CALL VII

Project title: Identification and characterization of gram pod borer resistant transgenic chickpea and pigeonpea for conducting Confined Field Trials

Project Code	**:**	7001
Duration of the project	**:**	February 2018 - January 2019
PI Name	**:**	Dr. Alok Das
Lead Centre	**:**	ICAR-IIPR, Kanpur

Objectives:

- Selection and characterization of best event in transgenic chickpea and pigeonpea harboring *Bt* gene
- Submission of Event Selection Trial Report and application for Confined Field Trials

Achievements:

- A superior transgenic event in chickpea and pigeonpea has been developed based on agronomic traits, bio-efficacy, and expression analysis.

Project title: Utilization and refinement of haploid/doubled haploid induction systems in rice, wheat and maize involving molecular and *in-vitro* strategies

Project Code	**:**	7002
Duration of the project	**:**	February 2018 - January 2022
PI Name	**:**	Dr. Sanghamitra Samantaray
CCPI Names	**:**	Dr. Puja Srivastava
	:	Dr. Rajesh Kumar Khulbe
Lead Centre	**:**	ICAR-NRRI, Cuttack
Cooperating centres	**:**	PAU, Ludhiana
	:	ICAR-VPKAS, Almora

Objectives:

- Clearing the most important scaling-up bottleneck in haploid/ doubled haloid induction for each of the three crop systems through innovative protocol interventions.
- DH production aimed at accumulation /consolidation of multi-trait marker tagged genes in elite backgrounds
- Training human resource and extending DH production services to other institutes for supporting the national breeding programmes in rice, wheat and maize

Achievements:

a) Publications

- Khulbe RK, Pattanayak A, Panday V (2019) R1-nj expression in parental inbreds as a predictor of amenability of maize hybrids to R1-nj-based doubled haploid development. Indian Journal of Genetics, 79(4) 678-684. https://doi.org/10.31742/IJGPB.79.4.5

Project title: Genetic improvement of rice for yield, NUE, WUE, abiotic and biotic stress tolerance through RNA Guided Genome Editing (CRISPR-Cas9/Cpf1)

Project Code	:	7003
Duration of the project	:	February 2018-December 2021
PI Name	:	Dr. Viswanathan Chinnusamy
CCPI Names	:	Dr. M. K. Reddy
	:	Dr. Prasanta K Dash
	:	Dr. Parameswaram
	:	Dr. Satendra Kumar Mangrauthia
	:	Dr. D. Sudhakar
Lead Centre	:	ICAR-IARI, New Delhi
Cooperating centres	:	ICGEB, New Delhi
	:	ICAR-NRCPB, New Delhi
	:	ICAR-NRRI, Cuttack
	:	ICAR-IIRR, Hyderabad
	:	TNAU, Coimbatore

Objectives:

- Development of enabling tools and resources (CRISPR-Cas9/Cpf1) for targeted genome editing of rice.
- Genetic improvement of mega rice cv. MTU1010, Swarna, Samba Mahsuri (BPT5204) and ASD16 with enhanced yield, NUE, WUE, abiotic and biotic stress tolerance through RNA Guided Genome Editing (CRISPR/Cas9/Cpf1).
- Development of human resources with expertise in RNA Guided Genome Editing of crops for functional genomics and crop improvement.

Achievements:

a) Publications

- Santosh Kumar VV, Verma RK, Yadav SK, Yadav P, Watts A, Rao MV, Chinnusamy V (2020) CRISPR-Cas9 mediated genome editing of drought and salt tolerance (OsDST) gene in indica mega rice cultivar MTU1010. Physiology and Molecular Biology of Plants 26(6):1099–1110.
- Biswal AK, Mangrauthia SK, Reddy MR (2019) CRISPR-mediated genome engineering to develop climate smart rice: Challenges and opportunities. Seminars in Cell and Developmental Biology, 96:100-106. https://doi.org/10.1016/j.semcdb.2019.04.005.
- Farhat S, Jain N, Singh N, Sreevathsa R, Dash PK, Rai R, Yadav S, Kumar P, Sarkar AK, Jain A, Singh NK, Rai V (2019) CRISPR-Cas9 directed genome engineering for enhancing salt stress tolerance in rice. Seminars in Cell and Developmental Biology. 96:91-99. doi: 10.1016/j.semcdb.2019.05.003.

Project title: Large scale production of multiple copies of elite buffalo bulls using animal cloning technology

Project Code	:	7004
Duration of the project	:	April 2018 - March 2022
PI Name	:	Dr. Prem Singh Yadav
CCPI Name	:	Dr. Manoj Kumar Singh
Lead Centre	:	ICAR-CIRB, Hisar
Cooperating centre	:	ICAR-NDRI, Karnal

Objectives:

- Production of multiple clones of elite bulls using cloning technology.
- Improvement of success rate of live calf production.
- Evaluation of the cloned animals for their growth, health, epigenetic status and reproductive performance.

Achievements:

a) Publications

- Dua S, Bajwa KK, Prashar A, Bansal S, Beniwal M, Kumar P, Pinetha M, Selokar NL, Yadav PS, Kumar D (2021) Empowering of reproductive health of farm animals through genome editing technology. Journal of Reproductive Healthcare and Medicine, 2(4):1-8. https://doi.org/10.25259/JRHM_17_2020.
- Birbal S, Gorakh M, Wilfried A. K, Yadav P S (2020) The domesticated buffalo-An emerging model for experimental and therapeutic use of extraembryonic tissues. Theriogenology, 151:95-102 https://doi.org/10.1016/j.theriogenology.2020.04.003
- Yadav PS, Selokar NL, Kumar D, Sharma RK, Kumar P, Kumar R, Saini M, Dua S. (2020). ICAR-CIRB produces seven clones of a superior buffalo breeding bull. Current Science, 119(7):1077.
- Shyam S, Goel P, Kumar D, Malpotra S, Singh MK, Lathwal SS, Chand S, Palta P (2020) Effect of Dickkopf-1 and colony stimulating factor-2 on the developmental competence, quality, gene expression and live birth rate of buffalo (*Bubalus bubalis*) embryos produced by hand-made cloning. Theriogenology. 157: 254-262.
- Saini M, Sheoran S, Vijayalakshmy K, Rajendran R, Kumar D, Kumar P, Sharma RK, Kumar R, Mohnaty TK, Selokar NL, Yadav PS (2020) Semen parameters and fertility potency of a cloned water buffalo (*Bubalus bubalis*) bull produced from a semen-derived epithelial cell. PloS One, 15(8), e0237766.
- Dua S, Sharma P, Saini M, Rawat N, Rajendran R, Bansal S, Wakil AM, Beniwal M, Parashar A, Bajwa KK, Selokar NL, Kumar R, Kumar D, Yadav PS (2020) Cryobanking of primary somatic cells of elite farm animals - a pilot study in domesticated water buffalo (*Bubalus bubalis*). Cryobiology,

https://doi.org/10.1016/j.cryobiol.2020.11.014.

- Rajendran R, Saini M, Dua S, Saini D, Kumar D, Yadav P S, Selokar NL (2019). Simple somatic cell assay to screen mammalian embryo toxicity caused by mineral oil. Current Science 117(8): 1270-1271.

