वार्षिक प्रतिवेदन
Annual Report
2025



भाकृअनुप
ICAR

भाकृअनुप-भारतीय दलहन अनुसंधान संस्थान
ICAR-Indian Institute of Pulses Research
कानपुर/Kanpur-208 024

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Editing, designing and layout : Dr. Rajesh Kumar Srivastava

Publication Committee :
Dr. G.P. Dixit, Chairman
Dr. (Mrs.) Meenal Rathore, Co-Chairperson
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Director's Desk



It gives me immense pleasure to present the Annual Report (2025) of ICAR-Indian Institute of Pulses Research, Kanpur. It is a privilege to lead a glorious Institute like ICAR-IIPR where every achievement stands as a testament to the collective dedication of our scientists, staff, and partners in advancing the cause of pulses research for the nation. It is a pleasure to mention that the Institute has accomplished achievements aiding to all India production of 256.83 lakh tonnes total pulses in 24-25. Over the past year, the Institute has strengthened its research programmes, expanded partnerships, and contributed significantly to national goals of enhancing productivity, resilience, and farmer prosperity. I am happy to share the Annual Report of the Institute that gives insight into the significant achievements made under different research/ extension and training programmes.

During this year, a total of 3 *desi* chickpea genotypes *viz*. IPC 2018-38 , IPC 2017-253 and IPC 2018-131 were recommended for identification and release for Uttar Pradesh during 2026 while two heat tolerant genotypes have been identified by Institute GIC for registration with NBPGR as a donor line with unique trait. Pigeonpea variety IPA 15-21 developed and released for cultivation in Jharkhand state. The urdbean variety IPU 18-02 (Vijeta) was released for cultivation in Uttar Pradesh state for Spring season while variety Tapti was notified for cultivation in Madhya Pradesh state for Spring season. Much new breeding material (ABLs, RILs *etc.*) is in advancement across pulses for desired traits like tolerance to heat, *Fusarium* wilt, mechanical harvesting, protein content, yield and yield attributing parameters, *etc.*

Advanced tools like genome editing is being used to improve pulses by targeting traits like early flowering, number of seeds per pod, Nodule specific Cysteine Rich (*NCR*)-genes, NLP1, double flowering, branch phenotype, reduction in ODAP content, and the pulses are in different stages of development. Knockout of PDS has been demonstrated in chickpea. Agronomic characterization of gene edited chickpea lines (Efl1) have indicated appearance of early flowering trait, compared to control. Methodologies have been developed for suction pressure-based agrobacterium mediated genetic transformation protocol for urdbean and *in vitro* regeneration in lentil. A large number of SNPs have been identified between F16 and F17 isolates of *Fusarium udum* infecting pigeonpea and 50 primers have been designed to differentiate the isolates and races. Several genes have been identified based on Omics study and homologs identified in required pulses crops.

Under crop production programme, long term studies document pulse inclusive cropping systems for enhanced productivity, profitability, and soil health and also use of integrated nutrient management to give higher yields that is at par with inorganic fertilizers. Conservation inclusive pulse-based based cropping systems document reduced production costs, increased productivity, improved soil fertility, improved soil organic content, productivity, and profitability over conventional tillage using standard package of practices. Using recommended sulphur dosage increased the maize-mustard-mungbean system productivity but with integrated approaches soil maintained available sulphur and showed strong positive correlations with crop yields, supporting efficient and sustainable sulphur management. Application of the nano-formulations of Urea and DAP both revealed positive results of reduced usage of nutrient, enhanced yields indicating a sustainable management option. Organic farming increased chickpea and mustard yields and recorded the highest system productivity *wrt* inorganic practice. Natural farming, however, recorded decreased yields, even though the reduction was lesser in comparison to previous years decrease (in chickpea, mustard and barley). Four chickpea genotypes have been identified for better performance under low P conditions.

Under crop protection programme, pulses germplasm were routinely screened for tolerance and response to biotic stresses like *Fusarium* wilt, *Phytophthora* stem blight (PSB), Yellow Mosaic Disease and Groundnut Bud Necrosis Virus (GBNV). Antimicrobial and PGP activity was demonstrated in *Trichoderma asperellum* formulation (IIPRTh-31) and also for Dalhanderma and Pulse Booster. Analysis of four years (2021–2024) revealed that YMD development in mungbean (DGGV-2) and urdbean (Co-5) varied strongly with season and year, with faster onset and progression during *kharif* than summer. The field efficaciesof IIPR Lep-Kill and IIPR Pulse Guard' against *H. armigera* and *M. vitrata* in pigeonpea IPH 15-3 and *S. obliqua* infesting blackgram, respectively were tested and found encouraging. With continuous use of Aluminium Phosphide 56% w/w for managing bruchids, a three-year monitoring revealed enhanced resistance of bruchids to the chemicals, especially in *C. analis*. Several resistant pulses have been identified against different bruchid species. Field evaluation of Emulsion and Rhizo-nil SP formulations for root knot nematode management in *mungbean* revealed that the seed treatment of both formulations was performing better in reduction of nematode population as compared to control

The Institute continues basic research by identifying sources tolerant to different abiotic stresses and selected also for plant type *eg*. lentil for heat tolerance and input response, pigeonpea for waterlogging stress tolerance and efficient plant type and urdbean for mechanical harvesting. Transcriptomics of heat tolerant and susceptible chickpea genotypes revealed two genes encoding 18.5 kDa heat shock proteins showed stronger induction in tolerant genotypes. Chickpea genes expressing only in root-nodule tissues have also been identified in chromosome No. 4 and 5 and characterized *in silico.*

Attempting to amplify our extension approach, E-learning platform of pulse production technologies is being developed for speedier dissemination of information on pulse production technologies among farmers and other potential stakeholders. To support the partner farmer's, improved pulse production technology, crop stage specific capacity building programmes are organized. A larger number of demonstrations, farmer participatory trials and pulse inclusive interventions have been conducted. Studies are underway wherein growth rates for yield and area across all major pulse-growing districts have been calculated; also AI enabled Biotic & Abiotic Stress Detection and Advisory Mobile Application for Crops is being developed.

All the regional centers and stations of IIPR are actively associated in ongoing breeding programmes, rejuvenation of germplasm, screening for desirable traits, germplasm collection, basic and adoptive research in prevailing agro-ecosystem, FLDs, trainings as well as seed production.

The Institutional progress and strategic advancement was possible with the steadfast support and able guidance and encouragement received from Dr. ML Jat, Secretary, DARE and Director General, ICAR; Dr. DK Yadava, Deputy Director General (Crop Sciences) and Dr. Sanjeev Gupta, ADG (O&P), ICAR whom I acknowledge with sincere gratitude and reverence.

The efforts of Project Coordinators, Dr. Shailesh Tripathi and Dr. Aditya Pratap, Heads of Divisions including Drs. Meenal Rathore, Uma Sah, Narendra Kumar, Mohd. Akram, Senthil Kumar and PK Katiyar are highly appreciated for research inputs from their respective Divisions. I am thankful to all the members of Publication Committee for their praiseworthy efforts in bringing out the Report in time. Last but not the least, I am thankful to all my staff and their families who are supporting and contributing to the progress of the Institute in the service of the nation.



(Girish Prasad Dixit)

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Executive Summary

Crop Improvement

A. Chickpea

- Machine harvestable chickpea variety IPC 2017-351 (Abha) was developed from hybridization (IPC 06-11/IPC 04-52) was released for cultivation in Madhya Pradesh. It produced mean yield of 1834 kg/ha with registered by 46.12% superiority to check JG 24 (1255 kg/ha) and matures in 116 days. It has medium seed size (19.1g/100 seed wt.) with resistant to wilt and moderately resistant to DRR diseases. It has erect growth habit and tall plant height (68-75 cm) with lodging resistant.
- *Desi* chickpea variety IPC 2017-292 (Kranti) was developed from hybridization (BG 256/ICC 96030) was released for Madhya Pradesh under rainfed condition. It produced yield of 1917 kg/ha with registered of 29.8% yield superiority to check JG 16 (1478 kg/ha). It matures in 115 days with resistant to wilt and moderately resistant to DRR diseases.
- *Desi* chickpea variety IPC 2012-108 (Krishna) was developed through hybridization (IPC 94-94/ IPC 02-120) was identified and released for Uttar Pradesh. It produced mean yield of 1565 kg/ha with registered by 12.4% and 7.99% yield superiority to the best check KWR 108 (1472 kg/ha). It matures in 133-136 days with resistant to wilt and moderately resistant to DRR diseases.
- *Desi* chickpea genotype IPC 2018-38 was recommended for identification and release for Uttar Pradesh during 2026. It produced mean yield of 1395 kg/ha with registered 15.38% yield superiority to the best check IPC11-112 (1209 kg/ha). It matures in 130-135 days with resistant to wilt and moderately resistant to DRR diseases. It has medium seed size (19.3 g of 100-seed wt).
- Desi chickpea genotype IPC 2017-253 was recommended for identification and release for Uttar Pradesh during 2026. It produced mean yield of 1368 kg/ha with registered 13.17% yield superiority to the best check IPC 11-112 (1209 kg/ha). It matures in 125-130 days with resistant to wilt and moderately resistant to DRR diseases. It has medium seed size (16.5 g of 100-seed weight).
- *Desi* chickpea genotype IPC 2018-131 was recommended for identification and release for Uttar Pradesh during 2026. It produced mean yield of 1281 kg/ha with registered 5.96% yield superiority to the best check IPC 11-112 (1209 kg/ha). It matures in 130-135 days with resistant to wilt and moderately resistant to DRR. It has medium seed size (15.1 g of 100-seed wt).
- Two *desi* chickpea doners namely IPC 2019-05 and IPC 2014-99 for heat tolerant were identified by the Institute GIC for registration with ICAR-NBPGR as a donor line with unique trait.
- A *desi* chickpea entry IPC 2020-208 has been promoted to AVT-2 under ECZ during *Rabi* 2025-26. Out of 15 entries evaluated under AICRP during 2024-25, three chickpea entries such as IPC 2019-93-TS (NEPZ/SZ); IPC2019-58 & IPC 2019-230-LS (ECZ) were promoted to AVT-1 during 2025-26.
- Ten chickpea entries *viz*., IPC 21-117& IPC 21-105 (Timely Sown); IPC 20-123 & IPC 21-169 (Late Sown); IPC 21-134 & IPC 21-126 (Rainfed); IPC 19-29 & IPC 20-91 (Machine Harvest); IPCK 18-171 & IPCK 20-118 (Kabuli) were submitted to AICRP for evaluation in IVT trials during *rabi* 2025-26.
- Three high protein ABLs *viz*., IPC 23-283 (Protein 26.48%), IPC 23-220 (Protein 26.28%), IPC 22-41 (Protein 25.76%) were evaluated in Biofortification Nursery under AICRP during *rabi* 2024-25.
- Four high protein content ABLs of chickpea *viz*., IPC23-306, IPC18-45, IPC19-139, IPC18-80) are being evaluated in Biofortification Nursery under AICRP during *rabi* 2025-26.
- Eight chickpea varieties (IPC 11-112 IPCB 15-132, IPCK 13-163, IPC 06-77, IPC 05-62, IPC 07-28, IPCK 09-145, IPC 10-142 were registered with PPV& FRA in 5th December 2024.
- Total six varieties, Kundan, Kuber, Kanchan, Madhav, IPC 2005-62, IPC 2006-77 were licensed with Vishwas Agri Seeds, IFSA Seed, Star Agri Seeds for commercialization.
- Eight chickpea entries, IPC 17-351, IPC 18-39 (Timely sown); IPC 17-04 (Late Sown); IPCK 10-124 (Kabuli) were promoted in SAT-1/SAT-2 under UP State Varietal Trials during

2024-25.

- Two entries IPCMB 19-1 and IPCMB 19-2 have been promoted for third year yield evaluation state varietal trials in Uttar Pradesh.
- Total 27 breeding lines are being evaluated in 8 locations from UP, Jharkhand, WB, MP, Bihar, Chhattisgarh for yield and yield attributing traits performance for their release.
- Twenty ABLs of *kabuli* and check IPCK 09-145 received from ICARDA was evaluated at Kanpur for yield and other traits. Entry FLIP 16-49C (2415 kg/ha, 34.5 g/HSW) was found top yielder.
- Total 383 chickpea lines including crossing block (115), trait specific (144), varieties (69), Turkey lines (23), and *kabuli* donors (32) were evaluated for crossing programme and seed enhancement for future research. A total of 113 wild accessions were maintained and rejuvenated in wild hybridization garden comprising of *C. reticulatum* (42), *C. judaicum* (32), *C. pinnatifidum* (27), *C. echinospermum* (6), *C. cuneatum* (3), *C. yamashitae* (2) and *C. bijugum* (1) accessions. Total 2285 lines accessions are being maintained in medium term cold module.
- Total 99 chickpea crosses were made including 74 crosses and 25 crosses during *rabi* 2024-25 and *kharif* 2025 at Kanpur and Off-Season Nursery, Dharwad, respectively to generate breeding material for yield, plant ideotypes, earliness, nutritional quality, abiotic/biotic stresses. Similarly, seven back crosses were made to generate new breeding matrial for heat tolerance.
- A total of 69 F_1's derived from different crosses were raised for generation advancement and 301 SPS were harvested during *rabi* 2024-25.
- The generation advancement of F_2, F_3, F_4, F_5, F_6, F_7, F_8, F_9 & F_{10} populations derived from 10, 29, 22, 12, 22, 9, 5, 4 & 5 crosses for drought and heat tolerance and SPS & line bulk were harvested.
- Breeding materials from different generations derived from 279 crosses were advanced and total 1141 SPS, 232 Line Bulk (LB) and 33 Plot Bulk (PB) (28 F_2: 28 PB; 55 F3: 611 SPS + 3 PB; 35 F_4: 280 SPS + 5 LB + 2 PB; 59 F5: 405 SPS + 7 LB; 58 F_6: 17 SPS + 217 LB; 4 F7: 5 SPS + 3 LB) were harvested. Few lines and plot bulks to be shared with NARS partners.
- A total of 448 Advanced Breeding Lines (ABLs) including 102 & 346 entries were evaluated as 5 station trials [(ST-1-MH, ST-4-RF, ST-5-LS, ST-6-K, ST-7-trait specific) and 6 PYTs (PYT-1A-MH, PYT-1B-MH, PYT-3-TS, PYT-4-RF, PYT-5-LS, PYT-6-*Kabuli*], respectively for yield and other traits during 2024-25 at ICAR-IIPR, Kanpur and its regional stations (Bhopal, Dharwad).
- Altogether, a panel of 26 advanced breeding lines of chickpea along with three checks were evaluated under timely and late sown conditions at ICAR-IIPR, Kanpur and ICAR-IIPR-RRS Bhopal during *rabi* 2024-25 for screening of heat tolerance.
- A panel of 26 advanced breeding lines of chickpea along with three checks were evaluated under irrigated and rainfed conditions at ICAR-IIPR, Kanpur during *rabi* 2024-25 for drought screening.
- Total 189 kg seed of chickpea released varieties/breeding lines/germplasm were shared with 11 NARS partners/KVK/farmers for research purpose and popularization among farmers.
- Seven mapping populations (RIL) were developed for nutrition *viz.*, JAKI 9218/T 39-1 (F_7, n=452), JG 16/T39-1 (F_7, n=267), ICC4958/T39-1 (F_7, n=238), DCP92-3/T39-1 (F_7, n=262); heat tolerance viz., DCP 92-3/ICC 1205 (F_{10}, n = 208), JG 315/ICCV 92944 (F_{10}, n = 206) and growth habit viz., HC 5/E100YM (F_6, n=350) and seede were harvested based on SDS method during *rabi* 2024-25.
- MAGIC population (F_5, n=300) was evaluated for various heat tolerance related traits.
- High protein variety IPC 05-62 (26-27%), IPC 06-77 (24%) along with checks T 39-1 (29%) and DCP 92-3 (21%) was grown in Kanpur, Bhopal & Dharwad for two seasons and assayed for protein content. The stable entries were identified for bulk density and soaking hours.
- Traits like protein content and soaking time showed quantitative response with a normal population distribution with discontinuous curve in F_2. Groups could not be linked with any Mendelian ratios through chi-square test. No significant association/positive correlation was observed between grain characteristics and milling parameters in chickpea (75 genotypes). Negative correlation

(-0.48) observed between soaking time and bulk density. High protein content was tending to be associated with long podding duration (gap between days to pod initiation and days to maturity) in ABLs bred for high protein content (Corr. Coeff. +0.64).

- A total of 113 ABLs were evaluated under wilt sick plot for screening *Fusarium* wilt (race-2). Eight chickpea entries namely, IPC 24-79, IPC 24-117, IPC 24-145, IPC 24-41, IPC 24-44, IPC 24-36, IPC 24-43, IPC 24-142) were shown resistant reaction.
- Total 21.0 q nucleus seed of 19 varieties developed by ICAR-IIPR, Kanpur were produced for enhancing breeder seed production and harvested 2000 SPS for maintaining genetic purity during 2024-25.
- Twenty Eight fresh crosses among parents possessing stable resistance against root diseases (FW & DRR) and foliar diseases (AB), yield traits *viz*. Phule G 0405, JAKI 9218, JG 16, GNG 2372, GNG 2171, GNG 2264, CSJ 515, CSJ 556, JSC 37, IPC 2005-28, SGPWR 28, SGPWR 30, BGM 20212, IPC 2008-69, DKG 964, IPC 2010-121, IC 117744, PBG 8 *etc*. were made at IIPR, Kanpur.
- During 2024-25, 40 crosses advanced to F_2, more than 2,000 single plants (455 SPS from 44 crosses in F_2; 610 SPS from 59 crosses in F3; 414 SPS from 42 crosses in F_4, and 345 SPS from 61 crosses in F_5) in different evaluation generations. More than 150-line bulks of 57 crosses were selected in F_6 for constituting PYT for next year. These were selected on the basis of seed traits, higher plot yield and presence of stress resistance donors in their pedigree.

Pigeonpea

- Pigeonpea Variety IPA 15-21 developed and released for cultivation in Jharkhand state under *Kharif*, normal sown rainfed condition and derived from a cross between NDA 1 × MAL 13. This variety showed moderate resistance to wilt and resistance to Sterility Mosaic disease and tolerance to pod borer (*H. armigera*) and pod fly. It matures in 239-248 days; it's 100-seed weight is 13 g and seeds are light brown in colour with high milling recovery.
- A total of 4.3 kg, 7.0 kg, and 26.5 kg of nucleus seed was produced for IPA 203, IPA 206 and IPA 15-2 based on single plant progenies bulk methods and supplied to seed production unit.
- Entries IPAL 25-3, 25-4 and 25-6 have shown more than 5.02 to 31.5% yield superiority over checks, IPA 206, IPA 15-2 and IPA 203. Beside this, all the three entries are resistant to wilt and sterility mosaic disease. These entries will be proposed for evaluation in IVT of AICRP trials in NEPZ.
- In station trial I, nine hybrid entries were selected for testing in trial using six check varieties. Hybrid IPH 23-1 (2008 kg/ha) showed 19.8% yield superiority over the best check. In station trial II, eight hybrids were evaluated using three checks. Hybrid IPH 23-10 (PA 163A x AK 250137R) (1952.78 kg/ha) showed 36.6% yield superiority over the best check.
- Fifteen new CMS line have been developed. GT 288A, ICPL 88039A and ICP 2089A have been used as cytoplasmic donors to induce pollen sterility in these crosses.
- A total of 96 sterile (A) lines, cognate maintainer (B) lines and 78 restorer (R) lines are being maintained at ICAR-IIPR, Kanpur.
- Thirty-four fresh crosses were synthesized using different donors possessing targeted traits like earliness, plant type; pods/plant, PSB; SMD and wilt.
- During *kharif* 2024 total 46 F_1 were evaluated and further advanced to F_2 stage. Similarly, different segregating generation *i.e.* 7 F_2 (77 SPS), 9 F_3 (144), 14 F_4 (111), 13 F_5 (158), 25 F_6 (276), 26 F_7 (199) and 27 F_8 (148) were evaluated and superior single plant/ progenies (given in parenthesis) were selected and advanced to next generation.
- Total 80 ABLs were screened against PSB in IIPR, Kanpur sick plot. UPAS 120 x D. DWARF, R. LOCAL X D. DWARF, ICPL 88039 X UPAS 120, ICPL 91045 X ICPL 20340, (UPAS 120 X ICPL 11255) X (BAHAR X ICPL 20338), (UPAS 120 X ICPL 20340) X ICPL 15739 lines were found resistant.
- Entry IPAE 23-2 (1651 kg/ha) has been promoted to AVT-1.

Urdbean

- One urdbean variety IPU 13-6 (Tapti) notified for cultivation in Madhya Pradesh state for Spring season (Notification No. 2082 dated 13.05.2025).
- One urdbean variety IPU 18-02 (Vijeta)

released for cultivation in Uttar Pradesh state for spring season.

- Ten new urdbean entries were nominated for evaluation in AICRP *Kharif* pulses trials.
- Twenty-one fresh crosses were obtained involving diverse breeding lines or parents in urdbean.
- A total of 28 F_1s were harvested during Kharif 2025, along with 28 F_2s, 11 F3s and 30 crosses of F_4s.
- From F_5-F_8 generations materials emanating from 57 crosses were evaluated during *kharif*, 2025.
- A set of 198 urdbean entries were tested under preliminary yield trial where yield of four rows of four-meter lengths ranged from 80 gm to 588 gm. The high performing entries will be promoted to station trials in the next *kharif* 2026 season.
- For yield evaluation a set of 17 urdbean entries along with three checks were tested in Main Farm. Yield ranged from 410 gm to 1300 gm. Best performing lines compared to the best check (Azad Urd 1: 12 q /ha) were: IPU 24-17, IPU 24-14, IPU 24-12, IPU 24-07 were having yield superiority more than 10 per cent.
- Total of 396+240 urdbean germplasm are maintained and characterized.

Mungbean

- Fourty ABLs of mungbean were evaluated in Spring/Summer 2024, with 4 checks in two separate Station trials (ST1 and ST 2) with twenty test entries each. In ST1, ABLs namely, IPM 21-23-17 (784 kg/ha.), IPM 21-15-2 and IPM 21-15-7 and in ST2, test entries IPM 2024-SS-14 (852 kg/ha.), IPM 2024-SS-18, IPM 2024-SS-8, IPM 2024-SS-7, IPM 2024-SS-17, IPM 2024-SS-3, IPM 2024-SS-6, IPM 2024-SS-15 outperformed the best check.
- Ninteen ABLs of mungbean were evaluated in *kharif* 2024 with 5 checks in a Station trial (ST1). Test entries IPM 2024-SS-7, IPM 2024-SS-17, IPM 2024-SS-11 and IPM 2024-SS-15 surpassed the highest yielding checks by >6%.
- Eighteen new crosses were developed.
- One hundred and fifty-one segregating populations of mungbean were advanced to next generation, which comprised of F_1 (17), F_2 (51), F_3 (18), F_4 (32), F_5 (27), F_7 (4), F_8 (1) and F_9 (1) populations.

Fieldpea

- IPFD 18-3 (Purvansh) variety released and notified for commercial cultivation in the North Eastern Plain Zone (NEPZ) comprising the states of eastern Uttar Pradesh, Bihar, Jharkhand, West Bengal and Assam. It is dwarf and leafy type field pea with slightly dimpled, creamy white-coloured, medium-sized (18.0 g/100-seed weight) seeds and is resistant to powdery mildew and Ascochyta blight disease.
- IPFD 18-8 (Arpit) variety released by the 37th SVRC meeting for the Bundelkhand region of Uttar Pradesh. It is a dwarf, leafy type and round & creamy colour seeded variety with resistance to powdery mildew and rust disease.
- A total of 59 crosses were synthesized by engaging various donors possessing specific traits *i.e.* large seed size, no. of seeds per pods, pod length, no. of pods per plants, earliness, powdery mildew resistant and rust tolerant.
- Nine varieties of field pea have been registered with PPVFRA.
- In station trial for dwarf, 12 genotypes were evaluated with three checks in RBD, of them, IPFD 2025-9 (3792 kg/ha), IPFD 2025-1 (3641 kg/ha), IPFD 2025-8 (3586 kg/ha) and IPFD 2025-3 (3547 kg/ha) out yielded the best check.
- In station trial for tall, 12 genotypes were evaluated with three checks, of them, four genotypes *i.e.* IPF 2025-19 (2916 kg/ha), IPF 2025-15 (2810 kg/ha), IPF 2025-21 (2814 kg/ha) and 2025-20 (2783 kg/ha) demonstrated superiority over the best check IPF 5-19 (2319 kg/ha).
- During *rabi* 2024-25 total of 30 crosses were raised in the F_1 generation. Segregating generations of 23 F_2 (1035 SPS), 28 F_3 (1520 SPS), and 33 F_4 (1155 SPS) were evaluated. In F_5 and F_6 generation 153, and 463 single lines were evaluated, respectively.
- Three genetic stocks, DMR 6, IP2K 101 and IPFD 24-1 recommended by Institute GGIC.
- The RIL population (310) of rust [HFP 4(S) / FC1(R)] was characterized for days to flowering, days to maturity, HSW, and grain yield.
- A panel of 150 advanced breeding lines was

evaluated for protein content. The maximum protein content was registered in IPF 25-199 (28.2%).

- During reporting period, total 409 accessions of fieldpea were planted for rejuvenation and evaluation.
- The nucleus seed production program of 19 field pea varieties developed by ICAR-IIPR was taken during 2024-25 as per DAC indent. The nucleus seed production was 3168 kg.
- In the national breeder seed indent IIPR varieties total share was about 58% and of which IPFD 12-2 had highest share (9.85%).

Lentil

- Lentil variety IPL 341 (Jagrati) released and notified for commercial cultivation in Madhya Pradesh. This large seeded variety has 3.0 g/100 seed weight having brown colour with red cotyledons and has resistance to major diseases including rust and Fusarium. Lentil variety IPL 342 (Uttam) released and notified for commercial cultivation in Madhya Pradesh. This large seeded variety has 3.2 g/100 seed weight having brown colour with red cotyledons and has resistance to major diseases including rust and Fusarium.
- Lentil variety IPL-232 has been released for cultivation in Uttar Pradesh by UP State Seed Sub Committee and submitted for notification. It is an attractive, small seeded (2.4 g/100 seeds) variety with red cotyledons and has tolerance to major diseases of lentil including Fusarium wilt and rust.
- Small seeded IPL 249 entry in NEPZ was evaluated in AVT-1 and six entries [IPL 248, and IPL 249 (small seeded), IPL 354,and IPL 355 (large seeded) and IPL 612 and IPL 613 (rice fallow)] were evaluated in IVT. Two entries (IPL 251 and IPL 252) were performed well across three zones (NHZ, NWPZ and NWPZ) and promoted to AVT-1 for evaluation.
- In ST-I, four large seeded entries IPL 22-25, IPL 22-55, IPL 22-18, and IPL 22-11 were identified. In ST-II, five small seeded entries IPL 22-38, IPL 22-56, IPL 22-12, IPL 22-27 and IPL 22-15 were identified.
- In PYT, 12 entries (IPL 23-90, IPL 23-65, IPL 23-85, IPL 23-03, IPL 23-94, IPL 23-6, IPL 23-1, IPL 23-80, IPL 23-78, IPL 23-73, and IPL 23-46) were identified promising over check variety IPL220 having average yield ranging from 1097 to 1428 kg/ha. The highest yielded entry (IPL 23-46) had yield 1428 kg/ha with a maturity of 116 days, while entry IPL 23-90 had fast grain filling ability of 31 days compared to check variety IPL 220 (39 days).
- During the *rabi* season 2024-25, 24 fresh crosses were generated for desirable traits and disease resistance.
- Total 140 F_1 plants were generated from 32 crosses from which F_2 seeds were harvested. The single plants were selected from 21F2 (297+ 3 Bulk), 29 F_3 (537353 SPS), 24 F_4 (399 SPS), 27 F_5 (222 SPS), and 656 progenies of 26 F_6 were bulked for yield evaluation. 60 improved breeding lines having higher yield potential (170-280 g/ line) were selected from F_6 bulk progenies for PYT.
- Total 1061 kg nucleus seeds of 11 released varieties was produced.
- Trait-specific RIL mapping populations for earliness (Precoz x L 4603; 137 RILs) and root traits (IPL 98/193 x EC 208362; 198 RILs) were maintained and evaluated for yield and root traits.
- Using MSTmap software, 441 SNP markers were mapped onto the seven chromosomes, spanning 3,009.1 cM and developing a linkage map for QTL identification related to root and other traits.

Rajmash

- One common bean entry, IPR 205-24 was promoted to AVT 1 in AICRP testing in Central Zone and North Eastern Plain Zone with 13% and 9% yield superiority, respectively.
- Two new entries in rabi Trial and two new entries in *kharif* IVT trial.
- Two accessions were submitted to National Gene Bank for early maturity.
- Nine crosses were made successfully during this period.
- *Phaseolus coccineus* was used in five successful crosses.
- Two mapping population for BCMV and *Anthracnose* disease are maintained.
- Environmental factors and their effects on phenological traits were worked out.

- The most stable and high-yielding genotypes identified - EC 931971, EC 931452 and Arun.
- Donors for BCMV resistance, early maturity, pod length, seed size identified.
- Transcriptomics of heat-tolerant common beans worked out.

Plant Biotechnology

- CRISPR/Cas9 based targeted mutation of 15-cis-phytoene desaturase (PDS) demonstrated in chickpea
- Allele mining of Sfl1 and Ln loci in chickpea germplasm demonstrated association ship to number of flowers/peduncle and number of seeds per pod, respectively
- Identified GRF-GIF candidates in chickpea for development of genotype independent regeneration system
- Identification of functional U3 and U6 loci in chickpea for driving guideRNA (gRNA) in gene editing experiments
- Agronomic characterization of gene edited chickpea lines (Efl1) indicated appearance of early flowering trait, compared to control.
- Established an efficient and reproducible *in-vitro* regeneration protocol for lentil genotype IPL 316 using cotyledonary node explants. This protocol was subsequently tested on four additional lentil genotypes (IPL 220, IPL 315, IPL 329, and IPL 406) as well as three field pea genotypes (IPF 5–10, IPFD 10–12, and IPFD 19–1), where it also proved successful.
- A comprehensive lentil proteomic atlas spanning eight tissues identified 1,657 proteins, revealed tissue–specific enrichment patterns, and through cross–species ortholog mapping to Arabidopsis and Medicago uncovered conserved pathways and lentil–specific innovations, providing key targets for molecular breeding, stress resilience, and seed quality improvement.
- Four SVP class MADS-box genes: Car_MADS 64, 72,15 and 46- have been cloned into pDonR221 entry vector by gateway cloning and confirmed by restriction digestion and sequencing.
- Generated improved line of GNG 1581 with QTL-hotspot genomic region to enhance drought tolerance through marker assisted back cross breeding approach and nominated one line for AICRP multi-location trial
- Screening of F_8 mapping population differing for earliness (ICCV 2 x ICC 12155) and genotyping these population with polymorphism present in flowering related genes identified Efl3 as a major locus governing earliness in this population.
- A total of 309, 418 SNPs, 11,456 insertions, and 12,653 deletions were identified between the F16 and F17 isolates of *Fusarium udum* infecting pigeonpea. of these, 300 InDels with more than a 20 bp difference were identified, and designed 50 primers to differentiate isolates and races
- Developed suction pressure-based agrobacterium mediated genetic transformation protocol for urdbean genotypes and generated tRNA based multiplex gene editing cassette targeting VmCKX2, VmCKX10 and HP6 genes of urdbean and developed. A total of 47 T_0 transgenic plants were developed, each carrying the T-DNA containing the gRNA expression cassettes and the Cas9 gene.
- Reconstructed CRISPR/Cas9 construct with gRNAs targeting pigeonpea CKX07 knock out and initiated genetic transformation using same in cv IPA15-6.
- Relative lower expression of 8 Cc CKXs identified in cultivar with higher number of seeds per pod during initial stages of pod formation and development. And of these, only 4 retained lower expression in further pod development.
- Identified MIC of Basta for leaf paint assays and *in vitro* selection.
- Analysis of a QTL region associated with cytoplasmic male sterility (CMS) showed unique SNP/INDEL variants in A, B, and R lines of *Cajanus cajan*. A gene (LOC109803998) associated with Root Primordium Defective1 (RPD1) was identified within this region, displaying differences in coding sequences (CDS) and amino acid lengths between lines. An INDEL-based marker was developed from this region, which can screen for true hybrids and might be linked to restoration.
- Identified potential flowering-linked genes, long non-coding RNAs (lncRNAs), and microRNAs from *Cajanus cajan* ATLAS transcriptome data.

- Identified ARE1 and *Gm*3GAox homologs in pigeonpea.
- Re-sequenced LsCAS gene from the Mahateora variety of grasspea and submitted to NCBI (Accession no. PV838138).
- Five sgRNA from the LsCAS gene and five from the LsBOS gene were designed, synthesized and cloned into CRISPR/Cas vector.

Crop Production

- In 22 years of long-term study, rice-based cropping systems with pulses significantly enhanced productivity, profitability, and soil health over long-term evaluation. Rice–wheat–mungbean (RWM) recorded the highest chickpea equivalent yield and net returns, while rice–wheat was the lowest. Integrated nutrient management (INM) produced system productivity comparable to inorganic fertilizers and superior to control. After 20 years, soil NPKS increased by 15–35% under pulse-based systems and up to 65% under INM. Carbon storage peaked in RWM (125.8 Mg/ha^{-1}) and INM (129.7 Mg/ha^{-1}).
- Long-term (22-year) maize-based croping systems integrating pulses significantly enhanced productivity, profitability, and soil health. Maize/pearl millet–wheat–mungbean under INM recorded the highest wheat-equivalent yield, net returns, and benefit–cost ratio, outperforming maize–wheat under RDF. Soil NPKS increased by 15–35% due to pulse-based rotations and up to 65% under INM over control. Carbon storage increased to 41.6 Mg/ha^{-1} in maize–wheat–mungbean and 45.6 Mg/ha^{-1} under INM, with strong positive correlations between yield, SOC, and soil nutrients.
- A field experiment (2020–21 to 2023–25) at ICAR-IIPR, Kanpur demonstrated that conservation agriculture (ZT–ZT with residues) significantly reduced production costs and increased productivity in the maize–chickpea system. ZT–ZT combined with 100% RDF and PRE+POST herbicide (pendimethalin–topramezone) reduced weed density and increased crop yields by 17–24% over CT–CT. This system generated additional net returns of ₹ 27,000 in maize and ₹ 32,000 in chickpea, while herbicide-based weed control provided ₹ 42,000 higher income than manual weeding, proving superior profitability.
- An experiment initiated in 2021 showed that conservation agriculture-based maize–wheat–mungbean with ZT–ZT–ZT increased system productivity by 11.3% and irrigation water productivity by 13.2% over CT–CT–CT. Fertilizer–residue integration (50% residue + 100% RDF or full residue + 75% RDF) enhanced productivity by 12–14%, improved NUE by 50%, and increased energy efficiency by up to 16%.
- Under CA, diversified cropping systems integrating legumes and brown manuring significantly improved soil fertility, productivity, and profitability. Available soil nitrogen increased to 209.1 kg/ha^{-1}, SOC to 0.35%, and water-holding capacity to 41.47%, while soil pH (7.48–7.55) and EC (0.14–0.19 dS m^{-1}) declined. The highest yield (3950 kg/ha^{-1}), net returns (₹ 1.76 lakh/ha^{-1}), and benefit–cost ratio (3.61) were achieved under Rice (DSR)+*Dhaincha*–Wheat–Mungbean.
- In a study on terminal water stress mitigation in summer, thiourea, KCl, and nano urea applied at early pod development increased yield by 10–13% under late sowing. In contrast, urea and $MgSO_4$ caused phytotoxicity and yield loss. Yield gains were associated with improved seed weight, biomass, and pods per plant.
- In a study on S-management in maize-mustard-mungbean system, significant yield responses were observed in all crops, the highest in mungbean, followed by mustard and maize. Integrated sulphur management with residue recycling and organic inputs produced yields comparable to recommended sulphur doses. System productivity was maximized under sole fertilizer treatments, while integrated approaches maintained soil available sulphur and showed strong positive correlations with crop yields, supporting efficient and sustainable sulphur management.
- Application of 75% nitrogen supplemented with nano-urea spray produced yields comparable to RDF and 100% N in rajmash. This approach reduced nitrogen use by 25% without yield loss and recorded higher net returns and B:C ratio, highlighting nano-urea as a sustainable nutrient management option.
- Integrating Nano-DAP with reduced phosphorus significantly improved yields. Application of 75% RDP plus two Nano-DAP

sprays was superior, matching 100% RDP and increasing maize and chickpea yields by 8–19% over conventional practices, demonstrating enhanced phosphorus use efficiency.

- A long-term field experiment assessed conservation tillage and irrigation in a sorghum–fieldpea system. Conventional tillage produced the highest sorghum and fieldpea biomass yields, while zero tillage improved soil organic carbon, available phosphorus, and nodulation. Irrigation responses differed: light irrigation optimized yields under conventional tillage, whereas normal irrigation was more effective under zero tillage, highlighting trade-offs between productivity and soil health.
- A field experiment compared inorganic, integrated, and organic nutrient management under pearl millet–chickpea and pearl millet–mustard systems. Organic farming significantly increased chickpea and mustard yields and recorded the highest system productivity (4.45 t/ha), 20.96% higher than inorganic practice. Pearl millet–chickpea outperformed pearl millet–mustard. Organic management improved nodulation, root growth, and soil biological properties, including higher microbial biomass carbon and phosphatase activities, indicating enhanced soil health and sustainability.
- On an average, natural farming recorded a yield reduction of 15.6% compared to recommended practices, although this reduction was lower than that observed in the previous year (23%). Yield reduction under natural farming was relatively lower in chickpea (17%) than in mustard (21%) and barley (22%).
- Post-emergence herbicide tolerance and weed management were evaluated in *rabi* and *kharif* pulses across multiple crops and genotypes. Significant genotypic variability was observed for herbicide tolerance, particularly in urdbean against halosulfuron-methyl, with IPU 2022-129 and IPU 2022-93 showing high tolerance and yield stability. Integrated weed management treatments significantly improved yields in mungbean and urdbean, notably pendimethalin–CPNaA and CPNaA alone. In *rabi* pulses, carfentrazone-ethyl proved selective and effective in fieldpea, controlling broad-leaved weeds without phytotoxicity and resulting in higher grain yield than current recommendations.
- An experiment at ICAR–IIPR evaluated rice establishment methods (PTR, CTDSR, ZTDSR) on chickpea and lentil under rice fallows. PTR gave 21–32% higher rice yield but caused soil cracking. CTDSR and ZTDSR supported higher chickpea and lentil productivity. Stable, high-performing genotypes included lentil IPL 526 and chickpea IPC 05-62 and IPC 04-98.
- A field experiment screened 210 chickpea genotypes under low (9.3 kg P/ha) and high (15.3 kg P/ha) soil phosphorus conditions. Significant variation was observed in root length, root dry weight, phosphorus content, and seed yield across genotypes. Phylogenetic analysis classified genotypes into phosphorus-efficient, moderately efficient, and less responsive groups. Genotypes such as Sadabahar, Radhey, ICC 1014, GCP 105, and RSG 991 showed superior performance under low-P conditions, highlighting their potential for developing phosphorus-efficient chickpea cultivars.
- In a study, residue incorporation with decomposer recorded the highest grain yield (4.50 t/ha), improved yield attributes, and maximum 1000-seed weight. Anchored residue with decomposer achieved the highest net return and B:C ratio, indicating superior productivity and profitability under sustainable residue management.

Crop Protection

- Extensive screening during *kharif* 2024–25 identified several *Fusarium* wilt–resistant pigeonpea genotypes, including PPW-17, PPW-54, PPW-83, PPW-85, PPW-51, PPW-30, IPAW-22, IPAW-22-31, IPAW-22-38, IPAW-22-44, IPA-17-5, POP-20, AICRP lines PFW 24-1, PFW 24-10, PFW 24-14, PFW 24-20, PFW 24-21, PFW 24-24, PFW 24-27, PFW 24-32, PFW 24-35, PFW 24-43, PFW 24-71, PFW 24-105, and donor lines such as KPL-44, BSMR-853, ICP 8862, ICP 9174, BDN-1, BDN-2, and IPA 15F.
- For *Phytophthora* stem blight (PSB), resistant genotypes identified included IPAC-3, IPAC-79, IPAPB 7-2-1-7, KPBR 80-2-1, DPPA 85-5, DPPA 85-7, DPPA 85-12, IPPSB 11, IPPSB 25, IPPSB 30, and AICRP lines PPM 24-31, PPM 24-73, PPM 24-92, and PPM 24-163.

- Twenty-one mungbean genotypes showed <10% yellow mosaic disease incidence at 60 DAS, namely Bhutan LM-1, EC 103821, EC 496839, GM 6, IPM 05-3-22, IPM 205-7, IPM 2-10, IPM 2-14, IPM 2-23, IPM 9901-10, KM 2241, LGG 607, MH 1142, MH 2-15 (SATYA), MH 241, MH 805, ML 131, PRATAP, PUSA-VISHAL, PUSA 9531, and SML 668, categorized as resistant to YMD.
- Fifteen urdbean genotypes recorded <10% YMD incidence, including BTU 111-5, DKU 98, GG 3120, H 1, JU 24-1, KUG 1097, KUG 1144, NPU 180, PANT URD 12, PDU 2E, PU 2205, PU 2210, RUB 15-08, UG 27, and VBG 22-02, and were identified as promising resistant lines.
- Groundnut Bud Necrosis Virus (GBNV) incidence remained low to moderate (4–8%), with symptoms observed in 16 mungbean and 3 urdbean genotypes.
- Molecular studies under the externally funded UPCST project showed that IPAC-79 (resistant) exhibits early and sustained activation of key defense genes (PR2, PAL2, CHS8, LOX, POX, PIF family), whereas UPAS-120 (susceptible) showed delayed and weak responses, explaining contrasting resistance to *Phytophthora cajani*.
- An emulsion-based *Trichoderma asperellum* formulation (IIPRTh-31) reduced pigeonpea wilt severity by ~55% and improved plant growth by 23–33%, while *Trichoderma* secondary metabolites enhanced chickpea germination (40%) and biomass (60%).
- Multi-location AICRP trials demonstrated strong field efficacy of Dalhanderma (60–70% wilt reduction in pigeonpea; 73% in chickpea) and Pulse Booster (40–60% in pigeonpea; 64% in chickpea).
- Butterfly pea (*Clitoria ternatea*) plants showing yellow mosaic symptoms in Kanpur were molecularly confirmed, for the first time, as a natural alternate host of mungbean yellow mosaic India virus (MYMIV), highlighting its role in virus survival outside pulse crops.The expanding host range of MYMIV underscores the epidemiological importance of ornamental and non-cultivated legumes as virus reservoirs, necessitating continuous surveillance in pulse-growing regions.
- Analysis of four years (2021–2024) revealed that YMD development in mungbean (DGGV-2) and urdbean (Co-5) varied strongly with season and year, with faster onset and progression during *kharif* than summer.Moderate temperatures (32–36 °C), high relative humidity (>80%), low sunshine hours, and favorable rainfall patterns during kharif enhanced whitefly populations and accelerated disease spread, while extreme summer temperatures delayed but did not prevent epidemics.
- Urdbean consistently showed faster disease progression and higher whitefly populations than mungbean, confirming the critical role of weather–vector interactions in shaping seasonal YMD epidemics in pulse ecosystems.
- In summer greengram, three sowing dates, 25 March, 5 April and 15 April were evaluated with respect to major sucking insect pests. It was concluded that aphid population was observed high in early sown crops whereas thrips population was recorded high in late sown crops.
- Population dynamics of whitefly (*Bemisia tabaci*), *Helicoverpa armigera*, and *Spodoptera litura* were monitored weekly from 2020 to 2025 using yellow sticky traps and pheromone traps. Whitefly populations showed two distinct annual peaks, one during 20–25 standard meteorological weeks (SMWs) and another during 34–36 SMWs. Adult populations of *H. armigera* began increasing around 11–12 SMWs and remained high up to the 25th SMW.S. litura populations were highest during 20–25 SMWs, with an additional minor peak during 38–39 SMWs.
- Pest population trends were integrated with key weather variables to develop ANN-based predictive models, using 70% data for training and 15% each for testing and validation. The most accurate prediction was achieved with an optimized ANN architecture of 9–4–1, demonstrating strong potential for forecasting pest outbreaks.
- The lab bio-efficacy of liquid formulations *viz*., IIPR Lep-Kill and IIPR Pulse guard was compared with their active ingredient (ai) alone against 3rd instar *Helicoverpa armigera* and found the formulation has lower LC_{50} than *ai* alone.
- The field efficacy of IIPR Lep-Kill was tested against *H. armigera* and *M. vitrata* in pigeonpea

IPH 15-3 and recorded the highest yield from IIPR Lep-Kill @ 2% (1.267 Kg/25m^2) followed by IIPR Lep-Kill @ 4.2% (1.203 Kg/25 m^2) whereas untreated control recorded lowest (0.667 Kg/25 m^2). No Phytotoxicity was observed in sprayed plots. Similarly, IIPR Lep-kill field efficacy in pigeonpea and cowpea at Dharward was evaluated and found effective in managing pod borer complex.

- The field efficacy of 'IIPR Pulse Guard' against *S. obliqua* infesting blackgram was evaluated at IIPR, Khurda wherein 100% reduction over control on 3rd DAT. Further, blackgram yield was significantly higher in IIPR Pulse Guard treatment (0.97 Kg/25 m^2) followed by other *Bt* formulations treatments as compared to control (0.45 Kg/25m^2).
- Flonicamid 50 WG, Thiamethoxam 25 WG and Dinotefuran 20 SG found effective in suppressing whitefly as well as aphids in greengram and blackgram. Strains of *Lecanicillium*, *Beauveria* and *Metarrhizium* also shown remarkable effectiveness.
- Four species of bruchids namely *Callosobruchus maculatus* (F.), *C. analis* (F.), *C. chinensis* L. and *Bruchus affinis*across different locations of India and *C. analis* was predominant species.
- The three-year monitoring demonstrated an average 3.11 to 5.23 folds resistance to Aluminium Phosphide 56% w/w in bruchid populations, with 35 and 68% increase in second and third year. The resistance to Deltamethrin 2.5 WP during 2024 was ranged between 6.72 and 8.03 folds. For both insecticides, *C. analis* recorded higher resistance than other species.
- Two chickpea genotypes, IPC 07-67 and IPC 92-39, were identified as resistant against *C. maculatus*. The lentil accessions (ILWL-55 and ILWL-39) were identified as resistant against *C. maculatus* and *C. chinensis.*
- Four *R. bracteata* accessions (IC 15815, IC 15816, IC 15817, IC 618509) were identified as stable highly-resistant donors against three bruchid species, while several *C. scarabaeoides* accessions were resistant to *C. chinensis* and *C. maculatus*.
- Biochemical characterization indicated that phenols, flavonoids, and tannins played key role in lentil and pigeonpea resistance against bruchids.
- Plant volatile oil terpenes, terpenoids, and phenylpropanoids showed strong bioactivity against *C. analis*, causing fumigant toxicity, ovicidal effects, 33–70% repellency, <5% seed damage, and 30–95% feeding deterrence.
- Thirty-one mungbean, 25 urdbean, 165 chickpea, 9 field pea and 14 lentil entries were screened for resistance against *M. incognita*. Only two chickpea entries *viz*., BDNG 2020-71 and DK 2303 were found resistant to *M. incognita*.
- The shelf life of the emulsion formulation was observed at fortnight interval and was 100% stable for minimum 12 months under ambient temperature. The shelf life of the emulsion formulation was also observed 100% stable under alternate freezing and thawing cycle for 12 hrs each @ four times.
- Field evaluation of Emulsion and Rhizo-nil SP formulations for root knot nematode management in mungbean revealed that the seed treatment of both the formulations was performing better in reduction of nematode population as compared to control. The number of galls and soil population of *Meloidogyne* spp observed the lowest in the application emulsion formulation were 9.67 and 48.33, respectively. Similarly, in case of Rhizo-nil SP application it was 10.67 and 42.67.

Basic Science

- Ten contrasting genotypes of lentil were evaluated/validated for heat tolerance in the field under normal and late sown conditions based on non-destructive physiological parameters (NDVI, Chlorophyll Index and Thermal Imaging), yield and yield attributes. Out of them, the performance of IG 3522 was found to be the best and had the least HSI compared to all other genotypes. Hence, genotype IG 3522 was identified as heat-tolerant, which may be used for the development of heat-tolerant varieties in lentil.
- Thirty-four chickpea genotypes were evaluated under normal and high-input management during *rabi* 2024–25. All genotypes exhibited a semi-determinate growth habit with variation in plant type and lodging resistance, which was identified as a key trait for high-input responsiveness. Based

on biomass accumulation, grain yield, and yield attributes, 21 genotypes showed superior performance under high-input management compared to normal conditions and were identified as promising for further evaluation.

- Pigeonpea genotypes ICP-5028, ICP-2376, IPAWL-22-7, IPAWL-22-8, and IPAWL-22-9 showed tolerance against water logging stress based on morphological scoring. The tolerant group showed the formation of adventitious roots but the susceptible group showed no adventitious roots.
- One hundred twenty-four genotypes of short duration pigeonpea were screened for efficient plant type. Among these, 04 genotypes namely ICPL 8094, Granula-1, IC 407260 and ICP 4009 showed maximum biomass production, pod number/plant, test weight, grain yield/plant, maximum number of primary and secondary branches, NDVI and Chlorophyll in leaves.
- A set of 56 urdbean genotypes was evaluated under irrigated conditions using an augmented design to identify suitability for mechanical harvesting. Angle of primary branch (45–50°) was identified as a key trait. Based on plant height and semi-erect growth habit, genotypes HUP 120 and ANU 11-12 were found suitable for mechanical harvesting.
- A HPLC-based method for amino acid profiling was standardized for chickpea seeds. A total of 17 amino acids were quantified through the acid hydrolysis of chickpea samples. Aspartic acid, glutamic acid, arginine, lysine, leucine and phenylalanine were found to be the predominant amino acids in chickpea seeds. Seven out of nine essential amino acids were quantified in chickpea seeds. Lysine, Leucine, and phenylalanine were the predominant essential amino acids in chickpea seeds.
- Transcriptome analysis of chickpea flowers under normal and heat-stress conditions revealed genotype-specific differential gene expression. Ten DEGs were common to all genotypes, mostly upregulated in heat-tolerant lines. Notably, two genes encoding 18.5 kDa heat shock proteins showed stronger induction in tolerant genotypes. Additionally, 14 DEGs were found to be common in heat-tolerant genotypes only, of which the majority were upregulated under heat stress.
- Dissipation study of glyphosate and its major metabolite, amino methyl phosphonic acid (AMPA) in field soil showed that glyphosate persisted in soil for up to 45 and 60 days at application rate of 1.5 and 2.25 kg a.i/ha, respectively. Half-lives for glyphosate ranged from 19.42 to 22.2 days in soil.
- Genes involved in autoregulation of root nodulation (AON)-pathway *via CaCLE12, CaCLE13, RDN-1, RDN-2*, and *SUNN* were characterized in chickpea. Chickpea genes that are expressed only in root-nodule tissues were identified in chromosome No. 4 and 5 and characterized *in silico* using FGENESH for gene prediction, signal-P for the presence of signal peptides *etc.*
- Inoculation of *Rhizobium* strain IIPR-RR-2022-1 produced maximum of 90 root nodules per plant in *rajmash* accession IC 383002. Leghaemoglobin content of rajma root nodules (866 µg/g nodule fresh weight) which is comparable to similar stage of chickpea root nodule (1033 µg/g nodule fresh weight). However, the nitrogenase activity estimated through acetylene reduction assay (ARA) using rajma root nodule is almost nil.
- A total of 144 seeds (76+68) of construct P5 (*CKX1*-LOC101493173), 38 T_1 seeds of Construct P12 (*CKX3-Like*-LOC101505170), 34 T_2 seeds of construct N1 (*CaNCR54*), 11 T_1 seeds of construct N2 (*CaNCR54*), 7 T_1 seeds of construct N3 (*CaNCR66*), and 3 T_1 seeds of construct N4 (*CaNCR24*) were sown for generation advancement and phenotyping. PCR assay to confirm presence of cas9 gene in T_2 seedlings is under progress.
- Two gRNAs targeting GAF2 and PB1-NLP domain of CaNLP1 were designed and cloned into *E. coli* strain MDS42RBR and *Agrobacterium rhizogenes* strain MSU440. *Agrobacterium* mediated genetic transformation into chickpea cultivar HC-5 is in progress.

Social Science

- District-wise time series data of Madhya Pradesh (MP), Bihar (BH) and Rajasthan (RJ) for the period from 1997-98 to 2022-23 on area, production and yield of major crops pigeonpea, chickpea, fieldpea, lentil has been

collected from Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Government of India and Directorate of Economics and Statistics, Government of UP. The growth rates for yield and area across all major pulse-growing districts have been calculated.

- Artificial Intelligence enabled Biotic & Abiotic Stress Detection and Advisory Mobile Application for Crops, a number of validator accounts and data entry accounts were created by the CCPIs for data collection. Images of diseases and insect-pests were collected for chickpea and pigeonpea during 2024-2025.
- Genome wide identification of AMPs has been carried out from the genome databases of the pulse crops such as chickpea, pigeonpea, greengram, blackgram, lentil, lathyrus, common bean and fieldpea based on their PFAM profiles of the conserved domains in the corresponding proteins. The identified proteins have been confirmed by verifying the presence of full length domain by using the SMART and interpro (PFAM) domains.
- CNN model achieved the highest accuracy of 92.00%, with the ensemble following closely at 91.00% and RF at 85.00%. The ensemble provides a optimal compromise, balancing high accuracy with efficient inference time (0.12 seconds for predictions)
- Input data related to projection of demand and supply of pulses for short term and long term are collected from different source. Growth in per capita income, expenditure elasticity of pulses and household consumption expenditure data was collected, compiled and computed. Major data source are the National Sample Survey office, Ministry of Consumer Affairs and NITI Aayog, Government of India.

Regional Stations/Centres

Bhopal

- In *kabuli* chickpea, three station trials were conducted at IIPR, RS, Bhopal and promising entries [IPC 22-122, DG 16-313, ICCV 211404] were identified for yield and large seed size. Identified a *kabuli* genotype (IPCKB 2021-0517-1) with trifoliate leaves.
- Breeding materials of pulses namely, pigeonpea, chickpea, grass pea and mung bean suitable for cultivation in central zone were generated at IIPR, RS, Bhopal.
- In pigeonpea, eight station trials (early and medium duration) were conducted and 11 promising entries (IPAC 23-105, IPAB 24-6-7, IPAB 24-4-1, IPAB 23-85, IPAB 23-19, IPAB 23-8 IPAB 23-63 IPAB 23-42, IPAC 23-56, IPAB 23-27-15) were identified.
- Two station trials were conducted and three superior wild derivatives of *Cajanus scarabaeoides* (WD 88, WD 115 and WD 23-1-6) were identified in pigeonpea.
- Two wild derivatives, namely WD 19 and WD 108 exhibited short height. These genotypes are being maintained and tested over the years for validation.
- One genotype of pigeonpea IPA 2022-02 (T2-IPAB 22-2) exhibited water logging tolerance for three seasons under field conditions. Pot experiments are being carried out for confirming the water logging tolerance under different stress conditions.
- Previously identified *Fusarium* wilt resistant genetic stocks, namely IPAC 66, IPAC 67 and IPAC 68, IPA 10W1-8, IPA10W1, IPAW22-67, IPA10W2, IPAW 22-38IPA 12W 26-1 and IPAW 22-38 and *Phythopthora* stem blight resistant lines *viz*. IPAC 2 and IPAC 3 were maintained as donor source.
- Seven cultivated accessions of pigeonpea were collected from Sehore and Raisen districts of Madhya Pradesh. Two hundred ninety seven cultivated germplasm accession including land races and 4 accessions of *C. scarabaeoides* were maintained as active collection as well as conserved under ambient condition.
- In grasspea, one low ODAP, high yielding local collection and two advanced mutant lines submitted to AICRP on *rabi* crops for multilocation initial varietal trial.
- Five trait specific genotypes (IPLa 62, IPLa 92, IPLa 111, IPLa 113 and IPLa 372) and total 195 SPS (mutants), two unique genotypes, *Maculata* (having white patches on leaves) and dark pink spots on keel and corolla of the flower were maintained and validated.
- In *desi* chickpea trial under timely sown irrigated condition, IPC 23-651 and IPC 22-117 yielded significantly higher than checks. Two heat tolerance trials conducted, IPC 2019-5, IPC-U-729 and GNG 2207, KPG 59, KWR 108 under very late sown condition gave significantly higher yield.

- Phenotypic data of 4,996 chickpea accessions characterized under heat stress conditions (during 2021-2024) have been uploaded to Indian Biological Data Centre (IBDC) for heat tolerance trait. IBDC is the first national repository for life science data in India supported by GOI through DBT.
- In lentil, three multi-location trials were conducted ILL-681911LL207-S2 and IL-10829 x 1LWL-130 (R- 56) yielded significantly higher than checks, two entries, namely IG 2559 and IG 3522 gave high ratio of filled to unfilled pods
- Three land race accessions of mungbean were collected from Madhya Pradesh. Seed and passport data submitted to ICAR-NBPGR for the allotment of IC number.
- Mungbean genotype (IC 653143) showed moderate powdery mildew resistance under natural epiphytotic condition for three seasons in 2023, 2024 and 2025.
- Total 285 accessions of wild species of pulses crop are maintained at IIPR, RS, Bhopal in the wild garden.
- Pathogenic isolates of putative *Fusarium oxysporum* f.sp. *lentis* and *F. oxysporum* f. sp. *ciceris* have been obtained and identified through partial *TEF-1a* gene sequencing. The *TEF-1a* gene sequence of *F. oxysporum* f.sp. *ciceris* has been submitted to NCBI database (PX277230).
- Rhizospheric soil and root samples were collected from 27 locations of M.P. along with one sample from the paddy fields at NBAIM, Mau, Uttar Pradesh. One hundred and fifty rhizospheric and 40 endophytic bacteria were isolated from the rhizosphere and roots of field (Paddy, Maize), legume (Lentil, Chickpea, Urdbean, Soybean, Pigeonpea, Mungbean), oilseeds (Sesame, Groundnut) and vegetable crops (Okra, Cucumber, Sponge gourd, Pumpkin, Bottle gourd). The antagonistic potential of these bacteria was evaluated against of *Sclerotium rolfsii* (Collar rot pathogen) and *F. oxysporum* (wilt pathogen).
- Ten and twelve bacterial isolates were found effective against *Sclerotium rolfsii* and *Fusarium oxysporum*, respectively.
- Supply chain of pulses in major pulse producing states of India with focus on eastern states survey work initiated.
- Total 301.7 q breeder seed of pulses were produced at regional Station, Bhopal
- 586.54 q quality seed of pulses were produced at farmers' field and procured at Regional Station, Bhopal under seed hub project.
- Sixty five FLD's (40 FPT and 25 TSP) in chickpea, lentil and fieldpea were conducted by IIPR, RS, Bhopal during *rabi* 2024-25.
- Total 897 farmers were benefited with the quality seed distribution of new varieties of pigeonpea, urdbean, mungbean, chickpea, lentil and fieldpea.
- Pulses production technology and quality seed information was extended to 392 farmers.

Bikaner

- Five accessions (IC-8311-A, IC-415127, IC-102283, IC-402286, IC-140616) demonstrated 8-20% higher yield than the best check (RMO-225, 415 kg/ha) under rainfed conditions, showing superior drought tolerance.
- Through mutation breeding, 27 mutants in RMO-225 and 31 mutants in RMO-435 showed significant yield improvements over their respective checks in M_3 generation.
- In station trials, seven entries out-yielded the best check (RC-101) with yields ranging from 550-1024 kg/ha, while five entries surpassed PL-4 check with yields of 350-880 kg/ha in different trials.
- Three advanced breeding lines (TICJG-18, TICJG-29, and TICJG-49) maintained high yield under late-sown heat-stress conditions with minimum yield reduction compared to timely-sown conditions, demonstrating superior thermotolerance.
- Through gamma irradiation and screening, 61 thermotolerant plants from GNG-1958 (300 Gy), 192 from HC-5 (350 Gy), 38 from JG-14, and 27 lines from RSG-888 were identified and advanced for heat stress tolerance.
- Four cowpea entries (IPCPB 2024-3, IPCPB 2024-7, IPC WP 2022-6, IPC WP 2022-8) and two chickpea entries (TICJG-18, TICJG-29) were nominated for national testing in Initial and Advanced Varietal Trials.
- Advanced 167 selections from F_5, 62 lines from F_6, and 49 promising lines from F_7 generation across multiple cowpea crosses.

- AA 10 mM seed priming + 25 mM foliar spray produced the highest mungbean and mothbean yield over the non-primed control.
- Lack of irrigation during *rabi* was the most critical constraint identified by the farmers
- MLE 5% seed soaking + 10% foliar spray gave the maximum seed yield over control treatment.
- The combination of biochar mulching + SAP @ 2.5 kg/ha resulted in the highest seed yield, improving productivity by 11.8% over the no-mulch control.
- PM+CB (1:3) was the most productive and profitable system with higher sustainable yield index indicating not just productivity but also greater temporal stability in system performance.
- Total yields under natural and organic farming were only 3% lower than RDF, but 7–10% higher than the absolute control across different cropping systems in arid conditions.
- Early sowing (25 October) with cultivar RSG-888 and foliar ALA @ 50 mM was the most effective in improving chickpea yield attributes under arid environments.
- Implementation of zero tillage in conjunction with residue management significantly enhanced system productivity and profitability as compared to conventional tillage practices in arid ecosystem.
- The clusterbean-mustard cropping system proved higher productivity and economic returns compared to the pearl millet-chickpea system under arid conditions.
- Application of 75% of the recommended fertilizer dose yielded results statistically comparable to 100% recommended dose across various tillage and residue management practices.
- Application of 15 kg N/ha and 40 kg P_2O_5 ha combined with foliar spraying of 2% urea at the flowering and pod formation stages resulted in significantly higher productivity and profitability in mungbean. Additionally, this treatment also significantly enhanced water use efficiency and water productivity.
- Irrigation applied at the branching + pod formation stages and flowering + pod formation stages resulted in significantly higher grain yield, total biomass accumulation, net economic returns, and benefit–cost (B:C) ratio compared to a single irrigation applied solely at the branching stage.
- Clusterbean-mustard cropping system significantly outperformed the pearl millet-chickpea system in terms of biomass production, net economic returns, and benefit-cost (B:C) ratio under organic farming practices in arid conditions.
- Organic farming practices did not show significant improvement in crop yield; however, organic management practices produced the highest grain and biomass yields, followed by inorganic and integrated nutrient management practices, respectively.
- Zero tillage with residue retention significantly reduced weed density by approximately 16%, with the cowpea-chickpea system (*kharif* season) and pearl millet-mustard system (*rabi* season) demonstrating pronounced smothering effects on weed proliferation through enhanced crop residue mulching.
- The mothbean-mustard cropping system exhibited superior productivity, yielding 10-16% higher chickpea-equivalent yield (2362–2370 kg/ha^{-1}) compared to the pearl millet-mustard system, establishing it as an economically viable alternative with enhanced net returns of 22.5% and improved benefit cost ratio.
- Integrated nutrient management strategies, comprising 50% recommended dose of fertilizer (RDF) supplemented with 5 t/ha^{-1} farmyard manure (FYM), biofertilizer inoculation, and crop residue incorporation, synergistically enhanced crop productivity while simultaneously improving soil organic carbon.
- The clusterbean-based cropping system demonstrated remarkable long-term sustainability, achieving approximately 36% higher system productivity over a five-year evaluation period, accompanied by superior net returns, enhanced benefit-cost ratio, and the highest sustainable yield index among evaluated systems.
- Energy use efficiency analysis revealed that the clusterbean-mustard cropping system recorded the highest energy output, net energy gain, energy use efficiency (EUE), and

energy productivity, indicating optimal resource utilization and energetic sustainability.

- Soil fertility improvement was the most pronounced in the clusterbean-chickpea cropping system, which maintained the highest available nitrogen, phosphorus, and potassium content in the soil, demonstrating improved nutrient cycling and long-term soil health benefits.
- For the effective management trial against dry root of chickpea disease, sick plot has been initiated for large scale effective screening of chickpea germplasm.
- A multi-district field survey in the arid region of western Rajasthan revealed bacterial andfoliar blights as the predominant diseases affecting clusterbean, mungbean, and mothbean, with bacterial leaf blight/spot showing the highest severities in clusterbean (up to 28.85%) and mungbean (up to 27.5%).
- Dry root rot occurred sporadically but reached high intensities at certain crop– location combinations, notably in mungbean (*e.g.* Churu, 9.5%) and mothbean (*e.g.* Jodhpur, 13.14%), suggesting emerging localized hot-spots.
- The study highlights the need for targeted surveillance and integrated disease management strategies focusing on bacterial blights and dry root rot in major pulse-growing districts of western Rajasthan.
- Total six trainings were organized for the farmers where in more than 500 farmers benefitted from the trainings. In addition to this, seeds of improved varieties (clusterbean, and mothbean), small farm implements, kitchen garden kit were distributed among farmers of Bikaner districts under SCSP projects.

Dharwad

During 2025, rainfall of 1030.1 mm fell and it was 34.5% higher than the average rainfall for last 39 years (1985-2025 *i.e.* 765.9 mm). The rainfall received during 2025 was higher in all the months resulted delayed sowing of crops during first fortnight of July as June received slightly higher rainfall (171.8 mm) than average rainfall of 110.5 mm. The rainfall that fell in August 2025 was slightly higher (141.0 mm) compared to the average rainfall of 116.9 mm and affected growth of all the pulses especially mungbean and cowpea due to water stagnation. Normal rainfall of 132.5 mm received during September resulted in timely sowing of *rabi* crops.

Plant Breeding

- During off-season, chickpea breeding materials received from AICRP Centres *i.e.* Jhansi, Bijapur, Kanpur and chickpea and lentil from IIPR, Kanpur were advanced during *kharif* season of 2025.
- During 2025, 250 accessions of horsegam, 298 accessions of cowpea, 90 accessions of mungbean and 233 accessions of urdbean were evaluated for different agronomic traits.
- Total 50 wild *Vigna* species were maintained for their utilization in pre-breeding programme.
- During 2025, Advance breeding lines of chickpea (164), mungbean (48), urdbean (57), cowpea (87) and horsegram (60) were evaluated for grain yield and its related traits during *kharif/rabi*/summer seasons.
- Advanced breeding lines of chickpea (IPC 22-30, IPC 21-118), mungbean (IPM 1707-1, IPM 21- 20-3), urdbean (IPUD 22-03, IPUD 22-06), horsegram (IPHG 20-06, IPHG 20-12), cowpea (IPCW 20-413, IPCW 21-24) and were found promising for cultivation during *kharif/rabi*/ summer seasons.
- Promising entries of mungbean (IPM 1604-1, IPM 1620-6 IPM 1205-2), urdbean (IPUD 19-202, IPUD 19-220) and chickpea (IPC IPC-21-143, IPC-20-84) are evaluated in state multi-location trials to assess their suitability for cultivation in Karnataka State.
- Total 450 kg of breeder seeds of *kharif* pulses and 500 kg of truthful labeled seeds of different *rabi* pulse crops were produced during 2025.

Crop Production

- The treatment T8 with 100% RRF *i.e.* 25:50 N:P kg/ha along with seed treatment of Microbial Consortia and 0.5% spray with $ZnS0_4$ and FeS04 at flowering recorded a significantly greater chickpea grain yield of 2642 kg ha^{-1} and WUE of 7.03 kg/ha^{-1} mm and were higher by 36% over farmers' practice i.e.1943 kg ha-1 and 5.17 kg/ha^{-1} mm during 2024-25.

- The treatment T8 produced higher net returns by 54% *i.e.* ₹ 102,278/ha^{-1}, B:C ratio by 19% *i.e.* 2.59 and net energy benefit by 34% *i.e.* 85,862 MJ/ha over control Rs. 66,300 ha^{-1}, 2.17 and 64142 MJ/ha, respectively in chickpea during 2024-25.
- The grain yield of winter sorghum and water use efficiency were higher by 38% in T8 *i.e.* 2346 kg/ha and 5.38 kg/ha mm with application of 100% RRF along with seed treatment of Microbial Consortia and application of ZnS04 and FeS04 at 25 kg/ha over the farmers' practice of sorghum cultivation (T1) *i.e.* 1700 kg/ha and 3.90 kg/ ha mm during winter sorghum 2024-25.
- The T8 produced higher net returns by 28% (₹ 91, 234 ha^{-1}), B:C ratio by 14% (2.22) and net energy benefit by 28% (91234 MJ/ha) over control (₹ 40,836 ha^{-1}, 1.95 and 71252 MJ/ha, respectively).
- The grain yield of maize and the WUE were higher by 45% in T8 i.e. 6481 kg/ha and 21.79 kg/ha mm with application of 100% RRF along with seed treatment of Microbial Consortia and application of $ZnS0_4$ and $FeS0_4$ at 25 kg/ha over the farmers' practice of maize cultivation (T1) *i.e.* 4467 kg/ha and 15.0 kg/ha mm during winter 2024-25.
- The T8 produced higher net returns by 28% (₹ 91,234 ha^{-1}), B:C ratio by 14% (2.22) and net energy benefit by 28% (91234 MJ/ha) over control (₹ 40,836 ha-1, 1.95 and 71252 MJ/ha, respectively).
- The grain yield of mungbean and WUE were higher by 35% in T8 *i.e.* 368 kg/ha and 25.39 kg/ha mm) with application of 100% recommended rate of fertilizer (RRF) along with seed treatment of Microbial Consortia and application of $ZnS0_4$ and $FeS0_4$ at 25 kg/ha over the farmers' practice of sorghum cultivation (T1) (273 kg/ha and 18.80 kg/ha mm) in mungbean during 2024-25.
- The treatment T8 produced higher B:C ratio by 14% (0.49) and net energy benefit by 38% i.e. 9639 MJ/ha over control *i.e.* 0.43 and 6990 MJ/ha, respectively.

Crop Protection

- Roving Survey in Karnataka indicated that mungbean is affected severely by foliar diseases and chickpea were more severely affected by wilt disease complex.
- Out of 234 entries screened against diseases, 42 entries were identified for yellow mosaic disease resistance and none of the entries tested were resistant to Anthracnose disease.
- In urdbean, eight entries namely, IPU 99-52, UH 817, IC 24129, PDU 19, IPU 31-1, IC 436583, PLU 429 and IC 395519 were identified as resistant to powdery mildew.
- In pigeonpea, the entries such as BRG 1, BRA 303, BRG 3, IPA 15-2, IPA 203, MAL 13, MAL 65, MAL 70, NTL 1168, BRG 4 were identified as highly resistant to SMD.
- In Management of mungbean major through novel fungicides: tebuconazole 50% + trifloxystrobin 25% WG and azoxystrobin 18.2% + difenoconazole 11.4% SC at 0.05 per cent were the most effective fungal foliar diseases control.
- Management of horsegram powdery mildew disease through novel fungicides: tebuconazole 50% + trifloxystrobin 25% WG (0.05%) was the most effective but, propiconazole achieved the highest B:C ratio (4.19), indicating better economic returns.
- Yield loss assessment due to powdery mildew diseases in horsegram (Var. CRIDA 18 R): three sprays of fungicide azoxystrobin (20% W/V) + difenoconazole (12.5% W/V) @ 0.1% resulted in avoidable yield loss of 424 kg/ha (37.48%) and a corresponding monetary loss of ₹ 20,343/ha.
- Two advanced breeding lines namely, no. 6 and No.16 (pedigree; ICP 8863 × Bahar) were identified for PSMD resistance and were proposed for registration.
- Severe incidence of pink pod borer *Cydia pytchora* in *Vigna* pulses was observed during *kharif* season. The pod damage in cowpea, mungbean., urdbean was to the extent of 83.2, 89.4, 91% and seed damage was 39.0, 60.6 and 40%, respectively.
- In cowpea, two foliar sprays of chlorantraniliprole 18.5 SC @ 0.5 ml/l at 50 % flowering and two sprays of same insecticide at pod maturity stage at 10 days interval reduced the incidence of spotted pod borer *Maruca vitrata* up to 61.1% and seed moth *Cydia pytchora* 67% over control.
- Higher grain yield (1290 kg/ha) of cowpea was recorded in this treatment and the avoidable grain yield loss by the pod borers

was to the extent of 58.56 % as compared to the untreated control.

- Based on the field efficacy data, novel insecticides, spinetoram 11.7 SC and cyantraniliprole 10.26 OD were identified for the management of spotted pod borer and seed moth whereas cyantraniliprole 10.26 OD and afidopyropen 50 DC for the control of black aphid in cowpea.
- Out of 22 advance breeding lines of cowpea screened, one-line IPCW 21-413 (4/13) recorded the lowest pod (30%) and seed damage (20%) by seed moth *C. pytchora*. Based on the % seed damage, this line can be categorized as moderately resistant and found promising against for seed moth.
- Under DoCA Project on supply chain of pulses in major pulse producing states of India with Focus on Eastern States, data collection in Dharwad district from more than 120 farmers in 4 villages in Dharwad and Hubli talukas and 14 stakeholders comprising Aggregators (2), Traders (2), Processors (2), Wholesalers (2), Retailers (2), Government officials (2) and Consumers (2), each from Dharwad and Hubali APMC on mungbean and chickpea crops from was completed. All the data collected were entered into the Google Forms platform for further analysis.
- Conducted frontline demonstrations in urdbean, horsegram and chickpea were taken up in the farmers' fields of Narendra, Rayapur, Yettinagudda, Mangalgatti villages of Dharwad district, Beldahadi Tanda of Gadag district and during *kharif*/*rabi*/ summer seasons of 2025.
- During *rabi* season of 2025-26 demonstrations with chickpea seeds *i.e.* BGD 111-1 alone with Microbial Consortium, *Trichoderma* and Micronutrient Mixture were distributed to 100SC farmers under SCSP program.
- Conducted two training programmes on "Improved Cultivation Practices for *kharif* Pulses" for SC farmers of Beladhadi Tanda of Gadag.
- Participated and displayed IIPR technologies during *Krishi Mela* organized by UAS Dharwad during 13-16th September, 2025.

Khorda

- Eleven varieties of mungbean were sown (3 rows of 4-meter length of each variety) at three dates of sowing at 10 days interval. The powdery mildew disease was observed with 100% disease incidence in all the mungbean and urdbean varieties in three dates of sowing except the local mungbean and urdbean genotype which was found resistant against powdery mildew.
- Six genotypes of urdbean were evaluated against YMD and found that YMD was observed only in susceptible check (MDU 1), Local Urd, IPU 13-1, local mungbean & remaining others genotypes of mungbean and urdbean were found resistant against YMD.
- In rice fallow conditions diseases like powdery mildew, yellow mosaic was observed in both mungbean and urdbean . The initial symptoms of yellow mosaic were observed at 2nd SMW on both mungbean and urdbean whereas the highest DI (100%) was at 11th SMW on urdbean. The initial symptoms of powdery mildew were observed at 1st SMW whereas the highest DI (100%) was at 6th SMW on urdbean.
- The incidence of H. armigera started in the 6th SMW and peaked in the 10th SMW (1.1 larvae/plant) and showed significant correlation with Tmax (r=0.60) and RH1 (r=-0.58). Maximum trap catches (13 adults/trap) of *H. armigera* were observed during the 10th SMW. The incidence of *Maruca vitrata* was reported on the 3rd SMW, with a peak incidence of 3 webbed buds/inflorescence/ plant during the 10th SMW. RH2 (-0.51) had shown a significant negative influence on the larval population.
- Incidence of pod bugs was reported on the 1st SMW, and the peak population was observed to be 2.2 bugs/plant on the 8th SMW. A significant negative correlation (-0.78) was observed with Tmin. The mosaic disease of pigeonpea was observed during the 3rd SMW with a DI of 4-5%. The wilt disease was observed in the same variety during the 2nd SMW, and the highest DI was found during the 6th SMW (10%). Incidence of blister beetles was found during 5-7 SMW.

About the Institute

Pulses continue to be an important ingredient of human diet, especially for the large vegetarian population in the country. In the era of Green Revolution with major focus on staple food like rice and wheat, pulses were relegated to the marginal lands with least inputs. This coupled with the increasing population, resulted in reducing per capita availability of pulses to the masses. To enhance the productivity of the existing varieties by improved production technologies, besides breeding for high yielding varieties of different pulse crops became the prime concern. To take up the cause, All India Coordinated Pulses Improvement Project (AICPIP) was started in 1966 at the Indian Agricultural Research Institute (IARI), New Delhi. Later in 1978, its headquarters was shifted to the then Regional Station of IARI at Kanpur under the name of Project Directorate (Pulses). It was further elevated as Directorate of Pulses Research (DPR) in 1984 and became an independent entity under the direct control of ICAR. In 1993, the DPR was upgraded and elevated to the status of Indian Institute of Pulses Research, and simultaneously, AICPIP was trifurcated into three coordinated projects on chickpea, pigeonpea and MULLaRP (mungbean, urdbean, lentil, lathyrus, *rajmash* and pea) to provide focused attention on each crop. Since then, the Institute is playing a key role in strengthening the nutritional security and sustenance of soil health. Besides generating basic knowledge and material, other activities of the Institute include development of appropriate crop production and protection technologies, production and supply of nucleus and breeder seeds of improved varieties, demonstration and transfer of technologies, and strategic coordination of pulses research through wide network of testing centres across the country.

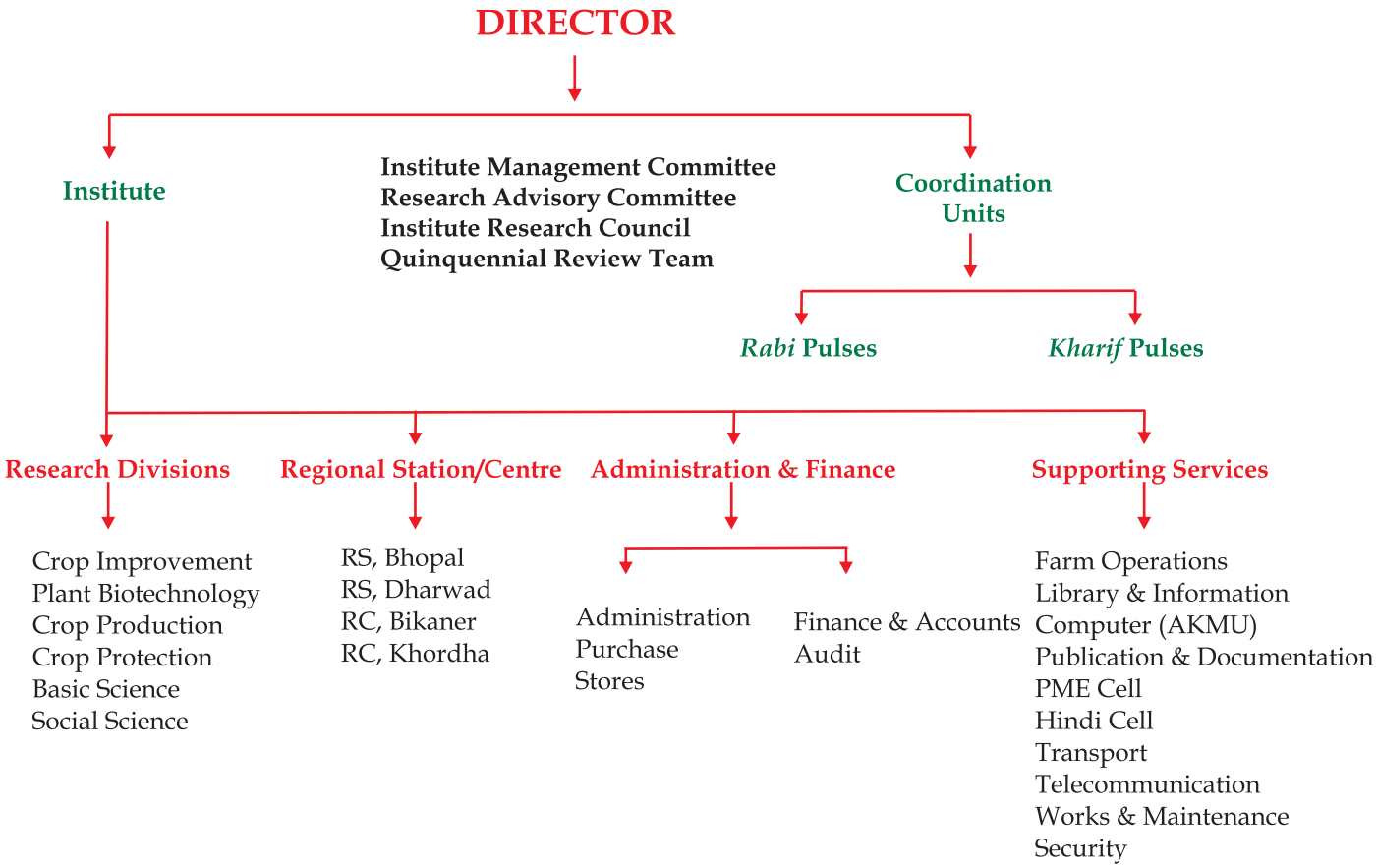
The Institute is located at Kanpur, Uttar Pradesh at 26^{0}27'N latitude, 80^{0}14'E longitude and 152.4 meter above the mean sea level. It is situated on Grand Trunk Road, 12 km from Kanpur Central Railway Station towards New Delhi.

The overall climate varies from semi-arid to arid. The summers are very hot and winters are cool and dry. The monthly weather data for the year reveals that the mean monthly maximum temperature varied from 19.2°C to 41.7°C and the minimum temperature from 3.4^{0}C to 26.8°C. The relative humidity varied from 15.7% to 99.00%.

Multi-disciplinary research of both strategic and basic nature is conducted under six Divisions namely, Crop Improvement, Plant Biotechnology, Crop Production, Crop Protection, Basic Science and Social Science. For region specific and strategic research, the Institute has one Regional Station *cum* Off-Season Nursery at Dharwad in Karnataka and one Regional Centre at Bhopal in Madhya Pradesh. Two more stations/centres, *viz.*, Bikaner in Rajasthan & Bhubaneshwar in Odisha have been established recently to cater to region specific research needs in pulses. To cater to the need of the Institute's activities and mandate, service units such as Farm Management, Library & Informatics, AKMU, Hindi Cell, Art & Reprography and Publication & Documentation are in place.

The Institute has a well developed 84 ha research farm at its headquarters, Kanpur. Physical Containment Facility has been created for advancing generation of the transgenic plants and further validation of the transgenic lines. In addition, screening facilities against major diseases of pulse crops have been developed. Rain-out shelter to screen genotypes against drought, well-equipped laboratories of biotechnology, molecular biology, biochemistry, physiology, pathology, bio-control, soil chemistry, medium-term germplasm storage and weather observatory provide necessary infrastructures for R & D activities. The Computer Cell provides facilities for database management, documentation, and statistical analyses. The library houses exhaustive literature on pulse crops besides CAB abstracting on CD ROM. The museum depicts pulse technologies developed by the Institute. The Institute has sanctioned strength of 100 scientists, 62 technical, 62 administrative and 31 supporting personnel.

Organizational Set-up



Staff Strength

As on 31.12.2025

Category	Sanctioned strength 2025-26	In position as on 31/12/2025	Vacant Posts as on (Col.3-4) 31/12/2025
RMP	01	01	00
Scientist	100	71	29
Technical	62	33	29
Administration	62	26	36
Skilled Support Staff	31	3	28
Total	**256**	**134**	**122**

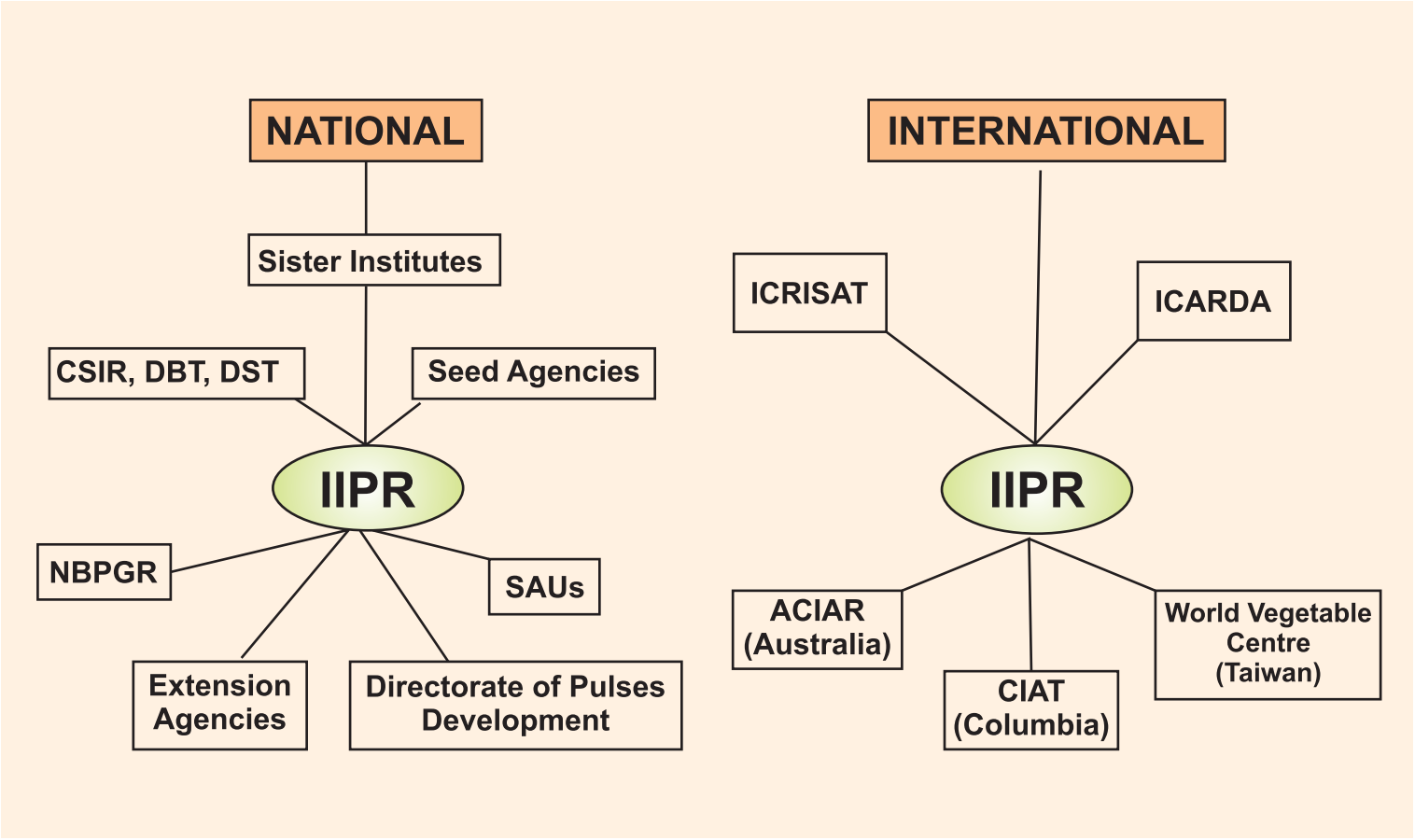
Mandate

- Basic and strategic research on pulses to improve productivity and quality
- To provide equitable access to information, knowledge and genetic material to develop improved technology and enhance pulse production
- Planning, coordination and monitoring of applied research on national and regional issues through All India Coordinated Research Projects
- Dissemination of technology and capacity building.

Major Research Programmes

- Genetic Enhancement for Yield and Quality
- Biotechnological Interventions
- Plant Genetic Resources : Collection, Evaluation and Conservation
- Cropping Systems Research
- Integrated Nutrients Management
- Integrated Pests Management
- Physiological Studies
- On-farm Research and Informatics
- Post-harvest Technology

Linkages and Collaborations



Financial Statement

Statement of Receipt and Expenditure for the Financial Year 2025-26

(As on 01.04.2025 to 31.12.2025)

		₹ in lakh
A.	**Receipt** (Inst. Revenue)	44.10
B.	**Expenditure** Plan (Including ONEH + TSP +NEH + SCSP)	2575.54
C.	**Pension and other retirement benefits**	Expenditure 289.80
D.	**AICRP on *Rabi* Pulses** a. Coordination Unit b. Grant-in-aid	Expenditure 514.95
E.	**AICRP on *Kharif* Pulses** a. Coordination Unit b. Grant-in-aid	Expenditure 676.96

Status of Implementation (upto 31.12.2025)

(As on 01.04.2025 to 31.12.2025)

(₹ in lakh)

Head	Approvd outlay (R.E.)	Expenditure from 01.04.2025 to 31.12.2025
A. Recurring		
Pay & Allowances/Wages & Pension	3816.30	3816.30
TA, HRD & Contingency	912.50	912.50
Total		
B. Non-Recurring		
Equipment, Information Technology		
Furniture & Fixture Other Works Library		
Total	**1015.21**	**1015.21**
C. TSP	**51.00**	**51.00**
TOTAL (A+B+C)	**5795.01**	**5795.01**

Crop Improvement

Institute Funded Projects

Chickpea

Project: Breeding for high yielding chickpea with multiple disease resistance

Performance of breeding lines in AICRP trials

The entry, IPC 20-208 has been promoted to AVT 2 (*Desi*-irrigated timely sown) trial in ECZ during 2025-26. Three new entries have been nominated for yield evaluation trial *viz*., IPC 2021-117 (*Desi*-Irrigated timely sown) and IPC 21-126 and IPC 21-134 (*Dbsi*-Rainfed) during 2025-26.

Performance of breeding lines in other states

Two entries, IPCMB 19-1 and IPCMB 19-2 have been promoted for third year yield evaluation state varietal trials in Uttar Pradesh. The entry, IPCMB 19-2 has been evaluated for two years in Madhya Pradesh and found promising testing during second year in both the states.

Evaluation of advance breeding lines under station trials

- Twenty-four advanced breeding lines from the project including 14 fresh entries and ten second year trial entries were evaluated in different station trials at ICAR-IIPR, Kanpur, Bhopal, and Dharwad. The entries IPC 22-162 and IPC 22-153 performed well in *Desi* (Irrigated, timely sown) trial while entries, IPC 22-128, IPC 21-118 and IPC 22-142 performed well in *Desi* (Rainfed trial).
- The *Desi* (Irrigated-timely sown) station trial was conducted with 20 entries at three locations (Kanpur, Bhopal and Dharwad). The entries, IPC 22-162 (2469 kg/ha), IPC 22-158 (2301 kg/ha) and IPC 22-153 (2242 kg/ha) performed well. Based on two years yield evaluation data (2023-24 and 2024-25) under five environments, the entries, IPC 22-162 (2161 kg/ha) and IPC 22-153 (2046 kg/ha) were identified for nomination in coordinated trials next year.
- The *Desi* (Rainfed) trials were conducted with 20 entries at three locations (Kanpur, Bhopal and Dharwad). Based on two years yield evaluation data (2023-24 and 2025-25) under five environments, IPC 22-108 (2092 kg/ha), IPC 22-112 (2042 kg/ha) and IPC 22-128 (2010 kg/ha) were identified for nomination in coordinated trials next year.
- Preliminary Yield Trials were conducted with 140 lines including rainfed trial at three locations (Kanpur-NRC, Bhopal and Dharwad) and irrigated trial at Kanpur and MH trial with 45 lines at Kanpur. The entries, IPC 24-697 (3856 kg/ha), IPC 24-652 (3411 kg/ha), IPC 24-708 (3278 kg/ha), IPC 24-628 (3206 kg/ha) and IPC 24-648 (3200 kg/ha) were selected for ST (*Desi*-Irrigated trial); entries IPC 24-706 (3357 kg/ha), IPC 24-672 (3331 kg/ha), IPC 24-645 (3329 kg/ha), IPC 24-668 (3271 kg/ha), IPC 24-670 (3271 kg/ha) and IPC 24-691 (3255 kg/ha) were selected for ST (*Desi*-Rainfed trial) and entries, IPC 24-732 (2278 kg/ha), IPC 24-741 (2261 kg/ha), IPC 24-733 (2256 kg/ha), IPC 25-742 (2178 kg/ha) and IPC 24-737 (2161 kg/ha) were selected for ST (*Desi*-MH trial) to be conducted next year.

Breeding material generated

Twenty eight fresh crosses among parents possessing stable resistance against root diseases (FW & DRR) and foliar diseases (AB), yield traits *viz*. Phule G 0405, JAKI 9218, JG 16, GNG 2372, GNG 2171, GNG 2264, CSJ 515, CSJ 556, JSC 37, IPC 2005-28, SGPWR 28, SGPWR 30, BGM 20212, IPC 2008-69, DKG 964, IPC 2010-121, IC 117744, PBG 8 *etc* were made at ICAR-IIPR, Kanpur. The details of crosses and seed set are presented below:

Generation advancement

During 2024-25, 40 crosses advanced to F_2, more than 2,000 single plants (455 SPS from 44 crosses in F_2; 610 SPS from 59 crosses in F_3; 414 SPS from 42 crosses in F_4, and 345 SPS from 61 crosses in F_5) in different evaluation generations. More than 150-line bulks of 57 crosses were selected in F_6 for constituting PYT for next year. These were selected on the basis of seed traits, higher plot yield and presence of stress resistance donors in their pedigree.

Mapping population development

Two RIL population (F_8) *viz*, IPC 2005-28 x BG 212 and JSC 37 x BG 212 for dry root rot resistance were maintained. $F_{2:3}$ mapping population for Ascochyta blight resistance L 550 x IC 117744 phenotyped at PAU, Ludhiana (n=160).

Phenotyping against biotic stresses

***Screening for Fusarium Wilt resistance in Wilt sick plot (Race 2) in segregating generation*:** A total of 260 wilt resistant plants were selected among 52 crosses in initial segregating generation from *Fusarium* wilt sick plot at ICAR-IIPR, Kanpur. These included 110 wilt resistant plants from 22 crosses in F_3 and 150 wilt resistant plants from 30 crosses in F_4.

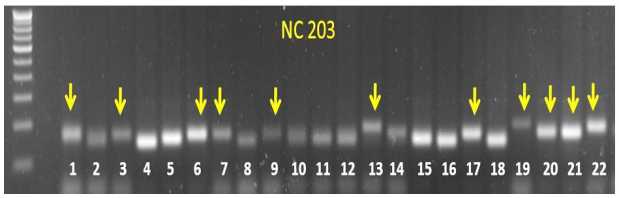
Maintenance breeding

- Total 151.21 kg of nucleus seed of chickpea varieties Samriddhi (71.71 kg), IPCB 2015-132 (51.00 kg) and IPC 2006-77 (28.5 kg) were produced and 250 SPS of each were harvested for maintaining genetic purity.
- Training population for GS (n=400) in chickpea was also maintained.

New initiative

Implementation of Marker assisted chickpea breeding

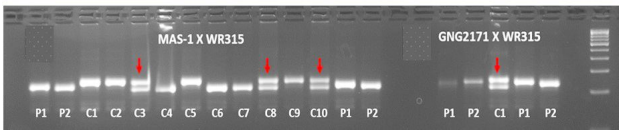
Efforts were made to integrate marker assisted breeding strategies in chickpea to increase the efficiency of selection. Genetic polymorphism among the parents utilized in crossing programme was undertaken. Thirty three markers were used to assess polymorphism among dry root rot resistant parents *viz*., RVG 202, JG 16, JG 14, JG 3-14-16, IPC 05-28, BG 212, JAKI 9218, AKG 1303, JG 24, CSJ 556, JSC 37, PG 0405. Twenty four markers were polymorphic with the markers TAA170, TR19, TA2, GA20, TR56 and H2I10 having high PIC values



Genetic polymorphism among CB parents. *(Lane 1-20: ICC 4958, ICC 5912, GNG 2299, GNG 2264, JAKI 9218, Phule G 0405, AKG 1303, JG 16, GNG 2207, BG 3043, GNG 1581, GNG 2171, GNG 2144, GL 13001, GNG 1958, GNG 2372, IPC 2020-198, GNG 2479, WR 315, Pusa 212, RVG 202, JG 62)*

- Hybridity testing among different crosses using trait specific markers *viz*., *Fusarium* wilt resistance, drought tolerance and *Ascochyta* blight resistance were done. These efforts would not only help the efficiency of selection but also reduce the genetic load in subsequent generation.

Trait	No of crosses	No. of Plants	True Hybrids	Markers
Fusarium Wilt	7	28	15	TR19, H2I10, H1B17, TAA170, TA110, TA2, QTL19, QTL21
Drought tolerance	4	23	11	QTL19, QTL20, QTL21, QTL25, QTL29
Ascochyta Blight	2	15	6	H2I10, GA16, TA37, TS45, TAA170



Project: Genetic enhancement of *desi* chickpea for higher grain yield and wider adaptability

Variety developed

A total of four *desi* chickpea varieties including one CVRC (IPCB 2015-132) and three SVRC IPC 2012-108 (Uttar Pradesh), IPC 2017-351 & IPC 2017-292 (Madhya Pradesh) were released for cultivation under NEPZ, Uttar Pradesh and Madhya Pradesh State.

i) **IPC 2017-351 (Abha):** It is a machine harvestable *desi* chickpea variety developed through hybridization (IPC 06-11/IPC 04-52) and released for cultivation in Madhya Pradesh under timely sown condition. It produced mean yield of 1,834 kg/ha with registered by 46.12% superiority to check, JG 24 (1,255 kg/ha) and matures in 116 days. It has medium seed size (19.1 g/100-seed wt.) with brown seed colour. It is resistant to wilt and moderately resistant to DRR diseases. It has erect growth habit and tall plant height (68-75 cm) with lodging resistant.

ii) **IPC 2017-292 (Kranti):** It is *desi* chickpea variety developed through hybridization (BG 256/ICC 96030) and released for cultivation in Madhya Pradesh under rainfed condition. It produced mean yield of 1,917 kg/ha with registered of 29.76% yield superiority to the best check, JG 16 (1,478 kg/ha). It matures in 115 days with resistant to wilt and moderately resistant to DRR diseases. It has medium seed size (15.7g/100 seed weight) with brown seed coat colour.

iii) **IPC 2012-108 (Krishna):** It is a *desi* chickpea variety developed through hybridization (IPC 94-94/IPC 02-120) followed by pedigree selection and released for the cultivation in Uttar Pradesh under timely sown condition. It produced mean yield of 1,565 kg/ha with registered by 12.4% and 7.99% yield superiority to check KWR 108

(1472 kg/ha) and KPG 59 (1,338 kg/ha), respectively. It matures in 133-136 days with resistant to wilt and moderately resistant to DRR diseases. It has large seed size (22.4 g/100-seed weight) with brown seed coat colour.

Desi chickpea genotypes identified for release in Uttar Pradesh

i) *Desi* chickpea genotype, IPC 2018-38 derived from HC 5/DCP 92-3 cross was recommended for identification and release for Uttar Pradesh under irrigated, timely sown condition. It produced mean yield of 1,395 kg/ha with registered of 15.38% yield superiority to the best check, IPC 2011-112 (1,209 kg/ha). It matures in 130-135 days with resistant to wilt and moderately resistant to DRR diseases. It has medium seed size (19.3 g of 100-seed wt.) with brown seed coat colour.

ii) *Desi* chickpea genotype, IPC 2017-253 derived from IPC 06-11/PA 1108 cross was recommended for identification and release for Uttar Pradesh under irrigated, timely sown condition. It produced yield of 1,368 kg/ha with registered of 13.17% yield superiority to the best check, IPC 11-112 (1,209 kg/ha). It matures in 125-130 days with resistant to wilt and moderately resistant to DRR diseases. It has medium seed size (16.5 g of 100-seed weight) with brown seed colour.

iii) *Desi* chickpea genotype, IPC 2018-131 derived from GNG 1581/ICC 15614 cross was recommended for identification and release for Uttar Pradesh under irrigated, timely sown condition. It produced mean yield of 1,281 kg/ha with registered of 5.96% yield superiority to the best check, IPC 11-112 (1,209 kg/ha). It matures in 130-135 days with resistant to wilt and moderately resistant to DRR diseases. It has medium seed size (15.1 g of 100-seed weight).

Chickpea varieties registered with PPV&FRA

Eight varieties, IPC 11-112 (REG/2024/0401), IPC 06-77 (REG/2024/0402), IPC 05-62 (REG/2024/0403), IPC 07-28 (REG/2024/0404), IPCB 15-132 (REG/2024/0405), IPCK 09-145 (REG/2024/0395), IPCK 13-163 (REG/2024/0396), IPC 10-142 (REG/2024/0397) were registered with PPV&FRA on 5th December 2024.

Commercialization of chickpea varieties: Total = Six

Total six varieties, Kundan, Kuber, Kanchan, Madhav, IPC 2005-62, IPC 2006-77 were licensed with Vishwas Agri Seeds, IFSA Seed, Star Agri Seeds for commercialization

Performance of breeding lines in AICRP / SATs trials:

- *Desi* chickpea entry, IPC 2020-208 has been promoted to AVT-2 under ECZ during *Rabi* 2025-26. Out of 15 entries evaluated under AICRP during 2024-25, three entries such as IPC 2019-93-TS (NEPZ/SZ); IPC 2019-58 & IPC 2019-230-LS (ECZ) were promoted to AVT-1 during 2025-26.
- Ten chickpea entries *viz*., IPC 21-117 & IPC 21-105 (timely sown); IPC 20-123 & IPC 21-169 (late-sown); IPC 21-134 & IPC 21-126 (Rainfed); IPC 19-29 & IPC 20-91 (Machine harvest); IPCK 18-171 & IPCK 20-118 (*Kabuli*) were submitted to AICRP for evaluation in IVT during *Rabi* 2025-26.
- A total of eight chickpea entries namely, IPC 17-253, IPC 17-351, IPC 18-38, IPC 18-39, IPC 18-131 (timely sown); IPC 17-04 (late-sown); IPCK 10-124 (*Kabuli*) were promoted in SAT-1/SAT-2 under UP State Varietal Trials during 2024-25
- Total 27 elite lines are being evaluated at seven locations from Jharkhand, West Bengal, Madhya Pradesh, Bihar, Chhattisgarh, Gujarat, J&K States. The data for yield and other traits performance is in progress.

Evaluation of trait specific germplasm/wild relatives

Total 383 chickpea lines including crossing block (115), trait specific (144), varieties (69), Turkey lines (23), and *kabuli* donors (32) were evaluated for crossing programme and seed enhancement for future research.

Generation of breeding material

- The chickpea breeding material including trait specific donor, advanced lines, released varieties were utilized in crossing programme. Agronomic base (IPCB 15-132, IPC 17-351, BG 3062, IPC 11-112, JG 16, HC 5, JAKI 9218, GNG 2207, GNG 2299, GNG 1581, GNG 2144, PG 0405, RVG 202, IPCK 13-163,

IPCK 09-145, IPCK 02); MHT (RVG 204, JG 24, IPC 06-11, Phule Vikram, ICC 8923, HC 5, GJG 1913); Early (ICC 96029, ICC 96030, BG D9971, ICC 5810); drought (BGM 10216, BG M 10221, IPCMAS-1, ICC 4958, RSG 888), heat (JG14, ICC 1205, ICC 15925, ICC 7110, ICC 15614, JG 14); salinity (CSG 8962); Multiple disease resistant (ICC 12237, ICC 11321, ICC 9001); wilt (GJG 0814, IPC 07-28, IPC 10-134, GJG 0921, SA1, JG 315 ICC 3935, GJG 0814, BGM 20211, BGM 4005), DRR (JSC 37, IPC 05-28, IPC 10-134); Ascochyta blight (ICC 3935, ICC 8933, ICC 9001, ICC 111321), Post-Emergence Herbicide (ICC 12315, IPC 18-186, ICC 1205, ICC 11101), Higher Seed Nos./Pod (IPC 2020-198); Long pod (ICC 14447); Phosphorus Use Efficiency (ICC 1052, ICC 1083 ICC 1098, ICC 1161, ICC 5504, ICC 6579, ICC 6571, ICC 5639, ICC 7413, ICC 8350); High input responsiveness (IPC 21-66, JG 36); Zn/Fe (ILWC 257), Protein (T 39-1/ICC 5912), T1-A/ICC 8397, ICC 5168, P 3318); Wild/Landraces (ILWC 21, ILWC 142, ILWC 263); Kabuli (ICC 7344, ICC 11883, PKV Kabuli-4, PG 0517, FLIP 07-183, FLIP 07-57C, FLIP 07-38C, Gokce) were used to broaden genetic base.

