CALL IV

Project title: Whey to Biofuel: Bioethanol Production by Stress Tolerant and Metabolically Engineered Yeast from Whey

Project Code	**:**	4001
Duration of the project	**:**	April 2013 - March 2015
PI Name	**:**	Dr. Shilpa Vij
Lead Centre	**:**	ICAR-NDRI, Karnal

Objectives:

- To evaluate the efficiency of the yeast isolates for stress tolerance and ethanol production
- To optimize parameters for enhanced ethanol production in high lactose whey by selected stress tolerant yeasts
- To over express gene PGM2 for galactose metabolism for enhanced ethanol production in high lactose whey by metabolic engineering
- To scale up ethanol production by novel stress tolerant immobilized yeast in whey to 10L fermentor for ethanol production

Achievements:

a) Publications:

- Saini P, Beniwal A, Kokkiligadda A, Vij S (2017) Evolutionary adaptation of Kluyveromyces marxianus strain for efficient conversion of whey lactose to bioethanol. Process Biochemistry. 62:69-79. https://doi.org/10.1016/j.procbio.2017.07.013.
- Saini P, Beniwal A, Malik RK, Vij S (2017) Comparative physiology of *Kluyveromyces marxianus* and *Saccharomyces cerevisiae* during batch cultivation on glucose as a sole carbon source. Indian J. Dairy Sci. 70(4):427-433.
- Saini P, Beniwal A, Vij S (2017) Comparative analysis of oxidative stress during aging of *Kluyveromyces marxianus* in synthetic and whey media. Applied Biochemistry and Biotechnology 183(1):348-361. DOI 10.1007/s12010-017-2449-9.
- Saini P, Beniwal A, Vij S (2017) Physiological response of *Kluyveromyces marxianus* during oxidative and osmotic stress. Process Biochemistry.56;21-29. DOI: 10.1016/j.procbio.2017.03.001.
- Kokkiligadda A, Beniwal A, Saini P and Vij S (2016) Utilization of cheese whey using synergistic immobilization of β-galactosidase and *Saccharomyces cerevisiae* cells in dual matrices. Applied Biochemistry and Biotechnology. 179:1469-1484. DOI: 10.1007/s12010-016-2078-8

Project title: Development of Parthenogenetic Goat from Embryonic Stem Cells

Project Code	**:**	4002
Duration of the project	**:**	April 2013 - March 2017
PI Name	**:**	Dr. S. D. Kharche
CCPI Name	**:**	Dr. M.K. Singh
Lead Centre	**:**	ICAR-CIRG, Makhdoom
Cooperating centre	**:**	ICAR-NDRI, Karnal

Objectives:

- To generate putative parthenogenetic embryonic stem (pES) cells
- To establish protocol for chimeric goat embryo (2n - 4n) production
- To study the differential gene expression in goat embryos, fetus and placental tissue
- To study the in vivo developmental potential of embryos obtained through putative pES cells

Achievements:

a) Publications:

- Kharche SD, Agarwal S, Sharma J, Sikarwar AKS, Gangwar C, Ranjan R, Goel AK, Jindal SK, Agarwal SK (2016). Influence of cysteamine supplementation during in vitro culture of early-stage caprine embryos on blastocyst production. Indian Journal of Animal Sciences. 86 (3): 304-306.
- Kharche SD, Pathak J, Agarwal S, Kushwah B, Sikarwar AKS (2016) Effect of Ca Ionophore on Blastocyst Production Following Intracytoplasmic Sperm Injection in Caprine Oocytes. Reproduction in Domestic Animals. 51(4):611-7. DOI: 10.1111/rda.12701.
- Sharma JR, Agarwal S, Kharche SD, Goel AK, Jindal SK, Agarwal SK (2015) Effect of different activators on development of activated *in vitro* matured caprine oocytes. Iranian Journal of Veterinary Research. 16: 42-46. doi: 10.22099/IJVR.2015.2922.
- Kharche SD, Goel AK, Jindal SK, Saraswat S, Pathak J, Agarwal S (2015) *In vitro* maturation of nude caprine oocytes recovered during oocyte collection. Indian Journal of Animal Science. 85(2):135-138.
- Kouamo J, Kharche SD (2014) An Overview of sex selection at conception in mammals. Iranian Journal of Applied Animal Sciences. 4 (3):463-476.
- Kouamo J, Kharche SD (2014) Oestrus synchronization in small ruminants. A Review. The Indian Journal of Small Ruminants. 20(2): 1-9.
- Kharche S D, Kouamo J (2014). An Overview of pregnancy diagnosis in small ruminants. Indian Journal of Animal Science. 84(4):331-342.

Project title: Diversity and synthesis of immunoglobulins in the Indian major carps

Project Code	**:**	4003
Duration of the project	**:**	April 2013 - March 2017
PI Name	**:**	Dr. Mrinal Samanta
CCPI Name	**:**	Dr. Surajit Das
Lead Centre	**:**	ICAR-CIFA, Bhubaneswar, Odisha
Cooperating centre	**:**	NIT, Rourkela, Odisha

Objectives:

- Identification of immunoglobulin (Ig) Z ortholog in rohu and catla and analysis of its expression following various types of pathogens /pathogens derived products including virus

- Investigation on the mechanism of IgM and IgZ synthesis in rohu and catla

Achievements:

a) Publications:

- Samanta M, Basu M, Swain B, Paichha M, Lenka SS, Das S, Jayasankar P, Maiti NK (2016) Molecular cloning and characterization of LrTLR4, analysis of its inductive expression and associated down-stream signaling molecules following lipopolysaccharide stimulation and Gram-negative bacterial infection. Fish & Shellfish Immunology. 60:164-176.

- Rauta PR, Samanta M, Dash HR, Nayak B, Das S (2014) Toll-like receptors (TLRs) in aquatic animals: Signaling pathways, expressions and immune responses. Immunological letters. 158(1-2):14-24.