- Selokar N L, Sharma P, Saini M, Sheoran S, Rajendran R, Kumar D, Sharma R K, Motiani R K, Kumar P, Jerome A, Khanna S and Yadav P S (2019). Successful cloning of a superior buffalo bull. Scientific Reports, 9:11366 https://doi.org/10.1038/s41598-019-47909-8.

- Saini M, Selokar N, Rajendran R, Kumar D, Kumar P, Yadav PS (2019). Isolation and culture of epithelial cells from stored buffalo semen and production of cloned embryos from semen-derived epithelial cells. Reproduction, Fertility and Development, 31(10) 1581-1588. https://doi.org/10.1071/RD18356.

Project title: Improving the usability of buffalo spermatozoa by sperm surface remodelling and immune acceptance in female reproductive tract.

Project Code	**:**	7005
Duration of the project	**:**	July 2018- June 2021
PI Name	**:**	Dr. Rakesh Kumar
CCPI Name	**:**	Dr. Sarika Jaiswal
Lead Centre	**:**	ICAR-NDRI, Karnal
Cooperating centre	**:**	ICAR-IASRI, New Delhi

Objectives:

- To assess the variation of epididymal coat proteins on the spermatozoa of buffalo bulls of varying fertility status.
- To develop recombinant beta-defensin for add-up assay of spermatozoa.
- To evaluate the immunoprotective ability of sperm beta- defensin under mimicked female reproductive tract immune conditions.
- To discover polymorphism and copy number variation of immunomodulatory genes affecting reproductive efficiency in buffaloes.

Achievements:

a) Publications

- Batra V, Dagar K, Nayak S, Kumaresan A, Kumar R, Datta TK (2020). A higher abundance of O-linked glycans confers a selective advantage to high fertile buffalo spermatozoa for immune-evasion from neutrophils. Frontiers in Immunology https://doi.org/ 10.3389/fimmu.2020.01928.

Project title: Development of a rapid and robust high throughput reporter cell-based bioassay for detection of xenobiotics in milk

Project Code	:	7006
Duration of the project	:	August 2018 - January 2022
Total budget (₹ in lakhs)	:	276.81639
PI Name	:	Prof. Surya Pratap Singh
CCPI Names	:	Dr. Dheer Singh
	:	Prof. Rakesh K Tyagi
	:	Prof. Partha Roy
Lead Centre	:	BHU, Varanasi
Cooperating centres	:	ICAR-NDRI, Karnal
	:	JNU, New Delhi
	:	IIT-Roorkee

Objectives:

- Detection and analysis of xenobiotics and heavy metals in processed milk samples (
- Development of novel cell-based assays (CALUX, LAMP, green/Red fluorescent protein (GFP)-tagged chimeric nuclear receptors assay) for xenobiotics.
- Validation of developed assay system for detection of xenobiotics and heavy metals in processed milk samples.

Achievements:

a) Publications:

- Sharma D, Rani P, Onteru S K, Roy P, Tyagi RK, Singh SP, Singh D (2021) Reverse transcription-loop mediated isothermal amplification (RT-LAMP) assay for detection of AhR receptor responsive xenobiotics. Toxicology Mechanisms and Methods, https://doi.org/10.1080/15376516.2021.1884923.
- Keswani C, Dilnashin H, Birla H, Roy P, Tyagi RK, Singh D, Rajput VD, Minkina T, Singh SP (2021) Global footprints of organochlorine pesticides: a pan-global survey. Environmental Geochemistry and Health 1-29. Doi: 10.1007/s10653-021-00946-7.
- Yende AS, Tyagi RK (2019) Influence of signalling kinases on functional dynamics of nuclear receptor CAR. Molecular and Cellular Biochemistry, 461: 127-139.

b) Technology Developed:

- A biochemical assay for BPA in milk.
- A cell line developed for CLAUX assay.

Project title: Production and Processing of Microalgal Biomass for Biodiesel and Other Industrially Important Co-products: An Algal Refinery Approach

Project Code	**:**	7007
Duration of the project	**:**	July 2018- December 2021
PI Name	**:**	Dr. Nirupama Mallick
CCPI Name	**:**	Dr. O. N. Tiwari
Lead Centre	**:**	IIT Kharagpur
Cooperating centre	**:**	ICAR-IARI, New Delhi

Objectives:

- Growth modelling of selected triacylglycerols (TAG)-producing microalgae under unialgal and mixed culture modes
- To study the hydrothermal processing of microalgal biomass for direct conversion to liquid fuel
- To explore the algal refinery approach for improving the economics
- Life Cycle Assessment (LCA) for microalgal biodiesel production

Achievements:

a) Publications

- Patnaik R, Mallick N (2021) Microalgal biodiesel production: realizing the sustainability index. Frontiers in Bioengineering and Biotechnology. 9: 620777. ttps://doi.org/10.3389/fbioe.2021.620777.
- Singh VL, Chakravarty S and Mallick N (2020) Production of Sodium Copper *Chlorophyllin* from a green microalga *Chlorella minutissima*: a value-added co-product for sustainable microalgal refinery. Food and Bioproducts Processing, 123: 322-334.
- Sonkar S, Deb D, Mallick N (2020) Outdoor cultivation of the green microalga Chlorella minutissima in mini pond system under batch and fed-batch modes integrating low-dose sequential phosphate addition (LDSPA) strategy for biodiesel production. Biomass and Bioenergy. 138: 105596.
- Bagchi SK, Patnaik R, Sonkar S, Koley S, Rao PS, Mallick N (2019) Qualitative biodiesel production from a locally isolated chlorophycean microalga *Scenedesmus obliquus* (Turpin) Kutzing GA 45 under closed raceway pond cultivation. Renewable Energy, 139(c): 976-987. https://doi.org/10.1016/j.renene.2019.02.115
- Chakravarty S, Mallick N (2019) Optimization of lipid accumulation in an aboriginal green microalga *Selenastrum* sp. GA66 for biodiesel production. Biomass and Bioenergy, 126:1-13. https://doi.org/10.1016/j.biombioe.2019.05.006
- Vishwakarma R, Dhar WD, Saxena S (2019) Influence of nutrient formulations on

growth, lipid yield, carbon partitioning and biodiesel quality potential of *Botryococcus* sp. and Chlorella sp. Environmental Science and Pollution Research, 26: 7589-7600 https://doi.org/ 10.1007/s11356-019-04213-2

- Mathimani T, Mallick N (2019) A review on hydrothermal processing of microalgal biomass to bio-oil - Knowledge gaps and recent advances towards sustainable fuel production. Journal of Cleaner Production, 217: 69-84. https://doi.org/ 10.1016/j.jclepro.2019.01.129

- Patnaik R, Mallick N (2019) Individual and combined supplementation of carbon sources for growth augmentation and enrichment of lipids in the green microalga *Tetradesmus obliquus*. Journal of Applied Phycology, https://doi.org/10.1007/s10811-019-01979-3.

