protection (Plant Pathology, Agricultural Entomology & Nematology)
- Social Science (Ag. Extension, Economics, Statistics and Computer Applications)
- Basic Science (PPH, Biochemistry, Microbiology and Ag. Chemicals)
- Plant Biotechnology

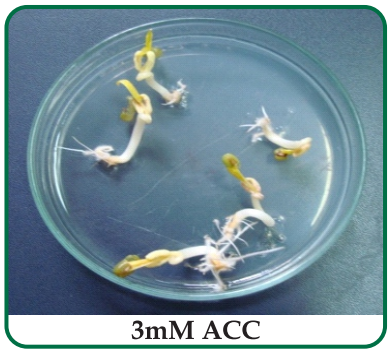
State of Art Facilities

- Physical containment facilities
- Medium-term cold modules
- Excellent facilities for basic research on transgenics, genomics, gene cloning, MAB, quality lab, biotic stresses, plant physiology and soil chemistry
- Sick plots for screening against soil-borne diseases
- Modern museum
- Modern library; CAB abstracting on CD ROM

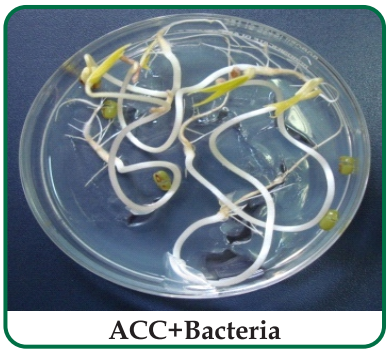
The Indian Institute of Pulses Research functions to improve competitiveness through knowledge based technological interventions for improving nutritional security and sustainability of the production base.

Microbial Consortium for Mitigationg Moisture Deficit Stress and Improving Nodulation in Pulses





3mM ACC



ACC+Bacteria

Microbial consortium for mitigation of moisture deficit stress in pulses

was developed using multiple bacterial determinants with ACC deaminase activity, biofilm forming ability, IAA production, *etc*. Bacterial strains are able to function and produce EPS and ACC deaminase at maximum stress level (−0.30 MPa).

Microbial consortia were evaluated under multi-location trials of AICRP-Chickpea during 2017-2020 and microbial consortium-II that recorded 8% enhanced yield over *Mesorhizobium* treatment was recommended for commercialization and available for licensing.

Host-specifc *rhizobium* liquid biofertilizers

Host-specific potential *Rhizobium* strains were identified through multilocation screening as well as AICRP programme.

Liquid biofertilizer technology with following strains is available for licensing.

- *Mesorhizobium* sp. IIPR-RFC-117 for chickpea
- *Rhizobium* sp. IIPR-PR315 for pigeonpea
- *Rhizobium* sp. MR-127 for mungbean
- *Rhizobium* sp. LaB-354 for lentil



ACC deaminase bacterial inoculated



Unionculated control



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Biochemical Profiling of Important Metabolites in Pulses

Low Raffinose Family Oligosaccharides (RFOs)

RFOs are metabolized in lower gut and lead to flatulence.

- Estimated RFO content varied from 3.24% to 6.60% in common bean, 6.68% to 10.18% in fieldpea, and 7.88% to 10.01% in cowpea genotypes.
- Low RFO containing common bean genotypes (3.2-3.8%) were identified *viz*. Uday, EC 932147, IC 360831, EC 931844, EC 931874, and EC 931772.
- The RFOs stachyose and raffinose only were detected in common bean and cowpea.
- All major RFOs (verbascose, stachyose and raffinose) were detected in fieldpea.

High Amylose Starches

High amylose starches are particularly beneficial for lowering post-prandial blood glucose levels as they have low digestibility compared to low amylose starches. The vegetable-type field pea varieties, Arkel and Azad P3 have 94.88 and 93.15% amylose of total starch, respectively.

Common bean starch was oval to elliptical with diameter ranged from 17.73 µm to 20.06 µm. It has typical C-type crystalline structure with 2 theta values of 16.5°, 18.5°, 19°, and 24°.

High Phenolics

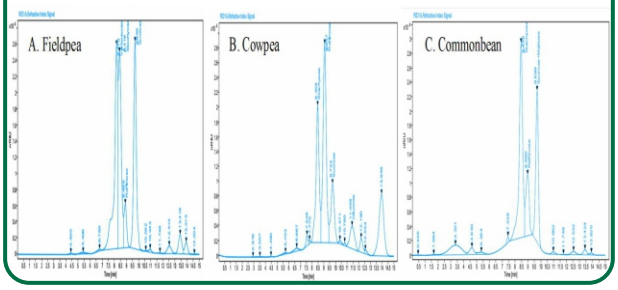
Polyphenols can protect cells and tissues from oxidative stress and damage caused by free radicals. The predominant phenolic compounds in

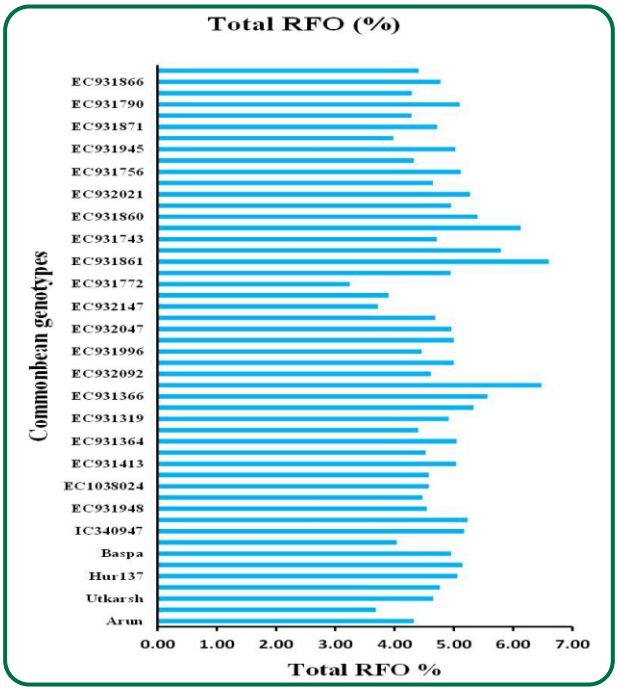
- cowpea are gallic acid, protocatechuic acid, catechin hydrate, p-coumaric acid, and ferulic acid.
- fieldpea are gallic acid and catechin hydrate
- common bean are gallic acid, catechin hydrate, ferulic acid, and p-hydroxy benzoic acid.

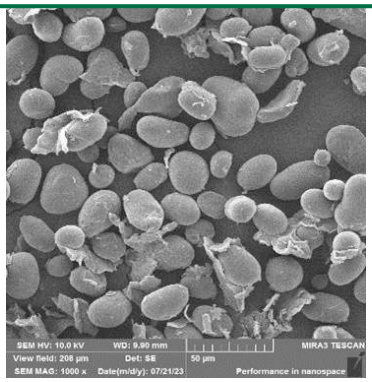
High Saponins

Saponins of pulses help in lowering cholesterol, protect against cardiac diseases and cancer especially colon cancer, and protect against liver injury. Chickpea contains 0.21 – 0.35 and 0.41 – 0.57 mg/g sapogenol A and sapogenol B respectively in grains.

Profiling RFOs







Common bean starch as seen through scanning electron microscopy

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Post-Harvest Technologies and Value Addition in Pulses






IIPR Mini Dal Mill (Gen-IV)

An integrated and versatile model of Mini Dal Mill suited for cottage scale pulse milling has been developed. For improved dehusking/pitting, emery roller mechanism has been modified, using composite emery grit roller and outer casing of the assembly. The mill can be used for milling of easy and difficult to mill kind of pulses, with suitable pre-milling treatments. Fourth generation of the mill has been commercialized with M/s Bharat Heavy Machines, Kanpur.

Value Added Products from Pulses Milling Byproduct

Pulses are mostly consumed after dehusking and splitting, in form of *dal*. In commercial dal mills, the milling operation causes loss of precious cotyledons in from of powder, which gets mixed with outer seed coat to generate milling byproduct that is commonly utilized as cattle feed. This byproduct, however, contains several bioactive compounds with health benefits. Various ready-to-eat and cook value added products like biscuits, Bun, Muffin, Idli, Noodles, Nachos, *etc.* have been developed utilizing pulses milling byproduct in effort to harness these health benefits.