- Total 71 chickpea crosses including 53 and 18 were made during *Rabi* 2024-25 and *Kharif* 2025 at ICAR-IIPR, Kanpur and IIPR-RRC, Dharwad locations, respectively to generate breeding material for yield, plant ideotypes, earliness, abiotic/biotic stresses and wide adaptability.
- Total 53 crosses including **25 *Desi*** (IPCB 15-132/IPC 20-198, IPCB 15-132/IPC 05-62, BG 3062/JSC 37, BG 3062/ICC 14447, JG 24/JG 36, JG 24/ICC 12237, JG 24/ICC 12315, RVG 204/RVSSG 64, RVG 203/RVSSG 64, RVSSG 64/P 3318, RVSSG 64/JG 16, JG 11/RVSSG 64, JG 11/JG 11-M, IPC 20-198/ ICC 14340, IPC 20-198/ICC 14335, IPC20-198/ICC 14447, IPC 10-134/IPC 08-57, IPC 10-134/IPC 09-50, IPC 09-50/IPC 08-57, IPC 09-50/BGD 9971, IPC 08-57/BGD 9971, IPC 19-37/ICC 5810, PG 0405/ RVSSG 64, JG 16/ RVSSG 64, JSC 37/RVSSG 64) and 28 Kabuli (IPCK 13-163/EC 1097390, IPCK 13-163/EC 1097383, IPCK 13-163/P 3318, IPCK 23-423/Dollar, IPCK 23-423/IPCK 23-413, IPCK 19-231 /PG0 517, IPCK 19-231/JGK 5, IPCK 23-479/FLIP 07-61C, IPCK 23-479/IPCK 23-508, IPCK 19-232/ IPCK 18-185, IPCK 23-508/FLIP 21-25C, IPCK 2/Dollar, IPCK 2/MNK 1, IPCK 20-68/IPCK 19-232, IPCK 20-68/MNK 1, IPCK 18-185/IPCK 13-163, IPCK 18-185/RKV Kabuli 4, MNK 1/P 3318, MNK 1 /JGK 5, MNK 1/RKV Kabuli 4, KAK 2/Dollar, KAK 2/MNK1, KAK 2/IPCK 19-231, KAK 2/IPCK 19-231, JGK 5/IPCK 13-163, FLIP 07-61C/FLIP 21-95C, ICCV 211306/Gokce) crosses were made at ICAR-IIPR, Kanpur during *Rabi* 2024-25.
- Similarly, 18 chickpea crosses including 14 *Desi* (IPC 22-44/IPC 21-108, IPC 21-168/IPC 20-123, IPC 23-70/IPC 21-168, BG 4014/BG 4005, IPC 23-331/IPC 22-30, IPC 21-65/ICC 90036, IPC 22-112/ IPC 21-55, IPC 23-318/IPC 22-30, IPC 22-146/IPC 23-326, IPC 23-655/IPC 23-326, IPC 23-311/IPC 23-331, IPC 23-318/IPC 23-331, PBG 9/GL 12021, IPC 22-108/IPC 22-146) and 4 *Kabuli* (IPCK 13-163/ EC 1097383, IPCK 14-02/Gokce, IPCK 13-163/EC 1097391, IPCK 13-163/Gokce) were made at Off-Season Nursery, Dharwad during *Kharif* 2025 to develop improve lines for yield, biotic/abiotic stresses resistance, earliness and wide adaptablity.

Segregating materials and Generation advancement

- The generations were advance during *Rabi* 2024-25 and *Kharif* 2025 at ICAR-IIPR-RRC-Dharwad (Off-Season Nursery) and ICAR-IIPR Kanpur, respectively.
- A total of 40 F_1's derived from different crosses were raised for generation advancement and 177 SPS were harvested during *Rabi* 2024-25.
- Breeding materials from different generations derived from 279 crosses were advanced and total 1141 SPS, 232 Line Bulk (LB) and 33 Plot Bulk (PB) (28 F_2: 28 PB; 55 F_3: 611 SPS + 3 PB; 35 F_4: 280 SPS + 5 LB + 2 PB; 59 F_5: 405 SPS + 7 LB; 58 F_6: 17 SPS + 217 LB; 4 F_7: 5 SPS + 3 LB) were harvested. Few lines and plot bulks to be shared with NARS partners.

Evaluation of advance breeding lines in *desi* chickpea

A total of 448 advanced breeding lines (ABLs) including 102 & 346 entries were evaluated as 5 station trials [(ST-1-MH, ST-4-RF, ST-5-LS, ST-6-K, ST-7-Trait Specific) and 6 PYTs (PYT-1A-MH, PYT-1B-MH, PYT-3-TS, PYT-4-RF, PYT-5-LS, PYT-6-Kabuli], respectively for yield and other traits during

2024-25 at ICAR-IIPR, Kanpur and its regional stations (Bhopal, Dharwad). The details trials are given below:

- ***ST-1 (Machine Harvest):*** Total 23 ABLs amenable to machine harvest (MH) and two respective checks were evaluated at Kanpur, Bhopal and Dharwad locations. Four ABLs were identified based on yield across locations significantly outyielding to the best check namely, IPC 23-318 (2664 kg/ha, 68.7 cm), IPC 23-331 (2541 kg/ha, 66.2 cm), IPC 22-30 (2531 kg/ha, 65.4 cm) and IPC 22-65 (2530 kg/ha, 72.9 cm). The best checks at Kanpur, Bhopal and Dharwad locations for MH trials were IPCB 15-132 (2629 kg/ha), JG 24 (2286 kg/ha) and JG 11 (1831 kg/ha) respectively. Based on pooled mean yield across locations, IPC 23-318 was found top yielder followed by IPC 23-331, IPC 22-30 and IPC 22-65 with registered of yield superiority by 18.5%, 13.0%, 12.5% and 12.5%, respectively to pooled yield of the best check (2249 kg/ha) across locations.
- ***ST-4 (Rainfed):*** Total 23 ABLs and two respective checks were evaluated during *Rabi* 2024-25 at Kanpur, Bhopal and Dharwad locations. Based on yield over locations, three ABLs were identified based on yield across the locations significantly outyielding against the best check namely, IPC 22-112 (2219 kg/ha), IPC 23-606 (2163 kg/ha) and IPC 23-326 (2130 kg/ha). The best checks at Kanpur, Bhopal and Dharwad locations were IPC 10-134 (2401 kg/ha), Vijay (1945 kg/ha) and JAKI 9218 (1988 kg/ha), respectively. Based on pooled yield across locations, entry IPC 22-112 was found top yielder followed by IPC 23-606 and IPC 23-326 with registered of yield superiority by 5.1%, 2.5%, 0.9%, respectively to pooled yield of best check (2111 kg/ha) across locations
- ***ST-5 (Late Sown):*** Total 20 entries with three checks (IPC 05-62, GNG 2299, KPG 59) recommended by AICRP for NEPZ were evaluated at Kanpur location. Five ABLs, IPC 23-67 (2947 kg/ha), IPC 23-70 (2894 kg/ha), IPC 23-84 (2857 kg/ha), IPC 23-71 (2854 kg/ha) and IPC 23-73 (2815 kg/ha) superseded to the best check IPC 05-62 (2615 kg/ha). Based on yield performance, IPC 23-67 was found top yielder followed by IPC 23-70, IPC 23-84, IPC 23-71 and IPC 23-73 with registered yield superiority by 12.7%, 10.7%, 9.3%, 9.1% and 7.6%, respectively against the best checks.
- ***ST-6 (Kabuli)*:** A total of 23 ABLs and two respective checks were evaluated at Kanpur, Bhopal and Dharwad locations. Four promising *Kabuli* ABL were identified based on yield across locations namely, IPCK 22-122 (2000 kg/ha, 32.3 g HSW,), IPCK 16-88 (1773 kg/ha, 31.1 g), IPCK 23-269 (1731 kg/ha, 31.6g) and IPCK 23-273 (1599 kg/ha, 30.2 g). The best checks at Kanpur, Bhopal and Dharwad were KAK 2 (1880 kg/ha), and JGK 5 (1876 kg/ha). Based on pooled mean yield across locations, IPCK 22-122 was found top yielder followed by IPCK 16-88, IPCK 23-269 and IPCK 23-273 with registered superiority by 37.1%, 21.5%, 18.6% and 9.6%, respectively against pooled mean yield of the best checks (1459 kg/ha) across the locations.
- ***ST-7 (Trait Specific)*:** Total 27 entries with two checks (IPCB 15-132 and IPC 10-142) were evaluated at Kanpur. Five ABLs namely, IPC 21-96 (2883 kg/ha), IPC 21-70 (2867 kg/ha), IPC 23-656 (2846 kg/ha), IPC 23-156 (2825 kg/ha) and IPC 21-71 (2802 kg/ha) superseded to best check, IPCB 15-132 (2621 kg/ha). Based on yield performance, entry IPC 21-96 was found top yielder followed by IPC 21-70, IPC 23-656, IPC 23-156, IPC 21-71 with registered of yield superiority by 10.0%, 9.4%, 8.6%, 7.8% and 6.9%, respectively to the best check.
- ***PYT–1A (Machine Harvest-Desi):*** A total of 52 entries and three checks (HC 5, IPCB 15-132, BG 3043) were evaluated during *Rabi* 2024-25. Entry IPC 23-46 (3200 kg/ha, 68.3 cm) was found top yielder followed by IPC 24-51 (3117 kg/ha, 70.7 cm), IPC 23-38 (3100 kg/ha, 68.0 cm), IPC 23-40 (3067 kg/ha, 66.0 cm), IPC 23-45 (2967 kg/ha, 71 cm) to the best check HC 5 (2833 kg/ha).
- ***PYT–1B (Machine harvest-Kabuli):*** Total 92 entries and three checks (IPCK 13-163, IPCK 09-145 and PG 0517) were evaluated during 2024-25. Entry IPC 23-346 (2100 kg/ha, 75 cm) was found top yielder followed by IPC 23-337 (1875 kg/ha, 66.7 cm), IPC 23-382 (1792 kg/ha, 79.3 cm), IPC 23-339 (1638 kg/ha, 66.7 cm), IPC 23-347 (1637 kg/ha, 83 cm) to the best check IPCK 13-163 (1583

kg/ha).

- ***PYT–3 (Timely Sown):*** A total of 31 entries and three checks were evaluated during 2024-25. Entry IPC 23-01 (3300 kg/ha) was found top yielder followed by IPC 23-05 (2700 kg/ha), IPC 23-02 (2667 kg/ha), IPC 24-114 (2433 kg/ha), IPC 24-96 (2300 kg/ha) to check GNG 2207 (2267 kg/ha).
- ***PYT–4 (Rainfed):*** Total 74 entries and three checks (IPC 11-112, RSG 888 and BG 3043) were evaluated during *Rabi* 2024-25. Entry IPC 23-227 (3417 kg/ha) was found top yielder followed by IPC 23-115 (3188 kg/ha), IPC 23-154 (3167 kg/ha), IPC 23-79 (3000 kg/ha), IPC 23-234 (2889 kg/ha) to the best check IPC 11-112 (2533 kg/ha)
- ***PYT–5 (LS):*** A total of 32 entries and three checks were evaluated during 2024-25. Entry IPC 24-97 (2792 kg/ha) was found top yielder followed by IPC 24-131 (2728 kg/ha), IPC 23-156 (2560 kg/ha), IPC 24-133 (2495 kg/ha), IPC 23-206 (2417 kg/ha) to the best check GNG 2299 (2185 kg/ha.
- ***PYT–6 (Kabuli):*** Total 44 entries and three checks were evaluated during *Rabi* 2024-25. Entry IPCK 24-04 (1575 kg/ha, 32 g/HSW) was found top yielder followed by IPCK 22-124 (1520 kg/ha, 35.5 g/HSW), IPCK 15-275 (1483 kg/ha, 28.1 g/HSW), IPCK 24-01 (1323 kg/ha, 46.5 g/HSW), IPCK 23-291 (1228 kg/ha, 47.7 g/HSW), against the best check, IPCK 09-145 (1158 kg/ha).

Phenotyping against biotic stresses

A total of 113 ABLs were evaluated under wilt sick plot for screening *Fusarium* wilt (race-2). Eight chickpea entries namely, IPC 24-79, IPC 24-117, IPC 24-145, IPC 24-41, IPC 24-44, IPC 24-36, IPC 24-43, IPC 24-142) were shown resistant reaction.

Evaluation of elite breeding lines of *kabuli* chickpea

Twenty ABLs of *kabuli* chickpea and local check IPCK 09-145 were evaluated during 2024-25 at Kanpur. Entry FLIP 16-49C (2415 kg/ha, 34.5 g/HSW) was found top yielder followed by FLIP 16-67C (2044 kg/ha, 32 g/HSW), FLIP 16-51C (2040 kg/ha, 40 g/HSW) against local check IPCK 09-145 (1888 kg/ha, 30.5 g/HSW).

Development of mapping population

A mapping population (RIL) were developed for growth habit *viz.*, HC 85/E100YM (F_4, n=350) and harvested based on SSD during 2024-25

Maintenance breeding

A total of 2,000 SPS were harvested from 19 chickpea varieties for maintaining genetic purity. Total 2106 kg nucleus seed of 19 varieties including DCP 92-3 (7 kg), IPCK 02-29 (67 kg), IPCK 04-29 (170.8 kg), IPC 06-77 (168 kg), IPC 05-62 (328.5 kg), IPC 11-112 (110.5 kg), IPC 04-01 (66 kg), IPC 04-98 (20.7 kg), IPC 07-28 (86 kg), IPC 10-134 (65.5 kg), IPCK 13-163 (182.4 kg), IPCL 4-14 (115 kg), IPCMB 19-3 (48.5 kg), IPCK 09-145 (183.7 kg), IPC 10-142 (163.3 kg), IPCB 15-132 (164.8 kg), IPC 17-351 (73 kg), IPC 17-292 (10 kg) and IPC 12-108 (75.5 kg) were produced based on single plant progenies method and supplied to concerned breeder.

Project: Genetic enhancement for grain quality and milling attributes in chickpea

- Eighty-seven ABLs (High protein donor: T 39-1, T 1-A, P 3318) and pure lines (From T 39-1) have been screened/assayed for total protein content. IPT 4 (IPC 04-98/T 39-1) have been identified with 29% protein content for three seasons, seed multiplication to be taken for next season for submission to ICAR-NBPGR, New Delhi for registration. Pure lines TI 47, 190 confirmed 28-25% Protein for 2nd year, 6 new pure lines were identified with 25-28% protein (TFIID 44, 10, 30, 46, 4, 15).
- Twenty-eight ABLs (JAKI 9218/ILWC 257) were assayed for Fe and Zn content, three promising ABLs identified for high Fe and Zn content separately. Nutritional profile-JAKI 9218: Fe 28.64; Zn 18.86 mg/kg; ILWC 257: Fe 76.80; Zn 20.31 mg/kg. ABLs profile range was Fe 9-75; Zn 15-52 mg/kg. Promising ABLs identified-JIL O: Fe 75.2, Zn 23.5 mg/kg; JIL P: Fe 20, Zn 52.3 mg/kg; JIL R: Fe 50.9, Zn 28.8 mg/kg.

Nursery for high protein chickpea under AICRP (*Rabi* Pulses)

- Three high protein advanced breeding lines (ABLs) of chickpea *viz.*, IPC 2023-283 (T 39-1/TPF 32, Protein 26.48%), IPC 2023-220 (T 39-1/TPF 20, Protein 26.28%), IPC 2022-41 (ICC 4958/T 39-1, Protein 25.76%) were evaluated in Biofortification Nursery Trial under AICRP (*Rabi* Pulses) during *Rabi* 2024-25.

- Four high protein content ABLs of chickpea *viz.*, IPC 2023-306, IPC 2018-45, IPC 2019-139, IPC 2018-80) have already been submitted to AICRP (*Rabi* Pulses) as candidate entries, which are being evaluated in Biofortification Nursery Trial during *Rabi* 2025-26.

Generation of breeding material

The chickpea breeding material including trait specific donor, advanced lines, varieties were utilized in crossing programme. **Agronomic base** (JG 11, BG 3043, BG 4012, BGD 112, PBG 9, AKG 1303, IPC 06-77, IPC 08-103, IPC 05-62, GNG 469, Sadabahar, GL12021), **Protein content** (ICC 5590, IPC 05-62, T 39-1, T 1-A, P 3318), **Green Seed** (BGD 112, Sadabahar), **Heat** (ICC 15925), **Milling recovery** (IPC 05-59), **Low Soaking Time** (CSG 8962), **Reduced Internodal Length** (E100YM) were used to broaden genetic base.

A total of seven chickpea crosses (ICC 15081/P 3318, ICC 16950/P 3318, IPCK 19-231/P 3318, ICC 8209/P 3318, (Pusa Green 112/T 39-1)//P 3318, Pusa Green 112/P 3318, RSG 991/P 3318) were attempted during *rabi* 2024-25 and *Kharif* 2025 at ICAR-IIPR, Kanpur and IIPR-RRC, Dharwad (Off-Season Nursery) locations to generate new breeding material for high protein content with yield and other traits like plant ideotypes, earliness, abiotic/biotic stresses.

Segregating materials and generation advancement

A total of 14 F_1's derived from different crosses were raised for generation advancement and 63 SPS were harvested during *Rabi* 2024-25.

Breeding pipeline for grain and nutritional quality traits (Traits: Soaking time, *Dahl* recovery, high protein and green seed), derived from 30 crosses were advanced and total 194 SPS, 25 line bulk (LB) and 7 plot bulk (PB) (3 F_2: 3 PB; 11 F_3: 111 SPS + 3 LB; 5 F_4: 42 SPS; 5 F_5: 29 SPS; 4 F_6: 12 SPS + 17 LB; 4 F_8: 8 LB + 1 PB) were harvested during *Rabi* 2024-25.

Evaluation of advanced breeding lines

- ***PYT-2B (Nutrition):*** A total of 135 entries including three checks (IPC 05-62, IPC 11-112 and T 39-1) were evaluated during *Rabi* 2024-25. Entry IPC 23-148 (3733 kg/ha) was found top yielder followed by IPC 23-141 (3500 kg/ha), IPC 23-101 (3444 kg/ha), IPC 23-168 (3333 kg/ha), IPC 23-145 (3167 kg/ha), IPC 23-150 (3056 kg/ha), IPC 23-149 (3000 kg/ha), IPC 23-153 (2833 kg/ha), IPC 23-237 (2778 kg/ha), IPC 23-251 (2722 kg/ha) and the best check IPC 05-62 (1733 kg/ha).
- High protein variety IPC 2005-62 (26-27%), IPC 2006-77 (24%) along with checks T 39-1 (doner, 29%) and DCP 92-3 (recipient, 21%) was grown in Kanpur, Bhopal and Dharwad for two seasons and assayed for protein content. The genotypes were found to be stable *w.r.t* protein content. Stable entries were identified for bulk density (IPC 04-98, T 39-1), and soaking hours (CSG 8962, GBM 2, RVG 203, DCP 92-3, IPC 05-62, IPC 06-77, HC 5, Sadabahar, CSJ 515, GNG 1958, GNG 1581, PBG 5, RSG 931).
- Traits like protein content (IPC 04-98/T 39-1) and soaking time (CSG 8962/HC 5) showed quantitative response with a normal population distribution with discontinuous curve in F_2. Groups could not be linked with any Mendelian ratios through chi-square test. No significant association/positive correlation was observed between the grain characteristics and quality/ milling parameters in chickpea (in panel of 75 genotypes). Negative correlation (-0.48) observed between soaking time and bulk density. High protein content was tending to be associated with long podding duration (gap between days to pod initiation and days to maturity initiation) in ABLs bred for high protein content (Corr. Coefficient +0.64).

Development of mapping population

Four mapping populations were developed for nutritional quality *viz.*, JAKI 9218/T 39-1 (F_6, n=452), JG 16/T 39-1 (F_6, n=267), ICC 4958/T39-1 (F_6, n=238) and DCP 92-3/T 39-1 (F_6, n=262) and harvested based on SSD during *Rabi* 2024-25

Project: Development of high yielding genotypes of chickpea having combined resistance against drought and heat stress

Evaluated for heat tolerance, 26 entries and three checks were assessed under timely and late sown conditions at ICAR- IIPR, Kanpur. Under timely sowing, IPC 23-717 (2,409 kg/ha) and IPC 23-706 (2,477 kg/ha) outperformed the best check, GNG 2207 (2,204 kg/ha). Under late sowing, IPC 23-715 (1,532 kg/ha), IPC 23-719 (1,404 kg/ha), and IPC 23-706 (1,480 kg/ha) recorded higher yields than the best check, ICCV 92944 (1,260 kg/ha).

- Evaluated for heat tolerance, 26 entries and three checks were assessed under timely and late sown conditions at Bhopal. Under timely sowing, IPC 23-701 (2,454 kg/ha) and IPC 23-702 (2,585 kg/ha) outperformed the best

check, ICCV 92944 (2,204 kg/ha). Under late sowing, IPC 23-701 (1,802 kg/ha), IPC 23-725 (1,789 kg/ha), and IPC 23-729 (1,954 kg/ha) recorded higher yields than the best check, ICCV 92944 (1,605 kg/ha).

- Evaluated for drought tolerance, 26 entries and three checks were assessed under irrigated and rainfed conditions at NRF, IIPR. Under rainfed condition, IPC 2021-168 (1571 kg/ha), and IPC 15-44 (1,564 kg/ha), showed superior yield to the best check, GNG 2207 (1,419 kg/hg).

Registration of genetic stocks

Two *desi* chickpea doners namely **IPC 2019-05** and **IPC 2014-99** for heat tolerant have been identified by the Institute Germplasm Identification Committee (GIC) for registration with ICAR-NBPGR, New Delhi as a donor line with unique trait. The registration proposal has already been sent to the concerned agency (NBPGR).

Performance of breeding lines in AICRP / SATs trials

A *desi* chickpea entry IPC 2019-230 has been promoted to AVT-1 for Eastern Central Zone under late sown conditions during *Rabi* 2025-26. One chickpea entry, IPC 2021-169 (late sown) was submitted to AICRP for evaluation in IVT trial during *Rabi* 2025-26.

Mapping population evaluated:

i) DCP 92-3 x ICC 1205 derived 208 F_{10} RILs

ii) JG 315 x ICCV 92944 derived 206 F_{10} RILs

iii) MAGIC population (F_5, 300 lines) mapping populations are evaluated for various heat tolerance related traits.

Plant genetic resource management and its utilization through pre-breeding in chickpea

Evaluation of trait specific germplasm/wild relatives

- Four hundred and eighty-four germplasm accessions were screened for source: Sink relationship (filled/unfilled pod ratio & seed setting in terminal pods) under rainfed and late sown conditions. Sixteen promising entries identified were utilized in crossing program for development of breeding materials.
- A total of 113 wild accessions were maintained/ rejuvenated in wild hybridization garden comprising of *C. reticulatum* (42), *C. judaicum* (32), *C. pinnatifidum* (27), *C. echinospermum* (6), *C. cuneatum* (3), *C. yamashitae* (2) and *C. bijugum* (1) accessions and a working collection (185 trait specific donors) for hybridization during 2024-25.
- Total 2,285 lines accessions are being maintained in medium term cold module

Generation of breeding material

Total 10 crosses (IPC 08-57/ILWC 105, IPC 08-57/ILWC 104, ILWC 104/ILWC 105, ILWC 105/ILWC 106, ILWC 105/ILWC 104, ILWC 106/ILWC 105, ILWC 105/ ILWC 109, IPC 08-57/ILWC 106, (ILWC 105/ILWC 106)//(JG 14/IPCB

Breeding material developed

F_1 crosses (5)	• JG 24 / JG 11
	• JG 24 / ICC 07110
	• JG 18 / JG 16
	• GL13001 / PG 0405
	• GNG 2207 / Phule Vikram
Segregating material	• F_2(10), F_3(29), F_4(22), F_5(12), F_6(22), F_7(9), F_8(5), F_9(4) and F_{10}(5)
Back crosses (7)	• JG 16 / ICC 15925// JG 16 (heat tolerance trait)
	• JG 11 / ICC 92944 (heat tolerance trait) F_1
	• Phule G 405 x ICC 15925//Phule G 405 (heat tolerance trait) F_1
	• BG 3043 / ICC 15925//BG 3043 (heat tolerance trait) F
	• RVG 202 / ICC 15925 // RVG 202
	• GNG 2207 / ICC 92944 // GNG 2207
	• GNG 2171 / ICC 92944 // GNG 2171

15-123, BGD 9971/ILWC 104) were made during *Rabi* 2024-25 at ICAR-IIPR, Kanpur. All the crosses with utilizing of trait specific donors. Similarly, seven crosses (IPC 22-106/IPC 20-198, IPCB 15-132/ICC 12315, HC 5/ICC 12315, IPC 20-198/IPC 22-106, IPCB 15-132/IPC 22-106, BG 4014/ICC 12315 and IPC 22-106/IPC 21-55) were attempted during *Kharif* 2025 at Off-season Nursery, Dharwad.

Segregating materials and generation advancement

- A total of 10 F_1's derived from different crosses were raised for generation advancement and 63 SPS were harvested during *Rabi* 2024-25.
- Breeding materials from different generations derived from 39 crosses were advanced and total 248 SPS, 48 line bulk (LB) and 5 plot bulk (PB) (5 F_2: 5 PB; 5 F_3: 110 SPS; 6 F4: 29 SPS; 11 F5: 97 SPS + 3 LB; 12 F_6: 12 SPS + 45 LB) were harvested. Few lines and plot bulks to be shared with NARS partners.

Traits addressed

Plant architecture, high podding, root traits, nutrition (high protein, Fe, Zn) & grain quality enhancement, heat/cold tolerance and better source: sink relation and deliberate variability, PAE.

Evaluation of advanced breeding lines

- ***Station Trial-2 (Pre-breeding):*** Total 23 ABLs including three checks (GNG 2207, BG 3043 and IPC 2010-134) were evaluated during *Rabi* 2024-25 at Kanpur location. Entry IPC 22-106 (3027 kg/ha) was found top yielder followed by IPC 22-44 (2916 kg/ha), IPC 21-108 (2879 kg/ha), IPC 21-78 (2641 kg/ha) and the best check GNG 2207 (2436 kg/ha).
- ***PYT–2A (Pre-breeding):*** A total of 16 entries including two checks (IPC 05-62 and GNG 2207) were evaluated during *Rabi* 2024-25. Entry IPC 23-234 (2633 kg/ha) was found top yielder followed by IPC 23-210 (2467 kg/ha) and the best check IPC 05-62 (2367 kg/ha).
- ***Herbicides tolerance:*** Forty-Eight germplasm accessions and ABLs have been screened for PEH tolerance (Imazethapyr @ 120 g a.i./ha.) over the seasons. Promising lines identified on the basis of lesser phytotoxicity, phenological shift and yield penalty: IPC 2020-134, IPC 2020-122, IPC 2020-51 and IPC 2020-122.

Donor improvement and pre-breeding

- ***T 39-1 (ICC 5912):*** Seventy selections (TPF) on the basis of nine grain characteristics & pink flower evaluated: 20 lines >23 q/ha 38 isolates (TI) based on plant type, pod setting, heat tolerance, were evaluated. 21 TI, TPF lines yielded 16.5–21.26 q/ha [CH: T 39-1 (6.8 q/ha), ICC 15925 (16.4 q/ha)]. Frequency of high pro. >25% was observed in TI pool.
- ***Mechanically harvestable variety:*** IPCB 2015-132 (Kundan) has been notified for NEPZ with a potential yield of 23-24 q/ha in 2024. IPCB 2105-132 is derived from wide hybridization of *Cicer arietinum/Cicer reticulatum* (GNG 1581/ILWC 21). Eighty-eight ABLs derived from prebreeding and wide hybridization have been evaluated in Station trials and 134 ABLs in Preliminary Yield trials, 7 ABLs out of those have been evaluated in AICRP trials under rainfed, timely sown, late sown and mechanical harvesting trials. Sixteen wild accessions of chickpea [CR (8), CP (3), CJ (1), CE (3) & CB (1)] out of 108 maintained in the wild hybridization garden of IIPR could be utilized as donors for ABLs with high yield potential (~27-29 q/ha in field trials) and with desirable seed/grain quality [14.81%]. Seventeen landrace and wild relatives out of 151 led to development of ABLs with high yield and desirable seed/grain quality [11.25%].

Pigeonpea

Project: Development of biotic and abiotic stress resistant superior varieties/hybrids through integrated conventional and modern breeding approach: Short duration pigeonpea

Generation of breeding materials

Thirty-four fresh crosses were synthesized using different donors possessing targeted traits like earliness, plant type; pods/plant, PSB; SMD and wilt.

Selections of promising genotypes from segregating population

During *kharif* 2024, total 46 F_1 were evaluated and further advanced to F_2 stage. Similarly, different segregating generation *i.e.* 7 F_2 (77 SPS), 9 F_3 (144 SPS), 14 F_4 (111 SPS), 13 F_5 (158 SPS), 25 F_6 (276 SPS), 26 F_7 (199 SPS) and 27 F_8 (148 SPS) were evaluated and superior single plant/progenies (given in parenthesis) were selected and advanced to next generation. Besides,

436 early duration pigeonpea ABLs were evaluated and promising lines were selected.

Evaluation of advance breeding lines

Two station trials including 12 entries in each trial with three checks were conducted. Likewise, preliminary yield trial comprises 80 genotype with four checks were conducted and genotypes were evaluated for grain yield and other yield attributing traits.

Performance of ABLs against PSB incidence

Total 80 ABLs were screened against PSB in ICAR-IIPR, Kanpur sick plot. The phenotyping result revealed that only six entries showed resistance reaction while other six entries expressed moderately resistance reaction and remaining were susceptible. The detail of resistant and moderately resistant lines are given below:

Promising entries in AICRP trials

A total of seven entries from different maturity duration were nominated for IVT trials of AICRP on *Kharif* Pulses namely, IPAE 23-1; IPAE 23-2; IPAE 23-3 (Early); IPAME 23-1; IPAME 23-2 (Mid-early); IPAM 23-1, IPAM 23-2 (Medium). Of them, one entry, IPAE 23-2 (1651 kg/ha) has been promoted to AVT-1 in CZ with 11.93% superiority over the best check variety, IPA 15-06 which yielded 1475 kg/ha.

Nucleus seed production

Produced the nucleus seed (35 kg) of released variety IPA 15-06.

Development of biotic and abiotic stress resistant superior Varieties/ hybrids through integrated conventional and modern breeding approach: Long duration pigeonpea

Variety developed

Long duration pigeonpea variety, IPA 15-21 (Vanshika) identified, notified and commercialized for Jharkhand State

Evaluation of fixed lines in station trials

In station trial, ten entries *viz*. IPAL 25-1, IPAL 25-2, IPAL 2 5-3, IPAL 25-4, IPAL 25- 5, IPAL 25-6 and IPAL 25-7 were evaluated along with three checks *viz*. IPA 203, IPA 15-2 and IPA 206. Entries. IPAL 25-3, IPAL 25-4, IPAL 25-5, IPAL 25-6 and IPAL 25-7 showed superiority (ranging from 2.34 to 31.67 per cent) in yield over IPA 15-2. Entries IPA 25-3, IPA 25-6 and IPAL 25-4 showed yield superiority of 5.02, 10.93 and 18.68, respectively over IPA 206. Entries IPAL 25-3, IPAL 25-4, IPAL 25-6 and IPAL 25-7 showed yield superiority of 12.67, 27.32, 19.01 and 5.86 per cent, respectively over check IPA 203. Thses promising entries are being multiplied and will be proposed for evaluation in AICRP multilocation trials.

Selections of promising genotypes from segregating population

During crop season 2024-25, segregating generations of 6 F_2 (456 SPS), 12 F_3 (568 SPS), 6 F_5 (178 SPS), 2 F_6 (70 SPS) and 30 F_8 (445 uniform Single planr progeny rows) were evaluated and superior single plants were selected considering targeted traits *i.e.* field attributes and multiple disease resistance.

Table : Resistant and moderately lines of pigeonpea against PSB incidence

Pedigree	PSB reaction	Total plant	ICAR-IIPR	% Incidence
UPAS 120 x D. Dwarf	R	5	0	0%
Ranchi Local x D. Dwarf	R	7	0	0%
ICPL 88039 x UPAS 120	R	13	0	0%
ICPL 91045 x ICPL 20340	R	21	1	4.76%
(UPAS 120 x ICPL 11255)x (Bahar x ICPL 20338)	R	20	1	5%
(UPAS 120 x ICPL 20340) x ICPL 15739	R	19	2	10.52%
ICPL 91045 x PAU 881	MR	12	2	16.66%
D 20 x ICPL 20338	MR	19	4	21.05%
CORG 9701 x Prabhat	MR	9	2	22.22%
ICPL 91045 x PAU 881	MR	13	3	23.07%
ICPL 88039 x Pusa 992	MR	13	3	23.07%
MN 05 x ICPL20340	MR	21	5	23.80%

Maintenance breeding

Total 23 SPSs were harvested from three varieties (IPA 203 (Prakash), 31 SPS from IPA 206 (Ganga) and 102 SPS from IPA 15-2 (Sharada) for maintaining genetic purity. A total of 4.3 kg, 7.0 kg, and 26.5 kg of nucleus seed was produced for IPA 203, IPA 206 and IPA 15-2 based on single plant progenies bulk methods and supplied to seed production unit for enhancing breeder seed. Beside this, pure seeds of nine IVT entries proposed for multilocation evaluation at AICRP locations and 9 entries proposed for UP state nomination were produced. In addition to this, the trait specific donors namely IPAV 16-1, IPAC 79 and IPA Cliesto 10, two kg each seed was produced. In addition to that, a set of parents were maintained for use in breeding programme.

Promising entries in AICRP trials

Based on performance of entries in station trials, following entries were proposed for the AICRP multilocation trials in crop season 2025-26 in IVT of NEPZ.

Entry	Superiority
IPAL 24-1	UPAS 120 x Dholi Dwarf
IPAL 24-2	PH 1063 x IDPPA 85-12

Hybrid Pigeonpea Programme

Evaluation of hybrid entries in station trials

- In station trial I, nine hybrid entries were selected for testing in trial using six check varieties *viz.*, IPH 15-03, BDN 711, Pusa Arhar 2018-4, AL 882, PAU 881 and IPH 9-5. The days to maturity varied from 134 days (PHP 177) to 162.5 days (PHP 178). Concerning yield superiority, only one hybrid IPH 23-1 (2008 kg/ha) showed 19.8% yield superiority over the best check *i.e.* IPH 15-03 (1676.04 kg/ha).
- In station trial II, eight hybrids were evaluated using three checks, IPH 15-03, IPH 9-5 and IPA 15-06. In context of yield-superiority, only one hybrid IPH 23-10 (PA 163A x AK 250137R) (1952.78 kg/ha) showed 36.6% yield superiority over the best check *i.e.* IPH 9-5 (1429.51 kg/ha).

Evaluation of test hybrids

Regarding testing of experimental hybrids, 255 A × R combinations were planted in augmented design using three checks *i.e.* IPA 15-06, IPH 9-5 and IPH 15-03. Range of these test hybrids is provided in Table. Among test hybrids, the days to maturity varied from 171 (AL 116A × GTR 7) to 140 (CORG 990052A × AK 250204R), while primary branches varied from 22 (PA 163A × GTR 23) to 11 (ICP 2156A × GTR 524). Likewise, 100-seed weight and 5-plant yield ranged from 12.3 g (PA 163A × GTR 13) to 6.21 g (AL 104A × GTR 524) and 424 g (ICPL 88039A × AK 250167R) to 36 g (ICP 2089A × AK 250159R), respectively.

Development of new CMS lines

With the aim of developing new male sterile lines, we have now developed 15 new CMS line. GT 288A, ICPL 88039A and ICP 2089A have been used as cytoplasmic donors to induce pollen sterility in these crosses. The names of these crosses and the number of seed harvested from respective cross, are given in Table.

Summary of the test hybrids evaluated during 2024-2025

S No	Traits	Maximum value	Minimum value	Average
1	Days to maturity	171 (AL 116A × GTR 7)	140 (CORG 990052A × AK 250204R)	155.5
2	Primary branches	22 (PA 163A × GTR 23)	11 (ICP 2156A × GTR 524), (AL 104 A × AK 250204R)	16.5
3	Seeds/pod	4.6 (AL 103A × GTR 6)	3 (ICPL 84023A × GTR 23), (AL 104A × GTR 524)	3.8
4	No. of pods/plant	610 (AL 116A × GTR 24)	44.6 (ICP 2089A × AK 250159R)	327.3
5	5- plant yield (g)	424 (ICPL 88039A × AK 250167R)	36 (ICP 2089A × AK 250159R	230
7	100-seed weight (g)	12.3 (PA 163A × GTR 13)	6.21 (AL 104A × GTR 524)	9.25

Seed obtained from the new CMS lines

S. No.	Cross	No. of seed	S. No.	Cross	No. of seed
1	(GT 288A × ICPL 88034) × ICPL 88034	100	9	(ICP 2089A × GT 288) × GT 288	80
2	(ICPL 88039A × MN 5 DT) × MN 5 (Dt)	50	10	(GT 288A × Pusa 992) × Pusa 992	100
3	(ICPL 88039A × MN 5NDT) × MN 5 (NDt)	30	11	(GT 288A × ICPL 11244) × ICPL 11244	80
4	(ICP 2089A ×Pusa 992) × Pusa 992	2000	12	(GT 288A × ICPL 11301) × ICPL 11301	60
5	(GT 288A × ICPL 20340) × ICPL 20340	30	13	(GT 288A × ICPL 20325) × ICPL 20325	200
6	(GT 288A × PAU 881) × PAU 881	500	14	(GT 288A × ICPL 20327) × ICPL 20327	600
7	(ICPL 88039A × AL 201) × AL 201	30	15	(GT 288A × ICPL 20329) × ICPL 20329	50
8	(ICPL 88039A × AL 15) × AL 15	50			

Maintenance of A, B and R lines

A total of 96 sterile (A) lines, cognate maintainer (B) lines and 78 restorer (R) lines are being maintained at ICAR-IIPR, Kanpur.



Fig. Maintenance of CMS and their cognate maintainer (B) lines at ICAR-IIPR, Kanpur

Seed production of pigeonpea hybrid IPH 15-03, IPH 9-5 and its parental lines

Seed production of both CMS-based hybrids, IPH 15-3 and IPH 09-5, which have been released and notified for NWPZ (North West Plain Zone) and their parental lines was undertaken at ICAR-Indian Institute of Sugarcane Research (IISR), Lucknow and CSA University of Agriculture & Technology (CSAUA&T), Kanpur.



Fig. Seed production plot of pigeonpea hybrid IPH 09-5 grown at CSAUA&T, Kanpur

Lentil

Development of biotic and abiotic stress resistant superior varieties through integrated conventional and modern breeding approach in lentil

Variety Notified for Cultivation

i) **IPL 341:** The lentil variety (IPL 341) has been submitted for notification through CVRC (No. S.O. 2128 (E) dated May 13, 2025) . It has been developed through hybridization from a single cross Sehore 74-3 × DPL 62. IPL 341 had yield superiority of 16.80% over the check variety, IPL 316 in Madhya Pradesh under the normal sown conditions with an average yield 1694 kg/ha. This variety had yield superiority of 39.95% in Shajapur, 28.60% in Sagar, 24.91% in Bhopal and 4.48% in Hoshangabad and matures in 111 days. This large seeded variety has 3.0 g/100-seed weight having brown colour with red cotyledons and has resistance to major diseases including rust and *Fusarium*.

ii) **IPL 342:** The lentil variety (IPL 342) has been submitted for notification through CVRC (No. S.O. 2128 (E) dated May 13, 2025). It has been developed through hybridization from a single cross Sehore 74-3 × DPL 62. IPL 342 had yield superiority of 21.97% over the check variety, IPL 316 in Madhya Pradesh under the normal sown conditions with an average yield 1769 kg/ha. This variety had yield superiority of 42.44% in Hoshangabad, 31.80% in Shajapur, 16.04% in Sagar, 12.07% in Bhopal and 5.32 % in Raisen and matures in 112 days. This large seeded variety has 3.2

g/100-seed weight having brown colour with red cotyledons and has resistance to major diseases including rust and *Fusarium*.

iii) **IPL 232:** The lentil variety IPL 232 (Sehore 74-3 x PL 5) has been released for cultivation in Uttar Pradesh by UP State Seed Sub Committee and submitted for notification. This variety has average yield of 1193 kg/ha and registered 11.91% yield superiority over the best check, KLS 218 (825 kg/ha). It is suitable for normal sown rainfed conditions and performed very well in Central (Hardoi) and western (Aligarh, Meerut, Mathura, Bareilly) regions of Uttar Pradesh compared to check varieties. It matures in 112-129 days in eastern region of Uttar Pradesh and hence suitable for cultivation in rice fallow areas. It registered potential yield up to 1698 kg/ha in NWPZ under AICRP trials. This is an attractive, small seeded (2.4 g/100-seed) variety with red cotyledons and has tolerance to major diseases of lentil including *Fusarium* wilt and rust.



Fig. Field view of varieties IPL 341, IPL 342, IPL 232 (left to right)

Performance of breeding lines in AICRP trials

During 2024-25, one small seeded IPL 249 entry in NEPZ was evaluated in AVT-1 and six entries [IPL 248, and IPL 249 (small seeded), IPL 354, and IPL 355 (large seeded) and IPL 612 and IPL 613 (rice fallows) were evaluated in IVT. Two entries (IPL 251 and IPL 252) performed well across three zones (NHZ, NWPZ and NWPZ) and promoted to AVT-1 for evaluation during current *Rabi* season 2025-26.

Entries in UP State Adaptive Trials

Three entries including one large seeded (IPL 542) with an average yield of 12.33 q/ha and one for late sown conditions (IPL 608) with an average yield of 10.24 q/ha performed well over three years and recommended for submission of their identification proposal for releasing as cultivars. Two large seeded entries (IPL 354 and IPLB 704), three late sown entries (IPL 609, IPL 612 and IPL 613) and two small seeded (IPL 246 and IPL 24 were promoted to AVT-1. Two small seeded entries (IPL 245 and IPL 611) were promoted to AVT-2 for evaluation during current *Rabi* season 2025-26. Six entries (IPL 249, IPL 250, IPL 356, IPL 357, IPL 614 and IPL 615) are being evaluated in IVT during *Rabi* season 2025-26.

Evaluation of promising breeding lines

During 2024-25, two station trials with 15 entries each and one preliminary yield trial with 60 entries were conducted at main and new research farm in order to evaluation of their performance for yield. In ST-I, four large seeded entries *viz*., IPL 22-25, IPL 22-55, IPL 22-18, and IPL 22-11, having an average yield ranging from 920 to 1030 kg/ha were identified promising over the check variety, IPL 316 (916 kg/ha). The highest yielding entry, IPL 22-11 showed flowering (81 days) and maturity in 115 days. In ST-II, five small seeded entries *viz*., IPL 22-38, IPL 22-56, IPL 22-12, IPL 22-27 and IPL 22-15 were identified promising having average yield ranging from 797 to 935 kg/ha over check variety IPL 534 (614 kg/ha). The highest yielding entries, IPL 22-27 and IPL 22-15 showed flowering (79 - 80 days) and maturity in 114-117 days having a reproductive period of 35-36 days. In PYT, 12 entries (IPL 23-90, IPL 23-65, IPL 23-85, IPL 23-03, IPL 23-94, IPL 23-6, IPL 23-1, IPL 23-80, IPL 23-78, IPL 23-73, and IPL 23-46) were identified promising over check variety IPL 220 having average yield ranging from 1097 to 1428 kg/ha. The highest yielded entry (IPL 23-46) had yield 1428 kg/ha with a maturity of 116 days, while entry IPL 23-90 had fast grain filling ability of 31 days compared to the check variety, IPL 220 (39 days).

Generation of breeding material

During the *Rabi* season 2024-25, 24 fresh crosses were generated for desirable traits and disease resistance.

Entry name	Pedigree	Yield kg/ha (check)	Zone	Stage
IPL 251	IPL 316 / LL 931	1739 (VL 126 : 1630)	NHZ	AVT-1
IPL 251	IPL 316 / LL 931	2059 (LL 1655: 1884)	NWPZ	AVT-1
IPL 252	ILWL 118 / IPL 220 // I PL 220	2046 (LL 1655: 18841)	NWPZ	AVT-1
IPL 251	IPL 316 / LL 931	1398 (HUL 57 : 1321)	NEPZ	AVT-1
IPL 252	ILWL 118 / IPL 220 // IPL 220	1421 (HUL 57 : 1321)	NEPZ	AVT-1
IPL 616 (Rice fallow)	ILL 2501 / ILL 6882	1300 (HUL 57 : 1292)	NEPZ	AVT-1

S. No.	Cross	Trait
1	DPL15 x DPL 62	Plant type
2	DPL 62 x IPL 406	MH
3	IPL 406 x DPL15	MH
4	DPL 62 x [(IPL S9-23 X DPL 62) x BARI 5]	Bold seed
5	IPL406 x[(IPL S9-23 x DPL 62) x BARI 5]	Bold seed
6	JL 3 x DPL 62	Pods/ plant
7	RKL 605-3 x IPL 406	High yield with MH
8	IPL 406 x RKL605-3	High yield with MH
9	DPL62 x RKL 606-3	High yield
10	IPL316 x RKL 605-3	High yield
11	IPL 316 x IPL 406	High yield with MH
12	Mokama Local x IG 54	Wilt resistance
13	Mokama Local x IPLPBR 1	Wilt resistance
14	Mokama Local x IC 315962	Wilt resistance
15	IPL 406 x IC 315962	Wilt resistance
16	DPL 62 x IC 315962	Wilt resistance
17	DPL 15 x IC 315962	Wilt resistance
18	Mokama Local x JL 1	Improved resistance
19	Mokama Local x JL3	Improved resistance
20	Mokama Local x DPL 62	Improved resistance
21	Mokama Local x IPL 406	Improved resistance
22	IPL 220 x Mokama Local	Improved resistance
23	IPL 406 x ICARDA MH	Mechanical harvesting
24	IPL 220 x ICARDA MH	Mechanical harvesting

Total 140 F_1 plants were generated from 32 crosses from which F_2 seeds were harvested. The single plants were selected from 21 F_2 (297+ 3Bulk), 29 F_3 (537353SPS), 24 F4 (399 SPS), 27 F5 (222 SPS), and 656 progenies of 26 F_6 were bulked for yield evaluation. 60 improved breeding lines having higher yield potential (170-280 g/ line) were selected from F_6 bulk progenies for PYT.

Development and maintenance of mapping populations

Trait-specific RIL mapping populations for earliness (Precoz x L 4603; 137 RILs) and root traits (IPL 98/193 x EC 208362; 198 RILs) were maintained and evaluated for yield and root traits. The root trait mapping population of 190 F_{10} recombinant inbred lines (RILs) derived was subjected to genotype-by-sequencing (GBS) analysis. Joint genotype calling identified 1,789,572 genomic variants across the RILs. After stringent filtration (Qual > 30, DP > 5, MAF > 0.3, F_missing ≤ 0.8), 22,256 high-quality variants were retained and annotated using the *Lens culinaris* reference genome *via* SnpEff. This yielded 7,486 SNPs distributed across all seven chromosomes. Using MSTmap software, 441 SNP markers were mapped onto the seven chromosomes, spanning 3,009.1 cM and developing a linkage map for QTL identification related to root and other traits.

Nucleus seed production

Total 1061 kg nucleus seeds of 11 released varieties (IPL 316, IPL 406, IPL 526, IPL 220, IPL 321, IPL 315, IPL 534, IPL 225 and IPL 329) were produced and 6500 single plants of above varieties were selected for next year nucleus seed production.

Plant genetic resources management and its utilization through pre-breeding

Germplasm registered to ICAR-NBPGR, New Delhi

Two unique germplasms namely IG 54 (Landrace of Iraq) and IPLPBR 1 [Prebreeding lines derived from a cross IPL 406 × ILWL 44 (*L. curlinaris subsp. tomentosus*)] were registered as donors for *Fusarium* wilt resistance in lentil.

Germplasm maintained and evaluated

- During 2024-25, 206 accessions of active germplasm were maintained and 94 diverse accessions were maintained. A total of 2,394 accessions of lentil germplasm were rejuvenated. Total 93 accessions (*L. orientalis*: 71, *L. tomentosus*: 5, *L. odemensis*:7, *L ervoides*: 7, *L. nigricans*: 3) of wild species were maintained. Two wide crosses were attempted for generating the prebreeding materials for pods/plant trait, *viz*., IPL 23-132 X ILWL 132 and IPL 23-132 X ILWL 92.
- Sixteen variety of lentil were evaluated for physical, mechanical, functional and pasting properties. The mean length, width, and height of lentil seed was 2.244 mm, 2.321mm and 2.281 mm and varied one variety to another from 2.014 mm (KLS 218) to 2.446 mm (IPL 316), 2.035 mm (Pant-L 234) to 2.727 mm (IPL 406) and 2.025 mm (KLS 218) to 2.625 mm (IPL 316), respectively. The variation in these parameters has led to

changes in the seed volume (*i.e* seed size) which varied from 4.351 mm^3 (KLS 218) and 8.337 mm^3 (IPL 406). Therefore, genetic variability for these parameters should be taken into considerations for breeding the high yielding genotypes. The variation in dimension led to the change in geometric and arithmetic mean diameter and varied in the range of 2.026 mm (KLS 218) to 2.516 mm (IPL 406) and 2.026 mm (KLS 218) to 2.521 mm (IPL 406), respectively. Similarly, mean area of surface, mean area of transverse surface and sphericity was 4.097 mm^2, 4.173 mm^2, and 101.648 %, and varied in the range of 3.223 3 mm^2 (KLS 218) to 4.955 mm^2 (IPL 406), 3.24 mm^3 (KLS 218) to 5.405 mm^2 (IPL 406) and 94.631 % (Pant L 234) to 109.166% (IPL 321), respectively. The variation in physical properties is observed directly correlated with the genetic constitution of the genotypes. Therefore, it can be positively used for the identification and development of handling and grading equipment for the lentil. The mean value of angle of repose, bulk density, and 100-grain weight was 0.326, 0.848, and 2.790 g and varied in the range of 0.265 (IPL 316) to 0.388 0.46 (IPL 220), 0.825 kg/mm^3 (Narendra Masoor 1) to 0.872 kg/mm^3 (KLS 218), and 1.9 g (HUL 57) to 4.025 g (IPL 406), respectively. The 100-seed weight (*i.e* seed size) showed medium to high positive correlation with all studied physical properties except bulk density and angle response. The colour of the lentil varied among sixteen cultivars. Mean values of 'L', 'a' and 'b' was 41.82769, 4.13625 and 12.89806 and varied in the range of 35.87 (IPL 534) to 52.257 (IPL 406), 2.14 (IPL 526) to 6.23 (IPL 406) and 9.217 (IPL 534) to 19.973 (IPL 406), respectively. The mean value of total colour difference (ΔE), Chroma, Hue, and BI was 52.62656, 13.56163, 72.30181, and 43.48231, and varied in the range 44.48 (IPL 406) and 57.983 (IPL 534), 9.904 (IPL 534) and 20.923 (IPL 406), 67.634 9 HUL 57) and 77.876 (IPL 526) and 34.088 (IPL 526) and 56.222 (IPL 406), respectively. Colour is one of the deciding parameters for consumer acceptance.

- Different functional properties of flour samples were analyzed for all tested sixteen lentil cultivars. Mean water absorption capacity (WAC) of lentil starch samples was 1.451 with a range from 0.968 (IPL 526) and 2.096 (Pant L-234) . Oil absorption capacity (OAC; g/g) of lentil samples ranged from 4.869 (IPL 81) to 5.568 (Narendra Masoor 1) with a mean value of 5.313. Solubility of starch and swelling power (SP) are controlled by amylose and amylopectin. The mean solubility of lentil starch (g/g) was 0.2938125 with a range from 0.202 (IPL 81) to 0.358 (IPL 220) . Swelling power of starch (g/g) of lentil cultivars ranged from 5.513 (Narendra Masoor 1) to 7.616 (IPL 329) with a mean value of 6.6356875. The pasting of lentil flour has been analyzed among sixteen cultivars. The mean values of pick viscosity, pasting temperature, holding viscosity, breakdown viscosity, and final viscosity, was 894.260, 73.795, 811.944, 82.989 and 1089.89 and varied in the range of 546.067 (KLS 218) to 1115.667 (IPL 329), 72.31 (IPL 225) to 74.77 (DPL 15), 466.433 (KLS 218) to 1003.933 (IPL 329), 53.15 (IPL 321) to 119.767 (DPL 62) and 851.2 (KLS 218) to 1252.667 (IPL 81), respectively. The different old and newly developed varieties had variable peak viscosity. No significant association was observed old/newly and small/large seeded cultivars with peak viscosity property of pasting.

Urdbean

Breeding for high-yielding, multiple stress resistant and nutrient-rich urdbean cultivars for diverse agro-ecologies

Variety released

i) **IPU 18-02 (Vijeta):** The variety has been thoroughly tested in different agro-climatic regions of Uttar Pradesh, along with check varieties Shekhar 1 and Shekhar 2 which are recommended for U.P. state. The overall performance of the variety at all locations, showed yield superiority of 17.84%. Based on three years testing data, the variety was tested in seven centers with an average yield of 10.04 q/ha. The best check (Shekhar-2) on the basis of three-year testing over five locations with an average yield of 8.52 q/ha. Wider adaptability, suitable for cultivation across different agro-climatic regions of Uttar Pradesh during *Zaid* season. Thoroughly tested in AICRP across the country in IVT (NWPZ) and IVT (NEPZ) during Spring 2023 and yield varied from 1190 kg/ha to 1257 kg/ha. During Summer,

IVT trials for the South Zone (SZ). the average yield was 1036 kg/ha. The variety possess multiple disease resistance. Highly resistant to Mungbean yellow mosaic virus and resistant to urdbean leaf crinkle virus, root rot, powdery mildew, stem necrosis and *Cercospora* leaf spots. Moderately resistant to white fly, pod borer and pod bug insects under field conditions. It matured during Spring season (*Zaid*), on average in 80 days in NEPZ and on average within 72 days in NWPZ under AICRP co-ordinated trials. In the South Zone of AICRP, average maturity duration was 74 days. Attractive black seed colour, medium large seeds (4.2 g/100-seeds) with high protein content (23%), good for *dal* and highly palatable. Variety proposal has been submitted to CVRC for notification.



Single plant



Seed



ii) **IPU 13-6 (Tapti):** The variety has been thoroughly tested in different agro-climatic regions of Madhya Pradesh, along with check varieties IPU 13-1, IPU 10-26 and KU 96-3 which are recommended for Madhya Pradesh state. The overall performance of the variety at all the locations, showed yield superiority of 11.33%. The variety was tested in KVK, Betul; KVK, Narsinghpur; KVK, Hoshangabad. It has wider adaptability, and suitable for cultivation across different agro-climatic regions of Madhya Pradesh. This variety was thoroughly tested in AICRP across all the zones in the country in IVT in NWPZ and NEPZ during Spring 2021 and yield varied from 633 kg/ha to 2189 kg/ha. The variety possesses multiple disease resistance. It is highly resistant to Mungbean Yellow Mosaic Virus and resistant to Urdbean Leaf Crinkle Virus, Leaf Curl Virus, Web Blight, Bacterial Leaf Blight, Powdery Mildew and Cercospora Leaf Spots. Resistant to white fly, pod borer and pod bug insects under field conditions. It is early maturing (75 days), and tolerant to pod shattering. This has attractive black seed colour, medium large seeds (4.50 g/100-seeds) with high protein content (22%), good for *dal* and highly palatable. This variety is notified for Madhya Pradesh state.



Promotion of entries in AICRP trials and state trials

Ten entries are being tested under AICRP in IVT stage for their yield performance. In Uttar Pradesh state varietal testing trials, based on yield superiority over three-year field trials, urdbean entry, IPU 18-02 or Vijeta was released for Uttar Pradesh suitable for *Spring* cultivation. Multiple disease resistance was reported from AICRP trials for example, IPU 19-31, IPU 18-7, IPU 19-53 (Resistant in Spring/Summer/*Kharif* over four locations), IPU 19-8 (Free or resistant to anthracnose), IPU 19-2 and IPU 19-6 (MYMV and PMW disease resistance).

Hybridization and advancing of segregating generations

Generation of breeding material

Twenty-one fresh crosses were obtained involving diverse breeding lines or parents in urdbean. The crosses were made as following: The crossed pods were harvested. The crosses were as following: IPU 17-2 × Azad Urd 1, IPU 17-2 × LBG 884, IPU 17-2 × PU 12, Mash 1008× IPU 17-2, Mash 11-37 × IPU 17-2, LBG 787 × IPU 17-2, IPU 13-1 × LBG 884, IPU 11-02 × LBG 883, IPU 13-1× PU 12, IPU 19-10 × LBG 884, *Vigna mungo* (collection no. 126) × IPU 17-2, *V. radiata* (collection no. 85) × IPU 17-2, IPU 11-02 × Azad Urd 1, IPU 24-17 × IPU 11-02, IPU 11-02 × *V. radiata* (collection no. 37), PU 14-28 × *V. radiata* (collection no. 37), SUG 1191 × IPU 17-2, IPU 13-1 × *V. radiata* (collection no. 37), IPU 17-2 × *V. radiata* (collection no. 37), PU 19 × LBG 17, *V. radiata* (collection no. 37) × IPU 17-2.

Advancement of segregating generations

- ***F_1 crosses:*** A total of 28 F_1s were harvested during *Kharif* 2025: IPU 19-10×LBG 904, IPU 19-10 × IPU 17-2, LBG 904 × IPU 17-2, LBG 752 × IPU 94-1, LBG 884 × IPU 19-10, Azad-2 × *Vigna radiata* (collection number-37), IPU 17-1× LBG 752, IPU 11-02 × *Vigna dalziana*, IPU 11-02 × LBG 752, IPU 10-26 × *Vigna khandaliensis*, *Vigna khandaliensis* × IPU 10-26, IPU 94-1 × IPU 11-02, IPU 94-1 × IPU 17-1, IPU 94-1 × *Vigna mungo*, *Vigna umbellata* × Goa cowpea, IPM 02-14 × MASH 114, IPM 410-3 × Pant U 19.

- ***F_2 generation:*** A total of 28 F_2s were harvested during *Kharif* 2025: Shekhar 2 × DPU 88-31, Shekhar 2 × IPU 11-02, IPU 11-02 × PM 6, IPU 17-1 × IPU 13-1, *Vigna radiata* (collection number 37) × IPU 17-1, IPU 13-1 × PM 6, IPU 13-1 × IPU 21-11, IPU 13-1 × *Vigna sublobata*, IPU 13-1 × IPU 11-02, IPU 21-21 × IPU 13-1, IPU 21-11 × IPU 13-1, IPU 21-26 × IPU 11-02, IPU 21-26 × IPU 17-1, IPU 21-26 × IPU 13-1, UH 85-5 × IPU 13-1, IPU 21-29 × IPU 21-15, IPU 21-15 × IPU 19-27, IPU 19-27 × IPU 21-15, Chaubepur local × IPU 19-27, IPU 19-53 × IPU 22-141, IPU 19-53 × Tusaru, IPU 22-142 × IC 349699, RILSP 64 × IC 349699, IPU 13-1 ×ANU, IPU 21-15 × ANU, IPU 94-1 × ANU, IPU 10-26 × ANU, IPU 19-53 × ANU.

- ***F_3 generation:*** F_3's harvested *Kharif* 2025 were from eleven crosses involving diverse parents (IPU 13-1 × VBN 3, IPU 13-1 ×*Vigna sylvestris*, IPU 13-1 ×*V. sublobata* (W 51), IPU 11-02 × LBG 752, IPU 11-02 × Pratap Urd 2, IPU 11-02 × VBN 8, IPU 94-1 ×*V. sublobata* (W-107), IPU 94-1 × KPU 405, IPU 21-11 × IPU 19-27, IPU 19-53 ×ANU, IPU 10-26 ×ANU).

- ***F_4 generations:*** F_4's of 30 crosses were harvested during *Kharif* 2025 involving diverse parents (IPU 12-5 × IPU 13-1, IPU 17-1 × IPU 13-1, Shekhar 3 × IPU 94-1, KUG 96-3 × IPU 17-1, ADT 3 × IPU 94-1, Mash 114 × IPU 17-1, LBG 752 × IPU 94-1, TU 94-2 ×IPU 10-30, KU 96-3 × IPU 13-1, NUL 7 × IPU 94-1, IPU 19-27 × IPU 17-1, IPU 13-1 × IPU 17-1, IPU 02-4 3 × IPU 13-1, PU 31 × LBG 752, IPU 94-1× IPU 13-1, IPU 02-43 × IPU 17-1, IPU 02-43 × Shekhar 3, IPU 02-43 × KU 96-3, IPU 94-1 × IPU 17-1, IPU 94-1 × IPU 19-27, IPU 02-43 × Pant M 6, BDU 1× *V. sylvestris* / / IPU 94-1, IPU 02-43 × IPU 19-27, IPU 94-1× LBG 787, IPU 94-1 × IPU 19-27, IPU 13-1 × IPU 19-27, IPU 13-1 × IPU 94-1, IPU 02-43 × LBG 752, IPU 13-1 × KUG 479, IPU 11-02 × IPU 19-27, IPU 21-11 × IPU 13-1).

- ***F_5 generation:*** Thirteen crosses were raised in this generation (Small wild urd × IPU 19-53, IPU 19-53 × *V. sylvestris*, IPU 19-53 × IPU 19-27, LBG 787 × LBG 17, IPU 94-1× IPU 19-53, IPU 94-1 × IPU 19-27, IPU 19-27 × Mukundra Urd 2, DPU 88-31× small wild urd, IPU 94-1 × small wild urd, IPU 94-1 × *V. umbellata*, DPU 88-31 × *V. sublobata* (W 51), IPU 02-43 × *V. sylvestris*, IPU 11-02 × *V. sylvestris*, small wild urd × IPU 94-1, IPU 94-1 ×*V. sublobata* (W 39), LBG 17 × IPU 02-43, LBG 685 × LBG 17, IPU 11-02 × Lalitpur local, KUG 489 × Barabanki local, DPU 88-31 × Mukundra Urd 2, IPU 11-02 × Pant M 6, IPU 2-43 × LBG-17, T9 × LBG 17, IPU 94-1 × Lalitpur local, PKGU 1 × IPU 99-95, IPU 94-1 × PLU 272, IPU 19-27 × IPU1 9-53, IPU 94-1 × *V.trilobata*, IPU 19-53 × *V. dalziana*, IPU 94-1 × *V. sublobata* (W-51), IPU 94-1 × Jalpaiguri local.

- ***F_6 generation:*** Eight crosses have been grown in this generation (IPU 19-27 × Jalpaiguri Local, IPU 19-27 × IPU 11-02, IPU 19-27 × IPU 19-53, IPU 94-1 × IPU 19-27, IPU 94-1×Jalpaiguri local, IPU 11-02 × IPM 101-10 2, IPU 13-1 × PLU 272, IPU 13-1 × IPU19-27).

- ***F_7 generation:*** Twelve crosses were raised in this generation (NUL-7 × DPU 88-31, Lalitpur Local × DPU 88-31, KVK-P × DPU 88-31, IPU 94-1× PLU 272, Lalitpur Local × IPU 94-1//Mash-1 × PU 11-14, IPU 94-1 × Shekhar 2, IPU 94-1 × Nodai Urd, IPU 94-1 × LBG 752, IPU 11-02 × IPU 13-1, IPU 11-02 × Jalpaiguri Local, IPU 13-1 × *V. sublobata*, IPU 94-1 × PM 6).

- ***F_8 generation:*** Eighteen crosses were grown in this generation (Mash 114 × PU 11-14, Mash 114 × Mash 1008, Mash 114 × LBG 623, Mash 114 × TU 103, PLU 59 × IPU 02-43, Mash 1008 × IPU 94-1, IPU 02-43 × PM 6, Lalitpur Local × DPU 88-31, Lalitpur Local × IPU 94-1, Lalitpur Local × IPU 11-02, IPU 94-1 × PLU 272, Lalitpur Local × IPU 02-43, KVK-P × IPU 02-43, DPU 88-31 × LBG 685//*V. umbellata*, KVK-P × IPU 02-43, IPU 11-02 × PM 6, IPU 11-02 × *V. umbellata*, T 9 × IPU 02-43.

Preliminary Yield Trial (PYT)

A set of 198 urdbean entries were tested under preliminary yield trial where yield of four rows of four-meter lengths ranged from 80 gm to 588 gm. The high performing entries will be promoted to station trials in the next *Kharif* 2026 season.

Station Trial I

For yield evaluation, a set of 17 urdbean entries along with three checks were tested in main farm. Yield ranged from 410 gm to 1300 gm. The best performing lines compared to the best check (Azad Urd 1: 12 q/ha) were: IPU 24-17, IPU 24-14, IPU 24-12, IPU 24-07 were having yield superiority more than 10 per cent. Seed will be increased for the best performing entries. Each entry was grown in 10 lines of 4 meters length.

Mapping populations

Besides three mapping populations, advanced segregating for seed colour, seed size, biomass and heat tolerance.

Development of KASP markers for MYMIV resistance in urdbean and its validation across multiple *Vigna* species

The present investigation pertains to the development of two Kompetitive Allele Specific PCR (KASP) markers for the Tobacco Mosaic virus (TMV) resistance gene and F-box/LRR resistance gene, respectively. The KASP-TMV marker consists of two novel allele-specific forward primers (5' TATGAACTCTAACATGAGTGGTGAG 3') and 5' GTTATGAACTCTAACATGAGTGGTGAT 3', and one novel common reverse primer (5' CTCTGCCAATTCCTTTGTCATCATTTCAT 3'. The KASP-F-box/LRR marker consists of two novel allele-specific forward primers (5' TCCTGGATTCCGAGCAAGAAAAA3', and 5' ATGGGAAGACCCGCCAATTC3') and one common novel reverse primer (5' CCAACAGAACC AAAGAACAA 3'). These markers enable reliable identification of resistant and susceptible urdbean and mungbean varieties/genotypes. In case of highly MYMIV resistant genotypes, resistance alleles for both the genes were found and in rest of the cases either of the resistance alleles were present, which further broadens the scope of marker assisted pyramiding of these resistance alleles in susceptible or moderately resistant genotypes to elevate their genetic resistance level. In case of urdbean, the most of the tested resistant genotypes were harbouring the resistance allele (G) for TMV gene and only two out of them were also carrying resistance allele (T) for F-box/LRR gene. In case of mungbeans, abundance of resistance allele (G) for TMV gene was not that prominent among the tested materials and many of the genotypes were also having susceptible allele (T) for the TMV gene. Susceptible allele (A) of F-box/LRR gene was found in 12 of the mungbean genotypes, and null allele in case of remaining 14 genotypes. This allelic status of F-box/LRR gene and TMV gene in the most mungbeans explained the lower degree genetic resistance compared to urdbeans for MYMIV infection. These two sets of KASP markers will be helpful in marker assisted introgression of MYMIV resistance alleles in future mungbean and urdbean breeding programmes.

Plant genetic resource management and its utilization through pre-breeding-Rajmash component

Status of germplasm rejuvenated

A set of 450 germplasm lines were rejuvenated during 2024-25 in new research farm of ICAR-IIPR.

- In PYT trial, 68 fixed lines were tested for their yield performance, ranging from 175 gm to 1060 gm for two rows of 4 meter length.
- A set of 104 biofortified lines were grown and will be tested for iron and zinc concentration.
- A mapping population comprising 176 lines of the cross Uday ×Amber were advanced to F_5 generation.



Fig. : Field performance of IPR 236 (a breeding line with synchronous maturity)

Genetic and genomic resources management and their utilization in urdbean

Germplasm maintenance

Total 636 (396+240) urdbean germplasm lines are maintained and characterized.

Breeding material developed

F_1 crosses between LBG 787 × *V. umbellata,* IPU 17-2 × *V. trilobata,* IPU 19-10 × *V. umbellata, and* IPU 19-53 × *V .umbellata* developed.

Mungbean

Genetic enhancement of mungbean [*Vigna radiata* (L.) Wilczek] towards development of superior plant types for different agro-ecological regions.

Spring/Summer Mungbean Programme

- During summer 2024, forty ABLs of mungbean were evaluated with four checks (IPM 205-7, IPM 312-18, IPM 512-1 and IPM 410-3) in two separate Station trials (ST 1 and ST 2) with twenty test entries each. In ST 1, ABLs namely, IPM 21-23-17 (784 kg/ha), IPM 21-15-2 and IPM 21-15-7 outperformed the best check, IPM 312-20 (634 kg/ha.). In ST 2, test entries, IPM 2024-SS-14 (852 kg/ha), IPM 2024-SS-18, IPM 2024-SS-8, IPM 2024-SS-7, IPM 2024-SS-17, IPM 2024-SS-3, IPM 2024-SS-6, IPM 2024-SS-15 outperformed the best check IPM 409-04 (684 kg/ha)
- During spring 2025, mungbean station trial with 22 entries and Preliminary yield trials (PYTs) with 68 entries were performed at New Research Farm (NRF), Kanpur. In station trials, 19 advanced breeding lines (ABLs) were evaluated against three checks (IPM 205-7, IPM 409-4 and IPM 410-3) in RBD using three replications. Based on mean plot yield, ABLs IPM 2024-SS-3, IPM 2024-SS-5, IPM 2024-SS-12, IPM 2024-SS-15, and IPM 2024-SS-16, outperformed the best check, IPM 205-7. Two non-replicated PYTs (PYT I and II) were conducted for identification of promising entries to be tested in spring/summer station trials.
- During summer 2025, mungbean station trial was conducted with 22 entries including three check varieties under two replications at IIPR main farm. Based on mean plot yield, ABLs IPM 2025-SS-1, IPM 2025-SS-4, IPM 2024-SS-3, IPM 2024-SS-5, IPM 2024-SS-11, IPM 2024-SS-17 outperformed the best performing check, IPM 2014-9.

Selections

- From 15 breeding lines, 23 single plant selections (SPSs) were done for earliness and yield related traits.
- Moreover, ttotal 45 SPS were taken from different segregating generations, as follows:
  - IPM 205-7 x WGG 42 F_2 = 8 SPS
  - IPM 302-2 x ML 1808 F_2 = 10 SPS
  - IPM 409-4 x ML 2479 F_2 = 13 SPS
  - IPM 2-3 x EC 398889 derived F_3 bulk = 4 SPS
  - IPM 302-2 x ML 1808 derived F_3 bulk = 4 SPS
  - IPM 410-3 x MH 421 derived F_5 = 6 SPS

Germplasm maintained

During summer 2025, total 196 germplasm lines of mungbean including released varieties, indigenous and exotic collections were grown for their rejuvenation and purification.

Nucleus seed production

During Spring/Summer 2025, Virat (24 kg), Varsha (13 kg), Soorya (16 kg), Shikha (19 kg), Heera (5 kg), IPM 2-14 (2 kg), IPM 2-3 (5 kg), Kanika (13 kg), Vasudha (10 kg), IPM 99-125 (5 kg) and Samrat (PDM 139, 7 was kg) produced.

Kharif Mungbean Programme

During *Kharif* 2024, 19 ABLs of mungbean were evaluated with five checks (IPM 409-4, IPM 205-7, IPM 99-125, IPM 302-2 and IPM 2K14-9) in a Station trial (ST 1). Test entries IPM 2024-SS-7, IPM 2024-SS-17, IPM 2024-SS-11 and IPM 2024-SS-15 surpassed the highest yielding checks, IPM 99-125 and IPM 409-4 by >6%. Twenty ABLs were evaluated against four checks, namely, IPM 302-2, IPM 2K14-9, IPM 410-3 and IPM 312-20. ABLs namely, IPM 21-22-11, PDM 1/DGG 5, IPM 21-20-3 surpassed the best check, IPM 312-20 by >5%. Two PYTs were also conducted with 11 and 17 entries with four (IPM 410-3, IPM 302-2, IPM 409-4 and IPM 2K-14-9) and two checks (IPM 302-2 and IPM 2K-14-9), respectively. ABLs 23/7 IPM 205-7/LGG 460 LB 9 and PDM139/UBG 04-02 were identified with near synchronous maturity. Entries IPM 2024-SS-7, IPM 2024-SS-17 and IPM 2024-SS-15 were observed to be promising during both *Kharif* and Spring Summer seasons in PYTs.

New Crosses developed: Total = 18

- Yield enhancement (Good / Good; Donors: RMG 1028, KM 2241, WGG 42)
- Plant architecture improvement (Donors: PRR 2008-2, PRR 2007-2, Landraces)
- Wide hybridization with V. *mungo* var. *sylvestris* for multiple disease resistance (Donors: DPU 88-31).Recipients: IPM 2-14, IPM 99-125, IPM 409-4, IPM 410-3, PDM 139, IPM 512-1, Pusa 672, IPM 312-20.

Generation *advancement*

During *Kharif* 2024, one hundred and fifty-

one segregating populations of mungbean were advanced to next generation, which comprised of F_1 (17), F_2 (51), F_3 (18), F_4(32), F_5 (27), F_7 (4), F_8 (1) and F_9 (1) populations.

Maintenance breeding

Nucleus seed produced

During *Kharif* 2024, nucleus seed of Virat (25 kg), Varsha (15 kg), Soorya (25 kg), Shikha (30 kg), Heera (10 kg), IPM 2-14 (10 kg), IPM 2-3 (7 kg), Kanika (10 kg), IPM 99-125 (8 kg), and IPM 2K-14-9 (Varsha, 10 kg) was produced.

Plant genetic resources management and utilization: Mungbean

Maintenance and rejuvenation

Four hundred ninety-one germplasm accessions of mungbean were maintained and rejuvenated during *kharif* 2024. 402 germplasm accessions of mungbean including landraces, released varieties and exotic lines were evaluated and rejuvenated during *kharif* 2024 under field conditions. Another diverse set of 89 accessions were maintained and rejuvenated under field conditions during *kharif* 2024. Another set of 40 landrace accessions were maintained in wild garden.

Accessions were selected for long duration, erect plant type post monsoon rains, drooping pods and other traits suitable for *kharif* season and following accessions IC 3264, IC 540488, LGG 460, PGRV, EC 520024, EC 520041 were selected as donors for development of breeding materials for *kharif* season.

New crosses developed

Five new crosses were developed with target of development of new plant type with reduced internodal distance and higher number of pods, increased pod length, erectness, drooping pod type utilizing landraces as donors.

- IPM 2-14/ PRR 2007-2; CoGG 8/ Landrace collection from MP with long pods and 12-14 seeds/pod
- IPM 409-4/ IC 251372
- IPM 410-3/IC 251372
- EC 398889//IPM 512-1/EC 398889.

Status of breeding materials/ Segregating populations developed from wide crosses and prebreeding

- Thirty-seven segregating populations in different filial generations were advanced to next generation which comprised of F_2 (8), F_3 (5), F_4 (11), F_5(13) populations.
- Sixteen promising advanced breeding lines derived from wide crosses (excluding mung/urd pedigree) and prebreeding are being evaluated in Station trials and Preliminary yield trials.

Fieldpea

Development of biotic and abiotic stress resistant superior varieties through integrated conventional and modern breeding approach: Fieldpea

Variety released and notified

i) **IPFD 18-3 (Purvansh):** This elite dwarf and leafy type fieldpea genotype is developed by crossing between 'HUDP 15 and 'P 1544-4 as parents through the pedigree breeding method. It is a medium-duration (117 days) variety with slightly dimpled, creamy white-coloured, medium-sized (18.0 g/100-seed weight) seeds. This variety registered a 13.36% yield superiority over the best check variety, SKNP 04-9, in NEPZ. The average grain yield of 1731 kg/ha was obtained across the different locations of NEPZ, and the highest was recorded at 3136 kg/ha. It is resistant to powdery mildew and *Ascochyta* blight disease, while moderately resistant to rust disease. Hence, it is released and notified for commercial cultivation in the North Eastern Plain Zone (NEPZ) comprising states of eastern Uttar Pradesh, Bihar, Jharkhand, West Bengal and Assam.



ii) **IPFD 18-8 (Arpit):** This is a dwarf, leafy type and round & creamy colour seeded variety developed through hybridization between EC 499761 x IPFD 1-10 following the pedigree method. The average grain yield of 1,471 kg/ha was achieved in Uttar Pradesh State adaptive trials, and the highest was recorded as 2,712 kg/ha. It has resistance to powdery mildew and rust disease. Thus, it

has been released by the 37th SVRC meeting for the Bundelkhand region of Uttar Pradesh.



Generation of breeding material

During winter season of 2024-25, total 59 crosses were synthesized by engaging various donors possessing specific traits *i.e.* large seed size, no. of seeds per pods, pod length, no. of pods per plants, earliness, powdery mildew resistant and rust tolerant.

Registration of varieties with PPVFRA, New Delhi

A total of nine varieties of fieldpea have been registered with PPVFRA, New Delhi, as per details given below:

Variety	Registration no.
IPFD 9-2	REG/2024/0391
IPFD 19-1 (Shikhar)	REG/2024/0399
IPFD 2014-2	REG/2024/0394
IPFD 10-12	REG/2024/0409
IPFD 19-3 (Arpan)	REG/2024/0398
IPFD 11-5	REG/2024/0393
IPFD 12-2	REG/2024/0400
IPF 16-13 (Harit)	REG/2024/0406
IPFD 6-3	REG/2024/0390



Evaluation of advance breeding lines

In station trial for dwarf types, 12 genotypes were evaluated with three checks in RBD, of them, IPFD 2025-9 (3792 kg/ha), IPFD 2025-1 (3641 kg/ha), IPFD 2025-8 (3586 kg/ha) and IPFD 2025-3 (3547) outyielded the best check, IPFD 19-1 (3297 kg/ha). Likewise, in station trial for tall types, 12 genotypes were evaluated with three checks, of them, four genotypes *i.e.* IPF 2025-19 (2916 kg/ha), IPF 2025-15 (2810 kg/ha), IPF 2025-21 (2814 kg/ha) and 2025-20 (2783 kg/ha) were demonstrated superiority over the best check, IPF 5-19 (2319 kg/ha). In addition, preliminary yield trials (PYT) were conducted in tall and dwarf categories with 52 and 48 advanced breeding lines with three checks; of these, 10 and 25 entries, respectively, demonstrated yield superiority over the respective best checks.

Selections of promising genotypes from segregating population

During *rabi* 2024-25, total of 30 crosses were raised in the F_1 generation. Segregating generations of 23 F_2 (1035 SPS), 28 F_3 (1520 SPS), and 33 F_4 (1155 SPS) were evaluated, and superior single plants were selected considering targeted traits, *i.e.*, earliness, pods per plant, seed size, pod length, resistant to powdery mildew, rust, and seed yield/plant. In F_5 and F_6 generation 153, and 463 single lines were evaluated, respectively. Besides, a panel of 111 advanced breeding lines was evaluated.

Trait-specific genetic stocks registered and developed

The Institute GGIC recommended below given trait-specific genotypes for registration as unique genetic stock at ICAR-NBPGR, New Delhi.

Genotype	Traits	Status
IPF 21-21 (INGR 2406)	Acacia type leaf pattern	Registered with NBPGR
DMR 6	Post-emergence herbicide	Recommended by GGIC
IP2K 101	Post- emergence herbicide	Recommended by GGIC
IPFD 24-1	Pod length & seed weight	Recommended by GGIC

Mapping populations development

The RIL population (310) of rust [HFP 4(S) / FC1(R)] was characterized for days to flowering, days to maturity, HSW, and grain yield. Besides, mapping population for earliness using IPF 5-19 / IPFD 18-14 has been advanced from the F_4 to F_5 stage

with a population size of 512 individuals.

Promising entries in AICRP trials

Based on the performance of tested entries in *rabi* 2024-25 under AICRP multi-location testing, the following entries have been promoted in different zones and ecologies.

Trial	Zone	Genotype (kg/ha)	Best check (kg/ha)	Superiority (%)
Tall	NHZ	IPF 23-23 (1304)	Pant P 42 (1034)	26.11
		IPF 23-19 (1154)		11.60
	NWPZ	IPF 24-13 (2436)	Aman (1889)	28.96
		IPF 24-15 (2089)		10.58
Dwarf	NHZ	IPFD 24-7 (1354)	Prakash (1105)	22.53
		IPFD 24-1 (1229)		11.22
		IPFD 24-8 (1165)		5.42

Likewise, in state adaptive trials of Uttar Pradesh, total of 15 entries were tested, including four new entries, *i.e.*, IPF 22-22, IPF 22-24, IPFD 22-9, and IPFD 22-6. One entry, IPF 20-20, was found promising based on three-year performance, and the identification proposal has been invited. While three entries, IPF 20-2, IPFD 21-5, IPF 21-14, have been promoted to AVT-2 stage testing.

Protein analysis of advanced breeding lines

A panel of 150 advanced breeding lines was evaluated for protein content. The result revealed that protein content ranged from 17.56-28.19%. The best five genotypes, considering protein content and high yield, were identified, which revealed that protein and grain yield have a negative relationship.

Germplasm rejuvenation and evaluation

During reporting period, total 409 accessions of fieldpea were planted for rejuvenation and evaluation. All the accessions were successfully rejuvenated and evaluated for different traits like anthocyanin, foliage: colour, foliage: wax bloom, leaf axil colour, stipule type, petal colour, days to flowering, first pod bearing node, last pod bearing node, blank node, pod length, reproductive period, days to maturity, 100-seeds weight and grain yield. The below presented two ways clustering based on qualitative and quantitative traits witnessed ample amount of variability exists in the studied materials.

Identification of trait specific donors

The evaluation results of different traits revealed some of the trait specific donors. Given trait specific donors will be used in regular breeding programme to design better plant type with high yield potential.

Maintenance breeding

During winter season of 2024-25, total 19 varieties of fieldpea developed by ICAR-IIPR, Kanpur were maintained by single plant selection to maintain the genetic purity of varieties.

Nucleus seed production of released variety of fieldpea

The nucleus seed production programme of 19 fieldpea varieties developed by ICAR-IIPR, Kanpur was taken during 2024-25 as per DAC indent. Total 3,168 kg nucleus seed of fieldpea was produced, of which, the highest was for IPFD 12-2 (484 kg) followed by IPF 16-13 (418 kg) and IPFD 13-2 (335 kg). Nucleus seed of varieties like IPFD 19-1 (232 kg), IPFD 19-3 (204 kg), IPFD 11-5(154 kg), IPFD 16-3 (135 kg), IPFD 12-8 (240 kg), IPFD 9-2 (299 kg), IPFD 14-2 (147 kg), IPFD 10-12 (94 kg), IPFD 6-3 (113 kg), IPFD 18-3 (101 kg), IPFD 18-8 (88.5 kg), IPF 4-9 (16 kg), IPFD 99-13 (24 kg), IPFD 1-10 (21 kg), IPF 5-19 (23 kg) and IPF 99-25 (39.5 kg) was produced.

Contribution of IIPR fieldpea varieties in National Breeder Seed chain

In the national breeder seed indent, IIPR varieties total share was about 58% and of which IPFD 12-2 had the highest share (9.85%) followed by IPF 16-13 (6.90%) and IPFD 9-2 (6.35%).

Copyright

Received copyright for a dataset of leaf miner infestation pattern in field pea leaves for AI-based diagnosis.



Externally Funded Projects

Project : Molecular breeding for improvement of tolerance to biotic and Abiotic stresses, yield and quality traits in crops: Chickpea

Salient Achievements

The project was undertaken with the objective of marker assisted pyramiding of multiple

race resistance genes against *Fusarium* wilt, Ascochyta blight and drought tolerance genes in popular chickpea cultivars. The objective-wise achievements are as follows:

Objective 1: Introgression of gene(s)/QTL governing resistance/tolerance to *Fusarium wilt* in elite chickpea cultivars

Fresh crossing has been initiated among mega varieties AKG 1303, BG 3043, GNG 1581, GNG 2171, CSJ 515 as recurrent parent and WR 315 as donor parent. Besides, another set of crossing was initiated for combining *Fusarium* wilt resistance in the recently released drought tolerant MABC lines *viz*., BG 4005, NC 7, Pusa JG 16, BGM 10216 as recurrent parent and WR 315 as donor for wilt resistance. One cycle of backcrossing was completed in the crosses (JG 16 x WR 315), (RVG 202 x WR 315) and (BGM 10216 x WR 315) with their respective recurrent parents. Besides, 18 advanced breeding material were multiplied for inclusion in AICRP trial. The backcross progenies (BC_3F_7) were subjected to marker analysis using foreground markers *viz*., TAA60, TA194, GA16, TA59 for race 1, TR19, TA110, TS47, TA37 for race 2, TR 19, TAA60, TA194, GA16 for race 3, TR19, GA16, TA59 for race 4. The true heterozygotes are further backcrossed to pyramid multiple race resistance against fusarium wilt. The nucleus seed production of IPCMB 19-3 (Samriddhi), the newly released variety of chickpea have been undertaken during *rabi* 2024-25. Two MABC entries *viz*. IPCMB 19-1 and IPCMB 19-2 were tested in yield evaluation trial in Madhya Pradesh and Uttar Pradesh.

Gel profile of polymorphic marker TR 19. (A) P1-GNG 2372, P2-WR 315, C1 to C11-F1 of cross (GNG 2372 x WR 315); C2, C4, C5, C7, C9 and C10 are true hybrids**. (B)**P1-IPC MB 19-1, P2-WR 315, C1 to C11-F_1 of cross (IPCMB 19-1 x WR 315); C1 is true hybrid**. (C)**P1-IPC MAS-1, P2-WR 315, C1 to C10-F_1 of cross (IPC MAS-1 x WR 315); C3, C8 and C10 are true hybrids**. (D)**P1-GNG 2171, P2-WR 315, C1-F_1 of cross (GNG 2171 x WR 315); C1 is true hybrid.

Objective 2: Introgression of gene(s)/QTL governing resistance/tolerance to *Aschochyta* blight in elite chickpea cultivars

Fresh crossing has been initiated among mega varieties CSJ 515, GNG 1581, GNG 1958, Pant G 5, PBG 8, GNG 2144, GNG 2171 as recurrent parent and GL 12021 as donor parent. One cycle of backcrossing was attempted in the cross (CSJ 515 x GL 12021) and (GNG 2171 x GL 12021) with their respective recurrent parents. Parental polymorphism was studied among recurrent parents (CSJ 515, GNG 1581, GNG 1958, Pant G 5, PBG 8, GNG 2144, GNG 2171) and donor GL 12021 using SSR markers.

(A) *P1-CSJ 515, P2-GL 12021, C1 to C7-F1 of cross (CSJ 515 x GL 12021); C2, C3, C5 and C7 are true hybrids.*

Objective 3: Introgression of gene(s)/QTL governing resistance/tolerance to drought in elite chickpea cultivars

Fresh crossing has been initiated among mega varieties AKG 1303, BG 3043, GNG 1958, GNG 2171, GNG 2144, Phule G 0405 as recurrent parent and ICC 4958 as donor parent. Besides, another set of crossing was initiated for combining drought tolerance in the recently released wilt resistant MABC lines *viz*., IPCMB 19-2 and Samriddhi as recurrent parent and ICC 4958 as donor for drought tolerance. Backcrossing cycles were undertaken in the crosses (JAKI 9218 x ICC 4958), (RVG 202 x ICC 4958) with their respective recurrent parents. Besides, improved lines of KWR 108 and GNG 1581 harbouring *QTL HOTSPOT* region for drought tolerance were multiplied. A new set of Insertion-deletion flanking primers were designed based on analysis of whole genome sequence data of ICC 4958, DCP 92-1, HC 5, Digvijay, JG 16, JAKI 9218, C 235, CSG 8962, ICCV 10 and KWR 108. The primers were tested in donor (ICC 4958) and mega varieties used as recurrent parent such as GNG 2207, JAKI 9218, BG 3043, Phule G 0405, GL 13001, AKG 1303, GNG 2299, GNG 1581, JG 16, GNG 2171, GNG 1958, GNG 2144 and GNG 2372. Five newly designed markers (Hotspot 9, 10, 11, 29 and 30) which were close to fine mapped QTL-hotspot region can clearly differentiate the donor and recipients.

Project : ICAR- Consortium Research Platform (CRP) on Agrobiodiversity (Chickpea)

The project was undertaken with the objective of utilization of *Ascochyta* Blight resistant lines identified in the project for improving adapted cultivars. During *Rabi*, 2024-25, the activities undertaken involved making fresh crosses utilizing donors for AB resistance and advancing the breeding material and mapping of AB resistance genes using biparental mapping population L 550 (AB susceptible) x IC 117744 (AB resistant). The status of breeding material under the project is presented below:

Generation	Breeding material	Remarks
F_4	6 crosses/58 SPS	Donor: DKG 964, IC 275447, IC 248147
F_3	18 crosses/100 SPS	Donors: IC 248147, IC 275447, DKG 964, PBG 8
F_2	21 crosses/10 SPS	Donors: IC 117744, IC 275447, IC 248147, PBG 8, DKG 964
F_1	10 crosses	Donors: IC 117744, IC 275447, IC 248147, PBG 8, DKG 964, GL 12021
Fresh crosses	Base Parents: CSJ 515, GNG 2171, GNG 2144 Donors: IC 117744, IC 258147, IC 245447, GL 12021	

Screening of segregating material

F_2 bulk of 18 crosses shared for screening against *Ascochyta* Blight resistance at PAU, Ludhiana

Mapping for ascochyta blight resistance genes

- At ICAR-IIPR, Kanpur, the mapping population [L 550(K) x IC117744(D)] was advanced to F_3. This $F_{2:3}$ mapping population [L 550 (K) x IC 117744 (D)] was evaluated for *Ascochyta* blight resistance at PAU, Ludhiana. Based on *Ascochyta* blight reaction, the frequency distribution among the individual lines of the $F_{2:3}$ mapping population was worked out. It showed near normal distribution curve.
- Genetic polymorphism among parents, resistant and susceptible bulks were studied. Among 40 markers screened, 19 were polymorphic among parents. Four markers *viz.*, QTL 21, QTL 23, NC 21 and H2I10 showed similar bands based on pairwise comparison among resistant parent (IC 117744) and resistant bulk; similar reaction was observed among susceptible parent (L 550) and susceptible bulk. Based on preliminary analysis, these markers were proposed to be putatively linked with Ascochyta blight resistance in chickpea.

Table. Genetic polymorphism among parents, resistant and susceptible bulks

Marker	Major Allele Freq.	Allele No.	Gene Div	PIC
TA59	0.3750	4	0.6875	0.6299
TR8	0.5000	3	0.6250	0.5547
QTL23	0.5000	2	0.5000	0.3750
TA2	0.5000	2	0.5000	0.3750
TR56	0.5000	2	0.5000	0.3750
TA96	0.5000	2	0.5000	0.3750
TA103	0.5000	2	0.5000	0.3750
TA37	0.5000	2	0.5000	0.3750
TAA170	0.5000	2	0.5000	0.3750

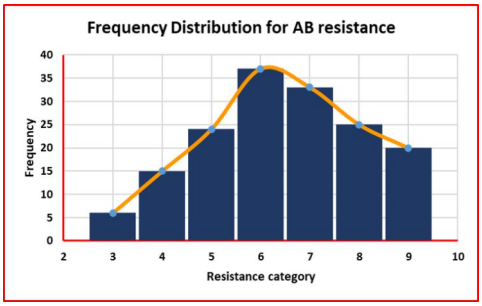


Fig. Frequency Distribution for AB resistance among $F_{2:3}$ mapping population.

Project: Enhancing Pigeonpea production and productivity in India by promoting high-yielding early maturing varieties and hybrids (DAC-GOI Funded)

- In this project, four trials *i.e.* extra early, early, mid-early and hybrids with 46, 46, 36 and 46 entries were conducted, respectively, along with four checks in alpha lattice design and evaluated for yield and yield attributes. The yield levels in the extra early, early and mid-early trials varied between 820-3187 kg/ha, 1900-2980 kg/ha and 1769-3127 kg/ha, respectively. Top five promising entries from each trial were identified considering earliness and grain yield for seed multiplication and next year yield trial at ICAR-IIPR, Kanpur location. In the case of hybrids, grain yield ranged from 1,156 to 3,513 kg/ha, while maturity ranged from 128 to 159 days.
- A farmers' varietal selection trials was conducted for eight varieties at three locations (Urdana, Bhakharna and Ramipur) by 23 farmers, of them, the highest farmers' preference was noticed for both the hybrids IPH 15-03 and IPH 09-05 followed by varieties KRG 33 and IPA 15-06.
- In this project to demonstrate pigeonpea hybrid potential, total 12 ha frontline demonstration were organised in Fatehpur and Hamirpur district of Uttar Pradesh for short duration

pigeonpea hybrid IPH 15-03 with full package technology. In demonstration, more than 30% yield advantage was recorded over farmers' practices.

- A Field Day-cum-Farmers' Training on improved pigeonpea technologies was conducted involving pigeonpea farmers of Urdana village of Hamirpur, Uttar Pradesh, where, on-farm trials and frontline demonstration (06 hectares) were executed in *Kharif* 2024.



Fig. Glimpses of Pigeonpea Hybrid (IPH 15-03) field in demonstration plot and Fieldday-cum-farmers' training programme

Project: Evaluation and genetic improvement of pigeonpea landraces for development of climate resilient varieties for Uttar Pradesh (UPCAR funded)

Collection and characterization of landraces

Seeds of 21 local/*desi* varieties of long duration pigeonpea *viz*. Kandlul-1, Kandlul-2, Kandlul -3, Kandlul -4, Kandlul-5, Kandlul-6, Mirzapur Local, Ram Arhar, Banda Tindwari Local, Kanwara Local, Bahraich Local, Bisanda Local, Naraini Local-4, Chitrakoot Local -7, Chitrakoot Local-8, Chitrakoot Local -11, Balaudha Local -1, Chhigree, Balaudha Local-2, Sitapur landrace and Sitapur Local were collected from the farmers. These landraces were characterized for qualitative and quantitative traits as per the pigeonpea descriptor.

Evaluation for yield, reaction to wilt and *Phytophthora* stem blight

These landraces showed the range of yield from 60 kg/ha (Kandul 5) to 2395 kg/ha (Naraini Local 4). After screening in wilt sick plot, it was observed that eleven landraces namely Kandul 1, Kandul 3, Kandul 4, Mirzapur Local, Ram Arhar, Banda Tindwari Local, Bahraich Local, Chitrakoot Local 7, Balaundha Local 1, Chigree and Sitapur Local-3 were resistant/ moderate resistant to wilt disease. In PSB sick plot, none of the entries was observed as resistant to *Phytophthora* stem blight disease.

Observation on high yielding and wilt resistant races

Observations reveal that the eight landraces *viz*. Mirzapur Local, Ram Arhar, Banda Tindwari Local, Bahraich Local, Chitrakoot Local 7, Balaundha Local 1, Chigree and Sitapur local-3 possessing resistance to wilt disease and promising from yield point of view. Chitrakoot Local 7 yielded (2,320 kg/ha) more than the best check IPA 15-2 (2,223 kg/ha). It also showed moderate resistance (14.28% wilt infection) to wilt. These promising landraces *viz*. Mirzapur Local, Ram Arhar, Banda Tindwari Local, Kanwara Local, Chitrakoot Local 7, Chitrakoot Local Eleven, Balaundha Local 1, Chigree and Sitapur landrace ae being grown in replicated yield trial for confirmation of yielding ability. These entries are also being grown to confirm their resistance to wilt diseases. One set of these landraces has been sent to BHU, Varanasi for screening against sterility mosaic disease.

Leaf sampling from landraces for DNA isolation

Leaf samples of promising eight landraces which were observed as promising from yield and resistance to wilt point of view and fourteen new landraces collected from Chitrakoot and Banda districts of Bundelkhand region were taken, by Dr. Sandhya Sharma, Scientist (Sr. Scale) at ICAR-IARI, New Delhi for DNA isolation and molecular work.

Project: Building lentil growing community resilience by the development of climate smart lentil varieties through farmers' participatory interventions (DA&FW funded)

A trial of 100 Advanced Breeding Lines (ABLs) was conducted at 12 centres to identify climate-resilient lentil lines. Under normal sown conditions, 21 promising entries have been identified, yielding between 883-1031 kg/ha with a 10.0-33.5% yield advantage over the check variety IPL 316. Notably, PL-20-235 was the highest yielder in 2024-25, while IPL-21-203 topped the list over two years with a yield of 1062 kg/ha and a 33.87% yield advantage. In rice fallow conditions, four ABLs have

shown promise, yielding between 1484-1584 kg/ha, with IPL 20-203 being the highest yielder and maturing early in 106 days. However, based on two-year data, IPL 21-28, demonstrated high yields of 1255 kg/ha with a 17.4% yield advantage over the check variety IPL 220 and matured in 106 days, making it suitable for rice fallow conditions. The evaluation of 60 lentil varieties across 12 centres has resulted in a genetic gain of 68-252 kg/ha for different zones. Additionally, 11 centres have produced 275.065 quintals of quality seeds of improved high-yielding lentil varieties less than 10 years old. Demonstrations of climate-resilient lentil varieties were conducted on 100.78 hectares of farmers' fields, and 18 training and awareness programmes were organized for 830 farmers on lentil quality seed production and improved technologies.

Project: Detection of genetic loci associated with yield attributes and seed quality traits under high temperature exposure in fieldpea (*Pisum sativum* L.) (SERB-DST)

Bioinformatics workflow

The genotypic data of 150 samples was generated by pair-end sequencing on Illumina® HiSeq/MiSeq platform were subjected to analysis to understand genetic diversity, population stratification and marker trait association. Total 2,290 SNP loci were used to perform diversity analysis and to identify the association with different traits.

Genetic diversity analysis and population stratification

The nucleotide diversity (π) is a reflection of genetic diversity, which can be used to monitor diversity and genetic variation in crops and related species or to determine evolutionary relationships. In our analysis, the value of π was 0.0599. The Watterson estimator (θ), which is an estimation of the population mutation rate, was 0.18552. Usually both π and θ range between 0 and 1, where the inclination toward 0 indicates the presence of less diversity. The estimated values of nucleotide diversity and watterson estimates suggest the presence of lesser diversity in the selected set of germplasm. The Tajima's D in our population was −2.35088. Tajima's D is computed as the difference between two measures of genetic diversity: the mean number of pairwise differences and the number of segregating sites, each scaled so that they are expected to be the same in a neutrally evolving population of constant size. When Tajima's D value is less than 0, it means abundant rare alleles are present, suggesting a possible selective sweep and population expansion. The STRUCTURE v2.3.4 was used for population stratification, where the number of sub-populations (k) was set from 1 to 10 with the burn-in period and the number of Markov Chain Monte Carlo (MCMC) replications was set to 1,00,000 under the "admixture mode". Ten independent runs were performed for each k-number. Finally, the structure was plotted using the STRUCTURE Harvester vA.2. The delta K method developed by Evanno and his coworkers was used to determine the optimal value of k. Population structure divided 150 accessions into two populations.

Marker Trait Association analysis

GWAS was conducted using the GAPIT package version 3.0 in R software, which employs Bonferroni correction to define statistically significant MTAs. For this study, seven association models were implemented, namely General Linear Model (GLM), Mixed Linear Model (MLM), Multiple Loci MLM (MLMM), Fixed and Random Model Circulating Probability Unification (FarmCPU), Bayesian-information and Linkage-disequilibrium Iteratively Nested Keyway (BLINK), and Settlement of MLM Under Progressively Exclusive Relationship (SUPER) algorithms. Using the multi-model analysis, identified a total of 6 marker trait associations. Of these, 4 MTAs were for 100-seed weight, 1 for grain yield and 1 for harvest index. The blink model identified MTA1 as associated with 100 SW in both normal and heat stress conditions of 2017. Similarly, the blink model identified MTA2 in normal condition of 2017, while the SUPER model identified it in heat stress conditions of 2017. The SUPER model identified 100 SW as associated with both normal and heat stress conditions in 2017. In 2018, we could identify only 1 MTA (MTA4) for 100 SW using the SUPER model in normal condition. In the case of GY, we could only identify one MTA (MTA5) in the extreme heat stress of the 2018 trial using the blink model. In the case of HI, we could only identify one MTA (MTA6) in extreme heat stress conditions of the 2017 trial using the MLMM, BLINK, and SUPER models. The Manhattan plots and Q-Q plots of 100 SW for both heat stress and non-heat stress conditions are presented below. Similarly, marker trait association analysis was performed for different traits and total 34 for SNPs were identified for different agro-morphological traits under different conditions. Besides, several SNPs were also found associated with different traits like chlorophyll content, flavonoids, NBI, and Fe content.

Quality Traits

The iron, zinc and protein analysis of seeds for non-heat stress and heat stress conditions were analysed which demonstrated increasing trends under stress conditions. The protein content under

non-heat stress conditions fieldpea genotypes (150) were analyzed which ranged between 19.70 and 28.28 per cent while under heat stress ranged from 17.14 to 28.12 per cent. Interestingly, it was noticed that seed size had negative association with protein content. Protein had positive association with both iron and zinc under heat stress and normal conditions, while iron and zinc had negative association.

Project: Pre-breeding and genetic enhancement of germplasm of common bean

Genetic stocks identified

A novel trait-specific donors were identified in common bean germplasm and germplasm registration will be initiated.

Accessions	Donor trait
EC 1038024	Long pod and medium-large seed size
IC 326623	Anthracnose resistance

Breeding materials generated

A large number of crosses were attempted for producing sufficient quantity of F_1 hybrids possessing specific characteristics. Ten F_1 were harvested. *Phaseolus coccineus* was used as a source of BCMV and anthracnose resistance and currently, F_2 populations will be grown during 2025-26 and initial selections will be made.

Project: Heat tolerance screening in common bean

Common bean is more sensitive to heat stress than other legumes. Transcriptome analysis of two heat-tolerant accessions: Bio-5 and IPR-277 (n=6, heat vs control) were conducted and sequencing was carried in a Nova-Seq 6000 and on average 10 GB data per sample was generated. Total number of reads generated was 352,248,584 and average read length was 151. This paired-end sequencing data used in a reference based differential gene expression analysis pipeline and putative genes were identified with significant differential gene expression.

A putative number of genes (seven genes in chromosomes 1, 5, 7, 10 and 11) were identified and validated in a quantitative gene expression study. This set of genes could be useful for screening for heat tolerant common bean genotype identification.

Chromosome	Candidate gene
Chr1	SWR1-complex protein 4 like
Chr5	Uncharacterized protein
Chr7	probable lipid-associated protein
Chr10	Uncharacterized protein
	cell number regulator 6-like
	WEB family protein At2g38370-like
Chr11	Protein Kinase like

Project: Computational analysis of lentil genome sequences for the identification of marker genes for heat tolerance (ICAR-IASRI funded)

During 2024-25 *rabi* season, a field trial was conducted comprising 200 lentil breeding lines following Alpha Lattice with two replications under normal and heat-stress condition. A few lines were found to be heat-tolerant compared to others; this is to be validated in second year of trial. In a QTL-Seq experiment about 32 GB data (8x coverage) for parents (IPL 316 and IG 4258) and heat-tolerant and sensitive bulks about 64 GB (16X coverage) data was generated on average and currently, SNP index and QTL mapping is underway. Ratio of number of empty pods to total number of pods/plants was found to be the key trait deciding heat-tolerant and sensitive lentil genotypes. In a GBS experiment, 200 RILs were genotyped and phenotyped for one year. This experiment will be repeated during 2025-26.

Table : Segregating materials (F_5) were advanced for desired targeted traits.