- Tiwari ON, Bhunia B, Bandyopadhyay, Oinam G (2019) Strategies for improved induction of lipid in *Leptolyngbya* sp. BTA 287 for biodiesel production. Fuel, 256:115896. https://doi.org/10.1016/j.fuel.2019.115896

b) Technology developed:

- Mass multiplication achieved for efficient green microalgal strains using optimized commercial NPK medium having Urea, Single superphosphate and Muriate of Potash in a definite ratio.

Project title: Valorization of industrially produced soybean and groundnut de-oiled meals/cakes by extraction, purification and production of protein isolates

Project Code	**:**	7008
Duration of the project	**:**	August 2018- December 2021
PI Name	**:**	Dr. Deep Narayan Yadav
CCPI Name	**:**	Dr. Suman Kapila
Lead Centre	**:**	ICAR-CIPHET, Ludhiana
Cooperating centre	**:**	ICAR-NDRI, Karnal

Objectives:

- To develop alternate non-chemical processes for purification and production of protein isolates from industrially produced soybean and groundnut de-oiled meals/cakes.
- To evaluate nutritional quality of prepared protein isolates.

Achievements:

a) Patents:

- Microbial process for Production of Protein isolate / concentrate from de-oiled cakes / meals (Patent file no. Indian Application number: 201911012570, PCT Application no PCT/IN2020/050287, PCT Publication No. WO2020/202185A1).

b) Technology developed:

- A non-chemical process for production of protein isolates/concentrates from soy meal and de-oiled groundnut cake.

Project title: CRISPR/CAS9 guided functional analysis of genes regulating early embryonic survival in buffalo

Project Code	**:**	7009
Duration of the project	**:**	August 2018- July 2022
PI Name	**:**	Dr. Sukanta Mondal
CCPI Names	**:**	Dr. D.N. Das
	:	Dr. D. Malakar
Lead Centre	**:**	ICAR-NIANP, Bangalore
Cooperating centres	**:**	ICAR-NDRI (SRS), Bangalore
	:	ICAR-NDRI, Karnal

Objectives:

- Studying the CRISPR-Cas9 based editing of COX-2, PTGES, PTGFS and AKR1B5 genes associated with prostaglandin biosynthetic pathways in buffalo
- Studying the in-vitro over-expression of COX-2, PTGES, PTGFS and AKR1B5 in mouse and buffalo uterine epithelial cells
- Generation of knockout mouse for most effective COX-2, PTGES, PTGFS and AKR1B5 gene for determination of their role in fertility

Achievements:

a) Publications:

- S Mondal., IJ Reddy1, S Nandi, PSP Gupta, DN Das and D Malakar (2021) Enhancing Embryo Survivality by CRISPR/Cas9 Mediated Editing of PTGFS Gene. EC Clinical and Medical Case Reports 4.6 (2021): 37-39.
- Tripathi, M.K., Mondal, S., Reddy, I.J. and Mor, A. (2021) Effect of Tumor Necrosis Factor-α on *in vitro* Prostaglandin Production in Buffalo Corpus Luteum. Indian Journal of Animal Research DOI: 10.18805/IJAR.B-4346.
- Mehra, V.K. and Kumar, S. (2022) The Application of CRISPR/Cas9 Technology for Farm Animals. Agricultural Reviews 43:54-61.

b) Patent:

- Das, D.N., Paul, D., Mondal, S., Shanmuga Priya, Malakar, D. and Ramesha, K.P. (2022) A process of CRISPR/Cas9 to specifically knock off buffalo COX-2 gene for enhancement of early embryonic survivality [submitted to National Dairy Research Institute (SRS), Bangalore.

Project title: Electric Field Based Novel Technologies for Pilot Scale Processing of Juice and Pulp from Potential Fruits of NE Region

Project Code	:	7010
Duration of the project	:	August 2018- July 2022
PI Name	:	Dr. Brijesh Srivastava
CCPI Names	:	Dr. Prem Prakash Srivastav
	:	Dr. S. Ruth Assumi
Lead Centre	:	Tezpur University
Cooperating centres	:	IIT, Kharagpur
	:	ICAR RC NEH Region, Umiam

Objectives:

- To develop a pilot scale set-up of Ohmic heating system for aseptic processing of fruit juice and pulp
- To fabricate a laboratory set-up for Cold Plasma assisted processing for fruit juice and pulp.
- To standardize the processing conditions for fruit juice and pulp processing by Atmospheric Cold Plasma (ACP) and its effect on self-life enhancement and nutritional benefits
- To disseminate the developed technology of fruit juice and pulp processing among prospective entrepreneur of NE region

Achievements:

a) Publications:

- Islam S, Kumar P, Cheroor R, Jaiswal M, Begum A, Srivastav PP, Srivastava B. (2024). Influence of non-thermal dielectric barrier discharge (DBD) plasma treatment on pectin methylesterase inactivation and ascorbic acid degradation in Citrus sinensis (cv. Malta) juice. Journal of Food Measurement and Characterization, 1 15. https://doi.org/10.1007/s11694-024-02907-x
- Kumar A, Kumar M, Mahboob MR, Srivastava B (2024). Influence of °Brix/Acid, and flow rate of pineapple juice and electric field strength on the performance of a continuous ohmic heating system. Journal of Food Science and Technology, 61(6):1188-1200. https://doi.org/10.1007/s13197-024-05961-x
- Kumar, A., & Srivastava, B. (2024). Inactivation of polyphenol oxidase and peroxidase in pineapple juice during continuous ohmic heating and modelling of inactivation kinetics during isothermal holding. Journal of Food Process Engineering, e14565. https://doi.org/10.1111/jfpe.14565.

Project title: To elucidate the unique biochemical adaptational strategies that allow two air-breathing catfishes (*Clarias batrachus* and *Heteropneustes fossilis*) to survive in ammonia enriched toxic waste

Project Code	:	7011
Duration of the project	:	August 2018 - January 2022
PI Name	:	Prof. Nirmalendu Saha
CCPI Names	:	Prof. Samir Bhattacharya
	:	Dr. Hirak Kumar Barman
	:	Dr. Vindhya Mohindra
Lead Centre	:	NEH University, Shilong
Cooperating centres	:	Visva-Bharati, Santiniketan
	:	ICAR-CIFA, Bhubaneswar
	:	ICAR-NBFGR, Lucknow

Objectives:

- To examine the intrinsic mechanism that catfish develop not only to maintain their life but also to grow reasonably fast under high ambient ammonia.
- To check the possible expression of a set of adaptive genes and their exclusive finely-tuned mechanistic pathways, which allow them to perfectly adapt high ammonia in their environment.
- To decipher and characterise the signalling molecules related to adaptation and growth in high nitrogenous waste contents by these catfish.