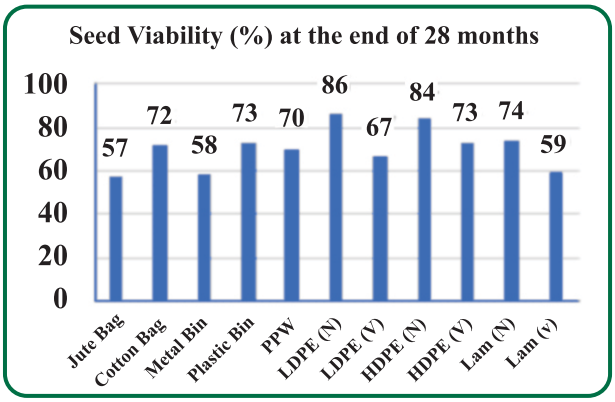
Long term storage of pulses

Mungbean seeds (Shikha variety) were fumigated and sun dried up to 12.1% moisture content (w.b.) prior to storage in different packaging materials, *viz.*, jute bag, cotton bags, PPW bags, metal bins, plastic bins, LDPE, HPDE, Laminated plastic films. Data of physical parameters, entomological parameters and seed viability were recorded. The results of long term storage indicated less infestation, higher *dal* recovery and maintained viability in packaging materials impervious to external environment.



IIPR Mini *Dal* Mill (Gen-IV)





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Recommended Efficient Weed Management Practices in Pulses

- In *kharif* pulses (mungbean, urdbean and pigeonpea), application of pendimethalin 1.0 kg a.i./ha (pre-emergence) *fb* imazethapyr 100 g a.i./ha (post) at 20-25 days after sowing (DAS) manages broad-spectrum weed control.
- In mungbean, clodinafop-propargyl + Na-acifluorfen (ready-mix) 187.5 g a.i./ha at 15-20 DAS is recommended for higher weed control efficiency up to 84%.
- Imazethapyr 80 g a.i./ha at 20-25 DAS is effective for spring/summer urdbean and mungbean.
- In *rabi* pulses (chickpea, lentil and peas), pendimethalin 1.0 kg a.i./ha (pre) *fb* quizalofop-p-ethyl 100 g a.i./ha at 20-25 DAS is recommended for efficient weed management.
- Topramezone 20.6 g a.i./ha at 15-20 DAS is a post-emergence herbicide for chickpea for controlling broad-leaved weeds with weed control efficiency up to 83%.
- In rice-chickpea system, application of pendimethalin 1.0 kg a.i./ha (pre) - bispyribac sodium 20 g a.i./ha (25 DAS) for rice and oxyfluorfen 150 g a.i./ha (pre) – propaquizafop 100 g a.i./ha (25 DAS) for chickpea under zero tillage with 20 cm standing rice stubbles leads to additional benefit of ₹ 35,000- 40,000 over conventional system.
- IIPR manual weeder with multi-tool bar carrier developed. It has field capacity of 0.02-0.03 ha/h with a weeding efficiency of 90% and a draft requirement of 31 N.
- IIPR herbicide applicator suitable for pulses consisting 4 litres water tank developed. It has field capacity of 0.05-0.07 ha/h and weeding efficiency of 80-85%.



Topramezone 20.6 g a.i./ha in chickpea



Clodinafop-propargyl + Sodium acifluorfen 187.5 g a.i./ha in mungbean



IIPR manual weeder with multi-tool bar carrier (gender friendly)



IIPR herbicide applicator

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Effect of Long-Term Crop Diversification and Nutrient Management on Soil Health, Crop Productivity, and Sustainability





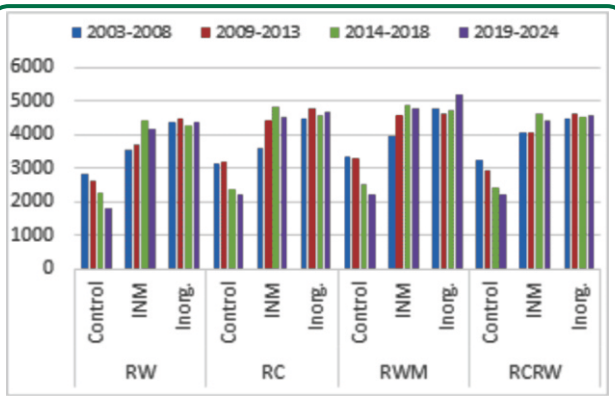
Long-term experiments, initiated in 2003, have provided critical insights into how pulses can enhance soil quality and production sustainability in the cereal-dominated systems of the Indo-Gangetic Plain regions. Results highlighted the potential of pulses in improving soil quality in both upland and lowland production ecologies, especially through integrated nutrient management (crop residue recycling) module.

These experiments have been used to systematically investigate soil labile-graded carbon (C) pools, C-sequestration, aggregation, biochemical functions (functional pools of phosphorus and potassium, enzymatic activities and microbial functions), physical attributes, weed seed bank community composition, while critically evaluating their influence on crop productivity.

Notably, short-duration mungbean has emerged as a vital crop for the sustainable intensification of rice-wheat system, facilitating C-sequestration and soil fertility enrichment, leading to yield benefits.

Including summer mungbean in lowland rice-wheat system increased active C-pool (18%), passive C pool (15%), water-stable macro-aggregate (30%), and microbial biomass carbon (28%) in long-run (2003-2016).





Yield trend of base crop rice over 20 years (2003-2024) in long-term experiment

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Biocontrol Formulations and Microbial Consortia for Protecting Pulse Crops

Dalhanderma (Reg. No. NAIMCC-R-5)

A talc based formulation of potential *Trichoderma asperallum* strain (IIPRTh-31) registerd with ICAR-NBAIM, Mau and certified by ICAR for next level of commercialization. It application as seed treatment @ 10 g/kg at the time of sowing,

- 25% increase in plant growth
- Ca. 26.49% decrease in wilt and root rot disease incidence
- 10-12% increase in grain yield under field condition.
- >18 months of shelf life (7.7×10^{6}) with thermo-tolerant ability (survive >40^{0}C).

Pulse Booster (Reg. no.NAIMCC-R-6)

A talc based formulation of *T. afroharzianum* (IIPRTh-33) is registered with ICAR-NBAIM, Mau and certified by ICAR. Its application as seed treatment @ 10 g/kg of seed reveals

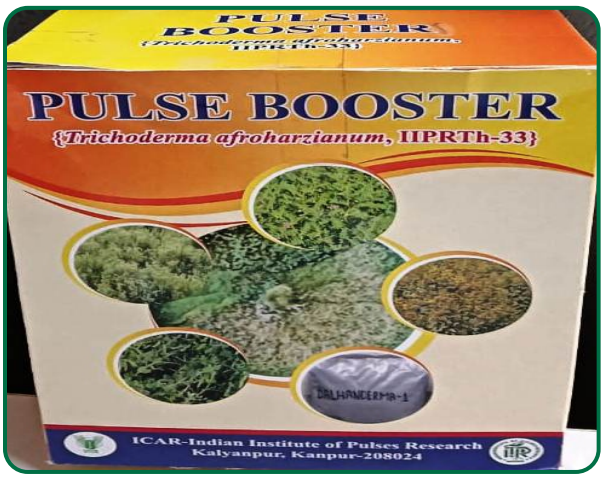
- 35% increase in plant growth,
- 30% increase in soil borne disease resistance and
- inhibits growth of *Meloidogyne* spp
- 18 months of shelf life (2.5×10^{6}).

Dalhan Bio-consortia

This consortia has been developed with the co-cultivation technology of *T. asperellum* (IIPRTh-31) and *Bacillus subtilis* (SHEP-6) and has plant growth and biocontrol potential. Its application

- increased seedling vigour,
- reduced N and P fertilizer requirement by 25–30%
- increased yield by 5-15 %.
- Dalhan bio-consortia is a powerful liquid solution with recommended CFU (5×10^{9}).