Pedigree	Population size (approx.)	Traits
EC 1038024 / EC 1037996	150	High Fe and Zn
Tripura Selection/EC 1038024	170	High grain yield, BCMV resistant
Varun / Arun	110	High grain yield, Early maturing, Bush plant type
EC 1038024/Kailash	142	High grain yield, Early maturing, Anthracnose resistant
Amber/Varun	160	High grain yield, Early maturing, Bush plant type
Kailash/EC 1038024	187	High Fe and Zn, Higher grain yield
Varun/EC 1038024	214	High Fe and Zn, Higher grain yield

Plant Biotechnology

Institute Megaproject: Genomics, Genetic Engineering and New Breeding Technologies for Pulses Improvement

SP1: Marker-assisted gene introgression for abiotic stress tolerance and their effect on primary metabolites in chickpea

Marker assisted gene introgression of the "QTL hotspot" region was done in the genetic background of KWR 108, JAKI 9215 and GNG 1581 respectively. Five Insertion Deletion (InDel) primers spanning fine mapped QTL-hotspot region were used in foreground selection of BC_2F_2 and BC_2F_3 lines of JAKI 9218 and GNG 1581. Identified lines harboring ICC 4958 donor segment present on chr.4 using InDel markers in the GNG 1581 and JAKI 9218 genetic backgrounds. These lines were tested under filed condition and identified 3 superior lines in the background of GNG 1581 in terms of yield and nominated for AICRP -2025-26 trail. Nucleus seed production of the newly developed drought tolerance MABC variety IPCL 4-14 was carried out at IIPR, Kanpur and produced 25 kg seeds. The sowing of advanced backcross lines of JAKI 9218 and station trials with selected lines of foreground marker positive and phenotypic similarity to the recurrent genotypes, will be carried out during *Rabi* 2025-26.

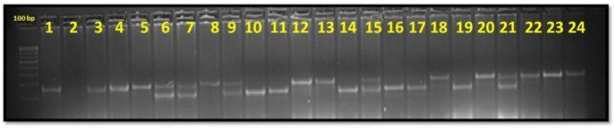
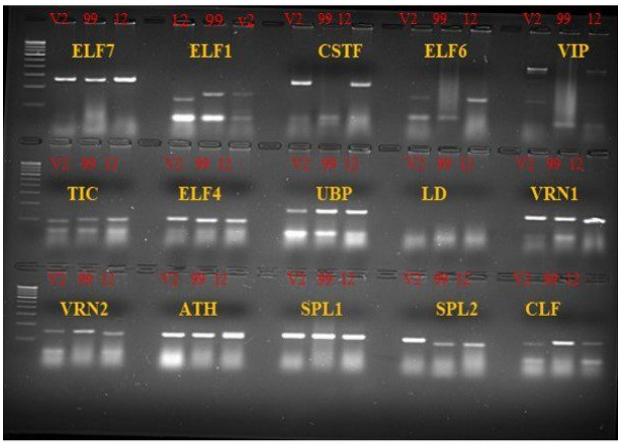


Figure : Segregation of QTL-HOTSPOT spanning InDel Markers in BC_2F_2 of Jaki9218 x ICC4958

SP 2: Molecular mapping of heat stress tolerance QTLs and understanding heat stress induced transcriptome dynamics in chickpea

Generation advancement of 6 mapping populations to RIL (F_8 to F_9) was carried out during *Rabi* 2024-25. Phenotyping and genotyping of F_8 mapping populations (BG 256 x EC 556270) following BSA-Seq approach identified 5 major genomic regions on Chr1, 4, 5, 6 and 7. Valisation of these identified genomic regions is in progress. Along with these, another two populations (ICCV 2 x ICC 9942 and ICCV 2 x ICC 12155) segregating for heat stress is also screened for heat stress at IIPR, Kanpur. ICCv2 is a heat escape genotype which flowers in 35 days during heat stress and segregants from these crosses showed high variability for 100-seed weight, fertility and per cent pod set. Screening of F_8 mapping population differing for earliness and



V2: ICCV2; 99: ICC9942; 12: ICC12155

Polymorhism in flowering related genes between ICCV 2 vs ICC 9942 and ICC 12155

genotyping these population with polymorphism present in flowering related genes (Figure) identified *Efl3* as a major locus governing earliness in this population.

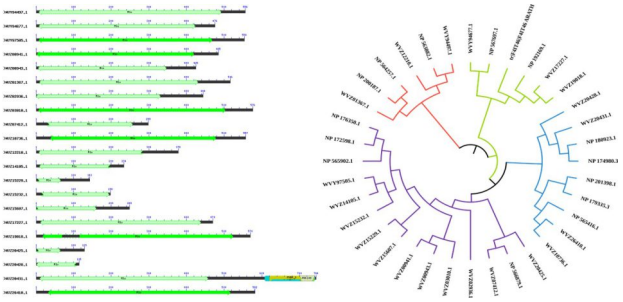
SP3: Molecular diagnosis of *Fusarium* sp. infecting chickpea and pigeonpea

Two *Fusarium udum* isolates (F 16 and F 17) differing for virulence were sequenced and genome assemblies (F 16 *vs* F 17) of these were differed in size (58 mb *vs* 56 Mb), mimp transposable elements (1 *vs* 3) and find genetic variations (SNPs and InDels) present between these two isolates. Both the isolates have ~460 effector coding genes. A total of 309,418 SNPs, 11,456 insertions, and 12,653 deletions were identified between the F16 and F17 isolates. Among these, approximately 300 InDels with more than a 20 bp difference were identified, and designed 50 primers (Mostly present in genes) to evaluate the isolates of *Fusarium udum*. Genotyping of *F. udum* isolates with designed InDel primers is in progress to differentiate the isolates/races.

SP 4: Molecular dissection of loci for powdery mildew resistance and photo-thermo-insensitivity in urdbean

Powdery mildew and photo-thermo insensitivity are among the major challenges in urdbean crop. In order to study the *Vigna mungo* genotypes against powdery mildew, approximately 250 blackgram genotypes were screened at IIPR RS, Khordha and IIPR RS, Dharwad. Two genotypes (IC 24129, UH 817) were found to be resistant to powdery mildew.Also, through genome-wide study, 21 MLO genes have been identified in the urdbean genome.

On phylogenetic studies, it was found that these genes falls under four major clades. The study of their physio-biochemical properties revealed that the size of MLO proteins ranges between 12.8 and 80.8 KDa and the isoelectric point ranges between 6.68 and 10.17.



Phylogenetic tree of Vm MLO gene family and the conserved MLO domains

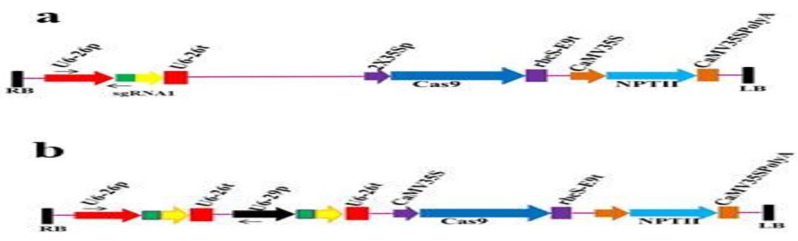
A photoperiod screening facility was established using full spectrum grow lights and sensor-based controlled temperature and photoperiod system. The genotypes which responded well in the field screening, were tested in photoperiod screening facility in two different conditions of 10 and 14 hours of photoperiod. The set of genotypes under 10 hours of photoperiod, completed seed development in 60-65 days, whereas the one under 14 hours photoperiod continued its vegetative growth even after 60 days of sowing.

P5: Precision plant breeding and rapid generation advancement in chickpea

The project envisages development of a facile genome editing system (SDN1) in chickpea by attempting knock-out of 15-*cis*-phytoene desaturase (PDS) gene (Gene ID: 101499699) located at Chr 5 using arrayed gRNA cassette under two component transcriptional unit (TCTU) system. Guides targeting Exon 4 (5'TAATGATCGGTTACAATGGA3') and Exon 5 (5'GCCTGCTATGCTTGGTGGAC3') of the gene were cloned under *Mt*U6.6 promoter in the binary vector p201N-Cas9 (RRID: Addgene_59175) harbouring *Spy*Cas9. *Rhizobium radiobacter* (LBA4404) mediated genetic transformation was attempted in chickpea cultivar GNG 2171. Albino and stunted shoots were obtained in tissue culture, which could be phenotypically distinguishable from the control green and healthy shoots. Sanger sequencing of the loci derived from 10 independent shoots (30-35 d old) indicated insertion and/or deletion (InDel) in either exon 4 or exon 5 and two drop-out mutants. This corroborates the amenability of the system including vector and protocol for targeted mutation in chickpea.

SP6: Molecular approaches for improving the nutritional quality of grasspea (*Lathyrus sativus* L.) and field pea (*Pisum sativum* L.)

The aim of this project is to characterize the ODAP biosynthesis pathway related genes in grasspea and RFO metabolism related genes in field pea, as well as to develop and optimize CRISPR/Cas based gene editing system in grasspea. Genomic DNA was isolated from 28 T_1 transformants derived from 6 T_0 plants, generated by transforming constructs carrying the *LsBOS* guide RNA (Fig a). PCR was done to check for the presence of Cas9 and other T-DNA specific elements. Twelve T_1 plants from the 6 T_0 showed the expected size of T-DNA specific band. Editing detection for the target region by sequencing is in progress. This year, 453 embryonic axis explants were transformed with two CRISPR/Cas constructs harboring guide RNA targeting the *LsBOS gene (Fig a, b)*. 15 T_0 plants were established by grafting and T1 seeds were harvested from 9 T_0 plants. 25 T1 seeds from 9 T_0 plants were sown in the containment facility, molecular analysis of these transformants is in progress. Since both BAP and kanamycin hinder establishment of transformed shoots in soil, we attempted an alternative approach for transformation without using BAP and kanamycin. Using this method, we established 106 T_0 plants out of 450 explants transformed with two constructs (Fig a, b). Three hundred seventy seven T_1 seeds from 106 T_0 plants were harvested and sown in the containment facility for further molecular analysis and target gene editing. To quickly assess the effectiveness of guide RNA, we optimised the hairy root induction protocol in grasspea using cotyledon with attached hypocotyl as an explant. The transformation of hairy roots was performed using a CRISPR/Cas vector harbouring guide RNA for the *LsBOS* gene (Fig a). Hairy roots were harvested from 37 explants and their DNA were isolated. Out of 29 hairy roots analysed, 23 were found to be positive for the presence of the transgene.



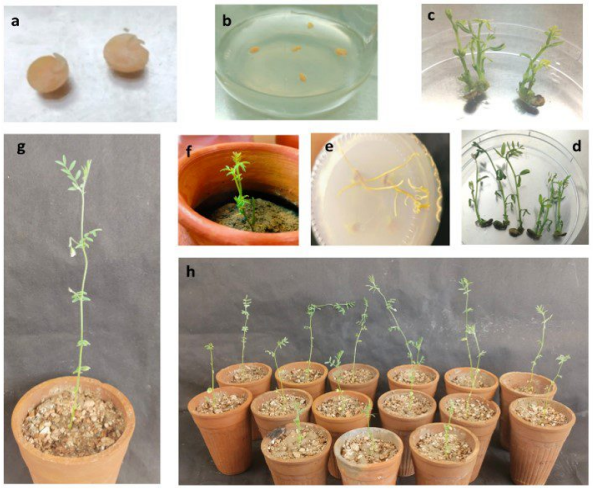
SP 7: Transforming *Vigna* for tolerance to whitefly (*Bemisia tabaci*)

The project envisaged establishment of a genetic transformation system in greengram and its utilization for developing genetically modified plants using the tma12 gene shared by CSIR-NBRI, Lucknow. Having established the *in vitro* regeneration system amenable to genetic transformation, Agrobacterium mediated transformation using two vector system for tma 2 and nptII in mungbean cultivar Samrat done and 405 explants transformed. Of these, 212 plants were directly regenerated, however molecular analysis revealed no transgene integration in these plants.

SP 8: Gene identification and development of triple gene technologies for pod borer resistance in transgenic chickpea

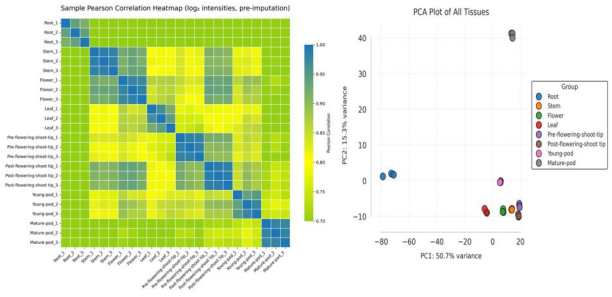
EFC Genome editing (Lentil component)

The central aim of this project is to enhance lentil productivity through genome editing of the **ckx gene**, which regulates seed number per pod. Establishing an efficient regeneration and transformation system is a critical prerequisite for this objective. Accordingly, efforts were undertaken to standardize regeneration protocols using cotyledonary nodes and embryos of the lentil variety **IPL 316**. A direct *in-vitro* efficient and reproduciblere generation protocol has been developed for the lentil genotype IPL 316 (Figure) using cotyledonary node explants was has been further evaluated in four other lentil genotypes (IPL 220, IPL 315, IPL 329 and IPL 406) and three field pea genotypes (IPF 5-10, IPFD 10-12 and IPFD 19-1) and found successful. Explants cultured on modified Murashige and Skoog (MS) medium supplemented with 2-isopentenyladenine (2iP) and kinetin (Kin) showed rapid shoot induction, with mean shoot length of approximately 3 cm by 7 days. Excised shoots transferred to a rooting medium containing indole-3-acetic acid (IAA) formed roots within 15 days. Across genotypes, the 2iP + Kin treatment significantly improved shoot emergence and shoot elongation compared with the plant-growth-regulator-free control. Genotype-dependent differences became more apparent during acclimatization and reproductive development: lentil genotypes IPL 316 and IPL 406 advanced earlier to flowering and pod initiation than IPL 220, IPL 315 and IPL 329, and fieldpea genotype IPFD 10-12 flowered earlier than IPF 5-10 and IPFD 19-1. Overall, the protocol provides a practical regeneration platform for multiple genotypes of lentil and field pea and supports downstream applications in legume



Direct in-vitro regeneration protocol in Lentil (IPL 316). (a) explant; cotyledons with plumule, b- inoculated explant in shoot inductionmedia, c- shoots after 7th day of inoculation, d- Shoots after 10th day ofinoculation, e- shoots transfer into root induction media for root induction, f-plants were transfer into vermiculite + soil combination, g- after 15 days plantsinduce flower buds, h- total number of plants that grow in the pot.

Further in order to decipher the expression pattern of the ckx genes across different plant tissue in lentil. We performed label–free quantitative (LFQ) liquid chromatography–tandem mass spectrometry (LC–MS/MS) to profile proteins from eight tissues—root, stem, leaf, pre–flowering shoot tip, flower, post–flowering shoot tip, young pod and mature pod—of plants grown under controlled conditions. In total, 1,657 proteins were identified; after filtering for ≥2 unique peptides and ≤50% missing values, 260 proteins comprised a high–confidence quantitative dataset. Differential abundance was assessed using one–way analysis of variance with false discovery rate control, followed by Welch's *t*–tests and a fold–change cut–off to define tissue–enriched proteins and major developmental shifts.



Global structure and quality of the lentil proteome dataset: (A, Left Panel) Sample–wise Pearson correlation heatmap for all samples based on log_2–transformed normalised intensities (260

high–confidence proteins). (**B, Right Panel):** Principal component analysis (PCA) of all samples. Each point represents one biological replicate (technical runs averaged). Colours indicate tissue type. PC1 separates root and mature pod from other tissues, while PC2 distinguishes young and mature pods and separates vegetative from reproductive organs, reflecting strong tissue– and stage–specific proteome signatures.

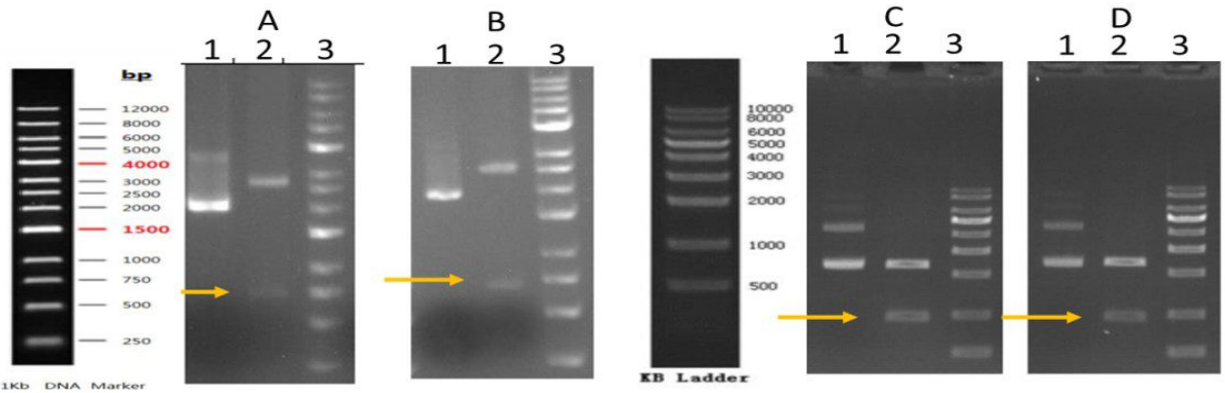
ANRF Funded Projects

Functional characterization of the *Cicer arietinum* short vegetative phase (SVP) genes, their promoters, and potential microRNAs regulating them towards elucidating their role in floral transition (Project Code: 1014190). PI: Dr. K. Aravind Kumar

The present project seeks to characterize the functional roles of three *Cicer arietinum* SVP (CaSVP) genes and its regulation by the Car_miRNA during floral transition in chickpea. The primary objective is to study the expression status of the genes and the Car_miRNA. To analyze gene expression levels across treatments, we need a set of reference genes whose expression is known to be stable in the samples being evaluated while using qRT-PCR. Minimum Information for Publication of Quantitative Real-Time PCR Experiments (MIQE) recommends set of standards towards achieving accurate and reproducible qRT-PCR experiments. Towards this, we evaluated a set of 15 primers belonging to eight known set of reference genes in chickpea and five sets of primer in lentil. The optimal combination of primer concentrations for each of the primer set was determined by evaluating for high PCR output. MIQE guidelines recommend the use of primer with an observed PCR efficiency of 90% of above. We evaluated qRT-PCR efficiency for each primer set using standard curve. Further to evaluate the function of each of the SVP paralogs in chickpea through complementation assays in Arabidopsis, Arabidopsis mutants for each of the two SVP loci were obtained from an SVP-double mutant line. Plants were found to be heterozygous for each of the loci and selfing of the F_1s is being done to realize the two SVP mutants as independent lines. Four SVP class MADS-box genes:Car_MADS64, 72,15 and 46-have been cloned into pDonR221 entry vector by gateway cloning andconfirmed by restriction digestion and sequencing (Figure x). The developed geneconstructs will be further sub cloned into destination vectors.

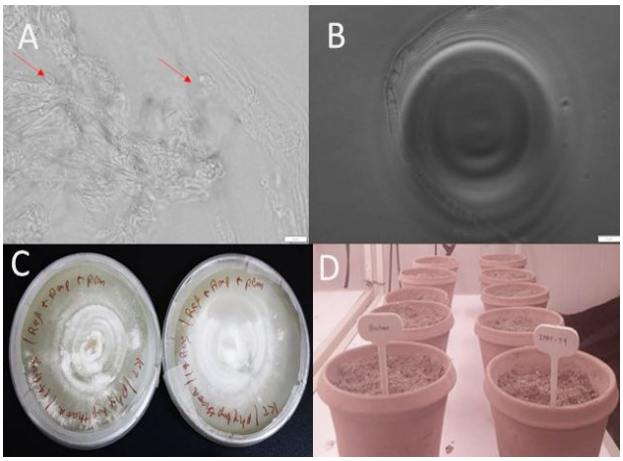
Genome wide identification and functional characterization of the effector genes of *Phytophthora drechsleri* Tucker F.Sp. *cajani* causing *Phytophthora* blight in pigeonpea.

Phytophthora blight, caused by *Phytophthora drechsleri* Tucker F. sp. *cajani*, is a devastating pigeonpea disease that can result in complete yield loss under favourable conditions, irrespective of soil type, cropping system, or variety. Identifying effector genes is critical for developing host resistance and understanding effector biology, with dual transcriptome studies serving as an effective approach to analyze effector expression during infection. For these studies, two pigeonpea cultivars—IPAC 79 (moderately resistant) and Bahar (susceptible)—were selected. Seeds were surface-sterilized with 0.1% (w/v) mercuric chloride, rinsed with sterile distilled water, and sown in pots containing field soil and vermicompost (4:1, v/v) under uniform conditions. Pathogen inoculum was prepared by transferring 6 mm mycelial discs from actively growing cultures into 100 g of sterilized sand–flour medium in 250 mL flasks, sterilized at



Cloning and verification of (A) Car_MADS64 (735 bp), (B) Car_MADS72 (735 bp), (C) Car_MADS15 (720 bp), and (D) Car_MADS46. Constructs A and B were digested with *XhoI–HindIII*, while constructs C and D were digested with *MluI*. The released inserts are indicated by arrowheads.

121.5 °C for 20 minutes, and incubated at 30 °C under a 12 h light/dark cycle for two weeks. Ten-day-old seedlings were inoculated by mixing 100 g of colonized medium into the potting soil with minimal root disturbance. To promote infection, pots were watered three to four times daily at 3–4 h intervals to maintain soil moisture. Pathogen purity was confirmed through ITS-1 and ITS-4 sequencing and microscopic examination.



(A) *Phytophthora drechsleri* Tucker F.Sp. *cajani* sporangia (highlighted). (B) Sporangia (zoomed in) (C) Pure culture on V8 Agar (D) Infection studies in pot.

SP 9: Identification of genes/QTLs for salinity tolerance in blackgram and earliness in lentil

Based on the hydroponics based screening system developed at Institute, contrasting lines have been identified and used for crossing. True hybrids have been identified. Comprehensive analysis of the NHX gene family in four *Vigna* species identified 47, 52, 44 and 44 NHX genes in *Vigna angularis*, *V. unguiculata*, *V. radiata* and *V. mungo*, respectively. The ion partitioning result supports the effluent mechanism of Na^+/K^+ ions in the tolerant genotype identified under salt stress, which was also supported by biochemical analysis.

From expression analysis, few candidate Vm_NHX genes (Vm_NHX16, Vm_NHX17, Vm_NHX29, Vm_NHX33, etc) were identified that could play potential role in imparting salinity tolerance in urdbean.

Programme: Enhancing climate resilience and ensuring food security with genome editing - legumes

Chickpea component:

The project aims to improve the productivity of chickpea using two pronged strategies: increasing the number of flowers per peduncle (Sfl1) and numbers of seeds per pod (Ln). Allele mining of the CaLn locus across a panel of chickpea genotypes and the wild species *Cicer cuneatum* revealed a largely conserved coding region, except for a single non-synonymous 1-bp substitution (GAT → CAT; Asp → His) in the conserved EAR motif of *C. cuneatum*, indicating its potential association with the number of seeds per pod trait. Real-time PCR showed constitutive expression of *Ca*Ln across all developmental stages in chickpea (cv. GNG 2171 and JAKI 9218), with marked up-regulation post-flowering. Two sets of prime-editing guide RNAs (pegRNA and ePEG modules) specific to the EAR domain of the Ln locus were designed and cloned into the vector pH-nCas9-PPE-V2 (RRID: Addgene_170131). *Agrobacterium*-mediated and direct transformation experiments were attempted in two chickpea cultivars (GNG 2171 and JAKI 9218). Allelic variation at the Sfl locus was assessed by PCR amplification and Sanger sequencing across diverse chickpea genotypes, and sequence variants were identified that correlate with pod number. qPCR-based expression profiling was conducted across multiple tissues of chickpea (cv. GNG 2171), revealing spatio-temporal differences in Sfl expression. Three sets of guide RNAs targeting the Sfl locus were designed: 220_SEQ (1036) cloned at the SwaI site of vector p201N-Cas9 (MtU6.6: 415 nt; gRNA 220(−)468: 20 nt; tracrRNA: 76 nt; terminator: 6 nt; guide RNA 220(+)392); 220:413_SEQ (1036) cloned at the SwaI site of vector p201N-Cas9 (MtU6.6: 415 nt; gRNA: 20 nt; tracrRNA: 76 nt; terminator: 6 nt). Agrobacterium-mediated and direct transformation were attempted in chickpea cultivars GNG 2171 and JAKI 9218.

Molecular characterization and sequencing analysis confirmed the expected U3 and U6 promoter regions in chickpea. Targeted expression analysis using RT-PCR showed clear amplified bands for the U3 and U6 genes, indicating that the promoters are actively driving transcription. In our effort to develop genotype independent regeneration system, two candidate GRF-GIF were identified from chickpea genome. The two candidates were cloned in binary vector, pCAMBIA2300 and genetic transformation of chickpea genotypes are in progress.

Grasspea component

The aim of this project is to reduce ODAP content in grasspea by manipulating the ODAP biosynthesis pathway related genes *viz.* LsBOS/LsCAS *via* genome editing approach. To achieve this, we have sequenced full length *LsCAS*

gene from the Mahateora variety of grasspea and gene sequence is submitted to NCBI (Accession no. PV838138). Multiple sequence alignment with the reference genome sequence of grasspea identified 195 bp deletion in the intron II of *LsCAS* gene of Mahateora and 15 SNP in the coding region of *LsCAS* gene. Five sgRNA from the *LsCAS* gene is designed, synthesized and cloned into pKSE401 vector and three constructs with dual sgRNA of the *LsCAS* gene is developed. Similarly, five sgRNA from the *LsBOS* gene region were designed, synthesized and checked their effectiveness by *in vitro* cleavage assay. Two vectors with dual sgRNA of *LsBOS* gene were constructed. These constructs were mobilized into *Agrobacterium tumefaciens* and transformation of grass pea using these constructs in two varieties of grasspea is in progress.

Pigeonpea component

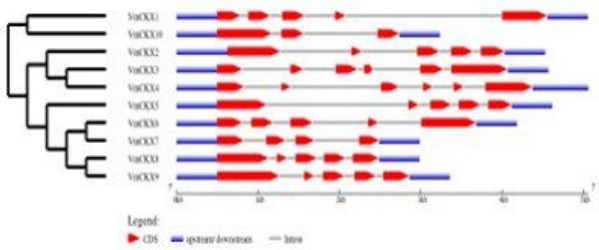
Hereby we aim to knock out the CKX genes in attempt tounderstand its effect on yield attributing parameters, and thus on productivity. With reference to published information on real time expression of CKXs in development of pod of pigeonpea , CKX7 was chosen as a target gene. Allele mining of the CKX 7 gene in cultivar IPA 15-6 revealed no sequence variation with cultivar Asha using the available reference genome. Guide RNAs specific to CcCKX7 have been designed for targeted deletion of the locus.

In attempt to find the few CKXs that may significantly affect number of seeds per pod, expression of CKXs during flower and pod development amongst cultivars varying for number of seeds per pod was assessed that revealed differential expression of the 17 CKXs within and amongst the genotype across different stages of pod formation and development. Eight CKXs were found tobe relatively less expressed in the cultivar with higher numberof seeds per pod during initial stages of pod formation and development. And of these, only 4 retained lower expression in further pod development.

Attempts were made to assess suitability of alternate selection pressure using Basta as choice herbicide and lower doses of basta have been identified suitable for use as selectable marker. Genetic transformation using the RUBY reporter gene is underway to assess efficacy of the published genetic transformation method of pigeonpea in use.

Blackgram component

Homology-based identification of cytokinin oxidase/dehydrogenase (CKX) genes in urdbean, using the urdbean genome as the subject and CKX gene sequences from monocot and dicot species as queries, led to the identification of 10 CKX genes. These genes are located on chromosomes 2, 5, 6, 7, 8, and 11, and are predicted to be localized in the plastid, lysosome, endoplasmic reticulum, and cytoplasm. Most of these genes possess 3-6 exons.

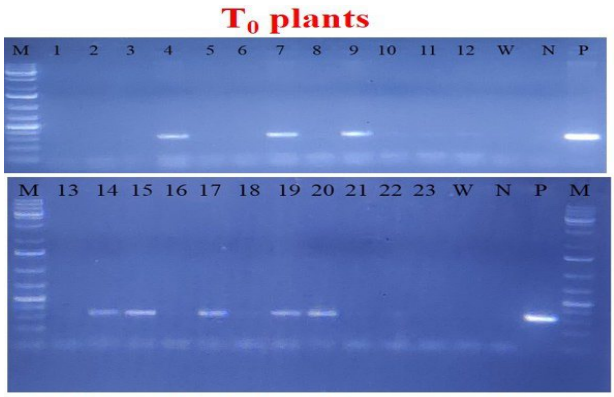


***VmCKX* genes and their structure**

Among them, VmCKX2, VmCKX10, and HP6 (a histidine phosphotransfer protein-coding gene) were selected for knockout using the CRISPR-Cas9 gene-editing approach. Two guide RNAs were designed for each of the three target genes and cloned into the p201N-Cas9 vector following a tRNA-based multiplexing strategy.

Half-cotyledon explants with the embryo were used for *Agrobacterium tumefaciens*-mediated transformation, and a standardized transformation and regeneration protocol was optimized for the genotypes IPU10-26 and IPU13-1. Transformants were screened using Cas9-specific primers in the T_0 plants (**Figure**) and subsequently advanced to the T_1 generation. Integration of the T-DNA was confirmed in the T_1 generation, and the results indicated that all Cas9 PCR–positive plants were also Southern blot positive.

The same protocol was applied to transform IPU 13-1 using the p201N-Cas9 vector harbouring six gRNA expression cassettes along with the Cas9 gene. A total of 47 T_0 transgenic plants were developed, each carrying the T-DNA containing the gRNA expression cassettes and the Cas9 gene. T_1 seeds were harvested from 25 T_0 plants, while the remaining plants are still at the maturation stage.



M :1 kb plus DNA Ladder; W:Water control; N:Negative control (non transformed plant); P:Positive control (Plasmid DNA); Lanes 1-23:putative transformed T0 plants; Positive plants for CAS9 primer will amplify 330 bp

Figure : PCR screening of T_0 transformants based on CAS9 specific primers



Figure : IPU 13-1 cultivar transformed with p201N-CAS9 plasmid harbouring gRNA expression cassette and CAS9 gene

New Mega Project: Genomic innovations, functional characterization, and precision editing for enhancing pulse productivity

SP2: Functional analysis of ABC repressor 1(ARE1) gene associated with nitrogen use efficiency (NUE) in chickpea (*Cicer arietinum* L.)

Institute project: Precision plant breeding and rapid generation advancement in chickpea

The project envisages development of a facile genome editing system (SDN1) in chickpea by attempting knock-out of 15-*cis*-phytoene desaturase (PDS) gene (Gene ID: 101499699) located at Chr 5 using arrayed gRNA cassette under two component transcriptional unit (TCTU) system. Guides targeting Exon 4 (5'TAATGATCGGTTACAATGGA3') and Exon 5 (5'GCCTGCTATGCTTGGTGGAC3') of the gene were cloned under *Mt*U6.6 promoter in the binary vector p201N-Cas9 (RRID: Addgene_59175) harbouring *Spy*Cas9. *Rhizobium radiobacter* (LBA4404) mediated genetic transformation was attempted in chickpea cultivar GNG 2171. Albino and stunted shoots were obtained in tissue culture, which could be phenotypically distinguishable from the control green and healthy shoots. Sanger sequencing of the loci derived from 10 independent shoots (30-35 d old) indicated insertion and/or deletion (InDel) in either exon 4 or exon 5 and two drop-out mutants. This corroborates the amenability of the system including vector and protocol for targeted mutation in chickpea.

NASF Project: CRISPR Crop Network: Targeted Improvement of stress tolerance, nutritional quality and yield of crops by using genome editing (Pigeonpea Component)

The project attempts to develop targeted mutation of the homolog of dense and erect panicle (DEP1) gene of pigeonpea (Guanine nucleotide-binding protein subunit gamma 3; Gene ID: 109808034) using CRISPR/Cas9 system. Guide RNA (5'ACAACAGCGCCACTTGGGTA3') designed from the exon 5 (targeting cysteine-rich domain) driven by *At*U6-26 promoter was cloned in the binary vector, pKSE401 (RRID:Addgene_62202). A total of 11 plants (kanamycin resistant primary transformants, E0) were established from which a total of 665 (selfed progenies, E1) were harvested. All the selfed seeds were sown in Containment Facility (PBSL1) and the progenies were screened for the presence/transmission of SpyCas9 gene in the progenies. Presence of 1000 bp amplicon specific to Cas9 sequences could be observed in the progenies. Agronomic characterization indicated short and dense phenotype (only 1 line) or early flowering (94-100 days after sowing) (total 7 lines) in the progenies, both the traits were not observed in control (*cv.* Asha). The target loci (DEP1) was amplified (800 bp) from all identified lines and outsourced for Sanger Sequencing.

EFC SCHEME: Enhancing climate resilience and ensuring food security with genome editing tools (Chickpea Component)

The project aims to improve the productivity of chickpea using two pronged strategies: increasing the number of flowers per peduncle (Sfl1) and numbers of seeds per pod (Ln). Allele mining of the CaLn locus across a panel of chickpea genotypes and the wild species *Cicer cuneatum* revealed a largely conserved coding region, except for a single non-synonymous 1-bp substitution (GAT → CAT; Asp → His) in the conserved EAR motif of *C. cuneatum*, indicating its potential association with the number of seeds per pod trait. Real-time PCR showed constitutive expression of *Ca*Ln across all developmental stages in chickpea (cv. GNG 2171 and JAKI 9218), with marked up-regulation post-flowering. Two sets of prime-editing guide RNAs (pegRNA and ePEG modules) specific to the EAR

domain of the Ln locus were designed and cloned into the vector pH-nCas9-PPE-V2 (RRID: Addgene_170131). *Agrobacterium*-mediated and direct transformation experiments were attempted in two chickpea cultivars (GNG 2171 and JAKI 9218). Allelic variation at the Sfl locus was assessed by PCR amplification and Sanger sequencing across diverse chickpea genotypes, and sequence variants were identified that correlate with pod number. qPCR-based expression profiling was conducted across multiple tissues of chickpea (cv. GNG 2171), revealing spatio-temporal differences in Sfl expression. Three sets of guide RNAs targeting the Sfl locus were designed: 220_SEQ (1036) cloned at the SwaI site of vector p201N-Cas9 (MtU6.6: 415 nt; gRNA 220(−)468: 20 nt; tracr RNA: 76 nt; terminator: 6 nt; guide RNA 220(+)392); 220:413_SEQ (1036) cloned at the SwaI site of vector p201N-Cas9 (MtU6.6: 415 nt; gRNA: 20 nt; tracr RNA: 76 nt; terminator: 6 nt). Agrobacterium-mediated and direct transformation were attempted in chickpea cultivars GNG 2171 and JAKI 9218.

Molecular characterization and sequencing analysis confirmed the expected U3 and U6 promoter regions in chickpea. Targeted expression analysis using RT-PCR showed clear amplified bands for the U3 and U6 genes, indicating that the promoters are actively driving transcription. In our effort to develop genotype independent regeneration system, two candidate GRF-GIF were identified from chickpea genome. The two candidates were cloned in binary vector, pCAMBIA2300 and genetic transformation of chickpea genotypes are in progress.

AINP on Biotech Crops: (Chickpea Component)

The project attempts to characterize genome edited chickpea lines for early flowering trait. During *Rabi* 2024-25, a total 326 plants (derived from 21 independent lines) IPC 2011-112 (sg: 76 seeds; dg: 95 seeds) and GNG 2171 (sg: 85 seeds; dg: 70 seeds) were raised under contained condition. Among several lines, two lines (I4 and F5) were identified that expressed early flowering trait (37-45 days, after sowing) in all progenies compared to the control genotypes. Plants also exhibited dual flowering behaviour which are otherwise absent in the control genotypes. During *Rabi* 2025, a total of 3,340 seeds were sown from selected lines with early flowering trait: [4 lines in GNG 2171: B2.22 (424) and B2.24 (428); F5.8 (395); M4.23 (560); N2.2 (430)] & [2 lines in IPC 2011-112: C2.8 (350); I4 1-8 (300, 312, 328, 368, 330, 413, 387, 333)]. Detailed agronomic characterization is in progress. PCR based analysis of the of the progenies derived from two lines also indicated the presence of vector backbone used in transformation. Around 1,300 crossed were attempted, and a total of 98 seeds could be harvested from the crosses.

In another study, a total of 90 seeds were sown in the Containment Facility to study the segregation pattern of a transgenic chickpea line harboring *Bt-cry1Aabc* (IR trait). Detailed analysis is in progress.

SP3: Gene editing to elucidate the function of the *Cytokinin Oxidase* (*CKX*) gene in *Vigna species* for enhanced productivity

Urdbean genome contains 10 CKX coding genes and none of those were functionally validated for their role in development and yield of crops. In this project, 6 such CKX gene function will be elucidated following CRISPR based gene knockout approach. The gene expression analysis identified CKX3 found be highly expressed in most of the tissues studied and mostly in shoots, leaves and roots. Two CKX genes are not expressed in any tissues which indicates that they might be a pseudogenes.

SP5: Molecular approaches for improving nutrient use efficiency in pigeonpea (*Cajanus cajan*)

The project aims to identify and characterize homologs of negative regulators involved in the uptake and signalling pathways of nitrogen and phosphorus in pigeonpea. Additionally, the project seeks to repurpose CRISPR/Cas reagents for editing the ARE1 genes in pigeonpea to improve nitrogen

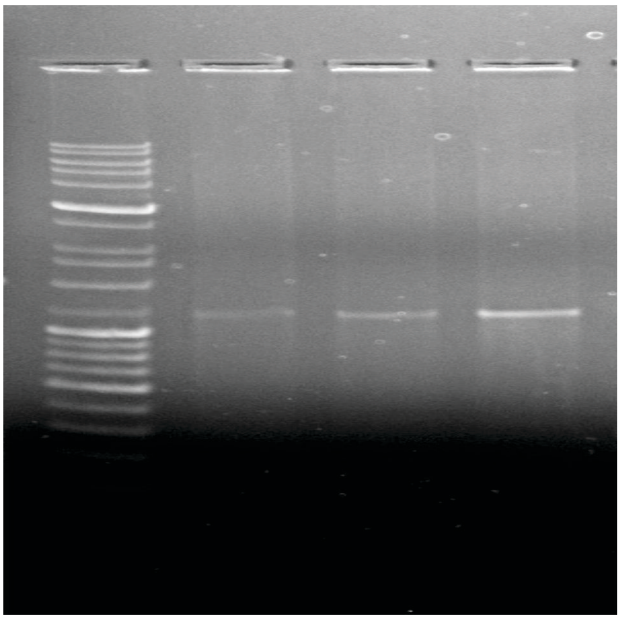


Fig 1. RT-PCR of ARE1 gene in different genotypes of pigeonpea

use efficiency. We have identified an ARE1 homolog located on chromosome 8 of pigeonpea. The gene spans approximately 62 kb, with a coding sequence (CDS) of 1440 bp, consisting of 7 exons and 6 introns. To check whether ARE1 gene is expressing in the chosen cultivars *viz.*, Pusa-Arhar 16, Dholi dwarf, ICPL-87., RT-PCR was done using the RNA from the seedlings of respective genotypes. All the genotypes produced the expected size of ARE1 amplicons, suggesting that ARE1 gene is expressed in the pigeonpea.

SP6: Understanding the effect of gibberellin 3β-hydroxylase on pigeonpea yields

The effect of phytohormoneson crop yields is a subject of research. This project is initiated to assess the effect of gibberellin absence or its reduced content on plant growth & development, phenology and yield to develop future strategies for pigeonpea improvement. Recent reports documented that reduction in GA content increased seed yield in soybean by knockingout the *Gm*3GA oxgene. Pigeonpea homologs of Gmgibberellin 3β-hydroxylase protein have been identified and genescharacterized in silico. Gibberellin 3-beta-dioxygenase 1 (*CcG3ox1-5*with82% similarity) is found on chromosome 11, has 2 exons, codes for 371aa while CcG3ox1-3 (70.8% similarity) is found on chromosome 10, has 2 exons and codes for 367 aa. CcGA3ox1-5 is hydrophilic in nature and has cytoplasm as its cellular location, while CcGA3ox1-3 has nucleus/cytoplasm as predicted cellular location. RT-PCR for both confirmed its expression in cultivars Asha, IPA-6 and IPAV16-1. They have the Pfam DIOX_N and 2OG-FeII_Oxy conserved domains.

Externally Funded Projects

Functional characterization of the *Cicer arietinum* short vegetative phase (SVP) genes, their promoters, and potential microRNAs regulating them towards elucidating their role in floral transition

Genome wide identification and functional characterization of the effector genes of *Phytophthora drechsleri* Tucker F.sp. cajani causing *Phytophthora* blight in pigeonpea

NASF Project: CRISPR Crop Network: Targeted improvement of stress tolerance, nutritional quality and yield of crops by genome editing (Pigeonpea Component)

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All India Network Project on Biotech Crops (AINP on Biotech crops)

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DAC -Incentivizing Research in Agriculture

Mapping quantitative trait loci for sodium/ potassium level with respect to salinity tolerance

DCP 92-3 X ICCV 10 mapping population phenotyped for leaf Na/K ratio under salt stress condition were used to map the QTLs using genotypic data of the mapping population genotyped with newly developed InDel markers identified QTLs on Chr6 which is co-localized with fine mapped QSSIY6.1 region between C_salt6-12 to C_salt6_14 which explains R^2 values of 6.5.

Validation of vegetative salt stress genomic region identified from QTL-seq approach

Genomic region/QTL on Chromosome CaLG02 (a 4 Mb region spanning the interval of 30 to 34 Mb) associated with salinity tolerance were identified using the QTL-seq approach and the same chosen for validation using genotypic and phenotypic data of DCP 92-3 and ICCv 10 mapping population. Primers specifically 27 InDels were designed in this genomic region and utilised for genotyping whole population. Of these 10 markers were polymorphic between ICCV 10 and DCP 92-3 and utilised for genotyping, linkage analysis and QTL mapping. Composite Interval mapping identified QTL for percent survival under salt stress between Salt_veg_ch2_2 and Salt_veg_ch2_5 with a physical distance of 30363268-30392805. This analysis narrows down the 4 Mb initial QTL region identified from QTL-seq approach to less than 50 kb region.

Fine-mapping of QTLs for salt stress tolerance

The major QTLs reported by Soren *et al* 2021 for reproductive stage salt stress tolerance QTL clustered on Chr6 was chosen for fine-mapping. Twenty eight InDel primers were designed spanning QTL-cluster intervals on chr6 and validated in parental genotypes DCP 92-3 and ICCV 10 for polymorphism. The 15 polymorphic InDels identified between DCP 92-3 and ICCV 10 were utilised for genotyping RIL mapping population derived from DCP 92-3 and ICCV 10 and generated linkage map and identified narrow genetic interval for q*SSIY6.1* (stress susceptibility index of yield) between markers C_salt6-9 to C_salt6_10 with a LOD score of 4.36 and phenotypic variance (R^2) 20.8. This short interval markers can be employed in marker assisted breeding of chickpea for improving salt stress tolerance.

Generation of Backcross population for salt stress tolerance

GNG 1581, JAKI 9218 and CSJ 515 was chosen as recurrent parents for introgressing salt tolerant QTLs using ICCV 10 as a donor. 120, 40 and 20 F_1 seeds were generated in GNG 1581, JAKI 9218 and CSJ 515, respectively using ICCV 10 as a donor. In case of JG 16 X ICCV 10, the population (40 lines) was advanced to BC_2F_3 stage and Phenotypic screening of selected lines will be carried out in coming *rabi* season at CSSRI, Karnal and IIPR, Kanpur.

Improving the nutritional quality of grasspea (*Lathyrus sativus* L.) using the mutagenesis approach (ANRF funded)

The project aims to identify low-ODAP mutant lines in the mutant population developed using electron beam and gamma irradiation. M_4 seeds were harvested from 80 low-ODAP mutants and subsequently re-evaluated for ODAP content using spectrophotometer assay. 61 gamma-irradiated and 2 electron-beam irradiated low-ODAP mutants were confirmed to maintain low ODAP levels in the M_4 generation as well. Their ODAP content was found in the range of 0.014% to 0.039%, which is 2-3 times lower than that of Mahateora. These lines are now being advanced for the M_5 generation.

Ongoing Institute Project

SP10: Tagging of restorer genes for CMS in pigeon pea (*Cajanus cajan*)

Analysis of QTL Region for CMS/restoration

Previously reported 0.41 Mb region from each genotype was studied, and it was found that 46, 42, and 16 SNP/INDELs are uniquely present in the A, B, and R line, respectively. These 16 SNPs/INDELs specific to the –line were studied further, and it was found that one gene with Gene_id "LOC109803998" was located in the genomic region. A total of 4 transcripts named XM_029272408.1, XM_029272407.1, XM_020365724.2, and XM_020365726.2 were transcribed from this region and code for Root Primordium Defective1 (RPD1) (as studied in Arabidopsis).

CDS and amino acid comparison of the Primordium Defective1 (RPD1) gene in A, B, and R lines

In case of A and B line, the CDS length was

1374 bp, but in case of R-line it was 1371 bp, a three bp deletion was found in the 3' terminal end at 1333-1335bp. As a result, in the amino acid sequence and its length also differs, 457aa length was found for A and B line, whereas 456aa for R-line. The promoter region analysis revealed a 10 bp deletion in A and B lines from 894 upstream of the TSS and a 10 bp insertion in the R-line. A indel marker was developed from the promoter region and used for screening the A, R and their F1 (Hybird progenies). It was found that this indel primer useful for hybridity testing and might be linked to fertility. Pollen viability also checked for the plants and plants number 1, 2 and 7 having sterile pollen whereas rest of the plants having fertile pollen.

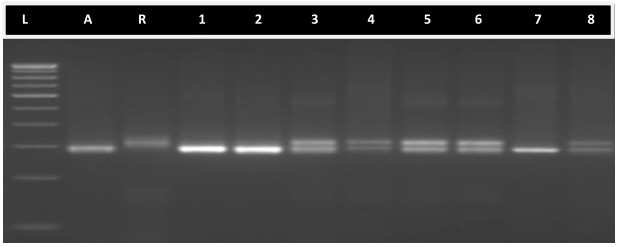


Fig A–L=Ladder=100bp,A-ICPL 2039A, R-ICPL Asha, 1-P1(AxR-F1), 2-P2 (AxR-F1), 3-P3(AxR-F1), 4-P4(AxR-F1), 5-P5(AxR-F1), 6-P6(AxR-F1), 7-P7(AxR-F1), 8-P8(AxR-F1)

SP-: Introducing the photo-insensitivity trait in pigeonpea (*Cajanus cajan*) through genome editing

Identification of flowering linked gene, lncRNAs and miRNAs: Transcriptome data of 30 stages/tissues of *Cajanus cajan* were reanalyzed (with reference based approach) for identification of potential genes for flowering pathways and flower abscission. More than four thousand long non-coding RNAs and 147 conserved microRNAs were identified from the ATLAS data, further analysis shown that 36 lncRNAs and 9 microRNAs are potentially linked to flowering pathways.

An approach for developing marker-free genome editing pigeonpea lines

In an attempt to develop marker-free genome-edited (GE) pigeon pea (*Cajanus cajan* L.) lines using the clean gene technology approach, embryonic axis explants were transformed with PCR

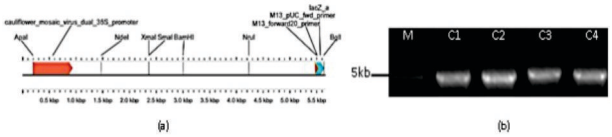


Fig. : (a) Annotated map of the genome editing cassette; (b) PCR amplified product containing the gRNA and Cas9 gene cassette for trait enhancement in pigeonpea

amplified gRNA containing Cas9 expression cassette. The expression cassette was designed by amplifying the left border (LB) and the right border (RB) region of modified p201NCas9 vector excluding the selection marker (NPT-II) gene that was present in the native vector. The modified p201NCas9 vector contains the gRNA sequence designed for the targeted genome editing in the pigeonpea. The protocol is an alternate method for genome editing in pigeonpea inspired from agrobacterium mediated transformation, where the region lying between the LB and RB are transferred and expressed in the host cell. The developed marker-free cassette can be utilized for direct transformation using the biolistic method for efficient transformation in pigeonpea.

Pigeonpea experiences a high rate of natural flower drop (abscission), with studies globally reporting that 70% to 96% of flowers abscise without forming pods. This can be avoided either by reducing the length of the crop cycle, thereby avoid adverse climatic condition or by modifying the gene responsible for abscission. So, two pigeonpea genes targeting the early flowering and the flower drop trait were attempted for modification via. genome editing in pigeonpea. The candidate genes for gRNA designing were selected based on the bioinformatic studies and earlier reports of the concerned trait.

Genes targeting the early flowering and flower drop trait, respectively, were selected for targeted mutation using four constructs for genome editing in pigeonpea. Two different promoters *viz.* MTU6 (derived from *Medicago truncatula*) and CCU6 (derived from *Cajanus cajan*) were used. Putative genome-edited pigeon lines were developed using the designed constructs employing both Agrobacterium-mediated transformation and the biolistic particle delivery system.

Crop Production

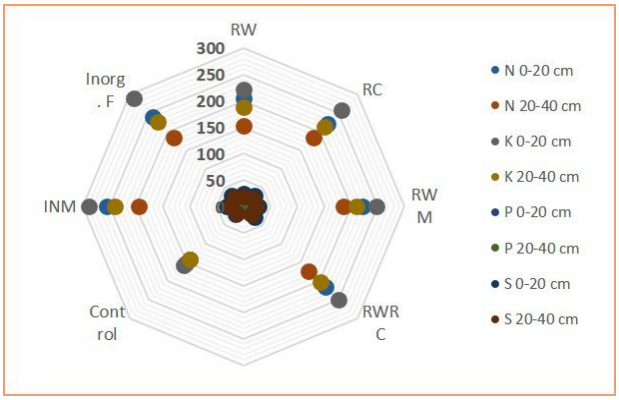
Institute Funded Project

Long-term effect of pulses in cereal-cereal cropping systems and nutrient management

Rice-based cropping systems involving pulses

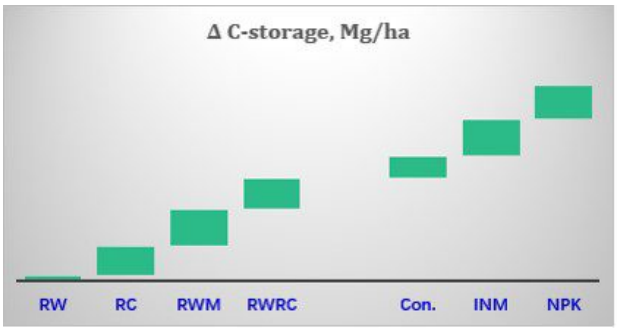
Four rice-based cropping systems—rice-wheat (RW), rice-chickpea (RC), rice-wheat-mungbean (RWM), and rice-chickpea-rice-wheat (RCRW) were evaluated under three nutrient management practices: control (CT), integrated nutrient management (INM; including crop residues, biofertilizers such as *Rhizobium* for pulses and phosphate-solubilizing bacteria for cereals, farmyard manure at 5 t/ha, and 50% of the recommended NPK), and inorganic fertilizers (RDF; recommended doses of N, P, K, S, Zn, and B). The cultivars used in the final year of the study were Pant Dhan 12 (rice), HD 2967 (wheat), IPC 11-112 (chickpea), and Virat (mungbean). The significant findings are as follows:

- Over the period, significantly highest system productivity in terms of chickpea equivalent yield (CEY) was recorded in RWM and the least under RW.
- Similarly, among nutrient management practices, maximum system productivity was recorded in INM which was at par with inorganic fertilizers and significantly higher over control.
- System productivity and economics follow the trend of RWM>RC≥RWRC≥RW; INM ≥ Inorg F>Control. Similarly, sustainability and Soil health followed trend of RWM>RC>RWRC>RW ; INM ≥ Inorg F>Control.
- Also, significantly highest system net return was recorded in RWM and the least under RW, whereas BCR was maximum in RCRW and the least in RW.
- Maximum system net return was recorded in INM and the least in control. BCR was also maximum in Inorganic-RDF and the least in control.
- After 20 years, the per cent increase in soil NPKS content was 15-35% due to cropping systems (RWM>RC) over RW, and up to 65% due to INM over control.



Soil nutrient status under different cropping systems and nutrient management after 20 years of experimentation

- The increase in C-storage was maximum in RWM (125.8 Mg/ha) and INM (129.7 Mg/ha) over initial value (78.4 Mg/ha).

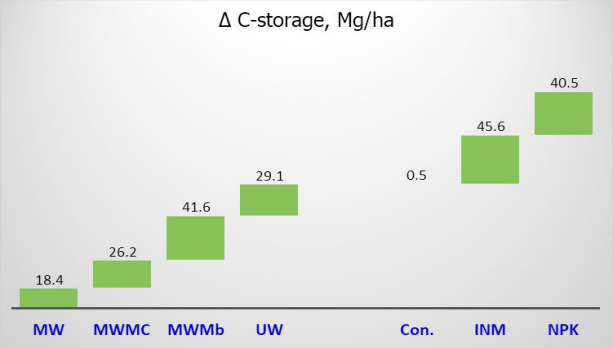


Changes in soil C-storage under different cropping systems and nutrient management after 20 years of experimentation

Maize-based cropping systems involving pulses

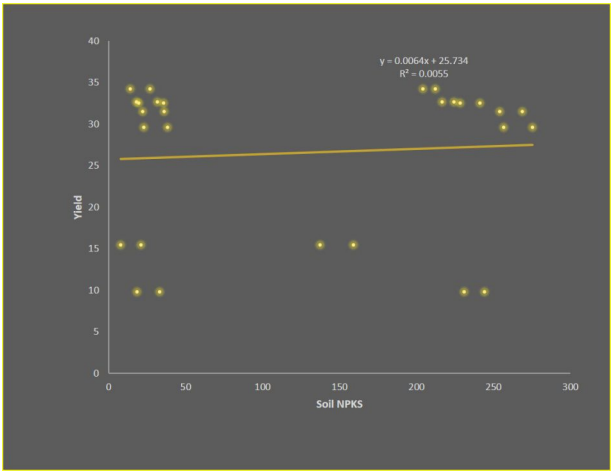
Four maize-based cropping sequences-maize/pearl millet-wheat (M/P-W), maize/pearl millet -wheat-mungbean (M/P-W-Mb), maize-wheat-maize-chickpea (M/P-W-M/P-C), and urdbean-wheat (U-W)—were evaluated under three nutrient management practices: control (CT), integrated nutrient management (INM; including crop residues, biofertilizers such as *Rhizobium* for pulses and phosphate-solubilizing bacteria for cereals, farmyard manure at 5 t/ha, and 50% of the recommended NPK), and inorganic fertilizers (RDF; recommended doses of N, P, K, S, Zn, and B). The cultivars used in the study included DKC 7074 (maize hybrid), MP-7878 (pearl millet hybrid), Uttara (urdbean), HD 2967 (wheat), IPC 11-112 (chickpea), and IPM 02-3 (mungbean). Results from the 22-year-old experiment can be summarised as follows:

- Under long term study, the highest system productivity (WEY) was observed under the M-W-Mb (INM) / B-W-Mb (INM).
- M-W-Mb (INM) provided the highest net returns, with additional net returns over M-W (RDF). Also, the M-W-Mb resulted the highest net B:C ratio, while M-W (RDF) had the least B:C ratio.
- B-W-Mb (INM) also recorded the highest net returns and the lowest in B-W (RDF). It also provided the highest net B:C ratio than B-W (RDF).
- After 20 years, the per cent increase in soil NPKS content was 15-35% due to cropping systems (RWM>RC) over RW, and up to 65% due to INM over control.
- Over 20 years, the increase in C-storage was maximum in MWMb (41.6 Mg/ha) and INM (45.6 Mg/ha).



Changes in soil C-storage after 20 years of cropping system and nutrient management

- Strong positive correlation exists among crop yields and SOC and soil nutrients.



Correlation between soil available NPKS and yield of crop after 20 years of experimentation

- In conclusion, system productivity and economics followed the order of M/BWM> RW ≥ RWRC ≥UW ; INM ≥ Inorg F>Control. Similarly, sustainability and Soil health followed the trend of RWM>RC>RWRC> RW ; INM > Inorg F>Control.
- In conclusion, the legumes such as chickpea and mungbean inclusive rotations (rice-chickpea, rice-wheat-mungbean, maize-wheat-mungbean, maize-wheat-maize-chickpea and rice-wheat-rice-chickpea) favoured higher sequestration of carbon in macro-aggregates. Soil microbial activity and enzymatic activities was improved following legume inclusive crop diversification (higher with mungbean inclusive rotations) and integrated nutrient management practices.

Conservation agriculture

Production cost reduction in maize-chickpea system

A field experiment was started during *kharif* season of 2020-21 at main farm of ICAR-IIPR, Kanpur with the objective to enhance the system productivity and sustainability, and to reduce the cost of production. The study was conducted in split-plot design with two tillage management systems (CT-CT and ZT-ZT) in main plots and six nutrient/weed management systems [100% RDF + Manual weeding, 100% RDF + CWM (PRE+POST), 75% RDF + CWM (PRE+POST), 100% RDF + CWM (POST), 75% RDF + CWM (POST) and GM + 75% N + 50% P + CWM (POST)] in sub-plots replicated thrice. The dominant weed flora in maize was *Cyperus rotundus, Leptochloa chinensis, Dactyloctenium aegyptium, Digera arvensis, Trianthema portulacastrum*, and *Eclipta prostrata*, and in chickpea was *Convolvulus arvensis, Coronopus didymus, Mediacgo denticulata*, and *Melilotus indicus*.

The significant findings are as follows :

- Over the year, the ZT in system mode (ZT-ZT + residues) & 100% RDF + (PRE+POST emergence herbicide) (pendimethalin - topramezone) reduced weed density in maize- chickpea system than CT with 100% RDF + manual weeding (conventional practice).
- Further, the CA-based system (ZT-ZT + added residues) resulted in 17-24% higher maize and chickpea yield than CT-CT.
- CA system resulted in additional net returns

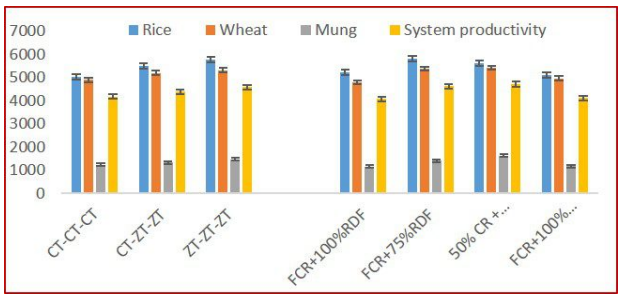
of ₹ 27,000 in maize and ₹ 32,000 in chickpea over CT-CT after four years of study.

- PRE +POST herbicide such as pendimethalin - topramezone in maize-chickpea system provided an additional income of ₹ 42,000 than pendimethalin – HW in maize-chickpea system.
- Over four years, study indicated ZT-ZT with 100% RDF with PRE-POST herbicide (pendimethalin – topramezone) is productive and profitable than CT-CT and manual weeding.

Integrated nutrient management in maize-wheat-mungbean system under conservation agriculture

A field experiment was started during *kharif* season of 2021 at main farm of the Institute to see the effect of tillage and fertilizers and residue management on productivity and sustainability of rice-wheat-mungbean system. The study was conducted with three tillage treatments (CT-CT-CT, CT-ZT-ZT and ZT-ZT-ZT) in main plots and four fertilizers and crop residue management in sub-plots (Full crop residue + 100% RDF, Full crop residue + 75% RDF, 50% crop residue + 100% RDF and Full crop residue + 100% NP with + 50% K in the initial two years followed by no K) under split plot design with three replications. The significant findings are as follows:

- System productivity was 11.3% higher under ZT-ZT-ZT over CT-CT-CT; and 12-14% in 50% CR+100% RDF and FCR + 75% RDF over reaming treatments. Net returns and B:C ratio also followed similar trends.
- Irrigation Water Productivity (IWP): 13.2% in ZT-ZT-ZT over CT-CT-CT, and 12-14% under 50% CR+100% RDF and FCR + 75% RDF over remaining two treatments



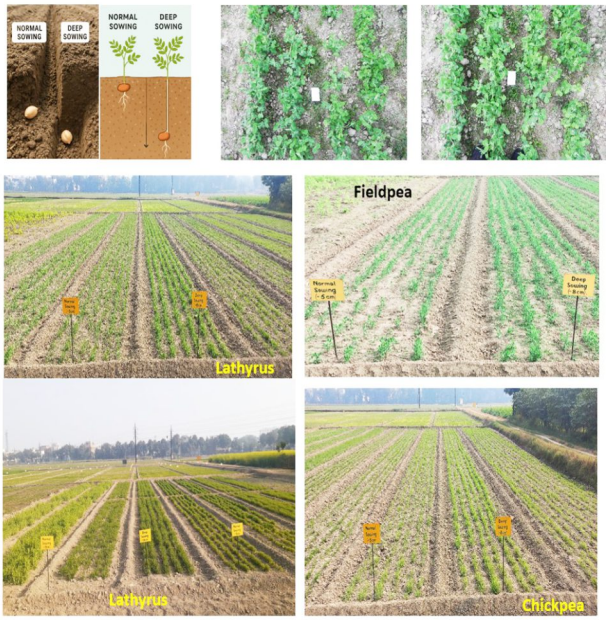
Yield of rice, wheat, mungbean and system productivity (kg/ha) under different tillage and nutrient management practices after four years of experimentation

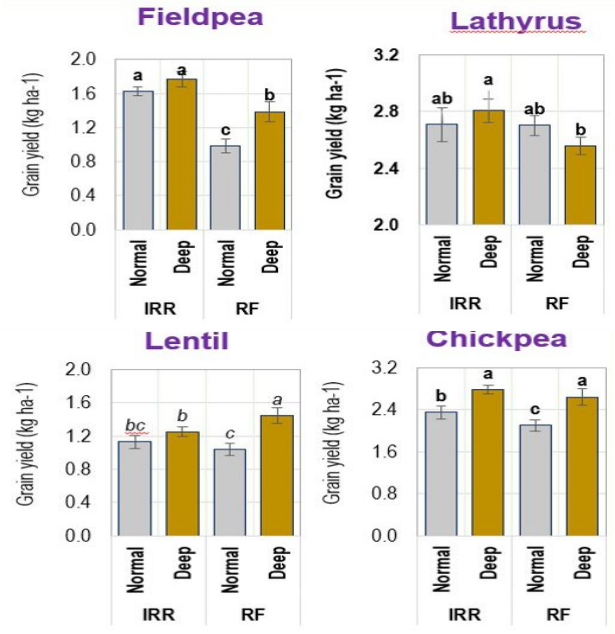
- Nutrient use efficiency (NUE): 12.5% higher in ZT-ZT-ZT, and 50% higher under FCR + 75% RDF over FCR + 100% RDF
- Energy efficiency: Significantly higher in ZT-ZT-ZT (13%) and FCR + 75% RDF (16%)

Climate resilient and resource conservation and agro-technologies

Comparative evaluation of deep and normal sowing depth in winter pulse crops under deficit water conditions

A field experiment was carried out at the main research farm of ICAR–IIPR, Kanpur over three consecutive years (2022–2025) to evaluate the effects of two sowing techniques deep sowing (~8 cm) and normal sowing (~5 cm) under rainfed and irrigated production systems in four winter pulse crops (chickpea, lentil, fieldpea, and lathyrus). Consistent with the findings of the first two years (2022–2024), the third-year results demonstrated a significant influence of sowing depth on early crop vigour, nodulation, and yield across the winter pulses. Under rainfed conditions, deep sowing conferred a clear yield advantage in fieldpea (40%), lentil (39%), and chickpea (26%) compared with normal sowing. However, in lathyrus, deep sowing did not provide any yield benefit under either rainfed or irrigated conditions. Across crops, deep sowing generally reduced nodulation, with the decline being more pronounced in lentil (16%) and fieldpea (24%), and relatively minor in chickpea and lathyrus (8%). Nevertheless, this reduction in nodulation did not adversely affect overall crop productivity.





Comparative effect of normal and deep sowing method on grain yield of winter pulse crops under irrigated and rainfed conditions.

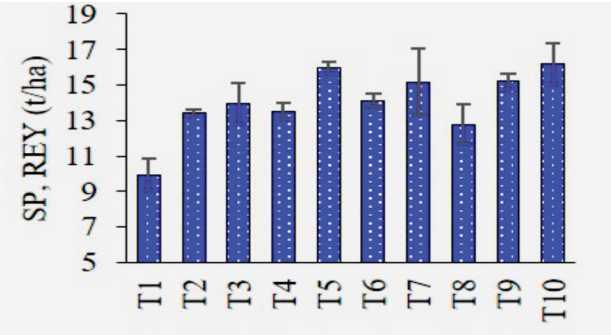
Foliar spray of chemical osmolytes to alleviate terminal stress in summer mungbean

A field experiment was conducted at the main farm of ICAR–IIPR, Kanpur using summer mungbean as the test crop to evaluate eight foliar spray treatments involving chemical osmolytes and nutrient supplements for mitigating yield losses under terminal water-deficit stress. Among the treatments, foliar application of thiourea (500 ppm), KCl (1%), and IFFCO nano urea (4 mL/L) at the early pod development stage (45 days after sowing) enhanced mungbean yield by 10–13% under late-sown, terminal water-deficit conditions. In contrast, foliar sprays of urea (2%) and $MgSO_4$ (250 ppm) induced phytotoxic symptoms, including leaf scorching, resulting in yield reductions of 7% and 14%, respectively. Grain yield exhibited a significant positive correlation with 100-seed weight, grain weight per plant, pods per plant, and aboveground biomass, indicating that these yield-contributing traits were strongly influenced by the foliar application of osmolytes and nutrient supplements at the early pod development stage, ultimately leading to yield improvement.

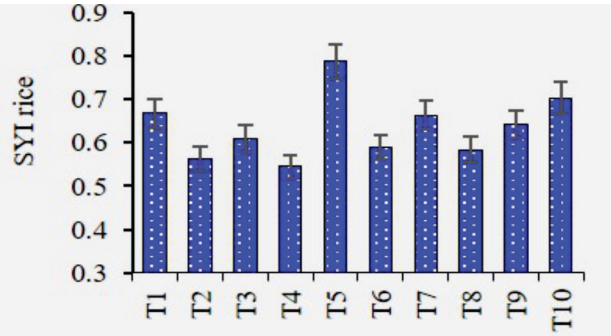
Tillage and crop residue management in rice-wheat-mungbean system for higher productivity and resources-use-efficiency

Findings:

- CA-based ZTDSR (+MR) + BM – ZT wheat + RRR + decomposer – ZT mungbean (+R) (T10) gave additional 2 q/ha (5%) rice yield.
- T10 resulted in additional yields of wheat by 3.0 q/ha (8%), mungbean 1.34 t/ha and 67% higher system productivity than PTR-CTW (-R).
- Residues burning resulted in yield loss of wheat by 21-26% than CA.
- System based CA increased system productivity by 63% and 23% over conventional tillage and residue burning. T5 and T10 increased SYI of rice by 6-18% than CT.
- Residues burning resulted in yield reduced SYI of rice.
- The yields under CA were stable over years and associated positively with yield parameters.
- Incorporated residues decomposed faster with higher NH_4+-N compared with CA-based anchored residue with higher $N0_3$--N.
- T5 and T10 increased 36% water productivity than CT. These provided additional income of ₹ 60,484 in R-W-Mb system than CT.
- Thus, CA enhance yields of rice, wheat and system with higher SYI, stability and RUE.



System productivity in terms of rice equivalent yield and total weed density in different treatment



Sustainable yield index of rice under different CA based systems

- **Crop morphological and root traits variability of chickpea under CA:** A RIL population of 211 lines and 50 genotypes were studied under CA for crop growth performance, nodulation, root morphology, and yield. RIL 70, 71, 178, and RSG 888 provided higher nodulation and grain yield (yield varied between 20.1 g and 101.1 g/m row length). Parameter considered: High biomass, root growth, higher nodulation, early maturity and grain yield.

- **Genotype variability found in chickpea for P acquisition efficiency**: An experiment on phosphorus acquisition and shoot P content was undertaken during winter season. Thirty chickpea genotypes contrasting in P utilization efficiency were selected and grown in plastic pots containing 3 kg of soil. The bulk soil from the top 15 cm was collected from the A2 block of new research campus of ICAR-IIPR, Kanpur. The soil was a sandy loam, alkaline in soil reaction (pH - 8.79), low in Kjeldahl nitrogen (180 kg/ha), organic matter (0.17%), low available phosphorus (5.30 kg P/ha) and low available potassium (79.5 kg/ha). The experiment was arranged in a completely randomized design having three replicates in net house under natural light. The required amounts of N, P and K were added at the time of pot filling while N was applied in three equal splits in P sufficient pots. Thirty chickpea genotypes were grown at two P levels [*i.e.*, adequate (P_2O_5 addition at 27 mg/kg soil @ 60 kg/ha P_2O_5) and deficient P (native soil P_2O_5 at 5.30 mg/kg soil without external P addition)]. At the active vegetative stage (45 days after sowing), three uniform and healthy seedlings of each genotype were uprooted for shoot P content estimation. The plants were dried at 70°C till constant weight for dry weight estimation and P analysis. Results revealed that the shoot P content varied across genotypes under deficit and sufficient P. Genotypes IL WC 21, JG 11, GG2, and JGM 7 had higher shoot P content under deficit P condition. This finding led to further identification of large genotypes of chickpea for P-acquisition and P-use-efficiency.

Nutrient management

System based sulphur management in intensive maize-mustard-mungbean system in alkaline *Fluvisol*

A field experiment was conducted at the main research farm of ICAR–IIPR, Kanpur, for three consecutive years (2022–2025) in an alkaline *Fluvisol* under a diversified maize–mustard–mungbean cropping system. The study evaluated ten system-based sole fertilizer and integrated sulphur (S) management treatments. In the third year (2024–2025), all component crops responded significantly to S management, with yield gains in the order: mungbean (18%) > mustard (17%) > maize (9%) compared with the control (MZ_0–MS_0–MB_0). The highest maize productivity was obtained under the system-based sole fertilizer treatment MZ_{14}–MS_{14}–MB_{14} (5.06 t ha^{-1}), representing a 9% increase over the control. In the post-rainy season mustard crop, the maximum grain yield was recorded under the integrated S treatment [MZ_7–MS_7–MB_7] + B + FYM (2.98 t/ha), followed closely by [MZ_0–MS_{21}–MB_{21}] (2.97 t /ha) and MZ_0–$MS_{10.5}$–$MB_{10.5}$ + SSB + 40% maize residue recycling (2.94 t/ha). For summer mungbean, the highest grain yield was achieved with [MZ_0–$MS_{10.5}$–$MB_{10.5}$] + B + 40% maize residue (1.78 t/ha), which was statistically comparable to the recommended sole fertilizer treatment MZ_{14}–MS_{14}–MB_{14} (1.75 t/ha), whereas the control yield was 1.52 t/ha. Integrated S management involving suboptimal fertilizer S (21 kg S/ha) combined with residue recycling produced yields equivalent to the recommended S dose (42 kg S/ha). System productivity, expressed as mungbean equivalent yield, was the highest in the sole fertilizer-based treatment MZ_{21}–MS_0–MB_{21} (5.27 t/ha), followed by MZ_0–MS_{21}–MB_{21} (5.11 t/ha) and MZ_0–$MS_{10.5}$–$MB_{10.5}$ + SSB + 40% maize residue recycling (5.07 t/ha). All integrated treatments-maintained soil available S levels comparable to those under sole chemical fertilizer application. Significant positive correlations were observed between soil available S and grain yields across all the three crops ($p < 0.05$), with stronger relationships for mungbean ($r = 0.62$, $p < 0.001$) and maize ($r = 0.56$, $p = 0.002$).

Nano-fertilizer for higher productivity and NUE in pulses

A field experiment was conducted at ICAR-IIPR, Kanpur to evaluate the agronomic performance of nano-urea in rajmash. The results indicated that application of 75% nitrogen (N) supplemented with either urea spray or nano-urea spray produced grain yields statistically at par with the RDF as well as with 100% N applied through urea or nano-urea sprays. Although RDF recorded a significantly higher yield over some treatments, the yields obtained with 75% N + urea spray and 75% N + nano-urea spray were comparable to those achieved under RDF and 100% N treatments. These findings clearly demonstrate

that nitrogen application can be reduced by 25% through the use of nano-urea spray without any yield penalty. Therefore, application of 75% N (basal + one split) along with nano-urea spray can be recommended as an effective and sustainable strategy for reducing large-scale nitrogen fertilizer use in *rajmash* cultivation. The highest cost of cultivation was incurred in 100% N + nano-urea spray and 100% N + urea spray, followed by RDF, while the lowest cost was recorded under the control treatment. Among the nano-urea treatments, the highest net returns and benefit–cost ratio were obtained with 75% N + nano-urea spray, whereas the control recorded the lowest values. Maximum N, P and K concentrations in plants were recorded under 100% N + urea spray, showing a marked improvement over the control. Plants receiving basal N along with nano-urea sprays exhibited higher nitrogen content, chlorophyll index (SPAD values), and dry biomass, particularly with two nano-urea sprays, compared to the treatments without nano-urea application.

Enhancing phosphorus use efficiency and crop productivity through nano technological interventions in pulse based cropping system

The experiment was conducted at the NRF of the ICAR–IIPR, Kanpur to improve phosphorus use efficiency and crop productivity through nano-technological interventions in a pulse-based cropping system. Application of nano-phosphorus (Nano-P) exerted a pronounced positive effect on the grain and straw/stover yields of both maize and chickpea. The results clearly indicated that integration of nano-P with reduced levels of conventional phosphorus fertilizer significantly enhanced crop performance. Among the different treatments, application of 75% recommended dose of phosphorus (RDP) combined with Nano-DAP spray (two sprays at 20–25 and 35–40 DAS) performed superiorly over other treatments and remained statistically at par with 100% RDP supplemented with one or two Nano-DAP sprays. All nutrient management treatments recorded significantly higher yields compared to the absolute control (no

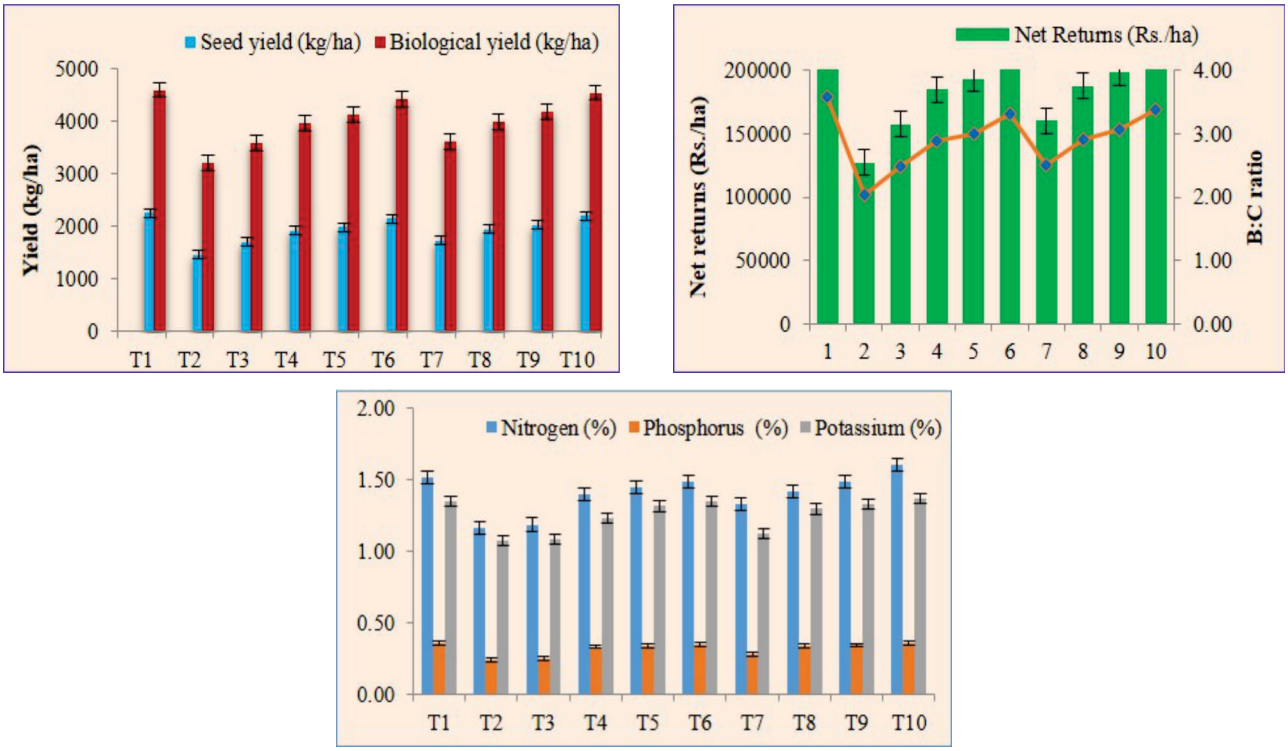
Effect of different S management treatments on grain yield (kg/ha) of component crops in maize-mustard-mungbean system

SN	Treatment	Mungbean	Maize	Mustard
T1	[MZ_0-MS_0-MB_0]	1517±26	4573±78	2567±55
T2	[MZ_{14}-MS_{14}-MB_{14}]	1754±14	5057±145	2855±68
T3	[MZ_{21}-MS_0-MB_{21}]	1787±33	5007±139	2896±36
T4	[MZ_{21}-MS_{21}-MB_0]	1640±34	4830±117	2948±78
T5	[MZ_0-MS_{21}-MB_{21}]	1730±14	4953±81	2974±59
T6	[MZ_7-MS_7-MB_7]+F	1643±26	4877±173	2832±54
T7	[MZ_7-MS_7-MB_7]+B+FYM	1621±24	4937±51	2975±10
T8	[MZ_0-$MS_{10.5}$-$MB_{10.5}$]+B+ MBR	1743±84	4804±137	2891±54
T9	[MZ_0-$MS_{10.5}$-$MB_{10.5}$]+B+ MZR	1787±80	5029±65	2884±158
T10	[MZ_0-$MS_{10.5}$-$B_{10.5}$]+B+F+MBR+MZR	1730±65	5011±61	2939±128
	LSD (p= 0.05)	140.2	244.7	194.3

Note: MZ, Maize, MS, Mustard, MB, Mungbean; subscript values represent rate of fertilizer S application to the corresponding crop.



Field view of mustard and mungbean crops



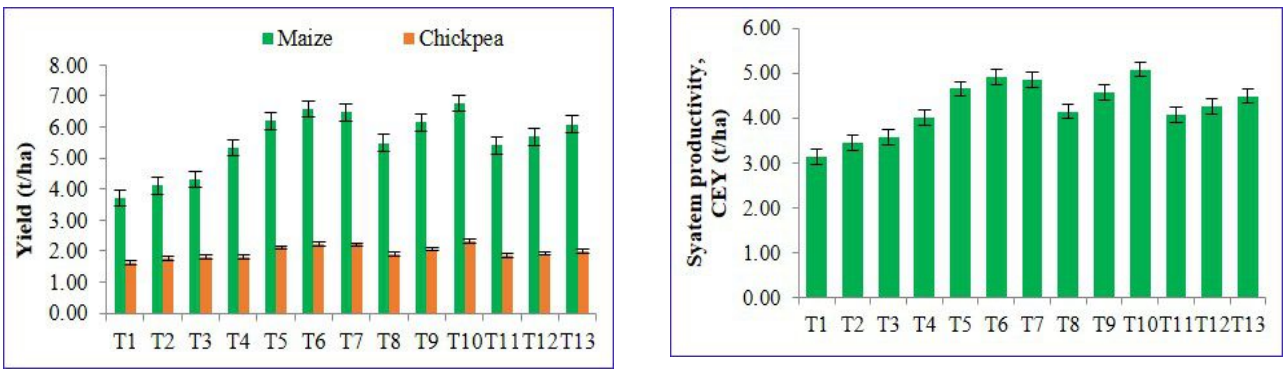
Effect of foliar spray of nano-urea and conventional urea on yield (a) and economics (b) and nutrient concentration in grain of *rajmash*

NPK). The treatment comprising 75% RDP + Nano-DAP spray (two sprays) increased maize yield by 8.42% and 19.01% over 100% RDP and 75% RDP without spray, respectively. Similarly, chickpea yield increased by 8.64% and 17.7% over the same treatments. Overall, this treatment achieved a 24% yield advantage over the control, highlighting the potential of nano-phosphorus in reducing fertilizer input without compromising productivity.

Water management

Effect of conservation tillage and light irrigation in post-rainy season fieldpea crop in sorghum-fieldpea system

A field experiment was conducted to evaluate the effects of conservation tillage and irrigation practices on crop productivity, soil health, and water productivity in a sorghum–fieldpea cropping system. The experiment comprised three tillage treatments *viz.* zero tillage (ZT), reduced tillage (RT), and conventional tillage (CT) as main-plot treatments that had been maintained for seven consecutive years, along with crop-specific irrigation treatments applied to the post-rainy season fieldpea crop. In the rainy season, sorghum grain yield was the highest under CT (4743 kg/ha), significantly outperforming RT and ZT (4,384-4,434 kg/ha; $p < 0.05$). Zero tillage maintained significantly higher soil organic carbon and available P compared to RT and CT ($p < 0.05$). For fieldpea, plant biomass was the



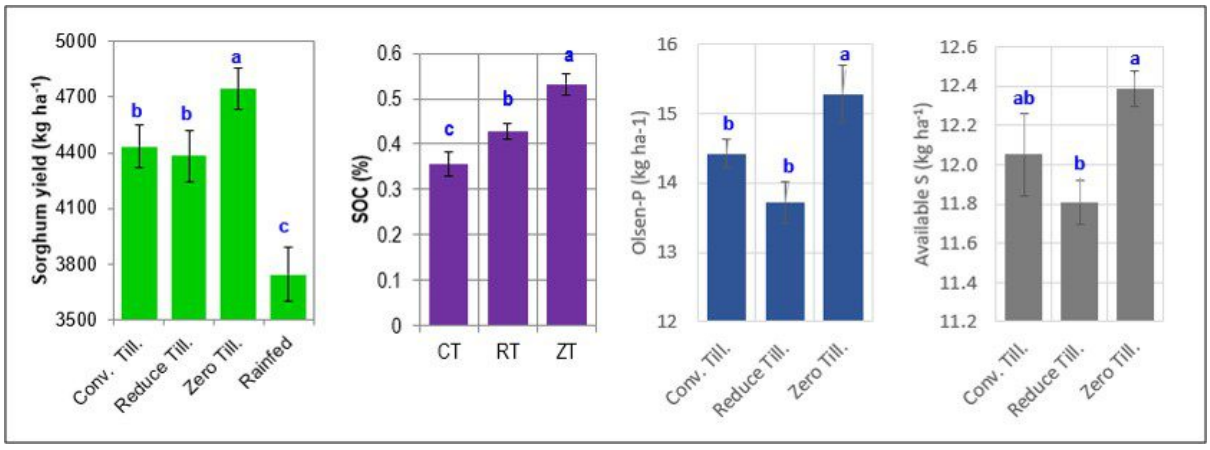
Effect of different treatments on yield and system productivity of maize and chickpea in maize-chickpea cropping system

greatest under CT, and was significantly higher than under ZT. In contrast, nodule number and nodule weight were markedly higher under ZT than under RT and CT, indicating improved biological nitrogen fixation potential in the conservation tillage system. Irrigation responses varied across tillage systems: in CT, light irrigation (~3 cm) resulted in the highest fieldpea yield (2,118 kg/ha), whereas in ZT, normal flooded irrigation (~5 cm) produced higher yields compared with light irrigation.

Organic/Natural Framing

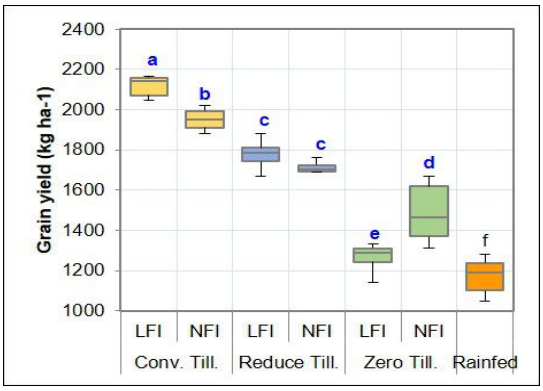
Organic farming in pulses and its cropping system with technological interventions in gangetic plains

A field experiment was conducted to evaluate different cropping systems under varied nutrient management practices. The main plots comprised three nutrient management treatments: (i) inorganic practice with 100% chemical fertilizers, pesticides, and herbicides; (ii) integrated practice with 50% nutrients from chemical fertilizers and 50% from organic sources (FYM, vermicompost, neem cake, biofertilizer, and rock phosphate); and (iii) organic practice with 100% nutrient supply through organic sources for both *kharif* and *rabi* crops. The sub-plots consisted of two cropping systems, namely pearl millet–chickpea and pearl millet–mustard. The experiment was laid out in a split-plot design with three replications. The results revealed that organic farming recorded 6.92% and 21.94% higher chickpea yield, and 14.61% and 22.06% higher mustard yield, over integrated and inorganic treatments, respectively. Among nutrient management practices, the highest system productivity (4.45 t/ha) was achieved under organic farming, followed by integrated (3.99 t/ha), while the lowest was observed under inorganic farming (3.52 t/ha). Overall, organic farming resulted in 20.96% higher system productivity compared to inorganic practice. Among cropping systems, the pearl millet–chickpea system recorded significantly higher system productivity (4.04 t/ha) over the pearl millet–mustard system (3.93 t/ha). Organic nutrient management also resulted in higher nodulation in chickpea and greater root length in pearl millet, chickpea, and mustard, followed by integrated and inorganic practices. Soil biological properties were markedly improved under organic farming, which recorded the highest

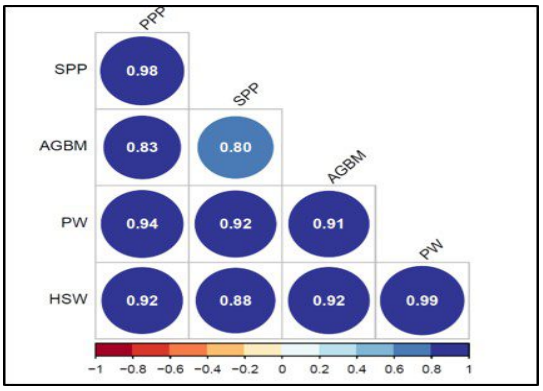


Effect of tillage treatments on sorghum grain yield (a), soil organic carbon, (b) and soil available P (Olsen-P) and sulphur (c)

(a)



(b)



Interactive effect of tillage and irrigation management on grain yield of fieldpea (IPFD 10-12) (a). Correlation matrix plot represents the associations bertween plant growth and yield traits (b)

microbial biomass carbon (MBC, 209.58 µg/g soil), acid phosphatase (ACP, 165.66 µg PNP/g/ h), and alkaline phosphatase (ALP, 234.59 µg PNP/g/h), representing increases of 67.26%, 41.95%, and 11.37%, respectively, over inorganic systems. The pearl millet–chickpea system also showed significantly higher MBC and phosphatase activities than the pearl millet–mustard system.

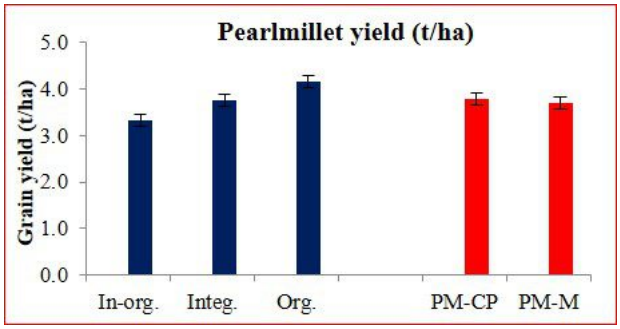
Development of pulses-based natural farming system for enhancing the sustainability of ecosystem

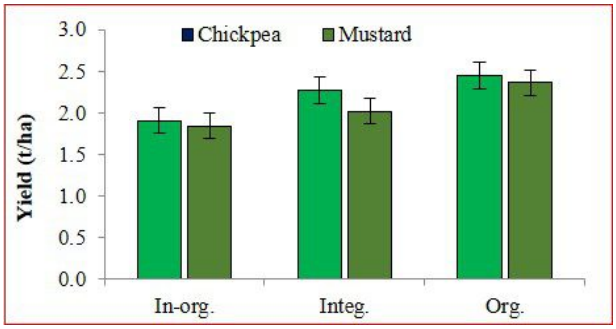
A field experiment was conducted to evaluate different cropping systems under diverse farming practices with the objective of developing a sustainable pulses-based natural farming system. The study was laid out in a split-plot design with three replications. The main plots comprised four farming practices: (i) control, (ii) natural farming, (iii) organic farming, and (iv) recommended farming practices, applied during both *kharif* and *rabi* seasons. The sub-plots included three cropping systems, namely urdbean + *bajra* (3:1), mungbean + *bajra* (3:1), and sole *bajra*, while during *rabi*, chickpea + mustard (6:2), chickpea + barley (4:2), and sole chickpea were evaluated. Additionally, mungbean was grown during the summer season as a ground-cover crop. The results revealed that the highest chickpea yield (1.68 t/ha) was obtained under sole chickpea, which was significantly superior to chickpea + mustard and chickpea + barley intercropping systems. System productivity was maximized under organic farming (5.01 t/ha), particularly with the urdbean + *bajra*–chickpea + mustard sequence, followed by recommended farming practices. Overall, system productivity followed the order: organic farming > recommended practices > natural farming > control. Natural farming recorded a yield reduction of 15.6% compared to recommended practices, although this reduction was lower than that observed in the previous year (23%). Yield reduction under natural farming was relatively lower in chickpea (17%) than in mustard (21%) and barley (22%). Natural farming plots showed higher weed infestation, including *Coronopus didymus*, *Chenopodium album*, *Medicago denticulata*, *Melilotus indicus*, and *Convolvulus arvensis*, compared to chemical and organic systems. However, intercropping of pulses with *bajra* during *kharif* and chickpea with mustard or barley during *rabi* effectively reduced weed density compared to sole cropping, highlighting the role of diversified cropping in improving sustainability under natural farming systems.

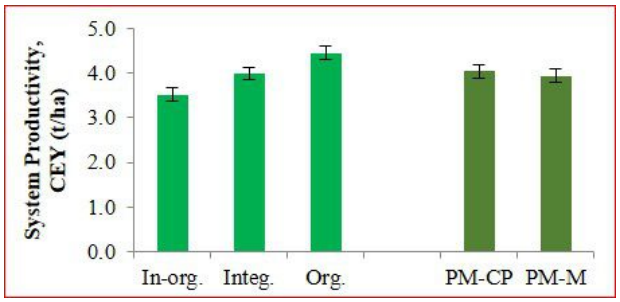
Weed management

Weed management in pulses through post-emergence herbicides, nano-based formulation and crop competitiveness

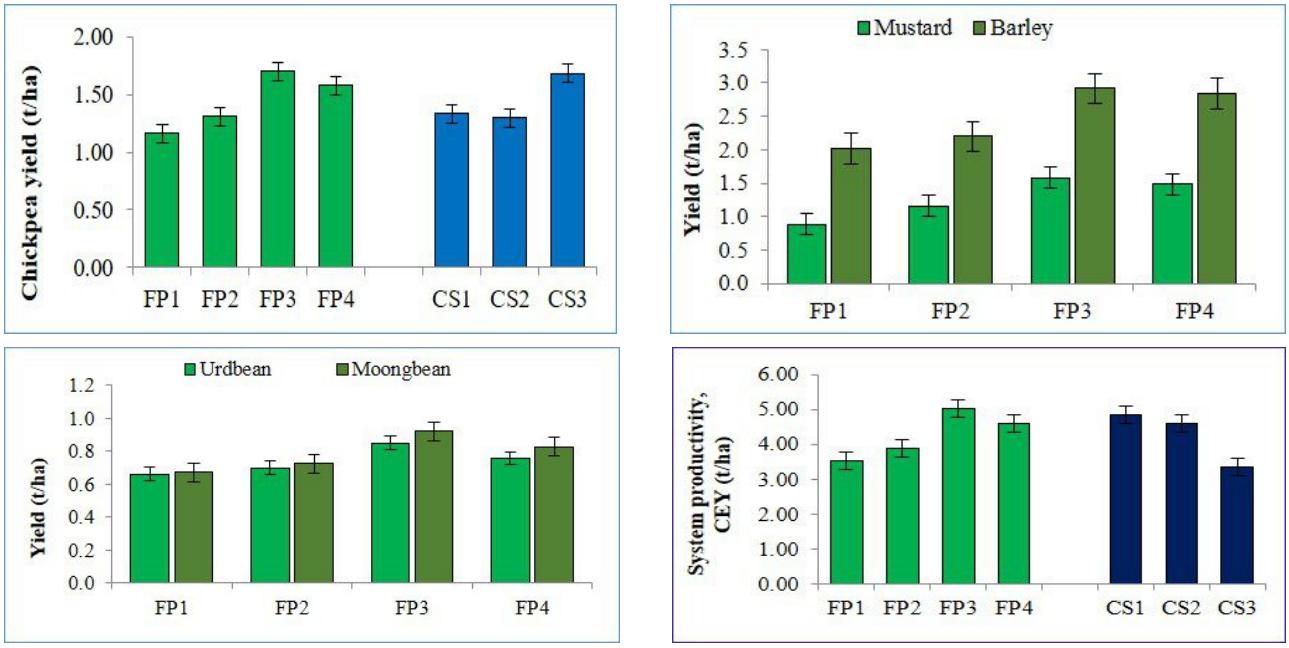
- ***Post-emergence (POST) herbicide tolerance:*** Genotypes tolerance and crop selectivity were tested in chickpea, fieldpea and lentil in *rabi* season; mungbean and urdbean in *kharif* season. The POST herbicides targeted in *rabi* pulses were topramezone 20.6, 25.7 and 30.9 g a.i./ha (pigment synthesis inhibitor), halosulfuron-methyl 70 and 105 g a.i./ha (ALS/ AHAS inhibitor), imazethapyr







Performance of different nutrient management practices on yield and system productivity



Effect of different farming practices on yield and system productivity

75, 100 and 112.5 g a.i./ha (ALS/AHAS inhibitor), carfentrazone ethyl 20 and 30 g a.i./ha (ALS/AHAS inhibitor). The POST herbicides targeted in *kharif* pulses were clodinafop-propargyl + Na-acifluorfen 122.5 - 245 g a.i./ha (lipid synthesis inhibitor) (CPNaA), halosulfuron-methyl 70 and 105 g a.i./ha (ALS/AHAS inhibitor). Three lines of each genotype was grown with treated and non-treated condition in 3 m bed.

- Urdbean 150 lines tested against halosulfuron-methyl 70 and 105 g a.i./ha (*C. rotundus* killer). Based on phytotoxicity scale and yield variability, a significant genotypic variability was observed. A range of phytotoxicity 0 to 10 was were observed across doses (among the tolerant genotypes). Yield variability against halosulfuron-methyl was 29% to –100% at 75 g/ha and -2 to -100% at 105 g a.i./ha. The higher yield was obtained in 'IPU 2022-129' and 'IPU 2022-93' genotypes (treated condition) with the lowest phytotoxicity (scale 2.3 at higher dose). The GIC evaluated the materials and suggested for one more season confirmation with the best genotypes only.

- ***Weed management in kharif pulses:*** The treatments included imazethapyr (imaz.) 100 g/ha PRE & POST; pendimethalin (pendi.) 1 kg/ha PRE; oxyfluorfen (oxyf.) 150 g/ha PRE; imaz. + propaquizafop 100 g/ha POST, CPNaA 183.5 g/ha POST, imaz. – CPNaA; oxyf.– CPNaA ; Pendi. – imaze. + propaqui. pendi. – CPNaA; unweeded control (UWC) and weed free check (WFC) in mungbean (Variety : 'Virat'). While imazethapyr 100 g/ha PRE & POST; pendi. 1 kg /ha PRE; oxyfluorfen 150 g/ha PRE; imaz. + propaquizafop 75 g/ha POST, CPNaA 183.5 g/ha POST, Imaz. – CPNaA 122.5 g/ha ; Oxyf. – CPNaA ; Pendi. – Imaze. + propaqui. Pendi. – CPNaA 122.5 g/ha ; UWC; WFC in urdbean (Variety : 'IPU 13-01'). In mungbean, pendimethalin 1 kg a.i./ha – CPNaA 183.5 g/ha resulted in 57% higher yield than control with WCE of 83.4%. In urdbean, CPNaA 183.5 g/ha had significantly higher yield than control and imazethapyr 100 g/ha POST.

- ***Weed management in rabi pulses:*** In chickpea, Imaz. 50, 75, 100, 125 g ai/ha P; Propaquiz.+Imaz. 62.5, 93.7, 125 g ai/ha 15 & 25 DAS ; Topramezone 20.6 g ai/ha ; Pendi. 1 kg a.i./ha – quizalofop. 100 g a.i./ha; Oxyf. 150 g & 250 a.i./ha - propaquiz. 100 g a.i./ha; UWC ; WFC were tested (Variety : 'JG 16'). While in fieldpea, Imaze. PRE (100 g/ha) & POST (100, 75 & 50 g/ha; Propa. + imaze. 62.5 g/ha POST ; Pendi. 1 kg/ha – quizal. 100 g/ha ; Carfentra. 20 g/ha POST ; UWC; WFC (fieldpea) (Variety 'IPFD 10-12'). The experiments were conducted in randomized block design with three replications.

- ***Carfentrazone-ethyl: a selective post-emergence herbicide found in fieldpea*:** The genotypic tolerance of 21 fieldpea genotypes were tested against carfentrazone ethyl 20 and 30 g a.i./ha as post-emergence (POST) application. Two lines of each genotype was grown with treated and non-treated condition in 3 m bed (treated 1.5 m length and non-treated 1.5 m length) at 25 days after sowing (DAS). The phytotoxicity and crop growth parameters were recorded. The tested genotypes showed tolerance against both the doses of carfentrazone ethyl (20 and 30 g a.i./ha). Carfentrazone ethyl is an ALS/AHAS inhibitor herbicide that can control broad-leaved weeds in fieldpea including Convolvulus arvensis (a problematic weed in fieldpea). Accordingly, performance of carfentrazone-ethyl as POST was evaluated to assess its efficacy and phytotoxicity. Carfentrazone-ethyl 20 g a.i./ha at 25 DAS effectively controlled weeds without any crop phytotoxicity. Major weed flora in fieldpea included *Chenopodium album, Coronopus didymus, Medicago denticulata, Melilotus indicus, Spergulla arvensis, Fumaria parviflora, Convolvulus arvensis* and *Phalaris minor*. In fieldpea, carfentrazone-ethyl 20 g a.i/ha resulted in significantly higher grain yield (1.39 t/ha) over pendimethalin 1 kg a.i./ha – quizalofop-p-ethyl 100 g a.i./ha (current recommendation).

Rainfed rice-fallows

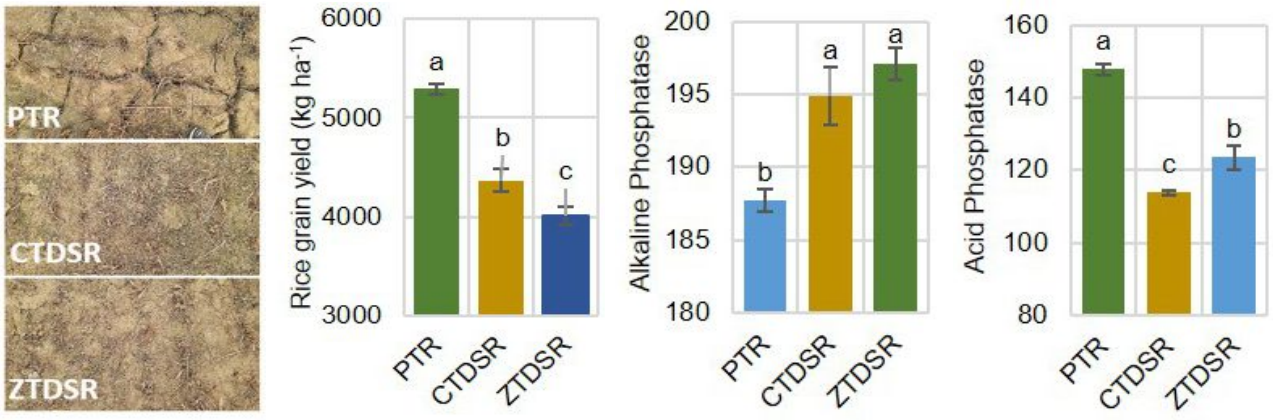
Integrated crop management for improving productivity of rice-fallow pulse production

The experiment is being conducted at the new research from of ICAR–IIPR, Kanpur to evaluate the effects of variable rice crop-establishment practices-puddled transplanted rice (PTR), zero-tillage direct-seeded rice (ZTDSR), and conventional-tillage direct-seeded rice (CTDSR) on the performance of chickpea and lentil cultivars /breeding lines grown under rice-fallow conditions. The overmarching goal is to identify the most suitable crop management practices for rice fallow systems. Results from the 2024–2025 cropping year indicated that PTR produced 21–32% higher rice yield compared with CTDSR and ZTDSR. Soil cracking was prominently observed under PTR, whereas no cracking occurred in CTDSR and ZTDSR plots. In both rice–lentil and rice–chickpea systems, the highest average lentil and chickpea productivity was recorded under CTDSR, followed by ZTDSR and PTR. Lentil genotypic performance was strongly influenced by the preceding rice crop-establishment method. For instance, genotypes IPL 329 (G17), IPL 21-57 (G12), and IPL 22-27 (G14) performed better under PTR; however, they showed higher instability across variable establishment conditions. In contrast, IPL 526, IPL 406, and IPL 22-27 were identified as highly stable and consistently high-yielding. Similarly, chickpea genotypes IPC 04-01 and IPC 05-62 performed better under DSR systems, with IPC 05-62 emerging as the best-performing genotype, recording a mean yield of more than 1,500 kg/ha. Stable and high-performing chickpea genotypes identified across establishment methods included IPC 05-62 and IPC 04-98.

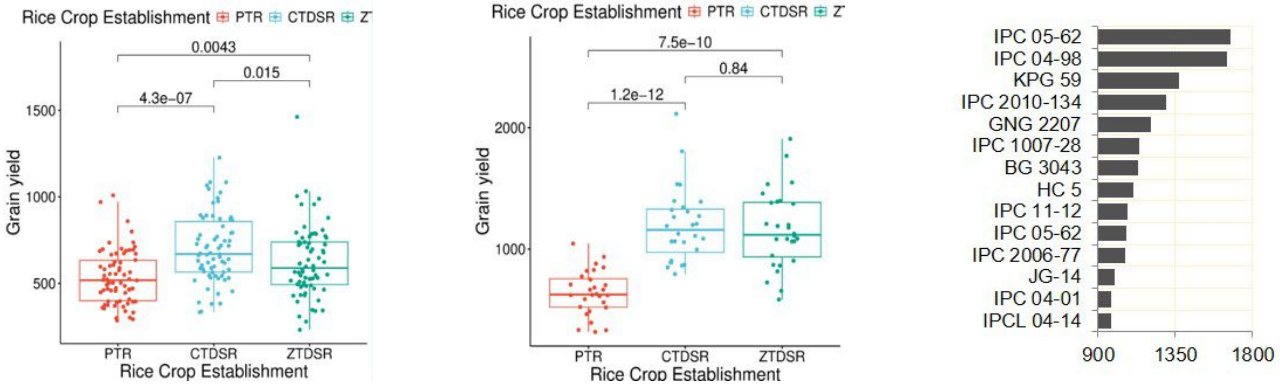
Farm Mechanization

Development and evaluation of a self-propelled chickpea planter

A two-row self-propelled chickpea planter for row-to-row spacing of 30 cm and plant-to-plant



Photographs showing variations in soil cracking under different tillage- cum- crop establishment practices. Effect of different tillage-cum-crop establishment practices on rice productivity, soil alkaline and acid phosphatase activities.



Grain yield performance of lentil (a) and chickpea (b) genotypes under different tillage cum rice crop establishment practices in rice fallow. Grain yield of chickpea genotypes under CTDSR system (c).

spacing of 10 cm was designed and developed for small and marginal farmers. It consisted of a prime mover with a 2 HP petrol engine. The seed is metered by an inclined plate metering mechanism of 8 cells and 8*8.5 mm size and semi-circular shape. It included two hoppers of capacity 5 kg each and two inverted T-type furrow openers, making it suitable for conservation agriculture. The planter has been evaluated for sowing of chickpea at a speed of 1.4 km/h and showed a field capacity of 0.04 ha/h and field efficiency of 81%.