- Samanta M, Swain B, Basu M, Mahapatra GB, Sahoo BR, Paichha M, Lenka SS, Jayasankar P (2014) Toll-like receptor 22 (TLR22) in *Labeo rohita*: Molecular cloning, characterization, 3D modeling and expression analysis following ligands stimulation and bacterial infection. Appl Biochem Biotechnol. 174(1):309-327. DOI: 10.1007/s12010-014-1058-0.

Project title: Chemo-profiling of potential phyto-acaricides and their functional characterization for controlling resistant cattle ticks

Project Code	**:**	4004
Duration of the project	**:**	April 2013 - March 2016
PI Name	**:**	Dr. Srikanta Ghosh
CCPI Names	**:**	Dr. A.K. Rawat
	:	Dr. Rajesh Kumar
	:	Dr. Sanis Julliet
Lead Centre	**:**	ICAR-IVRI, Izatnagar
Cooperating centres	**:**	CSIR-NBRI, Lucknow
	:	ICAR-IARI, New Delhi
	:	CVAS, Pookode, Kerala

Objectives:

- To understand the mode of action of bioactive fractions on physiological functions of ticks
- To characterize the active biomolecules of plant fractions that have shown anti tick properties

Achievements:

a) Publications:

- Ghosh S, Gupta S, Ajith Kumar KG, Sharma AK, Kumar S, Nagar G, Kumar R, Paul S, Fular A, Chigure G, Nandi A, Manjunathachar HV, Mohammad A, Verma MR, Saravanan BC, Ray DD (2017) Characterization and establishment of a reference deltamethrin and cypermethrin resistant tick line (IVRI-IV) of *Rhipicephalus microplus* (Boophilus). Pesticide Biochemistry and Physiology, 138: 66-70. DOI: 10.1016/j.pestbp.2017.03.002.

- Ravindran R, Chithra ND, Deepa PE, Chandrasekhar L, Sreelekha K, Nair SN, Juliet S, Ghosh S (2017) *In vitro* effects of caffeic acid, nortriptyline, precocene I and quercetin against *Rhipicephalus annulatus* (Acari: Ixodidae). Experimental & Applied Acarolology. 71(2): 183-193.

- Sreelekha KP, Krishna TPA, Krishna TPA, Deepa PE, Darsana U, Juliet S, Nair SN, Ravindran R. (2017). Pharmaco-chemical characterization of leaves of *Blumea mollis* (D. Don) merr. from Western Ghats of Wayanad region of Kerala, India. Journal of Pharmacognosy and Phytochemistry. 6(4): 319-323.

- Ravindran R, Juliet S, Ramankutty SA, Sathish N, Nair SN, Chandrasekhar L, Ghosh S (2017). Effects of ethanolic extract of the leaves of *Pongamia glabra* and *Gliricidia sepium* against *Rhipicephalus annulatus* (Boophilus). Advances in Animal and Veterinary Sciences. 5: 1-6.

- Nagar G, Anjali K, Gupta S, Kumar S, Saravanan BC, Rai A, Ghosh S (2016) Over-expression of esterases in acaricide resistant isolates of *Rhipicephalus microplus* (Boophilus). International Journal of Science, Environment and Technology. 5(5): 3457–3465.

- Kumar S, Sharma AK, Nagar G, Rawat SS, Tiwari SS, Kumar Rinesh, Dhakad ML, Sharma RK, Saxana RK, Mehraniya RS, Singh RS, Jain DK, Rai A, Ray DD, Ghosh S (2016) Characterization of acaricide resistance in tick isolates collected from Rajasthan, India. Indian Journal of Animal Sciences. 86(1): 14–23.

- Gupta S, Ajithkumar KG, Sharma AK, Nagar G, Kumar S, Saravanan BC, Ravikumar G, Ghosh S (2016) Esterase mediated resistance in deltamethrin resistant reference tick colony of *Rhipicephalus microplus* (Boophilus). Experimental & Applied Acarology. 69(2): 239-248. DOI: 10.1007/s10493-016-0032-7.

- Gupta S, Ajithkumar KG, Fular A, Sharma AK, Ghosh S (2016) Determination of optimum age of Rhipicephalus) microplus tick larvae for monitoring esterase mediated resistance development. Journal of Veterinary Parasitology. 30(2): 61-67.

- Ajith KKG, Sharma AK, Kumar S, Ray DD, Rawat AKS, Srivastava S, Ghosh S (2016) Comparative in vitro anti-tick efficacy of commercially available products and newly developed phyto-formulations against field collected and resistant tick lines of *Rhipicephalus microplus* (Boophilus). Journal of Parasitic Diseases. 40:1590-1596. doi 10.1007/s12639-015-0736-3.

- Ajith Kumar KG, Tayade AB, Kumar R, Gupta S, Sharma AK, Nagar G, Tewari SS, Kumar B, Rawat AKS, Srivastava S, Kumar S, Ghosh S (2016) Chemo-profiling and bioassay of phytoextracts from *Ageratum conyzoides* for acaricidal properties against *Rhipicephalus microplus* (Boophilus)(Acari: Ixodidae) infesting cattle and buffaloes in India. Ticks and Tick-Borne Disease. 7(2): 342–349 http://dx.doi.org/10.1016/j.ttbdis.2015.12.005.

- Nagar G, Sharma AK, Chigure G, Manjunathachar HV, Saravanan BC, Rai A, Ghosh S (2016) Identification of mutations in acetylcholinesterase 2 gene of acaricide resistant isolates of *Rhipicephalus microplus* (Boophilus). International Journal of Science, Environment and Technology. 5(5): 3440–3447.