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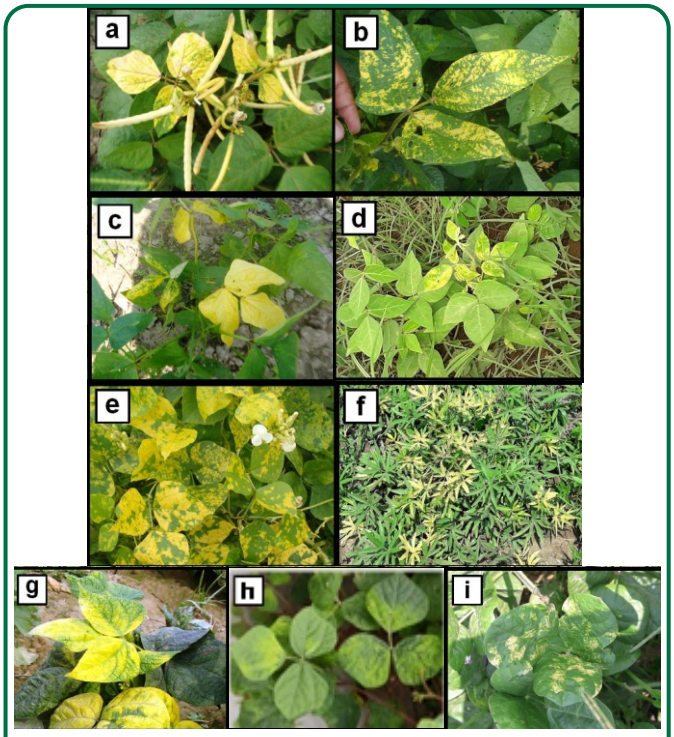
Distribution Map of Yellow Mosaic Disease (YMD) Causing Viruses

Yellow mosaic disease caused by several bipartite Begomoviruses is a major constraint of leguminous crops. It has been observed that improved cultivated pulse crops varieties show spatio-temporal variation in YMD development probably be due to overlapping cropping of legume crops, variations in weather conditions, fluctuations in vector population and the prevalence of different virus species at different locations.

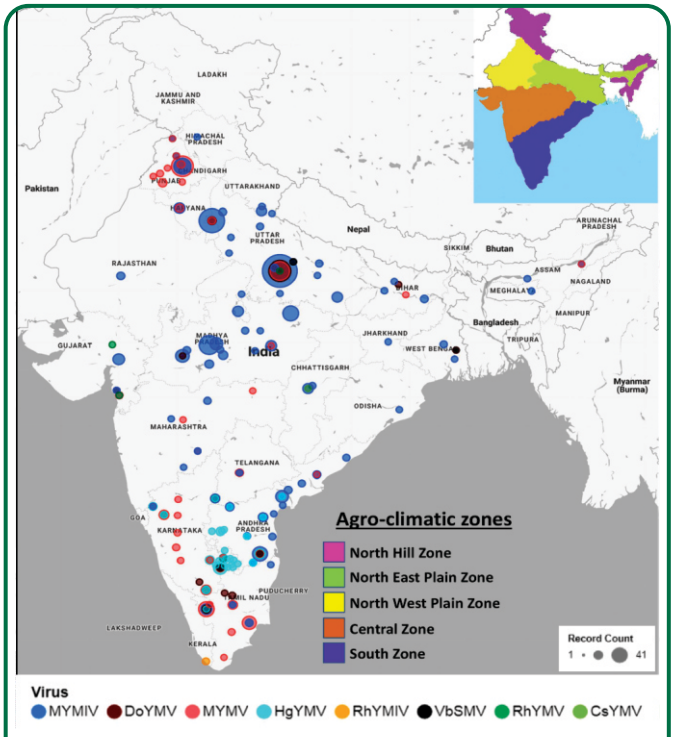
Investigation of more than 300 YMD affected pulse crop samples led to the detection of presence of five viruses (MYMIV, MYMV, HgYMV, DoYMV and RhYMV) across 32 locations in India. So far, CsYMV, RhYMIV, and VbSMV have been reported at a single location.

A comprehensive distribution map of these eight legumoviruses based on our research and available previous reports has been prepared to depict their presence in 119 locations of India, distributed across five agro-climatic zones. This map reveals the legumoviruses species present at a location along with its hosts.

Understanding the distribution of YMD-causing viruses in different agro-climatic zones will help in developing zone-specific YMD-resistant cultivars. Statistically, MYMIV is found to be prevail throughout the country followed by MYMV. However, the host range of MYMV is broader as compared to other legumoviruses.



Yellow mosaic disease in a. mungbean; b. urdbean; c. cowpea; d. horsegram; e. *Dolichos*; f. mothbean; g. French bean; h. *Rhynchosia minima* i. *Vigna stipulacea*.



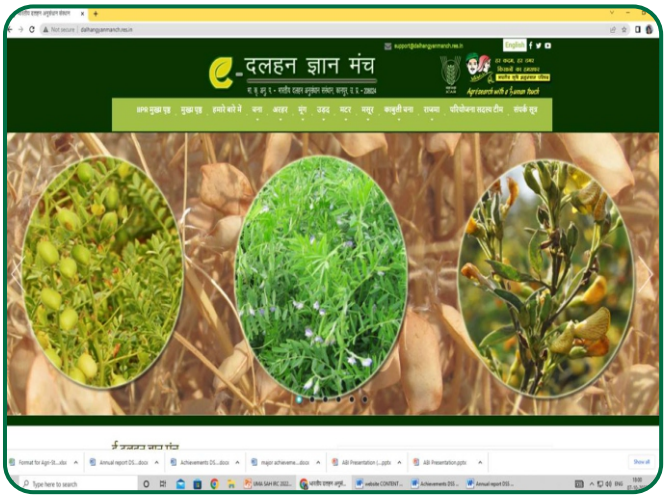
Size of spot is proportional to number of reports made per location. Several locations report multiple virus detections, and in such cases, the species with the least reports is shown in centre of the spots shown as concentric circles at such locations.

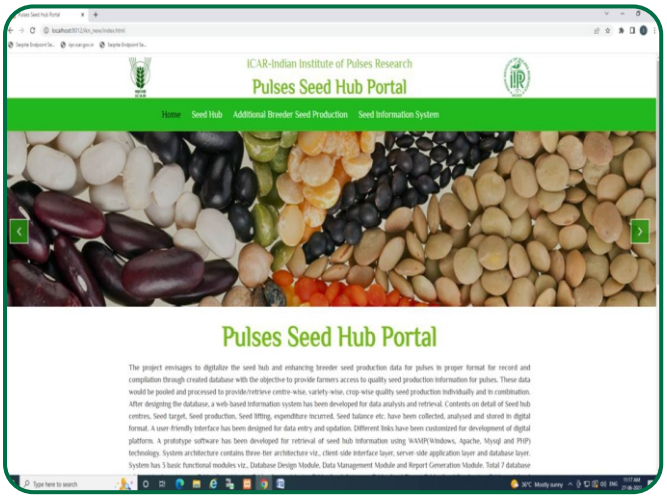
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Digital Resources for Information Dissemination

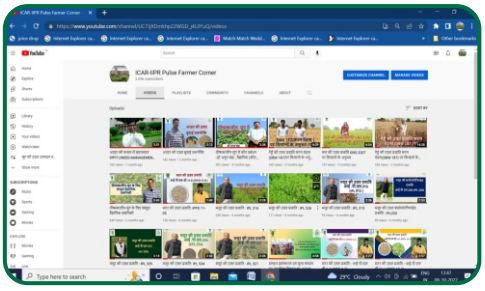
1. e-Dalhangyan Manch web portal is bilingual interactive portal containing comprehensive and validated information on chickpea, pigeon pea, field pea, urd bean, mungbean, rajmash and lentil crops for use by farmer, extension workers and other stakeholders. Varietal Information System on Pulses (VISP), Disease and Pest Information on Pulses (DPISP) and Weed Information System on Pulses (WISP) are also embedded in the portal. (https:// dalhangyanmanch.res.in) and it has reached more than 2.57 lakh viewers. .