Developed self-propelled chickpea planter and its field evaluation for chickpea

Development and evaluation of IIPR manual weeder

A manual weeder with a multi-tools bar carrier has been developed evaluated for weeding in pulses crop sown at 30, 25 and 22.5 cm row-to-row spacing. The weeding efficiency of the weeder varied from 85-90% for lentil, fieldpea and chickpea crop. Field capacity varied from 0.02-0.03 ha/h for weeding in different pulses with field efficiency of 91%. The technology has been certified by ICAR, and a design patent has also been filed. It has also been commercialized two firms Bharat Heavy Machines, Kanpur and Tyaagi Implements Pvt. Ltd., Agra, UP.

Development and evaluation of IIPR herbicide applicator

An herbicide applicator has been developed for the pulses crops at a row spacing of 30 cm. The roller wetting capacity is 0.205±0.002 m^2/s. The field capacity of the applicator is 0.05-0.07 ha/h. It can also be used on field bunds to control the weeds. It has a weeding efficiency of 80-85%. It is a gender-friendly equipment and can also be operated by women workers. The technology has been certified by ICAR, it has also been commercialized with two firms *viz.*, Bharat Heavy Machines, Kanpur and Tyaagi Implements Pvt. Ltd., Agra, UP.

Modification of sowing machinery for pulses

A commercially available seed drill has been calibrated for the row-to-row spacing of 30 cm for the sowing of mungbean and urdbean at a seed rate of 15-18 kg/ha. Initially, different tynes of seed drill machine was adjusted and fixed at the spacing of 30 cm to suit the requirement of mungbean and urdbean crop. Then the machine was lifted on a platform and plastic bags were attached to different tynes for the collection of the seeds. The seed drill had total width of 180 cm including 7 tynes placed equidistant at 30 cm. The ground wheel was rotated 39 times and the seed collected was multiplied by 100 to get the seed rate per hectare. This was repeated three times. Then the opening of the fluted roller metering mechanism of the seed drill was fixed at this position and duly marked for the field operation. The seed drill was used for the sowing of mungbean, urdbean, lentil, chickpea and fieldpea at NRC, ICAR-IIPR, Kanpur in the approximately 22 hectare area. The machine was operated at 3.2 km/h speed. The field capacity and



the field efficiency of the machine were obtained as 0.48 ha/h and 83%, respectively.

Evaluation of commercially available threshers and modification of ALMACO plot thresher

A commercially available muti-crop thresher was tested for its performance for threshing of stripped pigeonpea. Pigeonpea was stripped using pigeonpea stripper developed by ICAR-IIPR, Kanpur, with stripping capacity of 175 kg/h and stripping efficiency of >99%. The threshing capacity of the thresher for stripped pigeonpea was observed as 470 kg/ha. The threshing efficiency was observed as 100% for stripped pigeonpea. Whereas, the cleaning efficiency was 96.43% for stripped pigeonpea. The power source of ALMACO make thresher has been converted from engine to electric motor operated. The rubber of the cylinder has also been modified to make it suitable for threshing.

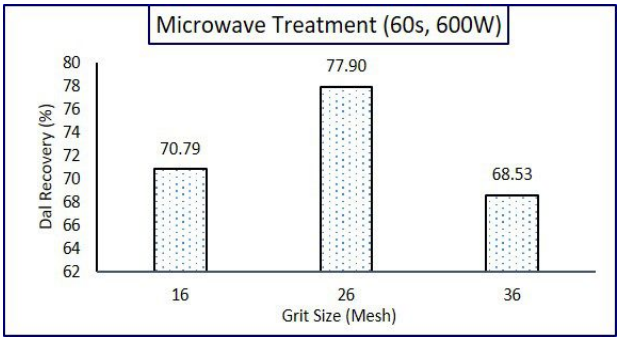


Modification in ALMACO make plot thresher for stripped pigeonpea threshing

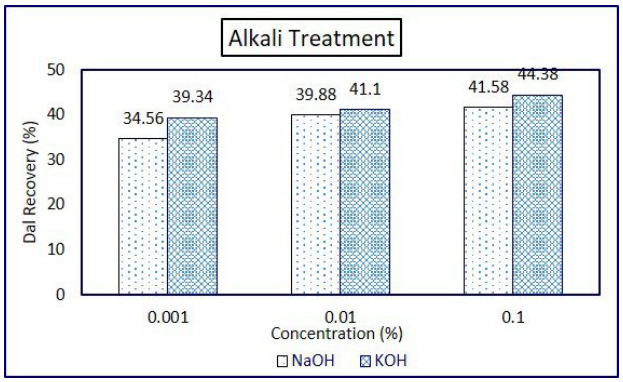
Post-harvest management of pulses, value addition and by-product utilization

Evaluation of existing pre-milling treatments and development of improved pre-milling treatments for ease of pulse milling

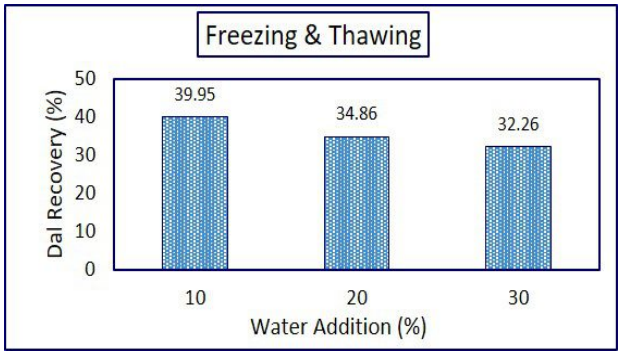
During the year, four treatments *viz.*, microwave treatment, Alkali Treatment, Freezing and Thawing, and Compressed Air Abrasive Dehusking methods were evaluated. Microwave Treatment: Pigeonpea grain with about 12 (%, w.b.) moisture content was microwaved at 600 watts for 60 seconds and milled in Universal Grain Testing Mill (Indosaw Make), using abrasive emery disk of 16, 26 and 36 mesh grit sizes. The results are shown in following Figures:



Alkali Treatment: Alkalis, like sodium hydroxide and potassium hydroxide are used to break the structure of hemicelluloses present in husk. The lye peeling system is quite prevalent in fruits and vegetable processing. It was expected that treatment with alkali will loosen the seed coat and help in dehusking process. Response of mild alkali (0.001, 0.01 and 0.10%) concentration solutions, were studied and results are shown in the following Figure:

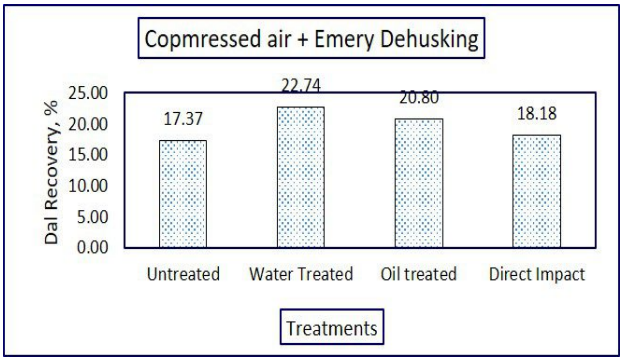


Freezing and Thawing: For novel process, contraction and expansion, of husk was envisaged to make husk brittle and loosen the grip over cotyledons. With is goal, pigeonpea grains with addition of 10, 20 and 30% water were kept in deep freezer for 8 hours and then allowed to thaw at room temperature. Grains were dried up to milling moisture content (12%, w.b.). The grains were milled in Universal Grain Testing Mill using 26 mesh emery grit.



Compressed Air Abrasive Dehusking: Untreated pigeonpea grains were subjected to pass

over abrasive emery disk of Universal Grain Testing Mill (Indosaw Make) and circulated over the surface using compressed air. Similarly, oil treated and water treated grains were also subjected to abrasive and compressed air dehusking. Compressed air dehusking with direct impact on irregular surface was also tried. The results are shown in the following Figure:







Compressed Air + Abrasive Dehusking

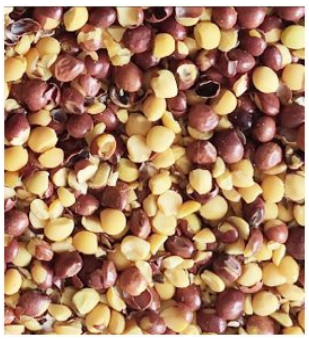


Compressed Air Direct Impact

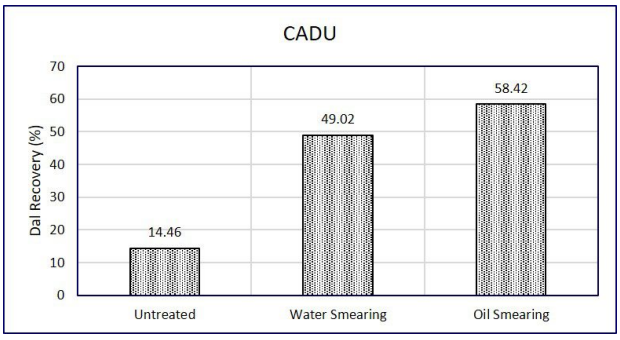
Based on the observation and results, it was observed that compressed air dehusking can be made feasible using appropriate pre-milling treatment using direct impact. Avoiding use of abrasive surface result into dehusked *dal* without powdering of cotyledons, which is quite common in abrasive surface dehusking. A Compressed Air Dehusking Unit was designed and fabricated. Water smearing @ 20% and oil smearing @ 10% treatments were given to the pigeonpea grains and allowed to equilibrate for 48 hours. Thus, treated grains were subjected to compressed air dehusking in the unit. The conceptual unit gave the *dal* recovery of 14.46% for untreated grains, 49.02% for water smeared grains and 58.42% for oil smeared grains in single pass. The process eliminates powdering and minimizes breakage (1.82%) of cotyledons. No bruising of cotyledons was observed.



CADU



Dehusked *Dal*



Testing of Nylon Rope Polisher: Nylon rope polisher was developed to polish the *dal* obtained from milling in IIPR Mini *Dal* Mill. In the Mill, in first pass, emery roller is used for scratching of whole grain, the process is called pitting, it facilitates ease of oil or water absorption during pretreatment, followed by prolong sun drying for loosening of husk. However, after pre-milling treatment treated grains are passed through rubber-steel disk *chakki* for soft dehusking and splitting. In soft dehusking mechanism, husk cover remains on about 15-20% splitted *dal*. To reduce *dal* with husk, a nylon rope polisher was developed and evaluated.



Nylon Rope Polisher

Output	Untreated		Water Treated		Oil Treated	
	Before	After	Before	After	Before	After
Dehusked whole	4.82	2.38	1.78	2.01	4.41	2.89
Dehusked *dal*	108.31	119.37	100.98	113.77	95.05	108.06
Dal recovery	113.13	121.75	102.76	115.78	99.46	110.95
Polishing efficiency, %	7.62		12.67		11.55	

The results are tabulated as below:

Processing of pulse seeds and development of methods for their long-term storage

Mungbean seeds (Shikha variety) was procured from the Institute farm was used in this investigation. Before being stored in various packaging materials, such as jute bags, cotton bags, PPW bags, metal bins, plastic bins, LDPE, HPDE, and laminated plastic films, the seeds were fumigated with aluminium phosphide (AlP) in airtight plastic containers and sun dried to a minimum moisture content of 12.1% (w.b.). Seeds for LDPE, HDPE, and laminated film bags were packed in both the standard and vacuum settings. Physical metrics, such as moisture content, bulk density, and milling recovery, entomological parameters, such as seed weight, number of grains containing egg, adult bruchids, and damaged grains, and seed viability parameters, such as germination, shoot length, and root length, were recorded at an interval of four months.

The results of the study after 36 months of storage were evaluated and presented in following graphs:

Moisture Content (%, w.b.): The least variation was observed in LDPE, HDPE and Laminated bags.

Germination (%): Viability of 84, 81 and 74%, was observed in HDPE, LDPE, and Laminated bags after 24 months.

Milling recovery (%): During 36 months of storage, milling recovery was maintained above 80%, in all the packaging materials. It indicates that grains can be stored for longer duration without any insect control measures, if initial field infestation prior to storage is controlled. It also increases with the length of storage duration.

The study was continued till 36 months, and it clearly indicated that the packaging materials impervious to external environment showed less infestation and higher *dal* recovery than the methods which permeable to external environmental conditions. Insect activity was observed where air tightness is not maintained. Viability can be maintained up to 80% in packaging materials impermeable to environmental conditions without any insect control measures up to 24 months.

Externally funded projects

Diversified cropping systems under conservation and conventional agriculture (DST-SERB/ANRF funded project, CRG/2022/00561)

A field experiment was started during 2023 to design a cropping system with higher system



Moisture, germination and dal recovery parameters in different packing materials at the end of 36 Months (Duration: 13.12.2021 to 13.12.2024)

productivity, resource-use efficiency and soil health for climate resilience. The treatments consist of 11 diversified upland cropping systems *viz*., Rice (DSR)-wheat (R-W), Rice (DSR)-wheat-mungbean (R-W-Mb), Rice (DSR) + *dhaincha*–wheat–mungbean (R+Dh-W-Mb), Rice (DSR) – chickpea + mustard (6:2) (R-C+Md), Rice (DSR)–mustard–mungbean (R-Md-Mb), Maize-wheat (M-W), Maize–wheat–mungbean (M-W-Mb), Maize– chickpea + mustard (6:2) (M-C+Md), Pearl millet – lentil + linseed (4:2) (Pm-L-Ls), Maize+ *dhaincha* (*In-situ GM*)–chickpea–mungbean (M+Dh-C-Mb) and transplanted rice and conventional till wheat (CP R-W) under randomized block design with three replications.

The results showed that diversified cropping systems produced measurable improvements in soil properties, resource-use efficiency, productivity, and profitability compared to the conventional Rice (Transplanted)–Wheat system. Integration of legumes and brown manuring increased soil nutrient availability across depths (0–100 cm). The Maize + *Dhaincha* (BM)–Chickpea–Mungbean system recorded the highest available nitrogen (209.1 kg/ha at 0–20 cm), phosphorus (12.53 kg/ha), potassium (224.6 kg/ha), and sulphur (55.58 kg/ha), whereas Rice–Wheat showed the lowest nitrogen (104.8 kg/ha at 80–100 cm). Soil organic carbon increased from 0.22% under conventional systems to 0.35% under diversified systems. Bulk density declined to 1.40–1.48 g/cm^3, while water-holding capacity increased to 41.47%. Soil pH decreased to 7.48–7.55 and EC to 0.14–0.19 dS/m, indicating reduced alkalinity. Micronutrient availability (Zn and Fe) and microbial activity increased substantially, with bacterial populations reaching 4.86 × 10^5 cfu/g and soil microbial biomass carbon peaking at 102.74 µg/g (41% higher than conventional). Water productivity reached 30.06 kg/ha/mm, nitrogen-use efficiency 59.70%, and energy output 626,886 MJ/ha (47.6% higher). Rice (DSR)+*Dhaincha*–Wheat–Mungbean achieved the highest yield (3950 kg/ha), net returns (₹1,75,670/ha), and benefit–cost ratio (3.61).

Identification of chickpea genotype for higher phosphorus use efficiency (DST-SERB/ANRF funded project, CRG/2022/004886)

The field experiment was done at contrasting phosphorus (P) levels with low and high available soil P. The high P and low P gradients were created by growing pearl millet (*Pennisetum glaucum*) without chemical fertilizers for P deficient strip across replication. Whereas, *dhaincha* (a leguminous plant: *Sesbania aculeata* (Willd.) Pers.) with 60 kg P_2O_5/ha was grown for creating low P strip across replication. The two P levels: Low P : 9.3 kg/ha and high P : 15.3 kg/ha were created at the beginning of experiment. 210 genotypes were screened under low P and high P regimes. Two lines of each genotype at three m length were grown in three replications. Key findings were as follows:

The root length varied between 10.8 and 14.0 cm in low P condition. While, it varied among 15.4 and 10.9 cm in high P condition. The root dry weight varied between 0.45 and 0.26 g/plant under low P condition and varied between 0.52 and 0.23 g/plant in high P condition. Genotypes like Radhey and Sadabahar aligned with "high P" (root length), indicating good root length under high phosphorus. A detailed study was undertaken on parameter such as seed P, stem P, root P, leaf P, leaf Mn and seed yield of each genotype under low P and high P condition. The phylogenetic tree clusters chickpea genotypes based on phosphorus responsiveness into three groups based on these studied parameters. The top-performing, phosphorus-efficient genotypes such as Sadabahar, Radhey, Digvijay, ICC 1014, IPC 20-156, GBM 2, and RVG 202, ideal for low-P environments. The moderately efficient genotypes like GCP 101, IPC 21-61, IPC 20-131, JG 16, Pusa Green 112, and RSG 963, showing stable adaptability. The less responsive genotypes such as ICC 4958, ICC 10302, PG 0405, and Vijay, less suited for P-deficient soils.

Chickpea genotypes based on seed P, leaf P, leaf Mn and seed yield under low P condition indicated P-efficient genotypes such as Sadabahar, GCP 105, ICC 1014, RSG 991, GNG 2144, HK 94-134, and Vishal, showing strong adaptability to low-P conditions. The low P-responsive genotypes such as PG 0405, ICC 8933, ICC 10301, and Pusa Green 112. It supports selection of superior genotypes like Sadabahar, GCP 105, and RSG 991 for breeding phosphorus-efficient cultivars. Based on the yield under low P condition, high-performing genotypes under low-phosphorus conditions included GJG 0814, ICC 8401, ICC 10035, ICC 12315, ICC 1164, RSG 141-1, Pusa Green 112, GCP 101, and HC 5. The P content in seed indicated ICC 8401, ICC 10035, and ICC 12315 superior phosphorus uptake and use efficient genotypes.

Crop residue management in rice-wheat-mungbean system for achieving Sustainable Development Goals [U.P. Council of Science and Technology (UPCST) funded project]

A field experiment was conducted for *in-situ* paddy straw management using decomposer with treatment details : T1: Residue burning, T2: Residue retention, T3: Residue incorporation, T4: Anchored





Field view of experiment comprising different genotypes under high and low P condition at active vegetative stage

residue (20 cm standing stubble), T5: Residue retention + Pusa decomposer, T6: Residue incorporation + Pusa decomposer, T7: Anchored residue + Pusa decomposer in randomized block design with three replications. Among the different crop residue management treatments, anchored residue (T4) recorded the longest panicle length (27.6 cm), which was 7.75% higher than residue incorporation (T3), the lowest (25.1 cm). Treatments involving Pusa decomposer also showed improved panicle length, with T6 and T7 reporting 27.4 cm and 27.2 cm, respectively. Panicle weight was the highest in T7 (4.39 g), showing a 25.1% increase over T3 (3.51 g), though differences were non-significant. T6 (4.12 g) and T2 (4.14 g) also showed relatively higher panicle weights. For filled grains per panicle, the maximum was recorded under T6 (181.9 grains), which was 17.8% higher than T2 (154.4 grains), the lowest. T1 and T4 also performed well, with 178.3 and 176.0 filled grains per panicle, respectively. The differences in this trait were significant. In terms of unfilled grains per panicle, the values ranged from 3.40 (T2) to 4.10 (T1 and T7), but these differences were not significant. Overall, T6 (residue incorporation + Pusa decomposer) and T7 (anchored residue + Pusa decomposer) were the most effective treatments, showing improvement in all major yield components compared to conventional residue management practices. Grain yield significantly varied among treatments. The highest grain yield (4.50 t/ha) was recorded under T6: residue incorporation + Pusa decomposer, followed closely by T3 (4.48 t/ha) and T7 (4.41 t/ha). Compared to T1 (residue burning, 3.96 t/ha), T6 showed a 13.6% increase, highlighting the yield advantage of combining residue incorporation with microbial decomposition.

Among the treatments, T3 and T6, both involving residue incorporation, consistently outperformed residue retention and anchored residue treatments. T2 (residue retention without decomposer) had a slightly lower yield (4.14 t/ha), while T5 (residue retention + Pusa decomposer) yielded 4.12 t/ha—suggesting marginal improvement due to decomposer application under retention. Regarding 1000-seed weight, T6 recorded a significantly higher value of 29.4 g, which was 47% higher than the lowest (20.0 g in T2), and significant. All other treatments ranged narrowly between 20.0 and 20.6 g. Overall, T6 (residue incorporation + Pusa decomposer) was the most effective treatment, showing both the highest yield and superior seed weight, indicating strong potential for improving crop productivity and grain quality under sustainable residue management practices.

Residue management practices significantly affected economic returns. Among treatments, T7 (anchored residue + Pusa decomposer) recorded the highest net return (₹ 68,264/ha) and B:C ratio (2.01), indicating superior profitability compared to other practices. Anchored residue without decomposer (T4) also performed well with a net return of ₹ 64,316/ha and B:C ratio of 1.89. Residue burning (T1) yielded the lowest net return (₹ 58,455/ha) and a moderate B:C ratio (1.72). Statistical analysis revealed that gross and net returns were non-significant, but B:C ratio differences were significant. Overall, anchored residue with Pusa decomposer (T7) proved the most effective for maximizing profitability.

Crop Protection

Research Achievements

Plant Pathology

Host Plant Resistance

Wilt of pigeonpea

A total of 846 pigeonpea lines were screened in the wilt sick field at the ICAR–IIPR Research Farm during *Kharif* 2024–2025 to identify resistant sources against *Fusarium udum* (Race-2), the causal agent of pigeonpea wilt. Pigeonpea variety was Bahar used as the susceptible check. Wilt incidence was recorded at fortnightly intervals beginning from the first appearance of the disease (from November onwards). Among 133 advanced breeding materials, the genotypes PPW-17, PPW-54, PPW-83, PPW-85, IPAW-22, PPW-51, PPW-30, IPAW-22-31, IPAW-22-38, IPAW-22-44, IPA-17-5, and POP-20 were identified as resistant, with disease incidence restricted to 10–15%. Further, a total of 202 genotypes from AICRP centres, along with the check variety Bahar, were evaluated. The genotypes PFW 24-1, PFW 24-10, PFW 24-14, PFW 24-20, PFW 24-21, PFW 24-24, PFW 24-27, PFW 24-32, PFW 24-35, PFW 24-43, PFW 24-71, and PFW 24-105 were found resistant.

A total of 11 wilt donors and differentials, KPL-44, BSMR-853, KPBR-80-2-1, ICP 88-59, IPC 7035, ICP 8862, ICP 9174, C-11, ICP 8863, BDN-1, BDN-2, and IPA 15F showed consistent resistance to *Fusarium* wilt. Among 33 ICRISAT genotypes, four, ICPWSMDN-102, ICPWSMDN-103, ICPWSMDN-108, and ICPWSMDN-112 were identified as resistant.

Phytophthora stem blight

A total of 299 early and medium duration pigeonpea lines were evaluated for resistance to *Phytophthora* stem blight (PSB) in the sick field during *Kharif* 2024–2025. The susceptible check UPAS-120 was sown after every four rows of the test entries. PSB incidence was recorded at fortnightly intervals in different genotypes from the seedling stage onward, beginning with the appearance of the first disease symptoms. Among 103 IIPR breeding lines, 10 genotypes, IPAC-3, IPAC-79, IPAPB 7-2-1-7, KPBR-80-2-1, DPPA85-5, DPPA85-7, DPPA85-12, IPPSB-11, IPPSB-25, and IPPSB-30 were identified as resistant and are recommended for further use in the PSB resistance breeding programme. Out of 168 AICRP lines, four genotypes, PPM 24-31, PPM 24-73, PPM 24-92, and PPM 24-163 were found resistant.

Fusarium wilt of chickpea

Out of 113 Advanced Breeding Lines, 8 lines showed resistant response namely IPC 24-142, IPC 24-145, IPC 24-41, IPC 24-44, IPC 24-36, IPC 24-43, IPC 24-79, IPC 24-117 and 29 lines show moderately resistant response such as IPC 24-140, IPC 24-107, IPC 24-141, IPC 24-146, IPC 24-194, IPC 24-137, IPC 24-156, IPC 24-44, IPC 24-22, IPC 24-148, IPC 24-43, IPC 24-89, IPC 24-110, IPC 24-25, IPC 24-23, IPC 24-83, IPC 24-37, IPC 24-113, IPC 24-127, IPC 24-69, IPC 24-109, IPC 24-77, IPC 24-65, IPC 24-26, IPC 24-42, IPC 24-27, IPC 24-101, IPC 24-121 and IPC 24-88.

YMD of mungbean and urdbean

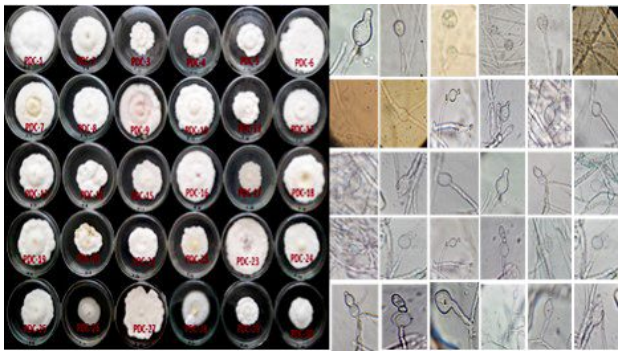
The *Kharif* 2025 trial was conducted at the main farm using an augmented block design, with susceptible checks, DGGV-2 and Co-5 placed after every two test entries for consistent comparison. Sowing was carried out on 25 July 2025, and each genotype was grown in 3-m rows. A total of 115 mungbean and 66 urdbean genotypes were evaluated for their performance and reaction to major viral diseases prevalent during the season. Among the tested materials, 21 mungbean genotypes and 15 urdbean genotypes recorded less than 10% YMD incidence observed at 60 days after sowing, indicating their potential as promising sources for resistance breeding. The identified resistant mungbean genotypes were: Bhutan LM-1, EC 103821, EC 496839, GM 6, IPM 05-3-22, IPM 205-7, IPM 2-10, IPM 2-14, IPM 2-23, IPM 9901-10, KM 2241, LGG 607, MH 1142, MH 2-15 (satya), MH 241, MH 805, ML 131, Pratap, PUSA Vishal, PUSA 9531, and SML 668. The resistant urdbean genotypes were: BTU 111-5, DKU 98, GG 3120, H 1, JU 24-1, KUG 1097, KUG 1144, NPU 180, Pant URD 12, PDU 2E, PU 2205, PU 2210, RUB 15-08, UG 27, and VBG 22-02.

Necrotic leaf curl and Urdbean leaf crinkle disease

Groundnut Bud Necrosis Virus (GBNV) incidence was observed at low to moderate levels, ranging between 4 and 8% across specific genotypes. In total, 16 mungbean and 3 urdbean genotypes showed symptoms of GBNV. Urdbean Leaf Crinkle Disease (ULCD) was detected at mild levels, with symptoms recorded in the range of 2–5% in a few entries. Urdbean Leaf Crinkle Disease (ULCD) occurred at mild levels, with incidence ranging from 2–5%; 9 mungbean genotypes and 4 urdbean genotypes exhibited symptoms within this range.

Morpho-cultural variability of *Phytopthora cajani* isolates causing blight disease of pigeonpea in India

A total of 26 *Phytophthora cajani* causing blight disease of pigeonpea were characterized by using ITS1/ITS4 primer, producing clear ~850 bp bands. BLAST sequencing confirmed all isolates as *P. cajani* with 97–100% similarity. Phylogenetic analysis grouped the isolates into three distinct clades, indicating considerable molecular diversity within the pathogen population.



Morpho-cultural variability and molecular identification of *Phytopthora cajani* isolates

Characterization of MYMIV infecting *Clitoria ternatea*

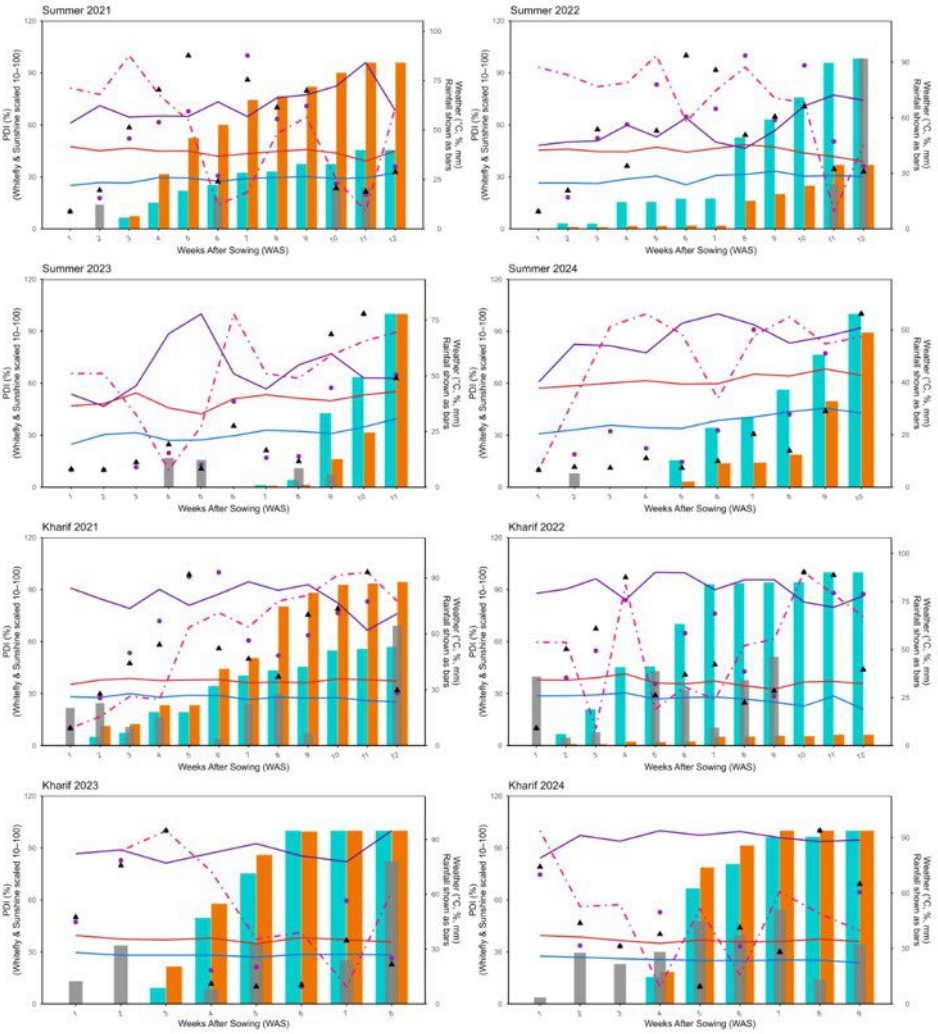
Butterfly pea (*Clitoria ternatea* L.), a widely cultivated ornamental and medicinal plant, was found exhibiting typical yellow mosaic disease (YMD) symptoms in Kanpur, India. Given the known susceptibility of multiple legumes and weeds to begomoviruses, symptomatic leaves were collected to investigate the causal agent. Molecular diagnostics confirmed, for the first time, that *C. ternatea* can serve as an alternate host of mungbean yellow mosaic India virus (MYMIV), a dominant legumovirus across India. DNA extracted from two symptomatic plants underwent rolling circle amplification, followed by PCR screening for YMD-associated viruses. Sample tested positive for MYMIV, enabled full-length amplification of both DNA-A (2,746 bp) and DNA-B (2,659 bp) components. Sequencing and BLAST analysis revealed high nucleotide identity (98.98% for DNA-A and 93.40% for DNA-B) with known MYMIV isolates, confirming the virus as MYMIV-[IN:Knp:Ct:2024]. Genome annotation showed typical begomovirus organization, including ORFs for AV1, AV2, AC1–AC5, BV1, and BC1. Given MYMIV's expanding host range and widespread prevalence, the identification of *C. ternatea* as a natural host highlights the need for continuous monitoring of cultivated and non-cultivated species to better understand virus reservoirs and epidemiology in pulse-growing ecosystems.

Weather dynamics on YMD development in past four years

Yellow mosaic disease (YMD) development in mungbean (DGGV-2) and urdbean (Co-5) during 2021–2024 displayed strong year-to-year and season-to-season variability, driven largely by the interacting effects of temperature, relative humidity, rainfall, sunshine hours and the population dynamics of the whitefly vector. Across all the years, the disease appeared earlier and progressed faster during the *kharif* season compared to summer, owing to higher humidity, moderate temperatures and frequent rainfall, which collectively created conditions conducive for whitefly multiplication and virus transmission.

Across both seasons and all four years, several consistent weather–disease relationships were evident. Moderate temperatures (32–36 °C), high humidity (>80%) and short sunshine hours (2–5 hours) strongly encouraged rapid YMD development during *kharif*. Conversely, extremely high temperatures (>40 °C) and low humidity slowed early infection in summer but did not prevent eventual epidemics once whitefly numbers increased. Disease progression was always faster in urdbean than mungbean, indicating a higher susceptibility or more efficient virus multiplication. Whitefly populations were consistently higher on urdbean in both the seasons, reinforcing its role in sustaining virus transmission pressure within fields. Rainfall peaks often coincided with temporary declines in whitefly abundance but promoted overall humidity that favoured disease build-up shortly after.

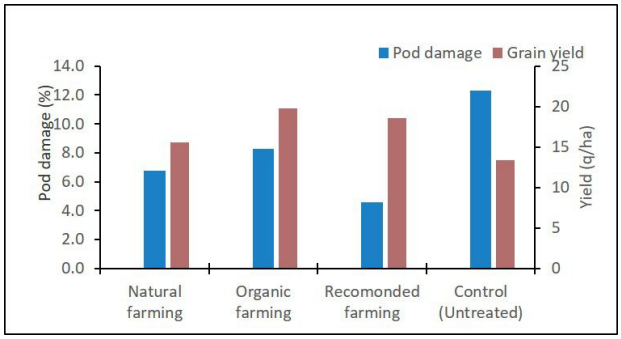
In summary, the four-year dataset demonstrates that YMD epidemics are tightly governed by weather-driven fluctuations in whitefly activity. *Kharif* conditions create an optimal environment for rapid disease establishment and saturation regardless of year, whereas summer epidemics are strongly temperature-regulated but ultimately reach high intensity once vector populations stabilize. These insights provide firm evidence that temperature–humidity interactions and vector dynamics jointly shape the seasonal progression of YMD in pulse ecosystems.



Seasonal progression of YMD (2021–2024): Summer seasons (top 4 panels) showed delayed disease onset (2–6 weeks after sowing) under high temperatures (38–45 °C), low–moderate humidity, and long sunshine, with faster escalation once temperatures stabilized near 40–42 °C. Co-5 consistently exhibited higher PDI and whitefly abundance than DGGV-2, with 2023 showing the latest onset but the fastest rise to 100% PDI. *Kharif* seasons (bottom 4 panels) showed early onset (2–3 weeks) supported by high humidity (80–95%), moderate temperatures (32–36°C), and rainfall. Rapid progression to high or complete PDI occurred each year, with 2023–2024 displaying the fastest epidemics aligned with peak whitefly populations (250–440 adults). Legends: Bars= DGGV2 PDI (cyan), Co-5 PDI (orange), Rainfall (grey); Dotted line= Sunshine hours (pink); Solid line= Minimum temperature (Blue), Maximum Temperature (Red); Shapes= DGGV 2 whitefly count (black triangle), Co-5 whitefly count (purple circle).

Effect of ancient formulation of insect pests in natural farming

Recommended Farming (RF) practices recorded 4.56% pod damage, while Natural Farming (NF) recorded 6.75% pod damage by gram pod borer. Organic Farming (OF) recorded the highest yield (19.75 q/ha), followed by RF (18.59 q/ha) and NF (5.54 q/ha). Spraying *Neemastra*, *Brahmastra*, and *Agniastra* at weekly intervals resulted in the highest coccinellid and syrphid populations under natural and organic farming conditions, whereas RF recorded the lowest natural enemy population.



Pad damage (%) by gram pod borer and yield data under natural farming, organic farming, recommended farming and control plots

Biological control

Development of Trichoderma based formulations and their exploitation Developed emulsion-based *Trichoderma* formulation for the management of pigeonpea wilt. *Trichoderma* isolates, specifically *Trichoderma asperellum* (NCBI GenBank accession numbers ITS: MK968811 and TEF: MN232100), were identified for developing a liquid formulation and subsequently tested for their biocontrol efficacy against wilt pathogens. Sorghum was used as the substrate in a solid-state fermentation process to produce mass cultures of the *Trichoderma* isolate. The application of the emulsion-based bioformulation IIPRTh-31 (@ 5 mL/kg^{-1}) significantly reduced wilt severity by 55% and enhanced plant growth in pigeonpea by 23–33%.



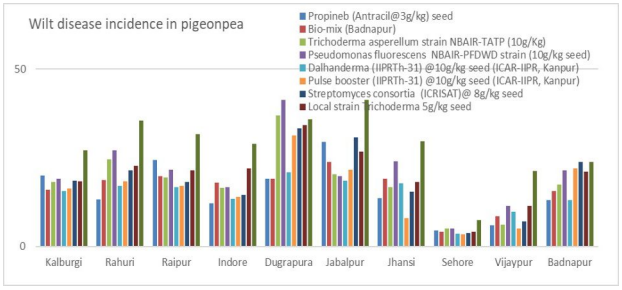
Effect of developed emulsion-based Trichoderma formulation on pigeonpea

Efficacy of extracted Trichoderma secondary metabolites on plant growth: To evaluate the effect of *Trichoderma*, secondary metabolites on chickpea plant growth, the plate-within-a-plate method was used under in vitro conditions. Chickpea seeds (cv. JG-62) were coated with secondary metabolites at 200 ppm and 400 ppm concentrations to assess their influence on seed germination and early plant growth. A 40% increase in seed germination and a 60% increase in biomass were observed in metabolite-treated plants compared with the untreated control.

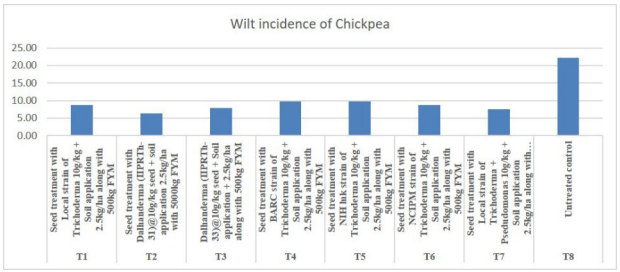


A-late Within a plate activity to check the efficacy of IIPRMUCK-1 on chickpea seeds B-Efficacy of extracted metabolites on chickpea plant growth

Field efficacy of Dalhanderma and Pulse booster formulation in pigeonpea and chickpea under AICRP: Field efficacy of the developed formulations *Dalhanderma* and Pulse Booster was evaluated under AICRP trials at ten different locations for the management of wilt in pigeonpea. Both formulations significantly reduced wilt incidence across all the locations. In pigeonpea, *Dalhanderma* reduced wilt incidence by 60–70%, while Pulse Booster achieved a reduction of 40–60%, depending on the location. Similarly, in chickpea, *Dalhanderma* was highly effective, reducing wilt incidence by 73%, whereas Pulse Booster reduced wilt incidence by 64% over the control across the tested locations.



Field efficacy of the developed formulations at ten different locations for the management of wilt in pigeonpea



Field efficacy of the developed formulations at ten different locations for the management of wilt in Chickpea

Entomology

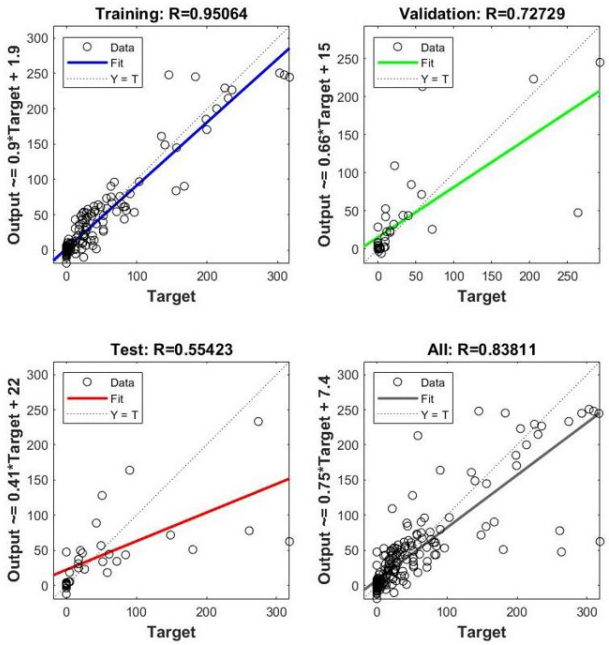
Population dynamics of insect pests in past five years

The population data of whitefly (*B. tabaci)* was recorded at weekly interval through yellow sticky traps installed in the field, whereas the adult catches of *H. armigera* and *S. litura* were recorded through pheromone traps at weekly interval. The average numbers of adult whiteflies per trap from 2020 to 2025, showed two major peaks, one during 20-25 Standard Meteorological Weeks (SMWs) and another during 34-36 SMWs. In case of *H. armigera*, the adult population started rising by 11-12 SMWs and remained elevated till the 25th SMW. *S. litura* adult population was also higher during 20-25 SMWs and a minor peak was also observed during 38-39 SMWs.

Based on the data recorded on population trend of *B. tabaci*, *H. armigera* and *S. litura* for the period of 2020 to 2025, clubbed with the weather data like maximum temperature, minimum temperature, relative humidity, evaporation and sunshine hours; different models were tested under ANN modelling. 70% data was used for training, 15% for testing and 15% for validation. The best optimized result was obtained with the network structure: 9-4-1 (four hidden layers).

Performance of the different ANN network structure

Network structure	Training R value	Validation R value	Testing R value	All R value
9-2-1	0.71096	0.81234	0.76375	0.72256
*9-4-1	0.95064	0.72729	0.55423	0.83811
9-6-1	0.83035	0.91233	0.7646	0.82389
9-8-1	0.79672	0.7999	0.62628	0.76416
9-10-1	0.78971	0.65364	0.72977	0.75852
9-12-1	0.83912	0.6027	0.40461	0.74523
9-14-1	0.84467	0.74594	0.81779	0.81165

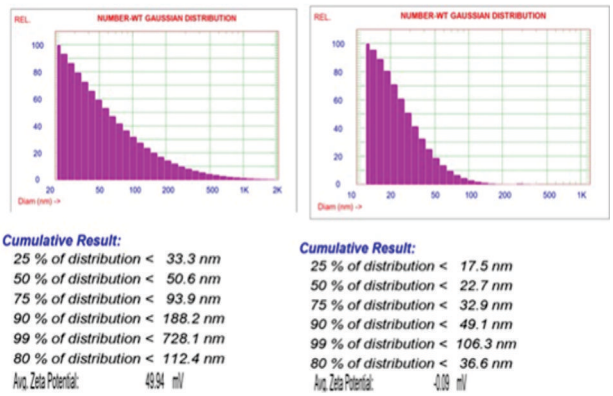


Biological control of insect pests

Lab bio-efficacy and particle size analysis of IIPR-LepKill

Laboratory assays showed that both IIPR Lep-Kill and IIPR Pulse Guard were more potent than their respective active ingredients alone, with significantly lower LC_{50} values. Blank formulation caused no larval mortality, confirming non-toxicity. *Synergism:* Addition of TiO□ nanoparticles to Lep-Kill increased mortality in *S. litura* beyond that caused by TiO_2 alone.

Formulation Stability: Both formulations remained stable after repeated freeze–thaw cycles. Particle-size distribution showed >90% of particles <188 nm with a zeta potential of ~50 mV, indicating good stability.



Particle size analysis of fresh and stored "IIPR Lep-Kill" at ICAR-CIRCOT, Mumbai

Bio-efficacy of IIPR Lep-Kill & IIPR Pulse Guard against 3rd Instar (5 DOL) *H. armigera* larva

S. No	Treatment	LC50 (%)	Lower boundary	Upper boundary	Slope ± SE	χ^2	DF
1	Lep-Kill (LK)	0.22115	-	-	0.3415±0.2101	0.1004	4
2	Active ingredient of LK	0.67195	-	-	0.0700±0.1786	0.0333	4
3	Pulse Guard (PG)	0.22404	9.8165E-16	0.98907	0.4252±0.2143	4.7054	4
4	Active ingredient of PG	0.46584	0.04431	0.91656	0.5211±0.2247	5.0557	4
5	TiO2Nano Powder	0.00492	-	-	2.0803±1.1603	0.9114	4
	S. litura						
5	LK	7.850	-	-	0.8129±0.1528	0.2169	4
6	LK+30PPM TiO2 Nano powder	1.3303	0.4068	3.4749	0.4200±0.1459	5.6061	4

Field trial of Lep-Kill against pod borer complex infesting pigeonpea

The pigeonpea hybrid, 'IPH 15-3' was sown during *kharif* 2024 and recommended agronomic package of practices were followed to raise a healthy crop except insecticidal spraying. Lep-Kill significantly reduced *Maruca vitrata* and *Helicoverpa armigera* populations. Treated plots showed consistently lower larval numbers, higher percent reduction over control, and markedly reduced pod and seed damage.

Across doses, pod borer damage was reduced from 10.7% in control to 2.5–4.2% in treated plots, and seed damage dropped from 25% in control to about 12–15% in Bt treatments. Natural enemies such as coccinellids, spiders, and dragonflies remained unaffected in Bt plots, while Indoxacarb caused substantial reductions. Yield response clearly favored Lep-Kill, especially the 2% dose, which produced the highest increase over control.

Field trials of Pulse Guard at IIPR-RRS Bhubaneshwar in Blackgram

The 'IIPR Pulse Guard' was sprayed on blackgram, 'IPU 13-1' when *Spilosoma obliqua* Walker incidence has occurred. Pulse Guard treatments demonstrated complete suppression (100% reduction) of *Spilosoma obliqua* by 3 DAT at higher doses. Natural enemy populations, especially coccinellids, remained unaffected, confirming safety of the Bt formulation. Yield increased significantly in treated plots, with D1 producing the highest yield.

Effect of IIPR Lep Kill on pigeonpea, IPH 15-03 yield during *kharif* 2024

S.No	Treatment	Yield (kg/25m ^{2})	Yield (kg/ha)	Increase in yield over control (kg/ha)	Additional Income* (₹)	PIYOC
1	IIPR Lep -Kill @ 2%	1.267 (1.33^{A})	506.67	239.87	18109.93	89.91
2	IIPR Lep -Kill @ 3.3%	1.133 (1.27^{A})	453.33	186.53	14083.27	69.92
3	IIPR Lep -Kill @ 4.2%	1.203 (1.30^{A})	481.33	214.53	16197.27	80.41
4	Indoxacarb 14.5SC @ 0.01%	0.857 (1.21^{A})	342.67	75.87	5727.933	28.44
5	Dipel8L @ 0.2%	1.043 (1.24^{A})	417.33	150.53	11365.27	56.42
6	Control	0.667 (1.01^{B})	266.80		-	-

Efficacy of 'IIPR Pulse Guard' on incidence of *Spilosoma obliqua* Walker in blackgram

Treatment	No of larva per square meter					Percent reduction over control				Yield (Kg/25m^2)
	Pre-spray	1 DAT	3 DAT	7 DAT	10 DAT	1 DAT	3 DAT	7 DAT	10 DAT	
IIPR PG D1	102	41	12	0	0	50.58	82.09	100.00	100.00	0.97 (1.21^{a})
IIPR PG D2	187	56	0	0	0	63.19	100.00	100.00	100.00	0.82 (1.15^{b})
IIPR PG D3	156	30	0	0	0	76.36	100.00	100.00	100.00	0.86 (1.17^{b})
Dipel 8L	112	29	0	0	0	68.17	100.00	100.00	100.00	0.89 ($1.18^{a,b}$)
Control	134	109	88	63	42	-	-	-	-	0.45 (0.97^{c})
CV										1.95

Efficacy of 'IIPR Lep-Kill' against pod borer in pigeonpea

Sl. No.	Treatment Details	% Pod damage		% Seed damage
		Maruca vitrata	Plume moth	
T1	IIPR Lep-Kill D1 @ 15 ml/l	13.59	50.51	65.40
T2	IIPR Lep-Kill D2 @ 25 ml/l	13.57	46.80	63.07
T3	IIPR Lep-Kill D3 @ 35 ml/l	10.30	49.43	65.67
T4	Dipel @ 2 ml/l	9.36	61.05	68.47
T5	Indoxacarb 14.5 SC @ 0.6 ml/l	14.45	51.90	57.93
T6	control	16.63	54.47	64.67

Efficacy of 'IIPR Lep-Kill' (liquid bioformulation of *B. thuringiensis* strain) against pod borer in cowpea

Sl. No.	Treatment Details	*Maruca vitrata*		*Cydia pytchora*		% Seed damage by *C pytchora*
		% Pod damage	No. of Larve/ 25 pod	% Pod damage	No. of Larve/25 pod	
T1	IIPR Lep-Kill D1 @ 15 ml/l	72.0	0.93	33.48	11.00	33.00
T2	IIPR Lep-Kill D2 @ 25 ml/l	64.9	0.65	41.82	8.33	25.67
T3	IIPR Lep-Kill D3 @ 35 ml/l	64.0	0.85	43.58	9.33	28.00
T4	Dipel @ 2ml/l	59.0	0.82	35.23	21.67	26.67
T5	Indoxacarb 14.5 SC @ 0.6 ml/l	60.0	0.75	41.71	9.33	24.67
T6	control	68.0	1.20	54.04	10.00	36.67

Bio-efficacy against fall armyworm (FAW) by two different methods

S. No	Treatment	LC_{50} (%)	95% Fiducial limits		χ^2	Slope± SE	LC_{90} (Hours)
			Lower boundary	Upper boundary			
1	FAW diet incorporation bioassay 24 h	0.07699	0.05766	0.10066	3.4108	2.7262±0.6480	0.25699
2	FAW diet incorporation bioassay 142 h	0.06557	0.05062	0.08050	6.1715	3.6612±0.7015	0.17018
3	FAW leaf dip method 24 h	0.11062	0.05587	1.80817	17.2644	2.0756±0.8388	0.43073
4	FAW leaf dip method 72 h	0.02198	0.0000787	0.04033	11.2704	3.4258±0.9287	0.09167

Field trials of Lep-Kill at IIPR-RRS, Dharward

Pigeonpea 'GRG-811'

Lep-Kill D3 (35 ml/L) lowered *Maruca vitrata* pod damage to about 10%, similar to the commercial *Bt* standard. Seed damage remained high across treatments due to generally low pest pressure during the season.

Cowpea 'DC 15'

Across all the treatments, pod and seed damage from *M. vitrata* and *C. pytchora* remained high (pod damage 59–72% and seed damage 25–37%), indicating limited efficacy under field conditions.

Bio-efficacy of IIPR Lep-Kill against *Chilo partellus* and *S. frugiperda*

Lep-Kill caused 100% mortality of *Chilo partellus* within 72 hours at all the tested doses. Against fall armyworm (FAW), both the diet incorporation and leaf-dip assays produced low LC_{50} values, indicating strong toxicity. Treated FAW larvae showed severe weight suppression across all the doses.

BIPM chickpea validation trial for insect pest and disease management

The Bio-intensive IPM modules [BIPM1 (Chickpea + coriander) & BIPM2 (Chickpea + mustard)] for chickpea cultivars '*Madhav*' and '*Phule G 12313*' were compared with their respective untreated check (Sole crop). Further a farmers practice also maintained in case of '*Madhav*'. The effect of BIPM1 and BIPM2 on chickpea are provided in Table 8 and Table 9. BIPM1 (Chickpea + Coriander) and BIPM2 (Chickpea + Mustard) consistently recorded the lowest pod damage (0.8–1.8% compared to 5.7–9.5% in checks), the highest populations of natural enemies such as coccinellids and syrphids, reduced Tylenchid nematode densities, and higher Simpson's diversity indicating improved ecological richness, and both modules outperformed farmers' practice in terms of benefit–cost ratio and ROI.



Field view of chickpea with different intercrops (Coriander & mustard)

BIPM in chickpea for pod borer, wilt and nematode management

Treatments	Coccinellids/5 plants$	Syrphids/5 plants$	Pod borer/plant$	Percent pod damage/plant*
BIPM 1	10.00 (3.24^{A})	2.33 (1.65^{A,B})	0.13 (0.80^{A})	0.78 (4.93^{E})
BIPM 2	5.33 (2.40^{B})	2.00 (1.56^{A,B})	0.13 (0.80^{A})	0.86 (5.12^{E})
FP	0.33 (0.88^{C})	0.00 (0.71^{C})	0.33 (0.91^{A})	3.20 (10.29^{C})
Check	1.00 (1.17^{C})	0.67 (1^{C})	0.33 (0.91^{A})	5.68(13.78^{B})
BIPM 1 PhuleG12313	12.67 (3.62^{A})	3.67 (2.04^{A})	0.13 (0.80^{A})	1.81 (7.72^{D})
BIPM 2 PhuleG12313	5.00 (2.34^{B})	1.00 (1.17^{B,C})	0.13 (0.80^{A})	2.54 (9.16^{C})
Check	0.67 (1.05^{C})	0.00 (0.71^{C})	0.13 (0.80^{A})	9.48 (17.93^{A})

*Values in parenthesis are arcsine transformed. $Values in parenthesis are square root (√x+0.5) transformed. In a column means followed by same letter are not significantly different from each other ($P > 0.05$).

Incidence of major nematodes in chickpea farmscaping trial field

Treatment	Tylenchids (per cc of soil)	Dorylamids (per cc of soil)	Rhabditids (per cc of soil)	Cephalobids (per cc of soil)	Fusarium (CFU/g)
BIPM 1	10.67 (3.34^{B,C})	15.00 (3.93^{B})	12.33 (3.57 ^{B,C})	12.33 (3.49 ^{A})	2.30
BIPM 2	10.33 (3.25^{B,C})	22.67 (4.81^{A})	26.33 (5.16 ^{A})	10.33 (3.25 ^{A})	2.67
FP	10.33 (3.28^{B,C})	11.33 (3.42^{B,C})	15.67 (4.01 ^{A,B,C})	12.00 (3.33 ^{A})	5.23
Check	17.67 (3.97^{A,B})	9.67(3.18^{C})	9.00 (3.03 ^{C})	10.33 (3.28 ^{A})	-
BIPM 1 PhuleG12313	9.33(2.92^{C})	13.00 (3.67^{B,C})	19.00 (4.40 ^{A,B})	3.67 (1.96 ^{A})	-
BIPM 2 PhuleG12313	8.67(2.97^{C})	15.00 (3.93^{B})	12.33 (3.58 ^{B,C})	4.67 (2.26 ^{A})	-
Check	19.33(4.46^{A})	10.33 (3.26^{C})	8.33 (2.84 ^{C})	3.67 (1.84 ^{A})	-

$Values in parenthesis are square root (√x+0.5) transformed. In a column means followed by same letter are not significantly different from each other ($P > 0.05$).

Field evaluation of Emulsion formulation for root knot nematode management *Meloidogyne* spp in mungbean

Treatment	Shoot length (cm)	Shoot weight (cm)	Root length (cm)	Root weight (g)	No of galls	Soil population (per100cc)
P. lilacinum	23.50±2.32^{b}	29.88±1.06^{bc}	10.39±2.02^{abc}	1.50±0.22^{a}	12.67±1.50^{b}	74.33±6.03^{b}
T. harzianum	20.17±1.92^{b}	27.40±1.15^{c}	11.50±0.72^{bc}	1.97±0.52^{a}	13.67±1.48^{b}	77.00±3.61^{b}
T. asperellum	23.06±3.75^{b}	26.05±2.12^{c}	12.46±0.90^{abc}	1.71±0.44^{a}	14.67±1.40^{b}	79.33±4.04^{b}
Formulation	26.49±0.93^{a}	32.72±0.66^{b}	12.61±0.94^{ab}	1.87±0.52^{a}	9.67±1.52^{c}	48.33±5.51^{c}
Carbofuran	28.41±2.50^{a}	36.23±1.55^{a}	13.33±1.80^{a}	2.54±0.43^{a}	7.00±1.00^{c}	39.00±7.21^{c}
Control	16.56±2.28^{c}	20.33±1.00^{d}	9.29±0.72^{c}	1.48±0.42^{a}	20.00±2.00^{a}	116.00±8.19^{a}
P (<.005)	0.001	0.001	0.004	0.65 (NS)	0.001	0.001
Pooled SD	2.43	1.34	1.84	0.46	1.54	5.98

Field evaluation of Rhizo-nil SP formulation for root knot nematode management Meloidogyne spp in mungbean

Treatment	Shoot length (cm)	Shoot wight (cm)	Root length (cm)	Root weight (g)	No of galls	Soil population (per100cc)
P. lilacinum	25.82±0.83^{c}	26.18±0.96^{b}	12.67±1.72^{abc}	1.61±0.35^{a}	15.33±1.50^{b}	67.33±6.03^{b}
T. harzianum	23.76±1.11^{c}	24.48±1.12^{b}	11.56±2.26^{abc}	1.41±0.65^{a}	14.67±1.47^{b}	72.33±3.61^{b}
T. asperellum	24.12±1.33^{c}	25.11±1.16^{b}	11.72±2.02^{bc}	1.33±0.39^{a}	16.67±1.53^{b}	71.33±4.04^{b}
Formulation	28.59±0.90^{b}	30.26±0.86^{a}	14.45±2.34^{ab}	1.64±0.74^{a}	10.67±1.52^{d}	42.67±5.51^{d}
Carbofuran	31.99±1.52^{a}	32.34±2.28^{a}	16.71±1.12^{a}	1.87±0.03^{a}	8.00±1.00^{d}	36.33±7.21^{d}
Control	16.41±1.53^{d}	18.44±1.17^{c}	9.28±1.11^{c}	1.30±0.15^{a}	21.00±2.00^{a}	102.67±8.19^{a}
P (<.005)	0.001	0.001	0.021	0.102 (NS)	0.001	0.001
Pooled SD	2.43	1.34	1.29	0.43	1.54	5.93

Nematology

Biological control of nematodes

Field evaluation of Emulsion formulation and Rhizo-nil SP formulation for root knot nematode (*Meloidogyne* spp) management in mungbean revealed that the seed treatment of both formulations were performing better in reduction of nematode population as compared to control. The number of galls and soil population of *Meloidogyne* spp observed in the application emulsion formulation were 9.67 and 48.33, respectively. Similarly, in case of Rhizo-nil SP application it was 10.67 and 42.67.

***Shelf life of Bioformulation*:** The shelf life of the emulsion formulation was observed at fortnight interval and was 100% stable for minimum 12 months under ambient temperature. The shelf life of the emulsion formulation was also observed 100% stable under alternate freezing and thawing cycle for 12 hrs each @ four times.

Resistance screening against root knot nematode: Total of 31 green gram, 25 blackgram, 165 chickpea, 9 field pea and 14 lentil entries were screened for resistance against *M. incognita*. Only two chickpea entries *viz.*, BDNG 2020-71 and DK 2303 were found resistant to *M. incognita*.

Storage entomology

Diversity of Bruchids: A total of 31 bruchid infested samples representing 10 different pulses were collected from 19 locations across India. From these samples, four species were identified as *Callosobruchus maculatus* (F.), *C. analis* (F.), *C. chinensis* L. and *Bruchus affinis*. Among 31 samples, *C. analis* was predominant infesting 11 samples followed by *C. maculatus* (10), *C. chinensis* (9) and *B. affinis* (1).

***Resistance status against Aluminium Phosphide (AlP) 56% w/w*:** The bruchid populations

demonstrated varied resistance/susceptibility to AlP. The Resistance Ratio (RR) in 31 populations representing four species was ranged between 1.1 (LC50- 0.016 mg L^{-1}) and 8.81 folds (0.11 mg L^{-1}). Among major species, *C. analis* recorded higher folds of resistance (4.62±2.11 folds, LC50- 0.064±0.021 mg L^{-1}) followed by *C. maculatus* (4.06±0.98 folds, LC50- 0.051±0.014 mg L^{-1}) and *C. chinensis* (3.87±1.15 folds, LC50- 0.047±0.019 mg L^{-1}). In 3 years of monitoring, the bruchids (irrespective of species) demonstrated 3.11 to 5.23 folds resistance, with 35 and 68 % increase in second and third year, respectively when compared to first year. *C. analis* demonstrated an average of 4.47 folds resistance to phosphine followed by *C. maculatus* (4.28) and *C. chinensis* (3.84).

Resistance status against Deltamethrin 2.5 W.P.: The bruchid populations demonstrated higher resistance to Deltamethin than AlP. Among 31 populations studied, the resistance ratio was ranged between 6.72 to 8.03 folds under three exposure periods. Higher resistance was demonstrated by *C. analis* (7.38-10.11 folds) followed by *C. maculatus* (6.99-7.85) and *C. chinensis* (5.62-5.68).

Essential oils' toxicity against bruchids: The plant volatile oil constituent bio-compounds, belonging to terpenes, terpenoids, and phenylpropanoids, exhibiting fumigant toxicity to bruchids adults (*Callosobruchus analis* F.) were characterized. Bio-compounds showed considerable fumigant toxicity by recording LC_{50} value of 21−108 µl/L of air against adult beetles. These bio-compounds demonstrated potent ovicidal activity and recorded < 27 % hatching in 5-days old egg stages at lethal concentration (LC_{90}). The bio-compounds exhibited moderate-to-strong repellent activity and recorded 33−70 % repellency at sub-lethal exposures (LC_{20} and LC_{50}). The *in-vivo* efficacy the bio-compounds recorded < 5% seed damage and 30−95% feeding deterrent index (FDI).

Bruchid resistance donors

Chickpea: A total of 54 germplasms of chickpea were screened against *C. analis* under no-choice condition and found none highly resistant or resistant. However, two germplasms were moderately resistant. Against *C. maculatus,* 27 germplasms were screened under no-choice condition and found two germplasms (IPC 07-67 and IPC 92-39) were found resistant. The results of free-choice screening for these germplams are awaited followed by CNC validation.

Lentil: Validatory no-choice screening of 17 lentil accessions was done against three bruchid species. Only 2 lentil accessions (ILWL-55 and ILWL-39) were identified as resistant against *C. maculatus* and *C. chinensis.*

Pigeonpea: Identified *Rhynchosia bracteata* accessions (IC 15815, IC 15816, IC 15817 and IC 618509) as convergent and stable highly resistant (HR) against three bruchid species. Further, several *C. scarabaeoides* accessions (e.g., IC 15698, ICP 15700, ICP 15725, ICP 15882, ICP 15883, ICP 15685, ICP 15689, ICP 15711, SG/DD-701, ICP 15922, ICP 15712, ICP 15727, SG/DD-15, SG/DD-64, ICP 15690, SG/DD-13) were also resistant, particularly to *C. chinensis* and *C. maculatus*, though less stable against *C. analis*.

Wild Vigna accessions: A total of 42 wild accessions belonging to *Vigna* were received from IIPR, RS, Dharwad for screening against bruchids. During 2024, screening was done under free-choice and no-choice, conditions and identified three accessions (an accession of *V. khandalensis*, IC 253924 and IC 277021) highly resistant with 0% seed damage and SI index, despite carrying an 2.11±0.2, 1.08±0.11 and 1.75±0.18 eggs per grain, respectively. Against *C. analis,* one accession of *V. khandalensis* found highly resistant despite carrying 3.12±0.22 eggs per grain. The identified accessions need validation in confirmatory no-choice screening

Externally Funded Project

Elucidate the molecular mechanisms of host plant resistance to develop resistant varieties/donors of pigeonpea for *Fusarium* wilt and *Phytophthora* stem blight in Uttar Pradesh (UPCST)

Comparative expression of pathogenicity-related genes in Phytophthora cajani in resistant (IPAC-79) and susceptible (UPAS-120) pigeonpea Genotypes: The quantitative RT-PCR analysis was conducted using 12 genes: PR2, PR10, PAL2, CHS8, ADC, SPMS, PR3 (chitinase class III), thaumatin-like protein, lipoxygenase (LOX), proteinase inhibitor (PIF, PIF-2), peroxidase (POX), and PPF. Expression levels were normalized using actin as the reference gene, and fold change was calculated relative to the uninoculated control samples.

Early Response (24 h post-inoculation)

- Resistant genotype (IPAC-79) showed strong upregulation of *PR2, PR10, PAL2,* and *CHS8*, suggesting rapid activation of salicylic acid (SA) and phenylpropanoid pathways.
- *ADC* and *SPMS* were moderately induced, indicating early activation of polyamine

biosynthesis.

- *PR3* and *Thaumatin-like protein* showed basal induction, implying initial cell wall defense reinforcement.
- In UPAS-120, only *PR2* and *PR10* showed mild induction, while most other genes remained near basal levels, reflecting delayed defense signaling.

Intermediate Response (48 h)

- IPAC-79 exhibited enhanced expression of *LOX*, *Peroxidase (POX)*, and *Proteinase inhibitor (PIF)* genes, signifying activation of jasmonate- and ROS-mediated defense mechanisms.
- *PAL2* and *CHS8* maintained high expression, supporting continuous phenolic accumulation.
- *SPMS* and *ADC* expression increased, aligning with the role of spermidine and putrescine in stress mitigation.
- UPAS-120 showed only slight elevation in *LOX* and *POX*, indicating limited defense activation at this stage.

Late Response (72 h)

- In IPAC-79, *PR3*, *PIFR-2*, *PPF* genes displayed peak expression, suggesting systemic defense reinforcement and establishment of acquired resistance.
- *Peroxidase* activity remained high, consistent with ROS detoxification during late defense.
- UPAS-120, however, showed decline in *PR2*, *PAL2*, and *CHS8* expression, and minimal induction of *PIF* and *POX*, indicating compromised sustained defense.

Furthermore, the resistant genotype IPAC-79 exhibited early and sustained induction of multiple defense-related genes associated with the salicylic acid (SA), jasmonic acid (JA), phenylpropanoid, and polyamine pathways. In contrast, the susceptible genotype UPAS-120 showed delayed and transient gene activation, resulting in ineffective pathogen containment. These findings highlight the multi-layered defense mechanisms in the resistant genotype, involving cell wall reinforcement, ROS scavenging, and accumulation of antimicrobial proteins. Overall, the coordinated and persistent expression of PR2, PAL2, CHS8, LOX, POX, and PIF-family genes in IPAC-79 underpins its resistance against *Phytophthora cajani*. In contrast, the subdued expression profile observed in UPAS-120 reflects its vulnerability, driven by weak or delayed activation of key defense pathways.

Basic Science

MEGA PROJECT-1

Physio-biochemical interventions for improving climate resilience and nutrition-enriched pulses

Sub-Project-1: Physiological characterization of pigeonpea genotypes for water logging tolerance

Water- logging stress is one of the important abiotic stresses in pigeonpea crop, especially in low lying areas in pigeonpea growing states particularly Uttar Pradesh, Madhya Pradesh, Bihar, Chhattisgarh, Jharkhand *etc*. Being a rainy season crop, pigeonpea is invariably exposed to intermittent water-logging conditions for different durations from germination to early vegetative growth stages, which damage the crop partially and sometime eliminate the entire crop depending on intensity and duration of water stagnation. Plants adapted to waterlogged conditions, have mechanisms to cope with this stress such as aerenchyma formation, development of numerous adventitious roots and lenticels, increased availability of soluble sugars, greater activity of glycolytic pathway and fermentation enzymes and involvement of antioxidant defence mechanism to cope with the post-hypoxia/anoxia oxidative stress.

As per approved technical programme, the experiment was conducted with IPAC 79, ICPL 7035, ICPL 20241, ICPL 87091, ICP 2376, ICP 5028, MA 6, IPAWL 22-7, IPAWL 22-8, IPAWL 22-9, IPA 2022-21, IPAB 20-2 and IPA 2022-1. IPAC 79 was used as check for tolerance and ICPL 7035 was used as check for susceptibility. Water logging stress was imposed for 72 h having minimum depth of water 12 inches at 30 DAS with three replications in field conditions. Meteorological data during water logging stress including rainfall, maximum and minimum temperature and relative humidity, were recorded. Morphological scoring (0-3) at the end of water logging stress was done and at harvesting, yield attributes and yields were recorded. Morphological scoring (0-3) at the end of water logging stress showed the highest score (0) in genotypes including IPAC 79 (Check for tolerant) followed by ICP 5028, ICP 2376, IPAWL 22-7 and IPAWL 22-8 and considered as water logging tolerant. Pigeonpea genotypes namely ICPL 20241, IPA 2022-21, IPAB 20-2 and IPA 2022-1 and MA 6 showed moderate score (01) and considered as moderately tolerant. Development of adventitious roots was observed under water logged condition only and it was recorded the highest in IPAC 79 (Check for tolerant) followed by ICP 5028, ICP 2376, IPAWL 22-7, IPAWL 22-8 and IPAWL 22-9 genotypes which were water logging tolerant group. In susceptible genotypes, no/negligible adventitious roots were found. Morphological scoring, Survival %, Development of adventitious roots, aerenchyma, lenticels, enhancement in anti-oxidant enzyme activity and conc. of soluble sugar in leaves are the parameters which may considered to screen the pigeonpea genotypes for water logging tolerance.



Adventitious roots in susceptible and tolerant genotypes

Sub-Project-2: Physiological characterization for efficient plant type in short duration pigeonpea [(*Cajanus cajan* (L Millsp.)]

Enhancing pigeonpea yield demands a renewed focus on restructuring the ideal plant type by using more efficient approaches like genomic tools. Ideotype a biological model combining morphological and physiological traits. Keeping the above facts in mind, this project was planned to determine the morphological and physiological traits in order to develop an efficient plant type of pigeonpea with high yield potential.

As per approved technical programme, during second year, the experiment was planted with 124 pigeonpea short duration lines in the last week of June, 2024. Morphological observations including branching initiation above ground level, number of primary and secondary branches/primary branch, angle of branching, days to initiation of flowering, days to 50% flowering and determinate/ indeterminate plant growth habit and plant height

were recorded in 124 genotypes which were germinated/survived in the field. Physiological traits like chlorophyll and Normalized Deviation in Vegetation Index were also recorded. Observations at harvesting including total biomass production, pod number, test weight and grain yield were recorded.

Amongst the short duration pigeonpea genotypes, evaluated four genotypes namely ICPL 8094 Granula 1, IC 407260 and ICP 4009 showed maximum biomass production, pod number/plant, test weight and grain yield/plant and they have also showed maximum number of primary and secondary branches, NDVI and Chlorophyll in leaves and were superior over all the checks used. Nine genotypes namely ICP 1967, EC 109897, H 82, ICPL 92045, J-I-A-30, P 173, IC 472664, LRG 36 and ICP 2022 showed moderate performance in respect of all the parameters studied. Twenty four genotypes showed very poor performance in all the characters studied. Majority of genotypes showed angular canopy followed by spreading and bunching. Out of 124 genotypes, 109 genotypes showed the determinate type of growth habit. The experiment of 2025 is in progress with 128 genotypes and observations are being recorded periodically.

Sub-Project-3: Identification and physiological characterization of urdbean genotypes suitable for mechanical harvesting

The experiment was conducted under field condition during *kharif* 2024-2025. In field under irrigated condition, 56 urdbean genotypes of diverse origin were sown in augmented design in two sowing dates *i.e,* normal and late to find out genotypes suitable for mechanical harvesting. Each plot consisted of double rows of 4 m length. Rows were spaced 30 cm apart and interplant distance was 10 cm. Maturity duration for these genotypes ranged from 70 to 75 days. Standard agronomic package and practices were followed to raise the crop. These genotypes were selected on the basis of their performance from large number of genotypes and various morphological, physiological observations were taken.

The genotypes were assessed involving few physiological traits (Phenological observations: days to germination, days to 50% flowering, early and late flowering, days to podding, early crop maturity and yield. flower setting, days to pod setting, duration of reproductive phase, days to crop maturity and yield. Morpho-physiological observation: Plant height->70 cm, 1st branching height, angle of primary branch >60 degrees, position of 1st pod, tolerant to lodging, synchronization of podding and maturity were recorded.

Character		No. of genotypes	Name of genotypes
Plant height	> than 35 cm	13	LBG 26 (29.8), IPU 2-43 (34.2), PKGU -1 (34.8), IPU 99-18 (35.0), LBG 17 (33.0), IPU2K-21 (31.6), IPU 2K-221 (31.9), TU 99-2 (33.2), LBG 87 (32.6), IPU 55-2 (32.5), IPU 11-02 (29.4), UH 85-15 (34.9), IPU 99-123 (34.8)
	< than 35 cm	38	Shekhar (40.0), IPU 94-2 (40.8), HUP 120 (39.75), PGRU 95016 (39.8), IPU2K 99-224 (40.4), IPU 99-200 (39.0), UH 32-3 (40.0), IPU 94-1 (42.2), IPU 94-31 (39.2), LBG 26 (29.8), IPU 2K-21 (38.0), IPU 30 (38.0), IPU 99-79 (35.8), IC 56408 (36.6), IPU 99-123 (36.6), IPU 10-26 (37.8), PLU 294 (35.4), Shekhar-2 (37.6), PU-19 (40.4), LPU 180 (36.4), IC 21003 (41.0), BG 387 (43.8), PLU 446 (39.4), H-1 (45.8), BGP 247 (37.8), IPU 98-36 (50.7), IC 21001 (37.8), NO 5-134 (37.0), PU 31 (40.8), PBU 04-004 (40.6), IPU 94-1 (35.4), IPU 13-1 (36.8), IPU 10-26 (35.4), PDI-1 (40.8), UH 14-14 (43.6), Shekhar-3 (37.8), Azad 2 (42.6), PGRU 95014 (37.2), IPU 99-32 (38.2),
Plant habit	Indeterminate	20	IPU 2-43, IPU 2K 99-22, IPU 94-31, IPU 2K-21, IPU2K-221, IPU 30, Shekhar-2, IPU 98-36, IC 21001, NO 5-134, PU 31, PBU 04-004, IPU 94-1, IPU 13-1, Shekhar-3, IPU 55-2, UH 85-15, IPU 99-12 IPU 99-79, PLU 294

	Determinate	31	Shekhar, IPU 99-32, PKGU-1,HUP 120, PGRU 95016, IPU 2K 99-22,IPU 99-200, IPU 99-190,NPU-246, IPU 94-1, IPU 99-293, LBG 26, LBG 17, IPU 2k-22,SU -2, IC 56408, IPU 99-123, IPU 10-26, LBG 787, PU 19, LPU 180, IC21003, BG 387, PLU 446, H-1, BGP 247, IPU 98-36, UH 14-14, Shekhar-3, IPU 11-02, PGRU 95014, ANU 44-22
Time of flowering	Early	36-45 (27)	IPU 2-46, Shekhar, PKGU-1, IPU 94-1, IPU 94-31, IPU 2K-22, IPU 2K-221, IPU 30, IPU 99-79,TU 99-2,IC 56408, IPU 10-26, shekher-2,LPU 180,BG 387,PLU 446,H1,NO 5-134, PU 31, IPU 94-1, IPU 13-1,IPU 10-26,PDU-1, Azad 2,UH86-15, PGRU95016, PU 19
	Late	46-50 (24)	IPU 94-2, HUP-120, IPU2K 99-22, IPU 99-200, IPU 99-18,UH 32-3, LBG 26, LBG 17, IPU 2K-21, IPU 99-23, PLU 294, LBG 787, IC 21003, BGP 247, IPU 98-36, IC 21001, UH 14-14, Shekher-3, IPU 55-2, IPU 11-02, PGRU 95014, IPU 99-32, IPU 99-12
Plant Growth habit	Erect Semi-erect Spreading	9 21 20	 

Morphological and yield traits of urdbean under 1st and 2nd sowing: It was recorded that plant height, branch no, and cluster number is more in 1st sowing as compared to second sowing. Seed yield, 100-seed weight in gram and pod number is also more in first sowing. Out of 56 urdbean genotypes, only 11 were erect, 19 were semi-erect and 20 genotypes were spreading type. Short listing of 20 promising genotypes on the basis of days to flowering and other above traits. Yield attributes and seed coat colour were recorded. Biomass/plant, pods/plant, yield and yield attributes were observed. Four promising genotypes (HUP 120, IPU 99-200, IPU 99-293, ANU 11-12) were identified based on non lodging habit, erectness, plant height, Branch angle 1st pod bearing from base the height to the first pod is an important trait for mechanical harvesting.

S. No.	Genotype	Plant growth habit	Plant height (cm)	Determ-inate/ Indeter-minate	Branch angle	Pod position (height from base cm)	Inter-nodal length	Ground clearance (gm)	Yield/ 5 plants (gm)	Days to matu rity
1.	HUP 120	Semi erect	42	determi nate	60	18	4	10	40	53
2.	IPU 99200	Spread-ing	56	determi nate	80	20	2	14	30	58
3.	IPU 9431	Spread-ing	65	determi nate	60	15	5	10	20	56
4.	LBG 17	Errect	42	Indeter minate	40	16	2	10	22	60
5.	IPU 2K-22	Errect	42	Indeter minate	45	19	5	17	20	51

6.	IPU 30	Errect	47	Indeter-minate	40	22	5	17	25	58
7.	IPU 99-123	Semi-errect	30	Determi-nate	90	11	3	10	22	59
8.	SHEKHAR -2	Semi-errect	36	Determi-nate	50	20	4	8	25	60
9.	BG 387	Semi-errect	54	Determi-nate	40	7	5	8	28	58
10.	IPU 99-32	Errect	49	Determi-nate	70	15	5	13	23	55
11.	IPU 99-293	Errect	40	Determi-nate	60	12	3	7	34	56
12.	SU-2	Errect	40	Determi-nate	40	10	3	7	23	59
13.	IPU 99-190	Errect	43	Determi-nate	50	12	3	10	34	58
14.	NPU-246	Errect	42	Determi-nate	50	12	6	7	32	60
15.	NO-7368-15	Errect	56	Determi-nate	40	27	5	12	20	61
16	PLU-708	Errect	56	Determi-nate	70	12	3	8	24	59
17.	ANU-11-12	Semi-errect	40	Determi-nate	50	15	4	12	33	60
18.	PLU-570	Errect	36	Determi-nate	90	12	4	16	26	58
CH-1	IPU2-43	Semi-errect	30	Determi-nate	70	6	3	5	27	55
CH-2	Shekhar	Semi-errect	35	Determi-nate	60	12	3	9	22	55

For reproductive study, five plants from each genotype under late sown condition were tagged at flowering and pod setting. A general reduction in all the growth and yield related traits (total number of pods per plant, total number of seeds per plant, single seed weight and seed yield per plant, was recorded in all the genotypes under late sown condition and compared with normal sown crop. Some of the genotypes maintained good crop vigour, produced pods on terminal branches and grain filling was recorded. Based upon these traits, HUP 120 and IPU 99-190 genotypes were identified as promising genotypes for both the seasons under irrigated condition. It was observed that higher crop vigour, pod formation in terminal branches, pod development and grain filling rate are the most important parameters to find out suitable genotypes for mechanical harvesting

Significant achievement

The experiment was conducted in field during *kharif* 2024-2025 Fifty six urdbean genotypes were sown in augmented design under irrigated condition to find out the mechanical harvested genotypes. These genotypes were selected on the basis of their performance from large number of genotypes and various phenological parameters, growth parameters and yield observations were taken.

It was observed that

1. Angle of primary branch (45-50) is an important trait. Genotype HUP 120 (42.8 cm, Semi-erect), and ANU 11-12 (40 cm Semi erect) are suitable for mechanical harvesting.
2. Height of first pod in urdbean genotype HUP 120 (18 cm), IPU 99-200 (20 cm) and ANU 11-12 (15 cm), is more than 15-20 cm from the ground level.
3. Early phenology *i.e.,* flowering, podding, maturity and synchronized maturity is

important characters for mechanical harvesting.

4. Plant height (cm) genotypes with 30 to 40 cm (HUP 120, IPU 99-200, were suitable for mechanical harvesting.

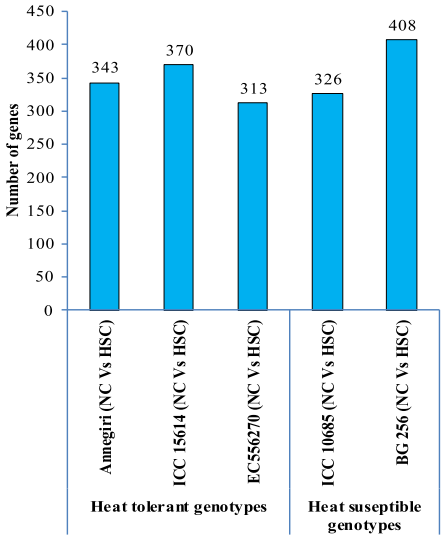
5. Erect to semi erect, non-lodging and determinate genotypes (IPU 99-203) suitable for mechanical harvesting

Sub-Project-4: Biochemical responses of chickpea to heat stress and identifying key factors limiting its productivity

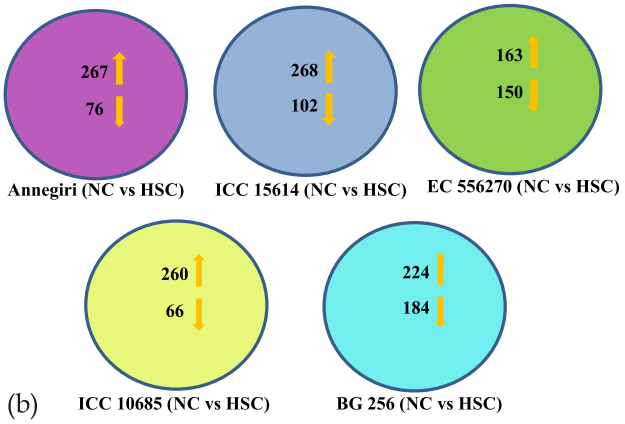
"Heat stress severely affects chickpea flower development, leading to reduced pollen viability, poor fertilization, and ultimately lower pod set and yield. Floral tissues are highly sensitive to elevated temperatures, making them a critical target for studying heat tolerance mechanisms. Transcriptome analysis of chickpea flowers identifies specific genes and transcriptional networks that respond to heat stress during reproductive stages. In this project, we conducted a transcriptome analysis of the flowers from both heat-tolerant (Annegiri, ICC 15614, and EC 556270) and heat-susceptible (ICC 10685 and BG 256) chickpea genotypes under both the normal and heat-stress conditions.

Identification of DEGs for heat-tolerant and heat-susceptible genotypes of chickpea flowers under heat stress

The transcriptome analysis revealed the number of differentially expressed genes (DEGs) under heat stress in various chickpea genotypes: 343 in Annegiri, 370 in ICC 15614, 313 in EC 556270, 326 in ICC 10685, and 408 in BG 256 (Fig. 1a). The number of upregulated DEGs was greater than that of downregulated DEGs across all the genotypes (Fig. 1b).



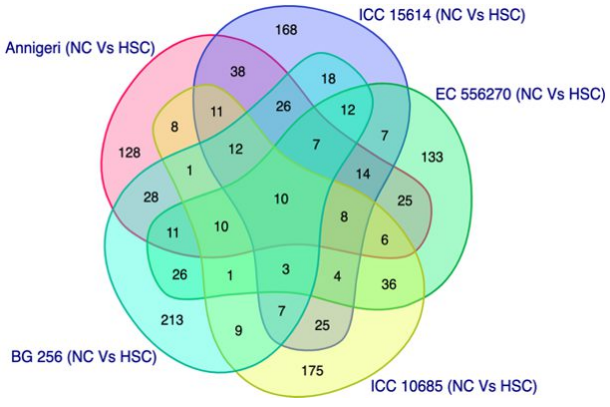
(a)



(b)

The representation of the total number of differentially expressed genes (DEGs) under heat stress in both heat-tolerant and heat-susceptible genotypes of chickpea includes: (a) a bar diagramme illustrating the total number of DEGs, and (b) a Venn diagramme showing the counts of upregulated and downregulated DEGs.

The analysis of overlapping genes across different chickpea genotypes was conducted using Venn diagramme analysis (Fig. 2). This analysis revealed that there were 10 differentially expressed genes (DEGs) common to all genotypes, with the majority being upregulated in heat-tolerant genotypes under heat stress conditions (Fig. 3a). Two specific genes (LOC101514603 and LOC101515262) were found to be highly upregulated in all the examined heat-tolerant genotypes. In contrast, these genes showed lower levels of upregulation in one heat-susceptible genotype (ICC 10685) and were downregulated in another heat-susceptible genotype (BG 256). Gene ontology analysis indicated that both the genes encode for an 18.5 kDa class I heat shock protein, which functions as a chaperone, helping to stabilise proteins and protect cells from damage caused by heat stress.



A Venn diagramme illustrating the overlapping different DEGs under heat stress in heat-tolerant and heat-susceptible chickpea genotypes

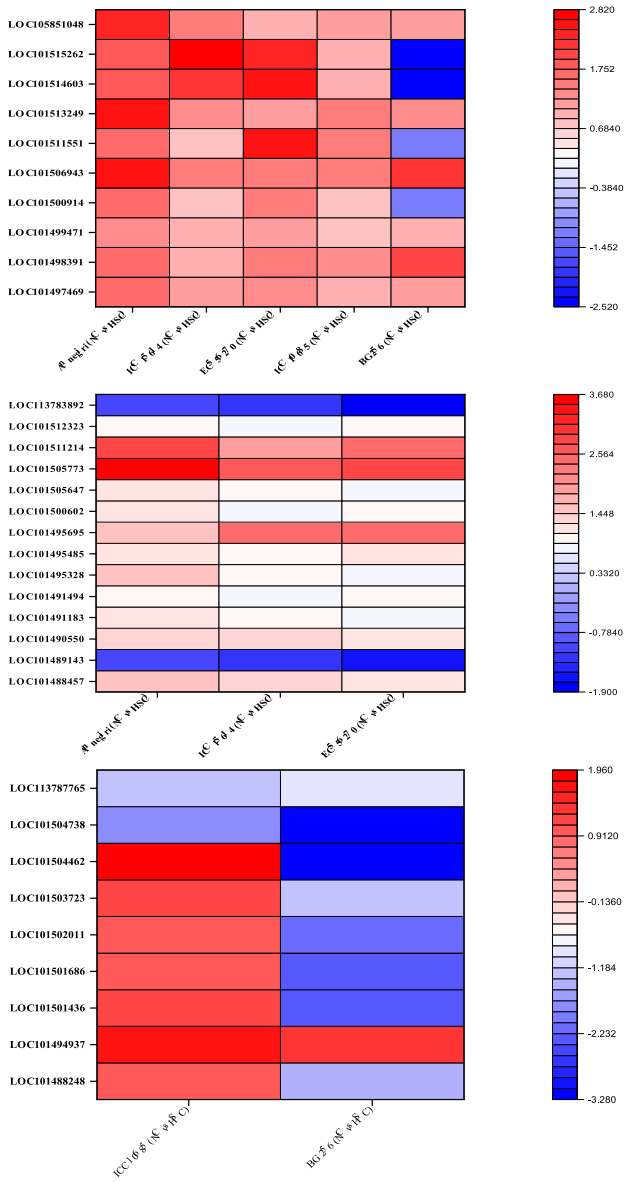
The table shows the number of differentially expressed genes (DEGs) categorised into various groups.

Sl No.	Category	No. of DEGs
1.	Common DEGs across all genotypes	10
2.	Common DEGs only in heat-tolerant genotypes	14
3.	Common DEGs only in heat-susceptible genotypes	9
4.	Unique DEGs in Annegiri	128
5.	Unique DEGs in ICC 15614	168
6.	Unique DEGs in EC 556270	133
7.	Unique DEGs in ICC 10685	175
8.	Unique DEGs in BG 256	213

A total of fourteen differentially expressed genes (DEGs) were identified as common across all studied heat-tolerant genotypes. Among these, twelve genes are upregulated while two are downregulated in all heat-tolerant genotypes (Fig. 3b). Notably, two genes, identified by locus IDs LOC101505773 and LOC101511214, are highly upregulated. The gene with locus ID LOC101505773 encodes an 18.2 kDa class I heat shock protein, while the gene with locus ID LOC101511214 encodes adenylate isopentenyl transferase 3, which is involved in cytokinin biosynthesis and enhances thermotolerance in flowers by reducing flower abortion rates in *Arabidopsis*.

A total of nine DEGs were identified as common only in heat-susceptible genotypes. Among these, two genes are downregulated, one gene is upregulated, and the remaining six are upregulated in one heat-susceptible genotype (ICC 10685) but downregulated in another (BG 256) (Fig. 3c). The gene with locus ID LOC101504738, which is downregulated in both the susceptible genotypes, encodes peroxidase 64 and is involved in the biosynthesis of secondary metabolites. Similarly, the gene with locus ID LOC113787765 is also downregulated in both the susceptible genotypes and encodes a GDSL esterase/lipase, which plays a role in lipid metabolism.

Further analysis revealed the number of unique DEGs found in the chickpea genotypes Annegiri, ICC 15614, EC 556270, ICC 10685, and BG 256 as 128, 168, 133, 175, and 213, respectively.



Heat map showing the expression patterns of DEGs in various categories: (a) Common DEGs across all genotypes; (b) Common DEGs present only in heat-tolerant genotypes; (c) Common DEGs found solely in heat-susceptible genotypes.

Sub-Project-5: Unravelling the nutritional and functional attributes of chickpea protein

Chickpea is an important pulse crop valued for its high protein content and macro and micronutrients. Recently, plant proteins have gained popularity for their positive health effects and sustainability. After soybean and pea protein, chickpea protein has emerged as a popular plant protein. Hence, it is of considerable interest to assess the protein quality of chickpea. An important step in

assessing the protein quality of any food is determining its amino acid profile. Therefore, the amino acid profile of 25 chickpea varieties having high seed indent (in the national seed chain)was determined through reversed-phase chromatography.

Methodology for amino acid determination

The chickpea flour (12 mg) was hydrolysed with 1.6 ml of 6 N HCl at 110 °Cand pre-derivatised with OPA and FMOC reagents before separating the amino acids using reversed-phase chromatography coupled to a PDA detector. The primary amino acids were detected at 338 nm, and the secondary amino acid proline was determined at 262 nm. The retention time of 20 amino acid standards, along with internal standards norvaline and sarcosinez was determined. A calibration curve was prepared by using different concentrations (0-1000 pmol/µl) of each amino acid, determining their corresponding peak areas and deriving a regression equation for each amino acid. As only acid hydrolysis of unoxidized samples was done, the amino acid profile of 17 amino acids could be determined. Cysteine, methionine, and tryptophan were not quantified as they require different hydrolysis. In the 17 amino acids, asparagine and glutamine were determined in terms of aspartic acid and glutamic acid, as these amides get hydrolysed during acid hydrolysis.

Amino acid profile:

Glutamic acid, aspartic acid and arginine were found to be the predominant amino acids in chickpea, indicating their significant role in contributing to its nutritional profile. The combined values of aspartic acid with asparagine and glutamic acid with glutamine were found to be particularly high due to conversion of amides during hydrolysis. These amino acids are crucial for cellular metabolism, nitrogen transport, and flavour enhancement in food products. The other amino acids such as arginine, serine, proline, glycine, alanine, tyrosine, histidine, isoleucine, leucine, lysine, phenylalanine, threonine and valine, were also detected in appreciable amounts. The detailed range and mean concentrations of each amino acid of 25 chickpea varieties have been illustrated in Figure 1.

Essential amino acids

Seven out of nine essential amino acids were successfully quantified in the studied chickpea varieties. Considerable variation was observed among genotypes, indicating genetic diversity. The highest concentration of histidine and threonine was noted in the variety BG 3062. The highest concentration of isoleucine, leucine, lysine, and phenylalanine was observed in the variety, Phule G 0405. The highest concentration of valine was noted in the variety GNG 1581. Overall, the varieties Phule G 0405, BG 3062, and JG 12 were found to have higher essential amino acid content among others (Table 1). Conditionally essential amino acids, aromatic amino acids and branched-chain amino acids were also determined.

Conditionally essential amino acids

The conditionally essential amino acids content showed considerable variation among chickpea varieties. Varieties JG 12 and GNG 2171 exhibited the highest concentration of conditionally essential amino acids. Arginine concentration was maximum in JG 12, while GNG 2171 recorded the highest proline levels.

Aromatic amino acids

The aromatic amino acid composition varied noticeably among chickpea varieties. Digvijay recorded the highest total aromatic amino acids (148.86 mg/g protein), followed by BG 3062, Phule G 0405, and JG 12. Tyrosine concentration was maximum in Digvijay, while BG 3062 showed the highest histidine content. Phenylalanine was the most abundant in Phule G 0405. Conversely, JG 315 exhibited the lowest levels of total aromatic amino acids.

Branched-chain amino acids

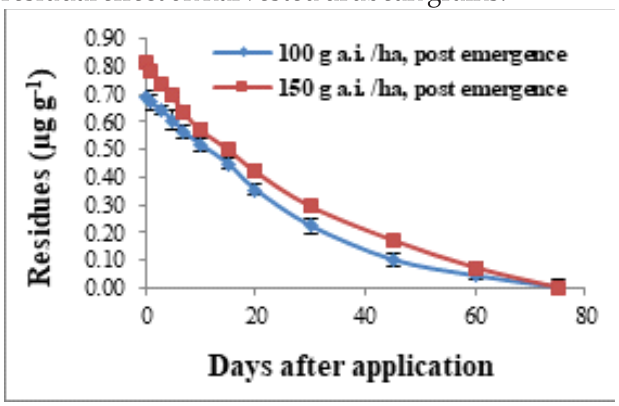
Branched-chain amino acids (leucine, isoleucine, and valine) play a crucial role in muscle protein synthesis and overall metabolic health. Their concentration showed remarkable variability among chickpea varieties. BG 3062 recorded the highest total branched-chain amino acids content (190.21 mg/g protein), followed closely by Phule G 0405, RVG 202, and GNG 15811. Phule G 0405 exhibited the maximum leucine concentration, while BG 3062 showed the highest valine level.

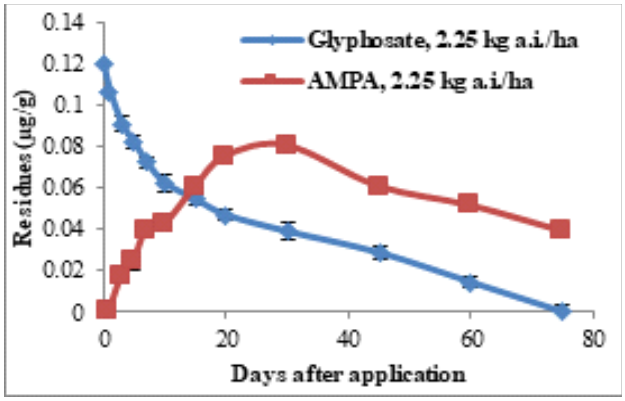
Sub-Project-6: Dynamics of imazethapyr and glyphosate residues in soil-plant system

Dynamics of imazethapyr in soil-plant system: Dissipation kinetics of imazethapyr in soil and its residual toxicity in urdbean grains and succeeding crop was determined. More than 90% of imazethapyr was dissipated within 60 days after application in soils, with half-lives ranging between 15.12 and 18.02 days. The residues of imazethapyr were not detected from urdbean grains as well as samples from subsequent crops such as mustard, wheat and chickpea. These results indicated that

Samples	Histidine (mg/g protein)	Isoleucine (mg/g protein)	Leucine (mg/g protein)	Lysine (mg/g protein)	Phenyla-lanine (mg/g protein)	Threonine (mg/g protein)	Valine (mg/g protein)	Total essential amino acids (EAA) (mg/g protein)
AKG 1303	31.46 ± 2.86	43.48 ± 2.29	76.66 ±2.29	78.38 ± 1.14	59.50 ± 4.58	36.04 ± 1.14	44.05 ± 3.43	369.57 ± 7.35
GNG 2207	25.06 ± 3.86	44.34 ± 2.89	76.63 ± 2.89	75.66 ± 5.30	58.31 ± 3.86	36.63 ± 2.89	47.71 ± 6.27	364.34 ± 11.05
Phule G 0405	31.93 ± 3.42	51.88 ± 4.56	91.22 ± 2.28	93.50 ± 4.56	68.99 ± 6.84	34.78 ± 3.42	43.90 ± 3.99	416.19 ± 11.53
NBeG 47	35.32 ± 2.21	42.49 ± 3.86	76.71 ± 3.31	72.85 ± 3.31	56.84 ± 3.31	39.18 ± 2.76	53.53 ± 1.66	376.93 ± 7.94
BG 3062	40.52 ± 3.94	47.27 ± 2.81	84.41 ± 5.63	72.03 ± 1.13	63.03 ± 2.81	41.64 ± 2.81	58.53 ± 4.50	407.43 ± 9.62
PG 5	36.96 ± 2.08	46.33 ± 1.56	42.69 ± 2.6	80.69 ± 3.64	60.39 ± 4.69	36.96 ± 1.56	52.58 ± 5.21	356.59 ± 8.85
RVG 202	35.87 ± 2.72	48.91 ± 3.26	79.35 ± 3.8	81.52 ± 1.63	58.15 ± 2.17	34.24 ± 3.80	54.89 ± 5.98	392.93 ± 9.49
JG-24	35.92 ± 1.04	43.21 ± 2.6	77.04 ± 3.12	80.17 ± 3.12	57.26 ± 4.16	34.36 ± 1.56	53.62 ± 3.64	381.57 ± 7.77
GNG 15811	34.02 ± 3.24	43.20 ± 2.7	77.21 ± 7.02	76.67 ± 5.94	55.08 ± 5.40	31.86 ± 3.24	62.08 ± 3.51	380.12 ± 12.42
Phule G Vikram	29.76 ± 2.19	39.39 ± 2.63	73.52 ± 2.19	75.71 ± 2.19	56.46 ± 2.63	31.95 ± 2.63	44.68 ± 3.94	351.47 ± 7.11
JG-36	33.58 ± 1.81	44.46 ± 1.36	83.48 ± 1.81	82.58 ± 1.36	62.16 ± 1.36	32.21 ± 2.27	45.19 ± 3.40	383.66 ± 5.37
JG-12	34.64 ± 0.92	47.58 ± 4.16	84.53 ± 3.23	84.99 ± 1.85	64.67 ± 5.54	35.57 ± 2.77	48.09 ± 2.25	400.06 ± 8.69
CSJ 575	31.36 ± 1.74	41.38 ± 3.05	75.35 ± 3.05	77.96 ± 2.18	56.62 ± 2.61	33.54 ± 2.18	42.46 ± 1.96	358.66 ± 6.46
GNG 2171	31.60 ± 2.79	46.93 ± 5.11	82.25 ± 2.79	83.18 ± 1.86	64.13 ± 2.32	35.32 ± 1.86	47.37 ± 3.25	390.78 ± 8.04
JG 315	29.40 ± 1.81	37.99 ± 3.62	63.77 ± 4.98	65.58 ± 4.52	49.30 ± 1.81	31.66 ± 2.71	47.63 ± 4.30	325.33 ± 9.52
GNG 2144	33.56 ± 2.92	39.40 ± 3.40	71.98 ± 4.38	72.96 ± 4.86	53.50 ± 3.40	32.10 ± 2.92	51.55 ± 3.40	355.05 ± 9.73
RVG 203	33.97 ± 2.46	41.85 ± 3.45	79.27 ± 3.94	78.78 ± 0.98	59.08 ± 5.91	32.00 ± 3.94	47.04 ± 3.69	372.00 ± 9.92
GNG 1958	30.97 ± 2.82	41.30 ± 2.82	68.51 ± 3.75	71.33 ± 3.75	54.43 ± 2.35	33.79 ± 1.41	46.07 ± 2.82	346.40 ± 7.71
Digvijay	36.36 ± 4.55	46.02 ± 2.84	82.39 ± 5.11	83.52 ± 3.98	64.77 ± 2.27	36.93 ± 1.70	45.23 ± 3.13	395.23 ± 9.41
JG-16	32.64 ± 3.06	41.82 ± 2.04	80.06 ± 2.55	81.59 ± 5.10	58.13 ± 2.04	34.17 ± 2.04	43.28 ± 2.04	371.68 ± 7.65
RVG-204	30.88 ± 1.63	44.96 ± 1.63	81.26 ± 5.42	79.63 ± 3.79	60.67 ± 10.83	35.21 ± 3.79	45.38 ± 2.17	377.99 ± 13.62
BG 3043	30.95 ± 3.15	45.12 ± 3.15	82.90 ± 3.15	82.90 ± 3.67	60.34 ± 2.62	35.68 ± 2.10	46.16 ± 2.10	384.04 ± 7.68
Jaki 9218	29.95 ± 2.72	44.92 ± 3.63	81.22 ± 3.63	80.76 ± 2.27	59.89 ± 2.72	33.58 ± 2.72	41.96 ± 2.95	372.27 ± 7.90
NBeG 49	35.92 ± 3.59	41.31 ± 3.59	74.99 ± 3.14	78.13 ± 4.04	55.68 ± 2.69	32.33 ± 3.59	45.64 ± 9.21	364.01 ± 12.53
T 39-1	29.29 ± 2.14	40.36 ± 1.07	73.93 ± 6.79	72.86 ± 1.43	56.79 ± 1.43	31.43 ± 2.14	45.18 ± 1.96	349.82 ± 8.02

imazethapyr can be successfully used to control weeds in urdbean field without any significant residual effect on harvested urdbean grains.





Dissipation kinetics of imazethapyr, glyphosate and AMPA

Dynamics of glyphosate and AMPA in soil-plant system: Dissipation behaviour of glyphosate and AMPA in soil was evaluated and their residual effect on subsequent urdbean crop was also studied. Glyphosate persisted in soil for up to 45 and 60 days at application rate of 1.5 kg a.i./ha and 2.25 kg a.i/ha, respectively. Half-lives for glyphosate ranged between 19.42 and 22.2 days in soil. AMPA persisted longer than glyphosate in soil, with half-lives ranging between 45.2 and 66.5 days. Residues of glyphosate and AMPA were not detected in leaves and grains of subsequent urdbean crop at the time of harvest. Hence, urdbean sowing can be done on the glyphosate treated field.

Schedule Caste- Sub Plan

- ✓ Served as **Nodal Officer in** Schedule Caste-Sub Plan and distributed approx. 250 quintal of seeds of pulses including pigeonpea, chickpea, fieldpea, lentil, mungbean, and urdbean seeds among the more than 2500 Schedule Caste farmers in Kanpur, Kanpur Dehat, Unnao, Hardoi, Barabanki, Raibarelly Fatehpur and Hamirpur and Auraiya districts of U.P.
- ✓ Distributed 600 Knapsack sprayers among SC farmers in Kanpur, Kanpur Dehat, Unnao, Fatehpur and Auraiya districts.
- ✓ Distributed 500 storage bins among 500 SC farmers in Kanpur Dehat, Unnao, Hardoi, Barabanki, Raibareli Fatehpur and Hamirpur and Auraiya districts of U.P.
- ✓ Distributed 2,100 poultry Chicks among SC farmers of Kanpur, Kanpur Dehat, Unnao, Fatehpur and Auraiya districts.
- ✓ ICAR-IIPR Regional Stations including Phanda-Bhopal-M.P., Bikaner-Rajasthan, Dharwad-Karnataka and Khorda –Odisha have also distributed more than 80 quintal of the quality seeds of Pulses and Knapsack sprayers among SC farmer.
- ✓ Organised more than 32 No. of farmer's trainings of SC category at ICAR-IIPR, Kanpur and at its regional stations.
- ✓ Organised animal health camp at RRS Dharwad -Karnataka

Mega Project-II: Establishment of effective symbiotic nitrogen fixation in pulses

Sub-Project-1: Unravelling the molecular basis for variations in nodulation and symbiotic efficiency of chickpea

Annual Progress 2024-25

- ✓ Genes involved in autoregulation of root nodulation (AON)-pathway *via* CaCLE12, CaCLE13, RDN-1, and SUNN were characterized in chickpea.

Project Achievements (2020-2025):

- ✓ Chickpea genome mining resulted in identification of novel nodule-specific genes (n=24) code for uncharacterized proteins and do not have homolog sequences during BLASTn/BLASTp search.
- ✓ A total of 35 CaCLE genes, 10 CaNLP genes involved in autoregulation of nodulation (AON) pathway were identified in *Cicer arietinum* characterized *in silico*. Similarly, a total of 26 CrCLE, 36 CeCLE, 10 CrNLP, and 11 CeNLP genes in *C. reticulatum* and *C.*

echinospermum were identified and characterized.

✓ *CaNLP*-1 was identified in chickpea chromosome No.5 that involved in autoregulation of root-nodulation. Autophagy protein 5, Ubiquitin-like protein ATG12, AP-2 complex subunit alpha, Extracellular calcium-sensing receptor, F-box protein interaction domain protein, and putative EEIG1/EHBP1 domain-containing proteins were identified as *CaNLP*1 Interacting proteins.