- Ghosh S, Tiwari SS, Kumar B, Srivastava S, Sharma AK, Kumar S, Rawat AKS (2015) Identification of potential plants extracts for anti-tick activity against acaricide resistant cattle tick, *Rhipicephalus microplus* (Boophilus) (Acari: Ixodidae). Experimental & Applied Acarology. 66(1):159-71. doi: 10.1007/s10493-015-9890-7.

- Ghosh S, Tiwari SS, Srivastava S, Kumar S, Sharma AK, Nagar G, Rawat AKS (2015) In vitro acaricidal properties of *Semecarpus anacardium* fruit and *Datura stramonium* leaf extracts against acaricide susceptible (IVRI-I line) and resistant (IVRI-V line) *Rhipicephalus microplus* (Boophilus). Research in Veterinary Sciences. 101:69-74. DOI: 10.1016/j.rvsc.2015.05.015.

- Ghosh S, Kumar R, Nagar G, Kumar S, Sharma AK, Srivastava A, Kumar SA, Kumar KG, Saravanan BC (2015) Survey of acaricides resistance status of

Rhipicephalus microplus (Boophilus) collected from selected places of Bihar, an eastern state of India. Ticks and Tick-borne Diseases. 6: 668–675. DOI: 10.1016/j.ttbdis.2015.05.013.

- Ravindran R, Chitra ND, Deepa PE, Juliet S, Ajithkumar KG, Nair SN, Darsana U, Suresh N, Leena C, Ghosh S (2015) Contrasting effects of ethanolic extracts of leaf and flower of Chromolaena odorata against *Rhipicephalus annulatus* (Boophilus). Indian Journal of Animal Sciences. 85(8):844-848.

- Sreelekha KP, Leena C, Jyothimol G, Dibya RL, Aswathi V, Ajith KG, Nair SN Reghu R, Juliet S, Ghosh, S (2015) Histoarchitecture of the Ovary of *Rhipicephalus annulatus* (Boophilus) during Pre- and Post-engorgement Period, The Scientific World Journal. 2015:126584. doi: 10.1155/2015/126584.

- Sreelekha KP, Leena C, Jyothimol G, Dibya RL, Aswathi V, Adarsh TP, Ajithkumar KG, Nair SN, Reghu R, Juliet S, Ghosh S (2015) Histoarchitecture of ovary of *Haemaphysalis bispinosa* during engorgement period. Tropical Biomedicine. 32:497–503.

- Kumar B, Srivastava S, Rawat AKS (2015) Intra-specific variation of Precocene I in wild population of *Ageratum conyzoides* L. from Western Himalayas. J. Planar Chr. 28(5):391-394.

- Adarshkrishna TP, Ajeeshkrishna TP, Chithra ND, Deepa PE, Darsana U, Sreelekha KP, Juliet S, Nair SN, Ravindran R, Kumar KG, Ghosh S (2014) Acaricidal activity of petroleum ether extract of leaves of *Tetrastigma leucostaphylum* (Dennst.) Alston against *Rhipicephalus annulatus* (Boophilus). Scientific World Journal. 715481, 1-6. doi: 10.1155/2014/715481.

- Ajeeshkrishna TP, Adarshkrishna TP, Kumuthakalavalli R, Sanyo RVN, Juliet S, Sobharani T, Darsana U, Nair SN, Ravindran R (2014) Physico-chemical evaluation and biochemical quantification of crude drug powder (stem) of the *Chassalia curviflora* (Wall. ex-Kurz.) Thwaites; A folk medicinal plant. Journal of Pharmacognosy and Photochemistry. 3(3):184-187.

- Darsana U, Ajeeshkrishna TP, Adarshkrishna, TP, Nair SN, Juliet S, Ravindran R, Pradeep AK (2014) Biochemical quantification, fluorescence analysis and phytochemical evaluation of ethanolic extract and its fractions of areal parts of *Artemisia nilagirica* (Clarke) Pamp. found in Western Ghats (Wayanad Region) of Kerala, India. International Journal of Comprehensive Pharmacy. 2 (05):1-4.

- Darsana U, Nair SN, Sreelekha KP, Ajeeshkrishna TP, Adarshkrishna TP, Juliet S, Ravindran R, Ayilliath KP (2014) Evaluation of phytochemical constituents, proximate and fluorescence analysis of ethanolic extract and its fraction of *Clerodendrum philippinum* Schauer found in Wayanad region of Kerala, India. Research Journal of Chemical Sciences. 4(9):1-6.

- Ghosh S, Nagar G (2014) Problem of ticks and tick-borne diseases in India with special emphasis on progress in tick control research - a review. Journal of Vector-Borne Diseases. 51:259 270.

- Nair SN, Nair MS, Nair DV, Juliet TS, Sreelekha KP, Sujith S, Reghu R (2014) Wound healing, anti-inflammatory activity and toxicological studies of *Leea asiatica* (L.) Ridsdale. International Journal of Biological & Pharmaceutical Research. 5(9):745-749.

- Ravindran R, Ajithkumar KG, Nair SN, Amithamol KK, Sunil AR, Adarshkrishna, TP, Chithra ND, Jyothimol G, Ghosh S, Juliet S (2014) Acaricidal effects of fenvalerate and cypermethrin against *Rhipicephalus annulatus* (Boophilus). Tropical Biomedicine. 31(3):449-455.

- Adarshkrishna TP, Ajeeshkrishna TP, Sanyo RVN, Juliet S, Nair SN, Ravindran R, Sujith S (2013) Evaluation of phytochemical constituents and proximate contents of the ethanolic leaf extract of *Tetrastigma leucostaphylum* (Dennst.) Alstone (Vitaceae) found in Western Ghats of Kerala, India. Research Journal of Pharmaceutical Sciences. 2:1-6.