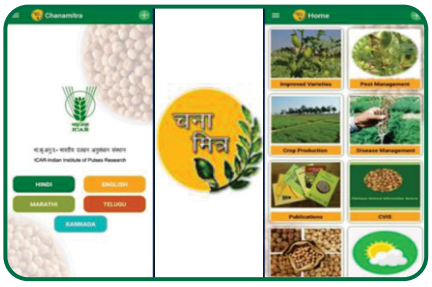
- ***Pulses Seed Hub Portal*** is a real-time system (https://iipr.icar.gov.in/iiprseedportal) provides crop-wise/variety-wise information pertaining to seed target, seed production, seed sale and total seed availability for use by farmers, researchers, exporters and policy makers.
- ***DalhanSandesh*** 2.0: Mobile based voice SMS advisory service was designed to improve the partner farmers' access to information related to pulse production technologies on real time basis.
- ***Chanamitra mobile app:*** The application is developed in Hindi, English, Marathi, Telegu and Kannada for covering prominent chickpea producing states of India. It provides comprehensive information related to chickpea production technologies to users.
- **Digital videos modules:** Videos(137 nos) on critical pulse production technologies and successful experiences of partner farmers developed in Hindi, Bengali, Marathi, Kannada, Tamil languages.
- **Expert System:** Puls Expert developed for identification and control of diseases/insect-pests in pulse crops"
- **Software developed:** "IRS-MULLaRP" and "Germplasm Information System for Pulse Crops"











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Entrepreneurship Development in Pulses

The Institute facilitates entrepreneurship development among potential entrepreneurs, enterprises, youth and farmers in the area of pulses. For the purpose, a range of incubation support services like technology mentoring, networking, access to state of art laboratories and developing forward and backward linkages for business promotion are extended.

In this line, Institute has identified five thrust areas *viz*., Pulse Processing, Pulse Value addition, Bio-fertilizer Production, Bio-pesticide Production and Pulse Seed Production for extending the needed support. EDPs, sensitization programmes, webinars and training programmes are carried out for creating awareness about the available avenues for agribusiness in pulse. The support has been extended to the following firms, company, FPCs and farmers societies.

1. **Pulse processing and value addition**

- Mamta Agro India, Kanpur, M/s Mahodhya Agriworks, Kanpur, Aatm Shakti Farmer Producer Company, Fatehpur and Neelam Tyagi Agri Industries, Ghaziabad

2. **Bio-fertilizer production**

- M/s Matra Bhumi Bio-Tech, Kanpur

3. **Seed production of pulses**

- Sehkar Farmer Producer Company, Fatehpur; JMD Seed Company, Kanpur Dehat; Ugta Farmer Producer Company, Kanpur Dehat; Rajpur Organic Farmer Producer Company, Kanpur Dehat and Vratadhara Farmer Producer Company, Kanpur Nagar

4. **Promotion of rural entrepreneurship among farmers in pulse processing**

- *Namami Gange Mahila Krishi Udyog Samiti*, Khadra, Fatehpur (13 women farmer members)

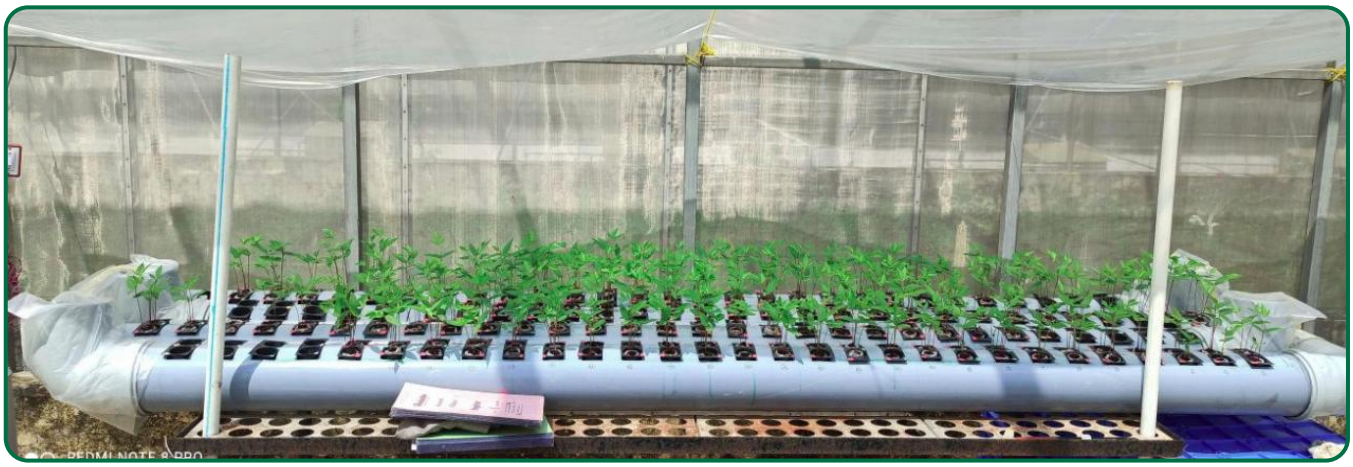






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Hydroponics-Based High Throughput Phenotypic Screening System (HydroPheS)



HydroPheS

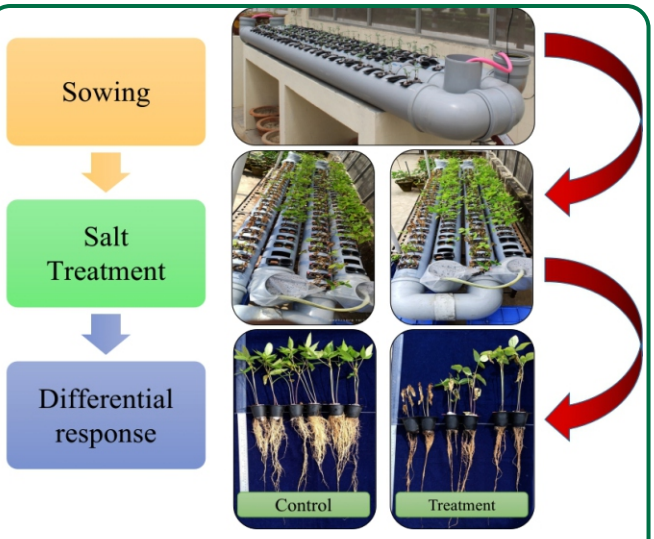
HydroPheS is a high throughput, quick, efficient and cost effective hydroponics based screening facility for precise phenotyping.

The methodology is good for root phenotyping, which otherwise is a major draw back in the previous screening protocols.

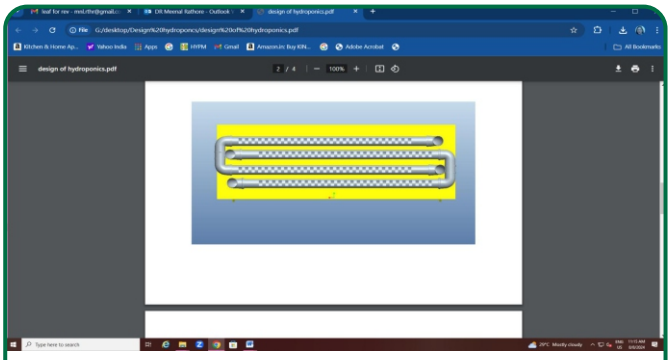
As the methodology is based on hydroponics, it is non destructive in nature as the active root growth can be seen without damaging plants.

The technology has been demonstrated to work well for screening urdbean panel against salinity stress, where contrasting lines have been identified. The results obtained are consistent and reproducible.

In the current methodology, the treatment (salt) is present in the active root zone, making the protocol scientifically more robust.