Sub-Project-2: Deciphering root signals for effective nodulation of *rajmash*

Annual Progress 2024-25

✓ Rajma accession IC 383002 produced 90 root nodules with fresh weight of 0.9 g per plant when it is inoculated with *Rhizobium* sp. Strain IIPR-RR-2022-1. Leghaemoglobin content of *rajma* root nodules (866 ug/g nodule fresh weight) which is comparable to similar stage of chickpea root nodule (1033 ug/g nodule fresh weight). However, the ARA activity of rajma root nodule is almost nil.

Project Achievements (2020-2025):

✓ *Rajmash* nodulating *Rhizobium* IIPR-RR-2022-1 was confirmed for its nodulation potential in a germplasm line of rajmash but not in Rajmash cv Arun. Rajmash genotypes (n=11) from the IIPR germplasm maintenance unit were reconfirmed for their root-nodulation potential.

✓ Root and root-nodules tissues were collected intermittently after inoculation of IIPR-RR-2022-1 along with uninoculated control and transcriptome analysis was performed.

✓ Rajma accession IC 383002 was observed to produce highest number of root nodules when inoculated with *Rhizobium* sp. Strain IIPR-RR-2022-1 under perlite growth medium. Leghaemoglobin content of *rajma* root nodules (866ug/g nodule fresh weight) which is comparable to similar stage of chickpea root nodule (1033 ug/g nodule fresh weight). However, the ARA activity of *rajma* root nodule is almost nil.

EXTERNALLY FUNDED PROJECT:

NASF Project: CRISPR Crop Network: Targeted Improvement of Stress Tolerance, Nutritional Quality and Yield of Crops by Using Genome Editing: Chickpea Component

Annual Progress 2024-25

✓ A total of 130 T_1 plants tentatively mutated for CKX1 (LOC101493173), KIX and NCR-genes [*CaNCR54, CaNCR66* were evaluated for the target trait (Yield and Symbiotic efficiency] expression. Two plants having guideRNA targeting NCR genes showed altered phenotype *i.e.* tall and bushy with late flowering and set the pod and seeds in high temperature regime. Similarly, a higher number of pods per plant (107 pods per plant) in CKX gene mutants was also observed. While the wild type plants set up to 30 pods per plant.

Project Achievements (2020-2025):

✓ The chickpea transformation with HC 5 cultivar was carried out to transfer the plasmid carrying the gRNA expression cassette targeting CKX3-Like locus (LOC101505170) and CaNCR54 and CaNCR24 and achieved the establishment of 9 T_0 chickpea plants (6 of CKX; two of CaNCR54 and one of CaNCR24). The PCR analysis using CAS9 gene specific primer identified that 8 plants were positive for CAS9 primer.

✓ Total of 10 T_0 plants of CKX (LOC101493173), 4 T_0 plants of KIX gene for seed size, one *CaNCR54* and one *CaNCR66* (For nodulation efficiency) having gRNA targeting respective loci were generated and found PCR positive for CAS9 gene. The T_1 seeds (130) were harvested from 16 T_0 plants [Ten T_0 plants of CKX (LOC101493173), 4 T_0 plants of KIX gene for seed size, one *CaNCR54* and one *CaNCR24* (For nodulation efficiency] evaluated for the target trait expression. Two plants having guideRNA targeting NCR genes showed altered phenotype i.e. tall and bushy with late flowering and set the pod and seeds in high temperature regime. Similarly, a higher number of pods per plant (107 pods per plant) in CKX gene mutants

was also observed. While the wild type plants set up to 30 pods per plant.

EFC-GENOME EDITING PROJECT: Enhancing climate resilience and ensuring food security with genome editing tool [Chickpea Trait: Nitrate insensitive nodulation, Target Gene: *CaNLP*-1]

Annual Progress 2024-25

- ✓ Mobilization of CRISPR construct with gRNAs targeting CaNLP1 into *A. tumefaciens* and development of *CaNLP*-1 knockout mutants of chickpea is under progress.

Project Achievements (2020-2025):

- ✓ Gene structure of *CaNLP*-1 was characterized to possess 4 exons. Developing knockout mutants for *CaNLP*-1 may induce nitrate insensitive root-nodulation in chickpea, so that the biological process of SNF will be established invariable to soil-N content.
- ✓ The guide RNAs targeting Exon-1 at upstream region of GAF-2 domain, exon-2 at upstream region of RWP-RK domain, and exon-4 at upstream region of PB-NLP domain were designed and cloned into *Agrobacterium rhizogenes*.

Social Science

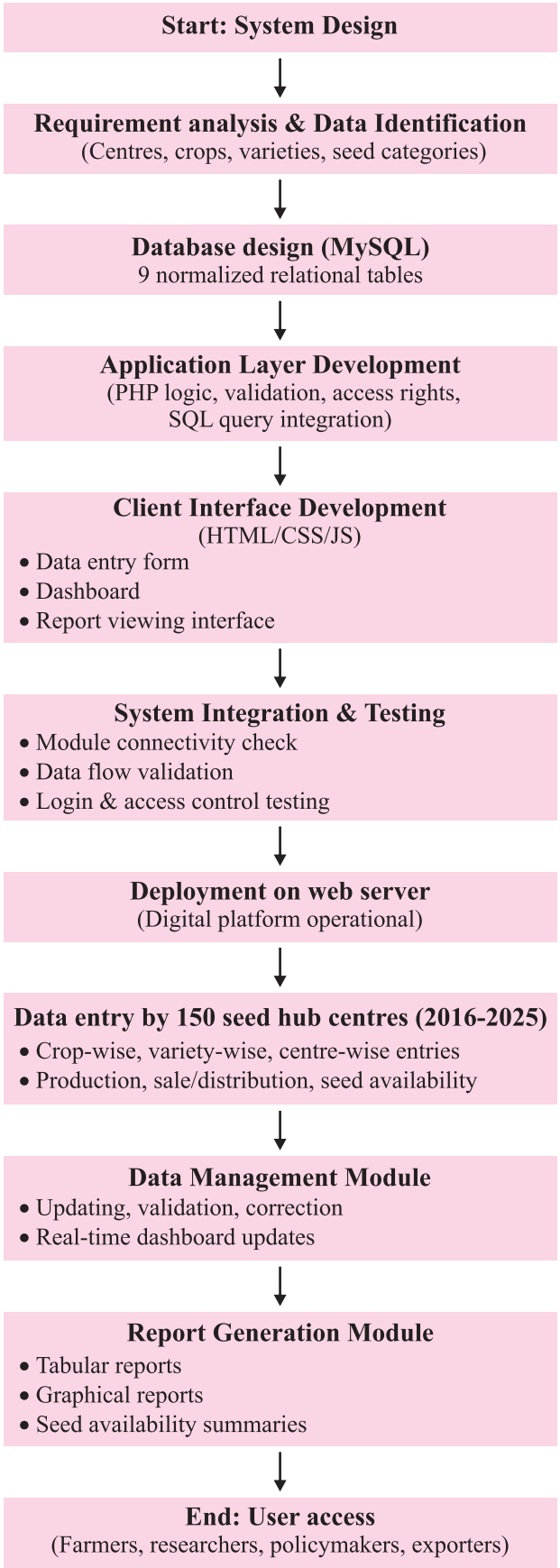
On-going Research Projects

Mega Project 1: IT enabled data management in pulses for policy support system

Sub-project 1: Digitalization of quality seed production and germplasm database for pulses

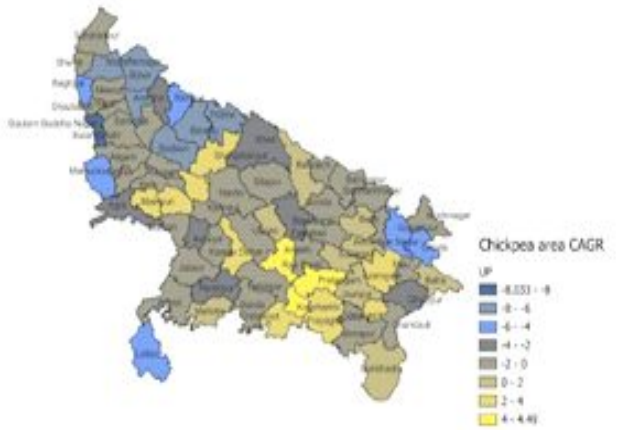
Digital platform for quality seed production data of pulses

Quality seed is a key determinant of productivity and sustainability in pulse cultivation. Farmers frequently encounter challenges in accessing timely and accurate information on improved varieties, seed availability, and centre-wise or crop-wise production, which affects planning and adoption of quality seeds. This study aims to develop a digital platform that enables systematic retrieval and dissemination of quality seed production data for pulses to support better decision-making across the seed value chain. The platform was conceptualized to consolidate seed production data from different seed hub centres and present it through an intuitive and searchable interface. Its structure includes three main functional modules: database design, data management, and report generation. Seed production data covering foundation, certified, and truthfully labelled classes were compiled and organized to facilitate efficient access. Users can retrieve information using flexible filters such as crop, variety, centre, and production quantity. A dashboard provides real-time summaries of total seed production, participating centres, and seed availability, allowing stakeholders including farmers, researchers, and policymakers—to quickly assess the current status of seed resources. The web-based deployment (https://icar-iipr.org.in/iiprseedportal/) demonstrates that distributed data entry with centralized reporting is both feasible and effective. The platform contributes to improved transparency, enhanced accessibility, and more efficient management of quality seed production data for pulses. By centralizing information that was previously dispersed, it serves as a valuable decision-support tool for planning and monitoring seed-related activities. A key limitation is that the system relies on timely data updates from participating seed hub centres, which may influence the accuracy of data-driven insights. Future enhancements may include automatic data integration and mobile-based access to increase usability and scalability. A methodology flow diagram is given below:

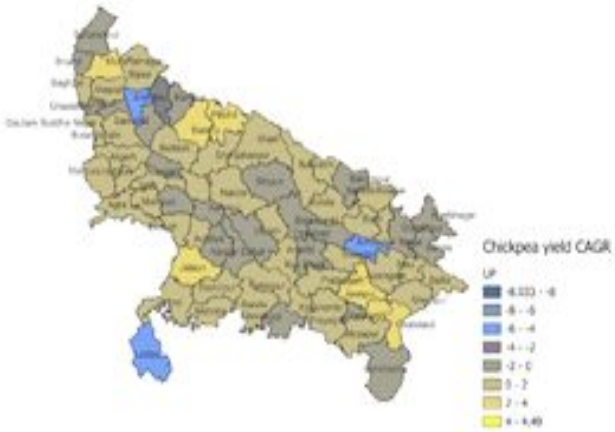


Sub-project 2: Analysis of trends and stability of pulses cultivation in India

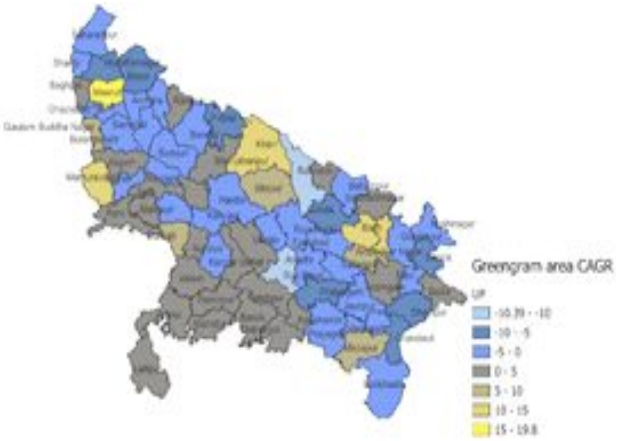
The district-wise time series data of Madhya Pradesh (MP), Bihar (BH) and Rajasthan (RJ) for the period from 1997-98 to 2022-23 on area, production and yield of major crops *viz.* pigeonpea, chickpea, fieldpea, lentil has been collected from Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Government of India and Directorate of Economics and Statistics, Government of UP. The growth rates for yield and area across all major pulse-growing districts have been calculated and are presented below:



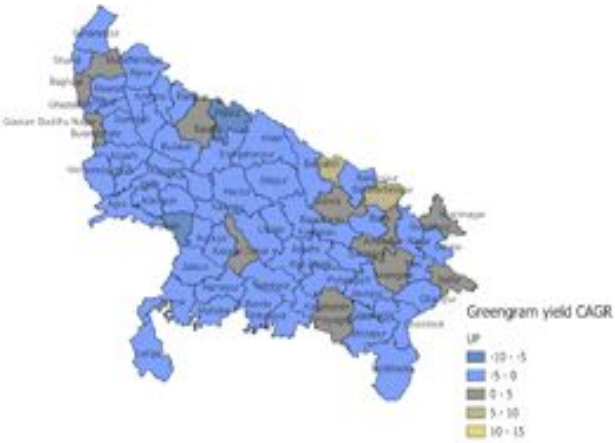
Growth rate of map of UP's chickpea area



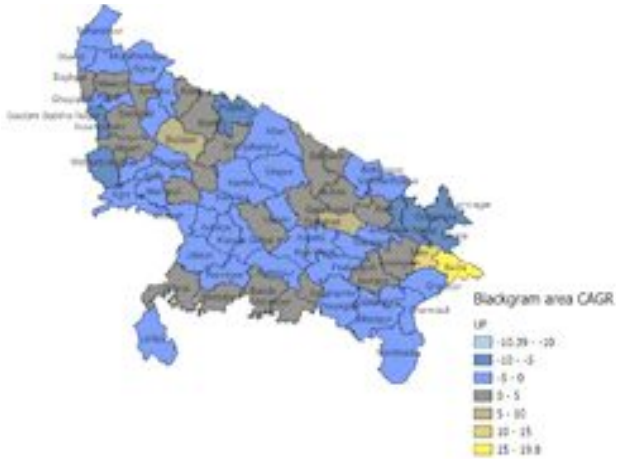
Growth rate of map of UP's chickpea yield



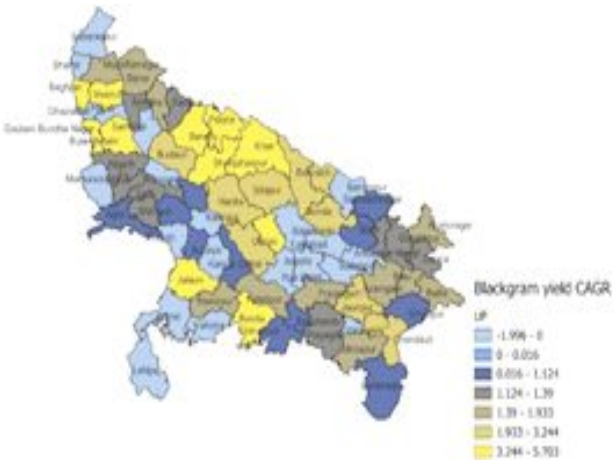
Growth rate of map of UP's greengram area



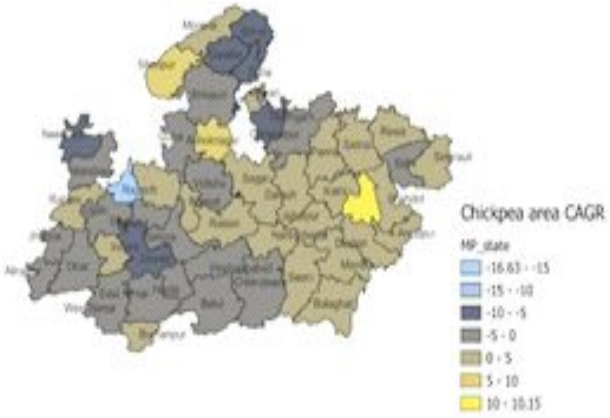
Growth rate of map of UP's greengram yield



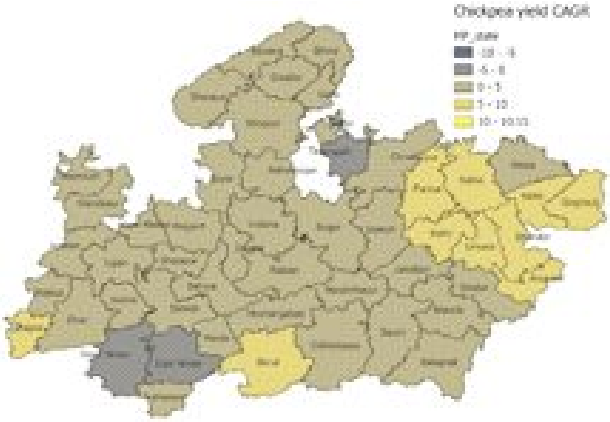
Growth rate of map of UP's blackgram area



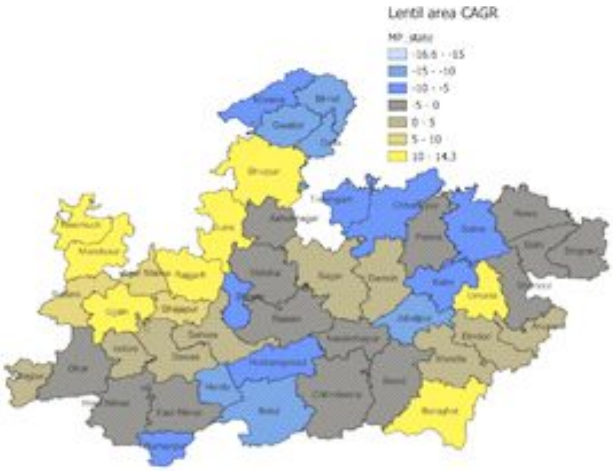
Growth rate of map of UP's blackgram yield



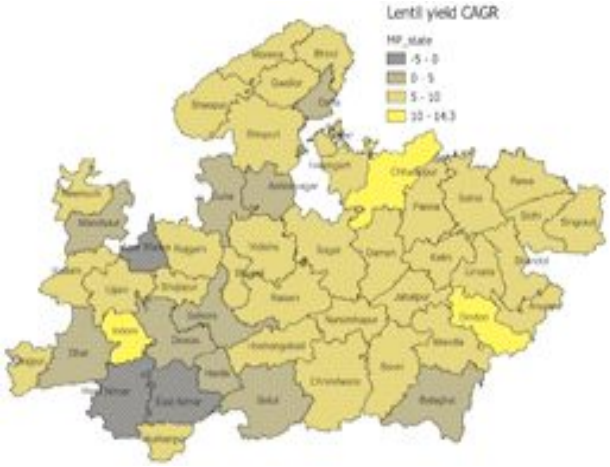
Growth rate of map of MP's chickpea area



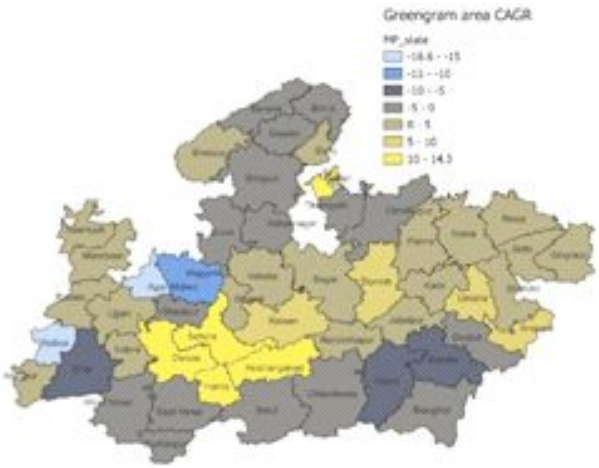
Growth rate of map of MP's chickpea yield



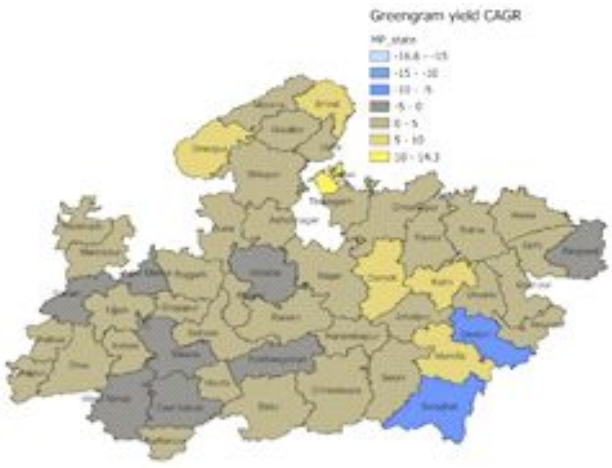
Growth rate of map of MP's lentil area



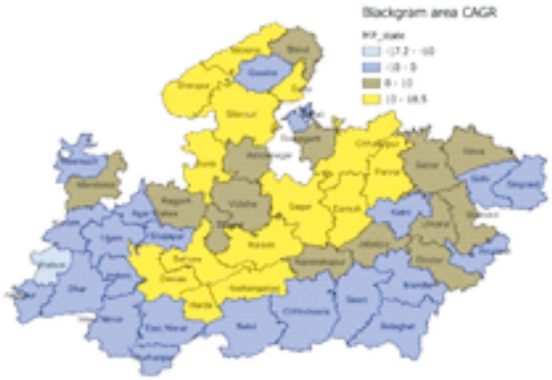
Growth rate of map of MP's lentil yield



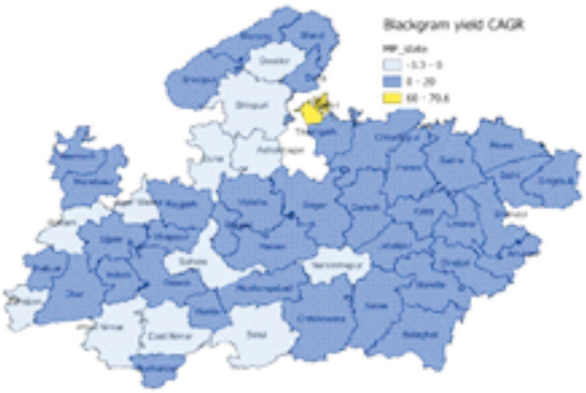
Growth rate of map of MP's greengram area



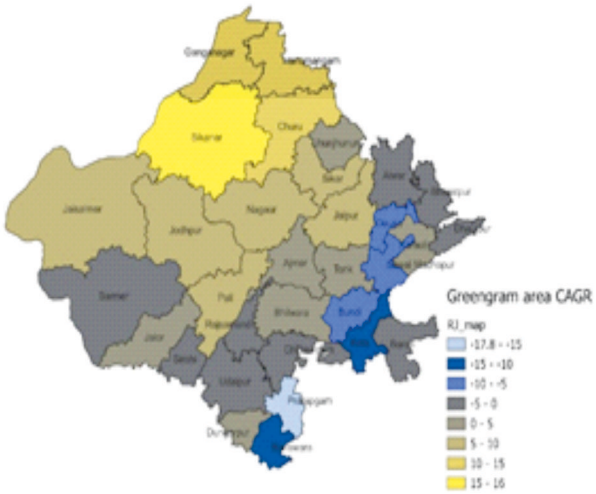
Growth rate of map of MP's greengram yield



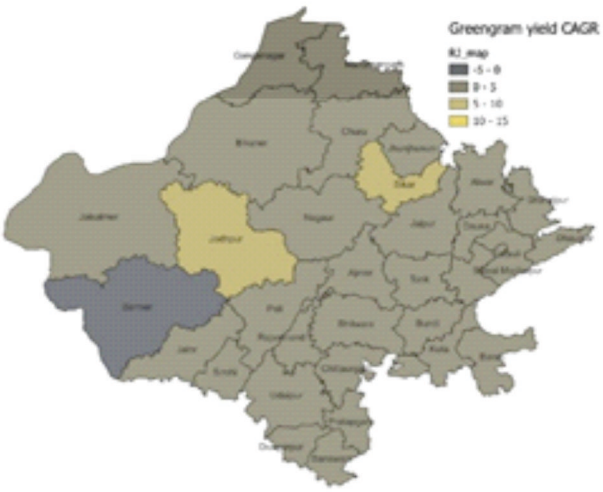
Growth rate of map of MP's blackgram area



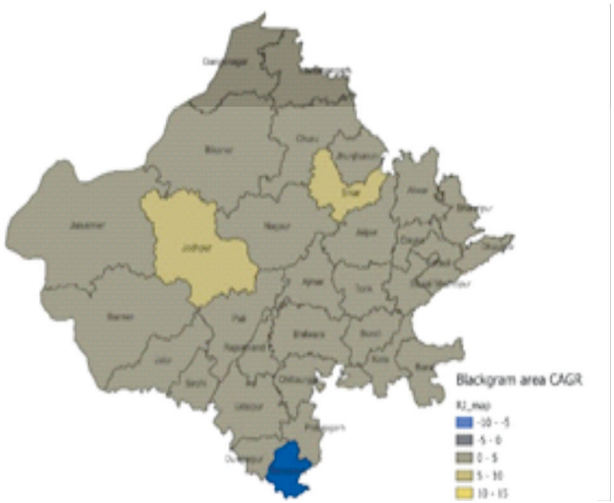
Growth rate of map of MP's blackgram yield



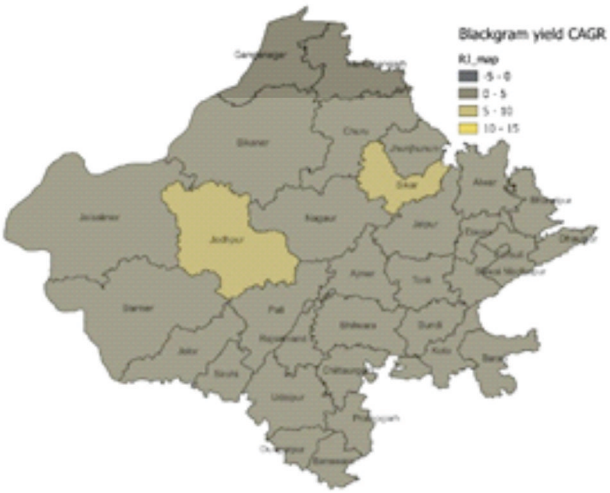
Growth rate of map of RJ's greengram area



Growth rate of map of RJ's greengram yield



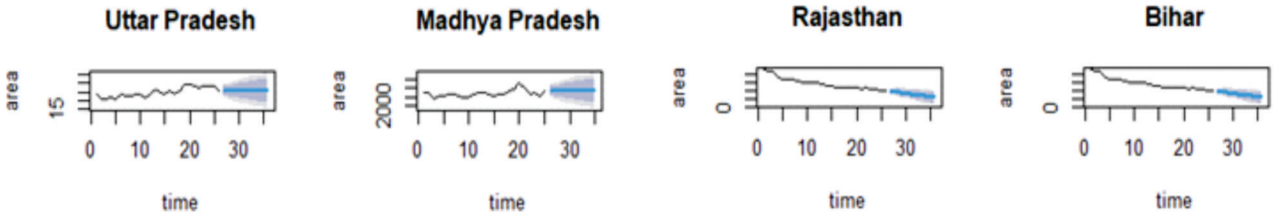
Growth rate of map of RJ's blackgram area



Growth rate of map of RJ's blackgram yield

From the studies conducted across the selected states, it is evident that although the area under certain pulse crops varies from district to district, their yield shows an overall increasing trend across all the districts. Futher area under total pulses crops has been forecasted using Autoregressive Integrated Moving Average (ARIMA) model. From the figure, it is clear that total area under pulses will remain constant in UP and MP. Furthermore, the forecasted area under pulses is expected to follow a declining trend in both the States of Bihar and Rajasthan.

Further Markov analysis was used to study the season-wise shifting among the crops in Uttar Pradesh and Results are summarised below :



Forecasted area using ARIMA model

***Kharif* crop scenario UP**

Crop	Pigeonpea	Green-gram	*Bajra*	*Jowar*	Maize	Rice	Black-gram	Other *kharif* crops
Pigeonpea	0.26	0.15	0	0	0.01	0.52	0.06	0
Greengram	0	0.715	0	0	0	0	0	0.285
Bajra	0.057	0	0.36	0	0.0369	0.45	0	0
Jowar	0.069	0	0	0.81	0.12	0	0	0
Maize	0.33	0	0	0.005	0.665	0	0	0
Rice	0	0	0.14	0.005	0.028	0.804	0.022	0
Blackgram	0	0	0	0	0	0	0.551	0.449
Other *kharif* crops	0.209	0	0.016	0	0	0.047	0.028	0.7

It is evident that *jowar* is a major crop and retaining around 81% of area under same crop during the study period, followed by rice (80%), greengram (72%), maize (66%), blackgram (55%) and *bajra* (36%). It is to be noted that rice may lose its area to pigeonpea (52%) and *bajra* (45%). Similarly, blackgram may lose its area to rice (2%).

***Rabi* crop scenario UP**

Crop	Barley	Chickpea	Lentil	Peas	Mustard	Wheat	Potato	Other *rabi* crops
Barley	0.407	0.390	0.000	0.000	0.000	0.000	0.000	0.203
Chickpea	0.191	0.410	0.238	0.000	0.000	0.000	0.000	0.161
Lentil	0.000	0.000	0.600	0.000	0.050	0.350	0.000	0.000
Peas	0.000	0.122	0.000	0.225	0.000	0.635	0.017	0.000
Mustard	0.000	0.000	0.000	0.278	0.562	0.000	0.000	0.159
Wheat	0.003	0.012	0.037	0.000	0.022	0.913	0.003	0.010
Potato	0.000	0.000	0.000	0.000	0.054	0.000	0.946	0.000
Other *rabi* crops	0.016	0.039	0.152	0.204	0.000	0.449	0.000	0.139

It is clear that potato is the most prominent crop to retain around 95% of area under the same crop followed by wheat (91%), lentil (60%), mustard (56%), chickpea (41%), barley (41%) and peas (22.5%). Potato crop may gain 5% area from mustard in near future. It is noted that mustard may gain from lentil (5%) and potato (5.4%). Similarly, lentil may gain from wheat (35%) and mustard (0.05%).

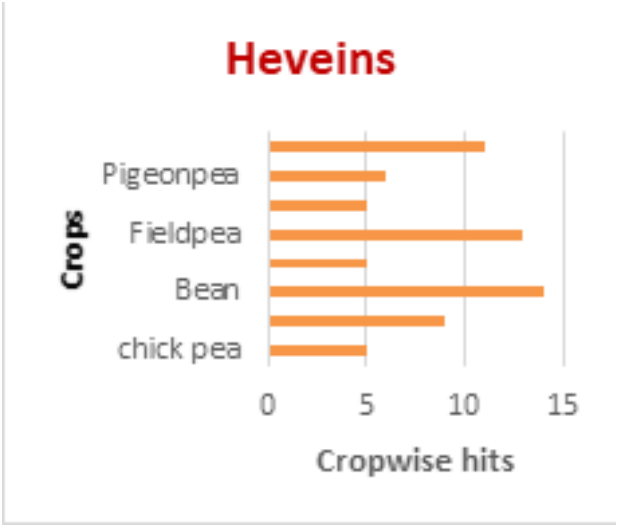
Sub-project 3: Development of a prediction tool for antimicrobial proteins in pulses

Genome wide identification of AMPs has been carried out from the genome databases of the pulse crops such as chickpea, pigeonpea, greengram, blackgram, lentil, lathyrus, common bean and fieldpea based on their PFAM profiles of the conserved domains in the corresponding proteins. The identified proteins have been confirmed by verifying the presence of full-length domain by using the SMART and interpro (PFAM) domains. The crop-wise total number of hits registered is summarized in Table.

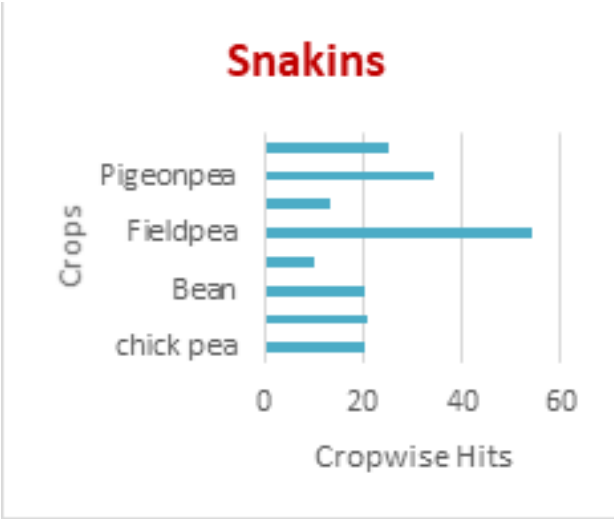
Crop wise hits

Crop	Total hits
Chickpea	199
Greengram	187
Common bean	248
Blackgram	160
Fieldpea	587
Lathyrus	207
Pigeonpea	284
Cowpea	293

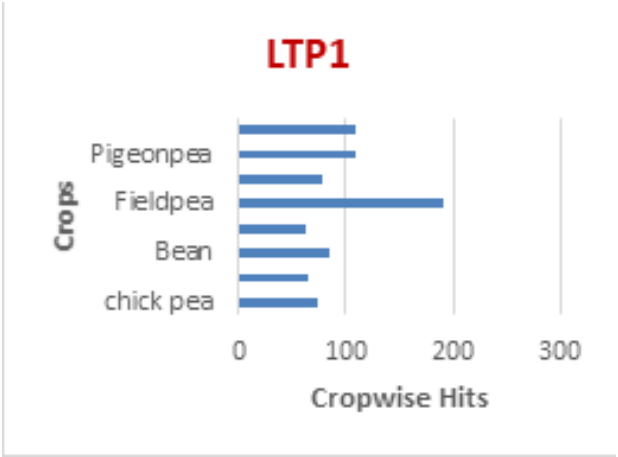
Further antimicrobial protein class-wise total number of hits has been calculated and represented in following figures:



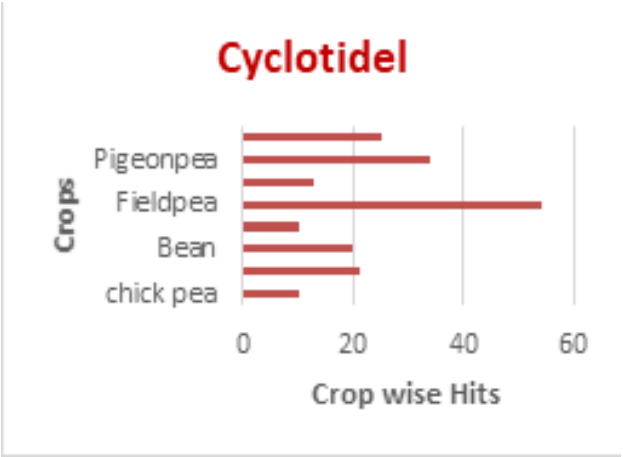
Total number of hits for Heveins class



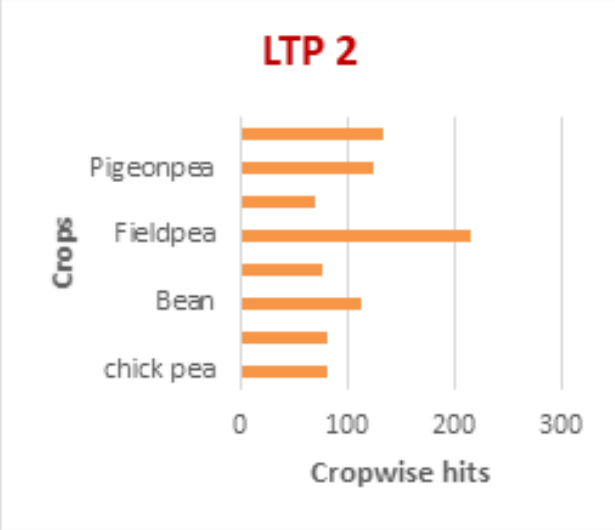
Total number of hits for Snakins class



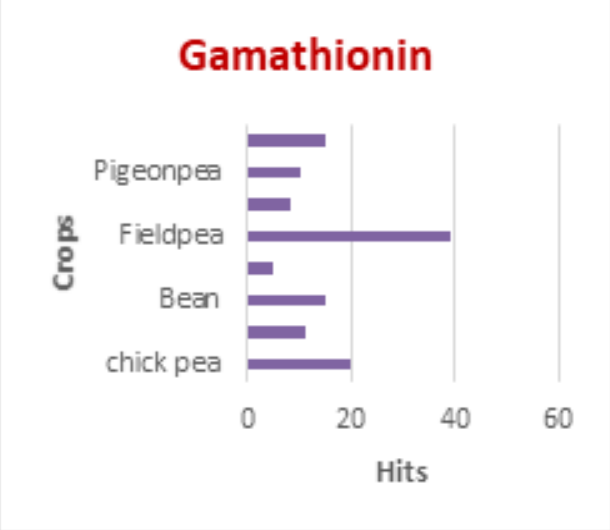
Total number of hits for LTP 1 class



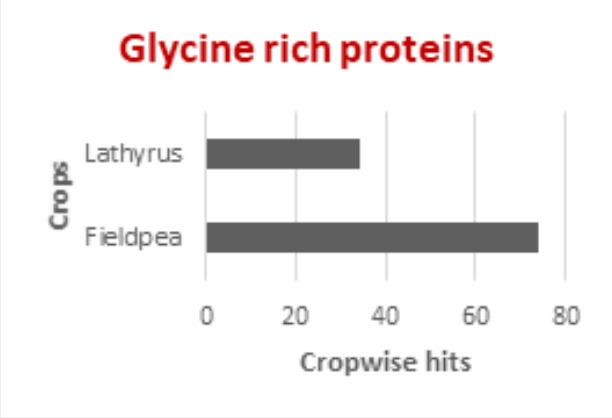
Total number of hits for Cyclotidel



Total number of hits for LTP 2 class



Total number of hits for Gamathionin class



Total number of hits for Glycine rich protein class

Sub- project 4: Development of pulses outlook in India

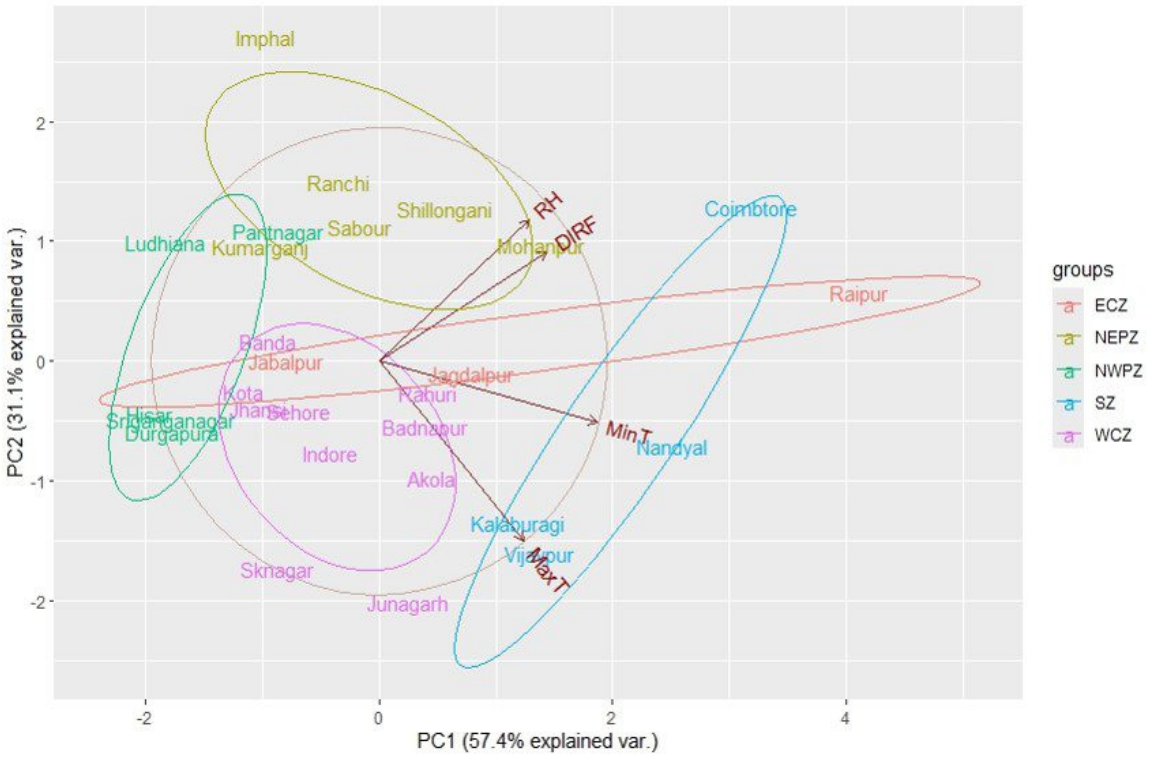
Input data related to projection of demand and supply of pulses for short-term and long-term are collected from different sources. Growth in per capita income, expenditure elasticity of pulses and household consumption expenditure data was collected, compiled and computed. Major data source are the National Sample Survey office, Ministry of Consumer Affairs and NITI *Aayog* Government of India. Growth in demand for the pulses will be projected using collected data, based on the behaviouristic approach the behaviour of an individual to choose pulses over a combination of other food grains in the market (measured as expenditure elasticity), depends on current consumption, growth in population, growth in income over a given time period. The supply projection is to be estimated under the assumption that the future forecasts of each of the selected crops will increase at the rate of past trends. The linear and exponential regression model of production on time (independent variable) would be fitted to get the coefficients of the model for each of the major pulse crops and growth rates of production for selected pulse crops. The growth rates would be used to predict the production for the respective crops.

Sub-project 5: Agro-climatic characterization and re-grouping of chickpea growing regions of India

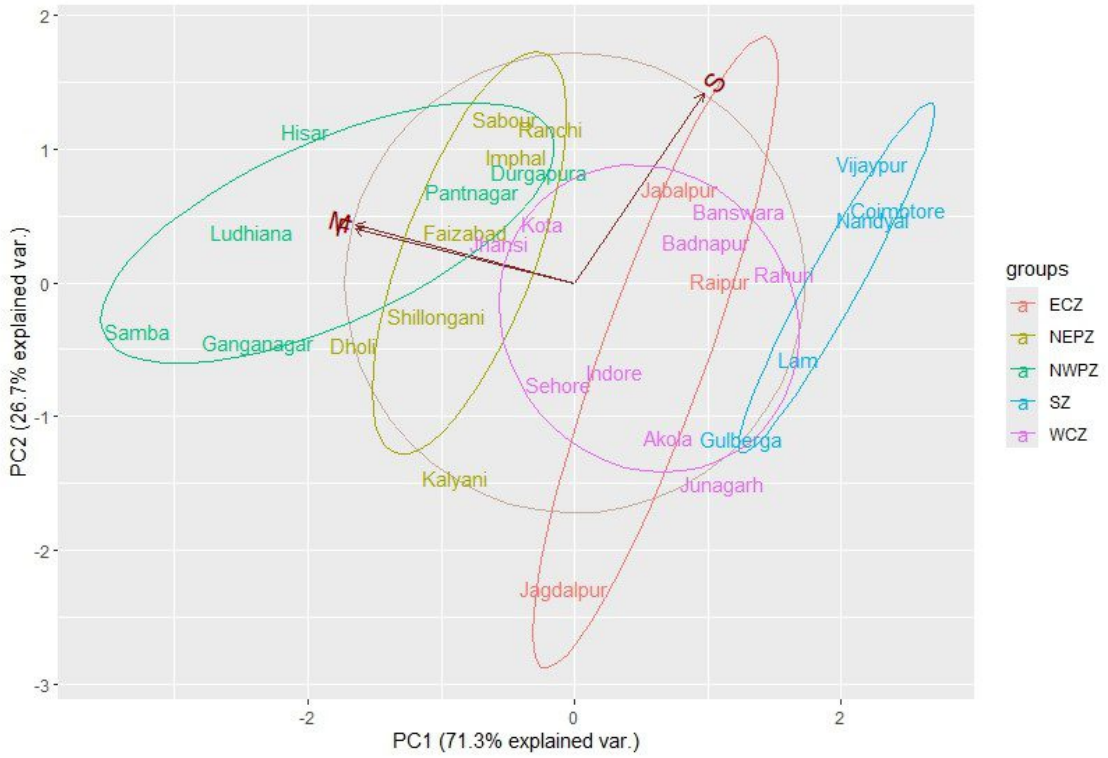
Chickpeas play a vital role in promoting sustainable food systems and securing a resilient future. Their production is influenced by a variety of factors, including changes in rainfall patterns, temperature variations, and the amount of sunshine during the growing season. Additionally, the timing of sowing and the weather conditions at different growth stages significantly affect chickpea yields, alongside challenges from pests and diseases. To better understand the impact of weather on growth and yield, it's essential to gather data on various traits through multi-year and site-based field experiments. Due to the diverse geographical and environmental

conditions where chickpeas are cultivated, the AICRP chickpea testing centre has established five distinct zones (ECZ, WCZ, NEPZ, NWPZ, and SZ) for evaluating experimental materials. It's important to note that no single variety can thrive in all the environments, as those grown outside their adaptation zones often face yield reductions because of complex genotype-environment interactions. Given that chickpeas typically thrive in different marginal environments, significant interactions between genotype and the environment (GEI) are common. To ensure healthy production levels of chickpeas, it is necessary to reorganize AICRP test sites based on agro-meteorological data and other characteristics related to yield. Data of maturity, 100-seed weight and days to 50% flowering of chickpea IVT *desi* trials are collected and compiled during the period of 2010-11 to 2022-23 from AICRP on *Rabi* pulses and climatic data related to maximum temperature, minimum temperature, relative humidity and rainfall during January 01, 2019 to December 31, 2023 collected from NASA POWER (power.larc.nasa.gov/) for the PCA Biplot analysis to find the outlier locations in existing zones.

Outliers based on climate and plant attributes			
Zone	**Existing location s**	**Climate**	**Plant attributes**
NWPZ	Durgapura, Hisar, Ludhiana, Pantnagar, Samba, Sringanganagar	Ludhiana	Hisar
NEPZ	Dholi, Kumarganj, Imphal, Kalyani (Mohanpur), Sabour, Shillongani	Kumarganj, Imphal	Dholi, Mohanpur
ECZ	Jabalpur, Jagdalpur, Raipur	None	Jagdalpur, Jabalpur
WCZ	Akola, Badnapur, Banda, Jhansi, Indore, Junagadh, Kota, Rahuri, Sehore, SK Nagar	SK Nagar, Junagadh	Jhansi, Junaga dh
SZ	Coimbatore,Kalaburagi (Gulb arga), Lam, Nadyal, Vijaypur	Coimbatore, Kalaburagi	Vijaypur, Kalaburagi



PCA Biplot of Plant Attribute



PCA Biplot of Climate Data

Sub-project 6: AI-enabled disease & insect-pests identification and advisory mobile application for mungbean and urdbean

Under this project, images of diseases and insect-pests were collected for mungbean and urdbean during *kharif* season 2025 as provided in Table 1. A comprehensive database of advisory and management practices has been created for both the crops in relation with disease and insect-pests. Mungbean (*Vigna radiata*), a crucial legume crop in tropical and subtropical regions, faces severe threats from Yellow Mosaic Virus (YMV), a begomovirus that can cause yield losses up to 100% in affected fields. Traditional detection methods, reliant on manual inspection, are inefficient and prone to errors, especially in large-scale farming. This comprehensive study introduced an innovative ensemble machine learning framework for YMV detection in mungbean using leaf image classification. We evaluate and compare three models: a Random Forest (RF) classifier for traditional feature-based analysis, a Convolutional Neural Network (CNN) leveraging ResNet50 with transfer learning for deep feature extraction, and a hybrid ensemble model that combines predictions from both *via* probability averaging. Trained on a dataset of 1,025 mungbean leaf images (balanced between healthy and YMV-infected classes), the models were assessed on key performance metrics including accuracy, precision, recall, F1-score, and runtime. The CNN model achieved the highest accuracy of 92.00%, with the ensemble following closely at 91.00% and RF at 85.00%. The ensemble provides a optimal compromise, balancing high accuracy with efficient inference time (0.12 seconds for predictions), making it suitable for real-time applications in resource-constrained environments. This study underscores the potential of hybrid models in precision agriculture, enabling early disease intervention, reducing chemical inputs, and enhancing food security. By integrating traditional and deep learning approaches, our framework addresses overfitting in small datasets and improves generalization across varying field conditions.

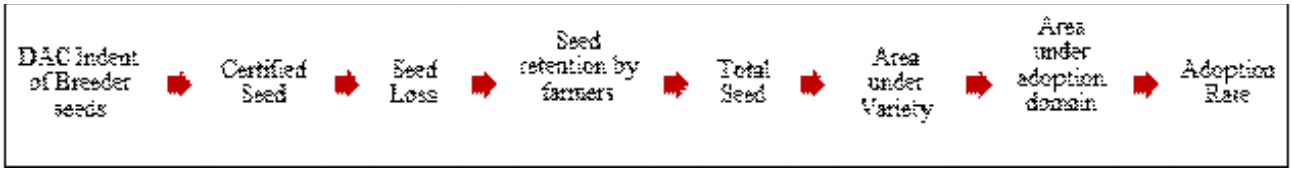
Table : Summary of images collected

Crops	Disease *(# of images)*	Insect-pests *(# of images)*
Mungbean	1025	195
Urdbean	1531	169

Mega Project 2: Innovative extension approaches for livelihood and nutritional security through pulse production technology in India

Sub-project 1: Impact assessment of pulse varieties developed by ICAR-IIPR, Kanpur

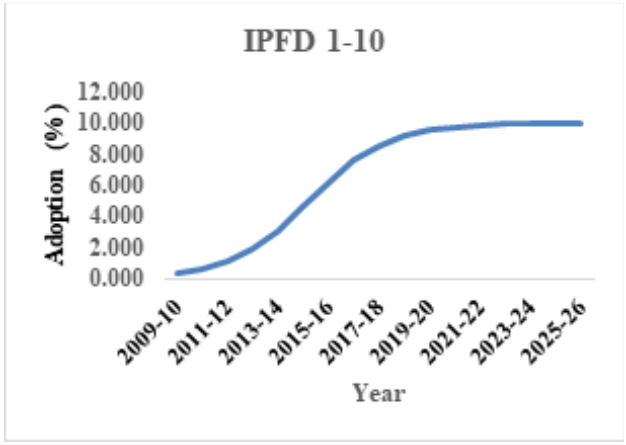
For the impact assessment, IPFD 1-10

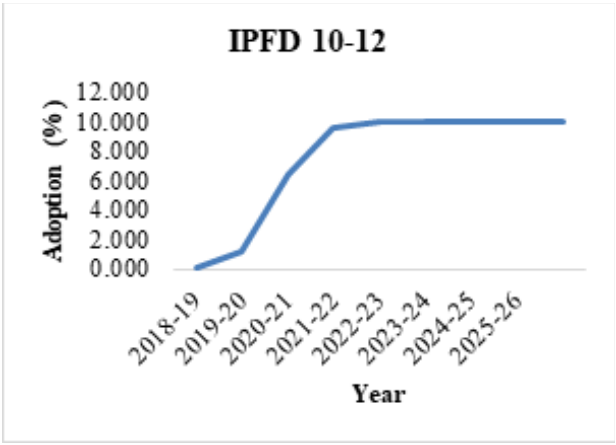


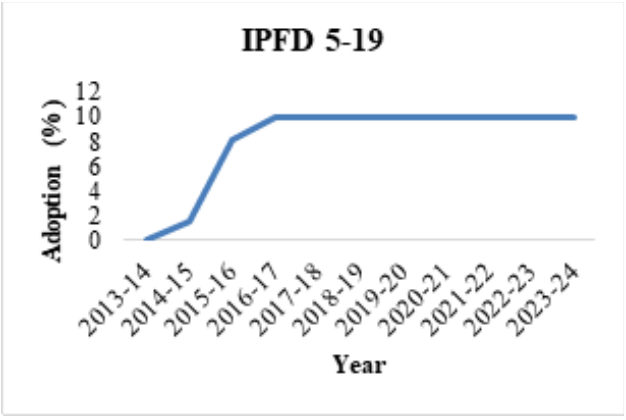
(Prakash), IPF 5-19 (Aman), and IPFD 10-12 varieties of fieldpea and IPM 205-7 (Virat), IPM 410-3 (Shikha), and IPM 02-03 varieties of mungbean were selected. The economic surplus model was employed for analysis. The adoption rate is one of the important parameters used in the analysis. It has been revised and calculated both by using the DAC breeder seed indent and the logistic regression function. The actual adoption rate has been calculated as dividing the area under variety by the area under the adoption domain as given below:

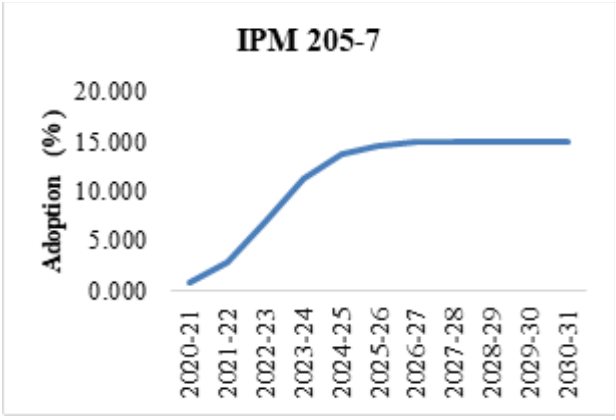
DAC indent of breeder seeds has been transformed to certified seeds by using the seed multiplication ratio (SMR) of respective crops. A 25% loss has been assumed in the seed chain. Seed retention by farmers in the next year has been calculated by using the seed replacement rate (SRR) of the respective crop. Further, considering the DAC breeder seed indent share of selected varieties in the total crops indent in the respective adoption domain and India, the adoption rate has also been calculated by using the logistic regression function. The adoption path derived from the logistic function has been found to be smoother, hence, used in the analysis.

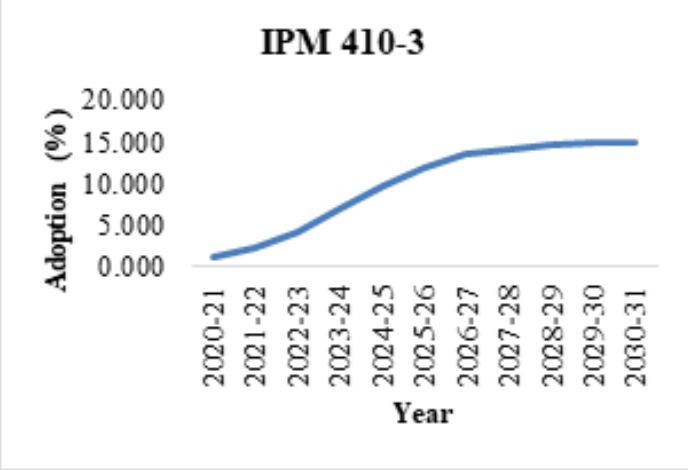
Considering the DAC indent share, a maximum adoption of 10% in the case of all the three varieties of fieldpea has been assumed to derive the adoption path till 15 years after the release of the variety. Similarly, a maximum adoption of 15% for mungbean varieties has been assumed. The mungbean variety, IPM 02-03 data is under review to derive the adoption path.











The parameters used in the model are under review, and the analysis is in the process of refinement. Further, based on the breeder seed indent share from 2015-16 to 2023-24, new pulse varieties developed by ICAR-IIPR, Kanpur, *viz*., IPA 15-06, IPM 302-2, IPM 2014-9, IPU 10-26, IPL 316, IPL 220, and IPFD 12-2, have also been included for impact assessment with the extension of the project.

Sub-project 2: Economic evaluation of programmes promoting pulses production in India

Over the past two decades, there has been remarkable progress in the production of pulses due to policy interventions and technological advancements. In this line, various programmes were launched to boost the pulse production in India. The Ministry of Agriculture and Farmers Welfare, GOI, implemented the project entitled 'Creation of Seed-Hubs for Increasing Indigenous Production of Pulses in India' during 2016-17. Under this project, 150 seed-hubs were created across the country with the aim of making available the quality seeds of recently developed high-yielding cultivars for achieving self-sufficiency in pulses.

The present study started with pulse seed-hubs as the first programme to assess its impact in terms of socio-economic profitability of partner seed-growing farmers. The objectives of the study are as follows: to study the trends in seed production under pulse seed hubs over the years, to study the impact of pulse seed hubs on the profitability of seed farmers, and to study the factors affecting the profitability of pulse seed farmers. The secondary data collection and analysis on seed production of pulse varieties across different seed-hubs is in process. Once the trends in seed production under pulse seed-hubs over the years are analyzed, the sampling framework will be finalized for primary data collection to achieve the second and third objectives of the study.

Externally funded project

Project: Artificial Intelligence enabled biotic & abiotic stress detection and advisory mobile application for crops

Under this project, initially the workflow of NIBPP (National Image Base for Plant Protection) application was demonstrated for the collection of images of diseases and insect-pests damages. Local Admin (Supervisor) accounts for Institute were created and shared with the project team for the overall supervision of the image collection. A number of validator accounts and data entry accounts were created by the CCPIs for data collection. Images of diseases and insect-pests were collected for chickpea and pigeonpea during 2024-2025 as provided in Table. A comprehensive database of advisory and management practices has been created for chickpea in relation with disease and insect-pests. A deep learning model is being developed for the identification of multiple stresses in chickpea.

Summary of images collected

Crops	Disease *(# of images)*	Insect-pests *(# of images)*
Chickpea	136	545
Pigeonpea	122	720

ICAR-IIPR Regional Station, Phanda, Bhopal

A. Institute Projects

Mega Project 1: Development of biotic and abiotic stress resistant superior varieties/hybrids through integrated conventional and modern breeding approach

Sub-project 1: CRSCIIPRSIL202000100156: Genetic enhancement of *Kabuli* chickpea for higher productivity and wider adaptability and better quality

Station trial

Two station trials, one *desi*, one *kabuli* chickpea from ICAR-IIPR, Kanpur having 23 entries and two checks, each in RBD were conducted at ICAR-IIPR, RS, Bhopal, during *rabi* 2024-25. In *desi* trial, top five highest grain yielding per plot (q/ha) entries were: IPC 22-117 (22.24), IPC 23-651 (AKS) (18.84), IPC 23-310 (18.73), IPC 23-661 (AKS) (17.73), IPC 23-662 (AKS) (17.46). Fifteen entries performed better than the checks, PG 0405 (11.25) and AKGk 1303 (6.21). In *kabuli* chickpea trial, the highest grain yielding per plot (q/ha) entry was: IPC 22-122 (18.67), performed better than the checks, KAK 2 (18.23) and PG 0517 (3.16).

Kabuli Station Trial 2024-25 Normal Timely Sown & late conditions having nine entries and three checks in RBD were conducted at ICAR-IIPR, RS, Bhopal, during *rabi* 2024-25. In timely sown conditions, entry DG 16-313 showed 35.21 grain yield per plot in q/ha, outyielded the average of checks (33.80). In late sown conditions, entries DG 16-313 (16.67) and ICCV 211404 (11.03) outyielded the average of checks (9.28) for grain yield per plot in q/ha.

Breeding material

Generation advancement was carried out for F_1-F_2, F_2-F_3, F_3-F_4 of four crosses for each, selections were made for bold seed size, earliness.

Seed multiplication

Seed multiplication of 127 germplasm accessions and five released varieties of *kabuli* chickpea were done in *Rabi* 2024-25.

Sub-project 2: Genetic enhancement for high yield and disease resistance in medium duration pigeonpea

Background

Utilization of parents from diverse sources with high level of resistance against wilt and SMD is the way out to develop high yielding varieties in medium maturity group. Therefore, productivity and resilience of medium early and medium duration varieties need to be enhanced by incorporating favourable alleles from diverse genotypes into the background of highly adapted mega varieties by means of multi-parent crosses to address the issue of narrow genetic background. The project was initiated in 2021 with the objective of incorporating earliness along with *Fusarium* wilt and SMD resistance in the high yield background of medium maturing genotypes.

Breeding materials generated

Eight new crosses (Rajeshwari/WD 115, IPAC 2 / IPA 15-06, TJT 501 / IPA 15-06, Rajeshwari / WD 23-1-18, Rajeshwari/ IPAB 23-32, CORG 9/ IPA 15-06, BDN 716/IPA 15-06, Rajeshwari/ Collection -16) were made and F_1's plants were raised for generating the recombinant sergeants. Two thousand five hundred fifty four SPS were selected from the breeding materials of medium duration pigeonpea and their final generations were advanced. F_2 population emanating from Pusa 16/WD 23-1-1, TJT 501/BDN 716, IPAB 10-35/IPA 15-6 and TJT 501/BSMR 736 were raised to derive the next generation. Selections were made from the segregating progenies of BDN 711/ PAU 881, BSMR 716/ICPL 88038 and Rajeshwari/ UPAS 120 to raise the F_3 progenies. Single plant selections were made in F_3 population of UPAS 120 x Pusa Arhar 16 and F_4 progenies were derived; selections were made in F_4's emanating from crosses (TJT 501 x CoRG 9701, JKM 189 x CoRG 9701, Asha x UPAS 120, Rajeshwari x BDN 711 and BSMR 736 x Manak) and advanced to the next generation. Advance derivatives of early maturing genotypes were selected and a trial was constituted for evaluation of yield potential. Shuttle breeding lines of medium duration pigeonpea were evaluated and selected for generation advancement. F_5 & F_6 progenies emanating from crosses, namely BDN 711 x ICPL 88034, BDN 711 x ICPL 20096, BDN 716 x ICPL 88038, BSMR 736 x ICPL 20096, BSMR 736 x ICPL 20338, BSMR 736 x AL 992 and BSMR 736 x LRG 41 were advanced through single plant selection to the next generation. F_5 & F_6 progenies were advanced through single plant selection to the next generation.



Field view of pigeonpea breeding materials

PYT and station trials

Eight station trials (early and medium duration) were conducted and 11 superior early/medium duration promising entries were identified. IPAC 23-105, IPAB 24-6-7, IPAB 24-4-1, IPAB 23-85, IPAB 23-19, IPAB 23-8 IPAB 23-63 IPAB 23-42, IPAC 23-56, IPAB 23-27-15. The entries namely, IPAC 23-105 and IPAB 23-27-15 were tested for three years and consistently superior to the best checks. One preliminary yield trial, comprising of 124 entries and four checks were laid down in augmented design and 30 promising genotypes were selected for inclusion in the station trials. One medium duration genotype (IPAB 23-27-13) was submitted for inclusion in AICRP IVT. Seed of promising lines were multiplied for AICRP and station trials. Released varieties of medium duration were maintained.

Sub-project 3: Development of biotic and abiotic stress resistant superior varieties/hybrids through integrated conventional and modern breeding approach in mungbean for spring/summer cultivation in Central India

Background

A mungbean breeding programme was initiated in *Karif* 2023 to address the requirements of summer mungbean in Central India. The objective is to breed high yielding lines that are determinate, matures synchronously within 60 days and are resistant to yellow mosaic disease.

Local germplasm collected

Three accessions of mungbean were collected and multiplied and passport data submitted to ICAR-NBPGR, New Delhi. The genotype (IC 653143) with black seed coat was free from powdery mildew under natural epiphytotic condition for three seasons in 2023, 2024, 2025 whereas all other genotypes had symptoms of high powdery mildew growth. This entry along with susceptible controls (Shikha and Virat) was also evaluated under artificial epiphytotic during 2024-25 spring and *kharif* seasons and found to be resistant against powdery mildew.



Powdery mildew tolerant line (IC 653143)

Breeding materials

Three new crosses **(Shikha/IC 653143; Shikha/Vashudha; Varsha/Shikha)** were generated with Shikha as the agronomic base and three F_2 populations were derived from Shikha/Virat, Varsha/IPM 409-4 and IPM 2-14/EC 398889.

Station trial

A set of 24 genotypes were evaluated in RBD with three replications during summer 2024 and 2025. Among the promising genotypes, IPM 1603-3 gave 19.3% superiority over the best check, Shikha and it was the most consistent over the two years of evaluation. This genotype was resistant to YMV in *kharif* as well as summer planting.


Mungbean Station Trial Summer 2025

Mega Project 2: Plant Genetic Resources and Utilization

Sub-project 1: Plant genetic resource management and improvement of grasspea for higher yield and low ODAP content

Plant Genetic Resources

Nine hundred three germplasm accessions were maintained. A set of 90 accessions were evaluated and maximum variation was observed for number of pods per plant (17-110) followed by yield per plant (7.4 - 81.5 gm). Unique genotypes (32) validated for various ago-economic traits such as green seed colour, purple pods and wings, 4-7 leaflets per leaf and for seed traits.

Pre-breeding

Four inter and two-intra-specific crosses were made to obtain low ODAP and higher yielding elite grasspea genotypes. F_1 (8 crosses) was selfed. Generations advanced [F_2 (4 crosses), F_3 (9 crosses) and F_4 (2 crosses). Single plants selections were made in F_2 (83), F_3 (349) and F_4 (192). New crosses made using *L. cicera* with cultivated genotypes and low

ODAP landraces.

Mutation breeding:

Two hundred eighty three M_4 families advanced to M_5 generation (Gamma rays). Total 195 SPS were maintained in M_5 generation and sufficient seed were collected for analysis of ODAP content. Two unique genotypes, Maculata (having white patches on leaves) and dark pink spots on keel and corolla of the flower were maintained and validated.

Low ODAP content

- Two low ODAP and high yielding advanced mutant lines submitted to AICRP on *Rabi* crops for multilocation initial varietal trial.
- ODAP content ranged from 0.00079 to 0.18750 per cent among 339 mutant lines. 328 low ODAP lines ranged from 0.01061-0.09935 % and 6 lines (0.10043-0.18750 %) at threshhold level as compared to the check varieties, Mahateora (0.05 %) and Ratan (0.06 %). Low ODAP (0.05-0.09 %) advanced mutant lines (M9) were also maintained.
- The ODAP content ranged from 0.04-0.8 per cent among 356 grasspea indigenous germplasm lines. Five low ODAP genotypes [IPLa 62 (0.04%), IPLa 111 (0.04%), IPLa 113 (0.04%), IPLa 92 (0.04%) and IPLa 372 (0.09%)] are maintained.

Sub-project 2: Plant genetic resources & their utilization: Chickpea

Total 7,512 cultivated chickpea germplasm and 22 wild accessions were maintained. A set of 184 germplasm evaluated and maximum variability was found in number of pods per plant (10.3-282) followed by yield per plant (7.0-229.7 gm per plant). Elite genotypes, EC 552174 and PAO 3716R selected for early flowering (34 days) and early maturity (94 days). A *kabuli* unique genotype, IPCKB 2021-0517-1 was identified for trifoliate leaves and being validated.

Sub-project 3: Genetic and genomic resource management in pigeonpea

Background

The objective is to collect, evaluate, utilize and conserve the germplasm of medium duration pigeonpea for the development of trait specific genetic stocks for biotic and abiotic stress tolerance and yield attributing traits. The sources of resistance against biotic and abiotic stresses are scarce in the released varieties and hence, there is need to explore the germplasm and crop wild species to harness the alleles for stress resistance. In the pre-breeding component, unadapted germplasm including wild species (*Cajanus scarabeoides* belonging to secondary gene pool) were used in cross for the incorporation of useful alleles in to the cultivated pigeonpea.

Collection and maintenance of germplasm

Seven cultivated accessions were collected from Sehore and Raisen districts of Madhya Pradesh. The seed of collected accessions were multiplied for submission in the ICAR-NBPGR, New Delhi for assigning IC number and conservation in national gene bank. Two hundred ninety seven cultivated germplasm accession including landraces and four accessions of *C. scarabaeoides* were maintained as active collection as well as conserved under ambient condition.

Characterization and evaluation of germplasm

Three sets of germplasm accessions are being characterized for DUS traits in augmented design for the third year. Sixteen local germplasm, that were collected from Madhya Pradesh, were evaluated for the second year in RBD with two replications and four checks for DUS and yield traits. Six genotypes that were consistent for yield and yield attributing traits were identified as donors for specific traits. IC 0649443 had large seed size. Pod branching length was significantly high in IC 0649446 and IC 0649439. Likewise, IC 0649438 and IC 0649446 exhibited more pods per plant. IC 0649438 showed significant higher yield than the best check, JKM 189.

Utilization of wild species of pigeonpea for the introgression of specific traits

Wild derivatives originating from cross between cultivated pigeonpea and *C. scarabeoides* were evaluated in augmented design with three checks, namely IPA 15-6, Pusa Arhar 16 and TJT 501. *C. scarabeoides* was used in cross for the incorporation of useful alleles in to the cultivated pigeonpea and advance generation progenies were evaluated for agronomic and yield attributing traits and single plant selections were made. One hundred one pre-breeding lines originating from *C. scarabaeoides* were maintained and multiplied the seed of promising genotypes for the constitution of station trial. In shuttle breeding, selections were made among 314 F_5 progenies derived from *C. albicans* and 205 pre-breeding lines were advanced to F_6 generation. Two station trials were conducted and 17 genotypes were evaluated in RBD with three replications for the identification of promising wild derivatives. Three entries *viz*. WD 88, WD 115 and WD 23-1-6 performed better than the best check, TJT 501.

Evaluation of genetic stocks

Two wild derivatives, namely WD 19 and WD 108 exhibited short height and these lines are being evaluated in RBD with five replications along with dwarf check, Pusa Arhar 16 for the 4th consecutive seasons. So far, in any season, the maximum height of WD 19 (determinate type) and WD 108 (indeterminate type) were less than 120 cm and 150 cm, respectively. A progeny of advance generation (F_9) of UPAS 120/*C. scarabaeoides* segregated for shattering and non-shattering pod. Non-segregating progenies of shattering and non-shattering pods were identified. Ten selected selfed single plants from one non-segregating genotype for each of shattering and non-shattering types were sown for confirming the fixation of traits.



WD 19: A short height pigeonpea genotype

Evaluation of waterlogging tolerance

One genotype IPA 2022-02 (T2-IPAB 22-2), that exhibited waterlogging tolerance in two previous seasons, and three checks namely, Pusa Arhar 16, Rajeshwari and IPA 2022-01 were evaluated under field condition and pot experiments for validating the waterlogging tolerance. The field trial was laid out in RBD with eight replications and replicated pot experiments were repeated three times. In field trial as well as pot experiment, waterlogging was imposed at 30 days old seedlings for 120 hrs. IPA 2022-02 (T2-IPAB 22-2) exhibited the highest survival, whereas Pusa Arhar 16 showed the least survival in both the field and pot experiment.



T1 – IPA 2022-01, T2 – IPAB 2022-02, T3 – IPA 2022-21, C1 – Pusa Arhar 16, C2 - Rajeshwari

Maintenance of biotic stress tolerant genotypes

In the genetic stock nursery, previously identified *Fusarium* wilt resistant genetic stocks, namely IPAC 66, IPAC 67 and IPAC 68, IPA 10W1-8, IPA10W1, IPAW 22-67, IPA10W2, IPAW 22-38IPA 12W 26-1and IPAW 22-38 and *Phythopthora* stem blight resistant lines *viz*. IPAC 2 and IPAC 3 were maintained as donor source.

Sub-project : Prevalence and characterization of wilt / root rot (WRR) complex diseases in chickpea and lentil and development of sick plots for resistance screening (PI)

For development of *Fusarium* sick plot, *Fusarium* wilt susceptible lentil (L 9-12) and chickpea (JG 62) varieties were planted in the sick plots. Date of sowings were November 22, 2024 and November 25, 2024. Natural incidence remained low (5-10%). Putative *F. oxysporum f. sp. ciceris* (Foc) and *F. oxysporum f. sp. lentis* (Fol) isolates have been successfully isolated from the samples collected from IPPR-RRS, Phanda and sick plot of RAK College of Agriculture, Sehore. Their pathogenicity has also been proved on chickpea var. IPC 2006-77 and lentil var. IPL 316 through sick soil method (Fig. 1). The molecular identity of pathogenic *Foc* isolate was confirmed as *Foc* through *TEF-1a* gene sequencing and sequence was submitted to NCBI database (PX277230). All the other pathogenic isolates are subjected to molecular identification for confirmation of their identity.

To study the prevalence and status of different soil borne diseases in chickpea, isolations were made from the samples collected from Juniya, Phanda, Sehore, and Jabalpur. During first 30 days of sowing, the wilting was due to *Sclerotium rolfsii* with 10-16% of collar rot incidence. In the isolation, the isolation frequency of *S. rolfsii* was 100%. In the samples collected after 30 days of sowing, the isolation frequency of *S. rolfsii*:18.34%, *Fusarium* spp.: 44.44%, *Macrophomina phaseolina*: 17.77%, other/ unknown fungi: 20%.

Activity under Mungbean breeding project (sub-project 3 of IIPR, RS, Bhopal under Mega Project 1)

Evaluation of mungbean genotypes for powdery mildew disease

During 2024, powdery mildew was observed on mungbean (*Vigna radiata*) varieties, Shikha and Virat at ICAR-IIPR Regional Station, Bhopal, Madhya Pradesh (23.22°N, 77.19°E) during both *Kharif* and *Rabi* seasons. The pathogen exhibited morphological features typical of *Podosphaera xanthii* (Castagne) U. Braun & Shishkoff. For molecular confirmation, the large subunit region of ribosomal DNA was amplified using primer pair T2/TW14, and the obtained sequence (PV248665) showed 99.71% identity with *P. xanthii* isolate (KX842351)

from the USA. In India, *Erysiphe polygoni* DC is usually reported as the major causal agent of powdery mildew in mungbean, and the most resistance breeding efforts have focused on this species. However, the present study provides the first evidence of *P. xanthii* infecting mungbean in Central India. Though, the species that predominates or holds greater significance remains unclear. Therefore, comprehensive survey with accurate species identification is crucial for developing effective disease management strategies. Interestingly, a local collection (IC 653143) showed no symptoms under natural infection, whereas Shikha and Virat were highly susceptible. To evaluate its resistance level, IC 653143, along with Shikha and Virat as susceptible checks, was planted in three replications during September 2024 and inoculated by dusting spores. Disease incidence and severity were recorded weekly after symptom appearance. At the 7th week, disease incidence in Shikha, Virat, and IC 653143 was 45%, 40%, and 3%, respectively. The disease severity index reached 100% in Shikha and Virat, while it remained 30% in IC 653143 at the 11th week. The AUDPC values were 4585, 4557, and 829.5%, respectively, confirming moderate resistance in IC 653143.

B. Externally Funded Projects

Externally funded Project 2 (DBT): Characterization of chickpea germplasm resources to accelerate genomics-assisted crop improvement for heat tolerance

A set of 588 chickpea germplasm grown in the late-sown condition in first fortnight of January. Temperature ranged from 36° to 43°C (January-April 2025) at phenological stage. Based on the filled pods and yield per plant, six genotypes (ICC 83565 (97 and 12.7 gm), ICC 2 (88 & 11.8 gm), ICC 2808 (68 & 13.3 gm), ICC 86 (63 & 13.1 gm), ICC 6687 (63 & 11.6 gm) & ICC 8986 (63 & 13.2 gm) were identified as heat tolerant. The heat tolerant genotypes (ICC 4410, ICC 6471, EC 267221, ICC 4409 & ICC 6462) identified during *rabi* 2020-21 to 2023-24 were also validated. Phenotypic data of 4,996 chickpea accessions characterized under heat stress conditions (during 2021-2024) have been uploaded to Indian Biological Data Centre (IBDC) for heat tolerance trait. IBDC is the first national repository for life science data in India supported by GOI through DBT.

Collaborative Project: ICARDA International and ICAR-IIPR, Within Project, Biodiversity for Opportunities, Livelihoods and Development (BOLD-AUGER) in Grasspea

Two station trials of INTL 2022-23 and INTL 2023-24 elites were conducted at ICAR-IIPR, RS, Phanda, Bhopal in RBD with three checks Ratan, Prateek and Mahateora and 9 and 7 entries, respectively. None of the entries found better than the best performing checks for grain yield per plot. However, entry 39-GP-F3-S2 (2.11) outyielded the best performing check, Prateek (1.68), for biomass yield/plot (kg), also Entry 252, 1.64, 0.41 found better than average of checks 1.56, 0.39 for biomass yield/plot (kg) and grain yield per plot (kg), respectively in 23-24 elites trial.

INTL CWR elites 2023-24 station trial with three entries and three checks in RBD was conducted across three locations, Phanda (MP), Amlaha (MP) and BCKV, Mohanpur (West Bengal). None of the entries found better than the best performing or average of checks for grain yield per plot. However, all the three entries, AF 2-8-18 (14.32), AF 2-8-17 E-5 (13.58) and AF 2-8-17 E-14 (13.89) showed higher 100 seed weight (g) than the best performing (Prateek, 8.30) or average of checks (8.09) across all the locations. New CWR_ BOLD META trial with 21 entries was also conducted in Alpha-Lattice with three checks, however, the trial showed no flowering except in the checks.

GMPYT 36 with 33 entries was conducted in Alpha-Lattice with three checks, 26 entries (ranging from 6.07 – 4.27) out yielded the best performing (Prateek, 4.14) check for biomass yield/plot (kg). Top three entries E-22 (1.08), E-8 (0.94) and E-10 (0.91) found better than average of checks (0.79) for grain yield per plot (kg).

Station trial Local GP elites was also conducted in RBD with three checks, Ratan, Prateek and Mahateora and nine entries. Entry Sel-553 (0.85, 2.72) outyielded the best performing check, Mahateora (0.78) and Ratan (2.69) for biomass yield/plot (kg) and grain yield per plot (kg), respectively. Other entries IC 143430 (0.84), IC 142698 (0.83), JRL-41 (0.81) and IC 142847 (0.79) also outyielded the best performing check, Mahateora (0.78) for grain yield per plot (kg).

Local germplasm evaluation was also conducted in augmented design with three checks, Ratan, Prateek and Mahateora and 97 entries. The best performing check was Mahateora (0.65) for grain yield per plot (kg). Total thirteen entries out yielded Mahateora, top three outyielding entries were, IC 142595 (0.97), IC 654328 (0.75) and IC 143430 (0.71). IC numbers were obtained from ICAR-NBPGR, New Delhi of 82 entries *i.e* from IC 654265 to IC 654346.

Exploration and application of soil-inhabiting and endophytic plant growth promoting bacteria including actinomycetes for biological management of soil-borne diseases of lentil (Funding Agency: MPCST, Madhya Pradesh)

Rhizospheric soil and root samples were

collected from 27 locations of Madhya Pradesh along with one sample from the paddy fields at ICAR-NBAIM, Mau, Uttar Pradesh. One hundred and fifty rhizospheric and 40 endophytic bacteria were isolates from the rhizosphere and roots of field (Paddy, Maize), legume (Lentil, Chickpea, Urdbean, Soybean, Pigeonpea, Mungbean), oilseeds (Sesame, Groundnut) and vegetable crops (Okra, Cucumber, Sponge gourd, Pumpkin, Bottle gourd). These 190 bacterial isolates were subjected to preliminary evaluation (qualitative) for their antagonistic potential. Out of which, 29 have shown strong mycelial inhibition of collar rot and *Fusarium* wilt pathogens. These 29 isolates were subjected to quantitative estimation of their antagonistic potential against collar rot and *Fusarium* wilt pathogens.

In case of *S. rolfsii*, out of 29 effective bacterial isolates, 10 isolates *viz*., KM S23 10-8, NA 1A, NA S1 1A, PK R9 10-7 A, PK31 10-5 A, SMAA S2 A, TAP S20 10-6, YM S20 10-6 A, SI.G7, and SI.A1 resulted in more than 60% mycelial inhibition (Fig. 2 & 3, Table 2). In case of wilt pathogen, 12 isolates (YM S1B, SMAA S2A, CB, NA S1A, ISP S18 10-8, YM S23 10-6A, KM S13 10-6, YM S20 10-6A, TAP S20 10-6A, KM S32 10-6, NA 1A, and S.I E) have shown significant (more than 60%) inhibition in the mycelial growth of *F. oxysporum* f. sp. *lentis* in single plate dual culture assay (Fig. 2). The bacterial isolates performing well in dual culture assays were screened for their abilities for IAA production, Phosphorus solubilization, Zinc solubilization, Potassium solubilization, Siderophore production, and Ammonia production.

Supply chain of pulses in major pulse producing states of India with focus on eastern states (Department of Consumer Affairs, DoCA)

The project was initiated in May 2025 with the major objective of mapping the supply chain in major pulses producing regions with focus on eastern states. Other objective included were to decipher the extent of use of digital platform in supply chain; challenges faced by supply chain stakeholders and to examine the arrival and price trend in APMC *Mandi*. In Madhya Pradesh, nine major pulses producing districts were selected for six major pulses (Chickpea, Pigeonpea, Mungbean, Urdbean, Lentil and Fieldpea) based on production during the last four years. In each district, two mandis were selected based on arrival of produce. Based on mandis, two blocks were identified and two villages were selected from each block. Proforma for *survey* data were made for different stakeholders like producers, aggregator, wholesaler, retailer *etc*. Secondary data of prices and arrivals of selected crops were compiled from the Agrimarknet website. Survey work to collect primary data has been initiated.

Multi-location trials conducted at ICAR-IIPR Regional Station, Bhopal

Irrigated Timely Sown Trial of *desi* chickpea

A *desi* chickpea trial with 23 genotypes and two checks, namely, AKG 1303, and Phule G 0405 were evaluated under timely sown irrigated condition in RBD with three replications. IPC 23-651 and IPC 22-117 yielded significantly higher than checks.

***Desi* chickpea heat tolerance trials**

Two heat tolerance trials were conducted in *rabi* 2024-25. In the first trial, 21 entries were evaluated in RBD with three replications with five checks, namely GNG 2207, KPG 59, KWR 108, JG 14 and BDG 374 for the 3rd consecutive year. Under very late sown condition (sowing on 26th December), IPC 2019-5 gave significantly higher yield over the best check besides high ratio of filled to unfilled pods. In the second trial, 25 entries were evaluated in RBD with three replications with three checks, namely GNG 2207, KPG 59, KWR 108. Under very late sown condition (sowing on 26th December), IPC-U-729 gave significantly higher yield.

Lentil trials

In lentil, three multi-location trials were conducted. In the first trial, 13 genotypes and two checks, namely IPL 534 and IPL 316 were evaluated under timely sown irrigated condition in RBD with three replications. IPL 22-13 yielded significantly higher than checks. In the second trial received from FLRP Amlaha, ICARDA; 25 genotypes and two checks, L 4729, RVL 13-7 were evaluated under timely sown irrigated condition in RBD with three replications. ILL-681911LL207-S2 and IL-10829 x 1LWL-130 (R-56) yielded significantly higher than checks. The third trial was for the evaluation of heat tolerance, wherein 10 genotypes and a check IPL 534 were evaluated under timely and late sown conditions in RBD with three replications. In the late sown condition, two entries, namely IG 2559 and IG 3522 gave significantly higher yield as well as high ratio of filled to unfilled pods

C. Seed Production

Sub-project 1: Enhancing Breeder Seed Production for Increasing Indigenous Production of Pulses in India

Breeder seed production was undertaken under BSP and EBSP during 2024-25 at ICAR-IIPR, RS, Bhopal. The detail is given in the Table:

Breeder seed production during 2024-25

Crop	Variety	Seed produced (q)
Urdbean	IPU 13-1	32.7
	IPU 11-2	
	IPU 10-26	
	IPU 17-1	
Pigeonpea	IPA 15-06	36.5
Fieldpea	IPFD 11-5	126.0
	IPFD 12-2	
	IPFD 2014-2	
	IPFD 10-12	
Lentil	IPL 316	19.0
	IPL 534	
Chickpea	IPC 2006-77	87.5
	IPCMB 19-3	
Total		**301.7**

Sub-project 2: Creation of seed hubs for increasing indigenous production of pulses in India

In the seed hub project, seed business license of the Institute and registration of seed processing plant were renewed with MPSSCA, Bhopal for quality seed production, certification and seed processing. The detail of seed produced by the farmers under seed-hub project is given in the Table:

Quality seed production at the farmers' field during 2024-25

Crop	Production (q)	Procurement (q)
Urdbean	39	24.87
Mungbean	35	19.1
Pigeonpea	90	40.88
Chickpea	970	374.83
Lentil	250	85.06
Fieldpea	62	41.8
Total	58	6.54

Genetic Stocks

- **IC Numbers obtained** in 2025 from ICAR-NBPGR, New Delhi of 82 entries of Local Grasspea germplasm accessions of India, collected from Chattisgarh, IC 654265 to IC 654346.
- Chickpea accessions (119) submitted to MTS module IIPR, Kanpur in 2025 as follows: 22 accessions of *Kabuli* and 8 *Desi* Chickpea procured from ICARDA; 85 accessions of *Kabuli* and 4 *Desi* Chickpea already available at RS, Phanda, Bhopal (Total 107 *Kabuli*, 12 *Desi*) were sent to MTS Module at ICAR-IIPR, Kanpur.

Extension activities

Frontline demonstrations conducted at ICAR-IIPR, RS, Bhopal during 2024-25

Sixty five FLD's (40 FPT and 25 TSP) in chickpea, lentil and fieldpea were conducted by IIPR, RS, Bhopal during *rabi* 2024-25. The frontline demonstrations were executed in Bhopal and adjoining districts for the dissemination of new varieties. In the full package technology, chickpea variety IPC 2006-77, lentil variety IPL 534 and filedpea variety IPFD 12-2, respectively gave 22.5%, 24.1% and 25.8% higher grain yield over the existing cultivars. In the TSP-FLD, IPL 534 of lentil exhibited 28.7% superiority, whereas fieldpea variety IPFD 12-2 gave 22% yield advantage over the existing varieties.

Crop	Variety	No of FLDs	B:C Ratio	% increase
Chickpea	ICP 2006-77	20	2.5:1	22.5
Lentil	IPL 534	15	2.2:1	24.1
Fieldpea	IPFD 12-2	5	2:1	25.8
Lentil (TSP)	IPL 534	15	2.4:1	28.7
Fieldpea (TSP)	IPFD 12-2	10	2.3:1	22

SC Sub Plan activities at ICAR-IIPR, RS, Bhopal

Quality seed, agricultural tools, seed bin and battery-operated spray pump were distributed among farmers of Bhopal and adjoining districts under SC Sub Plan, DAC Ministry of Agriculture and Farmers' Welfare, GOI. Four field visits were organized for SC farmers. In addition, scientists of IIPR, RS, Bhopal visited 10 villages and extended crop management technology during *rabi* 2024-25 and *kharif* 2025. Input distribution to SC farmers has been listed.

Input distribution to SC farmers during 2025

Input	No. of beneficiary farmers	Districts	No. of villages
HYV seed of pulses	897	Bhopal, Sehore, Raisen, Vidisha, Rajgarh	56
Small agricultural tools	200	Bhopal, Sehore, Raisen, Vidisha, Rajgarh	22

Spray pump	100	Bhopal, Sehore, Raisen, Vidisha	19
Seed storage bin	100	Bhopal, Sehore, Raisen, Vidisha	18

Model pulses village programme at ICAR-IIPR, RS, Bhopal

A SC dominated village was adopted in 2023 to develop as a model pulses village and SC farmers were given priority. The activities namely transfer of technologies, field visits and training undertaken. Under this project, quality seed of pigeonpea chickpea, lentil and fieldpea were distributed, farmers were given training and regular visits were made to address the crop management issues of the farmers. The average productivity of pigeonpea, chickpea, lentil, fieldpea and were improved by 21.5%, 26.6%, 19.4% and 27.4%,, respectively over the local varieties.

Outreach activities at IIPR, RS, Bhopal

- ICAR-IIPR, RS, Scientists visited two times in each seed hub plots of chickpea, lentil, fieldpea, urdbean and pigeonpea, for technical interventions and monitoring of quality seed production
- ICAR-IIPR, RS, Scientists visited Awalikheda and Henoiti, adapted village, three times during 2025 for technology interventions and crop management practices
- Plant Breeder of ICAR-IIPR, RS, Bhopal visited breeder seed plot at ICAR-DWR, Jabalpur (under MoU with ICAR-IIPR) for monitoring and seed certification
- During *Swachhata Pakhwada,* ICAR-IIPR, RS, Bhopal organized *swachhata* and awareness programme among local farmers and students and encouraged them for observing *swachhata* in daily life and incorporating pulses food in their diet for balanced nutrition.
- Scientists of ICAR-IIPR, RS, Bhopal attended brainstorming meeting at Regional Science Centre, Bhopal on October 27, 2025 for preparatory cum brainstorming meeting for conducting Science Fiesta in January, 2026
- ICAR-IIPR, RS, Bhopal officials distributed seeds of pulses crop Mungbean during spring season, Urdbean and pigeonpea during *kharif* season and chickpea and lentil during *rabi* season to farmers from SC community in 2025 for growing pulses crop in spring, *kharif* and *rabi* season for bringing pulses crop available in their food
- ICAR-IIPR RS, Bhopal officials distributed agriculture equipment (sickle, spade, seed bin and sprayer) to farmers from SC community in 2025 for growing pulses crops and bringing pulses crop available in their food.
- ICAR-IIPR, RS, Scientists visited 39 *Gram Panchayat* of Ashta block of Sehore district to take part in "*Viksit Krishi Sankalp Abhiyan*" and interacted with farmers and encouraged them for cultivation of pulses crops during May 29 to June 12, 2025.

Other activities at ICAR-IIPR, RS, Bhopal

- ICAR-IIPR RS, Bhopal scientists organized three day farmers training in which a group of 25 farmers of Bhopal and Sehore district participated during February 11-13, 2025.
- Organized a three day farmers training for 10 farmers of Maharashtra, from June 2-4, 2025.
- Organized one day on-line training programme on "Crop Protection and Post-harvest Technologies for *Kharif* Pulses" on 30th September 2025 for SMS/Head of KVKs engaged in Model Pulse Village Project from Madhya Pradesh and Chhattisgarh state in collaboration with ICAR-ATARI, Jabalpur.

IIPR Regional Station *cum* Off-Season Nursery, Dharwad, Karnataka

Crop Improvement

Plant Genetic Resources Management and its utilization through pre-breeding

Cowpea

Evaluation and Characterization of Germplasm Lines

Cowpea germplasm (n=280) was evaluated in an augmented design with checks, DC-15 and DCS 47-1. Observations (10) were recorded, revealing wide variation in morphological traits. Genetic variability analysis showed the following parameters:

Identification of Trait-Specific Donors

- Days to first flowering (<35 days): EC-724527, EC-528393, EC-724751, EC-724615, EC-723807, EC-738156
- Days to 1st podding (<40 days): EC-528393, EC-723909, EC-724601, EC-724780, EC-724621, EC-738143
- Days to maturity (<70 days): EC-723693, EC-723774, EC-723807, EC384779, EC170604, EC734527, EC-723909
- Pod length (>15 cm): EC-724615, EC-724780, EC-723959, EC-738125
- Pods/Plant (>15): IC 397427, EC-724532, EC-724774, EC-723807
- Plant height (60 cm): EC244020, EC7244826, IC257428, IC52094, EC738239
- Seeds/Pod (>15 gm): EC99680, EC724484, IC253276, IC52094, IC68768, IC2060

Horsegram

Evaluation and maintenance of germplasm: Total of 250 horsegram accessions were evaluated for different phenotypic traits including plant height (cm), days to maturity, number of pods per plant, pod length (cm), number of seeds per pod, seed yield per plant (g) and 100-seed weight (g). Considerable variation was observed among the accessions for all the traits studied. The accessions IC-321300, IC- 426525, IC-341310, IC-341312, HPKM-317 and IC-536686 exhibited early maturity when compared to the check varieties CRIDA-1-18R (89 days) and PHG-9 (98 days). Accessions such as IC-88995, IC- 261020 and IC-344222 exhibited a high number of pods per plant. Longer pod length was observed in IC- 24411, IC-201104 and IC-426525, while accessions such as IC-261020 and IC-344222 also recorded a higher number of seeds per pod. With respect to disease response, accessions IC-536686,

Performance of promising accessions of horsegram

Phenotypic traits	Promising accessions
No. of pods plant^{-1} (>35)	IC-88995, IC-121646, IC-139556, IC-261020, IC- 344222
Pod length (>5 cm)	IC-24411, IC-88995, IC-201104, IC-261020, IC-426525
No. of seeds per pod (>5)	IC-261020, IC-89015, IC-344222, IC-19447, IC-426531
100 Seed weight (>3.50 g)	IC-88995, IC-343105, IC-426525, IC-536686, IC- 561037
100 SeedSeed yield/plant (>10g) weight (>3.50 g)	IC-590834, IC-44010,GDH-1, IC-145271, IC-201104

Genetic variability analysis

Character	Mean	Range (Max-Min)	GCV	PCV	h²(bs)	GA	GAM
Days to 50% flowering	43.20	47.00-37.0	4.47	5.87	58.14	3.74	7.03
Days to maturity	70.71	74.00-67.0	2.93	3.29	79.07	3.79	5.37
Plant Height	36.01	88.47-24.0	11.42	22.28	26.26	4.34	12.06
Pod length	14.49	16.74-11.6	6.69	12.04	30.88	1.11	7.66
No of seeds per pod	13.99	19.40-8.8	13.36	18.37	52.84	2.80	20.00
No of pods per cluster	2.57	4.33-2.0	14.40	25.78	31.17	0.42	16.56
No of pods per plant	8.64	13.93-6.0	18.05	29.70	36.96	2.00	22.61
100 seed weight	11.48	16.31-9.2	14.33	23.38	37.60	2.08	18.11
Grain yield	0.32	0.56-0.02	37.89	51.57	53.97	0.18	57.33

IPHG-21-06, IC-49289, IC-280768, IC-68595 and IC-94599 showed a moderately resistant reaction to powdery mildew under field conditions. Trait specific donors were identified has been given below.

Screening against YMD: Total 100 accessions of horsegram were screened for yellow mosaic viral disease during spring/rabi season under natural field conditions. The accessions such as IC- 121646, IC-321300, IC-613404 and IC-347175 are identified as resistance to yellow mosaic disease under field conditions.



Screening of horsegram germplasm against yellow mosaic virus and powdery mildew

Mungbean germplasm: Total 190 accessions of mungbean were evaluated during spring/summer. The genotypes, AVMU-1609, AVMU-1640, AVMU-1634, AVMU-16 were identified as resistance to MYMV under field conditions.

Urdbean Germplasm: During the *kharif*/summer season, a total of 215 urdbean germplasm accessions were evaluated for key agronomic traits. Several promising accessions were identified for earliness and yield-related attributes. For early maturity (less than 70 days), superior performers included IC-274597, IC-305287, IC-541046 and IC-541882. Accessions exhibiting high seeds per pod (5 or more) were IPU 99-147, IPU 99-112, IPU 99-168, IPU 99-232 and UH-80-19. Long pods ranging from 5-10 cm were observed in IC-560408, SPS 29, PLU 25 and STY2289. High pod number per plant (>20) was recorded in IC-106068, IC-43647, IC-274045, UH-82-2 and STM-6. For plant height exceeding 60 cm, notable accessions were IC-427978, IPU-99-16, IPU-99-233, and IPU-11-02. Finally, accessions with high test weight (>4 g) included IPU 95-13, IPU 99-179, PDU 3, IC-106066, UH82-2 and SPS-39. These selections serve as valuable genetic resources for improving earliness, pod characteristics, plant architecture, and seed quality in urdbean breeding programs.

Maintenance of Wild *Vigna* species: Total 50 wild *Vigna* spp such as *Vigna unguiculata subsp.cylindrical, Vigna sinensis, Vigna Khandalsis, Vigna Vexillata, V.umbellata, V. aconitifolia V.trilobata, V.stipulacea Vigna dalzelliana, Vigna glabrescence, Vigna hainiana, Vigna pilosa, Vigna sublobata, Vigna sylvestries, Vigna trinervia var.bourbeae, and Vigna luteola* were rejuvenated and evaluated for various phenotypic traits. Wild Vigna (20) and Rhyncosia accessions (07) were characterized and rejuvenated in vigna garden for agro-morphological traits as per standard IBPGR plant descriptors for vigna and *Cajanus/Rhynchosia*. Trichome density, diversity and length were recorded. Some of the Rhynchosia species collected and evaluated were *Rhynchosia densifora*. Different types of trichomes on calyx, on leaves (adaxial and abaxial) on pods were recorded and were counted and and measured their length.

Genetic enhancement of Pulse Crops for yield, stability and quality

Mungbean station trials: Two station trials of mungbean each with 24 advanced breeding lines were evaluated during summer season. Among the tested entries, IPM-1603-3 recorded the highest seed yield (1280 kg ha^{-1}) with a maturity of 70 days, followed by IPM-1715-1 (1150) kg ha^{-1} compared to check variety, IPM-2-14 (950 kg ha^{-1}).

Evaluation of advanced breeding lines in state trial (MLT): Total 12 advanced breeding lines of mungbean were evaluated in various locations (Mugad, Akkialur, Mundgod) in Karnataka. Advanced breeding lines such as IPM-1620-6 (1260 kg ha^{-1}), IPM-1711-1 (1150 kg ha^{-1}), IPM-14-9 (1130 kg ha^{-1}), IPM-1205-2 (1100 kg ha^{-1}) were recorded higher grain yield with stable resistance to yellow mosaic virus disease in tested locations of Karnataka.

Urdbean: In Station Trial I (ST I) conducted during Spring/Summer 2025, ten entries were evaluated alongside three checks, with IPU 2-43 serving as a check variety. The check IPU 2-43 recorded 36 days to 50% flowering, 75 days to maturity, and a grain yield of 900 kg/ha. Among the test entries, three genotypes outperformed IPU 2-43. The top performer was IPUD 19-230, with 35 days to 50% flowering, 73 days to maturity, and a grain yield of 1050 kg ha^{-1}, exhibiting 16.6% superiority over the check. It was followed by IPUD 20-08 (37 days to 50% flowering, 75 days to maturity, 995 kg ha^{-1}; 11% superiority) and IPUD 20-02 (38 days to 50% flowering, 71 days to maturity, 980 kg ha^{-1}; 8.00% superiority). These promising genotypes demonstrated enhanced grain yield combined with comparable or earlier maturity, marking them as potential candidates for advancement in the urdbean breeding program.

Cowpea:

Evaluation of advanced breeding lines:

- **Preliminary Yield Trial I (PYT I, Summer 2025)**: Tested entries: 30; Checks: DC15, DCS 47-1; Superior entries: 13; Yield superiority: 10-30%. In the Preliminary Yield Trial I (PYT I) conducted during summer 2025, a total of 30 test entries were evaluated against two check varieties, DC-15 and DCS 47-1. Of these, 13 entries showed superior performance, with yield advantages ranging from 10% to 30% over the checks. These high-performing lines indicate promising potential for advancing improved cowpea genotypes in the breeding pipeline.
- **Preliminary Yield Trial II (PYT II, *Kharif* 2025)**: Tested entries: 39; Checks: DC15, DCS 47-1; Superior entries: 18; Yield superiority: 12-38%. In the Preliminary Yield Trial II (PYT II) conducted during *kharif* 2025, a total of 39 test entries were evaluated alongside two check varieties, DC-15 and DCS 47-1. Out of these, 18 entries demonstrated superior performance, exhibiting yield advantages ranging from 12% to 38% over the checks. Superior entries will be tested under station trial.
- **Station Trial I (Summer 2025, 10 entries + 3 checks)**: In Station Trial I conducted during summer 2025, 10 entries were evaluated along with three check varieties: DC-15, DCS 47-1, and KBC-9. The check varieties recorded days to maturity (DM), and grain yield per hectare (GYP) hundred seed weight (HSW), as follows: DC-15 (73.3 days, 1410 kg ha^{-1}, 12.0 g,), DCS 47-1 (75.16 days, 1430.57 kg ha^{-1}, 12.80 g,), and KBC-9 (73.35 days, 1213 kg ha^{-1}, 11.30 g). Among the test entries, five genotypes demonstrated superiority over the best check (DCS 47-1). IPCW 3-15 exhibited the higher yield of 1792 kg ha^{-1}with HSW of 11.50 g and DM of 71.30 days, showing 25.2% superiority. This was closely followed by IPCW 20-247 (1787 kg ha^{-1}, 10.80 g HSW, 68.30 days DM; 24.91% superiority), IPCW 20-206 (1753 kg ha^{-1}, 11.90 g HSW, 70.0 days DM; 22.5% superiority), IPCW 21-410 (1652 kg ha^{-1}, 12.7 g HSW, 68.0 days DM; 15.45% superiority), and IPCW 21-413 (1545 kg ha^{-1}, 12.0 g HSW, 68.0 days DM; 7.89% superiority). These results highlight promising genotypes with enhanced yield potential and earlier maturity for further advancement in the cowpea breeding program.
- **Station Trial II (*kharif* 2025, 14 entries + 3 checks)**: In Station Trial II conducted during *kharif* 2025, 14 entries were evaluated alongside three check varieties: DC-15, DCS 47-1, and KBC-9. The check varieties recorded hundred seed weight (HSW), days to maturity (DM), and grain yield per hectare (GYP) as follows: DC-15 (11.25 g, 74.6 days, 1218 kg ha^{-1}), DCS 47-1 (12.20 g, 78.5 days, 1258 kg ha^{-1}), and KBC-9 (10.24 g, 75.0 days, 1067 kg ha^{-1}). Among the test entries, five genotypes outperformed the best check (DCS 47-1). IPCW 20-207 achieved the highest yield of 1535 kg ha^{-1}with HSW of 10.0 g and DM of 75.0 days, demonstrating 22% superiority. It was followed by IPCW 03-20 (1510 kg ha^{-1}, 9.75 g HSW, 72.3 days DM; 19.99% superiority), IPCW 20-123 (1448 kg ha^{-1}, 11.5 g HSW, 69.3 days DM; 15.07% superiority), IPCW 21-410 (1409 kg ha^{-1}, 12.5 g HSW, 71.0 days DM; 11.98% superiority), and IPCW 21-413 (1365 kg ha^{-1}, 11.2 g HSW, 69.0 days DM; 8.49% superiority). These results underscore the potential of these genotypes for higher yield and relatively earlier maturity, warranting their promotion in the cowpea breeding program.

Horsegram: Among the evaluated advanced genotypes, IPHG-21-66 revealed the earliest maturity (84 days) along with the higher grain yield (1150 kg ha^{-1}**)**, while, IPHG-23-196 matured in 87 days and produced a grain yield of 1070 kg ha^{-1}, compared to check varieties, CRIDA-1-18R (950 kg ha^{-1}).

Chickpea: four station trials of both desi and Kabuli chickpea each with 25 advanced breeding lines (Mechanical harvesting, rainfed, timely sown and Kabuli) were evaluated during *rabi* season.

Station trial-I (Mechanical harvesting trial):

The evaluation of twenty-five chickpea entries during *rabi* season revealed variations in plant height, days to maturity, test weight, and grain yield. Among them, IPC-23-111 recorded the higher yield of 2417 kg ha^{-1}, along with a tall erect plant height (55 cm**)** and early maturity **(**87 days), indicating its suitability for mechanical harvesting. This was followed by IPC-23-318 **(**2236 kg ha^{-1}**)** and IPC-23-666 **(**2187 kg ha^{-1}**)**. Compared to check varieties**,** JG-11 **(**1891 kg ha^{-1}**),** and **N**BeG-47 **(**1393 kg ha^{-1}**)**.

Station trial-II (Timely sown): Total 23 advanced breeding lines along with two check varieties of chickpea evalauated during rabi. Among the tested genotypes, IPC-23-319 recorded highest yield (2386 kg ha^{-1}, test weight 25.50 g), followed by IPC-23-317 (2273 kg ha^{-1}) and IPC-21-67 (2157 kg ha^{-1}) compared to check varieties BGD-111-1 (2069 kg ha^{-1}) and JAKI-9218 (2086 kg ha^{-1}).

Station trial-III (Rainfed): The tested chickpea genotypes (23 advanced lines with two checks) revealed variations for days to maturity, test weight and grain yield. Among the entries, IPC-23-655 recorded higher grain yield (2193 kg ha^{-1}), with early maturity (87 days), followed by IPC-22-112 (2165 kg ha^{-1}) and IPC-21-118 (2070 kg ha^{-1}) compared to checks BGD-111-1 (1886 kg ha^{-1}) JAKI-9218 (1985 kg ha^{-1}).

a) **Station trial –IV (Kabuli):** The evaluation of Kabuli chickpea entries revealed variations in maturity duration, seed size, and yield. Among the test entries, IPCK-20-222 was recorded the higher yield (2034 kg ha^{-1}) with a higher 100-seed weight (34.95 g) followed by IPCK-23-269 (1948 kg ha^{-1}) compared to check varieties, JGK-1 (1870 kg ha^{-1}) and MNK-1 (1600 kg ha^{-1}).

b) **Preliminary yield trials (PYT)**: Total 140 advanced breeding lines of chickpea were evaluated in augmented design. The entries such as IPC-24-140 recorded the highest yield (2896 kg ha^{-1}) followed by IPC- 24-33 (2650 kg ha^{-1}) compared to check varieties JG-11 (2400 kg ha^{-1}) and SA-1 (2300 kg ha^{-1}).