Project title: Enhancing development competence of oocytes for better *in vitro* fertilizing ability

Project Code	**:**	4005
Duration of the project	**:**	April 2013 - March 2016
PI Name	**:**	Dr. T.K. Dutta
CCPI Name	**:**	Dr. Arindam Dhali
Lead Centre	**:**	ICAR-NDRI, Karnal
Cooperating centre	**:**	ICAR-NIANP, Bangalore

Objectives:

- To evaluate the expression pattern of developmentally important genes /proteins in BCB screened oocytes and resulted embryos in buffalo and sheep
- To identify affected pathways in more or less competent oocytes with respect to the BCB Screening status
- To assess alternative stimulation strategies for enhancing development ability of buffalo oocytes based on information generated from objective 2.

Achievements:

a) Publications:

- Monga R, Ghai S, Datta TK, Singh D (2012) Involvement of transcription factor GATA-4 in regulation of CYP 19 gene during folliculogenesis and luteinisation in buffalo ovary. Journal of Steroid Biochemistry and Molecular Biology. 130:45-56. DOI: 10.1016/j.jsbmb.2011.12.010.
- Sharma I, Monga R, Singh N, Datta TK, Singh D (2012) Ovary–specific novel peroxisome proliferator-activated receptors-gamma transcripts in buffalo. Gene. 504:245-252. DOI: 10.1016/j.gene.2012.04.090.

Project title: Luteinizing hormone-based Sensors for Estrus Detection in Buffaloes

Project Code	**:**	4006
Duration of the project	**:**	April 2013 - March 2016
PI Name	**:**	Dr. Dheer Singh
CCPI Name	**:**	Dr. Govindaraju Archunan
Lead Centre	**:**	ICAR-NDRI, Karnal
Cooperating centre	**:**	Bharathidasan University

Objectives:

- Confirmation and quantification and characterization of LH hormone in urine and blood during estrus
- Design and development of an easy-to-use immunostrip assay and or label free sensor for estrus detection

Achievements:

a) Publications:

- Nayan V, Sinha ES, Onteru S, Singh D (2020) A proof-of-concept of lateral flow based luteinizing hormone detection in urine for ovulation prediction in the buffaloes. Analytical Methods. 12:3411-3424.
- Selvam RM, Onteru SK, Nayan V, Sivakumar M, Singh D, Archunan G (2017) Exploration of Luteinizing hormone in murrah buffalo (*Bubalus bubalis*) urine: Extended surge window opens door for estrus prediction. General and Comparative Endocrinology, 251: 121-126.
- Saibaba G, Archunan G (2015) Does salivary protein(s) act an ovulation indicator for women: A hypothesis. Med Hypotheses. 84(2):104-106. doi: 10.1016/j.mehy.2014.12.009.
- Archunan G (2014) Stud male-originating chemosignals: a luteotrophic agent. Indian Journal of Experimental Biology. 52(1):5-16.
- Subramanian M, Ramalingam R, Durairaj R, Saibaba G, Liao C, Archunan G, Padmanabhan P, Balazs G (2014) Exploration of salivary proteins in buffalo: an approach to find marker proteins for estrus. The FASEB journal. 28 (11):4700-4709. doi: 10.1096/fj.14-252288.

b) Patents:

- A Peptide sequence and polyclonal antibodies against identified peptide for the detection of cow and buffalo luteinizing hormone. (Patent file no. 1854/DEL/2015)
- A Novel method for preparation of Green Gold Nanoparticle developed (Patent file no. 1854/DEL/2015)

Project title: Imprinted polymers for sensing and removal of selected antibiotic and pesticide residues

Project Code	**:**	4007
Duration of the project	**:**	April 2013 - March 2015
PI Name	**:**	Dr. Sunil Bhand
CCPI Names	**:**	Dr. Y.S. Rajput
	:	Prof. Sudhir Chandra
Lead Centre	**:**	BITS, Pilani, Goa
Cooperating centres	**:**	ICAR-NDRI, Karnal
	:	IIT, Delhi

Objectives:

- Preparation of molecularly imprinted polymers (MIPs) against one antibiotic and one pesticide and their removal using novel magnetic nanomaterials
- MIP-MEMS-based sensor device for analysis of selected antibiotic and pesticide residues

Achievements:

a) Technology:

- A technology is developed for real-time sensor for antibiotics in water/milk

Project title: Polymeric Nano Materials for Packaging and Efficient Delivery of Nutraceuticals

Project Code	**:**	4008
Duration of the project	**:**	April 2013 - March 2016
PI Name	**:**	Dr. Najam Shakil
Lead Centre	**:**	ICAR-IARI, New Delhi

Objectives:

- To study the physico-chemical characteristics of poultry egg shell and how these are related to the preservation of the highly nutrition rich egg white and yolk
- To design and develop suitable polymeric materials and composites mimicking egg shell without its brittleness and fragility for packaging of selected cut & whole fruits
- To design smart nano polymeric materials for the encapsulation and controlled release of nutraceuticals
- To evaluate the developed materials for storage and preservation of selected whole & cut fruits

Achievements:

a) Publications:

- Jain SK, Dutta A, Kumar J, Shakil NA (2020) Preparation and characterization of dicarboxylic acid modified starch-clay composites as carriers for pesticide delivery. Arabian Journal of Chemistry, 13, 7990–8002.
- Jain SK, Shakil NA, Dutta A, Kumar J, Saini MK (2017) Sorption kinetics and isotherm modelling of imidacloprid on bentonite and organobentonites. Journal of Environmental Science and Health, Part B 52(5), 326-337.
- Majumder S, Shakil NA, Singh BB, Watterson AC (2016) Synthesis and characterization of functionalized amphiphilic polymers for utilization as surfactants. Journal of Macromolecular Science, Part A: Pure and Applied Chemistry, 53(2), 75–81.
- Koli P, Shakil NA, Kumar J, Singh BB, Watterson AC (2015) Synthesis and Characterization of Novel Encapsulating Materials based on Functionalized Amphiphilic Block Copolymers, Journal of Macromolecular Science, Part A 51:9, 729-736.
- Singh BB, Shakil NA, Kumar J, Walia S, Kar A (2015) Development of slow-release formulations of β-carotene employing amphiphilic polymers and their release kinetics study in water and different pH conditions, Journal of Food Science and Technology, 52(12), 8068-8076.