Achievements:

a) Publications:

- Banerjee B, Koner D, Hasan R, Bhattacharya S, Saha N (2020) Molecular characterization and the expression of ornithine-urea cycle genes in air-breathing magur catfish (*Clarias magur*) during exposure to high external ammonia. Genomics, 112(3):2247-2260. https://doi.org/10.1016/j.ygeno.2019.12.021
- Hasan R, Koner D, Khongmawloh E and Saha N (2020) Induction of nitric oxide synthesis: a strategy to defend against high environmental ammonia-induced oxidative stress in primary hepatocytes of air-breathing catfish, *Clarias magur*. Journal of Experimental Biology, 223: jeb219626.
- Kumari S, Choudhury MG and Saha N (2019). Hyper-ammonia stress causes induction of inducible nitric oxide synthase gene and more production of nitric oxide in air-breathing magur catfish, *Clarias magur* (Hamilton). Fish Physiology and Biochemistry, 45: 907-920.
- Banerjee B, Koner D, Hasan R, Bhattacharya S and Saha N (2019) Transcriptome analysis reveals novel insights in air-breathing magur catfish (*Clarias magur*) in response to high environmental ammonia. Gene, 703: 35-49.
- Koner D, Banerjee B, Hasan R, Saha N (2019) Antioxidant activity of endogenously produced nitric oxide against the zinc oxide nanoparticle-induced oxidative stress in primary hepatocytes of air-breeding catfish, *Clarias magus*, Nitric Oxide, 84:7-15.

Project title: Role of dietary trace minerals in animals under biotic and abiotic stress conditions

Project Code	**:**	7012
Duration of the project	**:**	August 2018 - January 2022
PI Name	**:**	Dr. Sunil Ekanath Jadhav
Lead Centre	**:**	ICAR-IVRI, Izatnagar

Objectives:

- To ascertain the role of dietary zinc and selenium in amelioration of heat stress induced metabolic alterations in animals using nutrigenomic approaches
- To study the metabolic and molecular mechanisms of dietary zinc and selenium in alleviation of endotoxin mediated stress response in animals
- To assess the effect of dietary copper and manganese in altering the response of goats to optimal zinc and selenium supplementation under biotic and abiotic stress conditions

Achievements:

a) Publications:

- Chaudhary P, Jadhav SE, Muwel N, Lokesha E, Thamizhan P, Choubey PK, Pattanaik AK, Dutta N (2024) Performance and nutrient utilization in goats fed various levels of zinc under endotoxin mediated stress condition. Animal Nutrition and Feed Technology, 24(1), pp.15-30.
- Thamizhan P, Jadhav SE, Jadhav PS, Chaudhary P, Choubey PK, Singh VK, Dutta N (2023) Influence of Select Dietary Trace Minerals and their Levels on Growth Performance, Nutrient Utilization and Minerals Balance in Male Goats. Biological Trace Element Research, pp.1-10.
- Aderao GN, Jadhav SE, Pattanaik AK, Lokesha E, Chaudhary P, Dutta N, Singh G (2021) Performance and nutrient utilization of rats fed various selenium levels under heat stress- and thermoneutral conditions. Animal Nutrition and Feed Technology 21: 289-302.

Project title: Effective delivery of nutrients, insecticides and fungicides through Nano particulates and its effect on uptake and yield in groundnut and chilli

Project Code	**:**	7013
Duration of the project	**:**	August 2018 - November 2021
PI Name	**:**	Dr T.N.V.K.V. Prasad
CCPI Name	**:**	Dr. G.C. Satisha
Lead Centre	**:**	ANGARU, IFT, RARS, Tirupati
Cooperating centre	**:**	IIHR, Bengaluru

Objectives:

- To study the efficacy of application of nutrients (Zn, Si and Ca) through nanoparticulates, nano-chitosan encapsulated insecticides and fungicides on absorption and mobility.
- To study the physiosorption-induced mechanism by application of nanoparticulates under controlled conditions.
- To validate the effect of synthesised nanoparticulate on plant growth, biomass accumulation and yield at the field level.

Achievements

a) Technology Developed:

- Standardisation of the method of preparation of nanoscale calcium Oxide, nanoscale silicon dioxide and nanoscale chitosan particles.

Project title: Identification of super donors and alleles for spikelet fertility and low chalkiness under thermal stress in rice

Project Code	:	7014
Duration of the project	:	August 2018 - January 2022
PI Name	:	Dr. Anil Grover
CCPI Names	:	Dr. Madan Pal Singh
	:	Dr. Girish Chandel
	:	Dr. Manu Agarwal
	:	Dr. S. Vanisri
Lead Centre	:	University of Delhi, South Campus, Delhi
Cooperating centres	:	ICAR-IARI, New Delhi
	:	IGKV, Raipur
	:	University of Delhi, North Campus, Delhi
	:	PJTSAU, Hyderabad

Objectives:

- To identify genomic variations in known regulators of high temperature stress. The targeted known regulators will include Caseinolytic protease (Clp), small heat shock proteins (sHSPs) and heat shock factors (HSFs) gene families (UDSC).
- To phenotype the 436 rice cultivars (sequenced under 3000 genome project) for high temperature tolerance in relation to spikelet fertility and grain chalkiness and kernel fissuring and for low temperature tolerance in relation to wilting and leaf yellowing (IARI, IGKV and PJTSAU).
- To undertake GWAS for identification of superior alleles controlling spikelet fertility, grain chalkiness and kernel fissuring under high temperature and wilting under low temperature stress (UDNC).
- To generate expression dataset of coding and non-coding RNAs in selected genotypes for identification of genes controlling wilting and leaf yellowing under low temperature stress (PJTSAU).
- To generate expression dataset in selected genotypes for identification of genes controlling spikelet fertility, grain chalkiness and kernel fissuring under high temperature stress (UDSC).

Achievements

a) Publications:

- Lohitha P, Patil AH, Chandel G (2020) Characterization of physiological responses and deciphering differential expression of heat stress responsive candidate genes in rice under high temperature. International Journal of Bio-resource and Stress Management, 606-615. https://doi.org /10.23910/IJBSM/2019.10.6.204.

Project title: Process Development for Production of Dipeptidyl Peptidase-IV (DPP-IV) Inhibitory Peptides from Milk of Gir Cows and their Encapsulation through Double Emulsification Technique

Project Code	**:**	7015
Duration of the project	**:**	August 2018 - January 2022
PI Name	**:**	Dr. Satish Kumar
CCPI Name	**:**	Dr. Lata Sabikhi
Lead Centre	**:**	ICAR-NDRI, SRS, Bengaluru
Cooperating centre	**:**	ICAR-NDRI, Karnal

Objectives:

- Production of DPP-IV inhibitory peptides rich hydrolysates from Gir cattle milk proteins
- Encapsulation of the DPP-IV inhibitory peptides
- Evaluation of bioavailability and control release properties of the encapsulated DPP-IV inhibitory peptides

Achievements

a) Publications:

- Patange SR, Sabikhi L, Shelke PA, Rathod N, Hussain SA, Khetra Y and Kumar MH S (2022). Encapsulation of dipeptidyl peptidase-IV (DPP-IV) inhibitory peptides from alpha-lactalbumin extracted from milk of Gir cows – a *Bos indicus* species. International Journal of Dairy Technology 75(3) 575-587.
- Kumar A, Sathish Kumar M H, Rajani C S, Latha Sabikhi and Laxmana Naik N (2022). Dipeptidyl peptidase-IV inhibitory potential of alpha-lactalbumin extracted from milk of Gir cows: A *Bos indicus* species. International Journal of Dairy Technology 75(3) 527-537.