Promising entries in state MLT: IPUD 19-202, IPUD 19-220, IPUD 19-221, IPUD 19-209, IPUD 19-228 are in second year of state MLTs for suitability in Karnataka agro-climatic zones under UAS(D). IPUD 19-220, IPUD 19-221, IPUD 19-228 are in state trial *kharif* under UAHS Shimoga, similarly in IVT I Cowpea (*kharif*) IPCD 20-207, and IPCD 03-20. Cowpea (summer) IPCD 20-123 and IPCD 20-206. Urdbean (IPUD 20-23) is in IVT I in summer. Promising entries of chickpea (IPC-23-111, IPC-20-84), mungbean (IPM-1205-2, IPM-1620-6, IPM-1707-1, IPM-1604-1) and urdbean (IPUD 19-202, IPUD 19-220) were entered into state multi-location trial (MLT) to assess their suitability for cultivation in different agro-climatic zones of Karnataka

Generation of breeding material in pulses

Cowpea: During the current year, seventeen new crosses were attempted to enhance key target traits, including growth habit, erect plant type, number of pods per plant, pod length, seeds per pod, earliness, high protein content, and resistance to yellow mosaic virus (YMV), dry root rot, and bruchid species. The recipient parents utilized were DC-15, Goa Cowpea, KBC-9, PL-4, DCS 47-1, and GC-3. The donor parents included TPTC 29, GC-3, PL-1/PL-2, RC 101, RC 19, ITK-97K-499-35, EC-724035, and EC-723909. Additionally, interspecific hybridization was carried out involving *Vigna vexillata* (IC-0647708), *Vigna cylindrica* spp., and *Vigna sinensis*.

In the cowpea breeding program, a total of 156 crosses were advanced across various filial generations. Among these, 15 F_1 generations were developed and evaluated. Progeny from 25 crosses were bulked in the F_2 generation, comprising 132 lines, while 16 crosses progressed to the F_3 generation with 198 lines. In the F_4 generation, 19 crosses advanced, yielding 201 lines, followed by 20 crosses in the F_5 generation with 115 lines. The F_6 generation included 12 crosses, resulting in 72 lines from single plant selections (SPS) and 36 bulks. Similarly, the F_7 generation comprised 11 crosses, with 35 SPS lines and 22 bulks. Additionally, 40 lines were promoted to the Preliminary Yield Trial (PYT) for further assessment. Overall, the program handled 753 lines from SPS/bulk selections and 58 bulks across these generations, contributing to the development and selection of improved cowpea breeding materials.

In the urdbean breeding program, a total of 49 crosses were advanced across various filial generations. Progeny from 9 crosses were evaluated in the F_4 generation, comprising 22 lines. In the F_5 generation, 8 crosses progressed with 39 lines. The F_6 generation included 10 crosses, resulting in 68 lines from single plant selections (SPS) and 61 bulks. Similarly, the F_7 generation comprised 22 crosses, with 79 SPS lines and 72 bulks. Additionally, 42 lines were promoted to the Preliminary Yield Trial (PYT) for further evaluation. Overall, the program managed a substantial number of lines and bulks through SPS and bulk selections, facilitating the development and identification of superior urdbean breeding materials.

Horsegram: Fresh crosses (>12) were generated utilizing donor lines with earliness, resistance to YMV and moderately resistance to powdery mildew diseases in horsegram. Segregation generations (F_1-F_2 / F_2-F_3 / F_3-F_4 / F_5-F_6) were advanced during *rabi*. More than 100 single plant selections (SPS) were madebased on their superiority for seed yield and resistance reaction to powdery mildew disease.

Chickpea: 23 new crosses for different traits (Mechanical harvesting, Earliness, Wilt resistance, Dry root rot resistance & High protein content) were generated in chickpea during the off- season of 2025.

Off-season generation advancement of pulses: Off-season generation advancement of chickpea was undertaken to accelerate breeding cycles and advance segregating populations received from various AICRP chickpea centers such as Bijapur (19), CAU Jhansi (08) and IIPR Kanpur (45) during kharif 2025. The generation advancement was performed during the kharif season and advanced breeding materials were sent to the respective AICRP centers. Off-season Nursery: Lentil (110) breeding materials from IIPR HQ advanced during off-season.

Breeder/TL Seed Production: Total 450 kg of breeder seeds of mungbean cv. IPM 2-14, urdbean cv. IPU-2-43 were produced during *kharif*/ summer. Nearly 200 kg TL seeds of chickpea variety (SA-1) produced during *rabi*. In horsegram variety i.e. CRIDA-18 was produced seed yield of 300 kg during *rabi*.

CROP PRODUCTION

Sustaining Crop Productivity for Pulse based Cropping System through Integrated Nutrient Management in Vertisols of Peninsular India

The total rainfall received during 2025 is 1030.1 mm in 74 rainy days which was higher by 35% over 40 years (1985-2024) mean rainfall of 765.9 mm. The *rabi* sorghum was sown on 3rd October 2024 and harvested on 6th February 2025, whereas chickpea was sown on 6th November 2024 and harvested on 7th February 2025. The crop season rainfall that fell during crop growth of chickpea and *rabi* sorghum was 4.6 mm only during winter season of 2024-2025. Maize and mungbean were sown on 4th and 5th July, 2025, respectively with an antecedent rainfall of 47.0 mm that fell from 25th June to 4th July 2025 in five rainy days. Both Maize and mungbean were sown late in July due to continuous rainfall from May up to the sowing time. At sowing top 60 cm soil profile was completely wet. In general, very low yields of mungbean and lower yields of maize were attributed to the higher crop season rainfall of 330.5 mm and 488.5 mm with 33 and 40 rainy days that fell has led to water stagnation in the crop fields with excess soil moisture throughout the crop season. Higher rainfall during maize cropping season and during flowering to earhead formation reduced the maize yields by 20-30% during 2025.

The treatment T_8 with 100% RRF i.e. 25:50 N:P kg ha^{-1} along with seed treatment of Microbial Consortia and 0.5% spray with $ZnS0_4$ and $FeS0_4$ at flowering recorded significantly greater chickpea grain yield of 2642 kg ha^{-1} and WUE of 7.03 kg $ha^{-1}mm^{-1}$ and were higher by 36% over farmers' practice (1943 kg ha^{-1} and 5.17 kg ha^{-1} mm^{-1}). The higher grain yields in T_8 were attributed to higher values of yield components i.e. number of pods $plant^{-1}$, pods weight, and seed weight $plant^{-1}$ Stover yield was higher by 27% (2107 kg ha^{-1}) in T_8 over farmer's practice (1658 kg ha^{-1}). Higher yields of chickpea in T_8 were attributed to better utilization nutrients and soil moisture over other treatments. Treatment T_8 produced higher net returns by 54% (Rs. 102,278 ha^{-1}), B:C ratio by 19% (2.59) & net energy benefit by 34% (85,862 MJ ha^{-1}) over control (Rs. 66,300 ha^{-1}, 2.17 &64142MJ ha^{-1}, respectively).

Grain yield of winter sorghum and water use efficiency (WUE) were higher by 38% in T_8 (2346 kgha^{-1} and 5.38 kg ha-1mm^{-1}) with application of 100% RRF along with seed treatment of Microbial Consortia and application of $ZnS0_4$ and $FeS0_4$ at 25 kg ha^{-1} over the farmers' practice of sorghum cultivation (T1) (1700 kg ha^{-1} and 3.90 kg ha^{-1} mm^{-1}) during winter 2024-25) Higher grain yield in sorghum in T_8 treatment was attributed to better plant growth with higher values of yield components i.e. earhead weight, seed weight $plant^{-1}$ and 1000 seeds weight. The straw yield of *rabi* sorghum increased by 23% (2656 kg ha^{-1}) in T_8 treatment over farmers' practice (2338 kg ha^{-1}). Higher straw yields in T_8 were attributed to better root and plant growth with greater root weight over farmers' practice. The treatment T_8 produced higher net returns by 28% (Rs. 91,234 ha^{-1}), B:C ratio by 14% (2.22) and net energy benefit by 28% (91234 MJ ha^{-1}) over control (Rs. 40,836 ha^{-1}, 1.95 & 71252 MJ ha^{-1}).

The grain yield of maize and water use efficiency (WUE) were higher by 45% in T_8 (6481 kg ha^{-1} and 21.79 kg ha^{-1} mm^{-1}) with application of 100% recommended rate of fertilizer (RRF) along with seed treatment of Microbial Consortia and application of $ZnS0_4$ and $FeS0_4$ at 25 kg ha^{-1} over the farmers' practice of maize cultivation (T_1) (4467 kg ha^{-1} and 15.0 kg ha^{-1} mm^{-1}) during *kharif* season 2025 . Higher grain yield in maize in T_8 was attributed to better plant growth with higher values of yield components i.e. cob weight and seed weight $plant^{-1}$, 1000 seeds weight. Straw yield of maize was higher by 13% (6856 kg ha^{-1}) in T_8 over farmers' practice (6100 kg ha^{-1}). Higher straw yields in T_8 were attributed to better plant root and growth with greater root weight over farmers' practice. The treatment T_8 produced higher net returns by 34% (Rs. 72382 ha^{-1}), B:C ratio by 5% (2.02) and net energy benefit by 27% (170573 MJ ha^{-1}) over

control (Rs. 48,076 ha-1, 1.90 and 134500 MJ ha-1, respectively).

Grain yield of mungbean and WUE were higher by 35% in T_8 (368 kg ha^{-1} & 25.39 kg ha^{-1} mm^{-1}) with application of 100% RRF along with seed treatment of Microbial Consortia and 0.5% spray with $ZnS0_4$ and $FeS0_4$ at flowering over farmers' practice (T_1) (273 kg ha^{-1} and 18.80 kg ha^{-1} mm^{-1}) during *kharif* 2025 .Higher grain yield in mungbean in T_8 treatment was attributed to better plant growth with higher values of yield components i.e. pod weight and seed weight $plant^{-1}$, 1000 seeds weight. The stover yield of mungbean was higher by 31% (536 kg ha^{-1}) in T_8 treatment over farmers' practice (409 kg ha^{-1}). Higher stover yield in T_8 were attributed to better root and plant growth with greater root weight over farmers' practice. The treatment T_8 produced higher B:C ratio by 14% (0.49), and net energy benefit by 38% (9639 MJ ha^{-1}) over control (0.43 and 6990 MJ ha^{-1}, respectively).



Chickpea



Sorghum

Chickpea and winter sorghum crops as influenced by INM in Vertisols of Dharwad during *rabi* 2024-25

CROP PROTECTION

Survey for major diseases of pulses crops of Northern Karnataka

A roving survey conducted across major pulse-growing districts of northern Karnataka. In cowpea, stem rot incidence was generally low across locations, ranging from 0–3 per cent. In mungbean, yellow mosaic virus (YMV) incidence ranged from 0.5–10%, with higher levels recorded in Gajendragad (up to 6.5%) and Gadag taluk (up to 10%). Powdery mildew (PM) severity varied considerably, ranging from 8–40 PDI in Dharwad taluk and 20–24 PDI in Kushtagi. Anthracnose leaf spot (ALS) severity ranged from 8–40 PDI, while Cercospora leaf spot (CLS) severity was notably higher in Dharwad taluk (16–36 PDI) indicating favourable conditions for foliar diseases in these areas (**Fig. 14**). In urdbean, CLS severity ranged from 40–48 PDI and ALS severity from 12–16 PDI in Dharwad taluk, suggesting moderate to high disease pressure. In chickpea, wilt incidence varied widely, ranging from 0–1% in Yelburga to 2–20% in Dharwad taluk. Overall, the survey indicated that mungbean and chickpea were more severely affected by multiple diseases across surveyed districts.

Evaluation of mungbean genotypes against yellow mosaic disease and Anthracnose leaf spot disease

The experiment was carried out to identify resistant donors for YMV and anthracnose leaf spot disease during 2024-25. A total of 234 genotypes were evaluated for yellow mosaic disease. Among 42 entries namely, IPM1620-6, IPM1604-1, IPM1205-1, IPM1711-1, IPM1707-1, IPM21-15-2, IPM21-23- 1, IPM312-18, IPM14-10, IPM1620-6, IPMD18-1, -2, -5, -8, -11, -12, -19, -29, -33,-35, -36, -37,-42, -43, -50, -52, -53, -60, -62, -76, -96,-97,-98, IPMD19-20, -21, -45, IPMD-21-5, IPMD22-3,-5, 13,-14 and -17 were identified as resistant with per cent disease incidence was ranged between 0 to 100%. The susceptible check showed 100 percent incidence and severity of YMV. Another experiment conducted to evaluate 56 advanced breeding lines against anthracnose leaf spot disease under glass house conditions by artificial inoculation. None of the entries were found resistant however, five entries namely, IPMD-16, -26,-38, -53 &-79 were moderately resistant.

Evaluation urdbean genotypes against powdery mildew disease

A total of 243 entries of urdbean were evaluated against powdery mildew disease. Observations were recorded during flowering stage of the crop in which, eight entries namely IPU99-52, UH817, IC24129, PDU19, IPU31-1, IC436583, PLU429 and IC395519 were identified as resistant and seven lines viz., IPU99-190, IC47200, PLU625, No.4812, PLU966, ANU1108, no.5131 were found moderately resistant with percent disease index was ranged between 4.2 to 100%.



Field view of urdbean screening against PM

Evaluation of pigeonpea genotypes against sterility mosaic disease

A total of 178 entries of pigeonpea were evaluated against SMD disease by leaf stapling technique under field conditions. Among which, 10 entries namely, BRG- 1, BRA -303, BRG - 3, IPA 15-2, IPA 203, MAL-13, MAL65, MAL70, NTL 1168, BRG4 were found highly resistant. However

susceptiblecheck ICP8863 showed 100 per cent SMD incidence and resistant check reported less than 10 per cent SMD incidence.



Field view of pigeonpea lines evaluation against SMD

Management of mungbean major fungal foliar diseases through novel fungicides

The experiment was carried out to during 2024-25 at IIPR RRS Dharwad. Ten fungicides were evaluated against powdery mildew (PM), anthracnose leaf spot (ALS), and Cercospora leaf spot (CLS) diseases. All fungicidal treatments were significantly reduced the severity of diseases compared to the untreated control. Among the treatments, **tebuconazole 50% + trifloxystrobin 25% WG** was the most effective, recording the lowest PM (13.3 PDI), ALS (9.3 PDI), and CLS (24.0 PDI), corresponding to maximum disease reduction of 86.3%, 65.2%, and 75.7%, respectively, and the **highest grain yield (1136 kg ha□¹).** This was closely followed by **azoxystrobin 18.2% + difenoconazole 11.4% SC,** which resulted in low disease severity (PM 14.7, ALS 10.7, CLS 22.7 PDI), high disease reduction (84.9–77.0%), and a comparable yield (1129 kg ha□¹). In contrast, carbendazim, thiophanate methyl, carbendazim + mancozeb, mancozeb, and neem 0.3% were comparatively less effective. The control recorded the highest disease severity (PM 97.3, ALS 26.7, CLS 98.7 PDI) and the lowest grain yield (590 kg ha□¹) .

Management of horsegram powdery mildew disease through novel fungicides

The experiment was conducted during 2024-25 at IIPR RRS Dharwad. Ten fungicides including neem oil (5000ppm) were evaluated against powdery mildew (PM) disease. Among the treatments, tebuconazole 50% + trifloxystrobin 25% WG (0.05%) was the most effective, registering the lowest PM severity (9.3 PDI) and higher disease reduction (90.4%), which resulted in the greater yield (1177 kg ha□¹). This was followed by azoxystrobin 18.2% + difenoconazole 11.4% SC, which recorded low PM severity (13.3 PDI), high reduction (86.3%), and a comparable yield (1156 kg ha□¹). The fungicide, fluopyram + tebuconazole also provided effective disease control (84.9% reduction) with a high yield of 1100 kg ha□¹. Other fungicides like carbendazim, thiophanate methyl, mancozeb, and neem-based treatments were less effective. The control recorded the highest PM severity (97.3 PDI) and lower yields (739 kg ha□¹) (**Fig. 19c**). Although propiconazole recorded a relatively higher PM severity (24.0 PDI), it achieved the highest B:C ratio (4.19), indicating better economic returns.

Yield loss assessment due to powdery mildew diseases in Horsegram (Var. CRIDA 18 R)

The experiment was conducted during 2024-25 at IIPR RRS Dharwad. In the experiment, fungicide azoxystrobin (20% W/V) + difenoconazole (12.5% W/V) @ 0.1% used as standard to control powdery mildew disease. Application of fungicide significantly reduced PM severity and minimized yield losses. A single spray reduced PM by 51.2% and produced a yield of 860 kg ha□¹, but still suffered an avoidable yield loss of 271 kg ha□¹ (23.96%), translating to □13,002 ha□¹. Two sprays were more effective, recording 71.5% PM reduction and a higher yield of 1,019 kg ha□¹, with substantially lower avoidable yield loss (112 kg ha□¹; 9.90%) and monetary loss (□5,374 ha□¹). The untreated control recorded the highest PM severity (98.4 PDI) and the lowest grain yield (707 kg ha□¹), resulting in the maximum avoidable yield loss of 424 kg ha□¹ (37.48%) and a corresponding monetary loss of □20,343 ha□¹ in comparison to three sprays of fungicide.

Registration of breeding lines of pigeonpea for sterility mosaic disease resistance

A total of 306 advanced breeding lines were screened through leaf stapling technique. Among which two advanced breeding lines namely, no. 6 and no.16 (pedigree; ICP8863 x Bahar) were identified for PSMD resistance and were proposed for registration. The identified lines were free from sterility mosaic disease however susceptible check ICP8863 showed 100 per cent SMD.



Field view of experiment and proposed resistsny varieties

Project: Population dynamics of emerging insect pests of Vigna pulses (Cowpea, Mungbean and Urdbean) and their management in the Northern Transitional Zone of Karnataka

Monitoring the seasonal incidence of major emerging insect pests of cowpea, mungbean and urdbean

Cowpea

The incidence of pod borers viz., spotted pod borer (*Maruca vitrata)* and seed moth (*Cydia phytchora*) was monitored in cowpea (cv. DC -15) during the kharif season. *M. vitrata* infestation was observed from flower initiation to podding stage, whereas the *C. phytchora* infestation started at pod formation with peak incidence during pod maturity. The flower damage was 57%, number of larvae/flowers was 0.49 and pod damage at maturity stage was 38.7% by spotted pod borer. The pod damage by *C. pytchora* at maturity was 74.7 % with seed damage of 42.3%. At harvest the pod damage by seed moth was 83.2%, with 0.43 no. of larvae /pod, 39.0% seed damage and 11.80 g for 100 seed weight. This clearly indicates that spotted pod borer and cowpea seed moth are two major pod borers infesting the cowpea during *kharif* season with significant pod damage to the crop .

Mungbean

In mungbean crop (cv. IPM 2-14) incidence of foliar thrips was observed during Kharif season. The infestation of thrips was low due to continuous and intermittent rains during cropping period. However, during kharif season incidence of pink pod borer *Cydia pytchora* was observed at the time of podding. The average % pod damage was 89.40, with 0.91 larvae /pod, the seed damage was around 60.6% and the100 seed weight was 2.30 g. *C. pytchora* is one of the emerging pests of mungbean in Dharwad region, when abiotic conditions favorable for its population buildup.

Urdbean

In urdbean (cv. IPU2-43) the incidence of pod weevil *Apion amplum* was monitored on the crop sown during *kharif* season. During the cropping period *A. amplum* infestation was not observed. However, the crop was infested by pink pod borer during pod formation stages. The average % pod damage was 91.09, with 0.48 larvae /pod, the seed damage was around 39.96% and the 100 seed weight was 2.19 g. Pink pod borer *C. pytchora* is one of the emerging pests of Vigna pulses (cowpea, mungbean and urdbean) in Dharwad region, causing significant pod and seed damage when abiotic conditions are favorable for its population buildup .

Estimation of avoidable yield losses by pod borers on cowpea.

In cowpea, a field experiment was conducted to estimate the avoidable yield losses by spotted pod borer *Maruca vitrata* and seed moth/pink pod borer *Cydia pytchora* during *kharif* season. There were four different treatments comprising of different numbers of sprays at flowering and pod formation stages and one control treatment. Among different treatments, the treatment (T_4) with two foliar sprays of chlorantraniliprole 18.5 SC @ 0.5 ml/l at 50% flowering and two sprays of same insecticide at pod maturity stage at 10 days interval reduced the incidence of spotted pod borer to extent of 61.1% over control with lowest pod damge of 23.3% at pod maturity stage. The same treatment also had significant effect on seed moth *Cydia pytchora* and gave over 67% protection against the pest with lowest pod damage of 26.7% and 29.2% at pod maturity and harvest stages of the cowpea crop, respectively. The percent seed damage by seed moth was lowest (31.3%) in this treatment with 62.1% protections over control. Higher grain yield (1290 kg ha^{-1}) was recorded in the plots treated with the above treatment and there was 141.3% increase in cowpea grain yield. Based on the marketable grain yield the avoidable yield loss was estimated and it was observed the above treatment can reduce the loss of cowpea grain yield by the pod borers to the extent of 58.6% as compared to the untreated control.

Management of major insect pests of cowpea using novel insecticides

A field experiment was conducted to evaluate the efficacy of different novel insecticides against major insect pests in cowpea (cv. DC 15) during kharif season. There were eight treatments including untreated control. Two sprays of each insecticide treatment were applied at 50% flowering at 10 days interval. Among different novel molecules evaluated, spinetoram 11.7 SC @ 0.8 ml l^{-1} was found most effective with lower pod damage of 8.33 and 18.0%, this treatment gave 76.2 and 66.7% protection over untreated control against *M vitrata* and cowpea seed moth, respectively. Cyantraniliprole 10.26 OD @ 1.2 ml l^{-1} was next best treatments with 12.3 and 28.7% pod damage and gave 64.7 and 46.9% protection over untreated control, respectively. Cyantraniliprole 10.26 OD @ 1.2 ml l^{-1} was found most effective against black aphids with lowest population (0.50 $plant^{-1}$).



Field Experiment

Imidacloprid 17.8 SL @0.3 ml l^{-1} and Afidopyropen 50 DC@ 1.5 ml l^{-1} were next best treatments with lower aphid population of 2.40 and 9.35 $plant^{-1}$, respectivel. Highest grain yield of 1179 kg ha^{-1} was recorded in treatment spinetoram 11.7 SC followed by cyantraniliprole 10.26 OD (1118 kg ha^{-1}) and afidopyropen 50 DC (1079 kg ha^{-1}) treated plots. Higher cost benefit ratio of 1:1.50 and net returns of Rs 21668 was obtained in cyantraniliprole treatment as compared to the other treatments. Thus, among different novel insecticides, spinetoram 11.7 SC and cyantraniliprole 10.26 OD can be used for the management of spotted pod borer and seed moth whereas cyantraniliprole 10.26 OD and afidopyropen 50 DC may be used for control of black aphid in cowpea.



Cowpea Black Aphid

Screening of cowpea advance breeding lines for pod borers

In cowpea, 22 advance breeding lines including two checks were screened for the pod borer viz., spotted pod borer *Maruca vitrata* and seed moth *Cydia ptychora* during *kharif* season. All the entries of cowpea were susceptible to *M. vitrata* and *C. ptychora* under field conditions. The flower damage by *M. vitrata* was between 50-100%. The pod damage at green pod and maturity stage ranged between 14.89 to 55.77 and 20-90%, respectively in all the lines. Lowest pod damage by *M. vitrata* was recorded in line IPCW 21-413 (4/13) at both green pod and maturity stages of crop with 14.9% and 20%, respectively and found promising for spotted pod borer.

The pod and seed damage by seed moth *C. pytchora* at maturity was between 30-100 % and 20-90 %, respectively, whereas at harvest stage the pod damage and seed ranged between 50.56 to 90 % and 20 to 55%, respectively. Out of 22 advance breeding lines only one-line IPCW 21-413 (4/13) recorded lowest pod (30%) and seed damage (20%) by *C. pytchora*. Based on the % seed damage, the line IPCW 21-413 (4/13) can be categorized as moderately resistant and found promising against for seed moth.

Evaluation of germplasm/lines of cowpea against pod borers of cowpea

In cowpea, 25 entries were screened for spotted pod borer *Maruca vitrata* and seed moth *Cydia ptychora* during *kharif* season. All the entries of cowpea were susceptible to *M. vitrata* under field conditions. The average flower damage by *M vitrata* ranged from 20-90%, with lower damage in CPP 25-16 (20%) and higher damage in CPP 25-11 and CPP-25-20 (90%) entries. The pod damage during maturity stage in all the entries ranged from 30-100%. In 5 entries *viz*., CPP-25-1, CPP25-4, CPP025-12, CPP 25-14 and CPP 25-18 the pod damage by *M. vitrata* was between 21-30%. All the 25 entries of cowpea screened were highly susceptible to seed moth *C pytchora*, the damage at pod maturity stage was between 30-100 %, with lowest pod damage of 30 % in entry CPP 25-7. At the time of harvest per cent pod damage by seed moth ranged between 75.8 to 100% and seed damage from 28-100%. The seed damage less than 30% was recorded in entries CPP25-15 and CPP 25-5 with 28 and 29%, respectively and these entries can be categorized as moderately susceptible.

EXTERNALLY FUNDED PROJECT

DoCA Project on Supply Chain of Pulses in Major Pulse Producing States of India with Focus on Eastern States

Based on highest production of pulse crops in Karnataka, Belagavi, Bidar, Dharwad, Kalaburagi, and Vijayapura Districts were selected for the survey and data collection. For each pulse crop, the top two producing districts were selected. The sample size in each selected districts consist of two blocks, two mandis and two villages in each block with 30 farmers in each village. The selection of villages and markets was finalized based on the highest levels of production and market arrivals. The wholesale market prices and arrivals data for pigeonpea, blackgram, mungbean, and chickpea were collected

from AGMARKNET for the period 2012 to 2025. Structured proformas were prepared and exclusively reviewed for farmers and different stakeholders, namely Aggregators, traders, Processors, Wholesalers, Retailers, Govt. officials and Consumers. The finalized proformas were converted into Google Forms to facilitate efficient data entry and management after the field surveys.

In Dharwad district, a field survey was conducted for data collection on mungbean and chickpea crops in two talukas and APMCs viz., Dharwad and Hubli. In Dharwad Taluk, data was collected from villages, Garag, Aminbhavi and Dharwad APMC. In Garag village, data was collected from 40 farmers, of which 20 farmers cultivated both mungbean and chickpea, while the remaining 20 farmers cultivated either mungbean or chickpea. In Aminbhavi village, data were collected from 30 farmers cultivating mungbean and chickpea. RSK and Panchayat offices of the villages were also visited for secondary information.

In Hubballi Taluk, data was collected from villages Shirguppi, Byahatti and Hubballi APMC. In Shirguppi village, information was collected from 30 farmers cultivating mungbean and chickpea, whereas in Byahatti village, data was collected from 30 farmers cultivating mungbean and chickpea .

EXTENSION ACTIVITIES

Viksit Krishi Sankalp Abhiyan (VKSA):

All the staff Participated in Flag ship Program "Viksit Krishi Sankalp Abhiyan (VKSA)" for Pre Kharif- Campaign 2025 held at ICAR-KVK, Gangavathi, Koppal, ICAR-KVK, Gadag, ICAR-KVK, Kalaburagi and ICAR-KVK, Yadgir during 29th May to June 12, 2025. During the campaign scientists of ICAR IIPR with KVK staff visited different villages and interacted with farmers. Appraised the farmers about the importance of pulses in the cropping system, IIPR technologies and plant protection measures in different pulse crops.

Participation in *Krishi mela* held at UAS Dharwad

Scientists of the ICAR-IIPR Regional Station Dharwad participated in the "*Krishi mela*" held at UAS Dharwad from 13th-16th September 2025, under the theme "Soil Health and Traditional Varieties for Nutritional Food Security"

Front line demonstrations conducted: Conducted Front-line demonstrations in urdbean, horsegram and chickpea were taken up in the farmers' fields of Narendra, Rayapur, Yettinagudda, Mangalgatti villages of Dharwad district, Beldahadi Tanda of Gadag district and during *kharif/rabi/* summer seasons of 2025.



Scientists of ICAR-IIPR participated in Viksit Krishi Sankalp Abhiyan in Karnataka



Participation in *Krishi mela* by the scientists of ICAR-IIPR, RRS held at UAS Dharwad

SCSP plan: During *rabi* season of 2025-26 demonstrations with chickpea seeds (BGD-111-1) alon with Microbial Consortium, *Trichoderma* and Micronutrient Mixture were distributed to 100 SC farmers under SCSP program (**Fig. 36**).

Parthenium awareness week

A Parthenium Awareness Programme week was organized at ICAR-Indian Institute of Pulses Research, Regional Research Station (RRS), Dharwad, highlighting the growing threat of *Parthenium hysterophorus* and the importance of its eradication. Under this awareness programme cleanliness drive was organized on 21st August 2025 .

Nature Swacchata-Sanskar Swacchata programme under Swacchata Hi Sewa Campaign- (17/09/2025 to 01/10/2025)

The *Swachhta Hi Seva* Campaign 2025 is being observed across the country from 17th September to 1st October 2025 with the theme "Swachhotsav (स्वच्छोत्सव)" was celebrated at ICAR-IIPR, RRS Dharwad .

Swachh Bharat Diwas celebrated on 02/10/2025 under Swachhata hi seva campaign held at ICAR-IIPR, RRS Dharwad

The Swachh Bharat Diwas on 2nd October 2025 under Swahhata Hi Seva Campaign with the theme "Swachhotsav (स्वच्छोत्सव)" with active participation from all staff members through a **shramdaan programme.** The programme began with **puja of Mahatma Gandhi's photo** to pay tribute to the Father of the Nation at ICAR-IIPR RRS Dharwad

Rashtriya Ekta Diwas (National Unity Day)

The Rashtriya Ekta Diwas was celebrated at the ICAR-IIPR, RRS, Dharwad at 3.30 PM on 31.10.2025. All the Scientific staff i.e. Dr. S. L. Patil, Principal Scientist and Officer-in-Charge of ICAR-IIPR, RRS, Dharwad, Dr. M. H. Kodandaram, Principal Scientist (Entomology), Dr. P. R. Saabale, Senior Scientist (Plant Pathology); Dr. Revanappa S. B., Senior Scientist (Genetics and Plant Breeding), Dr. Manu B., Scientist (Genetics and Plant Breeding), Young Professionals and Skilled workers were present.

Vigilance Awareness Week (27.10.2025-2.11.2025)

The Vigilance awareness week meeting was conducted at the ICAR-IIPR, RRS, Dharwad at 11.00 AM on 27.10.2025. The event began with an address by Dr. S.L. Patil, Principal Scientist and Officer-In-Charge highlighted the importance of honesty, transparency, and ethical conduct in both professional and personal life. He emphasized that corruption-free work culture is essential for institutional growth and for maintaining public trust in government organizations .

Commemoration of 150 years of Vande Mataram

The *Vande Mataram Campaign* was observed with great patriotic fervour at **ICAR–IIPR, Regional Research Station, Dharwad** on **07th November 2025**. The event aimed to inspire unity, national pride, and respect for the motherland among all employees. The programme began with the rendition of the national song **"Vande Mataram",** followed by an address from **Dr. S.L. Patil,** Principal Scientist and Officer-In-Charge, ICAR-IIPR RRS, Dharwad. In his speech, he emphasized the significance of *Vande Mataram* as a symbol of India's freedom struggle and unity in diversity.

Celebration of Constitution Day (Samvidhan Diwas) on 26.11.2025

Samvidhan Diwas (Constitution Day) was observed at **ICAR–Indian Institute of Pulses Research, Regional Research Station, Dharwad** on **26th November 2025** to commemorate the adoption of the Constitution of India. The programme aimed to create awareness about the values, ideals and responsibilities enshrined in the Constitution. All scientific, technical, administrative and supporting staff participated in the Preamble reading and expressed their commitment to the ideals of the Constitution.

Training programme conducted: two training programs on *"Improved Cultivation Practices for Kharif Pulses"* for SC farmers of Beladhadi Tanda of Gadag.

IIPR, Regional Centre, Bikaner

Research achievements

Project: Genetic enhancement in arid pulses for abiotic and biotic stresses: Mothbean and Cowpea

Mothbean station trial: Twenty mothbean genotypes were evaluated in RBD under rainfed condition with three local checks RMO 2251, RMO 225 and RMO 435. Accessions IC 8311-A, IC 415127, IC 102283, IC 402286, IC 140616 were identified as drought tolerant as these accessions were out yielded (8-20%) than the best check (RMO 225, yield 415 kg/ha) in rainfed conditions.

Mutation breeding trials

M_1 generation: 300 gm seed of CAZRI Moth 2 variety was treated on GR50- 400 Gy. Seeds were space planted, out of them only 120 seedlings were reached at maturity. Seeds were harvested from 98 fertile plants individually for further advancement.

M_3 generation: In M_3 generation of RMO 225 and RMO 435 individual plant progeny rows were grown. Superior plants were tagged and data were recorded on days to first flowering, days to maturity, number of branch per plant, number of pods per plant, number of seeds per pod, pod length, test weight and yield per plant. Desirable mutants (67 spp in RMO 225 and 55 spp in RMO 435) were harvested individually at maturity, out of them, 27 mutants in RMO 225 and 31 mutants in RMO 435 were showing yield improvement 1.02-87% in RMO 225 and 1.70-94% in RMO 435 over their respective checks.

Yield evaluation trials

Cowpea station trial-1- Station trial was conducted with a set of 9 entries with two checks (PL 4, RC 101). Yield was evaluated and seven entries were identified superior to the best check (RC 101). The yield was varied from 550 to 1024 kg/ ha.

Cowpea station trial-2- In this replicated trial, 12 entries were evaluated for yield with two checks (PL 4 and RC 101). Five entries were identified superior to the best check (PL 4). Yield was varied from 350 to 880 kg/ha.

PYT-1: Forty-two cowpea entries were tested in preliminary yield trial for yield evaluation with two checks (PL 4 and RC 101). Promising entries will be promoted to station trial.

PYT-2: Another set of 44 cowpea entries comprised of nine different crosses was evaluated with two checks (RC 19, RC 101) in augmented design for yield evaluation. promising entries will be evaluated in station trial.

Advancement of segregating generations:

In F_4 generation, 121 spp of seven crosses (PL 4 x PL 3) x PL 4, EC 724615 x PL 4, ((GP 12 x EC 724306) x GP 12), EC 72306 x (GP 12 x EC 724306), GC 5 x PL 4, RC 101 XEC 724587, PL 4 x GOA Cowpea 3 were evaluated in arid environment and desirable 107 spp were selected on the basis of plant type, earliness, number of pods/plant, plant twining, pod shattering and plant height basis. In F_5 generation, material consisting of 17 different crosses were advanced to next generation, out of 217 spps, 167 sps were selected on the basis of desirability to arid environmental condition of this region.

In F_6 generation, 84 lines of ten crosses (PL 4 x PL 3, GP 11 x PL 4, GP 60 x GP 7, EC 724615 x PL 4, Goa Cowpea 3 x RC 101, PL 4 x GP 65, RC 101 x Palmyard bean, Palmyard bean x PL 4, RC 19 x PL 14, PL 4 x Palmyard bean) were evaluated and 62 superior lines were advanced. In F_7 generation, selections were made in 79 lines of nine crosses (PL 4 x PL 3, GP 11 x PL 4, GP 60 x GP 7, EC 724527 x PL 4, GC 6 x PL 4, PL 4 x GP 65, RC 101 x Palmyard bean). 49 promising lines will be evaluated in PYT.

Chickpea BARC trial

Yield evaluation trial of BARC ABLs: Twelve advance breeding lines with three checks, RSG 888, GNG 1581, GNG 2144 were evaluated for heat stress in two dates of sowing (early and late sown condition). Data were recorded on days to 50% flowering, days to maturity, plant height, number of branches/plant, number of pods/plant, number of seeds/pod, test weight, yield/ plant, biomass/plant and yield/plot. Among the tested genotypes, three lines TICJG 18, TICJG 29, and TICJG 49 maintained high yield under late-sown (heat-stress) conditions compared to the accompanying checks and showed minimum yield reduction relative to timely-sown conditions.

M_2 generation of GNG 1958 and HC 5: In GNG 1958 (300 Gy), 720 individual plant progenies were screened for thermotolerance in late sown condition. Checks were repeated after 10 lines. Morphological mutants (8) were identified on flower colour, leaf size and stem colour. For thermotolerance, early flowering plants (192) were tagged and data were recorded on yield and yield

attributing traits. Sixty-one thermotolerant single plants were advanced to next generation.



White flower mutant

In HC 5 (350 Gy), 1,050 individual plant progenies were grown and screened for thermotolerance in late sown condition. Checks were repeated after 10 lines. Morphological mutants (9) were identified on flower colour, leaf size and stem colour. For thermotolerance, early flowering plants were tagged and data were recorded on yield and yield attributing traits. 192 thermotolerant single plants were advanced to next generation.

M_3 generation of JG 14 and RSG 888: M_3 lines of JG 14 were screened for thermotolerance under late sown condition. 137 single plant progenies were grown in augmented design. Checks were repeated after 10 mutant lines. Single plants were tagged on the basis of early flowering, other data on yield and yield related traits were also recorded. Out of them, 38 thermotolerant plants were identified. M_3 lines of cultivar RSG 888 were screened for thermotolerance under late sown condition. Data were recorded on yield and yield attributing traits. Out of 87 lines, 27 lines were identified thermotolerant.

Breeding material shared in AICRP:

Cowpea: IVT - IPCPB 2024-3, IPCPB 2024-7

AVT- IPC WP 2022-6, IPC WP 2022-8

Chickpea: IVT – TICJG 18 and TICJG 29

Project: Enhancing productivity and resource use efficiency of arid pulses through agronomic management in arid region

Acetic acid-mediated enhancement of physiological, biochemical characteristics and productivity of mothbean (*Vigna aconitifolia* (Jacq.) Marechal) under hot arid conditions

The study investigates the potential of acetic acid (AA) applied through seed priming and foliar spray in enhancing stress resilience in mothbean (*Vigna aconitifolia*) under hot arid conditions. A field experiment was conducted for two years for evaluation of acetic acid application time and levels on stress tolerance in mothbean. Treatments included seed priming with AA (5 and 10 mM), foliar sprays (25 and 50 mM), and their combinations, with non-primed and water-treated controls kept for comparison. Results revealed significant enhancement in chlorophyll content, carotenoids, relative water content, antioxidant enzyme activity, and proline accumulation, along with a reduction in lipid peroxidation. The combined application of 10 mM AA seed priming + 25 mM foliar spray recorded the highest seed yield (10.12 q/ha), representing a 14.4% increase over the non-primed control (8.85 q/ha). Moderate AA doses proved more effective than higher concentrations, which occasionally induced mild stress symptoms. The findings establish acetic acid as a cost-effective, eco-friendly biostimulant for improving moisture stress resilience and productivity in mothbean under hot arid agro-ecosystems.

Low-dose acetic acid application improves growth, stress physiology and yield of mungbean (*Vigna radiata* L.) in hot arid region of India

Enhancing stress resilience and productivity in mungbean under moisture scarcity of rainfed arid regions remains a pressing challenge. Acetic acid (AA) is gaining attention as a low-cost agronomic input to improve crop performance under moisture-limited conditions. This study investigated the effects of AA concentration (25, and 50 mM) and application methods, *i.e.* seed soaking, foliar spray, and their combination on the growth, physiological traits, and yield of mungbean (*Vigna radiata*) under rainfed conditions. Results revealed that AA at 25 mM, particularly when applied as a foliar spray or combined with seed soaking, significantly improved plant height, leaf area index, dry matter accumulation, nodulation, chlorophyll content, and antioxidant enzyme activities ($p<0.05$). The most pronounced effect was observed with combined application of AA through seed soaking 10mM + foliar spray 25 mM, which resulted in higher relative water content and membrane stability, nitrate reductase activity, and reduced oxidative stress index. Reproductive attributes, including flowering duration, flower number, and pod fertilization efficiency, were significantly improved under low dose AA (25 mM) application. Yield was increased up to 10.32 q/ha under AA 25 mM (SS + foliar), representing a 15.4% gain over control and it was at

par with 50 mM AA, indicating no extra benefit with additional dose and greater efficiency at the lower dose. Our study concluded that acetic acid has strong potential as a sustainable low-cost biostimulant to improve drought resilience and productivity of mungbean in hot arid conditions.

Identification of suitable intercropping system and row ratio for pulses cultivation in arid region

A field experiment was conducted to evaluate the intercropping of CB and MB with PM in three different row ratios in replacement series of intercropping. Our hypothesis was that we can add pulses in the existing prominent crop sequence since PM is a major *kharif* crop of arid region. In the *kharif* season, three sole crops of PM, CB and MB were kept and nine treatment combination were taken for comparison. The experiment was conducted in RBD during *kharif* season and in the *rabi* season, all the plots were distributed in two equal parts and mustard and chickpea crop was taken in cropping sequence in all the treatments of *kharif* season to see the residual effect of *kharif* crops on mustard and chickpea. Results of the study revealed that all the crops performed better in sole stand as per their respective intercropping and row ratio, among I/c systems, PM performed better with MB especially in 1:1 row ratio, the yield of PM in PM+MB intercropping was 19.9% higher as compared to PM+CB, irrespective of the row ratios. This might be due to higher competition of CB with PM. MB and CB as intercrops performed better in 1:3 row ratio and poor in 1:1 row ratio, The seed yield of mothbean (MB) in the 1:3 row ratio was 71.8% higher than in the 1:1 ratio, while the seed yield of clusterbean (CB) increased by 64.9% in 1:3 over 1:1 row ratio, indicating improved intercrop performance at higher legume representation. Sustainable Yield Index (SYI) was also the highest in PM+CB (1:3) (0.778), indicating not just productivity but also greater temporal stability in system performance. To compare the yields, PMEY was calculated and it was found that CB outperformed the MB because of its higher yield potential and as per the total yield, PM+CB (1:3) was the most productive system followed by PM+MB (1:3).

Effect of acetic acid and aminolaevulinic acid levels on performance of chickpea cultivars sown at different sowing time in arid environment

A field experiment in *Rabi* was conducted to assess the effect of acetic acid (AA) and aminolaevulinic acid (ALA) in different application rate on different cultivars of chickpea under three sowing times. Three varieties of chickpea *viz*. RSG 888 (drought tolerant), IPC 11-112 (irrigated), and IPCL 04-14 (drought tolerant); 3 sowing time *i.e.* 25 October, 10 November, and 25 November and PBRs namely acetic acid (@ 25 mM and 50 mM) and 5-aminolevulinic acid (ALA) (@ 25 mg/l and 50 mg/l) was tested and applied as foliar spray at vegetative, flower initiation and pod initiation stage. Sowing time had a significant influence on growth and yield traits of chickpea. Among the three sowing dates, early sowing on 25th October resulted in the highest values for plant height (45.1 cm), number of pods per plant (32.3), number of seeds per pod (1.86), filled pods per plant (30.8), 100-seed weight (21.4 g), and seed yield (16.9 q/ha). Compared to 10th November and 25th November sowing, this represented an

Seed yield of pearl millet, mothbean, clusterbean, pearl millet equivalent yield (PMEY), total yield (TY) of sole and different intercropping systems of pearl millet, clusterbean and mothbean Intercropping systems PMMBCB Mean yield

Intercropping systems	PM	MB	CB	Mean yield (q/ha)	SD (σ)	SYI
PMS	12.11	-	-	12.64	0.49	0.647
MBS	-	7.83	-	7.15	0.88	0.336
CBS	-	-	10.66	10.90	0.74	0.543
PM+MB (1:1)	9.46	3.95		13.35	1.29	0.642
PM+MB (1:2)	8.14	5.84		14.10	0.58	0.718
PM+MB (1:3)	7.80	6.48		14.30	0.33	0.755
PM+CB (1:1)	8.26	-	5.45	14.99	2.09	0.711
PM+CB (1:2)	6.61	-	7.38	16.27	1.72	0.753
PM+CB (1:3)	6.12	-	8.86	17.39	1.60	0.778
LSD ($p \leq 0.05$)				0.91	-	0.022

increase in seed yield by 11.9% and 45.7%, respectively. Delayed sowing (25th November) led to a marked reduction in all traits, with the lowest number of filled pods (12.2) and seed yield (11.6 q/ha), likely due to terminal stress conditions during the reproductive phase. Among the genotypes, RSG 888 exhibited superior performance, recording the highest number of pods per plant (33.1), seeds per pod (2.12), filled pods per plant (29.4), 100-seed weight (23.2 g), and seed yield (18.2 q/ha). Compared to IPCL 04-14 and IPC 11-112, the seed yield of RSG 888 was higher by 20.5% and 76.7%, respectively. Application of ALA 50 mM resulted in the highest seed yield (15.9 q/ha), which was 20.5% higher than the untreated control, and also outperformed Acetic Acid (AA) 50 mM in all key traits. The results suggest that ALA enhances plant growth by improving photosynthetic efficiency, stress resilience, and pod filling, especially under heat and drought-prone environments. Therefore, foliar application of 5-Aminolevulinic Acid at 50 mM concentration is recommended as the most suitable plant growth regulator for improving chickpea performance in arid regions.

Project: Exploring agronomic interventions for sustainable pulses productivity in arid region

Harnessing natural plant extracts to boost stress tolerance and pulse productivity in arid regions

The field experiment was conducted on mothbean to evaluate the effect of moringa leaf extract (MLE) and Salvadora leaf extract (SLE) applied through seed soaking and foliar spray. The experiment aimed to assess the influence of these biostimulant-based interventions on the growth and productivity of mothbean under field conditions. The study was laid out in a Randomized Block Design (RBD) with three replications. Eight treatments were tested, including Control, Water spray, moringa leaf extract (MLE) as seed soaking (5%), MLE as foliar spray (10%), Salvadora leaf extract (SLE) as seed soaking (5%), SLE as foliar spray (10%), MLE as combined seed soaking and foliar spray, and SLE as combined seed soaking and foliar spray. In the seed soaking treatments, seeds were soaked in the respective leaf extract solutions prior to sowing, whereas foliar spray treatments involved application at the critical crop growth stage. Results revealed that application of biostimulants significantly influenced seed yield of mothbean ($P < 0.01$). The highest seed yield of 9.89 t/ha was recorded with combined application of MLE as seed soaking at 5% + foliar spray at 10%, which was 11.3% higher than the untreated control (8.89 t/ha) and statistically superior to all other treatments. Seed soaking with MLE 5% alone and foliar application of SLE at 10% also produced significantly higher yields than the control, with increases of 7.8% and 7.2%, respectively. Water spray alone registered only a marginal improvement over the control. Thus, integrated application of MLE (seed soaking + foliar spray) emerged as the most effective practice for enhancing productivity of mothbean under moisture-deficit conditions of the arid region.

Effect of clusterbean-based cropping system and moisture management practices on productivity and soil health in arid region

A field experiment was conducted during the *rabi* season of 2024–25 at the research farm of the ICAR-Indian Institute of Pulses Research, Regional Centre, Bikaner to evaluate the residual effect of clusterbean-based cropping systems and different moisture conservation practices on productivity of succeeding *rabi* crops and soil health under arid conditions. The experiment was laid out in a factorial randomized complete block design with three replications. The main plot treatments comprised three preceding *kharif* cropping systems, *viz.*, Clusterbean–Wheat, Clusterbean–Indian mustard, and Clusterbean–Chickpea, while the sub-plot treatments consisted of six moisture conservation practices, namely, no mulch (control), organic mulching with locally available grasses and bushes @ 5 t/ha, biochar mulching (mustard stover biochar) @ 5 t/ha, soil application of super absorbent polymer (SAP) @ 2.5 kg/ ha, organic mulch + SAP @ 2.5 kg/ha, and biochar mulch + SAP @ 2.5 kg/ha. The succeeding *rabi* crops (wheat, mustard, and chickpea) were sown on residual soil moisture and fertility after the harvest of clusterbean in *kharif* 2025. Results of the study revealed that combined application of biochar mulching + SAP @ 2.5 kg/ha recorded the highest seed yield which was 11.8% higher than the no-mulch control and superior to all other practices. It was closely followed by organic mulch + SAP. Organic mulching and biochar mulching alone were statistically at par with each other and produced 3.9–4.6 % higher yield than no mulch. Thus, under rainfed conditions of the hot arid region, biochar mulching combined with soil application of super absorbent polymer (SAP) @ 2.5 kg/ ha emerged as the effective moisture conservation practice for realizing higher productivity of clusterbean and creating favourable soil moisture regime for the succeeding *rabi* crops.





Project: Development of pulses-based natural farming system for enhancing the sustainability of ecosystem

A long-term experiment was initiated in 2022-23 to evaluate the performance of clusterbean (RGC 1033), mothbean (RMO 435) and pearl millet under four farming practices like control (Labour for weeding and other operations), Natural farming-NF (*Beejamrit*+*Ghanjeevamrit* @ 250 kg/ha + *Jeevamrit* @ 500 l/ha with irrigation twice in a month +straw mulch @ 5 t/ha +Whapasa irrigation, Organic farming-OF (FYM+VC+NC+PG+Rock phosphate as per the recommended dose of nutrients) and Recommended Farming Practice-RFP (Use of Chemical fertilizers, herbicides, pesticides and other operations). The experiment was laid out in a randomised block design (RBD) and replicated thrice. Result of the study revealed that the chickpea equivalent yield (CEY) was significantly influenced by the preceding *kharif* season cropping system and the *rabi* intercropping pattern. When pearl millet (PM) sole was grown in the *kharif* season, the CP + B 4:2 intercropping system recorded the highest CEY, followed by chickpea sole cropping. However, when legume-based intercropping (*e.g.*, clusterbean or mothbean with pearl millet) was adopted during the *kharif* season, a substantial improvement in *rabi* crop productivity was observed.The RDF treatment recorded the highest yield, with an 18.1% increase over control. NF and OF treatments also showed substantial improvements, with yields 7.3% higher than control, and were statistically at par with RDF. This indicates that Natural Farming and Organic farming-based management can sustain pulses based cropping system productivity comparable to conventional fertilization in arid soils.

Sub Project: Enhancing input use efficiency and productivity of pulses in arid ecosystem

Activity I: Tillage, residue and nutrient management in different cropping system under arid ecosystem

A field experiment was initiated during the *kharif* season of 2020 to investigate the impact of different cropping systems under conservation agriculture practices in an arid ecosystem. The experimental layout followed a split-plot design with three replications, facilitating robust statistical evaluation. The main-plot treatments comprised three tillage management strategies: (i) conventional tillage applied to both *kharif* and *rabi* crops (CT-CT), (ii) conventional tillage for *kharif* crops followed by zero tillage with residue retention for *rabi* crops (CT-ZT), and (iii) zero tillage for both *kharif* and *rabi* crops with residue retention (ZT-ZT). Sub-plots were allocated to two specific cropping systems: pearl millet–chickpea and clusterbean–mustard. Further, two nutrient management regimes were assigned to sub-sub-plots: 100% of the recommended dose of fertilizer (RDF) for both seasons, and 75% of RDF for both seasons. Experimental results indicated that, during the initial years up to 2022–23, grain yield was not significantly affected by tillage management treatments. However, from the fourth year (2023–24) onwards, grain yield was significantly higher under the ZT-ZT treatment as compared to the CT-CT

Chickpea equivalent yield (q/ha) of cropping systems under different management practices during *rabi* season

	PM sole			**PM+MB (1:3)**			**PM+CB (1:3)**		
	CP sole	CP+M (6:1)	CP+B (4:2)	CP sole	CP+M (6:1)	CP+B (4:2)	CP sole	CP+M (6:1)	CP+B (4:2)
Control	12.20b	9.28b	12.35b	12.35b	13.57c	12.70c	12.40c	13.75c	12.85c
RDF	14.40a	9.88a	14.97a	14.55a	16.08a	15.33a	14.60a	16.26a	15.48a
NF	13.00ab	9.53ab	13.33ab	13.15ab	14.50b	13.68bc	13.20bc	14.68bc	13.83b
OF	13.15ab	9.50a	13.50a	13.30a	14.63b	13.85b	13.35b	14.81b	14.01b

treatment in both the seasons. Analysis further revealed a significant cropping system effect, with the clusterbean–mustard system consistently achieving greater increases in grain yield than the pearl millet–chickpea system. Regarding nutrient management, application of 100% RDF produced significantly higher yields compared to 75% RDF in 2020–21; however, in subsequent years (2021–22 through 2024–25), yields under the 75% RDF treatment were statistically comparable to those observed with 100% RDF application.

System productivity, as measured by chickpea equivalent yield (CEY), was significantly influenced by tillage management practices. The highest CEY (2,555 kg/ha) was observed under the zero tillage for both *kharif* and *rabi* crops with residue retention (ZT-ZT) treatment, outperforming both the conventional tillage in both the seasons (CT-CT) and conventional tillage followed by zero tillage (CT-ZT) practices. Regarding cropping system, the clusterbean–mustard combination demonstrated a significantly greater CEY (2,653 kg/ha) compared to the pearl millet–chickpea system. Furthermore, the application of 75% of the recommended dose of fertilizer (RDF) yielded system productivity statistically equivalent to that achieved with 100% RDF.

Net returns and benefit-cost ratio (BCR) were significantly higher under the zero tillage with residue retention for both *kharif* and *rabi* crops (ZT-ZT) treatment, followed sequentially by conventional tillage for *kharif* and zero tillage for *rabi* crops (CT-ZT), and conventional tillage for both the seasons (CT-CT). Among the cropping systems evaluated, the clusterbean–mustard system proved more economically lucrative than the pearl millet–chickpea system. Regarding nutrient management, although the 100% recommended dose of fertilizer (RDF) yielded a higher net return compared to 75% RDF, the difference was not statistically significant. Conversely, the benefit-cost ratio was significantly greater under 75% RDF compared to 100% RDF, indicating more efficient economic returns at the lower fertilizer input level

Soil organic carbon content and dehydrogenase enzyme activity were significantly greater under the zero tillage with residue retention treatment for both *kharif* and *rabi* crops (ZT-ZT), followed by the conventional tillage-zero tillage combination (CT-ZT), and the lowest under conventional tillage in both the seasons (CT-CT). Among the cropping systems, the pearl millet–chickpea system enhanced soil health more effectively, exhibiting higher soil organic carbon content and dehydrogenase activity compared to the clusterbean–mustard system. Furthermore, nutrient management with 100% of the recommended dose of fertilizer (RDF) resulted in higher soil organic carbon and dehydrogenase activity than the 75% RDF treatment.

Zero tillage (ZT) consistently outperformed conventional tillage (CT) in enhancing soil microbial properties and system productivity. The ZT–ZT treatment recorded a 20.8% increase in microbial biomass carbon, along with 44.4% and 46.7% higher bacterial and fungal populations, respectively, compared to CT–CT. Nutrient management further influenced microbial activity, with 100% recommended fertilizer dose (RDF) sustaining significantly higher microbial biomass (12%) and microbial populations (20%) than 75% RDF. Cropping system effects were also evident, as pearl millet–chickpea rotation favoured higher microbial counts than clusterbean–mustard. From an energy perspective, ZT improved output by 20.8% over CT but lowered energy efficiency ratio by 5.6% due to higher energy inputs. The pearl millet–chickpea system demonstrated 4.1% greater energy efficiency over clusterbean–mustard, likely due to biological nitrogen fixation. Interestingly, 75% RDF enhanced energy efficiency (1.8%) compared to 100% RDF, suggesting that excessive fertilizer use reduces efficiency without proportional productivity gains.

Activity II: Irrigation and nitrogen management in arid legumes

Exp: I - Irrigation and nitrogen management in mungbean

A field experiment was conducted during the *kharif* season of 2024 to evaluate the effect of nitrogen and irrigation management on nutrient- and water-use efficiency in mungbean *(Vigna radiata* L.) under arid conditions. The experiment was laid out in a factorial randomized block design (FRBD) with three replications, comprising three nitrogen management practices and three irrigation regimes. The treatment consist of three level of nitrogen management (N_1: 15 kg N + 40 kg P_2O_5 + foliar spray of urea (2%) at flowering stage, N_2: 15 kg N + 40 kg P_2O_5 + foliar spray of urea (2%) at pod development stage and N_3: 15 kg N + 40 kg P_2O_5 + foliar spray of urea (2%) at flowering and pod development stages) and three level of irrigation management (I_1: single irrigation at branching stage, I_2: two irrigation at branching + pod development stage and I_3: two irrigation at flowering + pod development stages) under factorial randomized block deign with three

replications. The results indicated that N_3 (15 kg N + 40 kg P_2O_5 + foliar spray of 2% urea at both flowering and pod development stages) significantly improved grain yield compared with N_1 and N_2. Among irrigation treatments, I_2 (two irrigations at branching + pod development stages) recorded the highest yield, followed by I_3 (two irrigations at flowering + pod development stages), while I_1 (single irrigation at branching stage) resulted in the lowest yield.

Economic analysis revealed that both net return and benefit-cost ratio (BCR) were significantly influenced by nitrogen management. The maximum net return and BCR were obtained under N_3, demonstrating the advantage of split foliar urea application at critical growth stages. Similarly, irrigation at two critical stages (branching + pod development or flowering + pod development) significantly outperformed single irrigation at branching stage in terms of profitability.

Water productivity was significantly enhanced with the foliar application of urea at two critical growth stages, namely flowering and pod formation, compared with a single foliar spray applied either at the flowering or pod formation stage alone. Irrigation scheduling also exerted a notable influence on water productivity in mungbean. Both physical and economic water productivity were significantly higher under irrigation applied twice at branching/vegetative + pod formation stages or at flowering + pod formation stages than with a single irrigation at the branching/vegetative stage.

Project: Organic farming in pulses and its cropping system with technological interventions in arid ecosystem of western plains

A field experiment was initiated during the *kharif* 2023 season to evaluate the performance of different cropping systems under organic farming practices in an arid ecosystem. The experiment was laid out in a split-plot design with three replications. The main plots comprised three nutrient and crop management practices: (i) organic management (100% recommended dose of fertilizers (RDF) supplied through farmyard manure, vermicompost, neem cake, biofertilizers, and rock phosphate), (ii) inorganic management (100% RDF through chemical fertilizers along with recommended pesticides and herbicides), and (iii) integrated nutrient management (50% RDF through inorganic fertilizers + 50% RDF through organic manures). The subplots included two cropping systems: pearl millet–chickpea and clusterbean–mustard.

Results indicated that nutrient and crop management practices did not cause statistically significant differences in the yield of component crops. However, a trend was observed wherein organic management produced relatively higher grain and biomass yields, followed by inorganic and integrated management practices. Furthermore, the cluster bean–mustard system recorded higher grain yield, biomass yield, and chickpea equivalent yield (CEY) compared to the pearl millet–chickpea system during the *kharif* season. In contrast, during the *rabi* season, no significant differences were observed in grain yield and CEY across treatments.

System productivity, expressed in terms of chickpea equivalent yield (CEY), was not significantly influenced by the different organic farming practices. Similarly, net returns and the benefit–cost (B:C) ratio of the system did not show significant variation across the nutrient management approaches. However, the cropping system effect was evident, as the clusterbean–mustard rotation recorded significantly higher CEY compared to the pearl millet–chickpea system. Correspondingly, the cluster bean–mustard system also generated higher economic returns and a more favourable B:C ratio,

Effect of organic farming practices on yield of component crops

Treatment	Yield (kg/ha)					
	Kharif crops			*Rabi* crops		
	Grain	Biomass	CEY	Grain	Biomass	CEY
Nutrient Management						
Organic practices	1,407	4,533	881	1,853	7,476	1,897
Inorganic practices	1,444	4,704	912	1,691	6,528	1,723
Integrated practices	1,326	4,159	835	1,583	6,161	1,615
CD (P=0.5)	NS	NS	NS	NS	NS	NS
Cropping System						
Pearl millet -chickpea	1,556	4,810	715	1,545	4,843	1,545
Clusterbean -mustard	1,228	4,121	1,036	1,873	8,600	1,945
CD (P=0.5)	173	509	121	NS	1,974	NS

demonstrating its superiority over the pearl millet–chickpea system in terms of both productivity and profitability.

Project: Improving soil health and minimizing the yield gap in pulses through resource conservation technologies in arid ecosystem

Experiment 1. Effect of tillage and residue on productivity and sustainability of pulse inclusive cropping systems

A field experiment was initiated at the ICAR-IIPR, RRC, Bikaner research farm in *rabi* 2020 to evaluate the performance, economics, input use efficiency and weed dynamics of four different cropping systems (Pearl millet – Mustard, Pearl millet – Chickpea, Motbean – Mustard, Cowpea – Chickpea) under two tillage (conventional and zero tillage) and residue management (with and without residue) options in a split- split plot design.

Weed Dynamics: Zero tillage demonstrated significant efficacy in weed suppression, reducing weed density by 28.5% during *kharif* and 16.1% in *rabi* seasons compared to conventional tillage. Crop residue retention complemented this effect, contributing to 4.2% reduction in *kharif* and a more pronounced 17.5% decrease in *rabi* season weed density. The Cowpea–Chickpea system exhibited superior weed-smothering capacity during *kharif*, while Pearl millet–Mustard proved the most effective in *rabi* season. The predominant weed flora comprised *Dactyloctenium aegyptium* and *Cenchrus biflorus* in *kharif*, with *Chenopodium* spp. dominating *rabi* season. These findings underscore the synergistic potential of integrating pulse crops with conservation agriculture practices for effective weed management in arid agroecosystems.

System Productivity: System productivity, expressed as chickpea equivalent yield, was significantly influenced by cropping system and residue management, though tillage effects remained statistically non-significant. The Mothbean–Mustard system achieved superior productivity (2,370 kg/ha), representing a 10% advantage over Pearl millet–Mustard (2154.79 kg/ha). Residue retention enhanced system productivity by 18.76% compared to residue removal (2015.28 kg/ha). A significant tillage × residue interaction revealed that zero tillage combined with residue retention in the Mothbean–Mustard system optimized productivity outcomes.

Energy efficiency and economic returns: While conventional tillage yielded higher net energy due to superior yields, zero tillage demonstrated environmental superiority through substantially reduced energy inputs and fossil fuel consumption. Pearl millet-based systems exhibited higher energy efficiency among cropping systems. Residue incorporation contributed renewable energy but resulted in lower energy use efficiency (1.17) compared to residue removal (4.81), attributed to differential energy input requirements. Economically, zero tillage demonstrated superior efficiency with a benefit-cost ratio of 1.99 *versus* conventional tillage. The Mothbean–Mustard system proved as the most remunerative, generating net returns of ₹ 93,365/ha with a B:C ratio of 2.25. Residue retention enhanced profitability with improved net returns and a B:C ratio of 1.94.

Findings

- Zero tillage practices resulted in an approximate 16% reduction in weed density. The cowpea–chickpea system during the *kharif* season and the pearl millet–mustard system in the *rabi* season exhibit a strong smothering effect on weeds, while crop residue retention further suppresses weed growth.
- A significant positive interaction was observed under zero tillage with residue retention, resulting in enhanced system productivity, higher net returns, and an improved benefit-cost (B:C) ratio.
- Among the evaluated cropping systems, the mothbean–mustard system emerged as the most productive, providing a 10% higher chickpea-equivalent yield (2370 kg/ha) compared to the pearl millet–mustard system. It also proved to be an economically viable option. Additionally, this system demonstrated high energy use efficiency.

Exp 2: Integrated nutrient management for improving soil health and sustainability of pulse-based cropping systems in arid-ecosystems

The present field experiment was carried out during 2023-24 in Pearl millet – Mustard, Mothbean – Mustard, Pearl millet – Chickpea, Clusterbean + Sesamum (6:2) - Chickpea system to study the effect of nutrient management practices (1.) Recommended fertilizers (100% RDF) (2.) 75% RDF + 5 t FYM (3.) 75% RDF + 5 t FYM + Biofertilizers (4.) 50% RDF + 5 t FYM + Biofertilizers + Crop residue) on crop performance, and economics. The results revealed significant effects of both the cropping systems and nutrient management on system productivity. The Mothbean – Mustard (Mo-Mus) cropping system was found to

be the most productive, recording the highest chickpea equivalent yield of 2,361.94 kg/ha. Regarding nutrient management, the integrated application of 50% RDF + 5 t FYM + Biofertilizers + Crop residue resulted in the significantly highest system productivity, yielding 2,437.60 kg/ha. This integrated approach was markedly superior to all other treatments, particularly the application of 100% Recommended Dose of Fertilizers (RDF) alone, which recorded the lowest yield of 1,955.63 kg/ha.

The economic analysis of the experiment revealed that the Mothbean – Mustard cropping system was the most profitable, achieving the highest net return (₹ 92,862/ha) and benefit-cost ratio (2.02). In terms of nutrient management, the application of 75% RDF + 5 t FYM + Biofertilizers proved to be the most economically sound strategy, recording the highest net return (₹ 90,174/ha) and B:C ratio (1.80) among the nutrient treatments. When compared to the baseline application of 100% RDF alone, this integrated nutrient practice increased the net return by 20.4% and the B:C ratio by 13.9%, highlighting the significant financial benefits of an integrated nutrient management approach over the sole reliance on chemical fertilizers.

The highest soil organic carbon (0.15%) was achieved with an integrated nutrient strategy combining 50% RDF with organic amendments like FYM, biofertilizers and crop residue. Among cropping systems, the Clusterbean + Sesamum - Chickpea rotation was the most effective, reaching 0.14% SOC, likely due to the nitrogen-rich biomass from the legume. These findings confirm that combining organic and inorganic nutrient sources is the superior approach for enhancing carbon sequestration and building long-term soil fertility

Findings:

- The mothbean-mustard cropping system resulted in approximately 16% higher system productivity (2,362 kg/ha chickpea equivalent yield) compared to the pearl millet-mustard system. This system also enhanced net returns by 22.5% compared to the pearl millet-mustard cropping system.
- The integrated approach to nutrient management, including 50% RDF + 5 t FYM + biofertilizer + crop residue incorporation, enhances crop productivity and improves soil organic carbon.

Sub Project: Development of conservation practices in pulse production systems for production-cost reduction and higher productivity under changing climate

Exp-3: Diverse cropping system under conservation agriculture for climate resilience under arid ecosystem of western plains

A comprehensive five-year field experiment (2020-21 to 2024-25) conducted at ICAR-IIPR Regional Research Centre, Bikaner, evaluated nine cropping systems under hot arid conditions to identify sustainable alternatives for enhanced productivity and soil health. The study compared clusterbean, mothbean, mungbean, and pearl millet-based systems in combination with chickpea, mustard, and cumin as succeeding crops.

System productivity: Clusterbean-based systems demonstrated exceptional performance, with clusterbean-chickpea recording the highest system productivity of 2,802 kg/ha (chickpea equivalent), followed by clusterbean-mustard (2,752 kg/ha). These systems showed 36% higher productivity compared to pearl millet-based systems, which recorded the lowest yields (2,032-2,148 kg/ha). Mungbean-based systems exhibited moderate performance, yielding 2,618-2,625 kg/ha.

Sustainability and economic viability: The Sustainable Yield Index (SYI) analysis revealed clusterbean-mustard and mothbean-mustard as most sustainable (0.87 each), indicating superior yield stability across years. Economically, clusterbean-chickpea generated the highest net returns (₹ 1,21,114/ha) with a benefit-cost ratio of 2.81, representing 37.7% higher returns than pearl millet-mustard. Clusterbean-mustard achieved the highest B:C ratio (2.83), demonstrating optimal investment efficiency.

Energy efficiency and soil health: Energy analysis showed cluster bean-mustard exhibited 5.9% higher energy use efficiency and 5.2% greater energy productivity compared to pearl millet-mustard. Notably, legume-based systems significantly enhanced soil fertility, with clusterbean-chickpea improving available nitrogen, phosphorus, and potassium by 14.3%, 20.4%, and 12.2%, respectively.

Findings

- Based on five years of data, the clusterbean-

based system achieved approximately 36% higher system productivity, along with greater net returns and a higher benefit-cost (B:C) ratio.

- Clusterbean-Mustard and mothbean-Mustard cropping systems recorded the highest sustainable yield index, indicating superior long-term yield stability and reliability over other systems
- The Clusterbean-Mustard cropping system also recorded higher energy output, net energy gain, energy use efficiency (EUE), and energy productivity.
- The clusterbean-chickpea system improved soil fertility by maintaining the highest available N, P, K content in the soil.

Project: Integrated management of chickpea dry root rot caused by *Macrophomina phaseolina*

Survey and surveillance: Dry root rot caused by *M. phaseolina* can lead to severe yield losses in chickpea and management is challenging due to the persistence of the pathogen in soil and low level of resistance in chickpea varieties. Survey was conducted in the farmers' fields in ikaner district; the incidence was observed up to 18% in farmer's field. Higher disease severity was observed in areas where chickpea is grown continuously without crop rotation. Most farmers are not adopting seed treatment practices, which is a critical factor in dry root rot management.

Identification of resistance sources: To identify the resistant sources against *M. phaseolina* disease sick plot is necessary for effective screening under high disease pressure. The development of disease sick plot has been initiated for large scale effective screening of chickpea germplasm. Site identified for development of sick plot. Naturally infected plants were incorporated in sick plot. To develop a disease sick plot, inoculum typically needs to be multiplied under controlled laboratory conditions and then incorporated into the designated plot to ensure uniform and sufficient disease pressure. However, due to the unavailability of laboratory facilities, it was not possible to artificially multiply and apply the inoculum. As an alternative, only naturally infected plant materials were incorporated into the plot. Unfortunately, this method did not provide adequate inoculum levels, resulting in insufficient disease pressure for effective screening of plant materials. A total 96 germplasm line and varieties with to susceptible checks BG 212 and JG 62 were sown in the fields during *Rabi* 2024-25. Disease incidence was very low in sick plot and not appropriate for screening.

Project: Prevalence, distribution and management for major fungal diseases of *kharif* pulses in arid region

A new project was initiated on prevalence, distribution and management for major fungal diseases of *kharif* pulses in arid region especially targeting mungbean and mothbean crops. Prevalence and severity of major diseases of clusterbean, mothbean and mungbean in the arid region of western Rajasthan were assessed through a multi-district field survey. Bacterial and foliar blights emerged as the predominant constraints across the surveyed pulse crops and districts, whereas dry root rot was more sporadic but attained high intensity at specific crop–location combinations in the arid region of western Rajasthan. The survey was conducted in major pulse-growing districts of this region to quantify field severity and spatial patterns of key diseases of clusterbean, mothbean and mungbean under farmers' field conditions. In clusterbean, bacterial leaf blight exhibited the highest mean severity, reaching 28.85% and 25.76% in Nagaur and Jodhpur, respectively, followed by Alternaria blight with maxima of 11.25% (Nagaur) and 9.26% (Jodhpur), while dry root rot remained comparatively low and was not recorded in Nagaur. In mothbean, *Cercospora* leaf spot occurred consistently at low to moderate levels (approximately 3–3.25%) across districts, dry root rot was negligible except in Jodhpur (13.14% severity), and anthracnose and yellow mosaic virus were generally of low intensity but detectable in all the locations. In mungbean, bacterial leaf spot was the dominant disease, with very high severities in Nagaur (27.5%) and Jodhpur (25.7%), accompanied by moderate *Cercospora* leaf spot in several districts and localized dry root rot hot-spots, particularly in Churu (9.5%). Yellow mosaic virus, powdery mildew and *Anthracnose* in mungbean occurred at low severities, indicating a sub-epidemic status but highlighting the risk of future spread under conducive conditions (Figure 1). The surveyed locations have been mentioned in the Figure 2. Overall, the results identify bacterial leaf blight/spot as the major constraint in clusterbean and mungbean, respectively, and delineate distinct dry root rot hot-spots in the arid region of western Rajasthan that warrant intensive surveillance and location-specific integrated disease management interventions.

Project: Social vulnerability assessment and adaptation strategies to cope with the impact of climate change in the arid region of Rajasthan

Assessed the social vulnerability level of pulse growing farmers in the region

To assess the adaptive capacity and social vulnerability of the pulse-growing farmers to climate change in the region and to document the adaptation strategies of pulse-growing farmers to cope with climate change scenario. Interview schedule for primary data collection was finalized for data collection in Bikaner and Jaisalmer District. Data collection was carried out to gather data on farming and household characteristics for the adaptive capacity indicators. It was found that adaptive capacity of the household is operationalized as the combined effect of five types of livelihood assets (physical, human, natural, financial and social). It was also found that the most important indicator for adaptive capacity was financial assets followed by social assets. The adaptive capacity of farming households was measured using a composite index. The classification of score in three adaptive capacity levels showed that majority of respondents (59.16%) have moderate adaptive capacity followed by low adaptive capacity (29.16%). Only 11.66% have high adaptive capacity. The moderate adaptive capacity is majority of farmers is explained by their moderate or low score in important indicators. On an average, farming households scored the highest in social assets followed by human assets and the lowest in natural resources. majority of the respondents are ready to adapt to climate change despite their level of adaptive capacity. Majority of the respondents 69.16% employ adaptation measures while the remaining 30.83% did not report any adaptation measures. They claimed that they have been doing the same farming practices throughout the years and do not see the need for adaptation because they can't do anything against climate change which they consider as an act of God. High and moderate adaptive capacity farmers employed more adaption measures as compared to low adaptive capacity. Farmer with relatively very high adaptive capacity are able to adapt better to climate change by shifting from one adaptation measures to another in response to the different climate risks they face. Major perceived barriers to climate change adaptation by the pulse growing farmers in Jaisalmer district were identified and it was found that around 91% of the respondents reported lack of irrigation facilities during rabi season was a major constraint {Farmers are using *khad in* system of saving water for *rabi* crop and during *kharif* season water was harvested in khadin *i.e.* low lying area of the field}, followed by High cost of adaptation measures (85%), lack of knowledge and information on latest technological advancements (78%), lack of access to quality seeds (76%), lack of access to credit facilities (73%), lower prices of pulses in market (71%), lack of storage facility (69%), lack of transport facility (68%) are the major perceived barriers to adopt adaptation strategies.

Project: Development of model pulse villages through integrated technological interventions in selected zones of India

Under the model pulse village initiative, targeted technological interventions were implemented to enhance productivity, profitability, and varietal diversification in pulse-based farming systems. During 2024–25, emphasis was placed on dissemination of improved seed varieties of clusterbean and mothbean, along with large-scale demonstrations under farmer field conditions. A total of 12.5 quintals of quality seed of improved pulse varieties were distributed, covering 100 farmers. Improved clusterbean variety, RGC 1033 and mothbean variety, RMO 2251 were supplied to 50 farmers each. The field performance of the improved varieties was encouraging. Clusterbean variety, RGC 1033 recorded an average yield of 763 kg/ha, which was 274.20 kg/ha higher than the local check yield of 488.8 kg/ha. This translated into an income advantage of ₹ 13,505.20 per hectare for the beneficiary farmers. Similarly, mothbean variety, RMO 2251 demonstrated clear superiority over the existing local variety. The improved variety produced an average yield of 411.2 kg/ha as compared to the local check yield of 205.4 kg/ha, resulting in a yield advantage of 205.80 kg/ha and an income gain of ₹ 9,777.80 per hectare.

A total of fifty demonstrations each on clusterbean and mothbean were conducted during the period. The results consistently highlighted the benefits of adopting improved varieties in terms of higher productivity, better adaptability to arid conditions, and enhanced profitability. Farmers reported noticeable improvements in pod formation, seed quality, and tolerance to moisture stress in both the varieties.

Training and capacity development programmes organized

ICAR-IIPR, RC, Bikaner imparted training and technical guidance to SMS and farmers from across the arid region on *kharif* and *rabi* pulses crop management, pulses production and protection

Performance of improved variety seed of clusterbean and mothbean over conventional practice

Sl. No.	Crop	Variety	Quantity of seed (q)	No. of farmers	Average yield (kg/ha)	Yield advantage (kg/ha)	Income advantage (Rs.)
1.	Clusterbean	RGC 1033	6.25	50	763	274.20	13505.20
2.	Mothbean	RMO 2251	6.25	50	411.2	205.80	9777.80

technologies, empowering women through technological interventions and best crop management practices. Total six trainings were organized for the farmers where in more than 500 farmers benefitted from the trainings. In addition to this, seeds of improved varieties (clusterbean, and mothbean), small farm implements, kitchen garden kit were distributed among farmers of Bikaner districts under SCSP projects.

Seed distribution programme under the SCSP Scheme at IIPR-RRC, Bikaner

The IIPR, Regional Research Centre, Bikaner organized the input (Seed of Clusterbean Variety-RGC 1033) distribution programme on June 11, 2025.The programme was organized by Dr. R.L. Jat under the overall scientific and administrative mentorship of Dr. Sudhir Kumar, Head, IIPR, RRC Bikaner. This initiative was executed under the framework of the Scheduled Caste Sub-Plan (SCSP), aiming to enhance the socio-economic status and agricultural productivity of the target demographic. During the event, high-yielding seeds of improved varieties of clusterbean (*Cyamopsis tetragonoloba*, variety RGC 1033) were distributed to 125 participating farmers of Tehsil of Nokha, Pugal, Kolayat, Bikaner and chhatragarh of Bikaner.

Training-cum-seed distribution programme under the SCSP Scheme on the topic Integrated approaches for production of *kharif* crops in arid ecosystem

The ICAR-Indian Institute of Pulses Research, Regional Research Centre, Bikaner organized a farmer training- cum -input distribution programme under the Scheduled Caste Sub-Plan (SCSP) on June 20, 2025, at ICAR-IIPR RRC Bikaner. The programme was held under the esteemed guidance of Dr. Sudhir Kumar, Head of the Centre and coordinated by Dr. R.L. Jat. During the programme, high-yielding seeds of the improved clusterbean (*Cyamopsis tetragonoloba*) variety RGC 1033 were distributed among 125 participating farmers. The training emphasized scientific crop management practices, including soil fertility enhancement, precision nutrient management, integrated pest management (IPM), and water-use efficiency techniques. Farmers were also briefed to modern agronomic practices aimed at improving the productivity and resource-use efficiency of major pulse crops such as cluster bean, moth bean and mung bean under arid agro-ecosystems of western Rajasthan.

Training cum seed distribution programme under the SCSP Scheme on the topic Enhancing Livelihoods of Scheduled Castes through Agricultural Interventions

The ICAR- Indian Institute of Pulses Research, Regional Research Centre, Bikaner organized a farmer training-cum-input distribution programme under the Scheduled Caste Sub-Plan (SCSP) on July 25, 2025, at Salasar Village of Kolayat Tehsil, Bikaner. The programme was conducted under the guidance of Dr. Sudhir Kumar, Head of the Centre, and coordinated by Dr. R.L. Jat. A total of 125 farmers participated in the event, wherein high-yielding seeds of the improved clusterbean (*Cyamopsis tetragonoloba*) variety RGC 1033 were distributed. In addition, the participants received comprehensive training on advanced agricultural technologies aimed at enhancing crop productivity, soil health management, and resource-use efficiency in arid agro-climatic conditions.



Training-cum-seed distribution programme under the SCSP Scheme on the topic Integrated nutrient, pest and disease management in *kharif* pulses

The ICAR- Indian Institute of Pulses Research, Regional Research Centre, Bikaner organized a one-day farmer training-cum-input distribution programme under the Scheduled Caste Sub-Plan (SCSP) on August 8, 2025 at ICAR-IIPR

RRC, Bikaner. The programme was conducted under the guidance of Dr. Sudhir Kumar, Head of the Centre and coordinated by Dr. R.L. Jat. During the event, high-yielding seeds of improved varieties of mothbean (*Vigna aconitifolia*, variety RMO 2251) and clusterbean (*Cyamopsis tetragonoloba*, variety RGC 1033) were distributed to 100 participating farmers of Dirdesar village of Shridungargarh tehsil, Akkasar village of Bikaner tehsil, Chandasar and Kotada village of Kolayat tehsil. In addition, farmers received technical training on scientific crop production practices, including integrated nutrient management, water conservation strategies, and pest management techniques aimed at enhancing productivity, sustainability, and resilience of pulse-based cropping systems in arid regions of western Rajasthan.

Training-cum-convergence meeting under Mission *Atmanirbhar* in Pulses

An online training-cum-meeting programme with all Krishi Vigyan Kendras (KVKs) of Rajasthan and Haryana was organized on October 24, 2025, to discuss the roadmap for convergence under the Mission *Atmanirbhar* in Pulses. The meeting was held under the aegis of the ICAR- Indian Institute of Pulses Research (ICAR–IIPR), Kanpur, in collaboration with ICAR–ATARI, Jodhpur. The programme aimed to deliberate on region-specific strategies, technological interventions, and collaborative mechanisms to enhance pulse productivity and ensure self-sufficiency in pulse production during the *rabi* season.

Dr. G.P. Dixit, Director, ICAR–IIPR, Kanpur, elaborated on the vision and strategic framework of the Mission *Atmanirbhar* in Pulses and Dr. J.P. Mishra, Director, ICAR–ATARI, Jodhpur, addressed the participants and commended the proactive role of KVKs in promoting pulse cultivation. A total 31 districts in Rajasthan and three districts in Haryana have been identified for implementation under the Mission *Atmanirbhar* in Pulses. The technical sessions focused on region-specific technologies and field practices. Discussion was made on packages and practices of *rabi* pulses in Rajasthan, covering improved varieties, seed treatment, nutrient and water management, and pest and disease control measures tailored to different zones of the state.

Training on Crop Protection and Post-Harvest Technologies for *Kharif* Pulses

An online one-day training programme on *"Crop Protection and Post-Harvest Technologies for Kharif Pulses"* was successfully organized on 15th September 2025 under the ongoing project titled *"Ensuring Pulse Sufficiency in India by Capitalizing on Model Pulse Villages."* The event was jointly conducted by the ICAR-Indian Institute of Pulses Research (IIPR), Regional Centre, Bikaner, and ICAR-ATARI, Jodhpur. The training was specifically tailored for Subject Matter Specialists (SMSs) and Heads of Krishi Vigyan Kendras (KVKs) involved in the Model Pulse Village Project across Rajasthan. The technical sessions covered key areas essential for improving the production and quality of *Kharif* pulses. The training covered the current scenario of pulse production in Rajasthan, outlining key challenges and potential strategies for improvement. Further, a session on integrated disease and pest management provided detailed insights into identifying and managing major pulse diseases and insects through sustainable and scientific approaches. A total of 17 participants from various KVKs and ICAR-ATARI attended the programme. These participants actively engaged with the content and were benefitted with updated technical knowledge, practical field-level solutions, and strategic insights into improving pulse cultivation and post-harvest handling under the Model Pulse Village initiative.

Seed Production Programme at IIPR, RC Bikaner

Under the seed production programme, breeder seed multiplication of three mungbean varieties, Shikha, Virat, and Heera was undertaken, resulting in the production of about 55 quintals of quality seed. In addition, breeder seed production of eight chickpea varieties in the *rabi* season was carried out, yielding approximately 30 quintals of quality seed. Alongside breeder seed activities, truthfully labelled (TL) seed production was also initiated. TL seed of clusterbean variety, RGC 1033 led to the production of 70 quintals, while TL seed of mothbean variety, RMO 2251 resulted in 12 quintals of quality seed. These efforts enhanced the availability of quality seed material for farmers and supported the strengthening of seed systems in the region.

ICAR-IIPR Regional Station, Khordha (Odisha)

Research Achievement

Project-Seasonal abundance of major pests and diseases in mungbean and urdbean and their correlation with the weather parameters

Screening of mungbean and Urdbean genotypes against Powdery Mildew disease

Eleven (11) varieties of mungbean (IPM-312-20, IPM-205-7, IPM-2-3, IPM-312-1, IPM-302-2, IPM-99-125, IPM-109-4, IPM-2-14, IPM-2K-14-9, IPM-410-3, local mung genotype as check) and six (6) varieties of urdbean (IPU-10-26, IPU-17-1, IPU-11-02, IPU-13-1, MDU-1 & local urad genotype as check) were sown (3 rows of 4-meter length of each variety) at three dates of sowing at 10 days interval. The powdery mildew disease was observed with 100% disease incidence in all the mung and urd varieties in three dates of sowing except the local mung and urd genotype which was found resistant against powdery mildew.



Screening of mungbean and Urdbean genotypes against Powdery Mildew

Screening of mungbean and urdbean genotypes against Yellow Mosaic Disease

6 genotypes of urdbean (IPU-10-26, IPU-17-1, IPU-11-02, IPU-13-1, MDU-1 & local urad genotype as check) and 11 genotypes of mungbean (IPM-312-20, IPM-205-7, IPM-2-3, IPM-312-1, IPM-302-2, IPM-99-125, IPM-109-4, IPM-2-14, IPM-2K-14-9, IPM-410-3, local mung genotype as check) with susceptible check MDU-1 were evaluated against YMD and found that YMD was observed only in susceptible check (MDU-1), local urd, IPU 13-1, local mung & remaining others genotypes of mungbean and urdbean were found resistant against YMD.



Screening against YMD

Disease dynamics in mungbean and urdbean

In rice fallow conditions diseases like powdery mildew, yellow mosaic was observed in both mungbean and urdbean . The initial symptoms of yellow mosaic were observed at 2nd SMW on both mungbean and urdbean whereas the highest DI (100%) was at 11th SMW on urdbean. The initial symptoms of powdery mildew were observed at 1st SMW whereas the highest DI (100%) was at 6th SMW on urdbean.

Incidence of different insect pests in mungbean

Aphid population was highest during the 4th SMW with an average of 15.6 aphids/plant. It showed a significant positive correlation with Tmax (r=0.57). Whitefly population was highest during the 5th SMW with an average of 13.33 whiteflies/plant. It showed a positive correlation with Tmax (r=0.60). Jassid population was highest during the 5th SMW with an average of 5 jassid/plant. It showed a negative correlation with Tmin (r=-0.58). The thrips population was highest during the 3rd SMW with an average of 6.7 thrips/flower buds. Leaf folder (*Omoides indicata*) population was highest during the 4th SMW with an average of 17 insects/ 50 plants. It showed a significant correlation with Tmax (r=0.52). The pod bug (*Nezara viridula*) population was noticed during 4-6 SMW. The activity of whiteflies and jassids was recorded from the 51st SMW.



Incidence of aphids, pod bugs and leaf folder on mungbean

Incidence of different insect pests in urdbean

Aphid population was highest during the 3rd SMW with an average of 14.33 aphids/plant. It showed a significant positive correlation with Tmax (r=0.60).Whitefly population is highest during the 4th SMW with an average of 15.4 whiteflies/plant. It showed a significant positive correlation with Tmax (r=0.58). Jassid population was highest during the 3rd SMW with an average of 4.0 jassids/plant in urdbean. Thrips count was highest during the 3rd SMW with an average of 7.4 thrips/flower bud. It showed a significant positive correlation with Tmax

(r=0.70) and a negative correlation with Tmin (-0.86). Bihar Hairy Caterpillar (BHC) incidence was visible as a gregarious phase since 2nd SMW until 6th SMW, where it attained the solitary phase. The peak population was observed in 4 4th SMW (9 larvae/10 plants).



Incidence of aphids and BHC on urdbean

Project-Seasonal abundance of major pests and diseases in pigeon pea and their correlation with the weather parameters

Incidence of different insect pests and diseases in pigeon pea

The incidence of H. armigera started in the 6th SMW and peaked in the 10th SMW (1.1 larvae/plant) and showed significant correlation with Tmax (r=0.60) and RH1 (r=-0.58). Maximum trap catches (13 adults/trap) of *H. armigera* were observed during the 10th SMW. The incidence of *Maruca vitrata* was reported on the 3rd SMW, with a peak incidence of 3 webbed buds/inflorescence/



Incidence of Maruca, pod bugs and blister beetleson pigeon pea



Incidence of mosaic and wilt disease in pigeon pea

plant during the 10th SMW. RH2 (-0.51) had shown a significant negative influence on the larval population. Incidence of pod bugs was reported on the 1st SMW, and the peak population was observed to be 2.2 bugs/plant on the 8th SMW. A significant negative correlation (-0.78) was observed with Tmin. The mosaic disease of pigeonpea was observed during the 3rd SMW with a DI of 4-5%. The wilt disease was observed in the same variety during the 2nd SMW, and the highest DI was found during the 6th SMW (10%). Incidence of blister beetles was found during 5-7 SMW.

Project-Forecasting the inter- and intra-seasonal pattern of major insect pest of pulses using machine learning methods

Population intensity and infestation level of *H. armigera* was recorded in kabuli chickpea (IPCK-04-29) at Khordha station. The pest crossed its ETL level (0.33 to 3 larva/meter row length). Similarly, the maximum peak of the mean number of male moths/trap/week was 16.33 (11th SMW). The Whitefly population recorded through yellow sticky traps revealed a minor peak during 24 SMW and a major peak during 33SMW. Corresponding weather parameters viz. Temperature (max,min), Relative Humidity, Rainfall, Sunshine hours, Wind speed and Evaporation were recorded and averaged to individual SMW.

Project-Development of liquid bioformulation of indigenous *Bacillus thuringiensis* strains for enhancing its shelf life and field efficacy against pod borer

Field efficacy of bio-formulation (IIPR Pulse Guard EW) was tested against Bihar Hairy Caterpillar infesting urd-bean crop (variety- IPU13-1). Following doses viz., T1- 17.00ml/L,T2- 22.5ml/L, T3- 28.5ml/L, T4 (Dipel)- 10ml/5L and untreated control as T5. Except T1 and T5 all the doses had shown knockdown effect after 3 days of showing. However, T1 had shown complete mortality 7 DAS. Insect population in T5 was decreasing across subsequent weeks due to their solitary and dispersing behaviour.

All India Co-ordinated Research Projects
Rabi Pulses

Varieties released and notified

Chickpea

Karan Chana 20 (RSGD 1155): It is a *desi* chickpea variety derived from the cross RSG 807 x CSJD 884. It has moderate resistant to *Fusarium wilt*, dry root rot and stunt diseases with average yield 1638 kg/ha and maturity 116 days. Hence, the variety RSGD 1155 was released and notified for late sown conditions in North East Plain Zone comprising states of eastern Uttar Pradesh, Bihar, Jharkhand, West Bengal and Assam.

Pusa Chickpea Aswini (BG 4037): It is a *desi* chickpea variety derived from the cross ICCV 07110 x JG 11. It is the first machine harvestable chickpea variety released and notified for the North West Plain Zone (NWPZ) comprising the states of western Uttar Pradesh, northern Rajasthan, Delhi, plains of Uttarakhand, Punjab, Haryana and part of Jammu and Kashmir. It has resistance to *Fusarium* wilt and stunt disease. The average yield is 2673 kg/ha and maturity 145 days.

Raj Vijay Gram 2023 (RVG 2023): It is a *desi* chickpea variety derived from the cross Kripa x ICC 5912. It is suitable for machine harvesting with average yield 1589 kg/ha and matures in 125 days. It is moderately resistant to wilt and dry root rot. The variety Raj Vijay Gram 2023 was released and notified for timely sown conditions of the North East Plain Zone comprising of eastern Uttar Pradesh, Bihar, Jharkhand, West Bengal and Assam.

Raj Vijay Kabuli Gram (RVKG 2024): It is a *kabuli* chickpea variety developed from the cross BGD 1085 x PKV 4. The average yield is 1439 kg/ha and matures in 100 days. It is extra-large seeded with 100-seed weight 44.2 g and moderately resistant to *Fusarium wilt*. The variety Raj Vijay Kabuli Gram was released and notified for irrigated, timely sown conditions of the South Zone comprising of Andhra Pradesh, Telangana and Karnataka.

Nandyal Gram 924 (NBeG 924): It is a *desi* chickpea variety derived from the cross JAKI 9218 x ICC 12478. The average yield is 1722 kg/ha and matures in 105-115 days. It is bold seeded with 100-seed weight 23.5 g. It has moderate resistance to *Fusarium* wilt. The variety NBeG 924 was released and notified for the East Central Zone comprising of eastern Madhya Pradesh, Chhattisgarh and parts of Odisha.

Nandyal Gram 1267 (NBeG 1267): It is a *desi* chickpea variety developed from the cross JG 11 x ICCV 05106. It is suitable for machine harvesting with average yield 2095 kg/ha. It is early and matures in 90-95 days. It has moderate resistance to *Fusarium wilt*. The variety NBeG 1267 was released and notified for South Zone comprising of Andhra Pradesh, Telangana and Karnataka.

Pant Gram 10: It is desi chickpea variety derived from the cross PG 041 x PG 046. It has moderate resistance to *Fusarium* wilt and rust with average yield 1779 kg/ha, average maturity of 130 days. It is bold seeded with 100-seed weight 24.6 g. The variety Pant Gram 10 (PG 265) was released and notified for North East Plain Zone comprising of eastern Uttar Pradesh, Bihar, Jharkhand, West Bengal and Assam.

Lentil

Pant Lentil 14 (PL 320): It is a small seeded derived from the cross PL 5 x L 4145. The average yield is 1555 kg/ha and maturity is 128 days. It has moderate resistance to rust and resistant to *Ascochyta* blight. The protein content is 25.72%. The variety Pant Lentil 14 (Pl 32) was released and notified for the North West Plain Zone comprising the states of western Uttar Pradesh, northern Rajasthan, Delhi, plains of Uttarakhand, Punjab, Haryana and part of Jammu and Kashmir.

Pant Lentil 15 (PL 342): It is a small seeded derived from the cross PL 8 x DPL 58. The average yield is 1559 kg/ha and maturity is 127 days. It has resistance to *Ascochyta* blight and moderate resistance to rust. The protein content is 26.24%. The variety Pant Lentil 15 (PL 342) was released and notified for the North West Plain Zone comprising the states of western Uttar Pradesh, northern Rajasthan, Delhi, plains of Uttarakhand, Punjab, Haryana and part of Jammu and Kashmir.

Pant Lentil 16 (PL 366): It is a large seeded lentil variety developed from the cross L 4188 x L 4147. It is moderately resistant to rust and wilt. The average yield is 1491 kg/ha and maturity 154 days. Hence, the variety Pant Lentil 16 (PL 366) was released and notified for the North Hill Zone comprising the states of Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and hills of West Bengal and North eastern states.

Kota Masoor 6 (RKL 20-26): It is a large seeded lentil variety derived from the cross RKL 11 x PL 5. It is tolerant to drought. The average yield is 1600 kg/ha and matures in 125 days in the North West Plain Zone. In Central zone, the average yield was 1737 kg/ha and matures in 111 days. It is moderately resistant to rust and wilt. Hence, the variety Kota Masoor 6 (RKL 20-26) was released and notified for both the North West Plain Zone and Central Zone comprising the states of western Uttar Pradesh, Rajasthan, Delhi, plains of Uttarakhand, Punjab, Haryana, part of Himachal Pradesh, Madhya Pradesh, Chhattisgarh, Gujarat, Maharashtra, Bundelkhand region of Uttar Pradesh.

Fieldpea

Pant Pea 484: It is a dwarf fieldpea variety derived from the cross Pant Pea 200 x VL 201. It has an average yield of 2333 kg/ha and matures in 120 days. It is resistant to *Ascochyta* blight and moderately resistant to rust and powdery mildew. The seed protein content is 26.17%. The variety Pant Pea 484 was released and notified for the North West Plain Zone comprising the states of western Uttar Pradesh, northern Rajasthan, Delhi, plains of Uttarakhand, Punjab, Haryana and part of Jammu and Kashmir.

Pant Pea 497: It is a tall type fieldpea variety derived from the cross IPFD 5-19 x HFP 530. It has an average yield of 1966 kg/ha and matures in 123 days. It is resistant to *Ascochyta* blight and moderately resistant to rust and powdery mildew. The seed protein content is 25.05%. The variety Pant Pea 497 was released and notified for the North West Plain Zone comprising the states of western Uttar Pradesh, northern Rajasthan, Delhi, plains of Uttarakhand, Punjab, Haryana and part of Jammu and Kashmir.

Pant Pea 498: It is a tall type fieldpea variety derived from the cross IPFD 5-19 x HFP 530. It has an average yield of 2050 kg/ha and matures in 123 days. It is resistant to *Ascochyta* blight and moderately resistant to rust and powdery mildew. The variety Pant Pea 498 was released and notified for the North West Plain Zone comprising the states of western Uttar Pradesh, northern Rajasthan, Delhi, plains of Uttarakhand, Punjab, Haryana and part of Jammu and Kashmir.

Pant Pea 501: It is a tall type fieldpea variety derived from the cross IPFD 5-19 x HFP 530. It has an average yield of 2140 kg/ha and matures in 123 days. It is resistant to powdery mildew and *Ascochyta* blight and moderately resistant to rust. The variety Pant Pea 501was released and notified for the North West Plain Zone comprising the states of western Uttar Pradesh, northern Rajasthan, Delhi, plains of Uttarakhand, Punjab, Haryana and part of Jammu and Kashmir.

Pant P 509: It is a dwarf fieldpea variety derived from the cross Pant P 26 x FC 1. The average yield is 1809 kg/ha and maturity is 114 days. It has resistance to Powdery mildew and *Ascochyta* blight. Hence, the variety Pant Pea 509 was released and notified for the North East Plain Zone of India comprising the states of eastern UP, Bihar, Jharkhand, West Bengal and Assam.

Pant P 517: It is a tall type fieldpea variety developed from the cross IPFD 05-19 x HFP 530. The average yield is 2130 kg/ha, maturity duration is 125-130 days and average plant height is 151 cm. It showed resistance to Powdery mildew and *Ascochyta* blight. The variety Pant P 517 was released and notified for North West Plain Zone comprising the states of western Uttar Pradesh, northern Rajasthan, Delhi, plains of Uttarakhand, Punjab, Haryana and part of Jammu and Kashmir.

HFP 1709: It is a dwarf fieldpea variety derived from the cross Pant P 25 x HFP 8909. The average yield is 1652 kg/ha and maturity duration is 110-115 days. It has resistance to powdery mildew and is moderately resistant to rust. Hence, the variety HFP 1709 was released and notified for the North East Plain Zone comprising the states of eastern Uttar Pradesh, Bihar, Jharkhand, West Bengal and Assam.

IPFD 18-3: It is a dwarf and leafy type fieldpea variety derived from the cross HUDP 15 x P 1544-4. The average yield is l73l kg/ha and duration is 117 days. It showed resistance to Powdery mildew and *Ascochyta* blight. The seed protein content is 25.7%. Hence, the variety IPFD 18-3 was released and notified for North East Plain Zone of India comprising the states of eastern UP, Bihar, Jharkhand, West Bengal and Assam.

Germplasm registered with ICAR-NBPGR during 2024-25

Crop	National identity	Botanical Name	Year	Developing institute	Novel unique features
Lentil	INGR 25013	*Lens culinaris*	2025	BCKV, Mohanpur	High grain Fe content (116 mg/kg)
Lentil	INGR 25014	*Lens culinaris*	2025	ICAR-IIPR, Kanpur	Resistant to *Fusarium* wilt
Lentil	INGR 25015	*Lens culinaris*	2025	ICAR-IIPR, Kanpur	Resistant to *Fusarium* wilt

Genetic resource management

Crop	No. of accessions	AICRP centres involved
Chickpea	20,497	24
Lentil	7,492	17
Fieldpea	1,966	12
Lathyrus	3,248	04

Breeder seed production

Crop	Indent(qt)	Production(qt)	No. of varieties
Chickpea	7,104.01	13,426.95	101
Lentil	702.33	963.66	36
Field pea	630.18	749.44	26
Lathyrus	107.58	100.15	04

Front line demonstrations

Crop	No. of FLDs	Improved Practice	Farmers' Practice	% increase
Chickpea				
Package technology	321	1780	1384	28.60
Rice fallow	49	1441	1140	26.40
IPM	5	2040	1148	71.71
TSP	361	1540	1124	37.00
Lentil				
Package technology	171	1376	996	38.10
Rice fallow	50	885	671	31.90
TSP	190	1101	819	34.40
Fieldpea				
Package technology	45	1611	1117	44.20
Rice fallow	18	1068	840	27.10
TSP	95	1532	1116	38.00

Crop Production

Agronomy

Chickpea

- The combination of oxyfluorfen 150 g a.i./ha (pre-emergence) followed by topramezone 20.6 g a.i./ha at 14–21 DAS is recommended for effective broad-spectrum weed control in chickpea in NWPZ, NEPZ, and CZ, while oxyfluorfen followed by propaquizafop or quizalofop-p-ethyl at 15–20 DAS is suitable for the Southern Zone.
- Chickpea yield under organic cultivation was generally comparable to inorganic practices across locations, with Biophos and Biozinc showing consistent yield improvement.
- Conservation agriculture practices with 20 cm rice stubble retention improved chickpea yield, soil health, and economic returns, especially under zero tillage. The puddled transplanted rice–zero tilled chickpea system showed the highest profitability, while stubble retention consistently enhanced SOC and nutrient availability.
- Chickpea yield under natural farming was generally lower than the recommended practice across most of the locations, with few exceptions like Samba and Kalyani. Organic farming consistently improved soil health indicators such as SOC and available NPK, particularly at Durgapura, Kalaburagi, and Junagadh. Overall, recommended practices remained more profitable, while organic management offered soil sustainability benefits.

Lentil

- In organic cultivation of lentil and fieldpea with foliar application of Biophos and Biozincalong with 100% FYM significantly enhanced yields and soil health. Though yields are generally lower than inorganic systems, long-term sustainability benefits are notable.
- Retaining 20 cm rice residue, especially in

ZT-DSR followed by ZT lentil, is boosted yield, soil health, and profitability. However, fieldpea may perform better under conventional tillage at certain location suggesting that tillage response may vary with crop and location.

- In lentil across the locations recommended practice consistently produced the highest yields, economic returns, and input use efficiencies. In contrast, natural farming resulted in 17.6 % yield reduction. However, both natural and organic systems contributed to improved soil health and microbial activity, highlighting a trade-off between immediate productivity and long-term sustainability.
- Pendimethalin + Quizalofop-p-ethyl, Oxyfluorfen + Propaquizafop (pre+post), or Imazethapyr (post) are effective options for weed control, improving yield and profitability in NWPZ.

Fieldpea

- In field pea across the locations recommended practice consistently produced the highest yields, economic returns, and input use efficiencies. In contrast, natural farming resulted in 30% yield reduction. However, both natural and organic systems contributed to improved soil health and microbial activity, highlighting a trade-off between immediate productivity and long-term sustainability.
- Pendimethalin + Quizalofop-p-ethyl or Oxyfluorfen + Propaquizafop (pre+post) are recommended for effective weed control and high yields in NHZ, NWPZ, NEPZ, and CZ.

Microbiology

Chickpea

- Multilocation testing of five elite *Mesorhizobium* strains across eight centres revealed marked differences in plant response. The reference strain RFC 117 (Kanpur) recorded the highest nodule biomass across all locations, with 39% increase over the uninoculated control (UI), followed by NS 1 (New Delhi), which showed a 35% increase over UI. The highest grain yield was observed with NS 1 (New Delhi), NBAIM, and RDN, each showing a 21% increase over the uninoculated control. This was closely followed by RFC 117 and LCP-23-33, which recorded 20% increase.
- Rice fallow soil samples were collected from farmers' fields across 20 villages across four districts of Assam, in collaboration with AAU-ZRS, Shillongani. In addition, potential *endophytic* bacteria were isolated from rice fallow soil received from BCKV, Mohanpur.

Crop Protection

Plant Pathology

Chickpea

- For the management of seed and soil-borne diseases, the experiment was conducted at twelve centres using seed treatment by different seven new and combi-fungicides. The overall performance of seed treatment with Mancozeb 50 % + Carbendazim 25 % WP @ 3 gm/kg seed was found effective. However, the response of treatments varied in different centres.
- In Elite Plant Pathological Screening Nursery (EPPSN), seventy-one entries showing resistant/moderately resistant reaction to wilt in previous year (23-24), were included for confirmation of wilt resistance at selected thirteen locations having, established wilt sick plots. Out of 71 entries, twenty-nine entries belonging to different groups expressed resistance/ tolerance to wilt at 8 or more locations out of the 13 locations, confirming the wilt resistance for the second consecutive year.

Lentil

- Pant bio-agent-3 (*Trichoderma sperilum* + *Pseudomonas fluorescence)* was found highly effective for reducing the disease incidence of wilt and increasing the yield.

Lathyrus

- Seven entries of lathyrus were evaluated at four locations (Raipur, Shillongani, Dholi and Akola) against powdery mildew disease but the disease did not appear at any of the locations.