- Kumari A, Kumar J, Shakil NA, Singh BB, Watterson AC (2015) Synthesis and Characterization of Amphiphilic PEG Based Polymers and Their Self Assembling Behaviour, Journal of Macromolecular Science, Part A, 52:6, 417-424.

Project title: Modeling network of gene responses to abiotic stress in rice

Project Code	**:**	4009
Duration of the project	**:**	April 2013 - March 2017
PI Name	**:**	Mr. Sanjeev Kumar
CCPI Names	**:**	Dr. Kishore Gaikwad
	:	Dr. D. Subramanyam
	:	Dr. Ramaeshware Singh
	:	Dr. Rajendra Joshi
Lead Centre	**:**	ICAR-IASRI, New Delhi
Cooperating centres	**:**	ICAR-NRCPB, New Delhi
	:	ICAR-DRR, Hyderabad
	:	ICAR-DKMA, New Delhi
	:	C-DAC, Pune

Objectives:

- Development of high-performance computing solutions for gene regulatory network models
- Development of global Gene Regulatory Network (GRN) model of salinity and thermos tolerance (STT) in rice based on meta-analysis of available data
- Calibration and threshold estimation of GRN model for salinity and thermo tolerance genes for a few Indian rice cultivars using HPC solutions

Achievements:

a) Publications:

- Bhati J, Chaduvula KP, Rai A, Gaikwad K, Marla, SS, Kumar S (2016) In-silico prediction and functional analysis of salt stress responsive genes in rice (*Oryza sativa*). Rice Research. 4:1. DOI: 10.4172/2375-4338.1000164.
- Nigam D, Kumar S, Mishra DC, Rai A, Shuchi S, Saha A (2015) Synergistic regulatory networks mediated by microRNAs and transcription factors under drought, heat and salt stresses in *Oryza sativa* spp. Gene. 555:127-139. DOI: 10.1016/j.gene.2014.10.054.

Project title: The relationships of Phytoplasma with its host plants and insect vectors

Project Code	**:**	4010
Duration of the project	**:**	April 2013 - March 2016
PI Name	**:**	Dr. Suman Lakhanpaul
CCPI Name	**:**	Dr. Naresh M. Meshram
Lead Centre	**:**	University of Delhi (DU), Delhi
Cooperating centre	**:**	ICAR-IARI, New Delhi

Objectives:

- Studies on the phytoplasma occurrence and diversity in sesame, other selected crops and associated taxa
- Identification of taxonomically useful characteristics for unambiguous classification of Phytoplasma
- Studies on insect vectors of phytoplasma in sesame and other selected plants and associated endosymbionts
- Studies on *in vitro* culturing of Phytoplasma

Achievements:

a) Publications:

- Singh V, Kumar S, Lakhanpaul S (2018) Differential distribution of phytoplasma during phyllody progression in sesame (*Sesamum indicum* L.) under field conditions - An important consideration for effective sampling of diseased tissue. Crop Protection. 110:288-294. doi: 10.1016/j.cropro.2017.01.016.
- Meshram NM, Chaubey R (2016) Two new species of genus Hishimonus (Hemiptera: Cicadellidae) with a new record from India. Zootaxa 4103 (3): 259-266.
- Singh V, Kumar S, Bharat RNS, Naik MK, Bhat KV, Lakhanpaul S (2016) Devastation of sesame (*Sesamum indicum* L.) crops in different agroclimatic zones of India is associated by genetically diverse subgroups of phytoplasma. Crop Protection. 86:24-30. https://doi.org/10.1016/j.cropro.2016.04.004.

Project title: Relationship between *Sclerotium rolfsii*, *Rhizoctonia solani*, the soil and climatic variables in three major cropping system in the country and identification of markers for resistance to *Sclerotium rolfsii*.

Project Code	**:**	4011
Duration of the project	**:**	April 2013 - March 2017
PI Name	**:**	Dr. A.L. Rathna Kumar
CCPI Names	**:**	Dr. Subrata Dutta
	:	Dr. Bishnu Maya
Lead Centre	**:**	ICAR-DGR, Junagadh
Cooperating centres	**:**	BCKV, Mohanpur
	:	ICAR-IARI, New Delhi

Objectives:

- Study the nature of interaction of pathogen with crops, soil, temperature, and moisture in disease development
- Identification of QTLs governing genetic resistance of *S. rolfsii* in groundnut

Achievements:

- Identified environmental, soil, and host-related factors influencing stem rot disease in groundnut, along with molecular markers and histo-morphological traits associated with resistance, enabling improved disease management and resistant variety development.

Project title: The Role of Bacterial Endosymbionts in Shaping the Insect-Virus Relationship in *Bemisia tabaci*

Project Code	:	4012
Duration of the project	:	April 2013 - March 2016
PI Name	:	Dr. Rajagopal Raman
CCPI Name	:	Dr. S. Subramanian
Lead Centre	:	University of Delhi (DU), Delhi
Cooperating centre	:	ICAR-IARI, New Delhi

Objectives:

- To understand the role of endosymbionts in determining the specificity of association between Gemini-virus and *B. tabaci*

Achievements:

a) Publications:

- Naveen NC, Chaubey R, Kumar D, Rebijith KB, Rajagopal R, Subramanyam B, Subramanian S (2017) Insecticide resistance status in the whitefly, *Bemicia tabaci* genetic group Asia-II-1 and Asia-II-7 on the Indian subcontinent. Sci. Rep 7:40634. doi: 10.1038/srep40634

- Chaubey R, Andrew RJ, Naveen NC, Rajagopal R, Ahmad B, Ramamurthy VV (2015) Morphometric Analysis of Three Putative Species of *Bemisia tabaci* (Hemiptera: Aleyrodidae) Species Complex from India. Annals of the Entomological Society of America. DOI: 10.1093/aesa/sav028.