Project title: Epigenomics of Drought Acclimatization and Stress Memory in Rice

Project Code	**:**	7016
Duration of the project	**:**	August 2018 - July 2021
PI Name	**:**	Dr. Suresh Kumar
Lead Centre	**:**	ICAR-IARI, New Delhi

Objectives:

- To map the temporal and spatial variation in DNA methylation and histone modifications, and their roles in regulation of stress-responsive gene expression in rice genotypes with contrasting drought tolerance (i.e. N-22 & IR-64) grown under upland and lowland/irrigated conditions.

- To elucidate the role of RNA-dependent DNA methylation (RdDM) and RNA-dependent DNA demethylation (RdDeM) under drought stress in rice genotypes with contrasting drought tolerance.

- To analyze transgenerational stress memory and responses of drought stress-primed and non-primed rice genotypes.

Achievements

a) Publications:

- Kumar S, Mohapatra T (2021) Deciphering Epitranscriptome: Modification of mRNA Bases Provides a New Perspective for Post-Transcriptional Regulation of Gene Expression. Frontiers in Cell and Developmental Biology 9: 628415. doi: 10.3389/fcell.2021.628415.

- Kumar S, Kumar S, Mohapatra T (2021) Interaction between macro and micro-elements in plant. Frontiers in Plant Science 12: 665583. doi: 10.3389/fpls.2021.665583.

- Kumar S, Mohapatra T (2021) Dynamics of DNA base modifications in plant growth and development. Frontiers in Plant Science 12: 640. doi:10.3389/fpls.2021.596236.

- Kumar S (2020) Abiotic stresses and their effects on plant growth, yield and nutritional quality of agricultural produce. International Journal of Food Science and Agriculture, 4(4): 367-378. https://doi.org/10.26855/ijfsa.2020.12.002.

- Kaur S, Kumar S (2020) Crosstalk between food components and microRNAs: Role in metabolism, nutrition, health and diseases. Integrative Food Nutrition and Metabolism, 7: 1-11. https://doi.org/10.15761/IFNM.1000293.

- Kaur S, Kumar S (2020) Nutriepigenomics: Need of the day to integrate genetics, Epigenetics and environment towards nutritious food for healthy life. Food Science and Nutrition Technology, 5(6): 1-13. https://doi.org/10.23880/fsnt-16000239.

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- Kumar S (2019) Genome editing to epigenome editing: towards unravelling the enigmas in developmental biology. Trends in Developmental Biology, 12:31-38

- Kumar S, Chinnusamy V, Mohapatra T (2018) Epigenetics of modified DNA bases: 5-methylcytosine and beyond. Frontiers in Genetics, 9:640. https://doi.org/10.3389/fgene.2018.00640

Project title: Targeted immobilization of Y-bearing spermatozoa and modulation of oviduct milieu for skewing sex ratio towards female offspring in dairy cattle

Project Code	**:**	7017
Duration of the project	**:**	August 2018 - January 2022
PI Name	**:**	Dr. A. Kumaresan
CCPI Names	**:**	Dr. Ravi Sundaresan
	:	Dr. D. Rajendran
	:	Dr. Rakesh Kumar
Lead Centre	**:**	ICAR-NDRI, SRS, Bengaluru
Cooperating centres	**:**	IISc, Bengaluru
	:	ICAR-NIANP, Bengaluru
	:	ICAR-NDRI, Karnal

Objectives:

- Molecular differences between X- and Y-bearing spermatozoa in cattle and identification of sex specific surface proteins
- Development of a method for targeted immobilization of Y-bearing spermatozoa
- Modulation of oviduct microenvironment to facilitate preferential binding of X-bearing spermatozoa
- Assessment of the efficiency of developed technique using in vitro and in *vivo* methods

Achievements

a) Publications:

- Nag P, Kumaresan A, Sivamanikandan A, Manimaran A, Rajendran D, Paul N, Sharma A, Karuthadurai T, Kaustubh S, Jeyakumar S, Ramesha K (2021) Sperm phenotypic characteristics and oviduct binding ability are altered in breeding bulls with high sperm DNA Fragmentation index. Theriogenology 172:80-87. https://doi: 10.1016/j.

Project title: Exploiting alien genetic resources for developing climate resilient wheat and understanding mechanism of heat tolerance

Project Code	**:**	7018
Duration of the project	**:**	August 2018 - January 2022
PI Name	**:**	Dr. Sindhu Sareen
CCPI Names	**:**	Dr. Satindar Kaur
	:	Dr. Jasdeep Chatrath Padaria
Lead Centre	**:**	ICAR-IIWBR, Karnal
Cooperating centres	**:**	PAU, Ludhiana
	:	ICAR-NRCPB, New Delhi

Objectives:

- Identification of novel QTLs, and validation of QTLs for heat stress
- Characterizing the key pathways associated with the strength of source and sink under heat stress

Achievements

a) Publications:

- Navaneetha J. Kumar U, Dhillon G, Singh R, Sandhu N, Kaur S, Chhuneja P (2024) Dissecting root system architecture traits in *Triticum durum-Aegilops speltoides* backcross introgression lines. Plant Breed. 143:481–499.
- Navaneetha J, Kumar U, Kaur S, Chhuneja P (2023) Development of a novel imaging-based grain counting setup for accurate estimation of thousand grain weight in wheat. Indian Journal of Genetics and Plant Breeding 83(04) Doi: https://doi.org/10.31742/ISGPB.83.4.2

Project title: Assessing the potential impact of climate change and management on soil carbon and nitrogen storage in selected ecosystems of India

Project Code	**:**	7019
Duration of the project	**:**	August 2018 - January 2022
PI Name	**:**	Dr. Sangeeta Lenka
CCPI Name	**:**	Dr. Kaushik Batabyal
Lead Centre	**:**	ICAR-IISS, Bhopal
Cooperating centre	**:**	BCKV, West Bengal

Objectives:

- To determine the mean residence time (MRT) and quality of SOC under long-term soil management.
- To assess the effect of climatic drivers on soil C and N transformations under different nutrient and residue conditions.
- To determine the effect of long-term soil management and climatic drivers on site specific litter decomposition.