Entomology

Chickpea

- The incidence of insect pests of chickpea and their natural enemies throughout cropping

period was observed in early, timely and late sown crop conditions. There was less larvae per meter row length in early sown crop, hence, less pod damage and more grain yield than timely and late sown crop in different zones except at Sriganganagar in NWPZ. The population of larval parasitoid, *Campoleti schloridae* and spiders was more under early and timely sown conditions than late sown conditions.

- The bioefficacy experiment on biorationals insecticides against *H. armigera,* the data on per cent pod damage revealed that treatment Chlorantraniliprole 18.5 SC @ 0.25 ml/ L was the best treatment against this pest followed by Tetraniliprole 18.18 SC.
- The biointensive IPM module (BIPM) observed lower population of *H armigera*, lower pod damage and higher grain yield as well as higher population of natural enemies as compared to the farmer's practice and untreated control, resulting in higher net returns.
- Based on three years of data, the pooled avoidable yield losses in insecticide and biopesticide-treated plots, over the untreated control, were recorded 34.4% and 24.9% in the NWPZ, 8.8% and 4.51% in NEPZ, 12.1% and 8.7% in the CZ, and 12.4% and 9.1% in the SZ, respectively.

Lentil

- Studies on the seasonal abundance and population dynamics of key insect-pests and natural enemies revealed that the maximum incidence of aphid (22.4 aphids/10 cm shoot) was observed at Mohanpur, and was significantly positively correlated with maximum & minimum temperature, sunshine hours and rainfall. Maximum peak infestation of pod borer (4.6 larvae/plant) was recorded at Dholi during *rabi* 2024-25.

Fieldpea

- Evaluation of the bio-intensive IPM module (BIPM) against major insect pests of fieldpea revealed that the BIPM module was more effective as compared to the farmers' practice.

Lathyrus

- *Lecanicilliumlecanii* @ 7.5 g/l was found to be superior for the management of aphids in lathyrus at Mohanpur centre.

All India Co-ordinated Research Projects
Kharif Pulses

Crop Improvement

Varieties Released and Notified

During 2024-25, a total of 26 varieties were released and notified in different *Kharif* pulses including 8 each in pigeonpea and mungbean, 5 in cowpea, 3 in urdbean and 2 in mothbean. The details of these varieties are given below:

Pigeonpea

1. **Phule Pallavi (Phule Tur 12-19-2):** This pigeonpea variety has been recommended for cultivation in CZ. It is derived from the cross 'No. 10 x PT 04-214'. With an average yield of 21-22 q/ha, it matures in 157-159 days. It is moderately resistant to wlt and sterility mosaic disease.

2. **Telangana Kandi-4 (TDRG 272):** This pigeonpea variety has been recommended for cultivation in SZ (Telangana, Andhra Pradesh, Tamil Nadu, Karnataka, Odisha) for *kharif/rabi* seasons. It is derived from the cross RGT 44 x RGT 4. Recording an average yield of 16-17 q/ha, it matures in 160-165 days. It is resistant to *Fusarium* wilt, tolerant to pod borers and pod fly. It contains 22.37 % protein.

3. **NAAM 88:** This pigeonpea variety has been developed from the cross ICPL 87 X ICPL 87119 (Asha)-30* and recommended for cultivation in SZ. With an average yield of 13-14 q/ha, it matures in 140-150 days. It is moderately resistant to wilt. This variety recorded protein content of 20.38% and possesses good organoleptic traits.

4. **GJP 1820 (Gujarat Tur 111/ Sorath Ratan):** This pigeonpea variety has been developed from the cross GT 102 x BDN 2010 and it is suitable for *kharif* season cultivation in Gujarat. With an average yield of 21-22 q/ha, it matures in 163-198 days. It is resistant against SMD and Phytophthora blight and moderately resistant against wilt.

5. **Gujarat Tur 110 (Navtur/ NPD 18-03):** This pigeonpea variety has been developed from the cross GNP 360 x GT 1 and recommended for cultivation during *kharif* season in Gujarat. With an average yield of 19-23 q/ha, it matures in 170-180 days. It is moderately resistant to SMD & wilt. This variety recorded protein content of 23.06 %.

6. **Pusa Jawahar Arhar 21-29:** This pigeonpea variety has been developed from the cross Pusa Dwarf X ICP 8863 and recommended for cultivation in Madhya Pradesh. With an average yield of 19-20 q/ha, it matures in 137-142 days. This variety recorded protein content of 22.75 %.

7. **Pusa Jawahar Arhar 22-01:** This pigeonpea variety has been developed from the cross Pusa Dwarf X ICP 8863 and recommended for cultivation in Madhya Pradesh. With an average yield of 18-22 q/ha, it matures in 138-142 days. This variety recorded protein content of 22.50%.

8. **Pusa Jawahar Arhar Dwarf 22-02:** This Pigeonpea variety has been developed from the cross [(H 2001-4 × ICP 7035) X (Pusa Dwarf × ICP 7035)] and recommended for cultivation in Madhya Pradesh. With an average yield of 17-19 q/ha, it matures in 122-128 days. This variety recorded protein content of 22.70%. It is an extra early maturing variety of pigeonpea.

Mungbean

1. **Lam Pesara 610 (LGG 610):** This variety has been derived from the cross MGG 295 x LGG 486. It has been recommended for South Zone . It recorded an average yield of 11-12 q/ha. It has determinate growth habit with synchronous maturity. This variety is suitable for rice fallow & upland situations during *rabi* season. It contains 23.16% protein.

2. **PMS 8:** This mungbean variety has been derived from the cross Pusa Vishal x MH 318. with an average yield of 4.5-6.5 q/ha, it matures in 65-70 days. It is moderately resistant to MYMV, web blight, cercospora leaf spot (CLS), bacterial leaf blight (BLS), anthracnose, powdery mildew, macrophomina, urdbean leaf curl virus, leaf curl virus and root rot. It has been recommended for cultivation during summer season and is suitable for salt

affected condition in NCR, Delhi.

3. **PMD 9:** This mungbean variety has been developed from the cross Pusa Vishal x PM 5 and recommended for cultivation in NCR Delhi during summer season irrigated condition). With an average yield of 10-11 q/ha, it matures in 55-60 days. It is moderately resistant to MYMV, cercospora leaf spot (CLS), anthracnose, web blight and urdbean leaf crinkles (ULCV). It is also resistant to thrips, whitefly, pod borer, pod bug and maruca.

4. **PMD 10:** Derived from the cross Pusa Vishal x MH 318, this mungbean variety has been recommended for cultivation in NCR, Delhi during summer season. With an average yield of 11-12 q/ha, it matures in 55-60 days and is highly resistant to MYMV, CLS, Anthracnose web blight and urdbean leaf crinkle virus (ULCV),

5. **VBN 7 (VGG 18-002):** This mungbean variety has been derived from the cross EC 496839 x IPM 409-4 and has recommended for *kharif* cultivation in Tamil Nadu. with an average yield of 10-11 q/ha, it matures in 65-70 days. This variety is moderately resistant to Mungbean Yellow Mosaic Virus, powdery mildew and resistant to Urdbean Leaf Crinkle Virus.

6. **Ankush (WBN- 031):** This variety has been recommended for cultivation in West Bengal during *rabi* season. It has an average yield of 10-11 q/ha and matures in 62-69 days. It is resistant to MYMV, powdery mildew and moderately resistant to web blight. It is a small seeded light-coloured variety of mungbean.

7. **Phule Suvarn (M 0702-1):** The mungbean variety Phule Suvarn has been recommended for cultivation in Maharashtra state. It is suitable for *Kharif season*. With an average yield of 8-9 q/ha and matures in 62-74 days. This variety is moderately resistant to major diseases (powdery mildew, mungbean yellow mosaic virus) under field conditions.

8. **PMS 12 (Pusa Sodicity Mungbean 12) :** This variety has been derived from the cross Pusa Vishal x MH 318. and recommended for cultivation in Uttar Pradesh. It recorded an average yield of 12-14 q/ha, it matures in 70-74 days. It is resistant against MYMV, cersospora leaf spot, anthracnose, web blight and urdbean leaf crinkle virus (ULCV). It is suitable for moderate *usar* (sodic) conditions of Uttar Pradesh.

Blackgram

1. **IPU 13-6 :** This variety has been developed from the cross DPU 88-31 X UC 7-27. With an average yield of 15-16 q/ha, it matures in 70-75 days. This variety has been recommended for Madhya Pradesh for spring season. It is highly resistant to MYMV and resistant to urdbean leaf crinkle virus, leaf curl virus, web blight, bacterial leaf blight, powdery mildew and cercospora leaf spots.

2. **VBN 12:** This variety has been developed from the cross KU 2016 x VBN 3. With an average yield of 9-10 q/ha, it matures in 75-80 days. It is resistant to MYMV, powdery mildew and urdbean leaf crinkle virus diseases, resistant to white fly and pod borer. It has been recommended for cultivation in Tamil Nadu. It is suitable for irrigated and rice fallow conditions.

3. **Phule Rajan (PU-0819-18):** This variety has been developed from the cross LBG-752 x KUG-502. With an average yield of 8-9 q/ha, it matures in 72-81 days. It has earliness with bold black shiny colour seed and it is tolerant to YMV, PM, CLS, & Macrophomina Blight. It has been recommended for *Kharif* cultivation in Maharashtra.

Cowpea

1. **KBC 12:** This variety has been developed from the cross (C 152 × V 16) x (C 152 × V 57817and recommended for Central & South zone for *Kharif* season. With an average yield of 12-13 q/ha, it matures in 80-85 days. It possesses resistance to Bacterial blight, Cowpea mosaic virus, dry root rot and *Cercospora* leaf spot diseases.

2. **Sahyadri Samruddi (GP-1):** This variety has been developed from the cross C 152 X DC 1 and recommended for Karnataka for cultivation *Kharif* season. With an average yield of 13-14 q/ha, it matures in 80-85 days. It is moderately resistant to rust, and yellow mosaic disease.

3. **Shalimar Cowpea- 3 (SKAU-C-407):** Developed from GC 3, this cowpea variety

has been recommended for Jammu & Kashmir. With an average yield of 13-14 q/ha, it matures in 92-95 days. It is highly resistant to *Cercospora* leaf spot of cowpea and Cowpea mosaic virus.

4. **Pant Lobia 8 (PGCP-67):** Developed from the cross Pant Lobia-1 x Pant Lobia-5, this cowpea variety has been recommended for Uttarakhand. With an average yield of 12-13 q/ha, it matures in 65-70 days. Resistant to Cowpea Yellow Mosaic Virus, it is moderately resistant to thrips and aphids.

5. **BR 39:** Developed from the accession EC 530944, this rajmash variety has an average yield of 14-17 q/ha and matures in 80-90 days. It has been recommended for cultivation in temperate/hilly zone of UT of J&K. The variety is tolerant to anthracnose and angular leaf spot diseases under field conditions and highly tolerant to insect black bean aphid and thrips.

Mothbean

1. **CAZRI Moth – 6 (CAZRI 18-3):** This variety has been recommended for cultivation in all mothbean growing area s of the country. It is a mutant (Gamma rays – 200 Gy) of CAZRI Moth – 2 with an average yield of 11-12 q/ha, it matures in 74-76 days. It showed resistant reaction against foliar and root diseases of mothbean and also exhibited minimum incidence of white fly and leaf hoppers

2. **CAZRI Moth – 7 (CAZRI 18-4):** This mothbean variety has been recommended for cultivation in all mothbean growing areas. It is a mutant (Gamma rays – 200 Gy) of CAZRI Moth – 2 with an average yield of 11-12 q/ha, it matures in 75-77 days. It is resistant against foliar and root diseases.

Plant Genetic Resources

Registration of unique germplasm for desirable traits

A large number of germplasm lines and wild accessions of *Kharif* pulses were evaluated for resistance to biotic and abiotic stresses as well as other desirable traits at different centres and superior lines were identified which could be used as a donor in the breeding programmes. Subsequently, 9 germplasm lines belonging to different *Vigna* and arid legume species were registered as unique germplasm/donors with ICAR-NBPGR during 2024-25. The details are given in Table below:

Germplasm maintenance and utilization

Pigeonpea

A total of 9,566 germplasm accessions were maintained in pigeonpea at 24 collaborating of the total collections; 379 accessions were of wild type belonging to 17 different species. During *kharif* 2024, a total of 1361 germplasm lines and 699 fixed pigeonpea breeding lines were evaluated for yield attributes.

Mungbean, Urdbean, Rajmash and Arid Legumes (Cowpea, Mothbean, Horsegram, Ricebean and Cluster bean)

During *Kharif* 2024, a total of 13,184 germplasm accession across 8 *kharif* pulses were

New trait-specific germplasm registered in *Kharif* pulses during 2024-25

S. No.	Centre	Registration No.	Crop	Genotype	Trait
1.	TNAU, Aduthurai	IC 642783	Urdbean	ADT 7	Rice fallow cultivation
2.	UAS, Bengaluru	IC 652010	Cowpea	KBC 12	High grain yield
3.	NAU, Navsari	IC 621812	Mungbean	GM 6	YMV resistance, quality
		IC 625667	Mungbean	GM 7	YMV resistance, high yield
		IC 627754	Urdbean	GU 3	YMV resistance, quality
		IC 638463	Cowpea	GVC 9	YMV resistance, quality
4.	CAZRI, Jodhpur	INGR 23049	Cluster bean	CAZG 106	Bold Seeded
5.	ANGRAU, Lam	IC 639816	Mungbean	LGG 607	Resistant to MYMV
		22151	Urdbean	LBG 884	MYMV resistance
6.	ICAR-NBPGR, New Delhi	IC 418452	Mungbean	INGR 25041	Resistance to Bean Common Mosaic Virus (BCMV)

maintained at different centres. These included 5,269 accessions of mungbean, 4,642 of urdbean, 1,128 of cowpea, 922 of horsegram, 690 of clusterbean, 292 of mothbean, 238 of rajmash and 3 of ricebean. These accessions were evaluated for different traits and trait-specific accessions were utilized for introgression breeding.

Agronomy

Pigeonpea

- **Standardization of plant spacing and fertilizer doses in hybrid pigeonpea:** Fertiliser dose, 25:50:25:20 NPKS kg/ha with bio-consortia (NPKZn) showed better performance over sole application of 15:30:15:20 NPKS and was at par with 30:60:30:20 NPKS kg/ha with bio-consortia at maximum locations in first year of experimentation.
- **Studies on weed management in pigeonpea with different herbicide molecules:** Carried out at 17 locations, EPoE Propaquizafop ethyl 2.5 %+ Imazethapyr 3.75 ME @ 125 g ai/ha, EPoE Imazethapyr 10% SL @ 100 g a.i /ha + Quizalofop ethyl 5%EC @ 50 g a.i /ha), EPoE Imazethapyr 35% + Imazomax 35% WG @ 100 g a.i /ha and PE Pendimathalin + Imazethapyr (RM) 32% EC @ 800 g a.i /ha showed better control of weeds in pigeonpea and also recorded significantly more pigeonpea seed yield over weedy check and other herbicides.
- **Studies on conservation agriculture in pigeonpea:** During the first year of experimentation, permanent raised bed (90 cm RB with 30 cm furrow) + mulching with 50% pigeonpea crop stalks practices recorded significantly more seed yield over conventional tillage at all locations except at Kalburgi.
- **Studies on performance of pigeonpea with Intercropping:** Pigeonpea + intercrop (2:4) (pigeonpea on 90 cm spacing and intercrop on 30 cm spacing on BBF) showed higher PEY (pigeonpea equivalent yield) at Badnapur, SK Nagar and was at par with 90 × 30 cm and 90-150 x 30 cm at Rahuri.
- **Evaluation of pigeonpea varieties for intercropping system:** Pigeonpea varieties Godawari (Badnapur), Trupti and Godawari (Rahuri), GT 108 (SK Nagar), IPA 15-6 (Kota and Rahuri), WRG 255 (Warangal), V1 (Kalaburgi), BRG 5 (Bengaluru), CO 9 (Coimbatore), PA 421 (Tripura), V2 (Nagaland) gave significantly more seed yield under intercropping.
- **Evaluation of long duration pigeonpea-based intercropping System:** On the basis of pooled results of three years, it can be concluded that, pigeonpea + urdbean (1:2) and pigeonpea + turmeric (1:2) recorded significantly higher pigeonpea equivalent yield and net return than sole pigeonpea. However, significantly higher B:C ratio than sole pigeonpea was associated with pigeonpea + urdbean (1:2). Higher productivity in pigeonpea + turmeric and for higher economic return pigeonpea + urdbean in 1:2 row ratios should be adopted under rainfed condition of Bihar.

Mungbean

- The nutrient management treatments, 75% NPKZn + soil application of NPKZn microbial consortia (2 kg/ha) fortified FYM @100 kg/ha, resulted in the highest grain yield (902.7 kg/ha), net return (₹ 45,892/ha) with a B:C of 2.42 in NEPZ.
- In NHZ, NWPZ, NEPZ and SZ, 75% RD of NPKZn + seed inoculation with NPKZn microbial consortia @ 50g per kg + NPK (19:19:19) @ 2% at pre-flowering and pod initiation stages of mungbean led to better crop performance.

Urdbean

- Application of 75% RD of NPKZn + seed inoculation with NPKZn microbial consortia @ 50 g per kg + NPK (19:19:19) @ 2% at pre-flowering and pod initiation stages of urdbean emerged to be the best integrated nutrient management practice all over the country except in the Central Zone where the treatment comprising 75% RD of NPKZn, seed inoculation with NPKZn microbial consortia @ 50 g per kg and Nano DAP (8% N+16% P_2O_5) @ 2 ml/l at pre-flowering and pod initiation stages performed well with respect to grain yield (944.2 kg/ha).
- In NWPZ, raised bed sowing (2 rows on raised bed) by bed planter was found to be the best sowing method in urdbean ultimately resulting in the highest grain yield (941 kg/ha), net return (₹ 37,079/ha)

and benefit-cost ratio (2.20).

Arid legumes

- 100% RDF + seed inoculation with microbial consortium (3-4 ml/kg seed) and soil application of microbial consortium @ 5 l/ha mixed with FYM created the better crop environment and thus, resulted in the highest grain yield of clusterbean (1274 kg/ha), net return (₹ 50,958/ha) and benefit–cost ratio (2.78) as well as that of cowpea (1,394.7 kg/ha, ₹ 97,216/ha, 3.92, respectively).
- In clusterbean, imazethapyr 35% + imazamox 35% WG @ 75 g a.i./ha at 15-20 DAS and propaquizafop 2.5% + imazethapyr 3.75% w/w ME @ 62.5 g a.i./ha at 15-20 DAS controlled the weeds by 83.06-84.03%. These two combo-formulations of herbicide molecules recorded grain yield of 1167.2 and 1118.3 kg/ha with a net return of ₹ 44,455 and 41,252/ha and benefit-cost ratio of 2.61 and 2.50, respectively.

Plant Pathology

The 2024-25 AICRP on *Kharif* Pulses Pathology programme screened pigeonpea, mungbean, urdbean, cowpea, clusterbean, mothbean, horsegram and rajmash across multiple locations to identify resistance to region-specific diseases like yellow mosaic, powdery mildew, bacterial leaf blight Cercospora leaf spot *etc*. The study aimed to identify stable resistance & reduce yield losses due to diseases. New fungicides were also tested for improved disease control.

Pigeonpea

- **Screening:** The AICRP on *Kharif* Pulses Pathology team conducted a multi-location screening of pigeonpea entries across 22 locations to evaluate resistance against major diseases including *Fusarium* wilt, Sterility Mosaic Disease (SMD), *Phytophthora* Stem Blight (PSB), *Macrophomina* Stem Blight (MSB), *Alternaria* Leaf Spot (ALS), and *Cercospora* Leaf Spot (CLS). For *Fusarium* wilt, data from 11 locations showed that no entry was consistently resistant across all the zones, though 36 entries exhibited moderate resistance. Notably, eight entries BDNPH 23-03, BDNPH 21-01, WRG 466, WRGE 178 AVT-1, WRGE 173, RPS 2015-49, IPAM 23-3, and IPAM-23-1 were moderately resistant across all the three zones, indicating their broad-spectrum potential. For SMD, tested across 11 locations (with data excluded from Rahuri and Dholi), no entry was found fully resistant across zones; however, BRA-303, MAL-13, MAL-65, MAL-70, and BRG-1 showed moderate resistance at more than one center.
- **Epidemiology**: Consistent cooler temperatures favour Phytophthora Stem Blight (PSB) development across most locations. At Nagaland and Tripura, despite heavy rains, PSB incidence remained low, likely due to low pathogen load. However, *Alternaria* Leaf Spot (ALS) in Nagaland increased under cooler conditions, with moderate influence from rainfall and sunshine. At Varanasi, PSB incidence rose as temperatures dropped, showing strong negative correlation with temperature. Similarly, S.K. Nagar, Ludhiana, Pantnagar, and Kalaburagi reported higher PSB under cool, dry conditions, with strong negative correlations to minimum temperature and humidity. In Sehore, the disease progressed during the early warm, wet season but plateaued as weather turned cooler and drier, indicating suppression under such conditions.
- **Management of wilt complex** in pigeonpea was studied at Khargone, Badnapur, Kalaburagi, and Kanpur which evaluated the effectiveness of eight bio-control treatments against wilt complex in pigeonpea. Among the treatments, T2 (Dalhanderma IIPRTh-31) showed the best performance, recording the lowest wilt incidence (11.76%) and the highest yield (1298 kg/ha).
- The effectiveness of seed dressing fungicides in managing seed and soil-borne diseases of pigeonpea was studied across 14 agro-climatic zones. Among the treatments, T6 (Thiophanate Methyl 45% + Pyraclostrobin 5% FS) and T5 (Carboxin 37.5% + Thiram 37.5% DS) emerged as the most effective, recording the highest seed emergence (87.03% and 87.44%, respectively) and significantly reducing the incidence of wilt, Phytophthora stem blight (PSB), and collar rot.
- In the ICAR-ICRISAT collaborative programme, 33 pigeonpea genotypes were

screened across India for resistance to major diseases Fusarium wilt, Sterility Mosaic Disease (SMD), and Phytophthora stem blight. Wilt data from 13 locations revealed two entries (ICPWSMD2213, ICPWSMD 2219) resistant at 10 sites, with several others showing resistance at 8–9 sites.

Mungbean, Urdbean

- During 2024-25, 86 mungbean entries were evaluated across regions for resistance to key diseases including Yellow Mosaic Disease (YMD), Cercospora Leaf Spot (CLS), Anthracnose, Powdery Mildew, Web Blight, Root Rot, and Bacterial Leaf Spot. YMD resistance was observed in BCM 20-5 AVT-1, MH 1762, and ML 1839 in the North Eastern Plain and South Zones. Moderate resistance was observed for CLS in VBN 5 and MGG 527. BCM 20-5 and MI 13-47 (AVT-1) were resistant to Anthracnose, while resistance to powdery Mildew and Web Blight was minimal. ML 1839 and OBGG 114 showed resistance against root rot. ML 1808 and ML 1839 were resistant to Bacterial Leaf Spot
- During the 2024, spring/summer season at Ludhiana, 56 urdbean entries were screened for MYMV resistance. Four entries *viz*. PU 2021, IPU 19-31, IPU 18-7, and IPU 19-53—remained disease-free, showing consistent resistance to YMD. PCR analysis of 14 YMD-affected samples from Ludhiana, Faridkot, and Ropar confirmed the presence of MYMIV, with a 950 bp amplicon detected in all the samples.
- Disease management studies showed that chemical fungicides were the most effective in both mungbean and urdbean. In mungbean, the control (T8) had the highest disease severity and the lowest yields (587 kg/ha for CLS, 554 kg/ha for Anthracnose).
- Powdery mildew management in mungbean and urdbean was studied at Vamban and Dharwad. The fungicide combination Azoxystrobin + Tebuconazole + Prochloraz (T1) was the most effective, showing the lowest disease severity and the highest yields—902 kg/ha (mungbean) and 925 kg/ha (urdbean) at Vamban; 542 kg/ha (mungbean) and 596 kg/ha (urdbean) at Dharwad.
- Another study monitored virus vectors, tracking whitefly and thrips populations from May to November across centres. Whitefly was low in May–June but increased from July, peaking in August–September, especially at Pantnagar, Vamban, and Dharwad. Bikaner recorded the highest count of 927 whiteflies in SMW 33. The population remained high through October and declined in November. Thrips population also mirrored whiteflies, starting low and rising from July, peaking in September–October. Pantnagar recorded 620 thrips (SMW 42) and Durgapura 405 (SMW 41).
- ***Rabi* season Mungbean**: During the season, mungbean entries were screened at five locations for disease resistance. For YMD, OBGG 118 was disease-free, PMD 20 was resistant, and IPM 14-10-3 and OBGG 116 were moderately resistant. LGG 628 (AVT-2) showed moderate resistance to Cercospora Leaf Spot. No resistance was observed for powdery Mildew. For Anthracnose, LGG 717 and LGG 628 were resistant. DGG 24-21 showed moderate resistance to stem necrosis. Leaf crinkle and bud necrosis were noted but not assessed due to low disease pressure.
- ***Rabi* season Urdbean:** Entries were also screened for disease resistance. For YMD, IPU 19-6 was disease-free, IPU 19-2 was resistant, and PBG 276 and LBG 1006 were moderately resistant. For CLS, VBG 21-018 and DBG 24-11 showed moderate resistance.

Arid legumes

- Twenty one cowpea entries were screened across nine locations for major diseases. No resistance was found for cowpea mosaic virus and dry root rot. KMC 14 and PGCP 90 were resistant to Anthracnose, with four entries being observed as moderately resistant. KMC 12, KMC 14, and VCP 18-007 were disease-free for Cercospora Leaf Spot.
- In clusterbean, 13 entries were screened for four major diseases. CAZG 20-38 showed moderate resistance to Alternaria leaf spot; while all others were susceptible.
- In mothbean, 13 entries were screened. For Cercospora leaf spot, CZMO 18-12 and CZMO 20-12 were resistant, and CZMO 21-8 was moderately resistant.

- A three-year study across four locations assessed yield losses in cowpea, clusterbean, and moth bean due to major diseases. Cowpea suffered up to 44.64% loss from dry root rot at Durgapura. Clusterbean showed 39.13% loss from Bacterial leaf blight at S.K. Nagar, while mothbean faced 33.89% loss from root rot at Bikaner.

  Conclusion: Yield losses in cowpea due to dry root rot to be 29.15 per cent, clusterbean due to bacterial blight to be 27.80 per cent, due to root rot is 33.89 per cent.

- Managing Macrophomina blight in mothbean across Bikaner, S.K. Nagar, and Mandor found T6 (ST + Nativo @ 0.5 g/l) to be the most effective in reducing disease with the yield of 570 kg/ha.

Entomology

Recommendations (Technologies):

- Two applications of *Beauveria bassiana* 1.15 WP @ 5 g/L followed by *Lecanicillium lecanii* 1.15 WP sprayed at 30 and 45 days DAS, were found to be highly effective against whitefly and leafhopper infesting mothbean.

- Two applications of Spiromesifen 240 SC (22.9%) @ 1.0 ml/L followed by Pyriproxyfen 10 EC @ 1.5 ml/L proved effective against leafhopper and whitefly infesting cluster bean.

Pigeonpea

Out of 256 genotypes of different maturity groups tested, 81 genotypes were promising with less pod damage due to pod borer complex and registered pest resistance rating (PRR) of 3 to 4 which were considered under resistant to moderately resistant category.

- Early duration test entry, WRGE 171 was categorized as resistant at S.K. Nagar and moderately resistant at Nagaland, Tripura and Khargone out of 13 centres evaluated in NEHZ, CZ & SZ.

- Early duration test entry RKPV 1156 was categorized as resistant at New Delhi and Pantnagar; NUPPC-6A was categorized as resistant at New Delhi and moderately resistant at Pantnagar; PA 739 was categorized as moderately resistant at New Delhi and Pantnagar.

- Early duration hybrid entry IPH 22-1 was categorized as resistant at Pantnagar and moderately resistant at New Dehi out of three locations tested in North Western Plain Zone.

- Medium early duration hybrid entry BDNPH 22-04 was categorized as moderately resistant at Bangalore, Warangal and Coimbatore; BDNPH 23-05 was resistant at Bangalore out of four locations tested in South Zone.

- **Evaluation of novel and combination insecticide molecules against pod borers :** Treatment T_2 (Chlorantraniliprole 9.30%+ SC+ Lamda Cyhalothrin 4.60% ZC) was found superior in reducing pod borer damage at Badnapur, Rahuri and Gulbarga; treatment T_5 (Fluxametamide 10%EC) was superior in reducing pod borer damage at Khargone, Coimbatore and Viringipuram; T_6 (Isocycloseram 9.2%DC) superior in reducing pod borer damage at Raipur and Guntur and treatment T_3(Novaluron 5.25%+ Emamactin benzoate 0.90%SC) was found superior in reducing pod borer damage at SK Nagar and Warangal.

- **Evaluation of Bio-pesticides against *Helicoverpa* and *Maruca* in pigeonpea:** The standard insecticidal check *i.e.* T6 (Chlorantraniliprole 18.5 SC @ 0.3 ml/lt) was the best treatment at all the locations tested except Khargone. Among the bio-pesticides tested, T_2 (BARC Bt. *kenyae* formulation (ISPC-1 baterium) was found effective in reducing the pod borer damage at Gulbarga, Guntur, Pantnagar; the treatment T_3 (*Metarhizium anisopliae* ($2x10^8$ CFU/ml)) was found superior among all bio pesticides tested at Khargone and Coimbatore.

Mungbean (*Kharif*)

- Fifty Seven test entries of mungbean along with local checks were evaluated during *Kharif* 2024 against major insect pests at 11 locations. Entry ML 1839 against whitefly and ML 818, MH 2-15, PKV AKM 4 and RM 03-79 were found to be promising against pod borer.

- Among 8 promising entries, PMS 8, Pusa 0672, SKNM 2105 and BCM 20-05 were found to be promising against pod borer.

- On the basis of two years' pooled data of 08

promising entries, the entries IPM 1603-7 against whitefly and ML 2748 & MH 1772 were found to be promising.

- In the experiment on the evaluation of insecticides against pod borer in mungbean, Chlorantraniliprole 18.5 SC @ 40 ml (20 g.a.i./ha) was found to manage the pod borer effectively and this treatment also registered the highest grain yield as well as incremental cost-benefit ratio.

Urdbean *(Kharif)*

- Fourty three test entries of urdbean along with local checks were evaluated during Kharif 2024 against major insect-pests at 09 locations. Entries PU 1920, RUG 310, PU 2021, PU 31 & PU 1921 performed well against whitefly while KUG 1065, & RUV 1308 were found to be promising against pod borer.
- Eight promising entries of urdbean along with local checks were evaluated against major insect pests at 09 locations. KU 96-3, Azad U1, IPU 18-02 and IU 311 were found to be promising against pod borer and whitefly.
- On the basis of two years' pooled data of 08 promising entries of *kharif* urdbean, entry KUG 941 and IPU 19-27 were found to be promising against pod borer and whitefly at Mohanpur, respectively.
- Treatment Diafenthiuron 50 WP @ 200 g (250 g a.i./ha) was effective in managing whitefly population and also registered the highest grain yield as well incremental cost-benefit ratio.
- In the experiment on Biointensive Pest management against *S. litura* in urdbean, among the biorational treatments NSKE 5% followed by *Bacillus thuringiensis* was found superior to manage larvae of *S. litura*. However, NSKE 5% followed by *Beauveria bassiana* showed the best cost benefit ratio among the treatments.

Rabi Mungbean

- Twenty test entries of mungbean along with local checks were evaluated against major insect-pests at four locations. LGG 630, VBN-2 and VBN -4 were found to be promising against pod borer at Vamban during *rabi* 2024-25.

Rabi Urdbean

- Seventeen test entries of urdbean along with local checks were evaluated against major insect- pests at three locations. KKB 15, LBG 1006 and MBG 1164 were found to be promising against pod borer at Vamban during *rabi* 2024-25.
- Field survey at farmer's field indicated that urdbean crop witnessed heavy incidence of *S. litura* at Lam centre. At Berhampur, pod borers (*M. vitrata* and *Lampides boeticus*) were found major insect-pests during reproductive stage. *Spodoptera litura*, leaf hopper and pod borers were found major problem during survey at Vamban.

Nematology

Mungbean and Urdbean

- Green gram lines *viz*., BCM 20-5 AVT-1, MI 2023-1 AVT-1, VBN 4, and VGG 20-157 AVT-1 showed moderate resistant to *M. incognita* and *M. javanica* at three locations.
- Black gram entries viz., Azad 3 (KU 96-3), IPU 94-1 (Uttara), Kota Urd 5, and PU 31 showed moderate resistant to *M. incognita* and *M. javanica* at three locations.
- Blackgram lines *viz*., Birsa Urd -2 and Kota Urd 4 showed moderately resistant reaction to *H. cajani* at two locations.
- Newer chemical Fluopyram 34.48 SC (Velum Prime) @ 0.625 lit. /ha. @ 5 DBS and @ 21 DAG (days after germination) followed by Treatment No. 1 *i.e.* Fluopyram 34.48 SC (Velum Prime) @ 1.25 lit. /ha. @ 5 DBS (days before sowing) was found to be the best for the management of root-knot nematode in mungbean at three locations.

Arid Legumes

- Twenty-one test entries of cowpea along with local checks were evaluated against major insect pests at five locations. Entries GC-7, IPCWP 2022-7, GC 2202, Pant Lobia -4 against whitefly, DC-15, GC 2202, KMC 12, Pant Lobia-4, PCP 0306-1 against leaf hopper and VCP 18007, TPTC-29, PGCP 90, and VCP 18-024 were found to be promising against pod borer.
- Among thirteen entries of clusterbean along with local checks, entries GD 591, CAZG 21-3, GG 2210, against white fly and leaf hopper

were found promising at Durgapura.

- The application of Spinetoram11.7 SC @ 0.8 ml/L and Flonicamid 50 WG @ 0.35 g/L were found effective against leafhopper and whitefly infesting cowpea. Additionally, Cyantraniliprole 10.26 OD @ 1.2 ml/L exhibited significant effectiveness in mitigating pod borer infestations.

Microbiology

Pigeonpea

- A total of 61 new rhizobial and endophytic bacterial isolates were obtained from active root nodules of pigeonpea from Akola (13), IIPR, Kanpur (23) Ludhiana (20) and Vamban (5) and screened for biochemical, functional and plant growth promoting potential. Ten isolates from IIPR, Kanpur were characterized using 16S rDNA sequencing and were found to belong to *Sinorhizobium* sp. Two isolates each from Akola (AKPR-1-23 & AKPR-9-23) and Kalaburagi (KRR-21-8 & KRR-21-2) were found to be promising for improving nodulation and plant growth.
- Based on overall mean across different locations, IIPR-PR315 produced the highest nodule number (19.7 nodules/plant), nodule dry weight (45.55 mg/plant), plant dry weight (5.13 g/plant) and grain yield (1090 kg/ha). The overall increase in the yield was 23 % over uninoculated control.
- Based on the mean of 2024-25 across different locations, *Rhizobium* + PPR-46 resulted in the highest nodule number (22.1 nodules/plant), nodule dry weight (54.89 mg/plant), plant dry weight (5.32 g/plant) and grain yield (1113 kg/ha). This was followed by KKR-3 with nodule number (19.4 nodules/plant), nodule dry weight (52.17 mg/plant), plant dry weight (5.28 g/plant) and grain yield (1099 kg/ha). The grain yield was 22.3 % and 20.8 % higher for PPR-46 and KKR-3 as compared to uninoculated control.
- Grain yield was the highest (967 kg/ha) in 100% RDF (N, P, K, & Zn) followed by 962 kg/ha in treatment 75% P + Biophos (N, K, & Zn full) which was 18.9% and 18.3% higher than absolute control.

Mungbean

- Akola, Kalaburagi, Kanpur, Ludhiana and Vamban isolated 59 new isolates (rhizobia and nodule endophytes).
- *Rhizobium* inoculation with AMR 5-21 (Akola) resulted in 21% higher grain yield over the uninoculated control.
- In multilocation testing, *Rhizobium* (Local best), recorded the highest mean values for majority of parameters. Other treatments, such as, *Rhizobium* + KGPR-8 (Kalaburagi), *Rhizobium* + VGGE-4 (Vamban) and *Rhizobium* + MR-1 (Pantnagar) also resulted in up to 25% increase in the yield as compared to un-inoculated control.

Urdbean

- Kanpur, Kalaburagi and Vamban centres isolated 31 rhizobial and non-rhizobial nodule endophytes.
- The highest mean nodule number (36.5 nodules/plant), plant dry weight (7.09 g/plant) and grain yield (935 kg/ha) were obtained in KUR 20-9 (Kalaburagi). In multilocation testing, KUR 20-9 (Kalaburagi) resulted in the highest and 21% more grain yield over the uninoculated control.
- Based on overall mean among different locations, the highest mean nodule number (32.6) and grain yield (948 kg/ha) was observed in *Rhizobium* + UN-1 (Pantnagar) followed by 32.3 (nodule number) and 935 kg/ha (grain yield), respectively by inoculation with *Rhizobium* + PUK-171 (Pantnagar). The increase in the yield was 5.3% (*Rhizobium* + UN-1 (Pantnagar)) and 3.8% (*Rhizobium* + PUK-171 (Pantnagar)) as compared to *Rhizobium* inoculation alone.

Breeder Seed

Pigeonpea

- In the breeder seed programme, a total of 482.6 q of pigeonpea breeder seed was produced during *Kharif* 2024 against the consolidated indent of 331.64 q for 56 varieties. Additionally, a total of 11.61 q of breeder seed was produced over and above the allocation for three varieties from two centres located across two states.

Mungbean

- A total of 473.3 q of mungbean breeder seed was produced during *Kharif* 2024 against the consolidated indent of 470.5 q for 65 varieties Additionally, a total of 8.5 q of breeder seed was produced over and above the allocation for three varieties from three centres located across two states.

Urdbean

- A total of 618.94 q of urdbean breeder seed was produced during *Kharif* 2024 against the consolidated indent of 636.61 q for 53 varieties. Additionally, a total of 10q of breeder seed was produced over and above the allocation for three varieties from one centre.

Arid legumes

- The breeder seed production programme was taken for 47 varieties of six arid legumes and a total of 204.1 quintals breeder seed was produced against the indent of 166.82 quintals

Frontline Demonstrations

Pigeonpea

- During *Kharif* 2024-25, a total of 827 ha of pigeonpea FLDs were planned while 807 were executed in four different components *viz.*, Package technology (722 ha), Intercropping of pigeonpea (45 ha), Integrated Pest Management (30ha) and Weed Control (30 ha) at 22 centres spread across 15 states.
- Under Package Technology, a total of 717 ha of FLDs recorded 22.89% higher yield (1271 kg/ha) as compared to the 1079 kg/ha from farmers' practice. The net return from the FLD was ₹ 61,201/-. Further, for every one-rupee cost invested 1.71 rupees of benefit was generated as compared to the B:C ratio of 1.43 in farmers' practice.
- Intercropping of pigeonpea with soybean and cotton (40 ha) as a system was 29.34% more profitable (1695 kg/ha) as compared to the sole crop of pigeonpea (1085 kg/ha). The increased B:C ratio for intercropping system was 7.4 rupees of additional income generated for every one-rupee investment.

Urdbean

- A total of 398.5 (73.25%) FLDs were executed against the 544 FLDs targeted to conduct during *Kharif* 2024.
- The data from the 398.5 Urdbean Full Package technology revealed 19.46% (159 kg/ha) and 32.51% (265 kg/ha) yield increase due to adopting full package urdbean cultivation technology over farmers and district/state average yields, respectively.

Mungbean

- A total of 150 (75.00%) FLDs were executed against the 200 FLDs targeted to conduct during *Kharif* 2024.
- The data from the 150 ha of urdbean full package technology revealed 14.65% (130 kg/ha) and 31.11% (275 kg/ha) yield increase due to adopting full package urdbean cultivation technology over farmers and district/state average yields, respectively.

Arid Legumes

- A total of 100 ha FLDs were planned under arid legumes for four crops *viz.*, cowpea (25 ha), clusterbean (30 ha), mothbean (30 ha) and horsegram (15 ha)
- Cowpea package technology FLDs recorded 18.08% (150 kg/ha) and 31.48% (263 kg/ha) higher yield over the farmers' practice and district average yield. Further the B:C and increased B:C ratio was 0.60 and 1.58, respectively.
- Cluster bean/guar package technology FLDs recorded 18.53% (175 kg/ha) of higher yield over the farmers' practice and Durgapura **was** the potential center for high yield (1283 kg/ha), followed by Gwalior (998 kg/ha). Further, the B:C and increased B:C ratio was 0.70 and 1.96, respectively.
- FLDs on mothbean package technology recorded 20.77% (126 kg/ha) higher yield as compared to the farmers' practice with B:C ratio of 1.02 in Bikaner.
- Total 6 ha horse gram package technology FLDs have revealed 15.00% (113 kg/ha) higher yield over farmers' practice.

Outreach Activities

Promotion of Pulses in North-East Region under ICAR-IIPR NER Sub-Plan

- During 2025, the institute worked in collaboration with various centres in the North East region including ICAR-ATARI, Guwahati; ICAR RC for NEH Region, Umiam, Meghalaya, CPGSAS (CAU) Umiam, Meghalaya; CoA & CHF (CAU) Pasighat, Arunachal Pradesh; Central Agricultural University, Imphal; Nagaland University, Medziphema, Nagaland; Kohima Science College, Jotsoma, Nagaland; Assam Agricultural University, Jorhat; Sikkim University, Gangtok; College of Agriculture, Agartala, Tripura; and Directorate of Agriculture, Govt. of Mizoram, for promotion of Pulses in NE Region under IIPR-NER Sub-Plan.
- Till the end of the second quarter of 2025, a total of 128 Farmers' Training Programmes (Capacity building/Skill development programmes) were conducted on Pulse Production Technologies under the 'Promotion of Pulses in NE Region' under the IIPR NER Sub-Plan. Over 162 numbers of demonstrations of pulse production technologies and 45 numbers of Awareness programmes/Exposure visits were conducted aiming for the promotion of pulse crops in the region. Apart from these, 351.1 q quality seeds of different pulse crops were also distributed to the farmers. Fertilizers, including bio-fertilizers, FYM and vermicompost were distributed to the tune of 1053.06 q whereas 20.89 q plant protection chemicals were distributed for combating insect-pests and diseases. In addition, 2103 numbers of petty equipment were distributed to the farmers aiding small agricultural operations in pulses cultivation.
- A visit was conducted by Dr. Anup Chandra, Sr. Scientist & Co-Nodal Officer (IIPR NER Sub-Plan) to monitor the demonstration plots in the Sabroom area of South Tripura district, Tripura. The area adjoining Bangladesh border is well-known for *Rajma* cultivation. He was accompanied by Dr. D.P. Awasthi, Dr. Saurav Das (Asstt. Professors, College of Agriculture, Tripura) and Mr. Sudhir Chandra Das, Superintendent of Agriculture, Hrishyamukh Agricultural Sub-Division along with the Sector Officer. On the occasion, a Farmers' Training-cum-Input Distribution Programme was also conducted at Uttar Sonaichhari wherein seeds of *Rajma* and lentil were distributed under the ICAR-IIPR NER Sub-Plan.



Farmers' Training Programmes (Capacity building/ Skill development programmes)



Dr. Anup Chandra, Sr. Scientist & Co-Nodal Officer (IIPR NER Sub-Plan) monitoring the demonstration plots

Women Friendly Technologies

IIPR Manual Weeder

Detailed description about the technology

Weeding is one of the important operations in crop production systems. The average yield reduction due to weeds is about 37%. Keeping this in mind, the ICAR-Indian Institute of Pulses Research, Kanpur has developed a mechanical manual weeder at the Crop Production Division. The manual wheel-hoe weeder has a multi-tool bar carrier for multiple attachments of blades of different sizes and shapes to cater needs of the weeding at different stages and types of the pulses crop. For row-to-row spacings of 30 cm, the blade of size 18 cm was fabricated, whereas for the row-to-row spacings of 25 and 22.5 cm, blade size of 12.5 cm has been fabricated.

Salient features of the technology

1. A multi-tool bar carrier for multiple attachments of blades of different sizes, cab be useful for weeding in 30 cm row-to-row spacings as well as 25 cm and 22.5 row-to-row spacings crops.
2. Tested in lentil and chickpea crops field, and showed a field capacity of 0.02-0.03 ha/h, weeding efficiency of 90% with draft requirement of 31 N.
3. It is gender friendly and can be operated by even a single woman farm worker.

The problems specific to farm women being addressed by this technology

Weeding in a squatting position using traditional *Khurpi* creates discomfort and pain in the palm and leg.

The field capacity of *Khurpi* is five times lower compared to developed weeder.

Weeder helps in improving working position as well as increase capacity.

Details about the adoption of the technology Number of farm women/ women entrepreneurs who have adopted it.

This technology has been adopted by farm women working at ICAR-IIPR, Kanpur farm, and demonstrated to the women farmers from Kanpur Dehat district.

Scientists/Institutions involved in developing/ refining the technology.

Dr. Man Mohan Deo, Scientist (SS); Dr. Prasoon Verma, Senior Scientist and Dr. Narendra Kumar, Head-cum-Principal Scientist, Crop Production Division, ICAR-Indian Institute of Pulses Research, Kanpur

Contact details from where farmers/stakeholders can procure the technology.

1. M/s Bharat Heavy Machines, G-20, Bajrang Bali Industrial Estate, Site-4, Panki, Kanpur-208 020. Mob: +91 9260957315 ,9839115497, 9336111261; E-mail: bhmgroup@gmail.com
2. M/s Tyaagi Implements and Manufacturer Private Limited, 4 A Shri Ram Vihar Colony, Patholi, Agra, Uttar Pradesh, 283105. Contact details: 8868061660



License fee and Other

₹ 25,000/- for licensing of technology and approx. ₹ 2,000/- for piece of technology



Checklist for assessing women friendliness of technology

S. No.	Statements	Yes	No
1	Is it generated by considering the preferences of both the genders?	Yes	
2	Does it consider physical parameters of both the genders?	Yes	
3	Does it fulfill the location-specific needs of both the genders?	Yes	
4	Is it compatible with the existing socio-cultural climate of the society?	Yes	
5	Is it easily accessible and affordable to both the genders?	Yes	
6	Is it simple to understand by both farm men and women?	Yes	
7	Is it easy to handle and operate by both farm men and women?	Yes	
8	Is it efficient to reduce the drudgery of both the farm men and women?	Yes	
9	Does it reduce the workload of women?	Yes	
10	Does it boost the efficiency and productivity of both the genders?	Yes	
11	Does it work with less and easily accessible inputs?	Yes	
12	Is it adoptable to the existing skills of both the genders?	Yes	
13	Is it flexible to get modified according to the needs of both the genders?	NA	
14	Is this technology suitable for increasing the income of farm women?	Yes	
15	Is this technology suitable for improving household nutrition?	NA	

IIPR-Herbicide Applicator

Detailed description about the technology

Herbicide application plays an important role in weed control in the pulse crop production system. The average yield reduction due to weeds is about 37%. For the application of systemic and non-selective herbicides, proper applicators are required to control the weeds. Keeping this in view, a herbicide applicator has been developed for the crops at a row spacing of 30 cm. The applicator having dimension l*b*h =105*54*111cm, consisted of a water tank of 4 litres, a roller (length=24 cm and diameter(φ)=5.8 cm), a delivery pipe (φ=1 inch) with valve and orifice type of nozzles. The discharge rate of the developed applicator has been calculated at the different valve openings of 6.25, 12.5, 25, 50, and 100% were found as 0.61±0.01, 0.97±0.02, 1.22±0.03, 1.80±0.06, and 5.29±0.02 litres per minute (lpm) respectively. The roller wetting capacity is 0.205±0.002 m^2/s. The field capacity of the applicator is 0.05-0.07 ha/h. It can also be used on field bunds to control the weeds. It has a weeding efficiency of 80-85%. It is a gender friendly equipment and can be also operated by women worker.

Salient features of the technology

1. A roller contact type of herbicide applicator that prevents the operator from exposure of chemicals as it does not spread it into the air.
2. Can be used for the application of non-selective systemic herbicide application in the crops which have shown at row-to-row spacings of 30 cm and more.
3. It has field capacity of 0.05 to 0.07 ha/h, weeding efficiency of 85 to 90%.
4. It is gender friendly and can be operated by even a single woman farm worker.



The problems specific to farm women being addressed by this technology

Weeding in a squatting position using traditional *Khurpi* creates discomfort and pain in the palm and leg. In the application of herbicides through knapsack sprayer, there is a chance of

exposure of harmful chemicals through air, the developed applicator prevents it. The applicator helps in improving working position as well as increase capacity of weeding.



Details about the adoption of the technology: Number of farm women/ women entrepreneurs who have adopted it

This technology has been adopted by farm women working at ICAR-IIPR, Kanpur farm, and demonstrated to the women farmers from Kanpur Dehat district.

Scientists/Institutions involved in developing/ refining the technology:

Dr. Man Mohan Deo, Scientist (SS); Dr. Prasoon Verma, senior scientist and Dr. Narendra Kumar, Head-cum-Principal Scientist, Crop Production Division, ICAR-Indian Institute of Pulses Research, Kanpur

Contact details from where farmers/stakeholders can procure the technology.

1. M/s Bharat Heavy Machines, G-20, Bajrang Bali Industrial Estate, Site-4, Panki, Kanpur-208 020. Mob: +91 9260957315 ,9839115497, 9336111261; E-mail: bhmgroup@gmail.com
2. M/s Tyaagi Implements and Manufacturer Private Limited, 4 A Shri Ram Vihar Colony, Patholi, Agra, Uttar Pradesh, 283105. Contact details: 8868061660

License fee and Other

₹ 25,000/- for licensing of technology and approx. ₹ 2500/- for piece of technology.

Any published document (technology document brochure/ technical bulletin/folder/ papers etc.) https://www.youtube.com/watch?v=G6xRq9ZFgsM.

Checklist for assessing women friendliness of technology

S. No.	Statements	Yes	No
1	Is it generated by considering the preferences of both the genders?	Yes	
2	Does it consider physical parameters of both the genders?	Yes	
3	Does it fulfill the location-specific needs of both the genders?	Yes	
4	Is it compatible with the existing socio-cultural climate of the society?	Yes	
5	Is it easily accessible and affordable to both the genders?	Yes	
6	Is it simple to understand by both the farm men and women?	Yes	
7	Is it easy to handle and operate by both the farm men and women?	Yes	
8	Is it efficient to reduce the drudgery of both the farm men and women?	Yes	
9	Does it reduce the workload of a women?	Yes	
10	Does it boost the efficiency and productivity of both the genders?	Yes	
11	Does it work with less and easily accessible inputs?	Yes	
12	Is it adoptable to the existing skills of both the genders?	Yes	
13	Is it flexible to get modified according to the needs of both the genders?	NA	
14	Is this technology suitable for increasing the income of farm women?	Yes	
15	Is this technology suitable for improving household nutrition?	NA	

Transfer of Technology

Training Programmes Conducted (January-December 2025)

S. No.	Duration	Training programme	Participants (Nos)	Co-ordinator
Sponsored farmer training programme				
1	17/03/2025-21/03/2025	Five days training programme on Improved pulse production technology for farmers from ATMA, Navada, Bihar	42	Dr. Ashis Ranjan Udgata
2	20/03/2025-22/03/2025	Three days training programme on R for beginners : A Hands- on approach to data analysis	16	Dr. Ashis Ranjan Udgata
3	10/11/2025-14/11/2025	Five days training programme on Improved pulse production technology for farmers from ATMA, Samstipur, Bihar	20	Dr. Devraj
4	19/11/2025-20/11/2025	Two days training program on Improved pulse production technologies for farmers from Ranchi, Jharkhand	41	Dr. Rekha Rani
5	25/11/2025-27/11/2025	Three days training programme on Improved pulse production technology and Value Chain for farmers from ATMA, Puniya, Bihar	8	Dr. Rekha Rani
6	03/12/2025-05/12/2025	Three days training programme on Improved pulse production technology ATMA, Banka, Bihar	19	Dr. Ashis Ranjan Udgata
		Total	**146**	
Training programme under Farmer FIRST project (January – December 2025)				
7	22/09/2025	One day training programme on Improved pulse production technology of *Rabi* Pulses, Kanuata Danda, Hamirpur	52	-
Training programme under Model Pulse Village project (January – December 2025)				
8	22/04/2025	One day training programme on 'Crop Protection technologies of Summer Mung bean 2025 at Kaurawa Village, Kanpur Dehat	47	-
9	22/04/2025	One day training programme on 'Crop Protection technologies of Summer Mung bean 2025 2025 at Ingwara Village, Kanpur Dehat	35	-
10	19/09/2025	One day training programme on Improved pulse production technology of *Rabi* Pulses, at Kandhi Village, Kanpur Dehat	121	-
		Total	**203**	
		Grand Total	**401**	

Exposure visits conducted (January - December 2025)

S. No.	Duration	Exposure visit	Participants (Nos)
1.	03/01/2025	Exposure visit of students from Fatehpur, UP	54
2.	05/02/2025	Exposure visit of farmers from Prayagraj, UP	33
3.	17/02/2025	Exposure visit of farmers from Jhansi, UP	25
4.	25/02/2025	Exposure visit of farmers from Fatehpur and Kanpur Dehat, UP	18
5.	28/02/2025	Exposure visit of farmers from Gorkhpur, UP	50
6.	05/03/2025	Exposure visit of farmers from UP	21
7.	07/03/2025	Exposure visit of farmers from Deoria, UP	50
8.	10/03/2025	Exposure visit of farmers from Jhansi, UP	28
9.	11/03/2025	Exposure visit of farmers from Fatehpur, UP	33
10.	11/03/2025	Exposure visit of farmers from Kannauj, UP	50
11.	13/03/2025	Exposure visit of farmers from Damaoh, MP	23
12.	20/03/2025	Exposure visit of farmers from Chhatarpur, MP	10
13.	22/03/2025	Exposure visit of farmers from Vidisha, MP	100
14.	23/03/2025	Exposure visit of farmers from Damaoh, MP	6
15.	27/03/2025	Exposure visit of farmers from Satna, MP	101
16.	20/06/2025	Exposure visit of farmers from Fatehpur, UP	50
17.	13/08/2025	Exposure visit of farmers from Kanpur Nagar, UP	40
18.	11/09/2025	Exposure visit of student from Prayagraj, UP	01
19.	08/10/ 2025	Exposure visit of farmers from Unnao district,UP	40
20.	07/10/2025	Exposure visit of farmers from Kalahandi district, Odisha	45
21.	27/10/2025	Exposure visit of farmers from Satna district, MP	10
22.	04/11/2025	Exposure visit of students from Fatehpur, UP	25
23.	06/11/2025	Exposure visit of farmers from Kanpur Dehat, UP	50
24.	11/11/2025	Exposure visit of farmers from Fatehpur, UP	33
25.	13/11/2025	Exposure visit of farmers from Shahjahanapur, UP	20
26.	17/11/2025	Exposure visit of students and faculty from Hamirpur, UP	123
27.	17/11/2025	Exposure visit of students and faculty from Hamirpur, UP	113
28.	27/11/ 2025	Exposure visit of students from Axis College, Kanpur Nagar	110
29.	03/12/2025	Exposure visit of farmers from Damoh district, Madhya Pradesh	20
		Total	**1282**

Farmer- Scientist interaction conducted (January 2025- December 2025)

S. No.	Duration	Particular	Participants (Nos)
Farmer FIRST Project			
1	07/05/2025	Farmer-Scientist interaction at Kanuta Danda, Hamirpur	30
2	09/05/2025	Farmer-Scientist interaction at Khadra, Fatehpur	48
Field Day			
3	25/02/2025	Field Day on *Rabi* Pulses 2025 at Kanuta Danda, Hamirpur	108
Model Pulse Village project			
4	13/02/2025	Field Day on *Rabi* Pulses 2025 at Kandhi, Kanpur Dehat	129
		Total	**315**

Training of SMS/Heads & KVK staff

S. No.	Capacity building programme	Sponsoring agency	Period	Participants (Nos)
1	Improved pulse production technology of summer pulses	ICAR under project ensuring pulses sufficiency in India by capitalizing the Model Pulse Village	March 24-25, 2025 (2 days)	30
2	Plant protection technologies and post-harvest management of *Kharif* pulses	ICAR Under Project Ensuring pulses sufficiency in India by capitalizing the Model Pulse Village	September10, 2025 (1day online)	20

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- Kodandaram, M.H., Rachana, R.R., Gotyal, B.S., Nagaratna, W., Sabale, P.R., Manu, B. and Revanappa, S.B. 2025. Mixed composition of thrips species diversity in mungbean and cowpea. *Pulse News Letter*, IIPR, Kanpur.
- Kodandaram, M.H., Nagaratna, W., Sabale, P.R., B. Manu., B, Revanappa, S.B. 2025. Microbial and botanical based biopesticides for management of pod borer, *Maruca vitrata* (Pyralidae: Lepidoptera) in cowpea. 2nd Int. Conf. on Biological Control, ICAR–NBAIR, Bengaluru, Book of Abstracts p247.
- Kodandarama, M.H., Nagaratna, W., Sabale, P.R., Manu, B. and Revanappa, S.B. 2025. Microbial and botanical based biopesticides for management of pod borer *Maruca vitrata* (Pyralidae: Lepidoptera) in cowpea. In Second International Conference on Biological Control: Biocontrol Contributions to One Health, held at ICAR-NBAIR, Bengaluru,India from 25th–28th February 2025.
- Manu B. and Saabale P.R. 2025. Atmanirbharategagi IIPR mini dal mill article. *Krishi Munnade* 38(3): 5–7.
- Manu, B., Bhavani, Saabale P.R., Revanappa S.B., Parihar A.K. and Monika, P. 2025. Genetic variability analysis of advanced breeding lines for earliness in cowpea (*Vigna unguiculata* (L.) Walp.). *IIPR News letter*.
- Manu, B., Bhavani, Saabale P.R., Revanappa S.B., Parihar A.K., Kodandaram M.H. and Patil S.L. 2025. Identification of moderately resistant genotypes of cowpea for dry root rot disease under artificial inoculation in field and glasshouse conditions. *IIPR News letter*.
- Manu, B., Malav, P.K. and Bhatt, K.C. 2025. Plant germplasm exploration for collecting cultivated and CWR of pulses conducted at Chamarajanagar and Ramnagara districts of Karnataka. *IIPR News letter*.
- Manu, B., Bhavani, Jayashree, U., Saabale, P.R., Revanappa, S.B., Kodandaram M.H., Patil S.L. 2025. Evaluation of advanced breeding lines of cowpea (*Vigna unguiculata* L. Walp) for protein quality. Presented at International conference on recent advances in food science and technology. UHS Bagalkot.
- Naik, B.S.., Dupdal, R. and Patil, S.L. 2025. Rejuvenation of Low Yielding Bore Wells Vis-à-vis Ground Water Augmentation through Recharge Filter in Semi –Arid Region of Karnataka. International Conference on Traiblazing Trends in Sustainable Climate-Resilient Precision Agriculture through Artificial Intelligence and Remote sensing 23rd -24th January-2025. pp.21.

- Patil, S.L., Ramesha, M.N. and Reddy, K.K. 2024. Watershed Management Techniques for Climate Resilient Agriculture: Monitoring and Evaluation. pp.705-707. Cutting-Edge Solutions in Science-Agriculture, Technology, Engineering and Humanities (CSATEH-2025).
- Ramesha, M.N., Prabhavathi, M., B. Rao, K.B., Patil, S.L., Raizada, A., Naik, B.S., Kumar, M.P. and Ratha, K.P. 2025. Prosopis pallida on saline sodic soil-an agroforestry technique to be deployed for reclamation in semiarid tropical region of south India. In: Extended Summaries of 2nd International Conference on Rainfed Agriculture: Building Pathways for Resilience & Sustainable Livelihoods to be held on 29-31 January, at ICAR-Central Research Institute for Dryland Agriculture Hyderabad. Telangana, India (eds. Rama Rao *et al*). pp 1259-1261.
- Ramesha, M.N., Prabhavathi, M., Rao, K.B., Patil, S.L., Raizada, A., Naik, B.S., Kumar, M.P. and Ratha, K.P. 2025. Prosopis pallida on saline sodic: an agroforestry technique to be deployed for reclamation in semi-arid tropical region of south India. Extended Summaries 2nd International Conference–RainAgriculture: Building pathways for Resilience & Sustainable Livelihoods. pp.1259-1261.
- Rout, A. K., Anithaa, V., Chandra, A., Sujayanand, G. K., Baig, M. M., & Kumar, R. (2025). *Ecological impact of insecticides.* In A. Anokhe & G. K. Dinesh (Eds.), *Insecticides: Detection, management, and environmental impact* (pp. 193–216). Nova Science Publishers. https://doi.org/10.52305/ZSFQ1341.
- Sujayanand, G. K., Chandra, A., Rout, A. K., Dubey, P., & Jagadeeswaran, R. (2025). *Coreidae: Pod bugs emerging insect pest in legume crops and its management*. **Indian Farmer, 12**(9), 517–521. ISSN: 2394-1227.
- Shanmugavadivel, P.S., Saable, P.R., Yadav, G., Bohra, A., Kumar, S., Konda, A.K., Manu, B. and Dixit, G.P. 2025. BSA-Seq approach for identification of candidate genomic regions linked with sterility mosaic disease (SMD) resistance in pigeonpea. International Conference on One Health Perspectives in Global Plant Protection Research 2025 held from TNAU Coimbatore.
- Venkatesh, M.S., Patil, S.L., Revanappa, S.B., Hazra, K.K. and Kumar, N. 2025. Unveiling the Variations for Phosphorous Use efficiency in Mungbean Genotypes on Inceptisols of Northern Transitional Zone of Karnataka. Extended Summaries 2nd International Conference–Rain Agriculture: Building pathways for Resilience & Sustainable Livelihoods. pp.249-252.
- Vinaykumar, B.B. and Patil, S.L. 2025. Integrated nutrient management of maize-chickpea cropping system in vertisols of the SAT of South India. 8th Post Graduate Research Cconference-2025, organised by UAS Dharwad from 17-18th July, 2025. pp.111.

Training and Capacity Building

Participation /Papers presented in Conferences/ Seminars/Symposiums/International/National symposia attended/ Lectures delivered etc.

- Kumari N, Nagar N, Ghritlahre S, Datta D, (2025). Unveiling the etiology of powdery mildew in mungbean and screening for its resistance, in a national symposium "Frontier in plant health management: Integrating research, technology and sustainability" under theme; Revising pathogen biology and host pathogen interactions, during Nov. 18 – 20, 2025, pp. 123
- Dr. Surendra Ghritlahre participated as as External Examiner in a practical examination of B.Sc. (Agriculture) students at Department of Agriculture Sciences, IES University, Bhopal on on January 10, 2025
- Dr. Surendra Ghritlahre participated in ANRF sponsored three-day workshop on, "Molecular Strategies for Heterologous Gene Expression and Protein Purification", scheduled from March 17–19, 2025, at ICAR-IIPR, Kanpur.
- Dr. Dibendu Datta, Dr. Gitanjali Sahay, Dr. Archana Singh, Dr. Surendra Ghritlahre and Dr. Nidhi Kumari participated in "*Viksit Krishi Sankalp Abhiyan kharif* 2025" from May 29, 2025 to June 12, 2025 in Ashta block of Sehore district, M.P.
- Dr. S.K. Ghritlahre participated as an expert in the programme entitled "Working Group Meeting (WGM) for development of curriculum for the job role of Quality Seed Grower at PSSCIVE, Bhopal from Sep. 30 to Oct. 01, 2025 at PSS Central Institute of Vocational Education, Bhopal.
- IIPR Regional Station Bhopal scientists participated in Celebration of World IP day on 2nd May, 2025 at at ICAR-IIPR, Kanpur.
- Dr. Surendra Ghritlahre participated the Stakeholder Consultation Workshop on Strengthening the Seed Supply Chain held at the State Institute of Agriculture Extension & Training (SIAET), Bhopal, Madhya Pradesh, on 16th May 2025.
- Dr. Surendra Ghritlahre and Dr. Nidhi Kumari participated the Stakeholder Consultation Event on Strengthening Seed Supply Chain held at Jehan Numa Palace Hotel, Bhopal, Madhya Pradesh 17th September 2025.
- Dr. Surendra Ghritlahre and Dr. Nidhi Kumari participated the Stakeholder Consultation Event as a subject matter specialist on ***Mission Sunehra Kal*** programme in Madhya Pradesh held at R.A.K. Krishi Maha Vidyalaya Evam Krishi Anusandhan Kendra, Sehore, 4th November 2025.
- Dr. Surendra Ghritlahre participated an expert from IIPR, RS Bhopal for *Janjatiya Gaurav Diwas* programme and farmer–scientist interaction session in Raisen District on November 15, 2025.
- Chatti D, Jha U, Warburton ML, Nayyar H, Ghatak A, Siddique KHM, Schapaugh WT Jr and Prasad PVV. 2025. Heat stress-induced metabolomic shifts in chickpea (*Cicer arietinum* L.) flowers: insights from contrasting genotypes. Abstract presented at CANVAS 2025, Salt Lake City, Utah. https://scisoc.confex.com/scisoc/2025am/meetingapp.cgi/Paper/170325.
- Vaibhav Kumar participated in the International Conference on "World Congress Climate Change and Its Effects" by CCIE 2025 on September 06-08, 2025.
- Kalpana Tewari participated in the International Conference on "World Congress Climate Change and Its Effects" by CCIE 2025 on September 06-08, 2025.
- Vaibhav Kumar delivered a lecture on "*Manav Aahar ke liye Dalon ka Poshan Mahatva*" in a four-day training program on "Improved Pulses Production Technologies" held during November 10-14, 2025, at the Division of Social Sciences, ICAR-IIPR, Kanpur, for farmers from Bihar.
- Kalpana Tewari delivered a lecture on "*Manav Aahar ke liye Dalon ka Poshan Mahatva*" in a four-day training program on "Improved Pulses Production Technologies" held during march 17-21, 2025, at the Division of Social Sciences, ICAR-IIPR, Kanpur, for farmers from Bihar.
- Dr. Surendra Ghritlahre delivered a lecture on "Major important pulses varieties of

Central India and their package of practice" at IIPR Regional Station, Phanda, Bhopal during visit of DAESI (Diploma in Agricultural Extension Services for Input Dealers) trainees on January 29, 2025.

- Dr. Dibendu Datta, Dr. Gitanjali Sahay, Dr. Archana Singh, Dr. Surendra Ghritlahre and Dr. Nidhi Kumari delivered lectures on pulses crop development on farmers training programme organized at IIPR regional Station, Phanda, Bhopal during February 11–13, 2025.
- Dr. Dibendu Datta and Dr. Surendra Ghritlahre provided a "hands-on exposure and practical insights into pulse processing" to 40 trainees who visited to IIPR Regional Station Phanda, Bhopal on March 21, 2025. The trainees visited our station under five-day training programme entitled **"Training on Value Chain Development of Soybean and Pulses,"** were organized from March 17-21, 2025, for farmers and members of FPOs from Wardha, Maharashtra.
- Dr. Dibendu Datta, Dr. Gitanjali Sahay, Dr. Archana Singh, Dr. Surendra Ghritlahre and Dr. Nidhi Kumari delivered lectures on pulses crop development on farmers training programme organized for Maharashtra farmers at IIPR regional Station, Phanda, Bhopal during June 02–04, 2025.
- Dr. Surendra Ghritlahre delivered a lecture on "Major important pulses varieties of Central India and their package of practice and production of pulses quality seed & seed-hub programme" at IIPR Regional Station, Phanda, Bhopal during visit of DAESI (Diploma in Agricultural Extension Services for Input Dealers) trainees on August 22, 2025.
- IIPR Regional Station scientist delivered lecture on an on-line training program on "Crop Protection and Post-harvest Technologies for *kharif* Pulses" were conducted on September 30, 2025 for SMS/Head of KVKs engaged in Model Pulse Village Project from MP and Chhattisgarh state in collaboration with ICAR-ATARI, Jabalpur.
- Dr. Dibendu Datta and Dr. Surendra Ghritlahre the training programme for development of Master Trainers under *Rashtriya Karmayogi Jan Seva Programme* Phase II (Zone 1) held between October 6-8, 2025 (3 days) at ICAR-CIAE Bhopal.
- Dr. Gitanjali Sahay delivered Invited Lecture entitled, "Genetic improvement of chickpea and their role in enhancing pulse production in Madhya Pradesh" at Rabindra Nath Tagore University, (ICAR accredited) Raisen, Bhopal on April 25, 2025.
- "*Dalhani Faslon Mein Pramug Keet Aur Unki Prabandhan*" at FPO connect 2.0 event on September 29, 2025.
- "Insect pest management in *kharif* pulses cultivation" in Online Training on " Crop Protection and Post Harvest Technologies for Kharif Pulses, Bhopal on September 30, 2025
- "*Dalhani Faslon Mein Keet Prabandhan Takniki*" for Unnat dalhan uthpadan takniki (ATMA-Banka), Bihar on Decvember 05, 2025
- "*Dalhani Faslon Mein Keet Prabandhan Takniki*" for Unnat Dalhan Uthpadan Takniki for farmers from Jharkhand on November 20, 2025
- "Insect pest-dynamics in pulse crops with respect to climate change and its management" in ICAR-Sponsored Winter School on "Advances in Production and Post-production Technologies in Pulses for Achieving Self-Sufficiency, Food and Nutritional Security" at ICAR-Indian Institute of Pulses Research, Kanpur on February 05, 2025
- "Effect of climate change on population dynamics of crop pests with special reference to pulse crops" in online-mode at CCSHAU, Hisar on February 14, 2025
- "Technologies for insect-pests management in *kharif* pulses" in "Plant Protection Technologies and Post-Harvest Management in *Kharif* Pulses" organized for KVK SMSs of UP, Bihar and Jharkhand, under the project "Ensuring Pulse Sufficiency in India by Capitalizing the Model Pulse Village Approach" on 10th and 15th September 2025
- "*Rabi Dalhanee Fasalon Mein Keet Prabandhan Takneekee*" for *Unnat Dalhan Utpaadan Takneek, Kisan Prashikshan Kaaryakram* (Samastipur, Bihar) on 12 November 2025

- "*Dalhanee Fasalon Mein Keet Prabandhan Takneekein*" for *Unnat Dalhan Utpaadan Takneek* (ATMA) at Gopalganj, Bihar on 10 December 2025.
- Delivered lecture on 'insect-pest management in long term storage of pulses' in 21 days ICAR sponsored winter school "Advances in production and post-production technologies in pulses for achieving self-sufficiency, food and nutritional security" held between 29th January to 18 February 2025 at ICAR-IIPR, Kanpur.
- Delivered lecture on '*Dalhani Faslo Mein Bhandaran Keet Prabhandan Takniki*' in five days training programme on '*Unnat Dalhan Utpadan Takini*' organized for farmers of Bihar by ICAR-IIPR, Kanpur between March 17-25, 2025.
- Severity of nematode infestation in pulse crops in India and IPM modules for its management in ICAR-Sponsored Winter School on "*Advances in Production and Post-Production Technologies in Pulses for Achieving Self-sufficiency, Food and Nutritional Security*" during January 29, 2025 to February 18, 2025 held at ICAR-IIPR, Kanpur.
- Joshi, Khyati, Saravanan Matheswaran, Pritish Kumar Varadwaj, Aravind Kumar Konda, and G.P. Dixit. "Genome-wide comparative codon usage analysis in eleven grain legumes reveals distinct patterns between warm-season and cool-season legumes." Paper presented at National E-Conference on Frontiers in Agricultural, Veterinary and Biological Sciences-FAVBS-2024, March 8-9, 2025.
- Singh, Vishal, Velu Mani Selvaraj, Sujayanand G.K., Anup Chandra, Aravind Kumar Konda, and G. P. Dixit. "Unveiling the Genetic Diversity of *Bemisia tabaci* Infesting Pulse Crops in India." In: Frontier Sciences and Technologies in Agriculture for A Developed India (Book of Abstracts), edited by K. P. Singh *et al.*, Vol. II, 411-819. Pantnagar: GBPUAT, 2025.
- Dr. Aravind Kumar Konda presented a poster on, "CaSVP genes as candidate genes for CRISPR/Cas-based functional genomics to engineer early flowering trait in chickpea" in the International Conference on Developments in Plant Biology and Biotechnology, organized by Department of Plant Sciences, University of Hyderabad during January 29-31, 2025 at University of Hyderabad, Hyderabad.
- "Trichoderma: A Journey from pulse crop to broader agriculture application". National Conference on Emerging Issues and Sustainable Strategies in Plant Health Management: A global perspective March 19-21, 2025, Nagpur, Maharashtra, India.
- "Molecular analysis of disease-responsive genes revealing the resistance potential against *Fusarium* wilt (*Fusarium udum* Butler) Dependent on genotypic variability in pigeonpea". National Conference on Plant Microbe Interaction for Sustainable Agriculture and Food Security and IPS (MEZ) Meet from Jan 3-4, 2025, Jhansi
- *Akhil Bharatiya Kisan Mela & Krishi Udyog Pradarshani* CSAUA&AT, Kanpur on November 5-6, 2025
- "Boosting Pulse Productivity in Tripura: Evidence from Technology-Driven Demonstrations". International Conference on "The pursuit for sustainable hill farming: Innovations for profitability and ecological balance to ensure a future livelihood (PASEL-2025) held during at November 20-21, 2025, Agartala, Tripura.
- Workshop on "Integrative Taxonomic Approaches for Identification of Whiteflies and its Associated Natural Enemies" at ICAR-NBAIR, Bengaluru on September 29-30, 2025
- Meeting on "Encouraging cultivation of Potatoes and Pulses in Assam'-organized by Department of Consumer Affairs, Govt. of India on July 4, 2025
- Meeting on "Encouraging Cultivation of Potatoes/Pulses in Tripura"-organized by Oral presentation at international Conference on "One Health Perspectives in Global Plant Protection Research" at TNAU Coimbatore on February 19-21, 2025
- Oral presentation at Second International Conference on Biological Control: Biocontrol Contributions to One Health. Organized by Society for Biocontrol Advancement & ICAR–National Bureau of Agricultural Insect Resources at ICAR–National Bureau of Agricultural Insect Resources, Bengaluru

on February 25–28, 2025

- U.P. State pest Surveillance and Advisory Unit Meeting at Krishi Bhavan, Lucknow on 21 March 2025
- 30th Annual Group Meet of All India Coordinated Research Projects on *Rabi* Pulses at ICAR-RLBCAU, Jhansi during August 19-21, 2025
- National Symposium on Technological Advancements: Emerging Trends in Entomology (ESI-ETE-2025) at SKUAST-Kashmir, Srinagar on October 8-9, 2025
- Second International Conference on Biocontrol Contributions to One Health 2025, jointly Organized by ICAR-National Bureau of Agricultural Insect Resources & Society for Biocontrol Advancement. Bengaluru, India on February 25-28, 2025
- Dr. Narendra Kumar participated in National Workshop on 'Strategies and Approaches for Greening Rice Fallow Areas' held during January 3-4, 2025 at ICAR-Research Complex for Eastern Region, Patna, Bihar.
- Dr. Narendra Kumar participated in National Seminar on 'Progressive Agriculture - Viksit Bharat: Preparedness for Eastern Region (PAVER 2025)' February 21-23, 2025, ICAR-RCER, Patna, Bihar.
- Dr. Narendra Kumar and Dr. CP Nath attended Sixth International Agronomy Congress is "Re-envisioning Agronomy for Smart Agri-food systems and Environmental Stewardship" held during November 24-26, 2025 at CSIR-National Physical Laboratory, New Delhi.
- Dr. Mohammad Hashim participated in 1st international farming systems conference (IFSC 2025) on 'Transforming Food, Land and Water Systems under Global Climate Change' on March 7-9, 2025 at ICAR–Indian Institute of Farming Systems Research Modipuram, Meerut, Uttar Pradesh, India.
- Dr. Man Mohan Deo participated and presented an oral presentation in the 1st international farming systems conference (IFSC 2025) on 'Transforming Food, Land and Water Systems under Global Climate Change' on March 7-9, 2025 at ICAR–Indian Institute of Farming Systems Research Modipuram, Meerut, Uttar Pradesh, India.
- Dr. Aravind Kumar Konda (Course Director) organized Anusandhan National Research Foundation(ANRF, formerly SERB) sponsored 3 days training program on,"Molecular strategies for Heterologous gene expression andprotein purification", held during March 17-19, 2025 at IIPR, Kanpur.
- Dr. Aravind Kumar Konda (Course Director) organized Anusandhan National Research Foundation (ANRF, formerly SERB) sponsored 3 days, "Hands-on Training on Whole Genome and Transcriptome Analysis of Plants", held during November 17–19, 2025, at ICAR-IIPR, Kanpur.
- Dr. Aravind Kumar Konda presented a poster on, "CaSVP genes as candidate genes for CRISPR/Cas-based functional genomics to engineer early flowering trait in chickpea" in the International conference on Developments in Plant Biology and Biotechnology, organized by Department of Plant Sciences, University of Hyderabad during January 29-31, 2025 at University of Hyderabad, Hyderabad.
- Meenal Rathore attended iGOT *Karmayogi Training* in Leadership in Project management by ATI, Mysore on November 29, 2025
- Jat, R. L., Rolaniya, L.K., Hasim, M., Nath, C.P., Datta, A., Punia, M., Agarwal, S.K., Kumar, S., & Dixit, G.P. (2025). Organic farming and crop rotation strategies for sustainable pulse production in arid ecosystem. In Extended summaries: 6th International Agronomy Congress, November 24–26, 2025, India, Re-envisioning Agronomy for Smart Agri-food Systems and Environmental Stewardship (Vol. 2, pp. 526–527). The Indian Society of Agronomy, IARI.
- Rolaniya, L.K., Jat, R.L., Lal, B., Kumar, N., Punia, M., Kumar, S., & Aggarwal, S. K. (2025). Resource conservation technologies enhance productivity and economics of pulse-based cropping systems in western Rajasthan. In Extended summaries: 6th International Agronomy Congress, November 24–26, 2025, India, Re-envisioning Agronomy for Smart Agri-food Systems and Environmental Stewardship (Vol. 2, pp. 528–529). The Indian Society of

Agronomy, IARI.

- Lal B, Meena SK, Gautam Priyanka, Kumar S, Kumar N, Bishnoi RK (2025). Bioregulators as a solution to improve moth bean growth and productivity in hot arid India. In: Compendium of Extended Summaries: Second International Conference on Rainfed Agriculture: Building Pathways for Resilience & Sustainable Livelihoods during January 29-31, 2025 at ICAR-CRIDA, Hyderabad, pp 293.
- Gautam Priyanka, Lal B, Sawal RK, Rakshit S, Yadav VK (2025). Identification of Suitable food-fodder Intercropping System under Hot Arid Region of Rajasthan. In: Compendium of Extended Summaries: Second International Conference on Rainfed Agriculture: Building Pathways for Resilience & Sustainable Livelihoods during January 29-31, 2025 at ICAR-CRIDA, Hyderabad, pp 1147.
- Dr. Sudheer Kumar delivered an invited talk on Technological Integration for Enhancing Productivity & Income of Farmers- ICAR & Industry Perspectives in the Technical Session during Annual Zonal Review Workshop of KVK's of Rajasthan, Haryana & Delhi (November 12-14, 2025) at MPUAT, Udaipur.
- Dr. S.K. Aggrawal delivered a lecture on "Integrated Disease Management in Kharif Pulses" under one day online training programme on "Plant Protection Technologies and Post Harvest Management in *Kharif* Pulses for Rajasthan and Haryana state" under "Ensuring Pulses Sufficiency in India by capitalizing the Model Pulse Village Approach" on September 15, 2025.
- Dr. Sudheer Kumar, Head, IIPR, RC, Bikaner participated in the Brainstorming on "Microbial Solutions for Soil and Plant Health: Aligning Science with Policy Imperatives" organized by ICAR-NBAIM and the Crop Science Division, ICAR, on September 1, 2025, NASC Complex, New Delhi
- Dr. Sudheer Kumar, Head IIPR, RC, Bikaner Co-chaired Brainstorming Session on Technological Advances for frontline extension in Oilseeds, Pulses, Seed Spices, Horticulture & Livestock organized by ICAR-ATARI, Zone-II, Jodhpur (Rajasthan) and MPUA&T, Udaipur on November 12, 2025 at MPUA&T, Udaipur.
- Dr. S.K. Aggrawal attended winter school training on "Organic Farming Practices in Agriculture for Climate Resilience and Mitigation" during March 11-19, 2025 at SKRAU Bikaner.
- Dr. Devraj participated in *Vikshit Krishi Sankalp Abhiyan* in different villages of Kannauj and Auraiya during May 29, 2025 to 12.06.2025.
- Dr. Devraj attended online training programme on "Impactful AI Tools in Agriculture" organized by ICAR-NAARM, Hyderabad during September 15-19, 2025.
- Dr. Devraj participated in Technical program formulation meeting of Spring, Summer and Rice fellow Pulses (Mungbean, Urdbean, Cowpea) and *Kharif* Pulses organized by ICAR-IIPR, Kanpur on November 12, 2025.
- Dr. Devraj participated in *Akhil Bhartiya Kisan Mela & Krishi Udyog Pradarshani* organized by CSAUA&T, Kanpur on November 5-6, 2025.
- Hemant Kumar attended a training on Taining of Master Trainers on Vigilance Perspective" during November 17-19, 2025 at NAARM, Hyderabad
- Dr. Ashis Ranjan Udgata attended Workshop on "Deep Bioinformatics Boot camp- season 2, Theme- Transcription Regulation conducted by CSIR-Institute of Himalayan Bioresource Technology, Palampur, Himachal Pradesh during February 18-21, 2025
- Ashis Ranjan Udgata attended training programme on Foundations of Computable General Equilibrium (CGE) Modelling for Economic Policy Analysis conducted by ICAR-NAARM, Hyderabad during June 23-27, 2025.
- Ashis Ranjan Udgata attended Online Training Programme on Impactful AI Tools in Agriculture conducted by ICAR-NAARM, Hyderabad during September 15-19, 2025

Lectures delivered

- Dr. Devraj delivered lecture on " ICT in pulses for wider dissemination and farmers-

scientist interface" during ICAR sponsored Winter School "Advances in production and post-production technologies in pulses for achieving self sufficiency, food and nutritional security" during January 29 to February 18, 2025.

- Dr. Devraj delivered lecture on "Seed Hub Portal: Availability of seed for pulse crops" during farmers training programme organized by ICAR-IIPR, Kanpur under ATMA Scheme, Distt. Navada, Bihar held on March 17-21, 2025
- Dr. Devraj delivered lecture on " Digital Technologies for Knowledge Empowerment of Pulse Growers" during Capacity Building Program of KVK SMS on "Improved Pulse Production Technologies for Spring/ Summer Pulses" organized by ICAR-IIPR, Kanpur on March 24-25, 2025
- Dr. Devraj delivered lecture on " Pulse-based Digital Knowledge Resources: Seed Hub Portal" during farmers training programme organized by ICAR-IIPR, Kanpur under Jharkhand Social Welfare Institute held on November 19-20, 2025
- Dr. Devraj delivered lecture on "*Kisanon Ke Liya Bharat Sarkar Evam Rajya Sarkar ki Pramukh Yojnaein*" during farmers training programme organized by ICAR-IIPR, Kanpur under ATMA, Pooriya, Bihar held on November 25-27, 2025
- Dr. Ashis Ranjan Udgata delivered two lectures on Basic statistics and testing of hypothesis in Comprehensive training program on Statistical Data Analysis and Interpretation conducted by GKU, Bhatinda, Punjab during September 20-24, 2025.
- Dr. Ashis Ranjan Udgata delivered a lecture on QTL analysis in Advanced Statistical and Machine Learning Techniques for Data Analysis using Open Source Software for Abiotic Stress Management in Agriculture conducted by ICAR-NIASM, Baramati, Pune during July 16 to August 5, 2025
- Dr. Ashis Ranjan Udgata delivered a lecture on "Big data analytics using R" in ICAR sponsored winter school training programme conducted by ICAR-IIPR, Kanpur conducted during January 29 to February 18, 2025

Special assignments

- Dr. Meenal Rathore attended the ICAR-Stakeholders meet on August 30, 2025 for Director, IIPR.
- Dr. Meenal Rathore attended as Member, DPC of for senior scientist at ICAR-NBPGR, Delhi on Jaunary 03, 2025 (Meenal Rathore)
- Dr. Meenal Rathore attended as Nominee, DG-ICAR, DPC at ICAR-IIMR, Hyderabad on May 16, 2025.
- Dr. Meenal Rathore attended webinars on IP Awareness Week Programme on January 16, 2025 trademark and Design.
- Dr. Meenal Rathore chaired (ICC-gender sensitization, EPFO.
- Dr. Meenal Rathore was assigned reviewer for submitted DBT proposals – 2 nos. Reviewer for publication in Legume Research (dtd. April 30, 2025 for LRF 871)
- Dr. Meenal Rathore was nominated as DG Nominee member for assessment committee on May 16, 2025 at IIMR, Hyderabad
- Dr. Meenal Rathore acted as Chairman, ICC-EPFO, Kanpur vide ref letter sts April 30, 2025
- Dr. Meenal Rathore acted as Member, Assessment Committee of Scientist, NBPGR, January 2025
- Dr. Meenal Rathore acted as Incharge, EFC-Genome Editing flagship program from April 01, 2025 to October 06, 2025
- Dr. Meenal Rathore acted as Chairman, Proprietary article Committee, IIPR
- Dr. Meenal Rathore acted as Chairman, Internal Complaints Committee(SHEBOX), IIPR, Kanpur
- Dr. Meenal Rathore acted as Co chairman, Publication committee, IIPR, Knapur
- Dr. Meenal Rathore gave Invited lecture on February 13, 2025 on Molecular and Biotechnological approaches for developing climate resilient plant type inpulses in ICAR sponsored winter school Advances in Production and post production technologies in pulses for achieving self sufficiency, food and nutritional security January 29, 2025 to February 18, 2025

Training programme organized

- Dr. Devraj organised live streaming of PM-KISAN Programme on 2nd August, 2025 at ICAR-IIPR, Kanpur- As Technical

Coordinator.

- Dr. Devraj conducted one day Farmers Training Programme at Sujanpur village in Block Bhagya Nagars, Auraiya District under SC-SP Program on October 31, 2025
- Dr. Devraj conducted one day Farmers Training Programme at Pratap Khera and Makka Khera villages in Auras Block of Unnao District under SC-SP Program on November 7, 2025
- Dr. Devraj conducted 5 days training programme on "Improved Pulse Production Technology" organized by ICAR-IIPR, Kanpur on November 10-14, 2025 under sponsored by ATMA, Samastipur, Bihar – as Training Coordinator
- Dr. Devraj conducted one day Farmers Training Programme at Bingava village in Devmai Block of Fatehpur District under SC-SP Program on November 27, 2025

Training attended

- Dr. Neetu S Kushwah attend training on Recent Trends in Bioinformatics and its Applications in Agriculture" conducted by ICAR-NAARM, Hyderabad during February 04-13, 2025.
- Dr. Aravind Kumar Konda (Course Director) organized Anusandhan National Research Foundation(ANRF, formerly SERB) sponsored 3 daystraining programme on, "Molecular strategies for Heterologousgene expression and protein purification", held during March 17-19, 2025 at IIPR, Kanpur.
- Dr. Aravind Kumar Konda (Course Director) organized Anusandhan National Research Foundation (ANRF, formerly SERB) sponsored 3 days, "Hands-on Training on Whole Genome and Transcriptome Analysis of Plants", held during November 17–19, 2025, at IIPR, Kanpur.
- Dr. Adarsh Kumar participated in the 21-day Winter School on *"Advances in Production and Post-Production Technologies in Pulses for Achieving Self-Sufficiency, Food and Nutritional Security"*, held during January 29 - February 18, 2025 at ICAR–Indian Institute of Pulses Research, Kanpur.
- Dr. K.K. Hazra attended a four-day training programme on ISO/IEC 17025:2017 – Requirements and Internal Audit, conducted during September 24–25 and 29–30, 2025.
- Dr. Adarsh Kumar also attended a four-day training programme on ISO/IEC 17025:2017 – Requirements and Internal Audit, held on September 24–25 and 29–30, 2025.
- प्रियंका गौतम, बनवारी लाल, शांतनु रक्षित, राजेश कुमार सावल, विनोद कुमार यादव, बसंती ज्योत्सना, वेद प्रकाश (2025) फोगः शुष्क भूमि में पशुधन की स्थिरता के लिए एक उपयुक्त संसाधन। विस्तार पत्रक / भा.कृ.अनु.प.–रा.उ.अनु.के. / 2025 / 3.
- प्रियंका गौतम, बनवारी लाल, विनोद कुमार यादव, शांतनु रक्षित, राजेश कुमार सावल, वेद प्रकाश, बसंती ज्योत्सना, राकेश रंजन, अनिल कुमार पूनिया (2025) शुष्क क्षेत्र में पशुओं के लिए टिकाऊ चारा एवं चरागाह पद्धतियाँ। रा.उ.अनु.के. शोधबुलेटिन / 2025 / 1.
- प्रियंका गौतम, बनवारी लाल, विनोद कुमार यादव, राकेश रंजन, श्याम सुंदर चौधरी, वेद प्रकाश, बसंती ज्योत्सना, विश्वरंजन उपाध्याय, अनिल कुमार पूनिया (2025) शुष्क क्षेत्रों में ऊँटों के लिए उपलब्ध चारा संसाधन। विस्तार पत्रक / भा.कृ.अनु.प.–रा.उ. अनु.के. / 2025 / 05.
- Priyanka Gautam, B. Lal, Vinod Kumar Yadav, Rakesh Ranjan, Shyam Sundar Choudhary, Ved Prakash, Basanti Jyotsana, V.R. Upadhyay, Anil Kumar Puniya (2025) Fodder Resources for Camel in Arid Ecosystem. Extension Leaflet/NRCC/ 2025/05.
- Dr. Meenal Rathore organized an ANRF-sponsored three-day workshop on "Molecular strategies for heterologous gene expression and protein purification" in Division of Plant Biotechnology, ICAR-IIPR, Kanpur from March 17-19, 2025 as Co Course Director.
- Dr. Meenal Rathore organized an ANRF sponsored workshop on Molecular strategies for heterologous gene expression and protein purification during March 1-19, 2025 - Course Co Director
- Dr. Anup Chandra organized a one-day training programme on "Plant protection techniques for summer mungbean" and conducted an awareness programme under *Poshan Pakhwada* 2025 (8–22 April 2025) on 22 April 2025 for 120 farmers of Kurauwa

Village, Kanpur Dehat. He also organized farmer–scientist interaction meetings from 29 May to 12 June 2025 for approximately 2,000 farmers from Kannauj, Etawah, Fatehpur, and Kanpur Dehat, and on 11 December 2025 for 39 farmers from Gopalganj, Bihar.

Certification of technology by ICAR during 2024-25

- Two technologies have been certified by ICAR. 1. IIPR manual weeder, and 2. IIPR Herbicide applicator.

Intellactual Property Right

- Design registration patent obtained for weeder with multi-tool bar carrier and attached tool.

Intellectual Property Rights

Copyrights

- Filed Copyright of Software "Pulse_ GeneBank: Information System on Genetic Resources of Pulses"- Diary No. SW-43245/2025-CO dated 27-10-2025
- Filed Copyright of Software "IIPR Varietal Database for Pulses(IVDP)"- Diary No. SW-43248/2025-CO dated 27-10-2025

Trainings/demonstrations organized

- Dr. Jitendra Kumar attended One Day Farmer Training Programme on Improved technology for Lentil Cultivation at ICAR-IIPR, Kanpur on March 11, 2025
- Dr. Jitendra Kumar attended one Day Farmer Training Programme on Farmer's Participatory Seed Production in lentil at ICAR-IIPR, Kanpur at March 4, 2025
- Dr. Jitendra Kumar attended IRC meeting at ICAR-IIPR, Kanpur on May 22-23, and June 18-19, 2025
- Dr. Jitendra Kumar attended Field IRC for *Rabi* Crops at ICAR-IIPR, Kanpur on February 27 and March 7, 2025
- Dr. Jitendra Kumar attended Field IRC for *Kharif* Crops at ICAR-IIPR, Kanpur on September 26-27, 2025

Participation of Scientists in Training Programme/ Seminar/Symposia/Conference

- Dr. Jitendra Kumar attended Prof. M.S. Swaminathan Centenary International Conference: Evergreen Revolution - The Pathway to Biohappiness (Online mode) at Bharat Ratna C. Subramaniam Auditorium NASC, New Delhi, India on August 7-9, 2025
- Dr. Jitendra Kumar attended Evergreen Revolution - The Pathway to Biohappiness (Online mode) at Bharat Ratna C Subramaniam Auditorium, NASC, ICAR, New Delhi onAugust 7-9, 2025
- Dr. Jitendra Kumar attended Attended webinar on Post budget webinar- Investing in innovation (Online) at ICAR-IIPR, Kanpur on March 03, 2025
- Dr. Jitendra Kumar attended Annual Workshop on Rabi Pulses (2024-25) at RLBCAU, Jhansi on August 19-21, 2025
- Dr. AK Parihar attended Germplasm Diversity Day at NBPGR, New Delhi on March 5, 2025
- Drs. AK Parihar, Vishal Dinkar participate in ICAR-NORTH Zone sports tournament-2024 at NDRI Karnal on February 2-5 2025
- Dr. Jitendra Kumar participate in conducted monitoring of DA&FW funded project experimental trials and seed production programs of different five centres at TAC (Dholi), RCER (Patna), BAU (Ranchi) and BHU (Varanasi) Centers on March 18-23, 2025.

Lectures Delivered

- Dr. Asish Kumar Rout Participated in the "National Conference on Seed Chain Management in Eastern and North Eastern Hill Region: Challenges & Opportunities" during January 21-22, 2025 at ICAR-CHES, Bhubaneswar, Odisha.
- Dr. Asish Kumar Rout attended the ICAR sponsored short course on "Ameliorating quality and productivity of oil seeds and pulses through classical, modern and disruptive technologies" from February 17-26, 2025 at Division of genetics, IARI, New Delhi.
- Dr. AK Parihar delivered a lecture on Field pea: a potential crop towards achieving self-sufficiency in pulses at ICAR-Sponsored Winter School on "Advances in production and post-production technologies in pulses for achieving self-sufficiency, food and nutritional security" on January 29 - February 18, 2025
- Dr. Manu, B. awarded Best oral presentation at the international Conference on One Health Perspectives in Global Plant

Protection Research 2025 held from TNAU Coimbatore.

- Dr. Manu, B. awarded with Best Oral Presentation Award (1st in Technical Session), VIIth International Conference on Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2025), organized by Society for Scientific Development in Agriculture & Technology (SSDAT), Meerut, India.
- Dr. M.H. Kodandaram, Principal Scientist, IIPR-RRS Dharwad acted as external examiner for evaluation of thesis and conduct of qualifying Viva-voce examination of Ph.D. student in the Dept. of Entomology, College of Agriculture, Vellianikera, KAU, Thrissur, Kerala.
- Dr. M.H. Kodandaram, Principal Scientist, IIPR-RRS Dharwad acted as external examiner for evaluation of thesis and conduct of qualifying Viva voce examination of Ph.D student in the Department of Entomology, College of Agriculture UAS, Raichur.
- Dr. M.H. Kodandaram participated in Second International Conference on Biological Control: Biocontrol Contributions to One Health, held at ICAR-NBAIR, Bengaluru, India from February 25–28, 2025.
- Dr. M.H. Kodandaram, acted as examiner for evaluation of M.Sc Entomology Thesis received from ICAR-IARI, New Delhi, UAS Bengaluru, UAS, Raichur, ANGRAU, Lam, Guntur and Ph.D. thesis received from PJTAU, Hyderabad.
- Dr. M.H. Kodandaram, acted as external examiner to conduct online qualifying Viva voce examination of Ph.D student in the discipline of Entomology from IARI, New Delhi.
- Dr. M.H. Kodandaram, Principal Scientist, IIPR-RRS Dharwad, delivered a lecture on "Insect Pest Management in *Kharif* Pulses" in a "Training program on Improved Crop Production Technologies in *Kharif* pulses" held on March 25-26, 2025 held at Beladadi Thanda, Gadag District, Karnataka under SCSP Program organized by IIPR-RRS Dharwad.
- Dr. Revanappa, acted as examiner for evaluation of M.Sc. Thesis received from, UAS Bengaluru, and UAS, Raichur
- Dr. Revanappa, acted as External examiner to conduct qualifying Viva voce examination of Ph.D student in the discipline of plant breeding from UAS Raichur
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, nominated as an External ICAR Member KVK, Haveri (Hanumanamatti), and attended the 47th Scientific Advisory Committee meeting of KVK Haveri on February 03, 2025.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, attended the Pre-Action Plan Meeting of KVKs of UAS, Dharwad on February 5-6 2025.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, attended the "Third Foundation Day Lecture of Late Dr. S.V. Patil's Birthday" on February 25, 2025 at UAS, Dharwad.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, delivered a lecture on "Rainwater Conservation Approaches in the Watershed Management for Climate Resilient Agriculture" on the Occasion of Dr. S.V. Patil, Memorial Lecture at Institute for Studies on Agriculture and Rural Development (ISARD), Dharwad on February 25, 2025 at Dharwad.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, attended the Silver Jubilee Celebration of Seed Unit on February 28, 2025 at UAS, Dharwad.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, attended the Seminars on "Integrated nutrient management in maize-chickpea cropping system", "Advance technologies for crop production under moisture stress condition" and "Alleviating abiotic stress in maize and wheat with exogenous substances" at Department of Agronomy, UAS, Dharwad on February 28, 2025.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, attended the 19th Advice of Scientific Advisory Committee at UAS, Raichur, Koppal on March 07, 2025.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, attended

the 38th meeting of the Board of Studies (PGP) on April 05, 2025 as the Member of PG Board of studies at UAS, Dharwad.

- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, attended the All India Co-Ordinated Research Project on Forage Crops and Utilization: National Group Meet: *Kharif*-2025 on April 22-23, 2025
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, attended the A.S.Hadimani Memorial Lecture Series on May 05, 2025 at UAS Dharwad.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, attended the 38th Convocation at UAS, Dharwad on May 14, 2025.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, attended the Seminars Department of Agronomy, UAS, Dharwad on July 05, 2025.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, attended the Seminars on "Performance of cowpea (*Vigna unguiculata* L) varieties as influenced by phosphorus nutrition in conjunction with biofertilizers under rainfed condition" at Department of Agronomy, UAS, Dharwad on July 09, 2025.
- Dr. S.L. Patil attended the Seminars on "Studies on performance of developed …(IInd fill of July) annual fodder crops to nutrient management strategier during kharif in transitional tract of northern Karnataka." at Department of Agronomy, UAS, Dharwad on July 09, 2025.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, attended the Seminars on "Integrated phosphorus management in pigeonpea and groundnut intercropping under a soil in Northern transition zone of Karnataka" at Department of Soil Science & Agril Chemistry, UAS, Dharwad on August 06, 2025.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, attended the Seminars on "Effect of Inteforted nutrient management in maize chickpea cropping system" at Department of Agronomy, UAS, Dharwad on August 06, 2025.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, acted as external examiner for evaluation of MSc thesis (Ag) Department of Agronomy at the college of Agriculture, RVS Krishi Vishwa Vidyalaya Gwalior as an External Examiner on September 03, 2025.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, attended the Krishi Mela- 2025 at UAS, Dharwad on September 13-16, 2025.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, Nominated teacher for Farm Development Committee at UAS, Dharwad
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, as a Member of Board Agricultural Extension, attended the Seventh Extension Education Council meeting of UAS, Raichur on December 18, 2025.
- Dr. S.L. Patil OIC and Principal Scientist (Agronomy), IIPR-RRS Dharwad, delivered a lecture on "Improved and low cost Agronomic Management Practices in *Kharif* Pulses" in a "Training program on Improved Crop Production Technologies in *Kharif* pulses on March 25-26, 2025 held at Beladadi Thanda, Gadag District, Karnataka under SCSP Program organized by IIPR-RRS, Dharwad.
- All the staff participated in an interaction meeting with Dr. D.K. Yadava, DDG (Crop Science), ICAR- New Delhi during his visit to ICAR Institutes at Dharwad on April 22, 2025.
- All the staff Attended virtually in World IPR Day celebration organised by IIPR, Kanpur on May 02, 2025.
- All the staff Participated in online meeting on Vikisit Krishi Sankalp Abhiyan for Karnataka state organized by ATARI,
- All the staff Participated in Flag ship Program "Viksit Krishi Sankalp Abhiyan (VKSA)" for Pre *kharif*-Campaign 2025
- All the staff Participated in online meeting of Nodal Officers on Pulses for various states organized by IIPR, Kanpur on October 03, 2025

Awards/Recognitions

- Meenal Rathore was a*ssigned reviewer for submitted DBT proposals – 2 nos. Reviewer for publication in Legume Research (dtd. 30.4.25 for LRF 871)*
- Meenal Rathore was invited as Guest for Valedictory Function, International Conference on Advances in Life Sciences 2025 at CSJMU, 11.01.2025- delivered oral presentation on Bio-interventions for Pulses Improvement.
- Nidhi Kumari, Nainika Nagar, Surendra Ghritlahre and Dibendu Datta, received Second Best Poster Presentation Award in a National Symposium on "Frontier in Plant Health Management: Integrating Research, Technology and Sustainability" during 18-20 November 2025 at PAU-Ludhiana.
- Surendra Ghritlahre, acted as an external examiner of the subject Crop Improvement-II (*Rabi* Crops) for end term practical examination held at IES University, Bhopal on 15.05.2025.
- AK Parihar acted as member of editorial team of Pulses Newsletters of ICAR-IIPR, Kanpur published during reporting period.
- AK Parihar selected as a member of The National Academy of Sciences India (NASI), Prayagraj, Uttar Pradesh
- AK Parihar acted as Associate Editor in Heliyon (NAAS rating 9.4), A Cell Press journal.
- AK Parihar acted as Associate Editor in the Journal of Food Legumes published by ISPRD, Kanpur.
- AK Parihar acted as a member of the editorial board in Euphytica (International Journal of Plant Breeding) published by Springer, Wageningen University, The Netherlands
- AK Parihar acted as Treasurer of ISPRD, ICAR-IIPR, Kanpur
- AK Parihar acted as member of Editorial Committee of Pulses Newsletter published by ICAR-IIPR, Kanpur during 2024-25.
- Jitendra Kumar prepared and submitted the Annual Report of lentil breeding programme and other reports such as QRT, IMC, IRC, RPP-II, RPP-III *etc.*
- Jitendra Kumar performed the activities as I/C, Main Research Farm, I/C Horticulture, and Chairman Technical Evaluation Committee.
- Conducted monitoring of DA&FW funded project experimental trials and seed production programmes of different centers including TAC (Dholi), RCER (Patna), BAU (Ranchi) and BHU (Varanasi) Centres on March 18-23, 2025.
- Jitendra Kumar prepared and submitted ATR on IRC
- Received Best Poster Presentation award, "Genome wide comparative codon usage analysis in eleven grain legumes reveals distinct patterns between warm season and cool season legumes" authored by Khyati Joshi, Saravanan Matheswaran, Pritish Bharadwaj, Aravind Kumar Konda and G.P. Dixit in the National E-conference (FAVBS-2025) organized by SBBS and ARDO held during March 8-9, 2025.
- Aravind Kumar Konda was invited as an expert for panel discussion on, "Technological integration: Future of higher education in India", the occasion of 60th Foundation day celebration of Chhatrapati Shahu Ji Maharaj (CSJM) University, Kanpur, on February 09, 2025.
- Aravind Kumar Konda delivered an invited lecture on, "Genome editing in pulses crops for addressing national food and nutritional security" at the Department of Biochemical Engineering, School of Chemistry, Harcourt Butler Technical University, Kanpur, on Feb 21, 2025.
- Aravind Kumar Konda was invited as the Invited Speaker in the National E-conference (FAVBS-2025) in the theme of, "Recent Agricultural Sciences for promotion of Food and Livelihood security", organized by SBBS and ARDO held during March 8-9, 2025.
- Aravind Kumar Konda was invited as an external examiner for the recruitment of project SRF in ANRF Grant at the School of Life Sciences and Biotechnology, CSJM

University, held on April 21, 2025.