- Raina HS, Rawal V, Singh S, Daimei G, Shakarad M, Rajagopal, R (2015) Elimination of Arsenophonus and decrease in the bacterial symbionts diversity by antibiotic treatment leads to increase in fitness of whitefly, *Bemisia tabaci*. Infection, Genetics and Evolution. 32: 224-230. DOI:10.1093/ee/nvv062.

- Raina HS, Singh A, Popli S, Pandey N, Rajagopal R (2015) Infection of Bacterial Endosymbionts in Insects: A Comparative Study of Two Techniques viz PCR and FISH for Detection and Localization of Symbionts in Whitefly, *Bemisia tabaci*. PLOS ONE. 10(8): e0136159. doi:10.1371/journal.pone.0136159.

- Rana VS, Popli S, Saurav GK, Raina HS, Chaubey R, Ramamurthy VV, Rajagopal R (2015) A *Bemisia tabaci* midgut protein interacts with begomoviruses and plays a role in virus transmission. Cellular Microbiology. 18(5):663-78. https://doi.org/10.1111/cmi.12538.

- Chaubey R, Andrew RJ, Naveen NC, Rajagopal R, Ramamurthy VV (2015) Life history traits of three cryptic species Asia I, Asia II-1 and Asia II-7 of *Bemisia tabaci* (Hemiptera: Aleyrodidae) reconfirm their genetic identities. Florida Entomologist. 98(1): 254-259. http://dx.doi.org/10.1653/024.098.0142.

Project title: Common basis of defense induction in rice and mustard against sucking and gall insect pests

Project Code	**:**	4013
Duration of the project	**:**	April 2013 - March 2017
PI Name	**:**	Dr. Padmakumari
CCPI Names	**:**	Dr. Suresh Nair
	:	Dr. R. C. Bhattacharya
	:	Dr. S. Subramanian
Lead Centre	**:**	ICAR-DRR, Hyderabad
Cooperating centres	**:**	ICGEB, Delhi
	:	ICAR-NRCPB, New Delhi
	:	ICAR-IARI, New Delhi

Objectives:

- Evaluation of cross functionality of gall resistance gene of rice and defense elicitor gene of mustard through transgenic expression
- Identification and function validation of candidate virulence gall midge genes through whole genome sequencing
- Characterization of aphid induced mechanisms of host-defense suppression in relation to mustard defense elicitor gene *BjEli1*

Achievements:

a) Publications:

- Ojha A, Sinha, DK, Padmakumari A, Bentur JS, Nair S (2017) Bacterial Community Structure in the Asian Rice Gall Midge Reveals a Varied Microbiome Rich in Proteobacteria, Scientific Reports 7:9424. https://doi.org/10.1038/s41598-017-09791-0.
- Koramutla M, Bhat D, Negi M, Venkatachalam P, Jain PK and Bhattacharya RC (2016) Strength, stability and cis-motifs of in silico identified phloem-specific promoters in *Brassica juncea* (L.). Frontiers in Plant Science, doi: 10.3389/fpls.2016.00457.
- Koramutla MK, Aminedi R, Bhattacharya RC (2016) Comprehensive evaluation of candidate reference genes for qRT-PCR studies of gene expression in mustard aphid, *Lipaphis erysimi* (Kalt). Scientific Reports, 6: 25883. doi:10.1038/srep 25883.
- Agarrwal R, Padmakumari AP, Bentur JS, Nair S (2016) Metabolic and transcriptomic changes induced in the host during hypersensitive response-mediated resistance in rice against the Asian rice gall midge. Rice, 9:5 DOI 10.1186/s12284-016-0077-6.

- Koramutla MK, Kaur A, Negi M, Venkatachalam P, Bhattacharya R (2014) Elicitation of jasmonate-mediated host defense in Brassica juncea L. attenuates population growth of mustard aphid *Lipaphis erysimi* Kalt. Planta. 240:177–194 DOI:10.1007/s00425-014-2073-7.

b) Patent:

- Peptide elicitor of insect, and pathogen defense in brassica (patent file no. 201611026697)

c) Technology Development:

- Bio-formulation of BjEli1 peptide for the management of aphid in *B. juncea* is being optimized

Project title: Understanding the adaptation mechanism of wild forage halophytes in the extreme saline-sodic Kachchh plains for enhancing feed resources

Project Code	**:**	4014
Duration of the project	**:**	April 2013 - March 2016
PI Name	**:**	Dr. Devi Dayal
CCPI Names	**:**	Dr. Ashwani Kumar
	:	Dr. J. P. Singh
Lead Centre	**:**	ICAR-CAZRI, RRS-Bhuj
Cooperating centres	**:**	ICAR-CSSRI, Karnal
	:	ICAR-IGFRI, Jhansi

Objectives:

- Taxonomic, morpho-physiological and anatomical characterization of halophytes
- Comparison of salt tolerance mechanism in grass and non-grass halophytes and cultivated grasses
- Generation of technology for palatable halophytic grasses for developing pasture in salt degraded lands

Achievements:

a) Publications:

- Mangalassery S, Dayal D, Patel S (2017) Salinity characteristics of soils supporting halophyte vegetation in saline desert ecosystems in Western India. Annals of Arid Zone 56 (3&4): 65-73.

  Mangalassery S, Dayal D, Kumar A, Bhatt K, Nakar R, Kumar A, Singh JP, Mishra AK(2017) Pattern of salt accumulation and its impact on salinity tolerance in two halophyte grasses in extreme saline desert in India. Indian Journal of Experimental Biology. 55: 542-548. (NAAS rating – 6.0).