Screening for salinity tolerance using HydroPheS



Design of HydroPheS

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Genetic Engineering of Pulses for Insect Resistance and Event Selection Trial

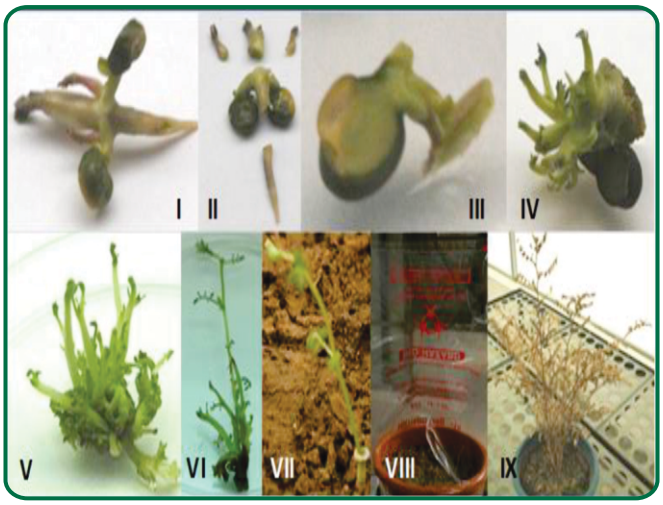
Transgenic lines in chickpea *cv*. DCP 92-3 and pigeonpea *cv*. Asha harbouring the synthetic *cry1Ac* gene and/or domain shuffled *cry1Aabc* gene were generated *via Agrobacterium tumefaciens* mediated genetic transformation.

Molecular characterization (PCR, Southern Blotting, RT-PCR, ELISA, Western Blotting) of generated lines across generations confirmed integration and expression of desired gene(s). Insect bioassay confirmed lines for trait efficacy.

Event Selection Trial of five selected lines of chickpea and pigeonpea were conducted under confined conditions.

No significant differences in agronomic characters and microbial community inhabiting the rhizoshpere were found and the trait efficacy (Per cent Reduction over Control) up to 87.77% (pigeonpea) and 85.16% (chickpea), were recorded. However, these lines were found hemizygous in nature.

Stability of transmission and expression in efficacious transgenic chickpea and pigeonpea line were assessed based on selfing, sib-mating and crossing with elite genotypes (chickpea JG 14 and ICC 4958; pigeonpea UPAS 120), and further screening indicated distorted segregation pattern in the T_1 progenies.

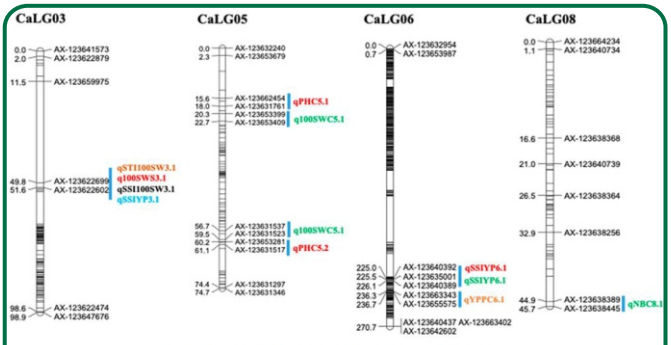




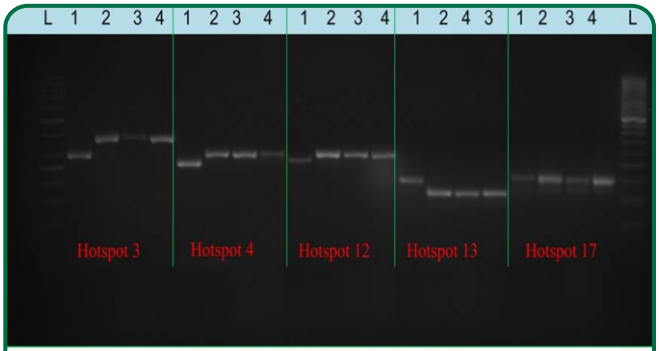


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Developing Genomic Resources for Pulses Improvement



Salt tolerant QTLs in chickpea



*L- Ladder 50bp, 1- ICC4958, 2- DCP92-3, 3- GNG1581, 4- JAKI9218

QTLs identified

- QTL clusters on CaLG03 and CaLG06 harboring QTLs for yield and yield component traits under salinity stress in chickpea.
- Major-effect QTLs for 100-seed weight and plant height explaining up to 59.70% phenotypic variance in a recombinant inbred line (RIL) population developed from ICC 4958 and DCP 92-3 in chickpea.
- Two QTLs on chromosome 2 and 8 for *Fusarium* wilt resistance in pigeonpea.
- QTLs for heat stress tolerance in chickpea mapped on chromosome 4, 5, 6 and 8 using F_2 population derived from Vishal and ICC 1205 for 4 traits namely pod number, per cent pod set, seeds per pod and yield per plant.
- Two QTLs on chromosome 1 and 10 for SMD resistance in BC_1F_2 mapping population derived from Maruti and Bahar following BSA-seq approach.
- A high-density linkage map in chickpea has been generated using Axiom®CicerSNP Array (1856 SNPs-1106.3 cM).

Marker Trait Associations

- Established 22 MTAs in pigeonpea for 5 ideotypic traits *viz.*, days to initial flowering, days to 50% flowering, days to maturity, plant height, and number of primary branches which explains upto 30.76% phenotypic variation
- Identified 6 significant Marker trait association with *Fusarium* wilt resistance and explained up to 6% phenotypic variance (PV) across the years

QTL mapping approach for identifying genomic regions linked with traits

Generation of the mapping population for target traits (F_2, DH, RIL, etc.,)

↓

Phenotyping the mapping population for target traits

↓

Genotyping the mapping population with SSRs, SNPs, CAPS, InDels,

↓

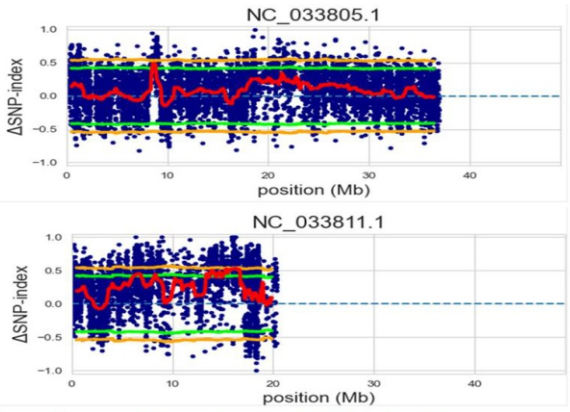
Linkage analysis: Linkage map construction with genotypic data

↓

QTL analysis: Co-segregation analysis of markers and phenotypic data with statistical tool

↓

QTL validation , Fine mapping and deploying in Marker assisted breeding



Fusarium wilt resistant QTLs in Pigeonpea

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Innovations in Extension Methodologies for Reaching Pulse Producers

- **Farmer to farmer extension model:** Farmer led farmer-to-farmer extension model was validated with participation of 143 key farmers who introduced quality seed of pulse varieties in structured and unstructured manner utilizing their social networks. The model resulted in 2.7, 4.4 and 3.7 fold increase in number of farmers, area sown and quantity of seed made accessible to farmers, respectively.
- **Capacity building programmes for farmers and extension personnel:** Regular customized trainings are being organized for farmers (9434 nos), extension personnel (1,598 nos) trained since 2007-08. Also, 512 exposure visits for 18,293 farmers across the country have been organised. A total of 23,243 demonstrations in pulse production technologies have been demonstrated on famers' fields across the country during last 16 years.
- ***Promotion of pulses production technology among tribal farmers*** **:** During 2013-2024, 7,660 tribal farmers of Madhya Pradesh, Chhatisgarh and Bihar states benefitted from demonstrations on improved pulse production techniques and trainings conducted.
- **Farmers' collective driven approach for strengthening seed system of pulses** is in place to enhance availability of quality seed of pulses. Farmers (11-21 nos) were organized into eight formally registered farmers' seed societies in Banda, Hamirpur, Chitrakoot, Kanpur Dehat and Jalaun districts of UP state and engaged in participatory seed production and contributed 97.53 tonnes of seed of improved varieties of major pulse crops to formal seed system since 2007-08. These societies also promoted diffusion of 55.06 tons of seeds through informal social networks in the region.
- ***Framework for development of Model Pulse Villages(MPVs):***

  Holistic framework developed for creation of MPVs with social, economic, technological, institutional and capacity building as major indicators. Framework leveraged multiple target groups (farmers, farm youth and farm women), multiple pulse crops and multiple technology interventions (seed treatment, crop production, crop protection, seed production technologies) along with multi-pronged extension strategy (technology demonstrations, capacity building, social institutions and digital extension services.