- Aravind Kumar Konda was invited as an external examiner for the practical examination held at the Department of Biotechnology, FET, Rama University, held on May 15, 2025.
- Aravind Kumar Konda was invited as the Guest Speaker for the Orientation Programme for the new batch of B.Sc. Biotechnology (BBT) & B.Sc. Medical Microbiology (BMM) organized by the Department of Life Sciences, Axis Institute of Higher Education, held on August 12th, 2025.
- Aravind Kumar Konda was invited as an external examiner for the recruitment of Project Assistant in ANRF-Early Career Research Grant at the School of Life Sciences and Biotechnology, CSJM university, held on August 14, 2025.
- Aravind Kumar Konda was invitedto serve as a Keynote Speaker at the SATHEE Summit 2025, flagship initiative of the Ministry of Education and IIT, Kanpur held on 6th December 2025 at IIT, Kanpur.
- Sudheer Kumar was conferred with "S.N. Dasgupta Memorial Award (2025)" by Indian Phytopathological Society, New Delhi
- B. Lal received Best Poster Presentation Award in 11th National Conference on FutureAG-2025 "Advancing Food & Farming for Sustainable Future" organized by Suresh Gyan Vihar University, Jaipur, Just Agriculture & ISAHRD Society held on September 9-10, 2025 at SGV University, Jaipur, Rajasthan.
- B. Lal received Best Oral Presentation Award in 11th National Conference on FutureAG-2025 "Advancing Food & Farming for Sustainable Future" organized by Suresh Gyan Vihar University, Jaipur, Just Agriculture & ISAHRD Society held on September 9-10, 2025 at SGV University, Jaipur, Rajasthan.
- Sharda Lele Memorial Award by Indian Phytopathological Society, New Delhi during National Conference on Plant Pathology at ICAR-CCRI, Nagpur on January 19-21, 2025
- Best oral presentation on Molecular Analysis of Disease-Responsive Genes Revealing the Resistance Potential Against Fusarium Wilt (*Fusarium udum* Butler) dependent on Genotypic Variability in Pigeonpea during National conference on Plant-Pathogen interactions at RLBCAU, Jhansi on January 3-4, 2025
- Best Team Award'-2025 by ICAR-IIPR, Kanpur.
- Best Hindi Lekhan Award'-2025 by ICAR-IIPR Kanpur
- Best Scientist (Young Scientist category) by ICAR-IIPR.
- Second best oral presentation International Conference on One Health Perspectives in Global Plant Protection Research (OHPGPR 2025).
- Best brief oral presentation for the oral paper to 'Revanasidda, Sanjay M. Bandi, Mohd. Akram, and GP Dixit (2025). Exploring wild pigeonpea germplasms for their stable resistance to multiple destructive bruchid species in India' presented in National Symposium on Technological Advancements: Emerging Trends in Entomology (ESI-ETE-2025) held at SKUAST-Kashmir, Srinagar, India during October 8-9, 2025.
- Dr. Narendra Kumar was conferred with the Fellowship of the Bihar Agriculture Science Academy (BASA), Bihar, for the year 2025.
- Dr. Narendra Kumar, C. P. Nath, K. K. Hazra, Krishnashis Das, Asik Dutta, R. K. Mishra, C. S. Praharaj, Man Mohan Deo, Mohammad Hashim, Banwari Lal and Ram Lal Jat. received the Institute Best Team Award (Research and Development for the year 2024-25) for the year 2024-25, ICAR-Indian Institute of Pulses Research, Kanpur.
- Dr. C. P. Nath received Young Scientist Award of Farming Systems Research and Development Association (FSRDA) of ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut – 250 110 (UP), India during 1st INTERNATIONAL FARMING SYSTEMS CONFERENCE" on "Transforming Food, Land and Water Systems under Global Climate Change" during 07-09 March, 2025.
- Dr. C. P. Nath received Best Oral

Presentation award in International Conference for paper presentation entitled "Pigeonpea-wheat-mungbean : a pulse-based intensive cropping system for diversification of rice-wheat system" in 1st INTERNATIONAL FARMING SYSTEMS CONFERENCE" on "Transforming Food, Land and Water Systems under Global Climate Change" during 07-09 March, 2025. Authors: C.P. Nath (Presenting Author), Narendra Kumar, K.K. Hazra, Mukesh Kumar.; Organization Name : Farming Systems Research and Development Association (FSRDA), Meerut; Year : 2025.

- Dr. S.L. Patil OIC and Principal Scientist (Agronomy) evaluated Thesis of M.Sc (Agri.), Department of Agronomy at the College of Agriculture, RVS Krishi Vishwa Vidyala, Gwalior as a External Examiner during September, 2025.
- Dr. M.H. Kodandaram, Principal Scientist, IIPR-RRS Dharwad received Best Scientist award (Senior Category) from ICAR-Indian Institute of Pulses Research, Kanpur during Institute Foundation Day held on 05 Sept. 2025.
- Dr. M.H. Kodandaram, Principal Scientist, IIPR-RRS Dharwad was awarded with Fellow of Society for Biocontrol Advancement, Bengaluru, India on 27th February, 2025
- Nidhi Kumari, Nainika Nagar, Surendra Ghritlahre and Dibendu Datta, received Second Best Poster Presentation Award in a National Symposium on "Frontier in plant health management: Integrating research, technology and sustainability" during 18-20 Nov 2025 at PAU-Ludhiana
- Dr. Surendra Ghritlahre, Scientist acted as an external examiner of the subject Crop Improvement-II (Rabi Crops) for end term practical examination held at IES University Bhopal on 15.05.2025.

On-going Research Projects

Division of Crop Improvement (2)

S No.	IIPR Code	Mega Project/Sub Project	PI	Co-PI	Period
1.	CRSCIIPRSIL 202500100168	**Designing climate resilient plant types for better quality, adaptability and productivity** Project Leader: Dr. P.K. Katiyar			2025-2030
	202500100168 SP 1	Development of high yielding and climate resilient chickpea genotypes with improved plant types	Dr. Yogesh Kumar	Dr. B. Mondal Dr. A.K. Srivastava Dr. U.C. Jha Dr. Shailesh Tripathi Dr. Archana Singh Dr. Gitanjali Sahay Dr. Revanappa B. Dr. Rishikesh Kumar Dr. C.P. Nath	
	202500100168 SP 2	Improving chickpea for yield and multiple disease resistance.	Dr. A.K. Srivastava	Dr. Yogesh Kumar, Dr. U.C. Jha Dr. Archana Singh Dr. Rishikesh Kumar	
	202500100168 SP 3	Breeding of *Kabuli* chickpea for better grain quality, productivity and adaptability	Dr. Gitanjali Sahay	Dr. Yogesh Kumar Dr. Nidhi Kumari	
	202500100168 SP 4	Tailoring high yielding chickpea genotypes with improved abiotic stress tolerance.	Dr. U.C. Jha	Dr. Yogesh Kumar Dr. A.K. Srivastava Dr. Gitanjali Sahay Dr. Monika Punia	
	202500100168 SP 5	Designing climate resilient varieties/hybrids of long duration pigeonpea using innovative breeding tools	Dr. I.P. Singh	Dr. Abhishek Bohra Dr. A.K. Parihar Dr. R.K. Mishra Dr. P.R. Saabale Dr. T.N. Tiwari	
	202500100168 SP 6	Genetic enhancement for high yield and disease resistance in medium duration pigeonpea	Dr. Dibendu Datta	Dr. S.K. Ghritlahre Dr. Nidhi Kumari Dr. R.K. Mishra	
	202500100168 SP 7	Developing high heterotic pigeonpea hybrids for crop diversification	Dr. Abhishek Bohra	Dr. A.K. Parihar Dr. I.P. Singh Dr. Revanasidda	
	202500100168 SP 8	Development of climate resilient, high yielding and nutrient dense short duration pigeonpea for wider adaptability	Dr. A.K. Parihar	Dr. Abhishek Bohra Dr. I.P. Singh Dr. R.K. Mishra Dr. Dibendu Datta Dr. Manu B. Dr. P.R. Saable	
	202500100168 SP 9	Breeding high yielding and nutrient-dense improved lentil varieties for diverse agro-ecologies	Dr. Jitendra Kumar	Dr. Debjyoti Sen Gupta Dr. Mohd. Akram	

	202500100168 SP 10	Development of high-yielding, climate resilient and nutrient-dense fieldpea	Dr. A.K. Parihar	Dr. Abhishek Bohra Dr. R.K. Mishra	
	202500100168 SP 11	Breeding for high-yielding, multiple stress resistant and nutrient-rich urdbean cultivars for diverse agro-ecologies	Dr. Debjyoti Sen Gupta	Dr. P.K. Katiyar Dr. Jitendra Kumar Dr. Anup Chandra Dr. Sunil Sunani Dr. Archana Singh Dr. Manu B.	
	202500100168 SP 12	Genetic enhancement for climate resilience, plant architecture and yield in *Kharif* mungbean	Dr. Biswajit Mondal	Dr. Vishal Dinkar Dr. Jitendra Kumar Dr. Monika Punia Dr. Lalit Rolaniya Dr. Surendra Ghritlahre Dr. Revanappa S.B. Dr. Mohd Akram Dr. Anup Chandra Dr. Aditya Pratap	
	202500100168 SP 13	Development of early maturing and high yielding spring/summer mungbean with heat stress tolerance	Dr. Vishal Dinkar	Dr. Biswajit Mondal Dr. Anup Chandra Dr. Surendra Ghritlahre Dr. Ashish Rout Dr. Monika Punia	
	202500100168 SP 14	Development of abiotic and biotic stress-resistant genotypes in arid pulses: Mothbean, Cowpea and Clusterbean	Dr. Monika Punia	Dr. A.K. Parihar Dr. Sumit Kumar Aggarwal Dr. Manu B Dr. L.K. Rolaniya Dr.Vishal Dinkar	
	202500100168 SP 15	Breeding for enhanced yield and multiple stress resistant cowpea *Vigna unguiculata* (L.) Walp. for southern India	Dr. Manu B	Dr. Revanappa S.B. Dr. A.K. Parihar Dr. Monika Punia Dr. M.H. Kodandaram	
	202500100168 SP 16	Development of high-yielding, climate-resilent horsegram (*Macrotylum uniflorum* L.) resistance to powdery mildew and yellow mosaic disease	Dr. Revanappa	Dr. Manu B Dr. P.R. Saabale	
	202500100168 SP 17	Grasspea improvement for enhanced yield and quality traits	Dr. Archana Singh		
	202500100168 SP 18	Genetic enhancement of mungbean for summer cultivation in Central India **(2023-2026)**	Dr. Surendra Ghritlahare	Dr. Dibendu Datta Dr. Nidhi Kumari Dr. Basavraj T Dr. Revenaappa	2023-2026

2.	**CRSCIIPRSIL 202500200169**	**Genetic and genomic resources management and utilization in pulses** Project Leader: Dr. I.P. Singh			
	202500200169 SP 1	Plant Genetic Resources management, pre-breeding, and utilization in chickpea (*Cicer arietinum* L.)	Dr. Biswajit Mondal	Dr. Yogesh Kumar Dr. Vaibhav Kumar Dr. PrasoonVerma Dr. Archana Singh Dr. Rakesh Bhardwaj* (Germplasm Exploration Div, ICAR-NBPGR, Biochemical assay) and Dr. Archana Joshi Saha* (BARC, Mumbai, Biochemical assay) Dr. Shailesh Tripathi	
	202500200169 SP 2	Germplasm characterization and breeding for high-yielding, multiple stress resistant and nutrient-rich *rajmash* for diverse agro-ecologies	Dr. Debjyoti Sen Gupta	Dr. Vishal Dinkar	
	202500200169 SP 3	Genetic and genomic resources management and their utilization in pigeonpea (Kanpur Component)	Dr. P.K. Katiyar	Dr. I.P. Singh Dr. A. Bohra, Dr. A.K. Parihar Dr. Vishal Dinkar	
	202500200169 SP 4	Genetic and genomic resources management and their utilization in pigeonpea (Bhopal Component)	Dr. S.K. Ghritlahre	Dr. Dibendu Datta Dr. Nidhi Kumari Dr. R.K. Mishra	
	202500200169 SP 5	Genetic and genomic resources management and their utilization in urdbean	Dr. U.C. Jha	Dr. Debjyoti Sen Gupta Dr. P.K. Katiyar Dr.Manu B.	

Division of Biotechnology (1)

S No.	IIPR Code	Mega Project/Sub Project	PI	Co-PI	Period
3.	**CRSCIIPRSIL 202500300170**	**Genomic Innovations, Functional Characterization, and Precision Editing for Enhancing Pulse Productivity** Project Leader: Dr. Meenal Rathore			**2025-2030**
	202500300170 SP 1	Functional characterization of the novel candidate genes for biotic stress tolerance in legumes	Dr. K Aravind Kumar	Dr. Antara Das Dr. Sujayanand G.K. Dr. Rishikesh Kumar Dr. Saravananmatheswaran	

	202500300170 SP 2	Functional analysis of ABC Repressor 1 (ARE1) gene associated with nitrogen use efficiency (NUE) in chickpea (*Cicer arietinum* L.)	Dr. Alok Das	Dr. Meenal Rathore Dr. Shanmugavadivel P S.	
	202500300170 SP 3	Gene editing to elucidate the function of the Cytokinin Oxidase (CKX) gene in *Vigna species* for enhanced productivity	Dr. Shanmuga-vadivel P.S.	Dr. Meenal Rathore Dr. Debjyoti Sen Gupta	
	202500300170 SP 4	Introducing the photo-insensitivity trait in pigeonpea (*Cajanus cajan*) through genome editing	Dr. Antara Das	Dr. Aravind K. Konda Dr. Abhishek Bohra	
	202500300170 SP 5	Molecular approaches for improving nutrient use efficiency in pigeonpea (*Cajanus cajan*)	Dr. Neetu S. Kushwah	Dr. Meenal Rathore Dr. Abhishek Bohra	
	202500300170 SP 6	Understanding the effect of gibberellin 3β-hydroxylase on pigeonpea yields	Dr. Meenal Rathore	Dr. Shanmugavadivel P.S. Dr. Antra Das Dr. Neetu S. Kushwah Dr. Abhishek Bohra Dr. Kalpana Tiwari	
	202500300170 SP 7	Tagging of restorer genes for CMS in pigeonpea Cajanuscajan (L.) Millsp.	Dr. Antara Das	Dr. Abhishek Bohra	2023-26

Division of Crop Production (2)

S No.	IIPR Code	Mega Project/Sub Project	PI	Co-PI	Period
4.	**CRSCIIPRSIL 202500400171**	**Innovative strategies for climate-resilient and resource-efficient technologies for sustainable pulses production** Project Leader: Dr. Narendra Kumar			**2025-2030**
	202500400171 SP 1	Carbon-footprint and microbiome community structure in long-term pulses inclusive cropping systems	Dr. Narendra Kumar	Dr. K.K. Hazra Dr. C.P. Nath Dr. Mohd. Hashim Dr. Adarsh Kumar Dr. R.K. Mishra Dr. M. Senthil Kumar	
	202500400171 SP 2	Enhancing nutrient use efficiency, crop productivity, and soil health in pulse-based production system through smart nutrient management including nano-fertilizers	Dr. Mohd. Hashim	Dr. K.K. Hazra Dr. Adarsh Kumar Dr. Vijay Laxmi	
	202500400171 SP 3	Sustainable nutrient management in pulse-based cropping system through microbial interventions under diverse tillage regimes	Dr. Adarsh Kumar	Dr. Md. Hashim Dr. C. P. Nath Dr. Shobit Thapa (ICAR_NBAIM, Mau)	

	202500400171 SP 4	Enhancing sustainability of maize-chickpea cropping system through precision irrigation strategies	Dr. Adarsh Kumar	Dr. K.K. Hazra Dr. Mohd. Hashim Dr. Manmohan Deo	
	202500400171 SP 5	Improving productivity of pigeonpea-wheat system through efficient resource recycling and smart agriculture technologies	Dr. K.K. Hazra	Dr. Manmohan Deo Dr. Mohd. Hashim Dr. Arup Kumar Pal (ISM, Dhanbad)	
	202500400171 SP 6	Innovations in conservation agriculture in pulse-based systems for resilient future farming	Dr. C.P. Nath	Dr. Narendra Kumar Dr. K.K. Hazra Dr. Adarsh Kumar Dr. Man Mohan Deo Dr. M. Senthil kumar Dr. Kamlesh Soni (ICAR-IIFSR, Modipuram)	
	202500400171 SP 7	Development of climate-smart weed management practices for sustaining pulse-based production systems	Dr. C.P. Nath	Dr. Narendra Kumar Dr. Mohd. Hashim Dr. Man Mohan Deo Dr. Rishikesh Kumar Dr. Vaibhav Kumar Dr. V.K. Choudhary (ICAR-DWR, Jabalpur)	
	202500400171 SP 8	Developing advanced predictive models of pulse crop for future climate scenarios with decision support framework	Dr. K.K. Hazra	Dr. Narendra Kumar Dr. Manmohan Deo Dr. Arup Kumar Pal (ISM, Dhanbad)	
	202500400171 SP 9	Implementing organic and natural farming in pulse-based production systems for agro-ecological sustainability and improved climate resilience	Dr. Mohd. Hashim	Dr. Narendra Kumar Dr. C.P. Nath Dr. Adarsh Kumar Dr. M. Senthil Kumar Dr. Rishikesh Kumar Dr. BanwariLal Dr. Ram Lal Jat Dr. Vaibhav Kumar Dr. Vijay Laxmi	
	202500400171 SP 10	Exploring agronomic interventions for sustainable pulses productivity in arid region	Dr. Banwari Lal	Dr. Lalit K. Rolaniya Dr. Ram Lal Jat Dr. Priyanka Gautam (NRCC, Bikaner)	
	202500400171 SP 11	Improving crop and water productivity through integration of regenerative agriculture and strategic irrigation management practices in arid ecosystem	Dr. Ram Lal Jat	Dr. Lalit K. Rolaniya Dr. R.K. Jhakar (Soil Science, SKRAU, Bikaner) Dr. Vikas Sharma Microbiology SKRAU, Bikaner)	

	202500400171 SP 12	Long-term impact of pulse-based diversified cropping systems on crop productivity and soil health in western dry region of India	Dr. Ram Lal Jat	Dr. Lalit K. Rolaniya Dr. Banwari Lal Dr. Sumit Aggarwal Dr. R.K. Jhakar (Soil Science, SKRAU, Bikaner) Dr. Vikas Sharma Microbiology, SKRAU, Bikaner)	
	202500400171 SP 13	Development of integrated weed management strategies for pulses-based cropping systems in arid region	Dr. Lalit K. Rolaniya	Dr. Ram Lal Jat Dr. Banwari Lal Dr. C.P. Nath Dr. Vikas Sharma Microbiology, SKRAU, Bikaner)	
	202500400171 SP 14	Effect of integrated nutrient management in pulses-based cropping system on soil properties, crop productivity and economics in Vertisols of semi- arid tropics of South India (up to 2026)	Dr. S.L. Patil		
5.	**CRSCIIPRSIL 202500500172**	**Advanced engineering interventions for mechanized pulse production and post-harvest management** Project Leader: Dr. Prasoon Verma			**2025-2030**
	202500500172 SP 1	Development of a database for physical and engineering parameters contributing to milling recovery and value-added products for major pulses	Dr. Prasoon Verma	Dr. Dev Raj Dr. Man Mohan Deo and Concerned Plant Breeder Dr. Uday Chand Jha (Chickpea) Dr. Abhishek Bohra (Pigeonpea) Dr. Jitendra Kumar (Mungbean) Dr. Debjyoti Sengupta (Urdbean) Dr. Jitendra Kumar (Lentil) Dr. Ashok K. Parihar (Fieldpea)	
	202500500172 SP 2	Design and development of farm machineries for drudgery reduction and efficient field operation	Dr. Man Mohan Deo	Dr. Prasoon Verma Dr. Mohd. Hashim Dr. Narendra Kumar	
	202500500172 SP 3	New generation tools and techniques for farm mechanization in pulses	Dr. Man Mohan Deo	Dr. PrasoonVerma Dr. K.K. Hazra Dr. Sanjay M Bandi Dr. C.P. Nath Dr. Bikram Joyti (CIAE, Bhopal) (Proposed)	

	202500500172 SP 4	Utilization of pigeonpea crop residue for soil health, energy pellets and fuel wood	Prasoon Verma	Dr. Man Mohan Deo Dr. KK. Hazra Dr. Mohd. Hashim	

Division of Crop Protection (1)

S No.	IIPR Code	Mega Project/Sub Project	PI	Co-PI	Period
6.	CRSCIIPRSIL 202500600173	**Diagnostics, phenotyping, forecasting and management for major pests and diseases in pulses** Project Leader: Dr. Mohd. Akram			2025-2030
	202500600173 SP 1	Development of rapid diagnostic protocols for viruses and identification of disease-resistant genotypes of mungbean, urdbean and lentil	Dr. Mohd. Akram	Dr. R.K. Mishra Dr. Asish Kumar Rout Dr. Anup Chandra	
	202500600173 SP 2	Host–Pathogen Dynamics and biological Management of Major Fungal Diseases in Pigeonpea and Fieldpea	Dr. R.K. Mishra	Dr. Mohd. Akram Dr. Krishna Kumar Dr. Sanjay M. Bandi (till 02 Oct 2025) Dr. Nidhi Kumari	
	202500600173 SP 3	Development of a high throughput screening protocol for dry root rot and fusarium wilt disease of chickpea and their management	Dr. Rishikesh Kumar	Dr. Mohd. Akram Dr. M. Senthil Kumar Dr. Sudheer Kumar	
	202500600173 SP 4	Assessment and validation of ancient pest management practices in pulses under natural farming system	Dr. Krishna Kumar	Dr. R.K. Mishra Dr. Mohd. Hashim Dr Sanjay M. Bandi (till 02 Oct 2025) Dr. Anup Chandra Dr. Rishikesh Kumar	
	202500600173 SP 5	Assessing thrips diversity and their behavioral response for monitoring/mass trapping in *Vigna* crops	Dr. Anup Chandra	Dr. Sujayanand G.K. Dr. Debjyoti Sen Gupta Dr. Biswajit Mondal Dr. Aravind K. Konda Dr. M.H. Kodandaram Dr. Ashis K. Rout	
	202500600173 SP 6	Development of biopesticide for sustainable management of pod bugs in pigeonpea	Dr. Sujayanand G.K.	Dr. Anup Chandra	
	202500600173 SP 7	Host plant resistance and management of pod fly in short duration pigeonpea	Dr Revanasidda Dr. Sanjay M. Bandi (till 02 Oct 2025)		

	202500600173 SP 8	Management of insect-pest infesting stored pulses using novel and eco-friendly approaches	Dr. Revanasidda	Dr. Sanjay M. Bandi	
	202500600173 SP 9	Potential of beneficial Rhizo-microbes for the management of key nematode and lepidopteran pests in pulses	Dr. R. Jagadeeswaran	Dr. G.K. Sujayanand	
	202500600173 SP 10	Identification of race-specific resistant donors against key nematodes pest, *Meloidogyne incognita* and *Heterodera cajani* in pulses	Dr. R. Jagadeeswaran	Dr. Sumit Aggarwal	
	202500600173 SP 11	Management of pigeonpea diseases caused by SMD and dry root rot	Dr. P.R. Saabale	Dr. M.H. Kodandaram	
	202500600173 SP 12	Prevalence, distribution and management for major fungal diseases of *kharif* pulses in arid region	Dr. Sumit Kumar Aggarwal	Dr. Sudheer Kumar Dr. Monika Punia Dr. Ram Lal Jat Dr. Ashok Kumar Dr. Laxman Singh Rajput	
	202500600173 SP 13	Population dynamics of emerging insect pests of *Vigna* pulses (Cowpea, Mungbean and Urdbean) and their management in Northern Transitional Zone of Karnataka	Dr. M.H. Kodandaraam	Dr. Anup Chandra	
	202500600173 SP 14	Identification of virulence factors arsenal of *Fusarium oxysporum* f. sp. lentis during its pathogenesis in lentil	Dr. Nidhi Kumari	Dr. Ritwika Das Dr. Arvind Kumar Konda Dr. Mohd. Akram	
	202500600173 SP 15	Surveillance, ecology and sustainable management of thrips on mungbean in Eastern Odisha	Dr. Ashis K. Rout	Dr. Anup Chandra	
	202500600173 SP 16	Integrated management of chickpea dry root rot caused by *Macrophomina phaseolina*	Dr. Sudheer Kumar	Dr. Monika Punia	2024-2029

Division of Basic Science (1)

S No.	IIPR Code	Mega Project/Sub Project	PI	Co-PI	Period
7.	CRSCIIPRSIL 202500700174	**Physiological and molecular characterization of suitable plant types and microbes for improving agronomic traits, nutritional quality and symbiotic efficiency** Project Leader: Dr. M. Senthil Kumar			2025-2030
	202500700174 SP 1	Identification of new plant type for high input responsiveness in chickpea and lentil	Dr. D.P. Patel	Dr. M.Senthil Kumar Dr. Yogesh Kumar Dr. Jitendra Kumar Dr. C.P. Nath	

	202500700174 SP 2	Unravelling molecular basis for high mineral nutrients in lentil grains	Dr. Vaibhav Kumar	Dr. Kalpana Tiwari Dr. Narendra Kumar Dr. Jitendra Kumar	
	202500700174 SP 3	Structural and functional diversity of root-nodule microbiome on improving symbiotic efficiency and plant growth of urdbean	Dr. M. Senthil Kumar		
	202500700174 SP 4	Physiological characterization for efficient plant types in short-duration pigeonpea	Dr. T. N. Tiwari	Dr. I.P. Singh Dr. A.K. Parihar Dr. Satheesh Naik S J Dr. R.K. Mishra Dr. Bandi Sanjay Maruti	2023-2027
	202500700174 SP 5	Unravelling the nutritional and functional attributes of chickpea protein	Dr. Kalpana Tewari	Dr. Vaibhav Kumar	2023-2028
	202500700174 SP 6	Identification and morpho-physiological characterization of urdbean genotypes suitable for mechanical harvesting	Dr. Vijay Laxmi	Dr. Mohd Hashim	2024-2027

Division of Social Science (2)

S No.	IIPR Code	Mega Project/Sub Project	PI	Co-PI	Period
8.	**CRSCIIPRSIL 202500800175**	**Development of Farmers centric extension models for supporting value chains, economic analysis and impact assessment (2025-2030)** Project Leader: Dr. Uma Sah			**2025-2030**
	202500800175 SP 1	Pulse based interventions for enhancing nutritional security of tribal farmers in Madhya Pradesh and Chhattisgarh States (2025-30)	Dr. Uma Sah	Dr. Hemant Kumar Dr. Ajay Kumar Rout (ICAR-ATARI, Jabalpur) Dr. Sandeep Chouhan (KVK, Anuppur) Dr. Shweta Masram (KVK, Dindori) Dr. R.P. Ahirwar (KVK, Mandla) Dr. Brij Kishor Prajapati (KVK, Shahdol) Dr. Dahan Singh Mandloi (KVK, Dhar) Dr. Jagdesh Morya (KVK, Jhabua) Dr. Chandu Lal Thakur (KVK, Kanker)	

				Dr. Praween Kumar Nishad (KVK, Dantewada)	
	202500800175 SP 2	Economic evaluation of programmes promoting pulses production in India	Dr. Rekha Rani	Dr. Uma Sah Dr. Devraj Dr. Ashis Ranjan Udgata Dr. P.K. Katiyar	
	202500800175 SP 3	Development of model pulses village through integrated technological interventions in selected zones of India	Dr. Uma Sah	ICAR-IIPR, Kanpur: Dr. C.P. Nath Dr. Man Mohan Dev Dr. Hemant Kumar Dr. Anup Chandra Dr. T. N. Tewari ICAR-IIPR RS, Bhopal: Dr. S.K. Ghritlehre Dr. Nidhi Kumari ICAR-IIPR, Dharwad: Dr. S.L. Patil Dr. P.R. Sabaale Dr. Revanappa B. ICAR-IIPR, Bikaner: Dr. Rajesh Bishnoi Dr. Banwari Lal ICAR-IIPR, Khordha: Mr. Sunil Kr. Sunani Dr. Ashish Kr. Raut	2025-2027
	202500800175 SP 4	Impact assessment of pulses varieties developed by ICAR-IIPR, Kanpur	Dr. Rekha Rani	Dr. Uma Sah Dr. Hemant Kumar Dr. Rajesh Bishnoi (w.e.f. 25.01.2023) Dr. Ashish Ranjan Udgata (w.e.f. 01.06.2023)	2025-2027
9.	**CRSCIIPRSIL 202500900176**	**Development of digital data base and data analytical procedures for pulses (2025-2030)** Project Leader: Dr. Devraj			**2025-2030**
	202500900176 SP 1	AI enabled disease & insect-pest identification and advisory mobile application for Mungbean and Urdbean	Dr. Devraj	Dr. Mohd Akram Dr. Uma Sah Dr. Sanjay Maruti Bandi	2025-2028
	202500900176 SP 2	Development of Pulse outlook in India (2025-30)	Dr. Hemant Kumar	Dr. Rekha Rani Dr. Ashis Ranjan Udgata	2025-2030

	202500900176 SP 3	Agro-climatic characterization and re-grouping chickpea growing regions of India	Dr. Hemant Kumar	ICAR-IIPR: Dr. Biswajit Mondal Dr. Ashish Ranjan Udgata ICAR-CRIDA: Dr. AVM Subba Rao Dr. Sarath Chandran MA Dr. Thimanna Dr. Santanu Kumar Bal	2024-2026
	202500900176 SP 4	Development of a prediction tool for antimicrobial proteins in pulses	Dr. Ashish Ranjan Udgata	Dr. Arvind Kunar Konda	2024-2027
	202500900176 SP 5	Growth and yield stability analysis of major pulses production in India	Dr. Ashish Ranjan Udgata	Dr. Devraj Dr. Rekha Rani	2023-2026

Externally Funded Projects

Crop Improvement (11)

Project Code/ S. No.	Name of the project	Funding agency	Principal Investigator	Associate	Period	Budget (₹ in lakh)
IIPR/EFP/ 2024-/01	AICRP on Seed Crops	IISS, Mau	Dr. P.K. Katiyar	-	2023 to Contd.	90.0
IIPR/EFP/ 2025-26/02	CRP on molecular breeding for improvement of tolerance to biotic and abiotic stresses, yield and quality traits in crops Chickpea	ICAR	Dr. A.K. Srivastava	Dr. Shanmugavadivel PS Dr. Rishikesh Kumar	2025-2026	50.00
IIPR/EFP/ 2025-26/03	CRP on hybrid technology in pigeonpea	ICAR	Dr. Abhishak Bohra	Dr. A.K. Parihar	2015-26	88.00
IIPR/EFP/ 2025-26/04	International Mungbean Improvement Network Phase-2	ACIAR/ AVRDC	**Programme Coordinator** : Dr. G. P. Dixit, Director, ICAR-IIPR **PI**: Dr. Aditya Pratap	Dr. Sanjeev Gupta Dr. Mohd. Akram	June 2022-27	105.75
IIPR/EFP/ 2025-26/05	CRP on Agro-biodiversity 1. Pigeonpea 2. Chickpea	ICAR	Dr. Aditya Pratap Dr. Shailesh Tripathi	Dr. Biswajit Mondal Dr. Rishikesh Kumar	2021-26 2021-26	47.35 40.90
IIPR/EFP/ 2025-26/06	Pre-breeding and genetic enhancement of germplasm of common bean	Alliance Bioversity International – CIAT & IIPR	Dr. Debjyoti Sen Gupta	--	November 2021	25.00
IIPR/EFP/ 2025-26/07	Building lentil growing community resilience by the development of climate smart lentil varieties through farmers' participatory interventions	DAC (NFSM)	Coordinator: Dr. G.P. Dixit Director, ICAR-IIPR PI: Dr. Jitendra Kumar	Dr. Debjyoti Sen Gupta	2023-24 to 2025-26	208.08
IIPR/EFP/ 2025-26/08	Enhancing pigeonpea production and productivity in India by promoting high-yielding early maturing varieties and hybrids	NFSM, GoI through ICRISAT	Dr. A.K. Parihar	Dr. Kali Krishna Hazra	June 2023 to June 2026	106.78

IIPR/EFP/ 2025-26/09	Evaluation for the genetic improvement of pigeonpea landraces for development of climate resilient genotypes for Uttar Pradesh State	UPCAR, Lucknow	Dr. I.P. Singh	Dr. A.K. Parihar Dr. R.K. Mishra Dr. Sandhya Sharma (Plant Biochemistry), ICAR NIPB, New Delhi	2023-26	**24.365**
IIPR/EFP/ 2025-26/10	Computational analysis of lentil genome sequenccs for the identification of marker genes for heat tolerance (Under Network Project on Agricultural Bioinformatics and Computational Biology)	ICAR-IASRI	Dr. Debjyoti Sen Gupta	Dr. Ashis Udgata Dr. Sudhir Srivastava (IASRI) Dr. Dwijesh Mishra (IASRI)	2024-2026	**20.00**
IIPR/EFP/ 2025-26/11	Genetic incorporation of dry root rot resistance in chickpea through Induced mutation	DAE (BRNS)	Dr. A.K. Srivastava		2025-2028	**25.48**

Plant Biotechnology (6)

S. No.	Name of the project	Funding agency	Principal Investigator	Associate	Period	Budget (₹ in lakh)
IIPR/EFP/ 2025-26/12	Incentivizing research in agriculture - molecular approaches for mapping of novel gene(s)/ QTL(s) for resistance/ tolerance to salinity stress in chickpea	ICAR-CRRI	Dr. Shanmugavadivel	Dr. Biswajit Mondal	2015 to 2026	26.35
IIPR/EFP/ 2025-26/13	CRISPR Crop Network: Targeted improvement of stress tolerance, nutritional quality and yield of crops by using genome editing	NASF (ICAR) (Part I)	Dr Alok Das (Pigeonpea)	-	2022-2026	105.34583 (IIPR Part I+II)
IIPR/EFP/ 2025-26/14	Functional characterization of the *Cicer arietinum* short vegetative phase (SVP) genes, their promoters,	DST-SERB	Dr. Aravind Kumar Konda	--	2022-2026	35.79

	and potential *micro RNAs* regulating them towards elucidating their role in floral transition					
IIPR/EFP/ 2025-26/15	Enhancing climate resilience and ensuring food security with genome editing tools. under Sub scheme of Basic and Strategic Research and Education of the scheme Crop Science for Food and Nutritional Security	ICAR-IARI	Dr Alok Das CC-PI	Dr. Meenal Rathore Dr. Neetu Singh Kushwah Dr. Shanmuga-vadivel PS Mr Sudhir K Jha (till March 25) Dr Kuldeep Kumar (till March 25) Dr. Arvind K Konda	2023-26 (Under SFC)	2000.00
IIPR/EFP/ 2025-26/16	Improving the nutritional quality of grasspea (*Lathyrus sativus* L.) using the mutagenesis approach	DST-SERB	Dr. Neetu Singh Kushwah	Dr. Archana Singh	2023-25	46.00
IIPR/EFP/ 2025-26/17	Genome wide identification and functional characterization of the effector genes of *Phytophthora drechsleri* Tucker f. sp. *cajani* causing Phytophthora blight in pigeonpea	DST-SERB	Dr. Aravind Kumar Konda	Dr. R. K. Mishra Dr. Saravanan Matheshwaran, IIT, Kanpur	15.06.2024 to 14.06.2027	38.56

Crop Production (7)

S. No.	Name of the project	Funding agency	Principal Investigator	Associate/ Co-PI	Period	Budget (₹ in lakh)
IIPR/EFP/ 2025-26/18	Carbon foot-print and microbiome community structure in diversified cropping systems under conservation and conventional agriculture	SERB (DST)	Dr. Narendra Kumar	Dr. C.P. Nath	2023-26	35.44128

IIPR/EFP/ 2025-26/19	Identification of chickpea genotype for higher phosphorus use efficiency	SERB (DST)	Dr. C.P. Nath	Dr. Narendra Kumar Dr.Yogesh Kumar Dr. U.C. Jha	2023-26	27.99
IIPR/EFP/ 2025-26/20	Study on determining storage losses in pulses stored in warehouses and to recommend norms for loss/gain during long-term storage	ICAR-DoCA	Dr. Prasoon Verma	Dr. Revanasidda Dr. Man Mohan Deo	2023-26	74.61
IIPR/EFP/ 2025-26/21	Crop residue management in rice-wheat-mungbean system for achieving sustainable development goals (2023-26)	UPCST	Dr. C.P. Nath	Dr. Narendra Kumar, Dr. K.K. Hazra, Dr. R.K. Mishra	2023-26	13.86
IIPR/EFP/ 2025-26/22	Conservation agriculture-led management of drought and heat stress of pulse-based cropping system in Bundelkhand region of Uttar Pradesh through participatory approach	UPCAR	Dr. C.P. Nath	Dr. Narendra Kumar, Dr. Uma Sah, Dr. R.K. Mishra, Dr. A.K. Singh	2024-27	22.55
IIPR/EFP/ 2025-26/23	Agri-Drone Project	RKVY	Dr. Narendra Kumar	Dr. Uma Sah Dr. Man Mohan Deo Dr. Hemant Kumar Dr. R. K. Mishra Dr. Sanjay M. Bandi	2022-25	**35.00**
IIPR/EFP/ 2025-26/24	Enhancing lentil productivity with osmolytes/Bio-regulators Induced tolerance to terminal deficit water and high temperature conditions	UPCST	Dr. K.K. Hazra	Dr. Narendra Kumar Dr. C.P. Nath Dr. R.K. Mishra	2024-27	**15.36**

Crop Protection (3)

S. No.	Name of the project	Funding agency	Principal Investigator	Associate	Period	Budget (₹ in lakh)
IIPR/EFP/ 2025-26/25	Elucidating the molecular mechanisms of host plant resistance to develop resistant varieties/donors in pigeonpea for *Fusarium* wilt and Phytophthora stem blight in Uttar Pradesh	UPCST	Dr. R.K. Mishra		2022-25	11.94
IIPR/EFP/ 2025-26/26	Exploration and application of soil-inhabiting and endophytic plant growth promoting bacteria including actinomycetes for biological management of soil-borne diseases of lentil	MPCST	Dr. Nidhi Kumari	Dr. Surendra Ghritlahre Dr. D.R. Saxena	Oct. 2023 to Sept. 2025	6.50
IIPR/EFP/ 2025-26/27	Production and popularization of low-cost *Trichoderma* - based formulation (DALHANDERMA) technology for mitigating losses due to soil-borne/ root diseases in pulse crops in Bundelkhand region of Uttar Pradesh	PM-RKVY	Dr. R. K. Mishra		2025-2028	**239.0**

Basic Science (1)

S. No.	Name of the project	Funding agency	Principal Investigator	Associate	Period	Budget (₹ in lakh)
IIPR/EFP/ 2025-26/28	CRISPR Crop Network: Targeted improvement of stress tolerance, nutritional quality and yield of crops by using genome editing	NASF (ICAR) (Part II)	Dr. M. Senthil Kumar (Chickpea)	Dr. P. Shanmugavadivel Dr. Alok Das	2022-2025	105.34583 (IIPR Part I+II)

Social Science (5)

S. No.	Name of the project	Funding agency	Principal Investigator	Associate	Period	Budget (₹ in lakh)
IIPR/EFP/ 2025-26/29	Integrated approaches for food, nutrition and livelihood security for rural household in Fatehpur district of Uttar Pradesh. (Farmers FIRST)	ICAR	Dr. Uma Sah	1. Dr. C.P. Nath 2. Dr. Subhash Chandra (CSAUA&T) 3. Dr. M.P.S. Yadav (CSAUA&T) Additional Team of Scientists (CC-PI) since 29.10.2021 4. Dr. R.K. Mishra, 5. Dr. A.K. Parihar, 6. Dr. Sujayanand, GK 7. Dr. Rekha Rani,	2016-25	268.79
IIPR/EFP/ 2025-26/30	Production systems, agri - business and institutions component I: impact assessment of agricultural technologies	ICAR-NIAP, New Delhi	Dr. Rekha Rani (CC-PI)	CC Co-PI: Dr. Uma Sah	2022-26	7.36
IIPR/EFP/ 2025-26/31	Artificial intelligence enabled biotic & abiotic stress detection and advisory mobile application for crops	ICAR, NASF	Dr. Devraj CC-PI	Dr. Sanjay Badi M. Dr. Rishikesh Kumar	2024-27	97.40
IIPR/EFP/ 2025-26/32	Supply chain of pulses in major pulse producing stateS of India with focus on eastern states	DOCA	Dr. Uma Sah	ICAR-IIPR Kanpur: Dr. Rekha rani Dr. Prasoon Verma Dr. Ashis R. Udgata ICAR-IIPR RS, Bhopal: Dr. Debendu Datta	2024-2026	219.31

				Dr. S.K. Ghritlehre ICAR-IIPR, Dharwad: Dr. M.H. Kodandaram Dr. Manu B. ICAR-IIPR, Bikaner: Dr. Rajesh Bishnoi Dr. Banwari Lal ICAR-IIPR, Khordha: Dr. Ashish Kr. Raut ICAR-Research Complex for Eastern Region-Patna: Dr. Anirban Mukherjee ICAR-Research Complex for Eastern Region, RC, Ranchi: Dr. Virendra Kumar Yadav		
IIPR/EFP/ 2025-26/33	Ensuring pulses sufficiency in India by capitalizing Model Pulse Village approach	ICAR, New Delhi	Dr. Uma Sah	Dr. Hemant Kumar, Dr. Ashis R. Udgata	2024-2026	3.75

Institute Mega- Project (6)

S. No.	Name of the project	Funding agency	Principal Investigator	Associate	Period	Budget (₹ in lakh)
IIPR/EFP/ 2025-26/34	Implementation of PVP legislation, DUS test (AICRP on *Rabi* Pulses).	PPV & FRA	Dr. Shailesh Tripathi PC (*Rabi* Pulses)	Dr. A. K. Parihar	2023-continue Project	PPV & FRA Budget
IIPR/EFP/ 2025-26/35	Implementation of PVP legislation, DUS test (AICRP on *Kharif* Pulses).	PPV & FRA	Dr. Aditya Pratap PC (*Kharif* Pulses)	Dr. B. Mondal	2023-continue Project	PPV & FRA Budget
IIPR/EFP/ 2025-26/36	Creation of seed hubs for increasing indigenous production of pulses in India	ICAR & DAC (NFSM)	**National Coordinator :** Dr. G.P. Dixit Director, ICAR-IIPR **Nodal Officer:** Dr. P.K. Katiyar	**Kanpur**: Dr. Yogesh Kumar **Bhopal:** Dr. Gitanjali Sahay (w.e.f. 21.10.2022)	2016-2020 (Continued Project from revolving fund)	22531.08

				Bhubneswer: Dr. Debjoytisen Gupta		
IIPR/EFP/ 2025-26/37	Enhancing breeder seed production for increasing indigenous production of pulses in india.	ICAR & DAC (NFSM)	**National Coordinator :** Dr. G. P. Dixit Director, ICAR-IIPR **Nodal Officer:** Dr. P.K. Katiyar	**Kanpur:** PI- Dr P. K. Katiyar **Bhopal:** PI- Dr. Dibendu Datta (w.e.f 21.10.2022)	2016-2020 (Continued Project from revolving fund)	2039
IIPR/EFP/ 2025-26/38	DBT - Chickpea mission programme of Characterization of genetic resource: Component 6: IIPR Kanpur- "Characterization of chickpea germplasm resource to accelerate genomic-assisted crop improvement"	DBT (Min of Science & Technology)	**Project Leader :** Dr. G. P. Dixit Director, ICAR-IIPR PI: Dr. Archana Singh	Dr. Shailesh Tripathi Dr. A.K. Srivastava	2020-2026	128.3304
IIPR/EFP/ 2025-26/39	Institute Technology Management Unit: Component I: Intellectual property management and transfer/ commercialization of agricultural technologies	ICAR (NAIF)	**Component I:** Dr. R.K. Mishra	Dr. A.K. Srivastava Dr. A.K. Parihar Dr. Debjoyti Sen Gupta	2016-Plan Scheme	Plan Scheme of ICAR
	Component II : Agri-business Incubation Centres in institutions developing agricultural technologies Incubation Fund (ABI)		**Component II :** Dr. R.K. Mishra	Dr. P.K. Katiyar Dr. M. Senthil Kumar Dr. R.K. Mishra Dr. Prasoon Verma Dr. Manmohan Deo	2019-Plan Scheme	

Women In Science and Engineering (WISE)-Societal Challenges with Opportunities (SCOPE) Fellowship Programme:

DST/ WISESCOPE/ AAS/2024/34 Dated 03.01.2025	Diversity and bio-control potential of natural enemies in the pulse crop ecosystem The Development of Entomophage park.	DBT (Min of Science & Technology)	Dr. Neelam Yadav	Mentor : Dr. Sanjay M. Bandi	Feb. 2025 to Jan. 2028	31.12 + HRA & Institutional Charges

Institute Management Committee

(As on 31.12.2025)

Dr. G.P. Dixit Director ICAR-Indian Institute of Pulses Research, Kanpur	Chairman
Director Agriculture, U.P.	Member
Director Agriculture, M.P.	Member
Director Research Rani Laxmi Bai Central Agriculture University Jhansi, U.P.	Member
Sh. Rakesh Shukla Noida, U.P.	Member
Sh. Gulbeer Singh Aligarh, U.P.	Member
Dr. C.S. Praharaj Principal Scientist ICAR-DGR, Junagadh	Member
Dr. C. Bharadwaj Principal Scientist (Genetics) ICAR-IARI, New Delhi	Member
Dr. Ramavtar Sharma Principal Scientist ICAR-CAZRI, Jodhpur	Member
Dr. V.K. Yadav Principal Scientist ICAR-IGFRI, Jhansi	Member
ADG (O&P), ICAR Krishi Bhawan, New Delhi	Member
Finance & Accounts Officer ICAR-Indian Institute of Farming Systems Research Modipuram, Meerut	Member
Senior Administrative Officer ICAR-IIPR, Kanpur	Member Secretary

Research Advisory Committee

(As on 31.12.2025)

Dr. P.M. Salimath Ex. Vice-Chancellor University of Agricultural Sciences, Raichur (Karnataka)	Chairman
Dr. Sanjeev Gupta ADG (O&P), ICAR, New Delhi	Member
Dr. P. Ananda Kumar Ex. Project Director ICAR-NRCPB, New Delhi	Member
Dr. (Mrs.) Om Gupta Director of Extension, JNKVV, Jabalpur	Member
Dr. Masood Ali Ex. Director ICAR-IIPR, Kanpur	Member
Dr. R.P.S. Rattan Ex. Director Extension BAU, Ranchi	Member
Director ICAR-IIPR, Kanpur	Member
Dr. B.B. Singh, Ex ADG (O&P) ICAR, Krishi Bhawan, New Delhi	Member
Mr. Rakesh Shukla 303, Tower-F, Amarpali, Noida, U.P.	Member
Mr. Ch. Gulbeer Singh Vilage Hirnoti, P.O. Digsara, Aligarh, U.P.	Member
Dr. Mohd. Akram Principal Scientist ICAR-IIPR, Kanpur	Member Secretary

Institute Research Council

(As on 31.12.2025)

Dr. G.P. Dixit Director ICAR-Indian Institute of Pulses Research, Kanpur	Chairman
Assistant Director General (O&P) ICAR, Krishi Bhavan, New Delhi	Member
All Scientists of the Institute	Member
Dr. Jitendra Kumar Principal Scientist, Division of Crop Improvement ICAR-IIPR, Kanpur	Member Secretary

Important Committees of the Institute

(As on 31.12.2025)

1.	Monthly Review Committee (MRC)	Director	Chairman
		All Project Coordinators All Heads of the Divisions All Scientists SAO, SF&AO, AAOS Chairmen of various committees Secretary IJSC and Incharge of various activities	Members
		Dr. Naimuddin, Principal Scientist	Member Secretary
2.	Farm Advisory Committee	Dr. Narendra Kumar, Pr. Scientist and HOD, CPD	Chairman
		All Heads of the Divisions, I/c Farms I/c Security Dr. Mohammad Hasim, Sr. Scientist	Members
		Dr. Jitendra Kumar, Principal Scientist	Member Secretary
3.	Estate Management and Works Committee	Director	Chairman
		Dr. P.K. Katiyar, Head, Division of Crop Improvement	Co-chairman
		Dr. Mohd. Akram, Pr. Scientist Dr. Narendra Kumar, Pr. Scientist Dr. (Er.) Prasoon Verma, Sr. Scientist Dr. (Er.) Man Mohan Deo, Scientist Chief Administrative Officer Chief Finance & Accounts Officer Sh. Yaduvir Singh Yadav, TA	Member
		Sr. Administrative Officer	Member Secretary
4.	Seed Advisory Committee	Dr. I.P. Singh, Principal Scientist	Chairman
		Dr. Dibendu Datta, Pr. Scientist & I/c, RS, Bhopal Dr. Yogesh Kumar, Pr. Scientist Dr. Mohammad Hashim, Sr. Scientist Dr. Banwari Lal, Sr. Scientist & I/c, RC, Bikaner Dr. Revanappa, Sr. Scientist (Dharwad)	Member
		Nodal Officer & I/c Seed	Member Secretary
5.	Library Committee	Director	Chairman
		All HoDs, CAO (SG), Sr. AO and CF&AO	Member
		Dr. A.K. Srivastava, Pr. Scientist	Member Secretary
6.	Publication Committee (English)	Director	Chairman
		Dr. (Ms.) Meenal Rathore, Head, Division of Biotechnology	Co-chairperson
		Dr. A.K. Srivastava, Sr. Scientist Dr. A.K. Parihar, Sr. Scientist Dr. Anup Chandra, Sr. Scientist Dr. Uday Chandra Jha, Sr. Scientist Dr. K.K. Hazra, Sr. Scientist	Members
		Dr. Rajesh Kumar Srivastava, ACTO	Member Secretary

7.	Publication Committee (Hindi)	Director	Chairman
		Dr. Uma Sah, Division of Social Science	Co-chairman
		Dr. R.K. Mishra, Pr. Scientist Dr. Vijay Laxmi, Sr. Scientist Dr. Vishal Dinkar, Scientist Mrs. Rashmi Yadav, ACTO	Members
		Dr. Rajesh Kumar Srivastava, ACTO	Member Secretary
8.	Purchase Advisory Committee (PAC)	Dr. Mohd. Akram, Head, Division of Crop Protection	Chairman
		Dr. Devraj, Pr. Scientist Dr. T.N. Tiwari, Pr. Scientist Dr. Pankaj Kumar, CAO (SG) Sh. Kunal Karla, CFAO Dr. Vaibhav Kumar, Scientist Dr. Arvind Kumar Konda, Scientist	Members
		Assistant Administrative Officer/ AO, Store	Member Secretary
9.	Institute Technology Management Committee (ITMC)	Director	Chairman
		Dr. M. Senthil Kumar, Pr. Scientist & HoD Dr. A.K. Srivastava, Pr. Scientist Dr. (Er.) Prasoon Verma, Sr. Scientist Dr. Raghavendra Singh, Pr. Scientist Sr. Administrative Officer AFAO	Members
		Dr. R.K. Mishra, Pr. Scientist	Member Secretary
10.	Institute Technology Management Unit	Dr. R.K. Mishra, Pr. Scientist	In-charge
		Dr. A.K. Parihar, Sr. Scientist Dr. Debjyoti Sen Gupta, Sr. Scientist Dr. Manmohan Deo, Scientist	Members
11.	Resource Generation and Farm Produce Price Fixation Committee	Dr. Shilesh Tripathi, PC (*Rabi* Pulses)	Chairman
		Dr. Krishna Kumar, Pr. Scientist Dr. Satheesh Nayak S.J., Scientist Dr. (Ms.) Rekha Rani, Scientist Ms. Shreya Srivastava, AFAO Sh. Shiv Saran Singh, AAO	Members
		Dr. Mohammad Hashim, Sr. Scientist	Member Secretary
12.	Results Framework Document Committee	Dr. D.P. Patel. Pr. Scientist	Chairman
		Dr. Rahul Dev, Sr. Scientist Dr. C.P. Nath, Scientist CFAO or His nominee	Members
		Dr. Mohammad Hashim, Sr. Scientist	Member Secretary
13.	Priority Setting, Monitoring and Evaluation Cell (PME Cell)	Director	Chairman
		Dr. R.K. Mishra, Sr. Scientist Dr. A.K. Parihar, Sr. Scientist Dr. G.K. Sujay Anand, Sr. Scientist Dr. SJ Satheesh Naik, Scientist Dr. Man Mohan Deo, Scientist	Members

		Dr. Ashish Ranjan Udgata, Sciencist	
		Dr. A.K. Srivastava, Sr. Scientist	Member Secretary & I/c
14.	Institutional Bio-safety Committee	Director	Chairman
		Dr. (Ms.) Meenal Rathore, Pr. Scientist & HoD Dr. G.K. Sujay Anand, Sr. Scientist Dr. (Ms.) Neetu Singh Kushwah, Scientist Dr. Jonaki Sen, IIT, Kanpur Dr. Sanjeev Kumar, IISR, Lucknow Dr. P.K. Singh, Govt. Medical College, Ambedker Nagar	Member
		Dr. Alok Das, Sr. Scientist	Member Secretary
15.	Germplasm & Genotype Identification Committee	Director	Chairman
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		Dr. A. K. Parihar, Sr. Scientist	Member Secretary
16.	Micro-organism Registration Committee	Director	Chairman
		Dr. Mohd Akram, Pr. Scientist & HoD Dr. R.K. Mishra, Pr. Scientist Dr. Antara Das, Scientist Dr. Jagadeeswaran, Scientist Dr. Nidhi Kumari, Scientist (Bhopal)	Co-Chairman Member
		Dr. M. Senthil Kumar, Pr. Scientist & HoD	Member Secretary
17.	Academic and HRD Committee	Dr. Yogesh Kumar, Pr. Scientist	Chairman
		Dr. Bandi Sanjay Maruti, Scientist Dr. Kalpana Tewari, Scientist Dr. Vishal Dinkar, Scientist Dr. Antra Das, Scientist	Member
		Dr. C.P. Nath, Scientist	Member Secretary
18.	Grievance Cell	Dr. P.K. Katiyar, Pr. Scientist & HoD	Chairman
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		Sh. Sujeet Kumar Verma, SAO	Member Secretary
19.	Proprietary Items Committee	Dr. Meenal Rathore, Head, Division of Biotechnology	Chairman
		Dr. Prasoon Verma, Sr. Scientist Dr. Vaibhav Kumar, Scientist Ms. Shreya Srivastava, AFAO Sh. Shiv Saran Singh, AAO (Store)	Member

20.	Computer/AKMU & Instrumentation Committee	Dr. Krishna Kumar, Pr. Scientist	Chairman
		Dr. Uday Chand Jha, Sr. Scientist	Member
		Dr. Abhishek Bohra, Sr. Scientist	
		Dr. G.K. Sujay Anand, Sr. Scientist	
		Dr. Man Mohan Deo, Scientist	
		Dr. Devraj, Pr. Scientist	Member Secretary
21.	IIPR Website and Social Media Maintenance and Updation Committee	Dr. Uma Sah, Head, Division of Social Science	Chairperson
		Dr. Devraj, Pr. Scientist	Co-Chairman
		Dr. Biswajit Mondal, Scientist	Member
		Dr. Rajesh Bishnoi, Scientist	
		Ms. Kancheti Mrunalini, Scientist	
		Dr. Ashish Ranjan Udgata, Scientist	
		Ms. Rashmi Yadav, ACTO	Member Secretary
22.	Consultancy Processing Cell	Dr. Devraj, Pr. Scientist	Chairman
		Dr. K.K. Hazra, Sr. Scientist	Member
		Dr. Biswajit Mondal, Scientist	
		Dr. Aravind Kumar Konda, Scientist	
		Dr. Anup Chandra, Sr. Scientist	Member Secretary
23.	Guest House Management Committee	Dr. D.P. Patel, Principal Scientist	Chairman
		Dr. Prasoon Verma, Sr. Scientist	Member
		Dr. Jagadeeswaran, Scientist	
		Dr. Rekha Rani, Scientist	
		Assistant Finance & Accounts Officer	
		I/c Guest House (SAO)	Member Secretary
24.	House/Quarter Allotment Committee	Dr. Mohd. Akram, HoD, Crop Protection	Chairman
		Dr. Shanmugavadivel, Pr. Scientist	Member
		Dr. C.P. Nath, Scientist	
		Sh. Sujeet Kumar Verma, SAO	
		Ms. Shreya Srivastava, AFAO	
		Sh. Akhil Kumar Gangal, Technician, IJSC	
		Sh. Rajendra Kumar Nigam, AAO	Member Secretary
25.	Institute Deputation Committee	Dr. M. Senthil Kumar, HoD, Div. of Basic Science	Chairman
		Dr. A.K. Srivastava, Pr. Scientist	Member
		Dr. S.J. Santheesh Naik, Scientist	
		Sh. Sujeet Kumar Verma, Sr. Admn. Officer	Member Secretary
26.	*Rajbhasha* Implementation Committee	Director	Chairman
		All HoDs	Member
		Dr. T. N. Tiwari, Pr. Scientist	
		Dr. Neetu Singh Kushwah, Scientist	
		Dr. Rahul Dev, Sr. Scientist	
		Dr. Rishikesh Kumar, Scientist	
		Dr. Rajesh Kumar Srivastava, ACTO	Member Secretary
27.	Vehicle Maintenance Committee	Dr. Prasoon Verma, Sr. Scientist	Chairman
		Dr. Anup Chandra, Sr. Scientist	Member
		Dr. Manu B., Scientist (RS, Dharwad)	

		Dr. Ram Lal Jat, Scientist (RC, Bikaner), Dr. Surendra Kumar Ghritlahre, Scientist (RS, Bhopal). Sh. Sujeet Kumar Verma, SAO Sh. Kunal Kalra, CFAO	
		Sh. Shiv Saran Singh, AAO (Stores)	Member Secretary
28.	Sports Committee	Dr. Ashok Kumar Parihar, Sr. Scientist	Chairman
		Dr. (Ms.) Vijay Laxmi, Sr. Scientist Sh. Kunal Kalra, CFAO Dr. C.P. Nath, Scientist Sh. R.K. Nigam, AAO Sh. Akhil Kumar Gangal, Technician	Member
		Dr. Jagadeeswaran, Scientist	Member Secretary
29.	Technical Specification Evaluation Committee	Dr. Jitendra Kumar, Pr. Scientist	Chairman
		Dr. Devraj, Pr. Scientist Dr. K.K. Hazra, Sr. Scientist Dr. Jagadeeswaran, Scientist Dr. Vaibhav Kumar, Scientist Indenting Officer Dr. Alok Das, Sr. Scientist CFAO or his nominee	Member
		Sh. Shiv Saran Singh, AAO	Member Secretary
30.	Local Purchase Committee	Dr. Yogesh Kumar, Pr. Scientist	Chairman
		Dr. Anup Chandra, Sr. Scientist Dr. Rishikesh Kumar, Scientist Dr. Adarsh Kumar, Scientist Dr. Revanasidda, Scientist CFAO or his nominee	Member
		AO / AAO, Store	Member Secretary
31.	Women Grievance Cell/ Local Committee under the Sexual Harassment of Women (Prevention, Prohibition and Redressal) at Workplace Act	Dr. (Ms.) Meenal Rathore, Head, Division of Biotechnology	Chairperson
		Dr. (Ms.) Gitanjali Sahay, Pr. Scientist, RS (Bhopal) Dr. (Ms.) Kalpana Tewari, Scientist Ms. Monika Punia, Scientist, Bikaner Ms. Reeta Mishra, Assistant	Member
		Sh. Rajendra Kumar Nigam, AAO	Member Secretary
32.	Institute CSR Fund Committee	Director	Chairman
		Dr. Narendra Kumar, Head, Division of Crop Production Dr. P.K. Katiyar, Head, Division of Crop Improvment Dr. Uma Sah, Head, Division of Social Science Sr. Admn. Officer Chief Finance & Accounts Officer Administrative Officer	Member
		Dr. R.K. Mishra, Pr. Scientist	Member Secretary

33.	Grievance Redressal Committee for persons with disability	Dr. Aditya Pratap, PC (*Kharif* Pulses)	GR Officer/ Chairman
		Dr. Bandi Sanjay Maruti, Sr. Scientist Sh. Sujeet Kumar Verma, SAO Sh. Satish Chandra, AAO	Member
34.	Institute Corpus Fund Committee	Director	Chairman
		Dr. Meenal Rathore, Head, Division of Biotechnology Dr. M. Senthil Kumar, Head, Division of Basic Sciences Chief Administrative Officer (SG) Sr. Administrative Officer	Member
		Chief Finance & Accounts Officer	Member-Secretary
35.	In-charges & Member Secretaries	In-charges, Nodal Officers, Link Officers, Managers, Member Secretaries *etc.* Dr. M. Senthil Kumar, HoD, Member Secretary, RAC Dr. A. K. Srivastava, Pr. Scientist, PME Cell, SFC, Library Dr. Jitendra Kumar, Pr. Scientist, Member Secretary, IRC & Farm (Main Campus) Dr. P.K. Katiyar, HoD, Seed Dr. Narendra Kumar, HoD, New Research Campus (NRC) -- Incharge Dr. Pankaj Kumar, CAO (SG), Member Secretary IMC; Head of Office Sh. Sujeet Kr Verma, Senior Administrative Officer, Security & Guest House, CPIO, Nodal Officer e-Office, eHRMS, ERP & AEBAS, Member Secretary, Works Dr Mohammad Hashim, Sr. Scientist, New Research Campus (NRC) -Asstt. Farm Incharge Dr. Yogesh Kumar, Pr. Scientist, Seed Hub (IIPR) Dr. Devraj, Pr. Scientist, PMS/Computer Under AKMU, Nodal Officer, ARMS; RTI, Co-Nodal officer SCSP Programme Dr. D.P. Patel, Pr. Scientist, Liaison Officer OBC/Nodal Officer, NEH Programme Dr. T. N. Tiwari, Pr. Scientist, Nodal Officer, SCSP Programme Dr. Anup Chandra, Sr. Scientist, Co-Nodal Officer (NEH Programme) Dr. R.K. Mishra, Pr. Scientist, ITMU/ABIC Dr. Vijay Laxmi, Sr. Scientist, Liaison Officer SC/ST Dr. C. P. Nath, Scientist, Technology Park Dr. Rahul Dev, Sr. Scientist, Gene Bank Including Cold Module Under Supervision of HoD (CI) Sh. Brij Kishore, PPS, Link Officer-1 (Guest House), Link Officer-2 (Security) Sh. Hasmat Ali, TO, Link Officer-1(Security Main Campus), Link Officer-2 (Guest House) Sh. Sukadeo Mahto, AO, Store Section & Nodal Officer (Legal Matters) Sh. Krishna Autar, STO, Farm Manager (NRC) Sh. H. N. Maurya, TO, Farm Manager (Main Farm) Sh. R. K. S. Yadav, STO, Horticulture under supervision of I/c Main Farm Sh. Rajendra Kumar Nigam, AAO, DDO, Vehicle, CPGRAM, Nodal Officer Sh. Shiv Saran Singh, AAO, Sanitation and Link Officer (Legal) Sh. Rohit Katiyar, T4, Link Officer Security (NRC), Farm Machinery & Seed Processing Plants at NRC Dr. Kanhaiya Lal, Sr. Technical Officer, Seed Production & Processing *etc.* (NRC) Maintenance of Power supply & other electrical work related to NRC under supervision of I/c NRC	

		Sh. Yaduvir Singh Yadav, T.A., EPABX, Electricity, Maintenance Work under supervision of Dr. Man Mohan Deo Dr. S. L. Patil, Pr. Scientist, OIC, ICAR-IIPR, RS, Dharwad Dr. Dibendu Datta, Pr. Scientist, OIC, ICAR-IIPR, RS, Phanda, Bhopal Dr. A. K. Rout, Scientist, ICAR-IIPR, RS, Khordha (Odisha)
Nodal Officer Various, Committees & In-charges at Regional Stations/Centre		
36.	Nodal Officers	Dr. Narendra Kumar, Pr. Scientist & HoD, ICAR-IIPR RS, Khordha (Odisha)
37.	Link Officers	Dr. Shailesh Tripathi, PC (*Rabi* Pulses), ICAR-IIPR RS, Dharwad (Karnataka) Dr. P.K. Katiyar, Pr. Scientist & HoD, ICAR-IIPR RS, Phanda, Bhopal Dr. Narendra Kumar, Pr. Scientist & HoD, ICAR-IIPR RS, Bikaner (Rajasthan)

ICAR - IIPR Regional Research Centre, Dharwad

1.	Farm Produce Auction & Purchase Committee	Chairman	: Dr. S.L. Patil, Pr. Scientist
		Members	: Dr. B.G. Shivakumar. Pr. Scientist, ICAR-IGFRI, RS, Dharwad Dr. M.S. Venkatesh, Pr. Scientist Dr. B.S. Patil, Pr. Scientist, ICAR-IARI, RS, Dharwad
		Member-Secretary	: Dr. Kodandaram M.H., Pr. Scientist
2.	Farm Development Committee	Chairman	: Dr. S.L. Patil, Pr. Scientist
		Members	: Dr. S.R. Salakinkoppa (Weed Control) Head, AICRP on Maize Dr. R.V. Hegde, Professor Horticulture
		Member-Secretary	: Dr. M.S. Venkatesh, Pr. Scientist
3.	Local Purchase Committee	Chairman	: Dr. Kodandaram MH, Pr. Scientist
		Members	: Dr. Narendra Kulkarni, PS, ICAR-IGFRI, RS, Dharwad Dr. Jayant Bhat, PS, ICAR-IARI, RS, Dharwad
		Member- Secretary	: Dr. Manu B, Scientist
4.	In-charges / Manager	Farm	: Dr. S.L. Patil, Pr. Scientist
		Security	: Dr. P.R. Saabale, Sr. Scientist; in the absence of In-charge Dr. Manu B. / Dr. Revanappa will look after the work
		Seeds Store & Off Season	: Dr. Revanappa, Sr. Scientist; in the absence of In-charge Dr. Manu B./Dr. Venkatesh MS will look after the work
		Farm Manager/ Imprest Holder & Vehicle	: Dr. Manu B., Scientist; in the absence of In-charge Dr. Venkatesh MS/Dr. Revanappa will look after the work

ICAR - IIPR Regional Research Station, Phanda, Bhopal

1.	Local Purchase Committee	Chairperson	: Dr. Gitanjali Sahay, Principal Scientist RS, Bhopal
		Members	: Dr. Archana Singh, Pr. Scientist : Dr. Nidhi Kumari, Scientist : Sh. Ashish Chaube, AO, ICAR-NIHSAD, Bhopal : Sh. Rajesh Dubey, F&AO, ICAR-CIAE, Bhopal
		Member Secretary	: Sh. Amit Kumar Bhatore, Technician
2.	Seed/Grain Auction Committee	Chairman	: Dr. Dibendu Datta, Principal Scientist & I/c, RS, Bhopal
		Members	: Dr. Lekh Ram, Scientist, College of Agriculture, Sehore : Dr. (Ms.) Gitanjali Sahay, Pr. Scientist : Dr. Surendra Kumar Ghritlahre, Scientist
		Member Secretary	: Sh. Amit Kumar Bhatore, Technical Assistant

3.	In-charges	Legal/Court Cases :	Dr. Dibendu Datta, PS & OIC
		Farm	Dr. Gitanjali Sahay, Pr. Scientist
		Vehicle	Dr. Surendra Ghritlahre, Scientist
		Farm Manager	Sh. Amit Bhatore, Sr. Tech. Assistant
		Security	Sh. Ritesh Pawar, Sr. Technician

ICAR - IIPR Regional Station, Bikaner (Rajasthan)

1.	Farm Produce Price Fixation Committee	Chairman	Dr. Sudheer Kumar, HoRC, ICAR-IIPR RC, Bikaner
		Members	Dr. Deepak Sarolia, PS, ICAR-CIAH, Bikaner Dr. Banwari Lal, Sr. Scientist Dr. Ram Lal Jat, Scientist Dr. Rajesh Bishnoi, Scientist
		Member - Secretary	Sh. M. M. Vanvi, AAO
2.	Committee Farm Produce sale at Agriculture Production Marketing Committee (APMC)/Auction	Chairman	Dr. Sudheer Kumar, HoRC, ICAR-IIPR RC, Bikaner
		Members	Dr. Deepak Sarolia, PS, ICAR-CIAH, Bikaner Dr. Rajesh Bishnoi, Scientist Dr. Lalit Kumar Rolaniya, Scientist Ms. Monika Punia, Scientist
		Member - Secretary	Sh. M. M. Vanvi, AAO
3.	Local Purchase Committee	Chairman	Dr. Sudheer Kumar, Pr. Scientist & HoRC
		Members	Dr. Deepak Kumar Sarolia PS, ICAR-CIAH, Bikaner Dr. Banwari Lal, Sr. Scientist Dr. Sumit Kumar Aggarwal, Scientist Ms. Monika Punia, Scientist Dr. Rajesh Bishnoi, Scientist
		Member - Secretary	Sh. M.M. Vanvi, AAO
4.	In-charges	Seed and Farm	Dr. Banwari Lal, Sr. Scientist
		Experimental Farm	Dr. Ram Lal Jat, Scientist
		Gardening and Landscaping	Dr. Lalit Kumar Rolaniya, Scientist
		Vehicle and Farm implements, Security	Sh. M.M. Vanvi, AAO

ICAR-IIPR Regional Station, Khordha (Odisha)

1.	Local Purchase Committee	Chairman	Dr. Asish Kumar Rout, Scientist & l/c
		Members	Dr. Sanatan Pradhan, Sr. Scientist ICAR-IIWM, Bhubaneswar
		Member-Secretary	Mr. Janardan Biswal, SFAO, ICAR-CIWA, Bhubaneswar
2.	In-charges	Farm & Vehicle / Farm Manager & other campus activities	Dr. Asish Kumar Rout, Scientist

Panorama

Celebration of World Pulses Day with Industry-Stakeholder Conclave

ICAR-Indian Institute of Pulses Research marked the World Pulses Day on February 10, 2025, with a Industry-Stakeholder Conclave. The event featured Dr. Masood Ali, former Director of IIPR as the Chief Guest, and Dr. R.K. Tripathi, Director, NSAI, New Delhi, as the Guest of Honour. Welcoming the distinguished guests, Dr. G.P. Dixit, Director, IIPR expressed that the event was a moment of immense pride for the Institute. Addressing the gathering, Dr. Masood Ali applauded the Institute's significant contributions to pulses research under the leadership of Dr. Dixit.



He emphasized that while notable success has been achieved in chickpea and mungbean, the current focus should now be on boosting pigeonpea and blackgram production. Highlighting IIPR advancements, he shared that over the last decade, 44 high-yielding pulse varieties have been developed, resulting in a substantial increase in productivity. However, he stressed the need for a mission-driven approach to reduce India's dependence on pulse imports. Acknowledging the Government's commitment, he noted that ₹ 1,000 crore has been allocated in the current budget to enhance pulse production, expressing confidence in achieving remarkable results in the coming years.

Dr. R.K. Tripathi, highlighted that with the remarkable progress under the Seed Hubs initiative, India's seed sector has become more robust and globally competitive, with Indian seeds being adopted across various areas. However, he emphasized the need for further advancements in breeder seed production, quality enhancement, and streamlining the seed licensing process to address existing challenges. Dr. G.P. Dixit provided insights into the Institute's key activities and achievements, emphasizing the success of international collaborations and national research programmes. He underscored that reducing the import of pigeonpea and blackgram remains a top priority, aligning with the Government's strategic vision. Dr. Dixit further highlighted IIPR's strong focus on public-private partnerships (PPP), which has led to over 50 strategic agreements with key industry stakeholders and the filing of 10 patents. To strengthen this ecosystem, five additional agreements were signed during the event. Three publications were also released on this day.



A key highlight of the event was honouring of progressive farmers from different parts of the State for their outstanding contributions to pulse cultivation. The event concluded with a formal vote of thanks from Dr. Raj Kumar Mishra, Principal Scientist, who also convened proceedings of the day.

Research Advisory Committee (RAC) Meeting at ICAR-IIPR, Kanpur

The 30th meeting of Research Advisory Committee (RAC), ICAR-Indian Institute of Pulses Research, Kanpur was successfully held on March 18-19, 2025 under the Chairmanship of Dr. R.M. Chauhan, Vice-Chancellor, Sardar Krushi Nagar Dantewada Agriculture University, Gujarat both in physical Research Advisory Committee Meeting and virtual mode. Dr. A.R. Sharma, Ex. Director Research, RLBCAU, Jhansi; Dr. Sarvjeet Singh, Ex-Professor (PB&G), PAU, Ludhiana; Dr. Ashwani Kr. Basandrai, Ex-Professor (Plant Pathology), HPKV, Palampur



and Dr. G.P. Dixit, Director, ICAR-IIPR, Kanpur, attended the meeting in physical mode. Dr. Debasis Chattopadhyay, Scientist VII, NIPGR, New Delhi, Member of RAC attended the meeting in virtual mode. Chairman Dr. R.M. Chauhan, in his opening remarks, briefed about the current scenario on pulses cultivation and importance to strengthen the collaborations with state agricultural universities. The Chairman and members of RAC visited the research fields including organic and natural farming plots at New Research Campus, IIPR. Scientists

interacted with the experts and discussed salient findings. RAC recommended the demonstrations of ICAR certified technologies of IIPR through outreach programmes. In his concluding remarks, Dr. R.M. Chauhan, applauded the research efforts of IIPR and added the importance of strong collaboration with state agricultural universities of this region to achieve self-sufficiency in pulses within couple of years. He expressed that the infrastructure facilities at IIPR and research farm were impressive.

Sensitization Programme on New Generation Pulses Innovation organized by Pulses Innovation Hub, ABIC



The Pulses Innovation Hub (ABIC) of ICAR-IIPR, Kanpur organized a one-day sensitization programme titled "New Generation Pulses Innovation-I" for B.Sc. (Ag) and M.Sc. (Ag) students from Chandra Bhanu Gupta Agriculture Post Graduate College, Bakshi Ka Talab, Lucknow, on March 26, 2025. A total of 130 students, passionate about agricultural innovation, along with five faculty members, actively participated in the event. The programme focussed on introducing students to the latest advancements in pulses innovation. Mentors, Dr. R.K. Mishra and Dr. Man Mohan Deo from ABIC, ICAR-IIPR shared valuable insights on start-up registration and the process of gaining incubation support under the Pulses Innovation Hub. They also discussed promising business opportunities in pulse processing, value addition, and the production of biofertilizers and biopesticides.

Dr. Mangi Lal Jat joined as Secretary, DARE & Director General, ICAR

Internationally acclaimed agricultural scientist, Dr. Mangi Lal Jat has been appointed as the Secretary of the Department of Agricultural Research and Education (DARE) and Director General of the Indian Council of Agricultural Research (ICAR). Dr. Jat currently served as the Deputy Director General (Research) and Director of the Global Research Programme at International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad. With a distinguished career in agricultural science, Dr. Jat has earned global recognition for his research and leadership in natural resource management and sustainable agriculture.



Dr. Jat brings with him over 25 years of rich experience in agricultural research and development. He served in various capacities within ICAR for more than a decade and later at the International Maize and Wheat Improvement Center (CIMMYT), contributing significantly to innovations in conservation agriculture. His pioneering work in zero tillage, carbon sequestration, and climate-resilient farming practices has been instrumental in promoting sustainable agriculture, particularly in dryland regions. His leadership at ICRISAT as Deputy Director General further cemented his reputation as a global expert in resource conservation agriculture-an area critical for India's agricultural transformation, especially in the face of climate challenges. His vision aligns with the urgent need to convert the country's dryland areas into productive green zones through science-led solutions.

Dr. Jat succeeds Dr. Himanshu Pathak who had earlier moved from ICAR to serve as the Director General of ICRISAT. This transition marks a new chapter in Indian agricultural research with stakeholders hopeful that under Dr. Jat's guidance, ICAR will continue to scale new heights in innovation and sustainability.

Successful organization of "*Viksit Krishi Sankalp Abhiyan* 2025"

The Indian Institute of Pulses Research, Kanpur successfully organized the *Viksit Krishi Sankalp Abhiyan* preceding *Kharif* 2025. This intensive campaign was conducted from May 29 to June 12, 2025 across five districts of Uttar Pradesh-Kanpur Dehat, Kannauj, Etawah, Auraiya, and Fatehpur. Seventeen teams of scientists from the Institute directly interacted with nearly 1,04,100 farmers from 819 villages and shared the latest technologies related to pulses cultivation. Scientists from Bikaner

(Rajasthan) centre reached out to 7,000 farmers across 42 villages in 6 blocks. Similarly, Dharwad (Karnataka) centre covered 51 villages and 7,100 farmers while Khordha (Odisha) centre connected with 15,000 farmers across 51 villages, disseminating information on advanced pulse farming technologies.

On this occasion, the Director of the Institute, Dr. G.P. Dixit, stated that the campaign was not limited to dissemination of technical knowledge but became a bridge of trust and collaboration between scientists and farmers. The campaign gave new direction to our pre-existing commitment of providing knowledge, respect and solutions to the farmers.

Farmers expressed that such campaigns are highly beneficial and boost their confidence in adopting modern and sustainable farming practices. IIPR scientists assured that the campaign would continue



until every village is reached and as many farmers as possible are trained. This intensive campaign not only increased awareness of innovations in agriculture but also inspired farmers towards self-reliance and modern farming. The agricultural challenges and suggestions received during the campaign will be analyzed to enhance the effectiveness of future research and extension activities. It was emphasized that such campaigns will be organized regularly in the future to ensure speedy and efficient transfer of the latest research and technologies to the farmers.

International Field Day Visit to Kenya

Dr. G.P. Dixit, Director of Institute and Dr. AK Parihar, Senior Scientist participated in the International Field Day on Pigeonpea and launch meeting of the UK-CGIAR project on 'Climate Smart Pigeonpea. They visited the Pigeonpea Germplasm and Breeding Material Dry Land Research Station at KALRO, Katumani, ICRISAT and CIMMYT in Kiboko in Kenya and interacted with the programme leaders and participating scientists and explored opportunities for innovations that may be best suited to enhance pigeonpea productivity in the Indian agro-climatic conditions.

The project entitled 'Deciphering the root-soil interface to develop efficient N_2 fixing, climate-smart pigeonpea cultivars with improved yields' (UK-CGIAR project) was launched and *vis-à-vis* objectives, work plan was finalized. This project will generate fundamental understanding for optimizing temperature resilience and productivity of



pigeonpea. Besides, importance and application of wild species of pigeonpea to design climate resilient pigeonpea was discussed in the Pre-breeding Workshop. The visit also gave exposure to the germplasm and breeding materials available with ICRISAT in Africa through field day. ICRISAT agreed to share germplasm and breeding material with ICAR-IIPR, Kanpur to strengthen our ongoing breeding programme. This visit enhanced knowledge about the international pigeonpea improvement programmes and the possibility of new international collaborations.

Annual Group Meet of AICRP on *Rabi* Pulses 2025 Organized

The Secretary, DARE and Director General, ICAR, New Delhi, Dr. M.L. Jat, chaired the inaugural session of the Annual Group Meet of All India Coordinated Research Project (AICRP) on *Rabi* Pulses and a brainstorming session on"Roadmap for attaining self-sufficiency in pulses production" held at RLBCAU, Jhansi on 19th August 2025. The group meet was attended by more than 175 scientists from different organizations, *viz.*, State Agriculture Universities, BARC, ICRISAT, ICARDA, and ICAR Institutes. Dr. Jat addressed the august gathering and emphasized to prepare an implementable action plan to achieve self-sufficiency in pulses. In the context of pulses, he mentioned about 3P approach for growing pulses, People, Planet, and Profit. He mentioned that pulses are important for both the people as well as the planet, but at the sametime for increasing pulses production, the scientists should put in efforts to make pulses cultivation profitable for farmers. He also emphasized that our research and development

programme must be aligned with the local socio-economic system. He suggested that scientists should focus on designing high-yielding cultivars suitable for surface seeding, relay cropping, stress-prone areas, and high/low input areas. The Deputy Director General (Crop Sciences), ICAR, Dr. D.K. Yadava said that the scientists should make efforts to develop production and protection technologies to minimize crop loss due to weeds, disease, and insect pests. He





said dedicated efforts should be made to mechanize pulse cultivation from planting to harvesting.

Celebration of 33rd Foundation Day of ICAR-IIPR

The Indian Institute of Pulses Research, Kanpur celebrated its 33rd Foundation Day on September 5, 2025. On this occasion, Prof. Vinay Pathak, Vice-Chancellor of CSJMU, Kanpur and Dr. Sunil Chandra Dubey, Vice-Chancellor of Birsa Agricultural University, Ranchi, Jharkhand, were the Chief Guests while Dr. Seema Paroha, Director, National Sugar Institute, Kanpur was the Distinguished Guest. Director of the Institute, Dr. G.P. Dixit stated that the country is steadily moving toward self-sufficiency in pulse production. He also shared that the Institute has received external funding for research projects worth approximately eight crores. Highlighting the achievements of the Institute, elaborated on other innovative technologies and in national development through its research contributions. Emphasizing collaborative research, he also discussed the importance of data management and analysis for the future. Prof. Pathak stressed that the farmers should be equally aware of agricultural marketing and business knowledge to maximize their benefits. Referring to former Prime Minister, Lal Bahadur Shastri's slogan "*Jai Jawan Jai Kisan,*" he underlined its significance in helping India achieve self-sufficiency in food production. Dr. Sunil Chandra Dubey presented a detailed research report on the significance of pulses and shared future strategies for innovation and updates in pulse research. Dr. Seema Paroha highlighted the nutritional value of pulses and praised the varieties







shared the significant achievements and outreach.

Dr. Dixit also emphasized the Institute's efforts in building public-private partnerships, mentioning that despite challenges, the Institute is fully capable and committed to overcoming them. He mentioned that the Institute is working to develop low-cost technologies for farmers and to ensure wider availability of improved seed varieties.. He also shared the active role of IIPR scientists during the recently held "***Vikst Krishi Sankalp Abhiyan 2025***,". He reassured that the Institute continues to receive full cooperation from the government and is working toward setting new records in pulse production. The Chief Guest, Prof. Vinay Pathak highly appreciated the Director's address and commended the Institute's work and accomplishments over the past year. He acknowledged that the Institute is playing a vital role developed under IIPR's breeding programmes. She lauded the Institute's achievements and commended the leadership of Director for ensuring smooth research progress. She also proposed collaborative research between the Pulses and Sugar Institutes.

Recognizing the importance of Public- Private Partnerships, the Institute continues to sign Memoranda of Understanding (MoUs) with various organizations. On this occasion, an MoU was signed between CSJM Innovation Foundation, Kanpur, and Pulses Innovation Hub (ABIC, IIPR, Kanpur). A few new publications were also released by the Chief Guest. Progressive farmers from different districts of Uttar Pradesh were honoured for their outstanding contributions to pulses cultivation and were provided with improved seed varieties. On this occasion, Institutional awards were also presented

for commendable contributions in research: Dr. M. H. Kodandarama – Outstanding Scientist Award (Senior Category), Dr. Sujayanand G.K. – Outstanding Scientist Award (Young Category), Mr. R.K.S. Yadav – Best Employee Award (Technical Category), Mr. Kunal Kalra – Best Employee Award (Finance and Accounts Category), Mrs. Meenakshi Varshney – Best Employee Award (Administrative Category), Dr. Narendra Kumar and Team – Outstanding Team Award for Research and Development. The vote of thanks was delivered by Dr. Shailesh Tripathi, Project Coordinator *(Rabi)* and the event was conducted by Dr. Rekha Rani, Scientist, and Dr. Rajkumar Mishra, Principal Scientist.

Workshop on Intellectual Property Rights (IPR) Organized at ICAR-IIPR

The ICAR–Indian Institute of Pulses Research (IIPR), Kanpur successfully organized a one-day workshop on Intellectual Property Rights (IPR) on December 22, 2025. The workshop aimed to enhance awareness on the protection of research outcomes, understanding of regulatory frameworks, and promotion of commercialization of agricultural innovations.

The programme witnessed enthusiastic participation from more than 200 participants, including scientists, researchers, students, start-ups, entrepreneurs, and other stakeholders.

On this occasion, the Chief Guest formally released the product "*Dal* Crunch", developed by Little One Agri Innovations, an incubatee of the Pulses Innovation Hub.







Dr Neeru Bhushan, Assistant Director General (IPTM), ICAR, New Delhi, graced the occasion as the Chief Guest. In her address, she emphasized the significance of IPR in safeguarding research outputs, encouraging innovation, and facilitating effective technology transfer from laboratories to farms and industries.

Presiding over the programme, Dr G.P. Dixit, Director, ICAR–IIPR, Kanpur, highlighted the critical role of IPR in protecting newly developed pulse varieties, technologies, products, and processes. He stressed that IPR not only safeguards the rights of scientists and innovators but also plays a vital role in promoting start-ups, strengthening industry–academia linkages, and transforming research outputs into tangible socio-economic benefits. He further informed that ICAR–IIPR is continuously making efforts for effective management and commercialization of the intellectual property generated at the Institute.

The keynote address was delivered by Dr K.L. Gurjar, Joint Director, Central Insecticides Board & Registration Committee (CIB&RC), who elaborated on regulatory requirements for registration of bio-pesticides and discussed challenges faced by entrepreneurs in this domain.

During the technical sessions, experts delivered insightful lectures on patents, copyrights, trademarks, and their practical applications. The programme concluded with a feedback session, and participation certificates were distributed to all attendees.

संस्थान में अन्तर्राष्ट्रीय योग दिवस मनाया गया

अन्तर्राष्ट्रीय योग दिवस 21 जून, 2025 को भारतीय दलहन अनुसंधान संस्थान के प्रांगण में बड़े उत्साह के साथ मनाया गया। प्रातः 6:30 बजे आयोजित इस योग कार्यक्रम में संस्थान के वैज्ञानिकों, तकनीकी व प्रशासनिक वर्ग के कर्मचारियों ने भाग लिया। इस अवसर पर संस्थान के निदेशक, डॉ. जी.पी. दीक्षित ने जीवन में योग के महत्व पर प्रकाश डाला। उन्होंने



कहा कि आज के इस प्रदूषित वातावरण में योग को जीवन में अपनाकर ही स्वस्थ रहा जा सकता है और तनावमुक्त जीवन जिया जा सकता है। योगक्रियां, आयुष मंत्रालय के प्रोटोकाल के अनुरूप पूर्ण करवाई गईं, बताया गया कि कौन से आसनों का नियमित अभ्यास करके कौन से रोगों से मुक्ति पाई जा सकती है। इस अवसर पर संस्थान के वरिष्ठ पदाधिकारी, परियोजना समन्वयक, विभागाध्यक्ष, वरिष्ठ प्रशासनिक अधिकारी, वरिष्ठ वित एवं लेखाधिकारी आदि मौजूद थे।

हिन्दी दिवस समारोह का आयोजन

भाकृअनुप– भारतीय दलहन अनुसंधान संस्थान में दिनांक 25 सितम्बर, 2025 को हिन्दी दिवस समारोहपूर्वक मनाया



गया। प्रो. राकेश कुमार शुक्ल, वीएसएसडी डिग्री कालेज, कानपुर समारोह के मुख्य अतिथि थे। समारोह की अध्यक्षता संस्थान के निदेशक, डा. जी.पी. दीक्षित ने की। समारोह में संस्थान के सभी वैज्ञानिक, तकनीकी, प्रशासनिक एवं सहायक वर्ग के कर्मचारियों ने भाग लिया। तत्पश्चात संस्थान के राजभाषा सचिव ने सभी अतिथियों एवं प्रतिभागियों का स्वागत करते हुए कहा कि हिन्दी दिवस का आयोजन हमारी भाषाई अस्मिता और राष्ट्रीय गौरव का उत्सव है। इस अवसर पर हम यह संकल्प लेते हैं कि संस्थान के अधिक से अधिक कार्य हिन्दी में संपादित किए जाएँ, ताकि राजभाषा का व्यावहारिक प्रयोग और अधिक प्रभावी हो सके।

मुख्य अतिथि, प्रो. राकेश कुमार शुक्ल ने अपने प्रेरक उद्‌बोधन में कहा कि देवनागरी लिपि में लिखी गयी हिन्दी हमारी राजभाषा ही नहीं, बल्कि राष्ट्रीय एकता का प्रतीक है। हिन्दी वह सेतु है जो भारत के विविध भाषाई क्षेत्रों को जोड़ती है। उन्होंने कहा कि ज्ञान–विज्ञान, अनुसंधान और तकनीकी विकास के क्षेत्र में भी हिन्दी को सशक्त माध्यम के रूप में अपनाने की आवश्यकता है। यदि भारत को विकसित राष्ट्रों की श्रेणी में लाना है, तो उसकी भाषा को भी विकास का आधार बनाना होगा।

अध्यक्षीय संबोधन में डॉ. जी.पी. दीक्षित ने कहा कि हिन्दी भाषा में अभिव्यक्ति की सरलता, स्पष्टता और व्यापकता निहित है। हम अपनी मातृभाषा में ही अपने विचारों और वैज्ञानिक कार्यों को सबसे प्रभावी ढंग से प्रस्तुत कर सकते हैं। संस्थान में राजभाषा के प्रयोग को बढ़ावा देने के लिए अनेक सार्थक प्रयास किए जा रहे हैं, जिनमें हिन्दी में वैज्ञानिक लेखन, कार्यालयीन पत्राचार, प्रकाशन और सृजनात्मक गतिविधियाँ शामिल हैं। उन्होंने सभी कर्मचारियों से आह्वान किया कि वे राजभाषा हिन्दी के प्रयोग को अपने दैनिक कार्यों में और अधिक प्रोत्साहन दें। संस्थान में राजभाषा हिन्दी के प्रचार– प्रसार, प्रयोग और सृजनात्मक उपयोग की दिशा में सतत और प्रभावी प्रयास जारी हैं, जिससे हिन्दी न केवल प्रशासन की भाषा बने, बल्कि विज्ञान और अनुसंधान की भी सशक्त अभिव्यक्ति बन सके।

हिन्दी पखवाड़े के अंतर्गत आयोजित विभिन्न प्रतियोगिताओं के विजेताओं – डॉ. राज कुमार मिश्रा, श्री सुजीत कुमार वर्मा, डॉ. अर्चना सिंह, डॉ. हेमंत कुमार, डॉ. मनमोहन देव, डॉ. ऋषिकेश कुमार, डॉ. अंतरा दास, डॉ. कन्हैया लाल, श्री अमित गुप्ता, श्री मनीष कुमार, श्री शिव शरण, श्रीमती मीनाक्षी वार्ष्णेय, श्री मयंक मिश्रा, श्री यदुवीर सिंह यादव, श्री अनिल



सोनकर, श्री अभिषेक सिंह राजपूत, श्रीमती रीता मिश्रा, श्रीमती रश्मि यादव, श्री अनुज गुप्ता, श्री शिवम सृष्टि तथा श्री सचिन सिंह को मुख्य अतिथि द्वारा प्रशस्ति पत्र एवं पुरस्कार प्रदान किए गए। कार्यक्रम का संचालन, डॉ. राज कुमार मिश्रा ने किया। समापन सत्र में डॉ. शैलेश त्रिपाठी, परियोजना समन्वयक (रबी) ने धन्यवाद ज्ञापन प्रस्तुत किया।

Personnel

(As on December 31, 2025)

A. Research Management

1. Dr. G.P. Dixit	Director

B. AICRP on *Rabi Pulses*

2. Dr. Shailesh Tripathi	Project Coordinator

C. AICRP on *Kharif Pulses*

3. Dr. Aditya Pratap	Project Coordinator

D. Scientific

Crop Improvement		
4. Dr. P.K. Katiyar	Genetics & Plant Breeding	Head of the Division
5. Dr. I.P. Singh	Genetics & Plant Breeding	Principal Scientist
6. Dr. Jitendra Kumar	Genetics & Plant Breeding	Principal Scientist
7. Dr Yogesh Kumar	Genetics & Plant Breeding	Principal Scientist
8. Dr. A.K. Srivastava	Genetics & Plant Breeding	Senior Principal Scientist
9. Dr. Uday Chand Jha	Genetics & Plant Breeding	Senior Scientist
10. Dr. Debjyoti Sen Gupta	Genetics & Plant Breeding	Senior Scientist
11. Dr. Abhishek Bohra	Genetics & Plant Breeding	Senior Scientist
12. Dr. Ashok Kumar Parihar	Genetics & Plant Breeding	Senior Scientist
13. Dr. Rahul Dev	Eco Botany & PGR	Senior Scientist
14. Dr. Biswajit Mondal	Genetics & Plant Breeding	Scientist (Senior Scale)
15. Dr. Satheesh Naik S.J.	Genetics & Plant Breeding	Scientist
16. Dr. Vishal Dinkar	Genetics & Plant Breeding	Scientist
Plant Biotechnology		
17. Dr. (Mrs.) Meenal Rathore	Biotechnology	Head of the Division
18. Dr. Alok Das	Biotechnology	Senior Scientist
19. Dr. P.S. Shanmugavadivel	Biotechnology	Senior Scientist
20. Dr. Neetu Singh Kushwah	Biotechnology	Senior Scientist
21. Shri Sudhir Kumar Jha	Biotechnology	Scientist (Senior Scale)
22. Dr. K. Aravind Kumar	Biotechnology	Scientist (Senior Scale)
23. Dr. Antara Das	Biotechnology	Scientist (Senior Scale)
24. Dr. Kuldeep Kumar	Biotechnology	Scientist
Crop Production		
25. Dr. Narendra Kumar	Agronomy	Head of the Division
26. Dr. (Er.) Prasoon Verma	ASPE	Senior Scientist
27. Dr. Mohd. Hashim	Agronomy	Senior Scientist
28. Dr. Kali Krishna Hazra	Agronomy	Senior Scientist
29. Dr. Chaitanya Prasad Nath	Agronomy	Sr. Scientist

30. Dr. Man Mohan Deo	FMP	Scientist (Senior Scale)
31. Mr. Asik Dutta	Soil Science	Scientist (on study leave)
32. Dr. Kancheti Mrunalini	Agronomy	Scientist
33. Dr. Adarsh Kumar	Agronomy	Scientist
Crop Protection		
34. Dr. Mohd. Akram	Plant Pathology	Head of the Division
35. Dr. Krishna Kumar	Plant Pathology	Principal Scientist
36. Dr. Naimuddin	Plant Pathology	Principal Scientist
37. Dr. R.K. Mishra	Plant Pathology	Principal Scientist
38. Dr. Sujyanand G.K.	Entomology	Senior Scientist
39. Dr. Anup Chandra	Entomology	Senior Scientist
40. Dr. R. Jagadeeswaran	Nematology	Scientist
41. Dr. Bandi Sanjay Maruti	Entomology	Scientist
42. Dr. Revanasidda	Entomology	Scientist
43. Dr. Rishikesh Kumar	Plant Pathology	Scientist
Basic Science		
44. Dr. M. Senthilkumar	Microbiology	Head of the Division
45. Dr. D.P. Patel	Plant Physiology	Principal Scientist
46. Dr. T.N. Tiwari	Plant Physiology	Principal Scientist
47. Dr. (Mrs.) Vijay Laxmi	Plant Physiology	Senior Scientist
48. Dr. Kalpana Tiwari	Biochemistry	Scientist
49. Dr. Vaibhav Kumar	Biochemistry	Scientist
50. Ms. Namrata Lashkar	Agril. Chemicals	Scientist
Social Science		
51. Dr. (Mrs.) Uma Sah	Agril. Extension	Head of the Division
52. Dr. Dev Raj	Computer Application	Principal Scientist
53. Dr. Hemant Kumar	Agril. Statistics	Principal Scientist
54. Dr. (Mrs.) Rekha Rani	Agril. Economics	Scientist
55. Dr. Ashis Ranjan Udgata	Agril. Statistics	Scientist
G. Regional Station-cum-Off-Season Nursery, Dharwad (Karnataka)		
56. Dr. S.L. Patil	Agronomy	Principal Scientist & I/c
57. Dr. M.S. Venkatesh	Soil Science	Principal Scientist
58. Dr. M.H. Kodandaram	Entomology	Principal Scientist
59. Dr. Revanappa	Plant Breeding	Senior Scientist
60. Dr. P.R. Saabale	Plant Pathology	Senior Scientist
61. Dr. Manu B.	Genetics & Plant Breeding	Scientist
H. Regional Centre, Bhopal (Madhya Pradesh)		
62. Dr. Gitanjali Sahay	Genetics & Plant Breeding	Principal Scientist & Station I/c
63. Dr. Dibendu Datta	Genetics & Plant Breeding	Principal Scientist
64. Dr. Nidhi Kumari	Plant Pathology	Scientist

65. Dr. (Mrs.) Archana Singh	Eco. Botany & P.G.R.	Principal Scientist
66. Dr. Surendra Kumar Ghritlahre	Genetics & Plant Breeding	Scientist
I. Regional Centre, Bikaner (Rajasthan)		
67. Dr. Sudheer Kumar	Plant Pathology	Principal Scientist & I/c
68. Dr. Banwari Lal	Agronomy	Senior Scientist
69. Dr. Ram Lal Jat	Agronomy	Senior Scientist
70. Dr. Lalit Kumar Rolaniya	Agronomy	Scientist
71. Dr. (Mrs.) Monika Punia	Genetics & Plant Breeding	Scientist
72. Dr. Sumit Kumar Agarwal	Plant Pathology	Scientist
73. Sh. M. Vanvi	—	AAO
J. Regional Station, Khordha (Odisha)		
74. Sh. Sunil Kumar Sunani	Plant Pathology	Scientist (on study leave)
75. Dr. Asish Kumar Rout	Agri Entomology	Scientist
K. Technical		
76. Shir S.P.S. Chauhan	Chief Technical Officer (T-9)	
77. Dr. Omkar Nath	Chief Technical Officer (T-9)	
78. Mrs. Rashmi Yadav	Assistant Chief Technical Officer (T 7-8)	
79. Dr. Rajesh Kumar Srivastava	Assistant Chief Technical Officer (T 7-8)	
80. Mr. Rakesh	Assistant Chief Technical Officer (T 7-8)	
81. Mr. Krishna Autar	Senior Technical Officer (T-6)	
82. Mr. Lakhan Verma	Senior Technical Officer (T-6)	
83. Mr. R.K.S. Yadav	Senior Technical Officer (T-6)	
84. Mr. R.K. Singh	Senior Technical Officer (T-6)	
85. Dr. Kanhaiya Lal	Senior Technical Officer (T-6)	
86. Mr. Malkhan Singh	Senior Technical Officer (T-6)	
87. Mr. Ashraf Khan	Senior Technical Officer (T-6)	
88. Mr. Arvind Singh Yadav	Senior Technical Officer (T-6)	
89. Mr. H.N. Maurya	Technical Officer (T-5)	
90. Mr. K.S. Meena	Technical Officer (Driver) (T-5)	
91. Mr. Arvind Kumar	Technical Officer (T-5)	
92. Mr. Hasmat Ali	Technical Officer (T-5)	
93. Mr. Satish Kumar Singh	Technical Officer (Driver) (T-5)	
L. Administrative		
94. Dr. Pankaj Kumar	Chief Administrattive Officer (SG)	
95. Mr. Kunal Kalra	Chief Finance & Accounts Officer	
96. Mr. Sujeet Kumar Verma	Senior Administrative Officer	
97. Mr. Brij Kishore	PPS to Director	
98. Mr. Shukdeo Mahto	Administrative Officer	
99. Mr. Rajendra Kumar Nigam	Assistant Administrative Officer	
100. Mr. Shiv Saran Singh	Assistant Administrative Officer	
101 Shri Satish Chandra	Assistant Administrative Officer	

Appointment, Transfer, Promotions, Retirements *etc.*

Appointments

(*All results declared in* 2025)

Name	Post	Date of Joining
Sh. Manish Kumar	Technician	08.05.2025
Dr. Priyanka Lal	Scientist	07.07.2025
Dr. Shamima Parveen	Scientist	07.07.2025
Dr. Shriniketan Puranik	Scientist	07.07.2025
Dr. Anwesha Dey	Scientist	27.10.2025
Dr. Ranjitha MR	Scientist	27.10.2025

Transfers

(*All results declared in* 2025)

Name	Designation	From	To	w.e.f.
Dr. Adarsh Kumar	Scientist (Agronomy)	ICAR-NBAIM, Mau	ICAR-IIPR, Kanpur	27.01.2025
Dr. Kuldeep Kumar	Scientist (Agricultural Biotechnology)	ICAR-IIPR, Kanpur	ICAR-NIPB, New Delhi	24.02.2025
Dr. Satheesh Naik S.J.	Scientist (Genetics & Plant Breeding)	ICAR-IIPR, Kanpur	ICAR-IARI, RS, Samastipur	15.04.2025
Dr. Rajesh Bishnoi	Scientist (Agricultural Extension)	ICAR-IIPR, Kanpur	ICAR-CSWRI, Avikanagar	13.05.2025
Dr. Rahul Dev	Senior Scientist (Eco. Botany & PGR)	ICAR-IIPR, Kanpur	ICAR-NBPGR, RS, Bhowali	02.06.2025
Dr. M.S. Venkatesh	Pr. Scientist (Soil Science)	ICAR-IIPR, RS, Dharwad	ICAR-DCR, Puttur	20.06.2025
Dr. Bandi Sanjay Maruti	Sr. Scientist	ICAR-IIPR, Kanpur	ICAR-CCARI, Goa	01.10.2025
Sh. Pavan Kumar Meena	Assistant	ICAR-IIPR, Kanpur	ICAR-NRIIPM, New Delhi	14.11.2025
Sh. Kunal Kalra	CF&AO	ICAR-IIPR, Kanpur	ICAR-CAZRI, Jodhpur	04.12.2025

Promotions

(*All results declared in* 2025)

Name and designation	Promoted to	w.e.f.
Dr. Uday Chand Jha, Sr. Scientist (Research Level-12)	Sr. Scientist (Research Level-13A)	15.12.2022
Dr. Revanappa, Sr. Scientist (Research Level-12)	Sr. Scientist (Research Level-13A)	23.01.2024
Dr. Satheesh Naik SJ, Scientist (Research Level-11)	Sr. Scientist (Research Level-12)	01.01.2024
Dr. Monika Punia, Scientist (Research Level-10)	Scientist (Research Level-11)	07.01.2024
Dr. Antara Das, Scientist (Research Level-11)	Sr. Scientist (Research Level-12)	01.07.2024
Dr. Kuldeep Kumar, Scientist (Research Level-10)	Scientist (Research Level-11)	07.01.2024

Name and designation	Promoted to	w.e.f.
Dr. P.R. Saabale, Sr. Scientist (Research Level-12)	Sr. Scientist (Research Level-13A)	15.09.2023
Dr. Sujayanand G.K., Sr. Scientist (Research Level-12)	Sr. Scientist (Research Level-13A)	02.07.2024
Dr. Bandi Sanjay Maruti, Scientist (Research Level-11)	Sr. Scientist (Research Level-12)	01.01.2024
Dr. Ram Lal Jat, Scientist (Research Level-11)	Sr. Scientist (Research Level -12)	01.01.2024
Dr. Chaitanya Prasad Nath, Scientist (Research Level-11)	Sr. Scientist (Research Level-12)	01.07.2024
Dr. Lalit Kumar Rolaniya, Scientist (Research Level-10)	Scientist (Research Level-11)	07.01.2024
Dr. Kancheti Mrunalini, Scientist (Research Level-10)	Scientist (Research Level-11)	07.01.2024
Dr. Banwari Lal, Sr. Scientist (Research Level-12)	Sr. Scientist (Research Level -13A)	28.09.2022

Retirements

(*All results declared in 2025*)

Name	Post held	Date of retirement
Dr. Naimuddin	Principal Scientist	31.05.2025
Sh. Gajraj	SSS	30.06.2025
Dr. Omkar Nath	CTO (T-9)	31.07.2025
Sh. R.K.S. Yadav	STO (T-6)	31.12.2025
Sh. Yashwant Singh	LDC	31.12.2025



भाकृअनुप
ICAR

भाकृअनुप-भारतीय दलहन अनुसंधान संस्थान, कानपुर-208 024
ICAR-Indian Institute of Pulses Research, Kanpur-208 024