- Kumar A, Kumar A, Lata C, Kumar S (2016) Eco-physiological responses of Aeluropus lagopoides (grass halophyte) and Suaeda nudiflora (non-grass halophyte) under salt affected environments. South African Journal of Botany, 105: 36-44.

Project title: Development of sucrose sensor for phenotyping of soil moisture-deficit stress tolerance in rice

Project Code	**:**	4015
Duration of the project	**:**	April 2013 - March 2016
PI Name	**:**	Dr. Prakash C. Nautiyal
CCPI Names	**:**	Dr. Aruanav Goswami
	:	Dr. S.K. Malik
	:	Dr. Rajib Bandyopadhyay
Lead Centre	**:**	ICAR-IARI, New Delhi
Cooperating centres	**:**	ISI, Kolkata
	:	ICAR-NBPGR, New Delhi
	:	Jadavpur University, Kolkata

Objectives:

- To understand the processes and their genetic variation in storage and remobilization of sucrose in rice during grain development, under soil moisture deficit stress
- To study the influence of sucrose transport during grain filling on seed quality
- To develop a real time measurement system for estimation of sucrose flow rate to panicle

Achievements:

- Developed and validated a portable, field-deployable NIR-based model for rapid, non-destructive measurement of sucrose concentration and flow in rice stem reserves, enabling efficient screening of genotypes for drought tolerance through NSC mobilization analysis.

Project title: Understanding the mechanisms of Non Host Resistance (NHR) against rust and blast in rice and wheat

Project Code	**:**	4016
Duration of the project	**:**	April 2013 - March 2016
PI Name	**:**	Dr. Aundy Kumar
CCPI Name	**:**	Dr. Shree Prakash Pandey
Lead Centre	**:**	ICAR-IARI, New Delhi
Cooperating centre	**:**	IISER, Kolkata

Objectives:

- To compare and decipher the behaviour of non-adapted pathogens*, Puccinia graminis tritici* and *Magnaporthe oryzae* on rice and wheat respectively
- To compare and decipher "phenotypic response" of rice and wheat genotypes to putative elicitors/PAMPs extracted from their non adapted pathogens, *Puccinia graminis tritici* and *Magnaporthe oryzae* as well as chemically synthesized molecules
- To identify and characterize role of putative NHR gene homologues in rice and wheat against rust and blast.

Achievements:

a) Publications:

- Sahu R, Kundu P, Sharaff M, Pradhan M, Sethi A, Mishra VK, Chand R, Joshi AK, Kumar A, Pandey SP (2017). Understanding the defense-related mechanism during the wheat's interaction with fungal pathogens. Indian Phytopath. 69 (4): 260-265.
- Prabhakaran N, Kumar A, Sheoran N, Singh VK Nallathambi P (2021) Tracking and assessment of Puccinia graminis f. sp. tritici colonization on rice phyllosphere by integrated fuorescence imaging and qPCR for nonhost resistance phenotyping. Journal of Plant Diseases and Protection. 128:457–469. https://doi.org/10.1007/s41348-020-00405-y.
- Sahu R, Prabhakaran N, Kundu P, Kumar A (2021) Differential response of phytohormone signalling network determines nonhost resistance in rice during wheat stem rust (*Puccinia graminis* f. sp. tritici) colonization. Plant Pathology. 00:1–12. DOI: 10.1111/ppa.13376.

Project title: Biodegradable electrospun fibre mat for use in packaging of fresh perishable agricultural material

Project Code	**:**	4017
Duration of the project	**:**	April 2013 - Sep 2015
PI Name	**:**	Mr. G.T.V. Prabu
Lead Centre	**:**	ICAR-CIRCOT, Mumbai

Objectives:

- To design and fabricate integrated multiphase electrospinning setup and investigate the physical principles of multiphase electrospinning process
- To optimize machine and process parameters for production of biodegradable nonwoven electrospun fiber mat and their characterization
- To develop electrospun fiber mat-based sensors for monitoring the quality/spoilage of packed fruits and vegetables

Achievements:

a) Publications:

- Prabu GTV, Guruprasad R, Sundaramoorthy C, Prasad V, Anabattula V, Vigneshwaran N (2016). Electrospinning of Cellulose Acetate Nanofibres. Manmade Textile Industry in India. 58:91-94.

b) Patent:

- Bi-axial electro spinning setup for production of nanofibre mat. (Patent file no. 4957/MUM/2015)

Project title: Production of phytochemicals from best chemotypes of some threatened medicinal plants through modified cultivation and *in-vitro* production technologies

Project Code	:	4018
Duration of the project	:	Apr. 2013 - Mar. 2017
PI Name	:	Dr. Sharad Srivastava
CCPI Names	:	Dr. Amita Bhattacharya
	:	Dr. K.S. Negi
Lead Centre	:	CSIR-NBRI, Lucknow
Cooperating centres	:	IHBT, Palampur
	:	ICAR-NBPGR, Bhowali

Objectives:

- Evaluation of the chemotypic variability available for the phytochemicals forskolin and colchicine in *Coleus forskohlii* and *Gloriosa superba* respectively and identification of best suited elite chemotype
- Development of tissue and cell cultures techniques for high content of phytochemicals

Achievements:

a) Publications:

- Misra A, Srivastava S, Rawat AKS (2016). Development of a cost-effective, novel RP (UV) - online OPLC validated method for efficient separation of Gallic acid. Journal of Planar Chromatography 29 (2016) 2, 127–13.
- Misra A, Srivastava S, Srivastava P, Shukla P, Agrawal PK, Rawat AKS (2016) Chemotaxonomic variation in forskolin content and its correlation with ecogeographical factors in natural habitat of *Coleus forskohlii* Briq. collected from Vidarbha (Maharashtra, India). Industrial Crops and Products 84 (2016) 50–58.
- Shukla PK, Misra A, Kumar M, Rajan S, Agrawal PK, Rawat AKS, Srivastava S (2016) Intra-Specific Chemotypic Variability of Forskolin Content in *Coleus forskohlii* (Wild.) Briq. Growing in Nilgiri Hills of India, Journal of Planar Chromatography 29 (5), 347–355
- Srivastava S, Misra A, Kumar D, Srivastava A, Sood A, Rawat AKS (2015) Cytotoxic and anti-oxidant activity of *Roscoea purpurea* extracts with simultaneous analysis of six major phenolic through reverse phase-HPLC. Pharmacognosy Magzine 11(44): S488-495.
- Srivastava S, Misra A, Shukla PK, Kumar B, Sneh L, Rawat AKS (2014) A validated over pressured layered chromatography (OPLC) method for separation and quantification of colchicine in *Gloriosa superba* (L.) tubers from different geographical regions. RSC Adv. 4, 60902. https://doi.org/10.1039/C4RA12337A.