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Intellectual Property (IP) Portfolio Management

Copyright: 10

- PulsExpert' (Software): for identification and control of diseases/insect-pests in pulse crop (L-65177/2017)
- IRS-MULLaRP' (software) (SW-10474/2018).
- "Germplasm Information System" (software) for Pulse Crops" (SW-10469/2018)
- "Pulses Seed Hub Portal" (Software) for digitalization Seed Hub project(SW-18412/2024)
- Commodity Profile for Pulses' (3766/2022-CO/L).
- DALHANDERMA' (INV005154/2023) brand of biopesticide formulation
- Image Database of Chickpea Phosphorus Deficiency (20935/2024-CO/L/2024)
- Samrat Pulse' (134055/2024) brand of IIPR products
- Image based data set of *Trichoderma* diversity from pulses rhizosphere
- Pulse booster' as brand of biopesticide product

Trade Marks: 4

- Trademark of PulseExpert (3229366/2016)
- DALHANDERMA (6045788/2024)
- Samrat Pulse (Label 6474243/2024)
- Pulse booster

Patents: 11 (Filed/published)

- Product: 3 (Diagnostics and Bioformulations)
- Process: 2 (Microbial formulations)
- Product & Process: 3 (Biocontrol formulations)
- Design: 4 (Machinaries/tools/packaging materials of biological products)

Pulses varieties registration with PPVFRA: 32

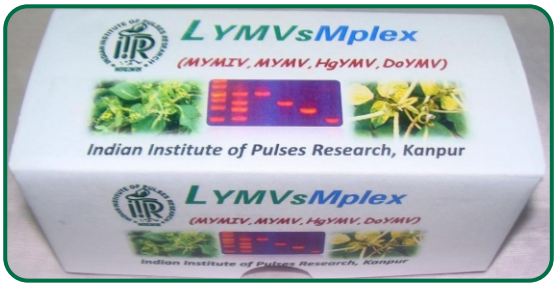
- Chickpea (8), Fieldpea (9), Pigeonpea (3), Urdbean (6), Mungbean (4), Lentil (2)

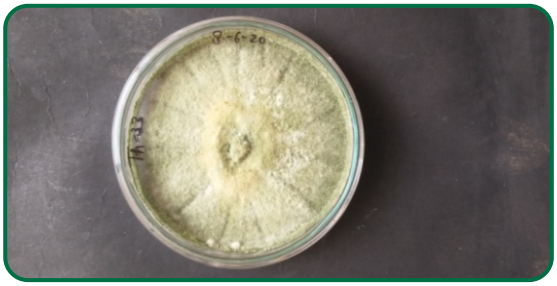
Microbial strains registered: 2

- *T. asperellum*, IIPRTh-31 (NAIMCC-R-5) for biocontrol potential, heavy metal degradation, thermotolerant.
- *T. afroharzianum*, IIPRTh-33 (NAIMCC-R-6) for biocontrol and PGP potential.







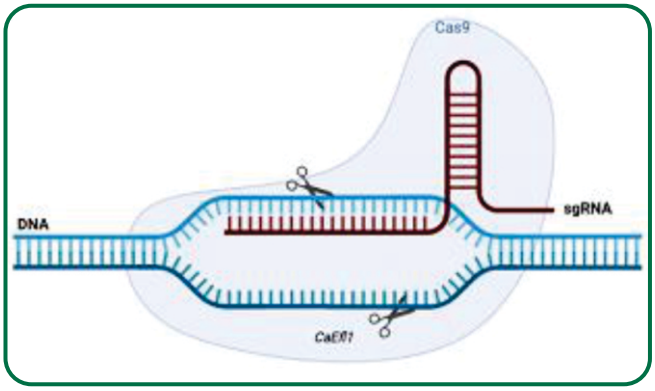


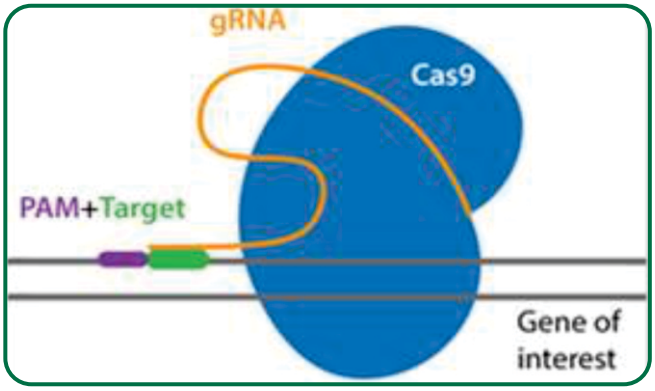
T. afroharzianum **(NAIMCC-R-6)**

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Genome Editing for Targeted Mutation and Genetic Improvement of Pulses

Genome Editing Technologies (CRISPR/Cas9) enable the manipulation of genome, epigenome and transcriptome of plants and have potential to transform productivity and nutritional quality of pulses.



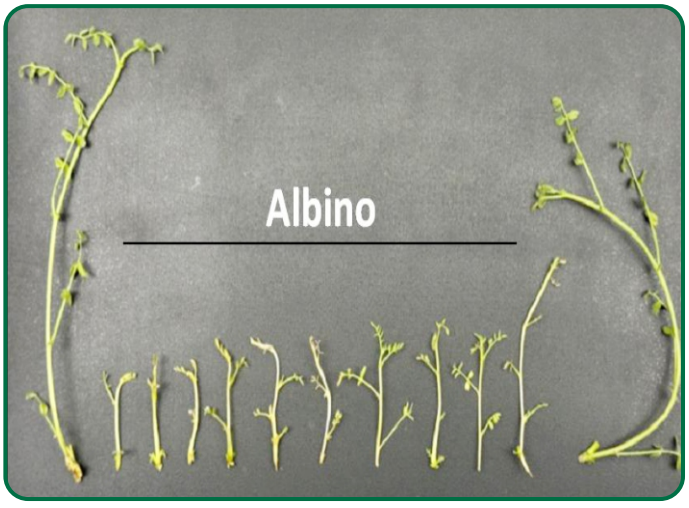


Attempts are underway to

- enhance productivity by mutating Cytokinin oxidases (CKXs), Single Flower gene (SFL), Dense Erect Panicle 1 (DEP1) genes, nodule-specific cysteine rich peptide coding NCR genes and NIN-Like protein (NLP) for nitrate insensitive nodulation in pulse crops.
- reduce anti-nutrient factor by targeting genes (BOS, CAS) of the ODAP biosynthesis pathway in grasspea.

CRISPR/Cas9 mutation (SDN1) of *PDS gene* homolog in chickpea and pigeonpea have resulted in an albino phenotype

Targeted mutation of *BS1* homolog in chickpea resulted in increased seed size and mutation in *Efl1* gene resulted in induction of early flowering in chickpea







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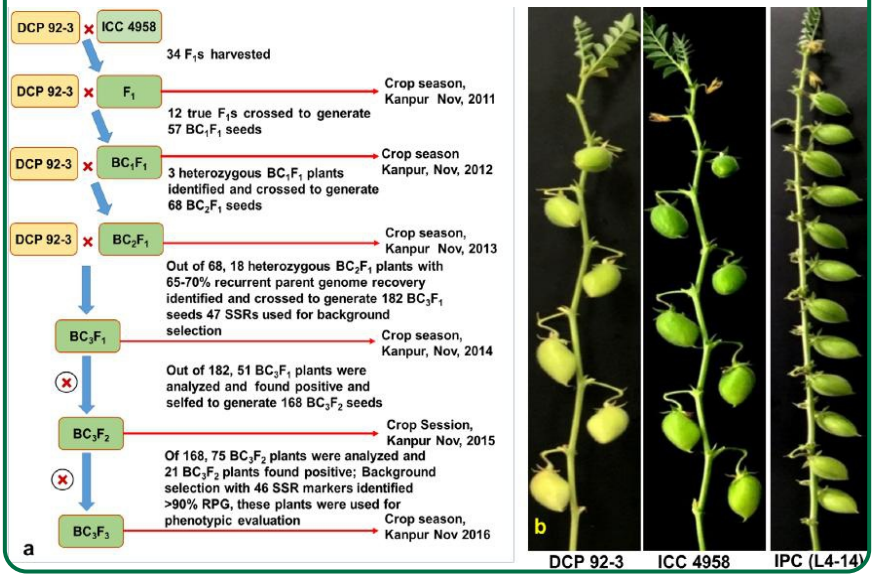
Genomics Integrated Breeding for Enhanced Efficiency and Genetic Gain

Chickpea MAS products IPC MAS-1 (Drought tolerance) and Samriddhi (*Fusarium* Wilt Resistance) have been released as varieties and Pigeonpea introgression lines for *Fusarium* wilt resistance are in pipeline for evaluation under AICRP trials.