Achievements

a) Publications:

- Choudhary R, Lenka S, Yadav DK, Lenka NK, Kanwar RS, Sarkar A., et al. (2024). Impact of Crop Residue, Nutrients, and Soil Moisture on Methane Emissions from Soil under Long-Term Conservation Tillage. https://doi.org/10.3390/soilsystems8030088 Soil Systems, 8(3), 88.
- Singh D, Lenka S, Kanwar RS, Yadav SS, Saha M, Sarkar A., et al. (2024). Drivers of greenhouse gas emissions in agricultural soils: the effect of residue management and soil type. Frontiers in Environmental https://doi.org/10.3389/fenvs.2024.1489070 Science1489070.
- Singh D, Lenka S, Lenka NK, Yadav DK, Yadav SS, Kanwar RS, Sarkar A, et al. (2024). Residue Management and Nutrient Stoichiometry Control Greenhouse Gas and Global Warming Potential Responses in Alfisols. Sustainability (Switzerland), 16(10), 3997. https://doi.org/10.3390/su16103997
- Singh D, Lenka S, Lenka NK, Yadav DK, Yadav SS, Kanwar RS, Sarkar A (2024). Optimizing residue return with soil moisture and nutrient stoichiometry reduced greenhouse gas fluxes in Alfisols. Frontiers in Sustainable Food Systems, 8, 1490523.
- Lenka S, Malviya SK, Lenka NK, Saha JK, Yadav DK (2022). Effect of temperature on soil organic carbon mineralisation in aggregate fractions under different tillage and nutrient management. Climate Change and Environmental Sustainability, 10(1), 23–29. https://doi.org/10.5958/2320-642x.2022.00003.5

➢ Lenka S, Choudhary R, Lenka NK, Saha JK, Amat D, Patra AK., et al. (2022). Nutrient Management Drives the Direction and Magnitude of Nitrous Oxide Flux in Crop Residue-Returned Soil Under Different Soil Moisture. Frontiers in Environmental Science, 10(3), 857233. https://doi.org/10.3389/fenvs.2022.857233

Project title: Identifying the genomic regions and genes for drought and heat tolerance in groundnut

Project Code	:	7020
Duration of the project	:	August 2018 - July 2022
PI Name	:	Dr. Ramesh Bhat
CCPI Names	:	Dr. Manish K. Pandey
	:	Dr. P. Latha
Lead Centre	:	UAS, Dharwad
Cooperating centres	:	ICRISAT, Hyderabad
	:	IFT, RARS, Tirupati

Objectives:

- To identify the genome-wide structural variation among the genotypes differing for drought and heat tolerance using whole-genome re-sequencing approach.
- To identify the linked markers for drought and heat stress tolerance traits in biparental (RIL) populations
- To identify the marker-trait associations in multiparent (MAGIC) population for drought tolerance traits
- To identify and validate the genetic markers for their further use in genomics-enabled breeding for improving groundnut for drought and heat tolerance

Achievements

a) Publications:

- Bhat RS, Rockey J, Shirasawa K, Tilak IS, Brijesh Patil MP, Reddy VB (2020) DNA methylation and expression analyses reveal epialleles for the foliar disease resistance genes in peanut (*Arachis hypogaea* L.). BMC Research Notes, 13: 20. https://doi.org/10.1186/s13104-13020-14883-y.
- Pandey MK, Bhat RS, Varshney RK (2020) Translational genomics for achieving higher genetic gains in post-genome era in groundnut. Theoretical and Applied Genetics.133:1679-1702.
- Chaudhari, S, Khare D, Patel SC, Subramaniam S, Variath MT, Sudini HK, Singh S M, Bhat RS, Janila P (2019) Genotype × environment studies on resistance to late leaf spot and rust in genomic selection training population of peanut (*Arachis hypogaea* L.). Frontiers in Plant Science. https://doi.org/10.3389/fpls.2019.01338.

Project title: Identification of host factors responsible for infection and development of nano-particle based dsRNA delivery system for imparting resistance to begomoviruses

Project Code	**:**	7021
Duration of the project	**:**	August 2018 - December 2021
PI Name	**:**	Dr. P.N. Sivalingam
CCPI Names	**:**	Dr. Senthil Kumar
	:	Dr. Bikash Mandal
	:	Dr. Neetu Singh
Lead Centre	**:**	ICAR-NIBSM, Raipur
Cooperating centres	**:**	ICAR-NIPGR, New Delhi
	:	ICAR-IARI, New Delhi
	:	IIT, Delhi

Objectives:

- To understand the host factors responsible for infection and replication in the identified hosts and non-hosts to begomoviruses
- To develop efficient delivery system of dsRNA conjugated with nano materials
- To study efficiency of ds RNA conjugated with nanoparticles in vector transmission and begomovirus infection.

Achievements

a) Publications:

- Sahu B, Dokka N, Mahajan MM, Sharma KC, Singh HK, Marathe A, Dewangan BP, Mooventhan P, Yele Y, Sridhar J, Kumar V, Sivalingam PN, Kumar J, Kaushal P, Ghosh PK (2021) Begomoviruses affecting pulse and vegetable crops are unevenly distributed in distinct agroecological zones of the eastern India. Journal of Phytopathology, https://doi. org/10.1111/jph.12978.
- Baruah A, Sivalingam PN, Fatima U, Muthappa SK (2020) Non-host resistance to plant viruses: what do we know? Physiological and Molecular Plant Pathology. https://doi.org/10.1016/j.pmpp.2020.101506.

Project title: Long-term conservation agriculture impact on microbiome and soil health indicators for resource efficiency and resilience in maize systems

Project Code	:	7022
Duration of the project	:	November 2018 – October 2021
PI Name	:	Dr. Shankar Lal Jat
CCPI Names	:	Dr. Aundy Kumar
	:	Mr. Rakesh Kumar
Lead Centre	:	ICAR-IIMR, New Delhi Unit
Cooperating centres	:	ICAR-IARI, New Delhi
	:	ICAR RC-ER-PATNA

Objectives:

- Quantify GHG mitigation potential, carbon dynamics & soil physical health and their relationship with crop yields and resource efficiency under long-term conservation agriculture in maize systems
- Understand, quantify and establish the whole microbiome composition & soil fauna responsible for increased yield under long-term conservation agriculture in maize systems
- Quantify pathogens and pest dynamics in maize-based cropping systems under long-term CA in maize systems
- Harnessing the maize microbial communities of CA for their potential to mitigate stresses and improve resource use efficiency in maize

Achievements

a) Publications:

- Pattanayak S, Chouhan V, Bashyal BM, Mandal PK, Kumar M, Gogoi R, Kumar A (2025). Exploring the endophytic microbiome of maize leaves: roles in plant growth promotion and defence against. Plant Soil. https://doi.org/10.1007/s11104-025-07519-y.
- Dinesh GK, Sharma DK, Jat SL, Venkatramanan V, Boomiraj K, Kadam P, Prasad S, Anokhe A, Selvakumar S, Rathika S, Ramesh T, Bandyopadhyay K, Jayaraman S, Ramesh KR, Sinduja M, Sathya V, Rao CS, Dubey R, Manu SM, Karthika S, Singh AK, Kumar B and Mahala DM (2024). Residue retention and precision nitrogen management effects on soil physicochemical properties and productivity of maize-wheat-mungbean system in Indo-Gangetic Plains Frontiers in Sustainable Food System. 8:1259607. doi: 10.3389/fsufs.2024.1259607.
- Kumar R, Rao KK, Mondal S, Choudhary JS, Kumar S, Jat SL, Mishra JS, Singh AK, Upadhyay PK, Das A, Singh VK, Kumar S, Jadhav SK, Sharma NK, Bhatt BP, Rakshit S, Chaudhari SK (2024) A comprehensive analysis of resource conservation Plains. Impacts on productivity, energetics, and environmental footprints in rice-

based systems of the Eastern Indo-Gangetic Current Research in Environmental Sustainability 8:100271. https://doi.org/10.1016/j.crsust.2024.100271.