- Srivastava S, Verma S, Gupta A, Kushwaha P, Rawat AKS (2014) Chemotaxonomic studies of Forskolin in *Coleus forskohlii* Briq. from Different Phyto-Geographical Zones of India. In P.K. Mukherjee ed. Traditional Medicine and Globalization: The Future of Ancient Systems of Medicine (Maven Publishers) 322-330.

Project title: Molecular and genetic analyses of guggul for the identification of genes governing adventive embryony

Project Code	**:**	4019
Duration of the project	**:**	April 2013 - March 2017
PI Name	**:**	Dr. S.R. Bhat
CCPI Name	**:**	Dr. K.A. Geetha
Lead Centre	**:**	ICAR-NRCPB, New Delhi
Cooperating centre	**:**	ICAR-DMAP, Anand

Objectives:

- Identification of candidate genes governing adventive embryony through study of ovule transcriptome
- Determination of the genetics of adventive embryony
- Molecular tagging of genes governing adventive embryony
- Development of transformation protocols for guggul and validation of candidate genes

Achievements:

a) Publications:

- Geetha KA, Kawane A, Bishnoyi AK, Phurailatpam AK, Ankita C, Malik SK, Srinivasan R, Bhat SR (2013) Characterization of mode of reproduction in *Commiphora wightii* (Arnot Bhandari) reveals novel pollen-pistil interaction and occurrence of obligate sexual female plants. Trees. 27:567-581. https://doi.org/10.1007/s00468-012-0810-8.

Project title: Evaluation of the applicability of a dominant nuclear male sterility system in rice for hybrid seed production

Project Code	**:**	4020
Duration of the project	**:**	April 2013 - March 2017
PI Name	**:**	Dr. O.N. Singh
CCPI Name	**:**	Dr. Sudip K. Ghosh
Lead Centre	**:**	ICAR-CRRI, Cuttack, Odisha
Cooperating centre	**:**	IIT, Kharagpur

Objectives:

- To evaluate the efficacy of the strategies for engineered male sterility and fertility system
- Integration of engineered male sterility and fertility genes into heterotic parental lines for hybrid development

Achievements:

- Developed and validated rice hybrid seed production system by maintaining, and restoring male sterile lines without dependency on specific maintainer or restorer lines, enhancing scalability and application.

Project title: Enhancing Phosphorus Availability in Alfisols: Hydrogel Based Input Delivery Approach

Project Code	**:**	4021
Duration of the project	**:**	October 2013-September 2015
PI Name	**:**	Dr. Anupama Singh
Lead Centre	**:**	ICAR-IARI, New Delhi

Objectives:

- To develop an appropriate gel formulation to carry phosphorus, lime and microbes that are released in the root zone at the right time and in right quantities and forms
- To show that the released material is taken up by the plant roots and soil acidity is modified to the desired extent

Achievements:

a) Publications:

- Dhaka R, Khan T, Mittal S, Singh A, Sarkar DJ, Singh SB, Ahmed N, Pandey R, Singh G and Singh A (2015). Organic acids-based hydrogel composites as potential chelators for free Al3+ Symposium on food and environmental safety. Pp 51
- Singh A, Sarkar DJ, Singh SB, Raghav T, Singh R, Solanki D and Ahmed N (2014). Mono calcium phosphate (MCP) loaded biopolymeric clay hydrogel composites for slow nutrient delivery: Characterization and release behavior. In Compilation of abstracts of Third international Conference on polymer Processing and Characterization (ICPPC, 2014) pp 27.

b) Patent:

- Application under process at Institute- Invention 'Novel phosphorus enriched hydrophilic compositions for integrated water and nutrient management in acid soils'

Project title: Behavioral Analysis of Farmers Decision Making on Agricultural Innovations

Project Code	**:**	4022
Duration of the project	**:**	April 2014 - March 2016
PI Name	**:**	Dr. M.J. Chandre Gowda
CCPI Names	**:**	Dr. S.S. Dolli
	:	Dr. M.V. Durga Prasad
	:	Dr. D. Saravanan
Lead Centre	**:**	ZPD, Zone VIII Hebbal, Bangalore
Cooperating centres	**:**	UAS, Dharwad
	:	IRMA, Gujarat
	:	SAMUHA, NGO, Karnataka

Objectives:

- Asses the farmers' decision-making process in selection, adoption and continuation of innovations in different cropping systems of Karnataka and Gujarat to evolve innovation decision process models
- Analyze the influence of push factors exerted from technology generation, dissemination and facilitation systems and the pull factors emanated from technology utilization, marketing and consumption systems on the farmers' decision making in the two states
- Categorize farmers on the basis of adoption rate for specific innovations and determine their characteristics based on which recommend strategies to hasten innovation decision among late adopters

Achievements:

a) Publications:

- Chandre Gowda M.J, Dixit S (2015) Influence of farmers educational level on comprehending, acting upon and sharing of agro advisories, Journal of Agriculture and Rural Development in the Tropics & Sub Tropics, 116(2): 167-172