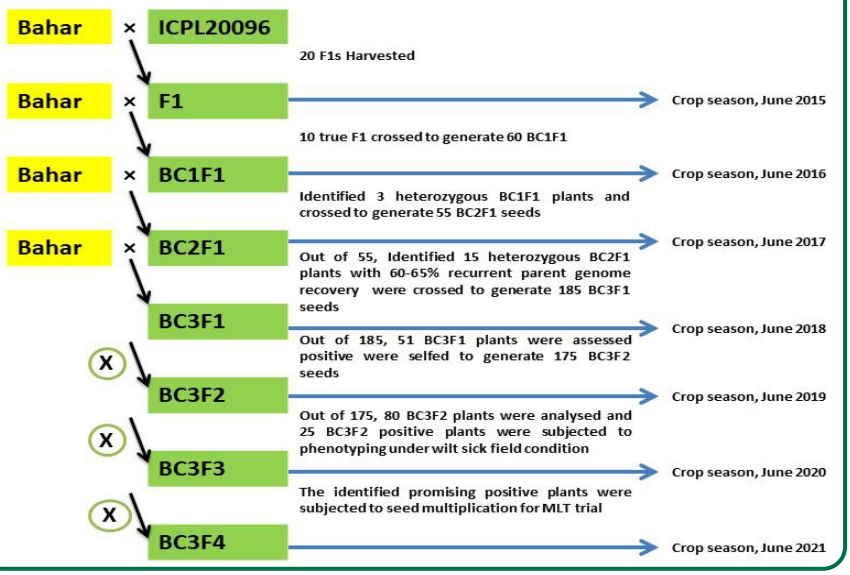
Chickpea MAS Products

- *Fusarium* wilt resistant chickpea variety IPCMB 19-3 (Samriddhi) has been developed through MABC by transferring QTLs controlling wilt resistance to popular varieties Pusa 256 using variety Vijay as the donor.
- Drought tolerant chickpea variety IPC MAS-1 has been developed by introgression of drought tolerant *QTL Hotspot* region into DCP 92-3 background. The drought-tolerant QTLs was transferred from the donor ICC 4958.

MABC scheme in chickpea for introgression of the "*QTL-hotspot*" genomic region in DCP 92-3



MABC scheme in pigeonpea for introgression of the Fusarium wilt resistant region in Bahar



Pigeonpea MAS Products

- Four promising Fusarium Wilt Resistant introgression lines of Pigeonpea *viz*., IPA MABC 79, IPA MABC 81, IPA MABC 83 and IPA MABC 85 developed by transferring QTL's for wilt resistance from accession ICPL 20096 to the recurrent parent Bahar, an extremely popular but *fusarium* wilt susceptible Pigeonpea variety.
- A set of 19 SNP markers were utilized for transferring *Fusarium* wilt resistant region.

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Plant Genetic Resource Management and its Utilization

A total of 15,000 germplasm collections including wild and cultivated accessions comprising Chickpea (5032), Pigeonpea (1988), Mungbean (805), Urdbean (510), Lentil (1486), Fieldpea (750), Rajmash (1208), Cowpea (572), Horsegram (240), Lathyrus (871), Mothbean (300), Ricebean (200) are under medium-term cold storage unit apart from germplasm used in active breeding programme.



Trait specific donors

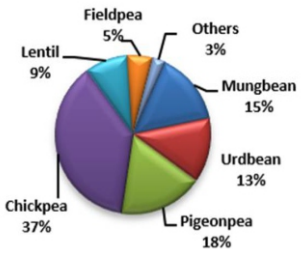
Trait-specific donors play a crucial role in enhancing various desirable characteristics. In this regard, 49 donors have been identified in different pulses *viz*., Chickpea (5), Pigeonpea (16), Mungbean (10), Urdbean (7), Lentil (1), Fieldpea (6), Rajmash (2), Cowpea (1).

Traits	Donors
Disease resistance	Chickpea (NILVC 35/5-4, IPC 2010-121); Pigeonpea (IPA 8f, IPA 9f, IPA 15f, IPA 204, IPA 234); Mungbean (IPM 526-11), Fieldpea (IPF 2014-16), Rajmash (IC 34097, IC 360831)
Insect pest resistance	Wild *Vigna* (IC 240326, IC 251442, IC 251439, IC 251385)
Herbicide tolerance	Chickpea (ICC 12315), Fieldpea (P 637)
Biofortification	Urdbean (HPU 120S, IPU 99-43)
Yield attributes	Chickpea (IPC 2020-198), Pigeonpea (IPAV 16-1)
Early flowering	Fieldpea (IPF 2014-13, IPFD 18-14), Lentil (ILWLS 118), Mungbean (IPM 205-7, IPM 409-4), Urdbean (IPU 19-27)

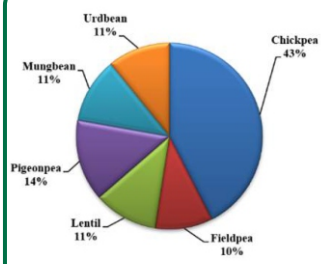


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Pulses Seed Hubs: Epicenter for Quality Seed in India



Quality Seed Production



Breeder Seed Production



Access to Quality Seed Availability across Pulses Seed Hubs

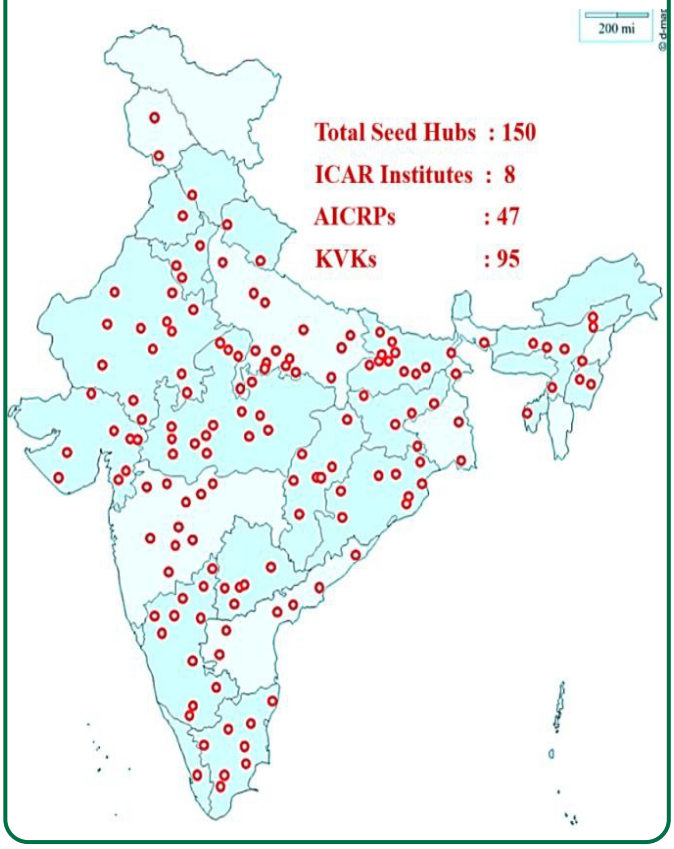


150 processing plants
Capacity: 54,000 t/month



150 seed storage godowns
Capacity: 2,25,000 q

Seed Hub Centers

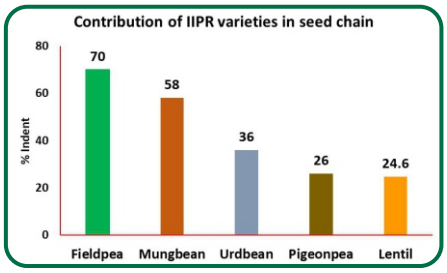


- One hundred fifty pulses seed hubs have been created in 24 states for enhancing pulses quality seed availability in the country.
- During 2016-24, 801,635.53 quintals of quality seed of eleven pulses were produced. Besides, 23,892 quintals of breeder seed of six pulses were produced to maintain seed health under Enhancing Breeder Seed Production programme.