- Dinesh GK, Sharma DK, Jat SL, Bandyopadhyay K, Rao S, Venkatramanan C, Kadam V, Sinduja PV, Sathya M, Nedumaran V, Bhatia S, Kumar A, Purakayastha P, Anand TJA, Boomiraj K (2023) Effect of Conservation Agriculture Practices on Carbon Pools in a Sandy Loam Soil of Indo-Gangetic Plains. Communications in Soil Science and Plant Analysis 54(20): 2845–2862. https://doi.org/10.1080/00103624.2023.2241513.

- Vijayan V, Sheoran N, Gogoi R, Kumar A (2023). Suppressive effects of maize rhizospheric fungi on Rhizoctonia solani f. sp. sasakii inciting banded leaf and sheath blight. Agricultural Mechanization in Asia (ISSN: 00845841). 54 (11): 16357-16367.

- Kadam PV, Jat SL, Mahala DM, Parihar CM, Singh AK, Kumar B, Gambhir G, Radheshyam, Chandra MS (2022). Residue retention and nitrogen management of preceding crops influences the productivity, profitability and environmental footprints of summer mungbean in maize-based cropping systems under conservation agriculture. Archives of Agronomy and Soil Science, DOI: 10.1080/03650340.2022.2130264.

- Dinesh GK, Sharma DK, Jat SL, Keerthana S, Bandyopadhyay KS, Bhatia KK, Sinduja A, Sathya M, Karthika V, Sethupathi S, Kadam P V, Kumar RR (2022). Ecological relationship of earthworms with soil physicochemical properties and crop yields in conservation agriculture. Indian Journal of Ecology 49(6):2135-2139. 10.55362/IJE/2022/3798.

- Jat SL, Suby SB, Parihar CM, Gambhir G, Kumar N, Rakshit S (2021) Microbiome for sustainable agriculture: a review with special reference to the corn production system. Archives of Microbiology 203: 2771–2793. DOI: 10.1007/s00203-021-02320-8. http://krishi.icar.gov.in/jspui/handle/123456789/46798

- Kumar N, Suby SB, Parihar CM, Jat SL, Gambhir G (2020) Earthworm activity under contrasting tillage practices and cropping patterns. Maize Journal 9(1): 56-58.

- Jat SL, Parihar CM, Singh AK, Kumar B, Choudhary M, Nayak HS, Parihar MD, Parihar N, Meena BR (2019) Energy auditing and carbon footprint under long-term conservation agriculture-based intensive maize systems with diverse inorganic nitrogen management options. Science of the Total Environment 664 (2019): 659-668. https://doi.org/10.1016/j.scitotenv.2019.01.425.

Project title: An inclusive agri-business model for sustainable cotton marketing in the state of Maharashtra

Project Code	**:**	7023
Duration of the project	**:**	November 2018 - October 2021
PI Name	**:**	Dr. Sundaramoorthy C
CCPI Name	**:**	Dr. A.R. Reddy
Lead Centre	**:**	ICAR-CIRCOT, Mumbai
Cooperating centre	**:**	ICAR-CICR, Nagpur

Objectives:

- To assess the existing market mechanism for its sustainability and profitability to cotton farmers
- To study the price quality relations in cotton marketing
- To evaluate the harvesting and post harvesting practices of the cotton farmers in relation to price-quality linkages in cotton market.
- To examine the utilization pattern and the market for the cotton by-product
- To identify an inclusive agri-business model to improve the profitability of the cotton farmers and the mechanism needed for its implementation

Achievements:

- Comprehensive insights into farmers' marketing practices and influencing factors guided the implementation of strategic initiatives—including market-oriented production, value chain management, agri-business development, and institutional mechanisms—resulting in enhanced market efficiency, improved product quality, increased farmer income, and the promotion of sustainable rural entrepreneurship.

Project title: Targeted editing of potato genome to develop variety specific True Potato Seed (TPS)

Project Code	**:**	7024
Duration of the project	**:**	November 2018 - October 2021
PI Name	**:**	Dr. Vinay Bhardwaj
CCPI Names	**:**	Dr. Kashmir Singh
	:	Dr. Ravi Maruthachalam
Lead Centre	**:**	ICAR-CPCRI
Cooperating centres	**:**	PU, UNIVERSITY
	:	IISER, Thiruvananthapuram

Objectives:

- Development of variety specific apomeiotic (MiMe mutant) strain to produce clonal gametes having somatic chromosome number
- Generation of in vivo haploid inducing strain by triggering CENH3 mediated uniparental genome elimination (UPE) to produce haploids in potato
- Hybridization of apomeiotic and haploid inducer lines to convert clonal gametes to variety specific clonal botanical seeds

Achievements

a) Publications

- Siddappa S, Sharma N, Salaria N, Thakur K, Pathania S, Singh B, Sharma H, Sood S, Bhardwaj V, Thakur AK, Mangal V, Kumar V, Muruthachallam R, Singh K, Tuli R (2023) CRISPR/Cas9-mediated editing of phytoene desaturase (PDS) gene in an important staple crop, potato. 3 Biotech 13:129.https://doi.org/10.1007/s13205-023-03543-w

Project title: Re-designing rice crop for improvised grain micronutrient quality using CRISPR- Cas9/Cpf1 genome editing

Project Code	**:**	7025
Duration of the project	**:**	January 2019 - December 2021
PI Name	**:**	Dr. Tanushri Kaul
Lead Centre	**:**	ICGEB, New Delhi

Objectives:

- To knockout the Fe-sensing genes and iron-binding haemerythrin RING ubiquitin ligases (OsHRZ1, OsHRZ2) for higher accumulation of iron and, simultaneously knockout the cadmium transporter gene (OsLCT1) to reduce the translocation of Cd to rice grains.
- To transform the individual and/or multiplexed sgRNAs loaded CRISPR-Cas9/Cpf1 plasmids of the selected genes in rice.
- Molecular analyses & validations of the KO rice lines using different approaches & other analyses for grain micronutrient content, iron allocation, storage, regulating networks and off-target effects etc.

Achievements

b) Publications

- Kaul T, Sony SK, Verma R, Abdel Motelb KF, Prakash AT, Eswaran M, Bharti J, Nehra M, Kaul R (2020) Revisiting CRISPR/Cas-mediated crop improvement: Special focus on nutrition. Journal of Biosciences 45:137. https://doi.org/10.1007/s12038-020-00094-7.