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Breeding Varieties for Traits of Tomorrow

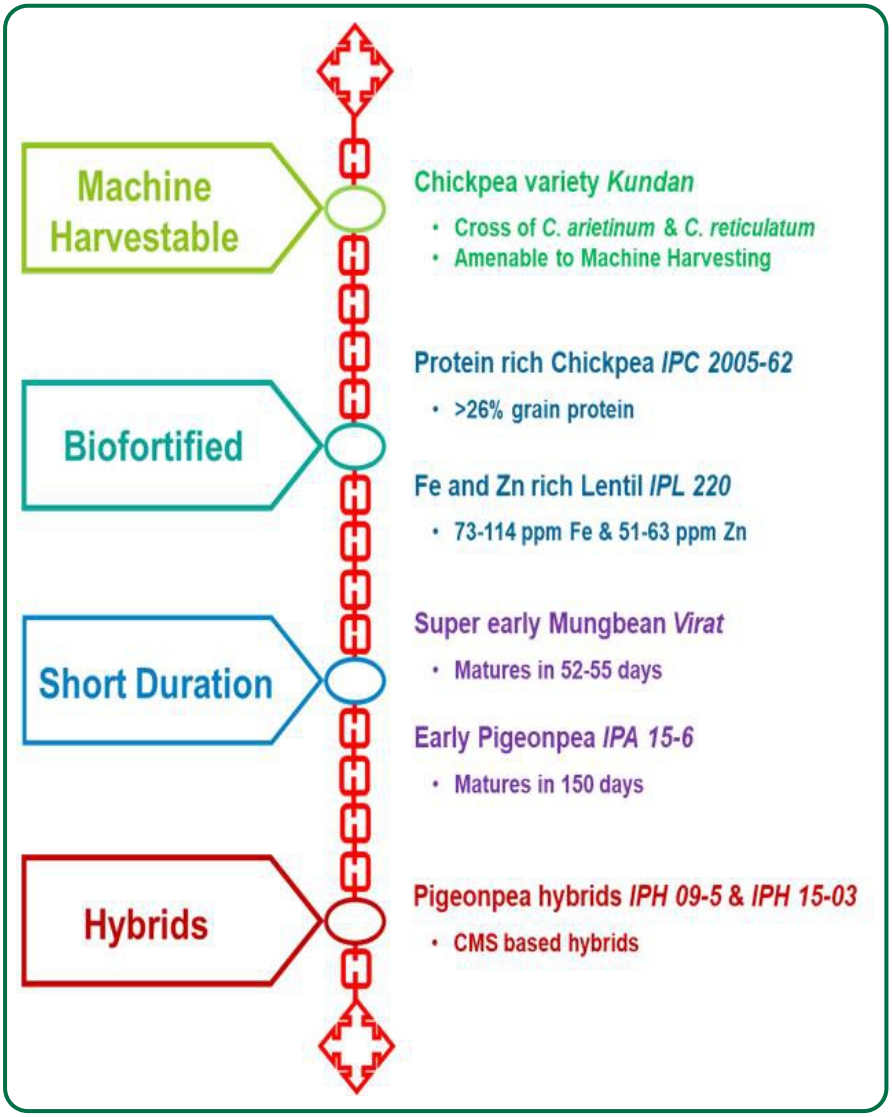
Breeding high yielding, stress resilient and nutrient dense varieties of pulses is core to ICAR-IIPR's vision of augmenting pulses production in the country. ICAR-IIPR is credited with development of more than 80 varieties of different pulses *viz*. Chickpea, Pigeonpea, Mungbean, Urdbean, Lentil, Fieldpea and Rajmash which are very popular among farmers.













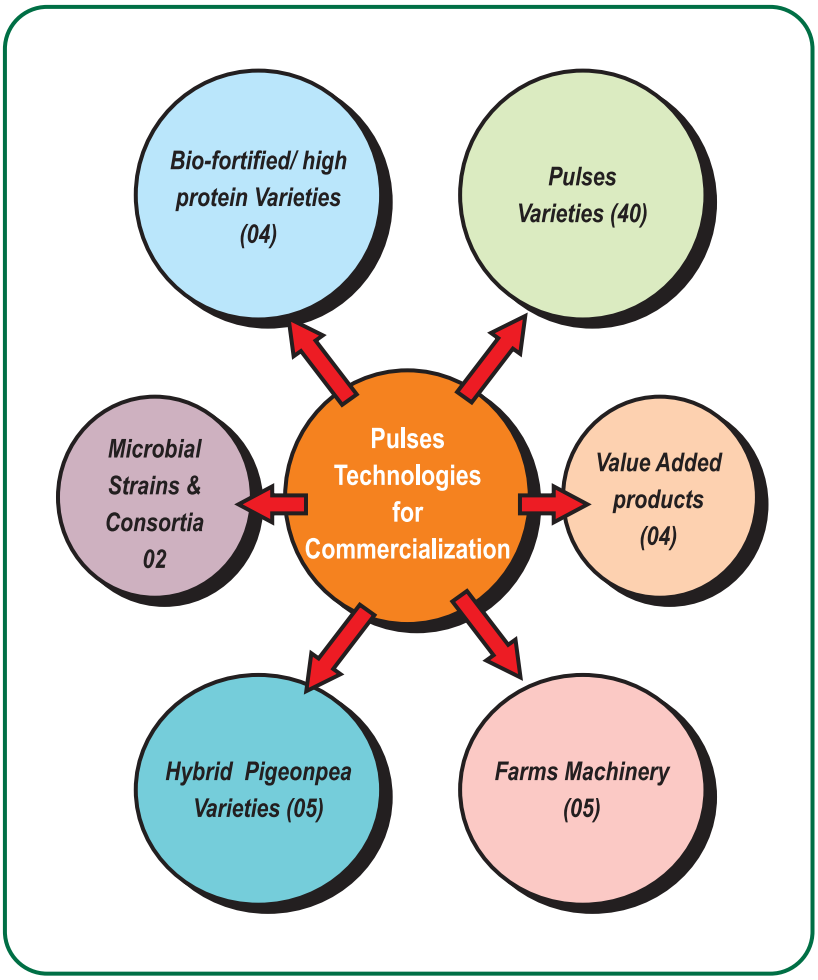


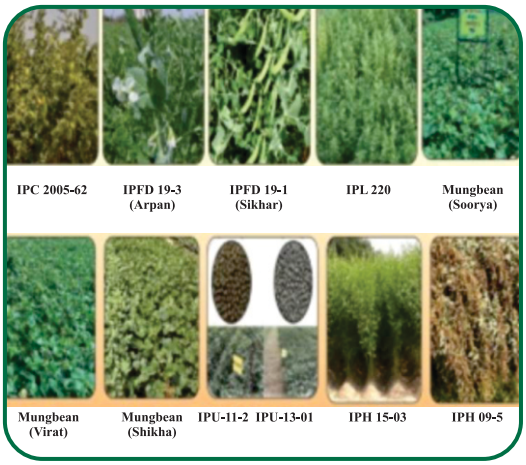


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Commercialization of Pulses Technologies with Industry Partners

Institute has developed 100 potential technologies for licensing with industires for commercialization among the industry and farming communities, and MoAs for pulses research and development.











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