Project title: Artificial intelligence based mobile app for identification and advisory of maize diseases and insect pests

Project Code	**:**	7026
Duration of the project	**:**	January 2019 - December 2021
PI Name	**:**	Dr. Sudeep Marwaha
CCPI Names	**:**	Dr. Brejesh Lall
	:	Dr. P Lakshmi Soujanya
Lead Centre	**:**	ICAR-IARI, New Delhi
Cooperating centres	**:**	IIT, Delhi
	:	ICAR-IIMR, Ludhiana

Objectives:

- To train the deep learning (Artificial Intelligence) algorithm for maize diseases and insect pests' identification
- To develop an artificial intelligence-based mobile app for providing advisory to the farmers using a trained deep learning algorithm
- Validation of the developed artificial intelligence mobile app using images from farmers' fields

Achievements

a) Publications

- Haque M, Marwaha S, Deb CK, Nigam S, Arora A, Hooda KS, Soujanya PL, Aggarwal SK, Lall B, Kumar M, Islam SN, Panwar M, Kumar P, Agrawal RC. (2022). Deep learning-based approach for identification of diseases of maize crop. Scientific Reports, 12(1), 1-14

Project title: Development and Validation of Smart Aquaculture Model (SAM): Application of ICT and Data analytics for sustainable shrimp aquaculture

Project Code	**:**	7027
Duration of the project	**:**	January 2019 - December 2021
PI Name	**:**	Dr. M. Kumaran
Lead Centre	**:**	ICAR-CIBA, Chennai

Objectives:

- To undertake comprehensive 'production system needs analyses' to assess day-to-day operational and technical requirements of shrimp farming.
- To develop an enabling mobile application for data acquisition and analytics for efficient management of shrimp farms.
- To implement and validate the mobile application for its usability and efficiency in shrimp farm management.
- To undertake pilot-scale integration of inputs, services and market through the mobile app for sustainable shrimp farming.

Achievements

a) Publications

- Kumaran M, Geetha R, Antony J, Kumaraguru Vasagam KP, Anand PR, Ravisankar T, Jani Angel JR, De D, Muralidhar M, Patil PK, Vijayan KK (2021) Prospective impact of coronavirus disease (COVID-19) related lockdown on shrimp aquaculture sector in India–a sectoral assessment. Aquaculture, https://doi.org/10.1016/j.aquaculture.2020.735922.

Project title: Entrepreneurship Development through Farmer-Led Innovations – A Case Study in the Plantation Sector

Project Code	**:**	7028
Duration of the project	**:**	April 2019 to March 2022
PI Name	**:**	Dr. S. Senthil Vinayagam
CCPI Names	**:**	Dr. T.S. Manoj Kumar
	:	Dr. K. Venkateswaran
Lead Centre	**:**	ICAR-NAARM, Hyderabad
Cooperating centres	**:**	ICAR-CPCRI, Kudlu
	:	IIPM, Jnana Bharathi Campus

Objectives:

- To study economically/commercially potential Famer-Led Innovations in plantation crops for Entrepreneurship Development.
- To evaluate validate the augmented Farmer-Led Innovations in plantation crops using innovation models/theories.
- To evolve strategies for entrepreneurship development and sustainable innovation management grid through Farmer-Led Innovations in plantation crops.

Achievements

a) Publications

- Venkateswaran K, Vinayagam SS, Murthy GRK, Akhila K. (2021) Organizational approach for scaling up of rural innovations. Journal of Rural Development. 40(3). Pp 460-470.
- Vinayagam SS, Akhila K, Bhat PS, Jacob MN, Mahesh A, Manojkumar TS, Venkateswaran K. (2020) Interdisciplinary Approaches for Translating Rural Innovations into Agripreneurship. Agriculture Update 15 (4) Pp 301-307

Project title: Developing climate-resilient adaptive strategies for the empowerment of farmers

Project Code	**:**	7029
Duration of the project	**:**	April 2019 - March 2022
PI Name	**:**	Dr. Bheemappa Anjinappa
CCPI Names	**:**	Dr. Nagaratna Biradar
	:	Dr. Bathula Vijayabhinandana
Lead Centre	**:**	UAS, Dharwad
Cooperating centres	**:**	ICAR-IGFRI, Dharwad
	:	ANGRAU, Guntur

Objectives:

- To study the documented wisdom of farmers on climate change, their scientific rationality and location specificity in selected agro-ecological zones.
- To identify and assess the adaptation methods practiced by farmers in response to perceived climate change.
- To study and analyse farmers' perception of climate change on agriculture systems and its relationship with adaptation methods followed by them.
- To identify and validate adaptive strategies evolved by various scientific institutions to enhance climate resiliency among farmers.
- To develop extension strategies to empower farmers' capacity to climate change.

Achievements

a) Publications

- Biradar N, Kerur A, Tirlapur L, Chand K, Bheemappa A (2021) Analysis of precipitation trend and farmers' practices to predict precipitation in North Karnataka. Journal of Pharmacognosy and Phytochemistry, Sp 10(1): 406-4

Project title: Development of sensors for blast and blight diseases and stomatal activity measurement in rice (*O. sativa* L.)

Project Code	:	7030
Duration of the project	:	June 2019 - May 2022
PI Name	:	Dr. Samarendra Pratap Singh
CCPI Names	:	Dr. P.N. Jha
	:	Dr. B. K. Sarma
	:	Dr. Debabrata Sircar
	:	Dr. Kavitha Sankaranarayanan
Lead Centre	:	SNU, Gautam Buddha Nagar
Cooperating centres	:	BITS Pilani, Rajasthan
	:	BHU, Varanasi
	:	IIT, Roorkee
	:	Anna University, Chromepet, Chennai

Objectives:

- To investigate and optimize molecular signatures from blast and blight pathogens of rice for developing organic and organic-inorganic hybrid materials and their optoelectronic characterization
- To characterize volatile organic compounds (VOCs) through profiling during different time-points of plant-pathogen interactions for the detection of signature VOCs for E-nose sensor development
- To correlate guard cell ionic current and leaf surface potential changes and its connection to stomatal conductance, the changes of which can be used to predict drought tolerance and pathogen infections
- To optimize and develop optoelectronic biosensor(s) based on organic-inorganic hybrid materials, VOCs based-E-nose sensor(s) and leaf surface potential based- sensor(s) for pathogen diagnostics
- To carry-out extensive field validation of sensor prototypes for diagnostics of rice blast and blight pathogens

Achievements

a) Publications

- Yadav Y, Singh SP (2022). Effect of dielectric surface passivation on organic field-effect transistors: spectral analysis of the density of trap-states. Semiconductor Science and Technology 37, 015015.

Project title: Causes and Consequences of e-National Agriculture Market (e-NAM) on the Economic Development of Indian Agriculture – A Case Study

Project Code	**:**	7031
Duration of the project	**:**	June 2019-May 2022
PI Name	**:**	Dr. K.M. Shivakumar
CCPI Names	**:**	Dr. I. Bhavani Devi
	:	Dr. T. Lavanya
	:	Dr. Jitender Kumar Bhatia
Lead Centre	**:**	TNAU, Coimbatore
Cooperating centres	**:**	ANGRAU, Tirupati
	:	PJTSAU, Hyderabad
	:	CCSHAU, Hisar

Objectives:

- To analyse the marketing practices of the agricultural commodities in the states of Andhra Pradesh, Tamil Nadu, Telangana and Haryana under phase I of e-NAM
- To measure the causes and consequences of the proposed e-NAM in terms of efficiency of agricultural markets in the selected States.
- To trace e-NAM-induced market linkages and price convergence in the agricultural markets.
- To suggest strategies to strengthen the e-NAM movement to improve the overall efficiency of the agricultural markets to bring economic development in Indian Agriculture.

Achievements

a) Publications:

- Bhatia JK, Bishnoi DK, Dhingra A, Nimbrayan PK (2022) Arrival and Price Behaviour of Major Mustard Markets in Haryana. Indian Journal of Extension Education 58(2): 177-180.